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Nutritional aspect of heifer management to reduce age at first calving and cost of heifer production

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Heifers are future herd of a dairy farm. They must be produced to replace the uneconomical females of the farm through voluntary culling. Production of heifer is most expensive part of the dairy farm operation. It requires more inputs for a longer period of time with no visible returns. The feed and management program for replacement heifers will have a lifelong effect on their productivity. It will determine how young they may be bred; whether they calve late, early or not at all; whether they are poor milkers or good milkers; the weaning weights of their calves; and how long they remain in the herd means longevity of heifer. Feed accounts for 50% to 70% of the cost of raising replacement heifers; hence, it is important to save on feed during the growing period and reduce cost of rearing without any adverse effect on health and reproduction. It is even more important to know whether their performance as adult animals can be enhanced by proper nutrition and management. Age at puberty is negatively correlated with plane of nutrition. Balanced feeding, proper management and disease resistance can be helpful in reducing the age at first calving. Proteins and energy are most critical nutrients influencing the growth of calves to become heifers. However, minerals and vitamins are also important. Other than essential nutrients, there are performances modifiers that can accelerate the growth rate of calves and help attain early puberty in heifers. The major issue is the lower growth rate of calves during early months of their age and just after weaning. Lower growth rate in the early life of the calves is either due to underfeeding or imbalanced feeding. The goal of replacement heifer selection is to identify heifers that will develop into high-output, low-input cows with longevity; and ultimately, high milk producer cow. Replacement heifers should be selected and managed so they will calve early in the calving season, provide adequate milk production, and rebreed and calve every year. Heifers bred as yearlings to calve as two-year-olds will produce an extra calf in their lifetime compared with heifers calving first as three-year-olds, without detrimental effects on mature size, milk production, or calf weaning weights. The type of management heifers receive from birth to breeding has a great influence on their lifetime calf production. It is important that heifers be

selected and developed properly for efficient and optimum production over 7 to 8 calf crops.

Development programs should focus on nutrition to achieve puberty by 12 to 14 months or younger with additional emphasis on early conception and rebreeding the following year. Care must be taken to ensure minimum calving abnormalities through heifer and sire selection. Do not provide heifers creep feed during the suckling period, as fat may be deposited in the developing udder, lowering subsequent milking ability.

REDUCING COST OF HEIFER PRODUCTION

Heifers production is the most expensive component of the dairy farm operations. Poor nutrition and poor growth rate resulting in delayed age at maturity in our local dairy animals further aggravates the situation. However, cost of heifer production can be reduced through better management, balanced feeding and better health care. Selection for higher milk yield is likely to have a favorable impact on age at first calving. Currently age at maturity in buffalo and Sahiwal cow can be reduced to 2 and 1.5 years, respectively, with better feeding and management.

Protein and energy along with minerals are the most critical nutrient affecting the weight and consequently age at puberty in heifers. Protein levels more than current recommendations of NRC for dairy cattle can reverse the adverse effects of high plane of nutrition on udder development. Performance modifiers accelerates growth rate to reduce the age at maturity is also helpful provided they do not adversely affect development of secretary tissue of udder for future milk production. Judicious use of balanced feed has led to reduced age at puberty in exotic dairy heifers. These data can be used to device optimum heifer production systems in the our country.

The success of attaining target weights for replacement heifers depends upon a soundness of nutritional program that balances rations around forage quality. Knowing forage quality means knowing whether protein, energy and minerals must be supplemented. Without forage testing, feeding a balanced ration is impossible; subsequently, heifer performance may suffer, and costs may be higher than necessary. Periodic weighing is helpful in determining whether heifers are gaining at calculated rate or not. Make sure weights are taken at the same time of day and use group weights because gut fill can cause bias errors in weights. Some reproductive cycling should be observed in the heifers by 40-60 days before breeding season; if not, additional grain or high energy supplement should be provided. However, for determining of solid recommendations on optimum heifer production requires well planned research to see the effects of proteins, energy, minerals and other performance modifiers for economical heifer production in our country.

NUTRITIONAL STRATEGIES AND THEIR IMPACT

Effect of suckling and hand feeding on calf health

Suckled calves are healthier than weaned calves. As per a experiment, conducted by Ryle and Orskov (1990) have advice given to farmers in developing countries to wean

calves early in order to increase the amount of saleable milk is inappropriate. They also summarized the results of various studies on calf rearing. Studies showing more economic returns to wean calves at the youngest age possible are also there but that does not apply to the farmers in resource-poor developing countries. This is mainly due to the unhygienic conditions prevailing during artificially feeding the calves. Furthermore, maintenance of desired temperature of milk fed to calves especially in winter is difficult. A study at Animal Sciences Institute, National Agriculture Research Centre, reported that calves reared by restricted suckling of their dams had better growth rate (552 vs 370 g/d) on less milk consumed (2.7 vs 3 kg/d) than those given milk through nipple pale. Holstein crossbreds in Vietnam, have also reported similar results. It was found that weight gain of direct suckling calves was higher (445 vs 422 g/d) than that of artificially reared calves. The milk consumed per kg of weight gain was less in suckling calves than on artificially reared calves (4.2 vs 4.7 kg respectively). In the light of these studies, the farmers in developing countries should follow the indigenous practices that can enhance daily growth rate to get a healthier calf crop. Further research studies are also needed to test the hypothesis whether weaning should or should not be practiced in Sahiwal cattle or Nili-Ravi buffalo that have a very strong mother instinct to milk let down in the presence of calf which if weaned results into either abandoning of the lactation or milk let down through oxytocin.

Effect of protein, energy and minerals in calf starter ration

In our country, fodder is usually available for calves rearing with limited amounts of concentrates low in protein and energy before and after weaning. This is one of the reasons for lower growth rate and delayed age at puberty in heifers. This issue is short out by research workers by various experiments in our country. Calf starter ration containing CP% and TDN%, 17, 78 and 16, 72, respectively, a higher daily growth rate (471 vs 336 gm) has been observed in buffalo calves (Ahmad and Jabbar, 2000). Beyond the level of 20% CP, no additional response was observed on the daily growth rate of calves. In our country, where there is no check on quality of concentrates for ruminants, offering a quality concentrate supplement with higher protein and energy may accelerate growth rate in the replacement calves with positive effects on reducing the age at puberty. Macrominerals as well as microminerals have great impact on growth of calves and significantly reduce the age at first calving. Calves, heifer and lactating animals should be supplemented with 2% area specific mineral mixture in their diet. It reduces the stress on animal and improves the health and production.

Effect of concentrate feeding on puberty

In a study in Nili-Ravi buffalo heifers fed green fodder only and fodder plus concentrate diet at rate of 1% of body weight in other group of buffalo heifers. They found that age at puberty was reduced by 8 months in heifers fed fodder plus concentrate than those fed fodder only. The concentrate ration had 15.4% CP and 65% TDN. Age at puberty could be reduced by one month through additional concentrate feeding for a few

months before the onset of puberty in Nili-Ravi buffalo heifers. Supplementation of concentrate with green fodder particularly in summer season reduced the age at puberty in buffalo heifers. In spring born Hereford x Angus cattle feeding high starch diet (73% corn; 53% starch) 60 days before breeding may increase the incidence of puberty during breeding of heifers that have inadequate yearling weight. Furthermore, the CP and energy concentration of the concentrate supplement are still less than the recommended levels for a total mixed ration for temperate breeds. This information provides further room for reducing the age at puberty by providing a supplement with higher CP and energy concentration or a total mixed ration.

Effect of bST on age at puberty

Pituitary, a small gland located at the base of the brain, secretes Somatotropin hormone from the anterior part which is transported by the blood to various body organs where it has its biological effects. It has been extensively used in ruminants for promoting growth and production. Radcliff *et al*. (1997) reported that injection of bST (25 µg/kg of body weight) in Holstein heifers increased daily body weight gain and weight at puberty by 10%, and 25 kg, respectively and reduced the age at puberty by up to 24 days. Also heifers with initial body weight of 135 kg, injection of bST at a rate of 25 µg/kg of body weight at a high plane of nutrition (CP: 19.7% and energy 2.8 Mcal/kg) reduced the age at puberty in Holstein heifers by 90 days. bST altered the intermediary metabolism in a manner that increased lean tissue and decreased fat deposition.

Effect of antibiotics on puberty

Antibiotics are the product of variety of microorganisms that acts over other organisms. Feeding of ionphore antibiotics increases the efficiency of feed utilization in ruminant animals. Monensin feeding significantly decreased the age at breeding by 15 and 24 d and age at calving by 36 and 61 days for heavy and light Holstein heifers, respectively. In an earlier study, Mosley *et al*. (1977) reported that 92% of the heifers fed monensin reached puberty earlier as compared with only 58% of heifers in without antibiotic group, with no effect on weight gain. Similarly cows fed 200 mg of monensin per day shows lower age at puberty.

Effect of diet on mammary gland development

As the growth rate increases, the requirements of crude protein increase at a faster rate than energy requirements. Therefore, increased protein to energy ratio for rapidly growing heifers can alters the adverse effects of high energy diets on their mammary gland development. It has been found that feeding protein to energy ratios above NRC recommendations improved feed efficiency and increased average daily gain and mammary development. Thus, increased protein concentration in the ration of dairy heifers with high energy can reduce the age at puberty without adversely affecting the mammary gland development and its subsequent effects on milk production.

CONCLUSIONS

Improved feeding strategies have significant effect on puberty. Protein, energy and mineral supplementation significantly reduces the age at first calving without any adverse effect on heifer and resulting in higher milk producing ability with longevity. bST and Ionophore antibiotics can be used to decrease the cost of heifer production with enhance reproductive performance. Increased protein and energy ration in dairy heifers can reduce the age at puberty without adversely affecting the mammary gland development and its subsequent effects on milk production.

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Enhancing input use efficiency of horticultural crops thorough new technologies

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The term 'resource use efficiency in Horticulture' may be broadly defined to include the concepts of technical efficiency, allocative efficiency and environmental efficiency. An efficient farmer allocates his land, labour, water and other resources in an optimal manner, so as to maximise his income, at least cost, on sustainable basis. However, there are countless studies showing that farmers often use their resources sub-optimally. While some farmers may attain maximum physical yield per unit of land at a high cost, some others achieve maximum profit per unit of inputs used. Also in the process of achieving maximum yield and returns, some farmers may ignore the environmentally adverse consequences, if any, of their resource use intensity. Logically all enterprising farmers would try to maximise their farm returns by allocating resources in an efficient manner. But as resources (both qualitatively and quantitatively) and managerial efficiency of different farmers vary widely, the net returns per unit of inputs used also vary significantly from farm to farm. Also a farmer's access to technology, credit, market and other infrastructure and policy support, coupled with risk perception and risk management capacity under erratic weather and price situations would determine his farm efficiency.

Moreover, a farmer knowingly or unknowingly may over-exploit his land and water resources for maximising farm income in the short run, thereby resulting in soil and water degradation and rapid depletion of ground water, and also posing a problem of sustainability of agriculture in the long run. Furthermore, a farmer may not be often either fully aware or properly guided and aided for alternative, albeit best possible uses of his scarce resources like drip irrigation and fertigation, high density planting, (HDP) mulching, bio fertilizers and plant bio regulators (PBRs). Thus, there are economic as well as environmental aspects of input use efficiency in horticulture. Besides, appropriate risk management policy would be crucial for stabilizing orchard income, which would encourage the farming communities to take proper interest in farming and maintain input use efficiency.

DRIP IRRIGATION AND FERTIGATION

The practice of supplying crops in the field with fertilizers via the irrigation water is called fertigation. In fertigation, timing, amounts and concentration of fertilizers applied are easily controlled. Fertigation allows the landscape to absorb up to 90% of the applied nutrients, while granular or dry fertilizer application typically results in absorption rates of 10 to 40% Fertigation ensures saving in fertilizer (40-60%), due to "better fertilizer use efficiency" and "reduction in leaching" (Kumar and Singh, 2002). Drip irrigation is often preferred over other irrigation methods because of the high water application efficiency on account of reduced losses, surface evaporation and deep percolation. Because of high frequency water application, concentrations of salts remain manageable in the rooting zone. The regulated supplies of water through drippers not only affect the plant root and shoot growth but also the fertilizer use efficiency.

Fertigation through drip irrigation reduces the wastage of water and chemical fertilizers, optimizes the nutrient use by applying them at critical stages and at proper place and time, which finally increase water and nutrient use efficiency. Moreover, it is well recognized as the most effective and convenient means of maintaining optimal nutrient level and water supply according to crop development stage, specific needs of each crop and type of soil.

Drip irrigation considered as one of the latest innovation which optimizes the use of irrigation water by providing it uniformly and directly to the roots of the plants, through a close network of plastic pipes and emitters. However, fertigation means application of soluble fertilizers through irrigation system. It is the most important management factor which affect plant growth and development, resulting higher production with better quality.

The advantages of drip irrigation and fertigation includes;

- It ensures regular flow of both water and nutrients, resulting in increased growth rates and higher yields
- Offers greater versatility in the timing of the nutrient application to meet specific demands at p r e d e t e r m i n e d times according to the crop
- Improves availability of nutrients and their uptake by the plants. It is a safer application method as it eliminates the danger of burning the plant root system, since the fertilizer is applied in very low concentration.
- Combining liquid fertilizers with insecticides and herbicides saves labour and machinery for their application separately. Substantial savings in quantity of fertilizers (30 to 50%).
- It also facilitates irrigation in undulating terrains and results in minimum pollution to soil coupled with less incidence of pests and diseases.

MULCHING

Plastic mulch can enhance fruit quality, weed control and also contributes to more efficient use of irrigation water and plant nutrients applied via fertigation. Plasticulture is crucial to horticulture in view of the changing technological scenario for boosting

quality and yield of horticultural produce. Introduction of linear low density polyethylene (LLDPE) as a mulch film has brought a revolution in horticultural water management. It is actually a boon to dry land horticulture. This is one of the fastest growing plasticultural applications in the world. The cost of LLDPE film is also lesser than one third of LDPE mulch film. (Deng, *et al.,* 2006). The plastic mulch covers the whole production bed and only a hole is made where the transplant can be inserted. The plastic colors that are currently used in farm operation are:

- Black mulch in winter and in the early spring
- Silver/black mulch in spring and autumn
- White/black mulch in summer

The color of the plastic mulch is important because it determines its radiation, the surface temperature and the underlying soil temperature. It creates a microclimate around the crop. The reflected energy from the mulch can affect plant growth, fruit yields and th behavior of insects that can get repel or attract by the color of the plastic mulch.

Organic mulches such as straw, hay, grass or leaf matter can provide multiple benefits for organic farms. They are capable of suppressing weeds, of regulating soil moisture and soil surface temperatures. They improve overall soil quality by increasing organic matter of the soil, soil porosity, water holding capacity while also stimulating soil life and increasing nutrient availability (Sadras, 2004). Use of organic mulch such as straw can reduce soil temperature beneath the mulch more effectively as when compared to the use of black plastic mulch. Use of straw mulch also results in higher soil moisture than plastic mulch while it also increases soil potassium levels. Tomatoes grown in a hairy vetch mulch can produce up to 85% of a maximum without using any N fertilizer and tomatoes plants continue also to produce 2 to 3 weeks longer than tomatoes grown with black plastic mulch.

HIGH DENSITY ORCHARDING

The high density planting (HDP) in fruit crops is one of the recent novel concepts of increasing the productivity without affecting the quality of fruits. India is the largest producer of fruits in the world after China. The average productivity and per capita availability of fruits in India is, however, low as compared to many developed countries. The main reasons for low productivity are old and senile orchards, wider spacing, low yielding varieties, poor orchard management and inadequate technological up-gradation and adoption by the growers. Presently, the continuing decline in the availability of cultivable land, rising energy and land costs together with the increased demand of fruit and fruit products, have given thrust to the concept of high density planting (HDP) in fruit crops.

High density planting gives earlier production and return per unit area, shortens juvenility, eco-friendly, provides efficient land use and better use of resources like light, water and fertilizers, efficient pesticides application, besides, in this system the harvesting becomes easy. Among the factors such as cultivar, rootstock, quality of planting material and cultivation practices contribute to high yield of fruit trees,

however, the number of trees-1 is the most important factor which brings about radical increase in fruit production. Therefore, high density planting has great potential for increasing productivity in fruit crops (Mishra *et al.,* 2003). Advantages of HDP

✓ It induces the precocity

✓ Enhanced fruit yield and quality

✓ Low cost per unit production

✓ Enables mechanization in fruit crops

✓ Efficient use of applied and natural re sources

For efficient use of horizontal and vertical space, HDP technologies have been developed in many horticultural crops. Planting of these crops rather at a closer spacing than the recommended one using certain special techniques with the sole objective of obtaining maximum productivity per unit area without sacrificing quality is often referred as 'High density planting' or HDP. However, success of HDP depends upon the control of tree size. This can be achieved by use of dwarfing and intermediate root stocks like MM 106, MM 109 and MM 111 in apple; Quince A, Adam and Quince C in pears. Use of spur type scions, training and pruning methods can also induce dwarfness. Growth regulators such as diaminozide, ethephon, chlormaquat and paclobutrazal are extensively used to reduce shoot growth by 30-0%. (Mishra and Goswami, 2016). High density orcharding appears to be the most appropriate answer to overcome low productivity and long gestation period for early returns and export of horticultural crops.

To meet the challenge of high productivity, optimization of growth parameters and minimization of the unproductive components of trees without sacrificing the overall health of the tree and quality of the product are required. The control of excessive vegetative growth in the tree for increased productivity is the major principle of high density orcharding. Therefore, controlling tree size by dwarfing rootstocks in high density orchards is one of the methods of increasing production. In high density system, yields are improved in early years of orchard life. Once the trees have filled their allotted spaces, crowding may occur and canopies of an adjacent tree begin to overlap. This may lead to excessive shading and reduction in photosynthesis by layered leaves within the tree canopy resulting in poor yields. In fact, at some point of time most horticultural trees require controlled vegetative growth particularly in high density orcharding. The horticultural methods most commonly known to control tree growth are training and pruning. The training begins when the tree is first planted and continues throughout its productive life. Once the tree is mature, excessive growth can be regularly removed by pruning to provide a short term or immediate benefit.

BIO-FERTILIZERS

Bio fertilizers are microbial preparations containing living cells of different microorganisms which have the ability to mobilize plant nutrients in soil from unusable to usable form through biological process. They are environmental friendly and play significant role in crop production. Bio fertilizers are use in live formulation of

beneficial microorganism which on application to seed, root or soil, mobilize the availability of nutrients particularly by their biological activity and help to build up the lost microflora and in turn improve the soil health. Generally horticultural crops have now received more attention than field crops.

Glomus fasciculatum, Glomus mosseae, Azospirillum, Azotobactor and phosphate solubilizing bacteria (PSB) are found useful for different horticultural crops. Nitrogenous bio fertilizers can provide 25-30% of chemical fertilizer equivalent nitrogen, whereas, PSB bio fertilizer can provide 12-20 kg P2O5/ha/season. Mycorrhiza effectively provide adequate phosphorous and other micro nutrients. These bio fertilizers help in increased water absorption, keeping soils biologically active and help in soil health maintenance. Thus, the use of bio fertilizer is increasing day by day due to increase in the price of chemical fertilizers, its beneficial effect on soil health and increase in production of horticultural crop while saving the cost of cultivation thereby, increasing input use efficiency of the orchard.

PLANT BIO REGULATORS

Plant Bio regulators (PBRS) are organic compound other than nutrient which in small amount promote/inhibit or otherwise modified any physiological response in plant. The exogenous application of bio-regulators (*auxin, gibberellin, cytokinin, abscisic acid, ethylene, brassinosteroide, jasmonates* and *salicylic acid)* might, therefore, act as a powerful tool not only for enhancing the growth, productivity, quality of horticultural crops but also in combating the ill effects generated by various biotic and abiotic stresses in plants in the near future. Some other important application of these plant bio regulators varies with crop to crop. Accelerating germination of seed, asexual propagation (budding, grafting, layering and cutting), tissue culture, flowering, fruiting, ripening, crop regulation, quality and storage.

Therefore, researchers require a better understanding of the mechanism responsible for developmental processes in plants at the cellular and molecular levels and a more comprehensive description of the specificity of bio regulators in mediating key biochemical steps. The use of these plant bio regulators thus results in enhancing quality, improving yield and shelf life of horticulture produce which are otherwise highly perishable in nature and indirectly accelerating input use efficiency.

CONCLUSION

From the fore going discussion it is clearly indicated that these innovative approaches result in sustainable production of horticultural crops at lowest cost thereby, enhancing input use efficiency. It will not, however, be the magic bullet to solve the overuse of input in horticulture system and still, wide range of approaches need to come together if we are to succeed in improving input use efficiency by above means. The approaches should aim at becoming more efficient and low-input horticulture needs to increase in productivity while retaining high efficiency of input use. Although, intensive and high-input horticulture has a key present and future role to play; however, it must attempt to do more with less and as argued by several researchers, it should aim at being more

sustainable. To meet the increasing quality and quantity food requirements from limited land resources, keeping the problems of climate change, increasing population in mind there is an urgent need to focus on theses smarter technologies like drip irrigation and fertigation, high density planting, mulching, bio fertilizers and plant bio regulators both on farm and under protected cultivation for round the year quality horticulture produce on commercial scale.

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Plant Poisoning their identification and treatment in Indian animals

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A poison is a substance which, when administered, inhaled or ingested, is capable of acting deleteriously on the human body. Thus, there are really no limits, between a medicine and a poison, for a medicine in a toxic dose is a poison and a poison in a small dose may be a medicine means, it depends on dose/quantity only. Poisonous plants are those which cause serious problems or even death occur, if a small quantity of its stem, leaves, seeds, fruits and roots are ingested. Some other plants are normally harmless but they may become toxic if preparative from them are taken in excess in strong doses or for a long period of time. In India environmental conditions varies throughout the year resulting in lack of availability of feed and fodders throughout the year. The peoples are not very aware about toxic content of plants so the plant poisoning is very common. So at least little knowledge should have about the toxin, toxicity and their treatment of plants which found nearby them is necessary to control plant poisoning in animals.

1. **Suicide Tree' or *Cerbera odollam***

The 'suicide tree', according to scientific reports, is responsible for killing many animals in India by poisoning. The plant grows all across India and is quite infamous for its sinister qualities. In Kerala, half of the deaths due to poisoning are contributed to Cerbera. The kernels of the plant, the most poisonous parts, have an extremely bitter taste. However, if mixed with spices and other spicy foods, it easily disguises the bitterness. The kernels hold the death toxin, cerberin. Cerberin is a cardiotoxin which

blocks some ion channels of the heart, stopping the heartbeat. Nausea, vomiting and abdominal pain are the primary symptoms of cerberin poisoning. This is followed by worsening of symptoms like diarrhoea, dilated pupils, heart burning, headache, coma and finally death within 3-6 hours.

Treatment- There is no specific treatment. Remove cattle from source as soon as possible. Only supportive treatment available based on symptoms on animals. Symptomatic treatment with cardio tonic drugs**.**

2. ***Datura stramonium***

Almost all parts of the Datura plants can kill animal. The plant is laden with dangerous poisons like hyoscyamine, atropine and scopolamine, overdose of which could lead to fatal consequences. The symptoms include delirium, amnesia, lowering of heartbeat, hyperthermia, pupil dilation with painful photophobia, bizarre behaviour and at high doses, death.

Treatment- Treatment is symptomatic, antidote of atropine like physostigmine can be used with caution.

3. ***Calotropis gigantean***

Used for malicious killing of animal. A shrub usually found in crop field and waste land. All parts of plant is toxic. It is not palatable but due to accidentally it can be ingested. The toxic principles are glycoside calotropin, gigantin and uscharin. Following oral administration it's leave and fruit cause severe gastro enteritis and cardiac arrhythmia and death due to cardiac arrest.

Treatment- Remove the source. Symptomatic treatment with cardio tonic drugs**.**

4. Ricinus communis

The seeds of Ricinus communis or the castor plant, contains ricin, one of the most potent toxins of the natural world. The castor bean contains two toxin, the ricin and RCA (Ricinus communis agglutinin). Ricin is the more dangerous toxin as it is easily absorbed by the intestinal wall which is not the case with RCA. The symptoms involve nausea and vomiting, bloody diarrhoea, severe dehydration, pain in the abdomen, drop in blood pressure and urine.

Treatment- Treatment consists of giving antiserum from previously hyper immunised animal. Removal of poison through gastric lavage or saline purgative. Fluid and electrolyte therapy, saline diuretic and urinary alkalizer.

5. *Strychnos nux-vomica*

Strychnine is an alkaloid poison derived from the Strychnos nux vomica tree. It has been used since the early 16th century as a rodenticide. Strychnine prevents the proper functioning of the chemical messenger system of the body, producing painful muscle spasm and in lethal doses, loss of the ability to breather followed by death. Fear and agitation, painful muscle spasms, tight jaws, breathing difficulties and darkened urine are some of the symptoms of strychnine poisoning.

Treatment- Treatment of toxicity is symptomatic, anticonvulsant and central muscle relaxant can be used. Morphine and Ketamine is contradicted. General antidote is used to neutralize the alkaloid poisoning and useful to reduce the absorption of Strychnine in GIT.

6. Bracken fern

Ingestion of bracken over several weeks when pasture is sparse can lead to toxicity. Acute disease and death in cattle can result following ingestion of young bracken fronds causing bone marrow suppression, loss of blood cells and clotting factors. Ingestion of bracken over many months (once used as bedding material for cattle) can lead to bladder tumours in older (beef) cows, and much less commonly tumours in the oesophagus and rumen. the toxic principle thiaminase in breaken fern. It blocks the Vitamin B_1 thiamine and aplastic anaemia.

Treatment- Tiamine supplementation in horse and pig (thiamine @100 mg sc twis a day) but no use in ruminants. The most effective treatment in cattle is blood transfusion with 3% sodium citrate.

7. Oak (*Quercus*) poisoning

Acorns from Quercus spp. can present a serious problem on pastures with oaks after autumn storms. Tannins in acorns cause serious, often fatal, kidney damage. Sudden deaths may occur but anorexia, depression and bloat due to ruminal stasis are more common signs. Initially there is constipation and associated straining progressing rapidly to foetid tarry diarrhoea. Death follows within 4-7 days despite supportive Treatment.

Treatment- Polyethelene glycol is antidote of tannin. Also supportive treatment includes large volumes of intravenous fluids which are prohibitively expensive. Remove cattle from pasture with oaks especially after autumn storms or heavy acorn falls.

8. Abrus precatorius

Commonly known as jequirity, Crab's eye, or crab's eye creeper and rosary pea, The plant is best known for its seeds, which are used as beads and in percussion instruments, and which are toxic because of the presence of abrin. Abrin cause haemagglutination in body. Ingestion of a single seed, well chewed, can be fatal to both adults and calve. Abrus seeds are the agents by which the native skinner of India carries on the felonious poisoning of cattle for the purpose of securing their hides. This is done by means of small spikes, called sui (needles) which are prepared by soaking the sui in a thin paste of the water-soaked, pounded seeds, and then drying the weapon in the sun, after which it is oiled and sharpened upon stone, affixed in a handle, and then used to puncture the skin of the animal.

Treatment- No specific antidote available, Remove the source as soon as possible. Emesis, gastric lavage, demulcents and saline purgative can be used to remove source and infusion of fluid and electrolytes should be given.

9. Nerium oleander

All parts of the N. oleander plant are toxic. Cardiac glycosides, the known toxins, are found in the roots, stems, leaves, flowers, seeds and fruit as well as sap, plant nectar and even water in which oleander leaves have been floating. Roots and stems contain the highest amount of toxin, with the amount in leaves and flowers following closely behind. Interestingly, the total cardiac glycoside content is reported to be highest in plants with red flowers. A number of different cardenolide glycosides have been identified in N. oleander, with some references suggesting there may be as many as 30 separate glycosides. Oleandrin, however, with a mechanism of action similar to digoxin or digitoxin, remains the most widely recognized cardiac glycoside in most scientific papers. Toxicity signs are vomiting, abdominal pain, diarrhoea, tenesmus, cardiac arrhythmia, heart block and tachycardia.

Treatment- Remove the source as soon as possible and Cardio tonic drugs can be used.

10. Lantana camara

Lantana camara, is a weed of national significance and threatens stock through its toxicity. All lantana should be treated as poisonous to stock. Red flowered varieties are thought to be the most toxic but some white and pink flowered varieties can also be highly toxic. Most lantana poisoning occurs when stock unfamiliar with the plant are introduced to areas where lantana is found. Young animals are most at risk. It contains hepatoxic principal triterpenes lentadane A and B, the toxicity is characterized by cholestasis and secondary photosensitization.

Treatment- No specific treatment only symptomatic treatment can be given with hepatotorics and anti-inflammatory drugs to decrease the adverse effect of photosensitization.

Backyard Poultry Farming

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Rural population living in India constitutes 72.2 per cent of the total population, which is predominantly occupied by poor, marginal farmers and landless labourers. Backyard poultry production is an old age profession of rural families of India. It is the most potent source for subsidiary incomes for landless and poor farmers. It is an enterprise with low initial investment but higher economic returns and can easily be managed by women, children and old aged persons of the households. Now-a-days, poultry meat and eggs have been the best and cheapest sources for meeting out the per capita requirement of protein and energy for rural areas of India. Though India has shown a tremendous growth in poultry production over decades but rural poultry farming is still lagging behind and always found neglected. As it is the best alternative for the small scale farmers to subsidise the income with negligible input, this farming system needs an upliftment with recent advancement of research in the field of rearing of chicks, balanced feeding, disease control and efficient marketing system for the egg and meat. Now-a-days, the backyard poultry can easily start with good egg laying birds of RIR (Rhode Island Red), Chabro, Punjab Red and Partapdhan breeds.

Backyard poultry production system is a low input business and is characterized by indigenous night shelter system, scavenging system, natural hatching of chicks, poor productivity of birds, with little supplementary feeding, local marketing and no health care practice. Poultry development plays a crucial role in increasing egg and chicken meat production. Indian demand for poultry products will be enhanced at 4.8 per cent where as the supply of poultry products will grow at 5.2 per cent per year over the decade which is faster than for any other type of animal product. The production of agricultural crops has been rising at a rate of 1.5–2 per cent per annum, where as eggs and broilers has been shown to rise at a rate of 8-10 per cent per annum but the growth has been mainly restricted to commercial poultry**.** In India, growth in the livestock sector can definitely contribute to poverty reduction, because of the peoples lived in rural areas depends on livestock for their daily livelihoods. It has also been observed that the demand for the animal protein source is increasing rapidly in developing countries.

Raising of local poultry breeds in backyard is an important source of livelihood for the rural people. Small holdings containing 2-3 hens per unit were found to be more efficient producer of eggs compared to those with 5 or more hens per unit. Main interest of the poultry farmers having backyard poultry is not production of eggs as returns are

very low from sale of eggs. They hatch all their eggs and sale them as birds because of broodiness habit of these breeds.

Advantages of backyard poultry farming

There are many advantages of rural poultry farming system which are given follows:

- Gives employment to the rural small scale and marginal farmers.
- Provides additional income to the rural communities.
- Aids in enhancing the soil fertility in backyards (15 chickens produce 1-1.2 kg of manure/day).
- Products from rural poultry farming fetches high price compared to those from intensive poultry farming. Almost double the rates of brown shelled eggs in the local market.
- Provides egg and meat with almost no or very less investment through backyard poultry farming in free range system.
- Birds reared under free range conditions give eggs and meat of low cholesterol concentration compared to those produced under intensive poultry farming.
- Lessens protein malnutrition in susceptible groups like pregnant women, feeding mothers and children.

Management of backyard poultry birds

Feeding

In backyard poultry farming, the feed cost is considered to be minimum. The birds collect the required protein, energy, minerals and vitamins etc. From snails, termites, leftover grains, crop residues and household wastes. Feed ingredients like broken groundnut straw and wheat grains can also be given to the chicks. The chicks may be supplied with extra concentrate ration@30-60 gm/day/chick for better performance. The chicks need balanced feed during the initial 6 weeks of age under brooder by providing balanced chick feed during the early period of growth. The average body weight of 1.5 to 2.0 kg will be attained upto 5 weeks and if required should be provided with supplemental calcium sources like lime stone powder, dicalcium phosphate (DCP), stone grit, shell grit at 4 to 5 grams/bird/day.

Floor space

The chick should be provided sufficient feed and floor space. Overcrowding results in stress and mortality chick requires 8 square inches of feeding space. During the 6^{th} week, 1 sq. ft. floor space per chick must be provided to avoid overcrowding.

Ventilation

Supply of fresh air to the chicks is highly essential. Brooding will cause depletion of oxygen and build up of carbon dioxide, ammonia etc., the airtight curtains should be avoided. It is recommended to keep a gap of 3.5 inches between the ceiling and side curtains to facilitate gas exchange between the house and environment. In extreme

weather conditions, windows, doors and fans need to be effectively used to maintain optimum ventilation.

Table 1: Ingredients for balanced ration

Ingredient	0-8 week old birds	9-20 week old birds	More than 20 week old birds
Maize	52	45	46
Soybean	18	-	15
Groundnut oil	13	13	8
Rice polish	-	35	-
Deoiled rice polish	15	-	22
Fish meal	-	06	-
Limestone	-	-	7
Dicalcium phosphate	2	01	02
Salt (g)	200	-	300
Vitamins (A,B,D,K) g	15	15	15
B complex	20	20	20
Vitamin B_{12}	15	-	-
Trace minerals (g)	50	50	50
Coccidiostat	+	-	-

Table 2: Space requirement for poultry

Age (Weeks)	Floor space (sq. ft)	Feeding space (cm)	Watering space (cm)
0-4	0.5	2.5	1.5
4-8	1.0	5.0	2.0
8-12	2.0	6.5	2.5

Beak trimming

Trimming of beak is an important managemental practice. This is done to prevent cannibalism and wastage of feed. Beak trimming is a sensitive operation and it should be done by trained people. The beak trimming is done at 3rd week and one third of upper beak should be trimmed.

Litter management

Litter management place a vital role in controlling the disease in the flock. When birds are housed on deep litter, placing of waters and their maintenance should receive due attention to keep the litter dry. The litter should be stirred at regular intervals depending on the environmental temperature, humidity, ventilation fecal moisture content, quality of water system.

Health issues

Rural chicks need brooding care during the initial 6 weeks of age. After 6 weeks, they can be let free for scavenging in the backyard. The excess males can be reared

separately and marketed for meat purpose. The night shelter should have good ventilation and protection from predators and plenty of clean water should be made available. The birds must be vaccinated against Marek's and Ranikhet diseases. There should be periodic de worming at 3-4 months intervals.

Importance of local breeds in backyard poultry farming system

Smallholder backyard poultry production utilizing local breeds is expected to come under serious competition with the commercial poultry sector and if not well planned the genetic resources of local poultry shall be lost. Conservation of local poultry breeds along with improvement for traits like meat and eggs will increase competitiveness to survive in the market. The socio-religious use of local poultry breeds, superior adaptability in their habitat, ability to perform in low input production system and the production system which is similar to organic production will the competitive advantages of backyard system over commercial poultry production. Poultry keeping in backyard gives very high return as the investment is very low. The local breeds of poultry/indigenous poultry genetic resources are held in high esteem even after 50 years of industrial poultry production because of the following reasons:-

- Local poultry breeds exhibit superior adaptability in their habitat and possess the ability to survive, produce and reproduce on low plane of nutrition and sub-optimal management.
- The inputs required are very small, as they scavenge their feed requirements and are raised with little veterinary care.
- They possess the ability to protect themselves from predators.
- All the local breeds show broodiness and hatch their own chicks making the system auto generating.
- People have a preference for eggs and meat of indigenous poultry compared to those realized from farm-bred chickens consequently eggs and meat from local breeds are sold at a premium price.
- Cock fighting is a popular sport for the ethnic tribes and the local breeds are superior to exotic breeds in fighting.
- Use of coloured bird for socio-religious use.

Points kept in mind for backyard poultry farming

- ✓ **Trainings:** Poultry farmers must approach to Krishi Vigyan Kendra's to obtain the basic training on backyard poultry farming. This is very useful for rearing of chicks, feeding, housing and disease management.
- ✓ **Exhibitions:** Through regular exhibition of local poultry breeds in Kisan Melas, Animal Camps, Livestock Championship and other poultry exhibitions. This helps in the selection of good quality birds.
- ✓ **Breeding of local poultry breeds:** Since most of the small holder poultry farmers are poor, Government should extend assistance to improve the poultry farming system by providing good quality chicks to the backyard poultry and suggest for multiplication of birds at their own level from these good quality hens. Within a time frame the skills are to be transferred to farmers at village level. Attempt, however, should be made to retain broodiness in the local stocks

since it makes the system auto generating. These hens used for producing the chicks at home level.

- ✓ **Record keeping:** In order to improve egg production there is a need to record the performance of individual hens for egg production. It is not a problem to obtain this information since each hen lays her egg in a separate nest regularly. This will provide information on laying capacity and hatching performance for each hen. Those hens with higher egg production and hatchability should be selected to reproduce next generation.
- ✓ **Vaccination schedule:** Follow the vaccination schedule given below:

Table 3: Vaccination schedule

Age of birds	Name of vaccine	Name of disease	Doses	Route of vaccination
Day old chicks	HVT MD Vaccine	Marek's disease	0.2 ml	s/c or i/m
4-7 days	F-1/Lasota	Ranikhet disease	One drop	Eye or nostril
14 to 18 days	Intermediate plus	Gumboro disease	-	Drinking water
35 days	F-1/Lasota	Ranikhet disease	One drop	Eye and nostril
6 to 7 weeks	Chicken embryo adopted	Fowl Pox	0.5 ml	Wing stab method
8 to weeks	Strain killed vaccine	Ranikhet disease	0.5 ml	s/c or i/m

- ✓ **Extension services:** Extension support for health care, input supply, market linkages and other aspects should be readily available at village level. The people should participate in the health care and breed development programme.

The majority of the farmers expressed their willingness to increase their poultry activities, although the highest proportions of the farmers were medium producers. In order to increase poultry production at the farmers' level, a systemic training program should be organized specifically for rural communities. Additionally, extension and motivational work along with technical support should also be conducted in the villages to en-courage farmers to rear and consume more backyard system of poultry production, since this is a means of sustainable livelihood of poorer sections of the society and will help in food production, food security and providing employment to rural peoples. Lack of technical knowledge, lack of suitable germplasm, decrease in availability of natural resources of feed and inadequate veterinary support is the alarming constraints of the traditional backyard poultry production system.

Krishi Vigyan Kendra's (KVK) must take a leading steps in providing technical training in backyard poultry production along with supply of 10-20 good quality birds of local breeds like RIR, Chabro, Punjab Red and Partapdhan. So, this may create awareness and education to the rural families to get encouragement in the line of egg and meat production. If possible the breeds may be supply after the brooding period of

6-8 week of age. So, there is less chances of mortality at the farmer's field. All are helpful to increase the backyard poultry production in the rural areas of Punjab/India. Hope these efforts helpful to our farmers/farm women and rural youth to show encouragement in poultry production specially "Backyard Poultry". KVK's may help in getting chicks for this farming by providing skill development trainings to improve the overall managerial skills in rural families.

Management of Summer Anestrus in Murrah Buffalo

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India possesses the best River milk breeds of buffaloes in asia like murrah is one of them. Majority of them are distributed in the state of Haryana, Punjab, areas nearby Ravi and Sutlej valleys, north sind and uttar Pradesh. Murrah breed has great potential for both milk and fat production. It is considered to be a polyestrus animal but shows seasonal pattern of reproduction. Breeding efficiency usually get reduced during hotter months of summer ranging from march to august due to longer day length associated with high temperature and increased humidity. Among the various seasonal reproductive problems like silent estrus, summer anestrus, poor conception rate, early embryonic mortality, summer anestrus is the major problem encountered by livestock owners. Summer anestrus is associated with changes in endocrine profiles leading to ovarian inactivity and absence of signs of estrus in the affected buffaloes. It has multifactorial etiology which includes heat stress, low availability of green fodder, poor body condition score, dietary heat increment, increased prolactin, hormonal imbalances, and poor heat detection. So focusing on proper management, optimum nutrition, selective breeding, homoeopathy, herbs and by use of various hormonal protocols the incidence of summer anestrus can be reduced with varied degree of success.

Management practices

- In summer season water should be sprinkled over the buffalo for 5-10 minutes atleast thrice a day.
- If possible buffalo should be wallowed for 2 hour daily in morning and in evening to overcome heat stress.
- Animal sheds should be properly ventilated.
- If the roof of the shed is made up of iron or asbestos sheet then spread paddy straw over it and make it wet by sprinkling water over it.
- Regular deworming

Nutrition Strategy

- Supplementation of mineral mixture

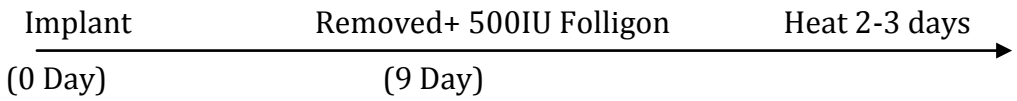
- Feeding should be done during cooler hours of day either early morning or late evening.
- As appetite get reduced during summer so improve the quality of ration.
- Feed low fiber and highly fermentable carbohydrate diets.
- Provide green fodder and ad libitum cool water

Improve heat detection methods

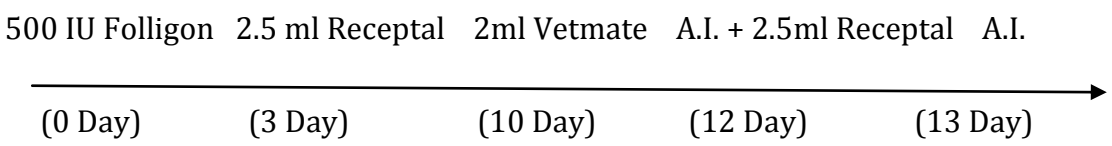
- Use teaser bulls, observe estrus signs carefully during cooler hours of day, tail head paint, temporary teat engorgement, pedometers, radio telemetric pressure transducer etc.

Hormonal protocols

- Progesterone implants (Crester, Triu B, CIDR)



- Ovulation synchronisation plus



Homoeopathic Veterinary Medicine

- Heato-Vet by Dr. John' pharmacy @ 1 tablet on 1/4th piece of chapatti followed by 20 drops on tongue after 10 minutes of tablet, thrice a day until buffalo comes in heat.

Herbal preparations

- Janova(Ayurvet) or Sajani (Zydus) 3 capsules/day for 2 days repeat after 10 days if no estrus observed.

Improving Nitrogen use efficiency-A Novel approach to improve Crop productivity

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Nitrogen (N) fertilizer is a major essential plant nutrient and key input for increasing crop yield, hence the most yield-limiting nutrient in rice (*Oryza sativa* L.) cropping systems worldwide. It in general plays a number of roles in the plant system some of which are imparting green colour, being an integral part of the chlorophyll, constituent of many cell components and nucleic acid and components of energy transfer compounds. Since nitrogen is an yield-limiting nutrient in rice, its deficiency causes symptoms like burning of leaf tips and margins beginning with more mature leaves, appearance of yellow-green colour (chlorosis), slow growth and stunted growth. The N cycle illustrates how N from manure, fertilizers and plants moves through the soil to crops, water and the air. Understanding the N cycle will help us make the best use of manure and fertilizers to meet crop needs while safeguarding the environment.

NITROGEN USE EFFICIENCY (NUE)

It is defined as the yield of grain per unit of available N in the soil including the residual N in the soil as well as the fertilizers. It can be divided into-

a. NupE- Referred as uptake efficiency. It is defined as the ability of the plant to remove nitrogen from the soil as nitrate and ammonium ions.
b. NutE- Referred as utilization efficiency. It is defined as the ability to use nitrogen to produce grain yield.

Despite efforts, NUE hardly exceeds 50% in case of cereal crops and in case of rice, NUE varies from 25-34%.

REASONS FOR INCREASING NUE

Fates of reactive nitrogen:

Fate of excess reactive nitrogen lost from agricultural system is an important aspect to be considered. Some soluble N is transformed into organic or volatile forms (N_2O, NO and NO_2 contribute to air pollution and acid rain) along the flow path from field to

ocean. Some portion of the soluble N leaches deep into ground water ultimately affecting human health. Elevated nitrate contamination (which causes Methaemoglobinemia) also tends to be associated with N fertilizer use.

Nitrous oxide & Climate change:

N_2O in the troposphere acts as a powerful greenhouse gas absorbing outgoing infrared radiations from the earth. It is 300 times more effective than CO_2. It has been estimated that 80% of it's sources are associated with agriculture largely (50%) with fertilized soils. Because most anthropogenic reactive N is produced for or in agricultural systems, so most of the increase in N_2O is ultimately due to agricultural uses of N.

Methane Emission:

Numerous studies have demonstrated that the application of N may directly or indirectly influence all of the processes in CH_4 production, oxidation, and transport from the soil to the atmosphere. The negative effect of ammonium-based fertilizer is mainly attributed to the stimulation on CH_4 oxidation via enhancing the growth/activity of methanotrophs.CH_4 emission, on an average, decreased by 42-60% in the ammonium sulphate treatment.

Resistance to NH_4 toxicity:

Irrational fertilization patterns, and deposition of atmospheric NH3/NH4+ have resulted in the accumulation of excess NH4+ in many agricultural soils. Inorganic nitrogen released from the fertilizers as NH4 has led to a drastic decline in the grain yield, NUE as well as affected the morphology of the roots.

Pest & Disease attack:

Increase in fertilizer application increases the possibility of disease and pest attack on the crop due to increased susceptibility and vegetative growth .Subsequently grain yield is reduced.

Social issues:

Increase in input cost due to over fertilizing. Application of pesticides and insecticides increases the cost even to a greater extent.High nitrogen use efficient cultivars can thus reduce the input cost along with an increased profit through an increased grain yield.

MOLECULAR BASIS OF NUE

Transporters can be divided into

LATS- Low affinity transport system. It is expressed when nitrogen is present in high concentration in the environment.

HATS- High affinity transport system. It is expressed when nitrogen is present in low concentration in the environment. It can be subdivided into-

- IHATS- Inducible high affinity transport system.
- CHATS- Constitutive high affinity transport system.

Nitrate transporter families can be divided into

- NRT1(53 genes)
- NRT2(7genes)
- CLC(7 genes)

NRT-1 is expressed when nitrate is present in surplus amount in external medium. It belongs to the LATS family.
NRT-2 is expressed when nitrate is present in low amount in external medium.It belongs to the HATS family.
Ammonium transporter families can be divided into-
OsAMT1- It can be further divided into-

- OsAMT1;1
- OsAMT1;2
- OsAMT1;3

WAYS TO INCREASE NUE

Genetic approaches:

- Increased NUE was achieved through over expression of alanine aminotransferase (AlaAT) in roots, which is a downstream process in N assimilation.
- Over expression of the Dof1 protein showed up to 30% higher N content, higher levels of amino acid, better growth under low N conditions and higher levels of mRNAs and enzyme activity for PEP carboxylase and pyruvate kinase
- Regulating the expression of the ASN1 gene to manipulate the relationship between Asn and seed N status might enhance nutritional status

Physiological approaches:

- Increasing leaf N content and delaying N efflux from leaf can improve the efficiency for biomass production (NUEb).
- Efficiency in N remobilization from old to new leaf and from straw to grain will affect both NUEb and NUEg (efficiency for grain production).
- One way of increasing NUE is to simply breed for a root system that is more efficient at taking up N.

Biochemical Approaches:

- Increasing the activity of the enzyme Glutamine synthetase increases the amount of protein nitrogen in a single rice grain at significantly.
- NADH–GOGAT is important in the utilization of N in grain filling, and its activity in developing grains is positively correlated with yield.
- Benzyladenine in combination with nitrate was shown to enhance NR-specific mRNA.
- Manipulation of GS2 and Fd-GOGAT genes has been responsible for the improvement of NUE. It was responsible for the improved re-assimilation of ammonia.

Management Practices:

- Site, time & dose specific nutrient management.
- Use of Nitrification inhibitors:
    i. N-serve
    ii. AM

iii. DCD (dicyadiamide)
iv. ST (sulphathiazole)

- Slow release nitrogen fertilizers:
  i. sulphur coated urea
  ii. polymer coated urea
  iii. neem cake coated urea
  iv. IBDU (isobutylidenediurea)
- Use of Urea super granules:increase NUE by 20-30%.

CONCLUSIONS

In the view of exorbitant increase in global population, it is practically impossible to feed the huge population through organic farming. Regulation and manipulation of the transporter families are needed which consist of judicious use of fertilizers, adoptability to avoid the N losses from soil and reduce the fertilizer loss and maximize the yield.

Embryo transfer technology in cattle

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ABSTRACT

An embryo is an egg that has already been fertilized by a sperm cell. It is an organism in the earliest stage of development. Embryo transfer is one step in the process of removing one or more embryos from the reproductive tract of a donor female and transferring them to one or more recipient females. Embryo transfer was first performed and recorded by Walter Heape in 1890. He transferred two Angora rabbit embryos into a gestating Belgian doe .The Belgian doe produced a mixed litter of Belgian and Angora bunnies. Embryo transfer in food animals began in the 1930s with sheep and goats, but it was not until the 1950s that successful embryo transfers were reported in cattle and pigs by Jim Rowson at Cambridge, England. By embryo transplanting we are getting new developed high yielding animals.

Embryo transfer is one step in the process of removing one or more embryos from the reproductive tract of a donor female and transferring them to one or more recipient females.

STEP FOR EMBRYO TRANSFER IN CATTLE

1.) Selection of donor cow
2) Super ovulation of donor cow
3) Insemination of cow
4) Flushing of embryo
5) Evaluation of embryo
6) Selection and preparation of recipient female
7) Transfer of embryo
8) Expected embryo transfer result

1. Selection of donor cow-:

Embryo transfer in cow.

It has been suggested that prospective donor cows in embryo transfer programs be selected on the following criteria:

1) Regular estrous cycles commencing at a young age
2) A history of no more than two breeding per conception
3) Previous calves with approximately 365-day intervals
4) No parturition difficulties or reproductive irregularities

5) No conformational or detectable genetic defects.

2) Super ovulation of the Donor Cow-:

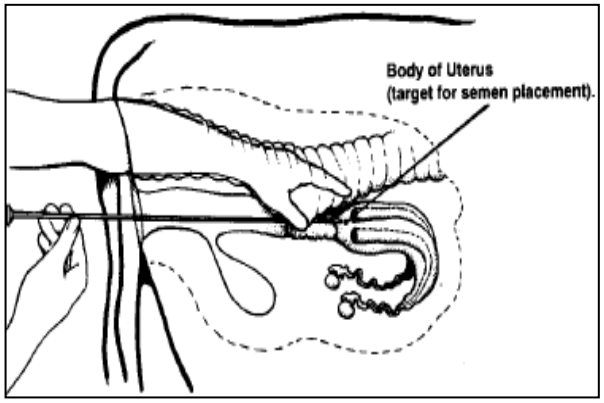
Super ovulation is the release of multiple eggs at a single estrus. Cows or heifers properly treated can release as many as ten or more viable eggs at one estrus.

Approximately 85 percent of all normal fertile donors will respond to super ovulation treatment with an average of five transferable embryos.

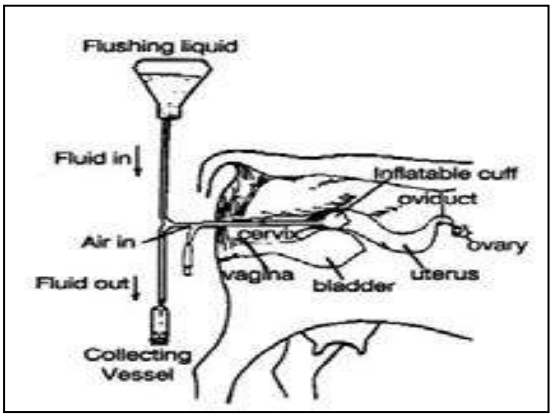
The basic principle of super ovulation is to stimulate extensive follicular development through the use of follicle-stimulating hormone.

SUPER OVULATION OF THE DONOR COW

3. Insemination of the Cow-:



Because of the release of many ova from multiple follicles, there is a greater need for viable sperm cells to reach the oviducts of the super ovulated females. Therefore, many embryo transfer technicians will choose to inseminate the cow several times during and after estrus. One scheme is to inseminate the super ovulated cow at 12, 24 and 36 hours after the onset of standing estrus. Using high-quality semen with a high percentage of normal, motile cells is a very critical step in any embryo transfer program. The correct site for semen placement is in the body.



4) Flushing the Embryos-:

To collect the embryos non surgically, a small synthetic rubber catheter is inserted through the cervix of the donor cow, and a special medium is flushed into and out of the uterus to collect the embryos seven or eight days after estrus.

This collection procedure is relatively simple and can be completed in 30 minutes or less without harm to the cow.

Flushing the Embryos

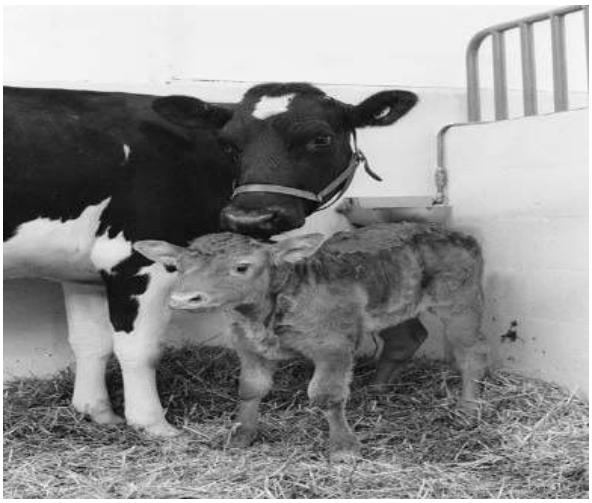
5) Evaluation of the Embryos-:

Regularity of shape of the embryo

Compactness of the blastomeric (the dividing cells within the boundaries of the embryo)
Variation in cell size
Color and texture of the cytoplasm (the fluid within the cell wall)
Overall diameter of the embryo
Presence of extruded cells
Regularity of the zona pellucida.
Classification of embryo:
Grade 1: Excellent or good
Grade 2: Fair
Grade 3: Poor
Grade 4: Dead or degenerating

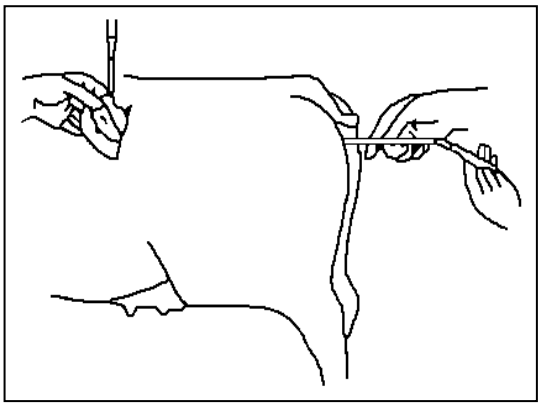
Evaluation of the embryo under microscope.

6) Selection and Preparation of recipient Females



Proper recipient herd management is critical to embryo transfer success.
Cows that are reproductively sound, that exhibit calving ease and that have good milking and mothering ability are recipient prospects.
They must be on a proper plane of nutrition. **Selection and Preparation of recipient Females**
These cows also must be on a sound herd health program.

7. Transfer of embryo-: The transfer of the embryo into the recipient cow first requires "loading" the embryo into a 1/4-ml insemination straw.
This is done under microscopic viewing with the aid of a 1-ml syringe and requires considerable practice, patience and dexterity.



Transfer of embryo

8. Expected Embryo Transplant results-:
Embryo production varies greatly from donor to donor and flush to flush. Average production is approximately six freezable (excellent and good) and eight transferable (excellent, good, fair and poor) embryos per super ovulation.
Pregnancy rates vary from flush to flush with fresh averages 60 to 70 percent and frozen 50 to 60 percent.

Advantages of embryo transfer in cattle-:

1. The reproductive potential of each normal newborn calf is enormous. There are an estimated 150,000 potential "eggs" or ova in the cow and billions of sperm produced by each bull.
2. By natural breeding, only a fraction of the reproductive potential of an outstanding individual is realized.
3. But, embryo transfer is a technique that can greatly increase the number of offspring that a genetically important cow can produce.

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Chilli Wilt Disease: A Serious problem in Chilli cultivation in India

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Chilli (*Capsicum annum* L.) is one of the most important vegetable and spice crop belongs to family Solanaceae and genus *Capsicum*. It is grown for its green and ripe red fruit which is an indispensable condiment, digestive stimulant as well as flavoring and coloring agent in sauces, chutneys, pickles and other forms of food. India is the leading producer and consumer of chilli in the world (Anonymous, 2016). It is susceptible to several diseases and pests, which become major constraints in its production. Among them the most devastating are fungal diseases which lower the yield considerably annually. One among the fungal diseases is Fusarium wilt, caused by the F*usarium oxysporum* has emerged as a serious problem in past decade (Anonymous, 2005). Leonian (1919) first time reported the wilt disease of chilli caused by *Fusarium* spp. *Fusarium oxysporum, F. solani, F. moniliforme* and *F. pallidoroseum* have been reported as the wilt causing agents from chilli growing areas but in India *F. oxysporum* and *F. solani* are the most prevalent species of *Fusarium* found associated with wilt disease of chilli (Naik, 2006). The pathogen is typically soil-borne with dry weather condition and excessive soil moisture conducive to the disease development.

Symptomatology and Ecology

Variable symptoms are observed which includes vein clearing, leaf epinasty, chlorosis, necrosis, abscission and wilting (Fig1). Symptoms are characterized initially by slight yellowing of the older leaves followed by younger leaves; the leaves became chlorotic and desiccated and the whole plant wither and die slowly. At first, the lower leaves and then upper leaves show loss of turgidity. Thereafter, stem shrivels and entire plant wilts. By the time above-ground symptoms are observed, the vascular system of the plant is discolored, particularly in the lower stem and roots. The characteristic symptoms of the disease are brown vascular discoloration followed by upward and inward rolling of the upper leaves and subsequently wilting of the plants. The wilting symptoms appear as a result of severe water stress, mainly due to the vessel plugging/occlusion. The disease manifests at all growth stages with maximum severity at flowering and fruiting stage and results in partial to complete failure of crop.

Wilt is a soil borne disease which cannot be managed effectively through chemicals. Wide host range of the pathogen also increased the survival potential of the pathogen. The pathogen is extremely adaptable, variable and capable of long persistence in soil in the form of chlamydospores. *Fusarium* spp. produces different types of spores, i.e., macro-conidia, micro-conidia and chlamydospores (Nelson *et al.,* 1981), which act as asexual spore and help in survival of the pathogen. Spores are disseminated by wind, ground water, by movement of the contaminated soil, stake, or equipment. Various conditions like spore density, temperature, and water potential affect the germination of *Fusarium* conidia. The optimum growth of the genus *Fusarium* is found between 25 to 28°C, while the maximum growth is generally obtained at 28°C, inhibited above 33°C and not favored below 17°C. Generally, the dry weather condition and excessive soil moisture enhance the disease development. Mycelial growth and cell wall degrading enzymes and toxins produced by the pathogen may contribute to vascular plugging/occlusion, which lead to the development of a systemic vascular disease in host plants.

Fig. 1: Wilt symptoms on chilli

Management

There are limited resistant sources available against wilt pathogen in the germplasm of chilli throughout the world. Therefore, disease can be managed by cultural, biological and chemical means and by screening of germplasms/lines for resistance. Being monocyclic disease, it can be managed by eliminating or reducing the primary inoculum in soil or in/on seed or propagating material besides making host evade or defend the attack of the pathogen.

a. Host Resistance

The cultivation of resistant varieties is the most effective, economical and environmentally safe method for controlling plant diseases. Because of the soil borne nature of wilt pathogens, cultivation of resistant genotypes, if any, is best way of managing the problem. Various chilli wilt resistant varieties available are Musalwadi, Arka Lohit, Pusa Jwala, Pant C-2, and Jwahar-218, (Nayeema et al., 1995, Joshi *et al.* 2012)

b. Cultural Management

Managing chilli wilt by manipulating cultural practices such as crop rotation and fallowing, field sanitation, deep ploughing, time and method of planting, irrigation and soil pH have been attempted by workers. These practices are sustainable, though some are labor intensive. Cultural practices offer an opportunity to alter the environment, the condition of the host, and the behavior of pathogenic organisms in ways that adequately controls a particular disease. Fusarium wilt of chilli can be successfully managed by sowing plants on ridges and avoiding excessive irrigation as wet soils were found to favour the disease. Higher pH levels are known to restrict the growth and development of *Fusarium* spp. in soil and hydrated lime has often been used for the purpose. Soil solarization can also reduce the population of *Fusarium oxysporum capsici* up to 0-15 cm depth in soil.

c. Biological Management

The biological management of plant pathogens is assuming significance on account of ill-effects of conventional measures of disease control by chemical fungicides, and has become quite popular strategy to manage especially those diseases which are soil borne in nature and, hence, difficult to manage chemically. *Trichoderma viride* and *Trichoderma* harzianum has been found as potent biocontrol agents against Fusarium wilt in chilli. The application of endophytic bacteria *Bacillus subtilis* and rhizobacteria *Pseudomonas fluorescens*, singly and in combination were found to be effective in controlling the Fusarium wilt of chilli disease by inducing systemic resistance (ISR). Also, the plant extracts (*Eucalyptus citriodora)* and essential oils (neem and garlic oil) provide an effective measure for Fusarium wilt disease management and it represents an alternative to reliance on fungicides.

d. Chemical Management

Chemical management is often the most feasible means of tackling a plant disease problem. It is often more economical and effective than any other measure. Pathogens which are mainly soil and/ or seed borne, disinfection of seeds and soil with chemicals / fungicides has yielded encouraging results. Some gaseous fumigants such as methyl bromide and chloropicrin were the only commercially feasible measures of vascular wilt control prior to 1970. Soil treatment with formalin, copper sulphate, as well as burning of bush wood was most effective in nursery against *Fusarium oxysporium.* Seed treatment with fungicides like carbendazim 50 WP or captan 50 WP or thiram 75 DS @ 2.5 g/kg seed before sowing, besides, seedling dip in carbendazim 50 WP (0.1%) or benlate (0.05%) or captan (0.2%)for 30 minutes before transplanting has been found effective in managing the wilt disease of chilli. Applying fungicides as a drench around the stem of plants at the time of transplanting and again at 50% flowering stage was found to be effective than using foliar sprays against wilt disease.

e. Integrated Disease Management

Integrated disease management attempts to use all the known suitable techniques of control to maintain the particular pest population at a level below that

which causes economical losses to the crop. Integration of different treatments, including seedling root dip in carbendazim (0.1%), addition of vermicompost, drenching with fungicide (carbendazim+mancozeb 0.2%) and soil application of *Trichoderma viride* was highly effective against Fusarium wilt disease in chilli, which showed 89.8 per cent reduction in the wilt incidence.

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Soil based crop selection increases farmers income

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Vidarbha region in Maharashtra is the most vulnerable to drought among drought-prone regions of India. Lack of appropriate management and vagaries of climate change have resulted in periodical water stress leading to poor yield, crop failure and subsequently huge economic loss to the farmers. Generally, cotton and pigeon pea are the major *kharif* season crops grown under rainfed conditions depending on south-west monsoon. The resource-poor small and marginal farmers cultivate cotton in unsuitable marginal lands. Cotton cultivation in soils with shallow depth, poor water holding capacity and inherent fertility led to poor returns for the farmers.

In such a scenario, alternate sustainable agricultural land use options comprising soil based crop selection and diversification must be the first step to sustain the farm income by avoiding crop failure. We demonstrated the importance of soil based crop selection to the tribal farmers of Warud tehsil, Amravati district for averting the economic loss. As first step, we evaluated the crop selection and management practices by the farmers through group discussion. We identified that growing deep-rooted crops such as pigeon pea and cotton in shallow soils resulted in poor economic returns and often crop failure due to mid-season dry spells during south-west monsoon (Fig 1).

Fig 1. Farmers cultivating pigeon pea and cotton in shallow soils with high stoniness

We identified three land management units (LMU) based on soil characteristics identified through soil survey. The three LMUs have shallow red soils (LMU 1),

calcareous moderately deep soils (LMU 2) and deep black soils (LMU 3). We conducted experiments in 38 farmers' fields distributed under the three LMUs by growing cotton and pigeon pea in each LMU in order to demonstrate the inherent capacity of the three soils to support the deep-rooted crops.

Table 1: Mean crop yield and B:C ratio under three LMUs

LMU	Pigeon pea yield (q ha^{-1})	cotton yield (q ha^{-1})	B:C ratio	
			Pigeon pea	Cotton
Shallow red soil	6.3	2.1	1.22	0.85
Calcareous moderately deep soil	15.4	4.5	2.15	1.48
Deep black soil	17.4	5.4	2.40	1.85

Experimental Results

Cotton (*Bt cultivar*) and pigeon pea were cultivated using standard package of practices under rainfed conditions. The rainfall received during the crop growing season was 698 mm. The farmers' practice of growing these crops in shallow red soil is assumed as control. The data in table 1 indicates that growing pigeon pea and cotton in shallow red soil produces poor yield and economic loss to the farmers. The shallow soils with poor depth and stoniness in the surface have poor water holding capacity. The accelerated erosion through surface runoff during the high intensity rainfall reduces the soil fertility. The loss of top soil also reduces the plant population because of wilting during early stages. Hence these soils lack the capacity to effectively provide root anchoring, water and nutrient supply through the length of growing period.

On the other hand, the moderately deep and deep black soils have the optimum depth to support the root activity and supply adequate nutrients with high cation exchange capacity. Cotton yield in deep black soils was more than double (157%) when compared to its yield in shallow red soils. It is also to be noted that the farmers who cultivated Bt cotton in shallow red soils incurred loss of investment (B:C ratio 0.85). This demonstrates the importance of selecting deep soils for cultivating cotton which could ensure income to the farmers in the event of natural hazards like mid-season droughts. Pigeon pea yield also higher (17.4 q ha^{-1}) in the deep black soils than shallow soils (6.3 q ha^{-1}) and high benefit (BCR 2.40). The higher yield of the crops were obtained due to the ability of the deep black soils to provide water to the plants during dry spells and sustain the plant growth. The high clay content of these soils leads to more absorption and storage of percolating water and release during the later stages. The high CEC of these soils also provides optimum nutrient supply during the crop growing season. Thus, the experimental results showed that growing crops in suitable soils is vital to avoid crop failure and assure returns from cultivation especially for the resource-poor farmers.

CONCLUSION

Given the influence of vagaries of climate change on crop production is high in recent times, awareness needs to be created among the farming community regarding the appropriate land use management. Sustaining farm income by averting crop loss through the cultivation of crops in most suited soils could be the first step towards agriculture intensification especially under rainfed farming systems. Our experimental results emphasize the fact that soils need to be considered while planning farm activities and by growing cash crops like cotton and pigeon pea in best suited soils the farmers can reap benefits.

Feeding management of goat

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Feeding may cost the highest expense in goat production. Goats raised for meat and milk need good quality feed in most situations and require an optimum balance of many different nutrients to achieve maximum profit potential. Majority of the goats reared in villages are hardly provided with any grain or good fodder. They have to browse and graze to meet out their nutritional requirements; as a result of which their body growth and milk production is very low. Goats respond readily to good management and proper feeding, and to ensure best results they should be taken care like other valuable animals. There is difference in feeding habit of goats from other farm animals, they response in different way to sweet, sour, bitter or salty feeds for acceptance and rejection. Goats produce more amount of milk than cow for the same amount of nutrients. Goats can use more amounts of low quality feeds for its maintenance than cow. Success in feeding can be achieved by formulating a nutritious and cheap ration. Preparation of balanced ration requires consideration of factors like nutritive value, bulk, palatability and digestibility, local availability and its cost. Fresh, clean water should be made available free of choice all the times. Water trough should be washed at least for twice in a month. Dairy goats require more water as compared to meat goats so; care should be taken in this regard.

FEEDING HABITS OF GOAT

Goats are small ruminants. They are sensitive animals with distinct feeding habits. They have actively movable upper lips and efficient prehensile tongue. They can graze on very short grasses and browse foliages of trees and plants. They spent 5-8 hours on grazing and browsing for their maintenance requirement. They are swift eaters and like wide variety of feeds. Goats do not like wet, stale or foul smelling feeds. They waste a lot of feed by trampling. They relish leguminous fodders like Lucerne, berseem, green arhar, cowpea, methi, and soybean more than non-leguminous fodders like sorghum, maize, oats, bajra. They relish variety of shrubs and weeds; and leaves of trees like babul, neem, subabul, ber, tamrind. They seldom like silage or straw. Rumen is undeveloped at birth but kids start picking up soft leaves at the age of 2-3 weeks and by 3-4 months of age rumen develops fully. Readily availability of green shrubs, tree leaves and leguminous fodders may constitute major part in goat ration. Goat producing good amount of milk or quick growth for more meat requires additional amount of leguminous fodders and concentrate feeds.

Nutritional Requirement of Goat

Sr.	Nutrient	Requirement
1	Dry matter	For dairy goats
		In temperate region 5-6% of live weight
		In tropical region 4-5% of live weight
		For meat type goats – 2.5-3% of live weight
2	Concentrate	
	For maintenance ration	250g for every 50 kg body weight
	For production ration	450g for every 2.5 lit. milk/ doe
	For pregnancy ration	During last 2 month of gestation 220g daily/ doe
	Stud buck	400g daily.
3	Water	450- 680 g/ day for a goat weighting 18-20 kg
4	Dry matter: total water intake ratio	1:4

Acceptable Quantity of Macro and Micro minerals in a Goat's Diet

Macro minerals (%)		Micro minerals (ppm)	
Calcium (Ca)	0.3-0.8	Iron (Fe)	50-1000
Phosphorus (P)	0.25-0.4	Copper (Cu)	10-80
Sodium (Na)	0.2	Cobalt (Co)	0.1-10
Potassium (K)	0.8-2.0	Zinc (Zn)	40-500
Chloride (Cl)	0.2	Selenium (Se)	0.1-3
Sulfur (S)	0.2-0.32	Molybdenum (Mo)	0.1-3
Magnesium (Mg)	0.18-0.4	Iodine (I)	0.5-50

Nutrient requirement of goats for pregnancy (Devendra, 1981)

Live weight(kg)	DM intake(g)	Total ME(MJ)	DP(g)
20	816	8.54	49.8
25	950	10.04	58.6
30	1104	11.55	67.4
35	1240	12.97	75.6
40	1368	14.31	83.4

Lactating Does

The amount of feed given to the lactating does depend on the amount of milk produced. For every additional kg of milk produced does depend on the amount of milk produced, 400g of concentrates or 0.1 kg good quality green fodder may be fed.

Some economic concentrate mixture (%)

Ingredients	Mix-1	Mix-2	Mix-3	Mix-4	Mix-5
Maize crushed	30	20	25	-	30
Wheat bran	20	20	25	25	20
Barley	-	10	5	20	10
Oats	10	10	10	25	-
Gram(crushed)	10	10	15	10	20
Groundnut cake	20	20	10	10	10
Gram/arhar chuni	10	10	5	10	10
Molasses	2	2	2	2	2
Common salt	0.3	0.3	0.3	0.3	0.3
Vit-A (g)	0.3	0.3	0.3	0.3	0.3
Vit-B2 (g)	0.3	0.3	0.3	0.3	0.3
Vit-D3 (g)	0.5	0.5	0.5	0.5	0.5
Mag. Sulphate	0.5	0.5	0.5	0.5	0.5
Phosphorus	2.4	2.4	2.4	2.4	2.4

Source: Dairy Handbook (production), NDRI, Karnal.

Proportions of ingredients for preparing goat ration of different categories

Ingredients	Kid ration	Growing ration	Lactating ration	Pregnant goat ration
Maize	37	15	52	35
Pulses	15	37	-	-
Oil cakes	25	10	8	20
Wheat bran	20	35	37	42
Mineral mixture	2.5	2	2	2
Common salt	0.5	1	1	1

Source: Sharma & Dabas (2009)

USEFUL INFORMATION FOR FEEDING OF GOATS

1. Goat is very efficient ruminant taking 80 % of its nutritive requirements through browsing.
2. Goat utilizes coarse fiber feed for efficient energy production.
3. DMI of goat is higher compared to large animal which is 4-5 % of their live weight.
4. A little high level of protein appears to be beneficial for goat feeding.
5. Due to smaller stomach capacity daily feed may be offered 3-4 times.
6. The goat have mobile upper lip and very prehensile tongue, goats are able to graze on very short grass and to browse on foliage, not normally eaten by other domestic livestock.
7. Goat has higher basal metabolic rate than cattle therefore maintenance requirement is higher than those of cattle.
8. Feed cost and labour per unit are comparatively higher than other livestock.

9. A mature goat will consume about 5 kg of green fodder daily (5 doe consume equivalent to a cow)

Feeding System:

A. Tethering
B. Extensive
C. Semi-intensive
D. Intensive

Tethering

When grazing facilities are limited and one or two goat are to be kept then tethering is convenient. In this system animal is tied with a rope of 3-5 meter with a slip knot to a peg of 35-50cm long. Peg is driven into the ground over a grazing area which permits the goat to brow over a limited area depending upon the length of the rope. Change the location whenever necessary so that goat may get sufficient grass to meet the requirement. Provide a temporary portable shelter closely within reach of animal so that it may turn to it in the event of extreme heat or heavy rains.

Note

- Goat has a strong dislike for rain and for getting wet.
- Goat should have tethered both in morning and evening.
- Goat should be kept in the shed in day.

Advantages

- It helps to keep the goat out of the door.
- Feeding goat is convenient.
- Utilization of grass properly.

Precaution: Graze animal on a plot which is definitely known to be free from parasites.

Extensive System

It has been observed that when a goat find opportunity to browse for about 8-9 hrs./day, the goat can take care of their maintenance but rate of growth slowdown. This system of rearing goat is common in India which includes migratory, free range, pasture and range management of goat. Small farmer and landless laborer take their goat and sheep together walking long distances in of feed and water.

Grazing method *(Bhatta et al., 2003)*

Cut and carry System: In this system animals are fed on fresh forage harvested from pasture under stall feeding. This system is more beneficial in region where precipitation and pasture growth is disturbed round the year.

Rotational

In this grazing system, animals are rotationally grazed with an interval of 45 days. The area is dividing into 4 paddocks; each paddock is grazed for 15 days and then shifted to

the next. Under this system, vegetation gets rest of 45 days which help them to regenerate and grow. It provides equal grazing pressure to all area of pasture.

Deferred Rotational

This is used when preparation of hay for lean period is an objective. In this system, one paddock is protected from grazing during the active phase. The grass from paddock is harvested before flowering for the preparation of hey. Remaining three paddocks are utilized under rotational system.

Continuous system

Utilization of range vegetation by all kind of livestock under continuous grazing is the most prevalent system in country. In this system, vegetation does not get an opportunity to grow. Successive high grazing pressure over a long period deteriorates the grazing resources.

Limitation of Extensive System

1. Natural potential of range land is low due to long dry summer, erratic rains, light textured soil, deficient organic matter.
2. There are marked fluctuations in availability of feed from region to region and season to season.
3. Poor nutritional availability to animal does not give enough opportunity to exhibit their genetic potential.

Advantages of Extensive System

1. Easy and convenient method of raising animal.
2. Use of low resources.
3. Managerial advantage due to small sized flock with farmers.
4. More economical than cattle under natural grazing or browsing (*Raut and Nadkarni, 1947*)
5. Indigenous goat 2.5 times more economical than sheep on free range grazing in semi- arid regions (Acharya *et al*., 1980).
6. Increase fertility of soil by way of manure and urine dropped by animals.
7. Help in control of weeds by animals thus reducing the expenses of weedicides.
8. Provision of abundance shed offered by tree on range lands.
9. Less expenses in rearing of goats.
10. Capital and labour expenses are less.

Semi-intensive System

This system is combination of intensive and extensive system in which limited free range grazing is allowed with stall feeding. Goat of different farmers are grazed together for 4-6 hrs. a day, and then kept in stalls where they are offered tree leaves, hay, dry fodder, green kitchen waste, crop residue and concentrate mixture depending upon the availability. Therefore, the performance of goats depends upon quality and quantity of

feeds made available through limited browsing and supplementing feeds in stalls. However the level of nutrition is better, than goat find in extensive system.

Note:

- Goat should not be loosed for grazing until the dew has dried up *i.e.* two hours after sunrise.
- Grazing
- Grazing on wet grass with dew cause intestinal inflammation and timpanists.

Intensive System

This system includes two methods:

1. Keeping goats in stalls and feeding them cultivated fodder and concentrate to meet their requirements.
2. Grazing of goats on developed pasture permitting stocking rate of 16-60 goats per hectare depending upon the kind of grass level of fertilization, irrigation and legume availability (*Devendra and Burns, 1983*).

Organic Farming of Vegetables: An Effort Towards Healthy Life

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Organic farming is a production system which avoids or largely excludes the use of synthetically compound fertilizers, growth regulators and livestock feed additives. To the maximum extent, feasible organic farming systems rely on crop rotations, crop residues, Animal manures, legumes, Green manures, off farm organic wastes and aspects of biological pest control to maintain soil productivity. Thus, the organic farming implies recycling of waste and residue to the native soil itself, replenishing the nutrients depleted from the soil during the crop growth, encouraging the growth of microorganisms which would regulates phased release of stored nutrients in the soil to the crop growth in the right proportion maintaining soil health by balancing the soil moisture and soil aeration and ensuring soil fertility by firmly binding the nutrient elements in the complex organic molecules.

ORGANIC FARMING IN INDIA

India, only 30% of the total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 70% of the arable land is mainly rain fed where negligible amount of fertilizers is being used. Farmers in these areas often use organic manure as a source of nutrients that are readily available either in their areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The Northern eastern region of India provides considerable opportunity for organic farming due to least utilization of chemical inputs, It is estimated that 18 million hectares of such land is available in the NE , which can be exploited for organic production. With the sizable acreage under natural organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic product in the world's organic market.

HOW IT WORKS ?

India is the second largest producer of vegetables next to china in World. The productivity of different vegetables in our country is comparatively lower than the world's average productivity. Again the per capita availability of vegetables (210g/head/day) is still behind the recommend quantity (285 g /head/day). Our demand by 2020 will be around 250 million tons. Thus due to rapid growth of the

population with reduction in land , in order to feed the population, the only solution is the vertical expansion or by increasing the productivity per unit area unit time as the potential available land and water resources and of technology still remain unexploited . Our strategy should be produced more vegetables from less land, less water with less pesticides and with less detrimental to soil and environment as will which will lead to healthy life.

Organic vegetable cultivation offers one of the most sustainable farming systems with resourcing benefits not only to long term soil health but also provides a lasting stability in production by importing better resistance against various biotic and abiotic stresses. Overall organic vegetable and fruits production will improve the nutritional quality which will protect from degenerative diseases like cancer and will improve healthy life of human being.

ORGANIC FARMING TOWARDS SUSTAINABILITY

Organic farming systems encourage the use of rotations and manures to maintain soil fertility. Green manuring and intercropping with legumes is another important aspect crop residues are also utilized in organic farming Burning of crop residues not only results in loss of organic matter and plant nutrients, but also causes environmental pollution , fire hazards and destruction of natural floora and fauna in the soil. However, application of organic resources to the soil can favorably affect its structure, as denoted by porosity, aggregation and bulk density as well as causing an impact in terms content , addition of organic manures supply essential plant nutrients including micronutrients to crop. These all benefits including improvement in environment and water quality results in sustainable agriculture.

CHALLENGES FOR ADOPTION OF ORGANIC FARMING

- To increase and enhance government policies and assistance especially during and for the conversion process.
- To introduce organic extension services and training schools for farmers.
- To build up adequate infrastructure for transport, storage, processing and market facilities.
- To create a guarantee system for the domestic market.
- To increase consumer awareness about the safe and environmentally friendly production of food.
- To spur production and supply of organic seeds, organic manure, organic bio-fertilizers and bio-pesticides .
- To provide funds for proper scientific studies on income generation, household income and food security, yields and soil improvement from organic agriculture.

CONCLUSION

Organic farming system not only ensures safe and healthy food but also promises sustained soil health, fertility and better profitability. The organic movement of India is however, seriously constrained because of the lack of policy support, research and technology back up and absence of proper extension mechanism. If these above

constraints are made favorable then organic farming can play a role in doubling the farmers income, food security and safety with sustainability and environment preservation in the country.

The early summer flies management at Breeding Centre

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The Breeding Bulls are utilised twice a week for semen collection and before collection grooming and washing thoroughly done to maintain hygienic semen collection as well as healthiness of bulls. However, the beginning of summer is pivotal for health management of breeding bulls to protect from pest flies infestation. The early summer is best breeding time for flies and mosquitoes and warm condition lessen the life cycle, as a result, the population growth of pest is tremendous around then. The flies, mosquitoes are major pests in tropical countries in this season and have an immediate connection with bull wellbeing. These pests make a stressful condition in bulls through biting on legs, bellies, hump regions, and blood-sucking lead to skin irritation, restlessness, rubbing of the body with pen wall and so on as consequence hair debasement, some part of the skin ruptured and blood come out from the damaged site of the skin. The irritation, nuisance controls are the assistance to enhances animal's general living conditions which help to enhance the quality of semen. In AI centre, bull health is traded off at the start of summer because of flies and mosquitoes issue. Here, our mean to share some pest controls administration at beginning of summer in semen station.

FLIES AND MOSQUITOES

They are the potential risk to the animal health with the human being. They act as blood-sucking parasites as well as vectors for several diseases transmission. The two main flies like house flies and stable flies are found in livestock farm whereas all types of mosquitoes are found inside farmyard. The confined areas in and around of livestock farm are suitable breeding and hiding places for different flies and mosquitoes.

THE PEST LIFE CYCLE AT BEGINNING OF SUMMER

The warm and humidity condition of at beginning of summer is appropriate breeding time for flies and mosquitoes. The life cycle and lifespan depend on temperature and humidity, and they become develop an adult too faster in early summer season than other seasons for that pest population is too much at that time create huge nuisance inside the bull shed. The stable flies cause extremely painful bites and irritation for the animal as well as human. Both male and female stable flies suck blood several times, one or two drops require at each meal whereas female require blood to produce viable eggs.

Similarly, mosquitos' population rise alarmingly at that time and they madly search the host for blood sucking and spread the diseases.

THE ANIMAL ACTIVITIES AND ANIMAL PERFORMANCE

The animals feel extremely annoyance at this season. The animals try and try to dislodge the flies' and mosquitoes from the bellies, legs, backsides, continuous movement of the tail, rubbing of the neck and hump with pen wall, many time sit up and down due to irritation. For that, the animal becomes restless, several times head movement, fatigue, heat stress, reduce feed intake and sometimes blood oozing seen due to skin rupture in irritated areas for excessive rubbing with pen wall. As a result, inner damage occurs in sperm and semen quality not reaches the optimum.

THE CLEANING, SANITATION AND WASTE MANAGEMENT

The decomposed organic matter in drain site, manure site, wet hay or straw, spilled silage or any other feeds, some water lodging sites and any damp and moist area are better survival place for immature pests like eggs, larvae, and pupae. So, the cleaning up all the waste material properly and dislodge the damp water and as a sanitary measurement, the bleaching powder and lime applied to destroy the immature ones before reaching the adult stage. Waste management is most prior work for flies and mosquitoes control programme at that particular time. The spreading of waste farm materials weekly, the open pit should be covered or not possible, weekly basis spreading of bleaching or lime or any others methods to be applied to break the life cycle of the pest.

CHEMICAL CONTROL

There are several controls measurement are present in mechanical controls (trapping, screens, fans etc.), biological controls and chemical controls. The chemical controls are required at that time because other methods have limited success. Pyrethrins can be used as flies repellent having a little residual effect quick push down the adult files in enclosed areas. The pyrethrins can't able kill the immature one but kill mature parasitoids. So, the spray should be done in advance before the release of immature parasitoids to reduce the large fly pest population.

Products	Farm Premises	Animal Body
Permectrin® II	40 ml in 4 lit. water mixed and It sprays 750 sq. ft. the area with 30-day residual effects.	75 ml in 4 lit. water mixed and Spray each animal with up to 240 ml of mixed spray.
Butox® Vet	2.0 ml in 1 lit. water mixed and spray 20 sq. meters area	2.0 ml in 1 lit. water mixed and A minimum of 3 to 5 liters of solution is required to fully wet a medium sized cattle

CONCLUSION

The cleaning and ideal sanitation in and around AI centre decrease the breeding habitat of the pest. It diminishes aggravation and parasites invasion. All the while, application of flies repellent is useful to get rid of from fatigue, severe irritation and restlessness. At last, we can't prevent biting and blood sucking yet controls the rate.

Fig1. Huge flies problem at beginning of summer

Fig2. This area should be clean properly at weekly interval

Fig.3 Cluster of pests on Bullpen wall

Fig.4 Pesticides Spray on Bull body

Finger Millet: Secure Food for Future

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The incidence of diabetes and obesity are increasing in an exponential manner globally and to fight them, a raise in demand for food containing complex carbohydrates with higher levels of dietary fiber and health beneficial phytochemicals has been in demand. Fortification of diets with food materials rich in phenolic acids was shown to impart antimutagenic, antiglycemic and antioxidative properties and this can be exploited in developing health foods. Utilization of wholegrain cereals in food formulations is increasing worldwide since they are rich sources of phytochemicals and dietary fiber which offer several health benefits. Millets are important underutilized crops in semiarid and tropical regions of the world due to their resistance to pests and diseases, good adaption to a wide range of environment, good yield of production, withstand significant levels of salinity, short growing season, resistant to water logging, drought tolerant and require little inputs during growth. With increasing world population and decreasing water supplies it represents important crops for future human use. Finger millet (*Eleusine coracana* L.) commonly known as ragi and mandua in India is one of the minor cereals, domesticated around 5000 years BC. It is an allopolyploid with chromosome number $2n = 4x = 36$ and evolved from a cross between two diploid species, *Eleusine indica* (AA) and *Eleusine floccifolia* or *E. tristachya* (BB) as genome donors. India is the largest producer of various kinds of millets. Out of which finger millet (*Eleusine coracana* L. Gaertn.) accounts 85% of production in India. It is a native of Ethiopia and an important staple food in parts of eastern and central Africa and India. In India it is extensively grown in Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, Gujrat, Maharashtra, Uttar Pradesh, Uttarakhand and Himachal Pradesh with a total area of 2.5 million hectares and 2.2 million tonnes of production. Karnataka is the leading producer of finger millet accounting 56.21 and 59.52% of area and production of finger millet followed by Tamil Nadu (9.94% and 18.27%), Uttarakhand (9.40% and 7.76%) and Maharashtra (10.56% and 7.16%), respectively.

NUTRITION AND HEALTH BENEFITS

If there is any single factor that should tilt the scales in favour of millets in the food, it is nutrition. On this parameter, finger millet is miles ahead of rice and wheat. Among all major cereals, it is an important preventative against malnutrition. It holds a significant place in diet programs for weight loss. When it comes to calcium, there is no other plant source that comes even close to ragi. Calcium and vitamin D that makes it as an important component for increasing bone strength. Since the millets are normally

prepared from the whole meal, the dietary fiber, minerals, phenolics and vitamins concentrated in the outer layer of the seed coat form the part of the food and offer their nutritional and health benefits. It is also a rich source of thiamine, riboflavin, iron, methionine, isoleucine, leucine, phenylalanine and other essential amino acids. The abundance of anti oxidants, mainly tryptophan and amino acids help in fighting damage causing free radical and reducing oxidative stress. Ragi sprouts helps in increasing blood formation in persons suffering from anaemia or low haemoglobin levels. Lactating mothers are suggested to include green ragi in their daily diet in order to improve milk production. It can be used as a most effective natural anti- aging drink.

The nutraceutical importance of finger millet lies in its high content of calcium (0.38%), protein (6-13%), dietary fiber (18%), carbohydrates (65-75%), minerals (2.5-3.5%), phytates (0.48%), tannins (0.61%), phenolic compounds (0.3-3%) and trypsin inhibitory factors and is recognized for its health beneficial effects such as anti-diabetic, anti-tumerogenic, anti-diarrheal, antiulcer, anti-inflammatory, atherosclerogenic effects, antioxidant and antimicrobial properties. Moreover, finger millet is also useful in management of various physiological disorders such as diabetes mellitus, hypertension, vascular fragility, hypercholesterolemia, prevention of oxidation of low-density lipoproteins(LDLs) and also improves gastrointestinal health.

The main constituents of the millet kernel are seed coat (testa), embryo and endosperm. Among several varieties of finger millets such as yellow, white, tan, red, brown or violet colour only the red-coloured are cultivated extensively throughout world. The presence of five layered testa in finger millet makes it unique compared to other millets such as foxtail millet, pearl millet, kodo millet and proso millet. This could be one of the possible reasons for the higher dietary fiber content in finger millet. Due to rich fibre content, finger millet is believed to be a good laxative and prevents constipation. People who suffer from liver diseases, high-blood pressure and asthma should consume roasted green finger millet. It is considered to be a boon for diabetes patients and obese people, as the digestion of finger millet takes place at a slow pace and hence, glucose is released slowly into the blood. Also millet contains an amino acid known as typtophan. This compound reduces the appetite and thus helps to control your diet. So if you are aiming at shedding a few kilos, consuming finger millet can be of great help. It is specially recommended to kids, as the millet is rich in calcium and therefore helps in proper growth and development.

CULTIVATION SYSTEM

Ragi is the most important food grain in India and its cultivation in different states depending upon the weather, nature of the crop, soil type and water availability.

There are two system of cultivation is practiced in ragi i.e., irrigated and rainfed.

1. **Irrigated System:** Irrigated crop can be raised in December- January and April- May seasons. Sowing should be done soon after onset of monsoon and the field is fertilized and irrigated adequately.

Methods Practiced

A. Direct Sown Crop

B. Transplanted Crop

C. System of Ragi Intensification (SRI)

2. **Rainfed System:** This system followed in the month of June- July. It also grown in winter season (rabi) by planting in September- October in Tamil Nadu and as a summer irrigated crop by planting January – February. Mostly rainfed ragi is mixed or intercropped with sorghum, pearl millet, oil seeds and pulses.

   Line sowing is ideal and seed drills giving spacing of 22.5- 30 cm between rows should be used. Recommended seed rate is 15-20 kg per hectare. Sowing should be done early in rainfed areas, to avoid moisture stress at critical stage of flowering. Apply recommended dose of N: P: K 40:20:20 kg/ha. 50% of fertilizer at the time of sowing and the remaining 50% around 35 days after sowing are recommended. Seed treatment with *Azospirillum brasilense* and *Aspergillus awamori* @ 25 g/kg seed is beneficial. In case seeds are to be treated with seed dressing chemicals, treat the seeds first with seed dressing chemicals and then with bio-fertlizers at the time of sowing.

   In line sown crop 2-3 inter-cultivations are necessary. In assured rainfall and irrigated areas spraying 2, 4-D sodium salt @ 0.75 kg.a.i./ha as post-emergent spray around 20-25 days after sowing effectively controls weeds. In broadcast crop two effective hand weeding will minimize weeds as inter cultivations is not possible.

Methods Practiced

A. Direct Sown Crop

B. Transplanted Crop

A. Direct Sown Crop: The seeds are directly sown in lines with the spacing of 22.5 X 30cm or broadcasted in the main field with the seed rate of 10 Kg/ha. Apply NPK @ 22.5 Kg/ha each before sowing and top dress N at 21 days after sowing. Furrows and ridges are prepared for irrigation. Irrigate the field at weekly intervals increase growth rate and yield. Weeding should be done three weeks after sowing and completed before top dressing. Spray insecticides and fungicides for the control of pest and diseases. Crop matures after 3-5 months of sowing, depending on variety, season and soil properties. Harvest the crop when the ears are yellowish brown.

B. Transplanted Crop: Seed rate should be 3-5 Kg/ha. Spacing for irrigated crop should be 22.5 X 10 cm and for rainfed 22.5- 30 X 7.5-10 cm. It is common where early rains are uncertain. Seedlings are raised in nursery and planted in main field. Prepare the nursery field to fine tilth and form beds and channels and sow the seeds uniformly on the beds and cover by stirring the soil. Transplant the seedlings to main field when they are three weeks old. Plough the main field 3-4 times and incorporate FYM or compost. Irrigate the field on the day of transplantation. Irrigation at weekly intervals increases growth rate and yield. Apply N, P_2O_5 and K_2O @ 22.5 Kg/ha each before sowing or planting. Top dress N at 22.5 Kg/ha 21 days after planting. Weeding should be done three weeks after sowing and completed before top dressing. Spray insecticides and fungicides for the control of pest and diseases. Crop matures after 3-5 months sowing, depending on variety, season and soil properties. Harvest the crop when the ears are yellowish brown.

C. System of Ragi Intensification: SRI Technology uses less input. It uses less seed, water, chemical fertilizers and pesticides but uses more organic manures. Under SRI, ragi fields are not flooded but only kept moist by alternate wetting and drying.

Seed selection, priming and treatment

There is no specific preference for using any particular variety of millet seed, but it is always better to start with newer seeds rather than use older ones. Various varieties that are being used in the area now are:

- Early-maturing varieties- can be used in less-productive soils
- Birsa Gourav / A404- an improved variety for better yield (duration 110-115 days)
- VK 149 – drought- and disease-resistant (duration 95-100 days)

Seeding rate: 300-400 gm per acre, recommended carrying out the **priming of seeds:** soaking seeds in water, and then mixing in 2.5-3 gm/kg of Carbendazim (Bavistin) with the seeds, and leaving the mixture for 24 hours.

Seed treatment with Bijamrita- It is a natural solution for effective protection against pest, diseases and fungi. For this treatment wrap 5 kg of cow dung in a large cloth and bind it by tape. Put it in 20 liters of water for up to 12 hours. Take one liter of water and add 50 gm of lime to it and let it stabilize overnight. Next morning, squeeze all of the liquid in the bundle of cow dung out of the bundle and into a bucket, compressing it at least thrice, so as to collect a concentration of cow dung. Add a handful of soil to this liquid solution and stir it well. Then add 5 liters of cow urine or human urine to the solution and add the lime water, stirring all together, making what is called Bijamrita. Spread this solution on the seeds of any crops, treating these seeds well by hand, drying them well, and using them for sowing. The microorganisms and nutrients added this way will make the seedlings that emerge more vigorous.

Nursery preparation

Nursery material: Sow the treated seeds in a nursery with planting material as a mixture of sand, soil and compost (1:1:1).

Area of nursery: 40 sq. meters for every one acre to be cultivated.

Dimensions of the nursery bed: 1 meter with the length appropriate for the desired nursery area. Bed should be 9 to 12 inches above ground level.

Timing for sowing nursery: 1st to 3rd week of July.

Sowing of seeds: Put the seeds into nursery soil at a depth of 1/2 inch and keep the spacing about 3 to 4 inches between the seeds.

Care for seeds: Cover the seeds with vermicompost, and then sprinkle Jiwamrita regularly over the nursery to keep the soil functioning well.

Preparing Jiwamrita (organic manure): Put 10 liters of water in a barrel and add 5 kg of cow dung and 5 liters of cow urine to the water. Then add 250 g of jaggery (raw unrefined sugar), 250 g of pulse flour and a handful of soil from the bund of the field or termite soil; and stir the solution well. Let it ferment for 48 hours in the shade and it will be ready for use after this. To use, add 1 liter of solution to 20 liters of water at the time of use. For every 1 acre of land, use 200 liters of this diluted solution.

Field preparation: Plough the field 3 times, 2 of these ploughings should be done within an interval of 8-10 days during the nursery preparation. Sprinkle Jiwamrita over the field to moisten the soil and preserve the organic matter. After ploughing the field, make it level using a wooden leveler. For transplanting, mark lines on the field in a square grid pattern at a distance of 10 inches apart, one direction being perpendicular to the gradient wooden markers can be used for lines. When transplanting the plants it should be spaced at a distance of 10 X 10 inches. Furrows and ridges can be made on the field's surface with a cycle wheel or hoe.

Use of young seedlings for transplanting: 10 to 15 days old seedling with just two leaves have to be transplanted. This ensures more tillers and more root growth. While 30 tillers per plant are fairly easy to achieve, 50 tillers per plant are quite attainable.

Taking out seedlings from the nursery: Take an iron sheet of sufficient thickness measuring 18" by 15". Push through this sheet into the nursery bed beneath the plants about 3 inches down from the surface. Then lift the sheet gently. Now the plants along with the mud have come on to the metal sheet. Carry seedlings with the soil to the main field. With your right thumb and forefinger, take plant by plant along with soil and place the plant along with mud and roots gently at the intersection of grid lines made for the purpose to plant at wider spacing in a square pattern.

Careful Transplanting: It is important to avoid 'shock' or 'trauma' while transplanting the seedlings. Remove seedlings from nursery with seed, soil and roots intact carefully and plant it in the field without plunging too deep into the soil. The seed should be attached to the seedlings and transplanted as soon as possible after being removed from the nursery, within half an hour and preferably within 15 minutes to avoid desiccation and traumatization of the plant. Care is to be taken to ensure that when the seedlings are transplanted that their root tips are not inverted as usually happened during the hurried, rough transplanting done in the conventional method. If the root tip was turned upward- shaped like a J rather than an L it could take a week or more for the tip to reorient itself downward and resume growth. Hence, do not thrust seedlings downward into the soil. Rather, each seedling is slipped into the soil very 'gently' and close to the surface so that its root lies horizontally in the moist soil. This makes the shape of the transplanted seedling more like 'L' than like 'J' and facilitates root growing quickly downward. Only single seedling is to be planted at the intersection rather than in clumps of 2 or 3 or more.

Weeding and Aeration: As there is no standing water in rice fields under SRI method, weed growth is very high. Use simple mechanical hand weeder (rotary hoe) to churn the soil for weed control. Rotate the weeder at least 2 to 4 times. This incorporates the weeds into the soil. The first weeding should be done at 10-12 days after transplanting to eliminate weeds when these were just germinating rather than wait for them to grow. Subsequent weedings are done at 10 days interval. Working with rotary weeders helps in greater aeration which results in more root growth, reduced weed competition, more oxygen and nitrogen to roots. Weeds incorporated into the soil with each weeding can add-up to 1 ton green manure per hectare per weeding and also helps build up large

and diverse microbial population in the soil. Herbicides are not recommended under SRI method. Instead, weeds have to be incorporated into the soil.

Water Management: Water should not be allowed to stagnate under SRI method. Give regular irrigations to keep the soil moist. Alternate 'wetting and drying' should be done which give aerobic and anaerobic soil conditions for better nutrient mobilization by soil biota. This avoids root degeneration, which usually happens under continuous flooding. Unflooded conditions, combined with mechanical weeding, result in more air in the soil and greater root growth. Higher root growth provides access to more nutrients.

Organic Manures: Instead of chemical fertilizers, FYM or compost is applied @ 10t/ha which is quite sufficient as a source of nutrients. As a result, more plant growth is achieved because of better soil health and more balanced nutrient supply. Apply diverse organic manures. Organic manures act as food for microorganisms.

Pest and Disease Control: Pest and disease problems appear to be less with SRI method, perhaps healthier and vigorous plants have more capacity to resist pest and disease attacks.

SRI Vs Conventional Method:

Conventional Method	**SRI Method**
3 - 5Kg seed is used per hectare	1.25 Kg seed is used per hectare
25 to 30 day old seedlings are transplanted	Only 8-12 day old seedlings are transplanted
Seedlings are pulled with force, roots, washed, bundled, stacked thrown thereby causing lot of shock to the plants	Seedlings are treated very gently by scooping. No pulling, no washing, no bundling and no stacking.
Planted at random	Planted in square pattern
3 or more plants are planted in clumps	Only one plant is planted per hill
Application of NPK, fertilizers as recommended	Application of organic manures only basal dose of fertilizers at present. No top dressing

Some farmers are hesitant at first to use SRI methods because they require more labour and skill and appear risky. At first, SRI may take 50 to 100% more labour. Planting and weeding are initially the most labour intensive part of SRI. Since yields can be double or even trippled than with current practices, it justifies mobilization of labour for profit. But over time this amount is reduced. It requires even less labour once tools designed and techniques are mastered and confidence gained.

Benefits of SRI: Higher grain and straw yields, reduction in duration by 10 days, Lesser chemical inputs, less water requirement (About half that of conventional method), Less chaffy grain, grain weight increased without change in grain size, higher head ragi recovery, withstood cyclonic gales and soil health improves through biological activity.

CONCLUSION

There is a high demand for finger millet malt due to its high nutritional value with appealing flavor and taste. Finger millet possesses tremendous potential for product diversification. The potential for export of finger millet in the form of grain, flour and value added products needs to be explored. Thus, there is a need to discover the markets for augmenting the exports through organizing trade fairs, exhibitions to create awareness and also gain knowledge about the quality preference and thereby plan measures to promote finger millet exports. If India needs to secure its food for this century, there is an urgent need to recognize finger millet as the future crop and adopt relevant steps, there is no doubt that we will see a dramatic change in the food and nutrition picture of India.

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Azolla as an organic quality livestock feed in improving milk production

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ABSTRACT

The success of a dairy plant depends largely on increasing milk production without escalation in feeding cost. Growing fodder grass is a good option, another is *Azolla* cultivation. *Azolla* is a floating fern which resembles algae. It is rich in proteins, amino acids, vitamins and minerals. High protein and low lignin content contribute for its high digestibility by livestock. *Azolla* can be mixed with commercial feeds in 1:1 ratio for feeding livestock (Pillai *et al.,* 2005). *Azolla* as a low cost organic quality feed ingredient, it improves both quality and quantity of milk yield in bovines. Hence, dairy farmers can gain profit in their occupation. Besides dairy animals, it may be supplemented in feed for sheep, goat, pig, rabbits and poultry.

INTRODUCTION

Green plants have long been recognized as the cheapest and most abundant potential source of proteins because of their ability to synthesize amino acids from a wide range of virtually unlimited and readily available primary materials (Fasuyi and Aletor, 2005). The demand for milk and milk products in India is creating new potential in the profitability of dairy farming as an occupation. At the same time, there is a substantial decline in fodder availability. (Pillai *et al.,* 2005). The area under forest and grasslands is decreasing, largely due to the introduction of high yielding dwarf varieties of cereals. In addition the area under food crops is also declining owing to urbanization and industrialization. The shortage of fodder due to ever decreasing area under cereals and fodder crops is getting compensated with increased use of commercial cattle feed, resulting in increased costs of milk production (Reddy, 2007). Several attempts have been made to find alternate sources of cattle feed. *Azolla* is considered as the most economic and efficient feed substitute and a sustainable feed for livestock.

IMPORTANCE OF *AZOLLA*

Azolla is an aquatic fern consisting of a short, branched, floating stem, bearing roots which hang down in the water. The leaves are alternately arranged, each consisting of thick aerial dorsal lobe containing green chlorophyll and a ventral lobe which is slightly larger thin, colourless, floating. Under some conditions, an anthocyanin pigment gives the fern a reddish-brown colour. They give the appearance of a dark green to reddish carpet, except *Azolla nilotica* that does not produce the red anthocyanin pigment. The most remarkable characteristic of *Azolla* is its symbiotic relationship with the nitrogen-

fixing blue-green alga (Cyanobacterium) *Anabaena Azollae*. The fern provides nutrients and a protective cavity in each leaf to Anabaena colonies in exchange for fixed atmospheric nitrogen and possibly other growth-promoting substances (Lumpkin *et al.,* 1980).

Research and promotion of *Azolla* as a livestock feed has been increasing. Because *Azolla* has a higher protein content (19-30%) than most green forage crops and aquatic macrophytes, and an essential amino acid composition (notably lysine) favourable for animal nutrition, *Azolla* can be a valuable protein supplement for many species, including ruminants, poultry, pigs and fish (Hasan *et al.,* 2009).

AZOLLA CULTIVATION

Azolla growth is promoted by some optimal ecological factors. It grows in water or wet mud, and it dies within a few hours under dry conditions. *Azolla* can survive a water pH range of 3.5–10, but optimum growth occurs when pH is between 4.5-6.5 and salinity of between 90-150 mg/L. The optimum temperature for *Azolla* is between 64 - 82°F (18–28°C). *Azolla* grows in full to partial shade (100–50% sunlight), with growth decreasing quickly under heavy shade. *Azolla* is established by vegetative propagation (Kathirvelan *et al.,* 2015).

Preparation : An artificial water body preferably under the shade is made to grow *Azolla*.

1. A pit size of 2 Mt. length, 1 Mt. width and 20cm depth should be dug on earth.
2. This pit is then covered with plastic gunnies to prevent the growth of roots of nearby trees, protect the soil temperature and seepage water.
3. Silpuline plastic sheet / plastic sheet is spread over the plastic gunnies without any fold.
4. About 10-15 kg sieved soil is uniformly spread over the plastic sheet.
5. Five kg of cow dung and 40 gms of Azophos and 20 gms of Azofert or single super phosphate made into slurry in 10 liters of water and is pour in the pit, then more water is poured to make the water level at about 8 cm.
6. About 1-2 kg of fresh, pest and disease free *Azolla* seed culture is inoculated in the pit.
7. *Azolla* will fill the pit within 7-10 days. About 1-1.5 kg of *Azolla* can be harvested daily thereafter.
8. About 2kgs of dung, 25gms of Azophos and about 20gm of Azofert made into a slurry in 2 liters of water should be applied once in 7 days to keep the *Azolla* in rapid multiplication phase and to maintain the daily yield of 1- 2kg/pit.

Harvesting and preparing *Azolla* as livestock feed (NARDEP)

1. Harvest the floating *Azolla* plants using a plastic tray having holes of 1 to 2cm mesh size to drain the water.
2. Wash the *Azolla* to get rid of the cow dung smell. Washing also helps in separating the small plants which drain out of the tray. The plants along with water in the bucket can be poured back into the original bed.

3. For use as a livestock feed, the fresh *Azolla* should be mixed with commercial feed in 1:1 ratio to feed livestock. After a fortnight of feeding on *Azolla* mixed with concentrate, livestock may be fed with *Azolla* without added concentrate.
4. For poultry, *Azolla* can be fed to egg layers as well as broilers.
5. In case of severe pest attack the best option is to empty the entire bed and lay out a fresh bed in a different location.

Precaution:

1. Plants should not be allowed to enter maturity stage or sporulation stage by periodic application of cow dung slurry, super phosphate and other macro and micronutrients except nitrogen. Temperature should be retained below 30 degree centigrade, in case the temperature goes up, the light intensity should be maintained by providing shade net or other devices.
2. Bio-mass should be removed every day or alternative days to avoid overcrowding.
3. pH should be tested periodically to see that it never goes below 5.5 and above 7.
4. Seed stock is maintained separately, treated with pesticides and fungicides.
5. Biomass collected from the field applied with the pesticide should not be used as a feed for livestock.

Fig: *Azolla* sp.

Fig: *Azolla* cultivation

Fig: Harvesting *Azolla*

Fig: Feeding *Azolla*

Nutritive value of fresh *Azolla* (AFZ, 2011)

Nutritional content	Unit	Average
Dry matter	% as fed	6.7
Crude protein	% DM	20.6
Crude fibre	% DM	15
Crude fat	% DM	5.8
Ash	% DM	15.9
Starch	% DM	4.1
Gross energy	MJ/kg DM	17
Calcium	g/kg DM	11
Phosphorous	g/kg DM	6.1
Potassium	g/kg DM	17.4
Sodium	g/kg DM	9
Magnesium	g/kg DM	5
Manganese	mg/kg DM	762
Zinc	mg/kg DM	38
Copper	mg/kg DM	16
Iron	mg/kg DM	3900

BENEFITS OF AZOLLA

Balanced and proper feeding results in better utilization of nutrients and optimum milk production. There will be a substantial improvement in the quantity, as well as, quality of milk produced, when dairy cattle are fed with *Azolla* combined with commercial feed along with an improvement in the health of the cattle. The cost of producing *Azolla* using NARDEPS' method is less than Rs 0.65 per kilogram. The expenditure on preparing a 6 X 4 feet pond is minimal at Rs.500 (sheet plus labour cost). A farmer can realize a net profit of over Rs. 4000 per annum from the additional milk yield and reduced usage of concentrates' feeding for livestock.

Nidhi *et al.,* 2015 stated 11.85% increase in milk yield after *Azolla* supplementation in dairy cows. They observed that the milk productivity started to increase after one week of *Azolla* supplementation, which further increased for next four weeks and thereafter it became constant at increased level. A study by Giridhar *et al.,* 2012 on *Azolla* cultivation and feeding to milch animals @ 800 grams (fresh weight) on an average per day, improved the monthly milk yield by at least 10 liters per cow. The net profit per annum was over Rs. 4000 when additional milk yield due to feeding of *Azolla* and savings in usage of concentrates for milch animal were considered.

Meena *et al.,* 2017 also reported about 16.25 % increase in the milk yield in lactating buffaloes after 60 days of feeding 1.5 Kg *Azolla* per day with conventional feed cottonseed cake. The same was reported by Singh *et al.,* 2017 and Mathur *et al.,* 2013.

CONCLUSION

Azolla fodder is an excellent alternate feed supplement for livestock, poultry and fish. It is a good source of protein and contains almost all essential amino acids and minerals such as iron, calcium, magnesium, potassium, phosphorus, manganese etc. apart from appreciable quantities of β-carotene (vitamin A precursor) and vitamin B12. It is considered to be the most promising because of the ease of cultivation, high productivity and good nutritive value. It is a highly productive plant and it doubles its biomass in 4–10 days period. This is a boon for dairy farmers because; it drastically reduces the feed cost and results in increased milk yield.

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Weather based agro advisories:
A boon for farming community

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ABSTRACT

Weather parameters influence on agricultural operations and farm production. Aberrant weather is one of the most important reason for crop losses in India. The losses could be minimized by making modification in field operation by using weather based agro advisories. Agro-meteorological Field Unit under the project of Gramin Krishi Mausam Sewa provides weather based crop and location specific advisories and disseminated to the farmers. Studies of different location showed an increase in benefit of farmers those are followed weather based advisories as compared to no advisory followed farmers. The additional benefit was due to the crop management done by the farmers according to weather condition.

INTRODUCTION

Agricultural sectors contributes a huge percent to the Indian economy and Indian farmer largely depends on the Monsoon rains for their agricultural operation. At present, about 60% of total net sown area is rainfed, contributing a significant amount of the total food production as well as to the livestock population. Weather plays an important role in agricultural production. Besides rainfall, others weather parameters are also playing an important role in influencing agricultural production. Unfavourable weather conditions are major concerns to the farming community. The advance prediction of these weather events and crop planning based on prediction would help the farmer enormously in reducing the crop losses under aberrant weather situations and also taking-up suitable contingency measures. Under Gramin Krishi Mausam Sewa project (GKMS), India Meteorological Department, Ministry of Earth Science in collaboration with State Agricultural Universities /Indian Council of Agricultural Research etc. is issuing crop and location specific weather based agro advisories for the benefit of farming community on every Tuesday and Friday. The major objective of this programme is to guide timely and requirement (weather condition) based crop management practices.

TYPES OF WEATHER FORECAST

Forecasting means the process of estimation of the value of some variable at some future time.

- Now casting: A short-time weather forecast issued generally for the next few hours and validity of less than 24 hours.
- Short range forecasts: Forecasts having a lead time period of 1 to 3 days.
- Medium range forecasts: A weather forecast issued for a period from about 4 days to 10 days in advance.
- Long range forecasts: A weather forecast issued for a period greater than 10 days in advance and up to a season of more than three months. The monthly and seasonal forecast comes under long range forecast.

Elements of medium range weather forecast for issuing agro advisory bulletin

Medium range weather forecast should refer to all weather elements that immediately affect farm operations. Normally a medium range weather forecast includes the following parameters and forecast issued for 5 days in advance.

i. amount of rainfall
ii. maximum and minimum temperature
iii. type of cloud over
iv. maximum and minimum temperature
v. wind speed and direction

Agro-met field unit, Malkangiri, Odisha

Agro-meteorological Field Unit (AMFU) under the project of Gramin Krishi Mausam Sewa (GKMS) is operational in the South Eastern Ghat agro climatic zone of Odisha. It comprises of Malkangiri district and parts of Koraput (Jeypore). The climate in the district is warm and sub-humid with maximum temperature ranging from 25^0C to 46^0C and minimum temperature ranging from 12^0C to 30^0C. The average annual rainfall is about 1667.6 mm with 79.4 average rainy days.

How to prepare bulletins

Weather forecast data is received from MC Bhubaneswar on each Tuesday and Friday. The data are clarified by a team of experts on every Tuesday and Friday. Bi-weekly Agro-advisory bulletin is prepared with the help of expert members based on the information on weather forecast, crop condition obtained from the farmers' field (such as crop growth stage, incidence of pest attack and diseases and water stress) and weather condition of previous days.

Usefulness of weather based agro advisory bulletins

Agro-met Advisory on set of monsoon rain is very much useful in deciding sowing time of *kharif* crops. The advisory is useful for planning of irrigation and fertilizer management in crops. Advisory on plant protection is very much helpful for protecting crops from insect pest and diseases of crops. Advised on kept harvested crops in a safe place during rainfall forecasted days restrict post-harvest losses. Standard Precipitation

Index map is useful for providing irrigation and sowing information. Normalized difference vegetation index provide crop vigour and benefited for better crop management.

Dissemination

Weather based advisories were directly send to farmer's mobile number through mkisan portal. Published in Odia newspaper Sambad in collaboration with Reliance Foundation - Information Services, Bhubaneswar and send to the line departments as well as NGO officials for disseminating to the farming community. Bulletins were also uploaded in website of IMD Pune, website of IMD, MC Bhubaneswar, website of university, website of KVK Knowledge network and website of the department of agriculture and farmers' empowerment (Govt. of Odisha) by the respected officials. Beside these, started voice message services for weather based agro advisories in collaboration with Reliance Foundation - Information Services, Bhubaneswar.

Economic impact assessment

As per the survey, 17 number of farmers made use of this bulletin in planning of their field operation out of 20 farmers from whom feedback was collected and 85% farmer think this is useful information and should continue. The economic benefit obtained by farmers following the advisories has been tabulated in Table 1. From this, it was observed that the AAS farmers (who followed weather based agro advisory) have realised good benefit than non-AAS farmers. In case of paddy, AAS farmers got benefit cost ratio of 1.99 to 4.53 whereas non AAS farmers got the same from 1.89 to 3.43 (Table 1). In the same way, the farmers who cultivated maize, green gram and chilli could get more benefit cost ratio as compared to non AAS farmers (Table 1).

Table 1: Impact of weather based agro advisories (AAS) on farmer's income

Crops	Location	Benefit cost ratio		Source
		AAS farmers	Non AAS farmers	
Paddy	Mahasamund, Chhattisgarh	2.29	2.04	Gandhi *et al.*, 2018
	Keonjhar, Odisha	1.99	1.89	Ray *et al.*, 2017
	Pantnagar, Uttarakhand	2.87 - 3.21	2.27 - 2.65	Maini and Rathore, 2011
	Kalyani, West Bengal	2.16 - 4.53	1.94 - 3.43	Maini and Rathore, 2011
Maize	Keonjhar, Odisha		2.2	Ray *et al.*, 2017
Green gram	Keonjhar, Odisha	2.31	1.8	Ray *et al.*, 2017
Chilli	Madurai, Tamil Nadu	2.03 - 2.10	1.90 - 1.93	Kumar *et al.*, 2015

CONCLUSION

The study showed that, medium range weather forecast issued by India Meteorological Department and agro advisory bulletins based on predicted and observed weather is useful for farming community to improving the agricultural activity. Study also revealed that, the farmers received more benefit those are followed weather based advisories in their agricultural operations.

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Disruptive Technologies in Strengthening Extension and Advisory Services (EAS) in Agricultural Sector

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ABSTRACT

Disruptive technologies are exciting because they challenge established patterns and the way we do things. Past two decades have witnessed several digital pilot projects in India. Now there is a need to bring rapid transition so as to remain relevant and cater to the emerging - information and service needs of farmers. With the proposed EAS framework, it is expected that farmers will be in a position to pull the knowledge and services on real time basis by use of diversity of sources. The success of disruptive technologies such as IOT (Internet of things) and big data analytics for rural development depends on the participation and support of both, public and private organizations. A series of such disruptive extension processes will surely transform the vary nature of Extension and Advisory services (EAS).

Keywords: Advisory services, Big data, Disruptive, Internet of things.

INTRODUCTION

In a wider sense, EAS means the transfer of know-how and information, which will eventually enable the client/farmer to make his/her autonomous decision to change or modify the production and/or adopt innovations. A disruptive technology is an innovation that creates a new market and value network, and eventually disrupts an existing market and value network, displacing established markets, leading firms, products and alliances. The term was defined and phenomenon analyzed by Clayton M. Christensen beginning in 1995.

Disruptive technologies are relate with the extension systems in two ways: a) Bringing disruption in an extensionists' functioning that includes transformed services, new innovations in the extension processes and b) Emergence of new players in EAS with disruptive innovations. Through farmers' perspective, it is a situation where extension systems cease to function in the usual manner, and start responding to rapid changes that may transform the very nature of the organization. A disruptive innovation in agriculture will allow small and marginal farmers' access to technologies and/or services that were historically inaccessible to them or accessible at very higher costs. For instance, rural societies are now able to access e-commerce goods and other services such as railway and bus tickets due to the availability of digital platforms.

Similarly, goods (agri-input, credit) and services (extension advisory and marketing) are yet to be accessed in agriculture, as there is no disruption.

Futuristic Extension and Advisory Services

- Future EAS needs to strategize convergence of big data with disruptive technologies such as mobile/cloud computing, Internet of Things (IOT), Location based social (LBS) networks etc.
- Highly personalized extension advisories are possible in India only when EAS embraces big data analytics and links them to unique *Aadhaar* (12 Digit unique identification number) numbers of farmers.
- With digitized land records and soil health status linked with GPS coordinates, the future of input supply can lead to a radical transformation.
- Big data in EAS will integrate information provided by farmers, players in the Agri-food chain and markets (e-National Agricultural Market), which can be used to enhance productivity, reduce risk, increase resilience and improve profitability.
- If this can be realized, from seed to seed, seed to harvest, post-harvest to storage and marketing, every farming decision can be supported with the digital extension strategies.

Framework for harnessing Disruptive technologies in Agriculture:

The EAS Framework for harnessing disruptive technologies may be explored with three distinct areas viz., pre-production, production and post-harvest. Effective technologies can be integrated in these stages for developing needs based EAS strategies. Digital cashless transactions, transactions linked to unique IDs and bank account numbers, linking credit and marketing with bio-metrics will give EAS leverage over the past efforts. Digital networking solutions, risk sharing systems for agricultural lending, agricultural value chain networks, e-vouchers distributed through mobile interfaces, will transform EAS strategies in the developing world. Virtual platform like Virtual-Pooling and Virtual Reality can be an effective way to enable Extension agencies to provide specific non-cash services and should be beneficial both farmers and private organizations. Disruptive technologies may offer new expanded opportunities for extension system, to evolve into a completely unimaginable service providing organizations. Disruption may positively impact the very nature of EAS if only extension policies could be flexible to make structural and functional adjustments. Digital extension strategies would accelerate the impact of extension advisory, when they provide highly personalized, time critical services to the farmers.

Ways for effective Innovation practice in Agricultural Research Organizations:

- Challenge of how to make research a more responsive contributor in the wider innovation landscape of farmers, entrepreneurs/Agripreneurs and policy makers.

- Diverse innovation challenges and opportunities require different configurations of research and other stakeholders.
- New research practice aimed at promoting innovation, needs leadership endorsement and support at organizational level.
- Interventions (including research) need to be able to work with and support and strengthen these national styles of innovation rather than trying to replace them with models transferred from elsewhere.

Role of Government in Promoting Disruptive technologies:

- Investing in disruptive innovations in agriculture can boost garnering and harnessing new ideas.
- Governments should support entrepreneurs/ agripreneurs with business models which have the potential to strengthen and promote digital agriculture.
- Government should provide financial assistance many startups are emerging that can initiate digital disruption in EAS.
- Support could be in terms of finance, standards development, data sharing and access, analytical tools and technology.

Ways Forward:

Disruptive technologies requires a series of strategic and ongoing conversation and exchange of perspectives on what the look and feel of this brave new world might actually be-

- Looking beyond the smart phone analogy
- Investing in disruption for the long run.
- Catching the next wave.
- Brokering opportunities
- Getting policy settings right
- Technological futures.
- Imagining the future market.
- Building disruptive capability

CONCLUSION

A disruptive technology is an innovation that creates a new market and value network, and eventually disrupts an existing market and value network, displacing established markets, leading firms, products and alliances. A series of such disruptive extension processes will surely transform the vary nature of Extension and Advisory services (EAS). A disruptive innovation in agriculture will allow small and marginal farmers' access to technologies and/or services that were historically inaccessible to them or accessible at very higher costs.

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Scientific Assessment of Colostrum Quality and Quantity to Ensure Calves Health

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Colostrum is defined as the secretion from the mammary gland of mammals during the first few days after parturition. In the dairy industry, secretions from the cow's udder for one day after parturition are commonly referred to as colostrum. Colostrum is also known as beestings or first milk. Colostrum is so important that it is sometimes called as "Liquid Gold". Colostrum is a mixture of lacteal secretions and constituents of blood serum such as immunoglobulins (Ig) and other serum proteins that accumulate in the mammary gland during the pre-partum dry period and are collected via milking at parturition.

Secretions produced on the second and third day after parturition is known as transition milk. Colostrum contains antibodies to protect the newborn against most common diseases like septicemia, diarrhea and pneumonia. The ability of the offspring to suckle this milk within a few hours after its birth determines which newborns are strong and able to survive in future. In general, protein concentration in colostrum is substantially higher than in milk. Colostrum differs from normal milk in many ways. It is markedly higher in immunoglobulins, total solids, fat, protein, vitamin and lower in lactose. The amount of solids and protein (especially Ig) declines rapidly after the first day, so that by 4th day the milk reaches its normal composition. Fat concentration is substantially higher in colostrum than in milk in some species e.g. sheep and horses but lower in other species like camels and humans. Fat concentration in bovine colostrum is

extremely variable. Differences in composition of colostrum and milk depicted in table given below.

Table 1: Composition of colostrum and milk

Constituents	Colostrum (%)	Milk (%)
Total solids	28.30	12.86
Ash	1.58	0.72
Fat	0.15 to 12.0	4.00
Lactose	2.50	4.80
Casein	4.76	2.80
Albumin	1.50	0.54
Globulin	15.06	-
Total protein	21.32	3.34

Significance of colostrum feeding

New calves (as well as pigs, foals, and some other species) are born without measurable concentrations of serum Immunoglobulin which are critical to the proper function of the immune system. Calves are born with no immunity against diseases. The neonatal digestive system can absorb large molecules such as Ig intact for a limited time after birth by a process unique to the immature intestinal cells. As these cells mature, they lose this ability, so early feeding of colostrum is essential. Until they can develop their own natural ability to resist disease, through exposure to the disease organisms in their surroundings, they depend entirely on the passive immunity acquired by drinking colostrum from their dam. Colostrum is thick, creamy-yellow, sticky milk first produced by cows initially following calving and contains the antibodies necessary to transfer immunity to their calves. The chances of calves survival, the first few weeks of life are greatly reduced if they do not ingest and absorb these antibodies into their bloodstream.

The blood proteins transfer passive immunity from mother to offspring through maternal antibodies or immunoglobulins (Ig). Insufficient serum IgG concentration (<1,000 mg/dl by 48 hours of age) is called failure of passive transfer (FPT). Many factors are responsible for failure of passive transfer. However, the two most important factors affecting serum IgG concentration are the amount of IgG consumed and age of the calf at the first colostrum feeding. If intestinal absorptive sites are not saturated by colostral proteins, other molecules and possibly bacteria, may reach these sites and be absorbed into the calf's system. If bacteria reach absorptive sites before colostral proteins, they will be at high risk of septicemia, which is often fatal. Newborns that do not receive colostrum have more difficulty in emptying the intestine of its content of dead epithelial cells and remnants of swallowed amniotic fluid called meconium compare to the calves that not receive colostrum. Calves receiving inadequate amount of colostrum usually grow more slowly than those receive adequate amounts of colostrums and the former often suffer from diarrhoea. Antibodies supplied by colostrum to new born calves persist for 4-6 weeks after birth and provide immunity to

calf up to 3 months of age. That's why vaccination of calves scheduled after 3 months of age.

Amount of Immunoglobulins and its absorption

The two major factors that determine maximum serum Ig concentration for each Ig class in calves are age at first feeding and the amount of colostrum. Both these factors exhibit a linear response, as age of colostrum feeding increases, Ig concentration decreases and as the amount of colostrum feeding increases, up to 2 liters, serum Ig concentration increases. These factors interact with each other so calves whose initial feeding of colostrum done at progressively older age needs less colostrum to reach maximum absorption. However, the age and amount at which colostrum is first fed affect the Ig absorption from colostrums. Environmental factors such as heat stress, severe cold stress and dystocia have also been found to decrease Ig absorption from colostrum. Unfortunately, even this list of factors does not explain why calves fed equal amounts of pooled colostrum at the same age do not always have similar levels of serum IgG which is represented by a progressive decline in serum Ig concentration with increasing age.

Period of Immunoglobulin absorption

The closure or termination of intestinal permeability to colostral Ig occurs spontaneously with age and the rate of closure progressively increases after 12 hours of age. Calves fed colostrum soon after birth has an earlier cessation of absorption. Thus age at first feeding influences closure time while the amount of colostrum feeding has no effect on this. This period of intestinal permeability is crucial to the transfer of colostral Ig. Reports find that calves fed colostrum after birth had a closure time for IgG absorption at 21 hours, IgM at 23 hours and IgA at 23 hours. When feeding was delayed until 24 hours after birth the closure time was found 33, 31 and 32 hours for IgG, IgM and IgA, respectively. Thus, length of absorption time is reduced with delayed feeding (for example, calves fed at birth had 24 hours to absorb Ig, while those not fed until 24 hours of age, had only 8 hours of absorption time). By lengthening time of first feeding of colostrum and therefore decreasing the length of absorption time. Calves have increasingly less chances to absorb sufficient quantities of colostrum to achieve 10 mg/ml of serum IgG. All of the calves fed colostrum prior to 12 hours of age absorbed all classes of Ig. Different studies shows that calves not ingesting colostrum by 12 hours of age are subject to gut closure before any Ig absorption takes place. The calf is physiologically limited by the mass of Ig that it can absorb from a specific volume of colostrum. Due to this physiological limitation, there is wide variation in the amount of Ig transfer in calves. This variability results in 10 to 30% of calves being hypogammaglobulinaemic or low in serum Ig concentration. The high frequency of hypogammagloulinaemia may be due to a low concentration of colostral Ig, inadequate colostrum intake, colostrum being fed too late or an early loss of absorption capability. So keeping these points in mind following colostrum feeding schedule may be adopted for better calves health.

Colostrum feeding schedule

1.	Positively within 30 minutes after birth	1/10thof body wt.
2.	After 12 hours	1/20th of body wt.
3.	At 24 hours	1/20th of body wt.
4.	At 36 hours	1/20th of body wt.

Optimum Colostrum quality

The first step to ensure adequate levels of serum Ig in calves is to provide them with high quality colostrum. However, colostrum quality is influenced by a variety of factors including volume of colostrum produced, season of the year, breed and lactation number. Colostrum containing greater than 50 gm Ig/L is considered to be high quality. The diet of the mother is very important to colostrum production. Colostrum containing less than 100gm Ig are at risk for failure of passive transfer. Dam on low energy diets produces less colostrum than the one with adequate nutrition. Younger females tend to produce less colostrum than mature females. Inadequate nutrition during late pregnancy can reduce the quantity and quality of colostrum.

In addition to breed differences, the parity (or lactation number) of a cow will also influence colostrum quality. The concentration of Ig is lower in the colostrum of first calf heifers than older cows. This is because first calf heifers have probably not been exposed to as many herd-specific pathogens as older cows which gives them a limited range of protective antibodies Across the major dairy breeds researchers found that the average total colostrum Ig concentration to be 5.91%, 6.26%, 8.15%, 7.49% for first, second, third and fourth lactation. The quality of colostrum plays a major role in the success of providing the calf protection from diseases, so it is necessary to evaluate the quality of colostrum quickly and easily. Numerous methods are available to evaluate the quality of colostrum, the easiest of which is a device called a Colostrometer. The Colostrometer is a calibrated hydrometer developed for practical use to determine the specific gravity of colostrum. The Colostrometer works by measuring the specific gravity of colostrum and then taking advantage of the linear relationship between the specific gravity of colostrum and its Ig concentration.

COLOSTROMETER WITH JAR

Factors affecting absorption of colostrum

The interactions of three factors influence the rate and pattern of colostral Ig absorption. These are:

- Starting age at which colostrum is fed
- Quantity of colostrum fed

- Time of feeding colostrum

In ruminant colostrum like milk passes directly to the abomasums and small intestine. In newborn, immunoglobulin in colostrum is absorbed through intestinal epithelium without degradation. The concentration of immunoglobulins in colostrum decreases rapidly after parturition. Therefore, the sooner colostrum is consumed; the better will be the calf's immunity. Thirty minutes are considered optimum for initiation of colostrum feeding. When a calf is 6 hours old, it is able to absorb 66% of the immunoglobulins in colostrum but by the time it is 36 hours old it is only able to absorb 7%. Newborn should receive 10% of the body weight as colostrum within 24 hours after birth. Ideally they should receive half of this within 6 hours of birth. The concentration of immunoglobulins in colostrum decreases rapidly after parturition. Therefore, sooner the colostrum is consumed, better the immunity of calves. For colostrum feeding thirty minute is considered as the optimum time.

CONCLUSION

In Current dairy production systems administration of sufficient amounts of high quality colostrum is not possible due to early weaning and more commercial oriented. Additionally, the presence of transmissible disease organisms in colostrum makes administration of colostrum problematic. The transfer of immunity from dam to newborn on bovine species is made only through colostrum. This process is conditioned by the time between parturition and first administration of colostrum and also by the quality of colostrum regarding IgG concentration from colostrum. Feeding high quality colostrum to calves as soon as possible after birth will provide them not only with immunoglobulins to help to fight diseases, but also with other nutritive values such as energy and high levels of vitamins and minerals and non-nutritive growth factors. So there is urgent need to popularize the colostrum feeding through the extension activities like Animal camps, Kisan Mela's and Training to farmers so that they can get healthy and productive calves and get maximum profit.

Discharge of untreated wastewater effluents can impact on the environment and human health concern

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ABSTRACT

Nowadays, the effect of the untreated industrial effluents and households discharge are emerging as a public concern throughout the world. The massive releases of toxic chemicals, heavy metals, and harmful microorganism from the byproduct of textile, paper, rubber, dye, electronic, plastic-ware industries and hospital waste can lead to a destructive role in the ecosystem as well as human health. On an average 38354 million liters per day (MLD) sewage was generated in major cities of India, however, the capacity of sewage treatment was only 11786 MLD which is approximately 30% of total sewage production. Due to lack of awareness in public, enough funds, effective sewage treatment plant and innovative technologies, the solution of this major issue is still missing. Millions of tonnes of wastewater discharge into the water body daily, without any proper treatment that may further lead to polluting the aquatic environment like Rivers, groundwater and Ocean etc and with this effect it will favorable for outbreak a deadly disease like Mini-Mata (Mercury), Itai-Itai (Cadmium), Diarrhea, Gastroenteritis, and Dysentery etc. To overcome this problem, there is a need to the involvement of Government bodies, Pollution Boards, NGOs and public to understand the cause and eradicate together with established the effective amendments and policies are to be implemented properly regarding wastewater discharges and their treatment.

INTRODUCTION

Globally, the condition of rivers is gradually declining due to excessive drainage of untreated industrial effluents and domestic waste which can enter directly into the water body and disturb the aquatic environment condition. On an average 38354 million liters per day (MLD) sewage was generated in major cities of India, however, the capacity of sewage treatment was only 11786 MLD which is approximately 30% of total sewage production. Similarly, Only 60% wastewater coming from the large-scale industries were treated effectively (Kaur *et al* 2012). These effluents have abundance of toxins like byproducts of automobiles, textile, paper, plastic-ware industries, laboratories, construction, and hospital waste can responsible for secretion of harmful chemicals and metals ions such as Arsenic (As), Chromium (Cr), Cadmium (Cd), Zinc (Zn), Copper (Cu), Lead (Pb), Mercury (Hg) and organic/inorganic material like Urea, Phosphate (PO_4^{3-}) Ammonia (NH_3) Nitrate (NO_3^-) Sulphates (SO_4^{2-}) Chloride (Cl^-) and Aluminium (Al) etc. The waste from the hospitals like pharmaceutical and other

chemotherapy agents (Paclitaxel, Pentostatin, and carboplatin) play a destructive role in aquatic flora and fauna and degrade the water quality which is no longer use for households, drinking and agricultural purposes.

Source of pollution

The demand of the limited water resources is increasing gradually and more valuable water resources like rivers, lakes, and groundwater getting contaminated with rising global population and industrialization which ultimately lead to considerable public issues involved in industrial effluents and household sewage management. The major source of water pollution is coming from the small and large scale industries cluster which established near the seashore or Riverside areas so easy to dump without any particular treatment. The factories liquid waste are characterized by their abnormal parameters like pH, Turbidity, Conductivity, Biological oxygen demand (BOD), Chemical oxygen demand (COD), Total Hardness, and Total suspended solids (TSS).The concentration of the microbial nutrient is high in the effluents (untreated sewage) coming from land-based sources, due to the availability of decomposed organic matter which is favorable for the growth of pathogens and other coliform bacteria when discharge into the water body particularly in an unintended form. The households waste containing plastic-ware, polythene, organic matter, sewage effluents, rotten vegetables are responsible for environmental degradation and stuck the sewage pipes.

Chemical/toxins

Since the industrial revolution, the toxic waste has increased abundantly in substantial form, which becomes later on the major source of disease and creates a serious global health issue. With the advancement in technology, the certain amount of products such as solar panels, smartphones, laptops, and televisions have hazardous chemical/metal components which affect the environment, if they are not treated as they should be. The cluster of small and large scale industries such as rubber, cement, textile, refineries, sugarcane, plastic-ware, brewery, food and beverages, dyes, paper, pulp and palm oil is widely distributed in India to meet the basic requirements of the daily life, eventually, the byproducts of the factories are responsible for the release of harmful toxin, chemicals and heavy toxic metal which is later on outbreaks of disease. The toxin metals such as arsenic are used for making electric circuits and also as one of the ingredients in the pesticide which has carcinogenic property. Cadmium (Cd) is found in the batteries and plastic-ware that exposure to harmful to the lung, digestive tract and kidney dysfunction, softening of bones and finally cause to Itai-Itai disease. Database of patients with 150 women were reported in 1979 to 1984 who lived in cadmium-polluted areas (Jinzu river basin, Toyama, Japan) were suffered from Itai-Itai disease, maintained by the Ministry of Environment, Japan (Nishijo et al 2017). The solid metal such as Chromium (Cr) is used as a making steel, chrome plating, leather tanning and manufacturing of dyes and pigment which lead to cause chronic disease and damage lungs tissue if exposed to the environment in active form. Other heavy metals like Cyanide (CN-) are used as a poison in pesticides and rodenticides which can affect the

body by paralysis and respiratory stress when to enter into the body. Lead (Pb) as a metal majorly found in batteries, paints, and ammunition can mix with groundwater through improper drainage activity, ultimately lead to harm the nervous and reproductive systems after ingestion. Mercury (Hg) is one of the highly toxic metal can be used for dental fillings, thermometer, batteries, and production of chlorine gas. The deadliest disease called Mina-Mata was firstly occurred in 1956 due to a release of methylmercury from industrial wastewater in Minamata city, Japan (Harada 2008). Hydrocarbons like PCBs (Polychlorinated biphenyls) and POP (Persistent organic pollutants) are widely used as a pesticide in agriculture farming. These compounds can leach out in the surface layer of soil and mix in the groundwater or drinking water which later on responsible for human health risk.

Impact on aquatic environment

India is a developing country which has a huge infrastructure and industrialization like metals, chemicals, dyes, fertilizers, drugs, and petroleum etc. Various types of compound either organic or inorganic form are present in effluents release from industrial as well as a domestic sections can contaminate the aquatic environment like a river, lake, and groundwater. The major source of water for farming and drinking purpose are coming from the groundwater and river which is consistently degrading day by day. The unintended chemicals can disrupt the habitat of aquatic flora and fauna. On the other side, organic matter forms the waste which is constructive for the growth of harmful microorganisms that carries toxin genes and responsible for outbreaks of disease. The toxic chemicals may reduce the growth of the plant and interrupt the breeding of many fishes and sometimes mutation may occur in between the species due to prolong discharge of effluents in the particular water body. One of the largest rivers in India named as Ganga (provide water about 40% of Indian population across 11 states) is no longer safe and sound from effluents and have major threats to human life and environment due to anthropogenic activity (Conaway 2015). The major cause for polluted holy river Ganga is increasing population density and various human activities (such as bathing, ash discharge, religious and industrial waste). Accordingly to pollution assessment report submitted by central pollution control board over river Ganga in 2013 has identified 138 drains who discharging 6087 MLD of wastewater. Approximately 440 MLD of industrial and domestic wastewater coming from 14 drains in Uttrakhand can discharge directly/ indirectly way to river Ganga. 45 numbers of drains have a 3289 MLD of wastewater from small and large industries/ households in Uttar Pradesh releases into Ganga. In Bihar state, 25 nos. of drains identified discharging 579 MLD of wastewater to river Ganga. 1779 MLD of wastewater through 54 drains discharges to river Ganga in West Bengal are mentioned in Table 1:-

Table no. 1: Pollution assessment: River Ganga 2013 by Central Pollution control Board

State	No. of Drains	Flow (MLD)	BOD Load (tonnes/day)
Uttrakhand	14	440	42
Uttar Pradesh	45	3289	761
Bihar	25	579	99
West Bengal	54	1779	97
Total	**138**	**6087**	**999**

Case study of Budha Nullah at Ludhiana city:

The Budha Nullah runs parallel to the river Sutlej and joins at village Gorsian Kadar Baksh in the northwestern corner of the district. Ludhiana and Machhiwara, Punjab is shown in Fig.1. Due to the mixing of Budha Nullah at river Sutlej, the water of the stream becomes polluted after it enters the Ludhiana city (Singh *et al*, 2013). With the massive industrialization/ urbanization of the city, Budha Nullah has become the contaminated pollutant, household sewage as well as industrial effluent carrier for the Ludhiana leading to River Sutlej. The water in Budha Nullah is to come under E class of water, which cannot be used for drinking, outdoor bathing, propagation of wildlife and fisheries, irrigation and industrial cooling. The water is highly contaminated and colored due to the activities textile industries and sewage activities which are added by the human settlements. The garbage releases from the industries are discharge into the water which results the stuck the flow of this Nullah at many places where the water is Stagnant and hinders the self–purification mechanism of water and is one of the major factors for the occurrence of diseases like malaria, jaundice, cholera, diarrhea, and gastroenteritis.

Fig.1 Wastewater of Budha Nullah entering the Sutlej River in near district, Ludhiana, Punjab.

Impacts on Human health

Due to an intensive load of effluents released from industries and households sewage hold a large quantity of an organic and inorganic substance which causes a majority of water born disease and impact on human as well as animal health. The wastewater contains a wide range of microorganisms (bacteria, virus, and protozoa) and heavy

metals/chemical toxin that may get contaminate when discharged into drinking water or receiving water bodies (Kris, 2007). The pathogens present in water act as a vehicle of several waterborne diseases such as cholera (caused by Vibrio spp), Diarrhea, Typhoid fever, Shigellosis, Salmonellosis, Campylobacteriosis, Giardiasis, Dysentery, cryptosporidiosis and Hepatitis A (WHO, 2004). Different types of microbial pollutants are always chance of having harmful pathogens in wastewater which are difficult to identify, isolate and also particularly in the context of an expensive and time-consuming process (Paillard et al 2005). The high concentration of nitrate in drinking water when entering the body it can reduce to nitrite which can attack the hemoglobin and lead to cause methemoglobinemia (blue baby disease). With above the maximum contaminant level of nitrate is 10 mg/l as set by the US Environmental protection Agency (EPA, 2002) are susceptible to cause methemoglobinemia.

CONCLUSIONS AND RECOMMENDATIONS

Globally, the current statistics depicts that the majority of the water sources such as groundwater, inland, and marine water sources are getting polluted and surprisingly it will increases day by day due to the rise of population and industries. The conditions are even more adverse in India due to highly effluents discharge into main river Ganga, Satluj, Brahmaputra and other tributaries. With related to public health and prevent the degradation of environmental resources, guidelines and policies aimed at treating the industrial effluents and sewage contamination before draining into receiving water body are being adopted in nationals and international levels. For water quality assurance, utilization of new technologies like sewage treatment plants is the way to treat wastewater, remove the sludge, debris, chemical/toxin, heavy metals and microbial contamination. A number of Government schemes such as National Mission for Clean Ganga (NMCG) under National Ganga River Basin Authority (NGRBA), Sewage Treatment Project (STP) in India have been continuously working on cleaning of major rivers and their tributaries. Treatment of wastewater in mass level is still a major issue due to lack of funds, strategies, laxity, public awareness, technologies and proper implementation. For instance, there is need to be established the performance, evaluation and amendments to different policies and acts/ guidelines regarding wastewater system treatment are to be implemented properly. Through, this way can enhance the water quality (free from contamination) and be making new strategies for further with respect to rectify the wastewater effluents issues.

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Unconventional feeds for livestock feeding

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Unconventional feed resources refers to all those feeds that have not been used in animal feeding and are not normally used in commercially produced ration for livestock. Due to population explosion there is an increase in demand for both protein and energy rich animal feeds. Because of industrialization and commercialization of land, rapid decrease in agricultural land availability for fodder cultivation is happening. Also, an increasing cost of quality feed ingredients demand leads to need for alternate feed resources for sustainable livestock production. Hence, interventions are required for efficient utilization of available feed stuffs along with search for newer feed resources.

Characteristics of unconventional feeds:

- End products of production that have not been used or recycled.
- They can be in a solid, slurry or liquid form
- Excellent sources of fermentable carbohydrates
- Majority are bulky poor quality roughages

Classification of unconventional feeds:

1. Agricultural crop residues
2. By-products from sugar industry
3. Oil seeds and cake
4. Animal protein sources
5. By-products from forests
6. Animal organic waste
7. Fruit and vegetable by-products

1. Agricultural crop residues:

Crops usually grown in our country are cereals like paddy, wheat, maize, jowar and legumes like red gram, bengal gram, green gram, black gram, peas, etc. After harvest,

usually available crop residues are straws, stovers and their by-products like husks, hulls, bran etc. Straws are commonly used for livestock feeding. The by-products from paddy are rice straw, rice husk, rice bran and broken rice. The by-products from wheat include wheat straw and wheat bran. Both paddy and wheat contain phytic acid and treatment with phytase enzyme increases digestibility. The by-products from maize are maize stover, maize cobs. Dry adult can be maintained with straw as a sole feed with small quantities of protein supplements but extensive use is limited by factors like high lignin and oxalic acid content, dustiness hence reduced palatability and reduced calcium absorbability. Straw treatment can be done for increasing palatability and enhancing nutrient content using methods like alkali treatment (1.25% NAOH @ 1 liter solution/kg straw) soaking straw in water (1 kg straw in 1 liter of water decreases dustiness), enrichment of straw with urea molasses and ammonia treatment.


Paddy straw


Rice bran


Rice husk


Maize bran


Maize stover

2. By-products from sugar industry

Cattle and buffaloes relish sugar cane tops which include growing points of cane, few upper nodes and accompanying leaves. They serve as roughages and they can be converted into silage of good quality and palatability.

Sugarcane bagasse - It is a fibrous residue of sugarcane stalks after juice has been pressed out in sugar factories. It is of two types, namely, finer bagasse and coarser bagasse.

Molasses – By-product of raw sugar syrup which serves as a good energy source for livestock feed. It acts as an agent for reducing dustiness in feed, enhances palatability, binder for pellets and carrier for urea.


Molasses


Sugarcane bagasse

3. Oil seeds and cake

Commonly used oil seed cakes are cotton seed cake, ground nut cake, neem cake, coconut cake, karanja cake, etc.


Neem cake


Coconut cake


Cotton seed cake


Groundnut cake

4. **Animal protein sources**

Blood meal- Which is a derivative of dried blood collected from slaughter house. Inclusion in feeds should be less than 2%, if more palatability in taste gets affected and cannibalism may develop in pigs and poultry.


Blood meal

Bone meal- Derived from bones. The protein is of low quality comparatively and may be included up to 3% in feed/cattle, sheep, pigs and up to 6% in poultry feed.

Blood and bone meal – Derived from thermo chemical process of slaughter refusal. Protein is of low quality bit and contains high calcium and phosphorus.

Feather meal- Feathers are treated under high temperature and pressure. It may be included up to maximum 2% for pigs and poultry and less than 2% in cattle and sheep feed.

Fish meal – Derived from fish and parts of fish. Protein is of good quality and can be included in pig and poultry feeds but not in cattle feeds.

Fish meal

Animal fat – obtained from cadaver processing. Fat is used in layer and broiler feed to meet high energy requirement of birds.

5. **By-products from forest**

Fallen leaves or forest foliage can be used for livestock feeding. By-products available from the forest for cattle feeding are dry leaves and seeds. Goats relish variety in their diets and feeding tree leaves help to extend their diet preferences.

6. Animal organic waste

Poultry manure consists of dry excreta, feathers and broken eggs. Poultry excreta is of two main types, namely, caged layer manure and deep litter manure. Caged layer manure is suitable for non ruminants and about 20-30% is optimum levels for utilization in poultry feed. Palatability problem of poultry manure can be overcome by ensiling or chemical treatment. Molasses increases palatability. Adaptation to livestock must be done gradually (3-5 days).

Poultry by-products meal is the dried, ground tissues of undecomposed necks, heads, fat, carcass, feathers of poultry either of with or without oil extraction, it is a valuable protein source.

7. Fruit and vegetable by-products

Mango seed kernel - Fat is extracted from kernel and deoiled mango seed meal is used for livestock feeding. Inclusion in feed can be done to the extent of 5 -10% and the limiting factor in this feed is the presence of tannins.

Mango seed kernel

Citrus pulp – It is a bye product from fruit juice or pulp factory. Dried and ground citrus, orange, lemon peals can be used in feeds to the extent of 10-15 %.

Palm kernel by-products - Palm kernals are the centres of stones within the fruit, the stone shell needs to be removed before the kernals are processed. Kernals contain 50-60% oil. Palm kernels are used in high energy compound feed. They are included less than 5%.

Tomato processing waste – consists of skin, pulp and seeds after extraction of juice. Tomato pomace is residue from processing of pulp, sauce, juice, paste and cutups

Potato waste – it includes peelings, culled potatoes and other products. Potato waste is equal in energy to cereal grains.

Future scope of unconventional feed resources:

1. There is an increasing demand for unconventional feeds due to limited resources of quality feeds.
2. Use of waste from livestock and agro industry reduces cost of production on one hand; on the other hand it reduces human animal health hazards.
3. Though unconventional feeds are low in digestible crude protein and energy their nutrient values can be enriched by practical pretreatment to increase palatability, digestibility and nutrient availability.
4. Management of anti nutritional factors needs to be attended to improve utilization of unconventional points.
5. Newer technologies should be made use of for reducing environmental pollution from animal waste.

Summary

Use of unconventional feeds is likely to gain more weightage in years to come, as it can fill the feed supply gap largely, in addition to ease competition for food between humans and animals and will be effective in lowering of feed cost and contribution in providing self-sufficiency in nutrients from feed sources, available locally.

Care and Management of Livestock during Flood

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Floods are the most common and widespread of all natural disasters. India is one of the highly flood prone countries in the world. Around 40 million hectares of land in India is prone to floods as per National Flood Commission report. Floods cause damage to houses, industries, public utilities and property resulting in huge economic losses, apart from loss of lives. Though it is not possible to control the flood disaster totally, by adopting suitable structural and non-structural measures the flood damages can be minimised. For planning any flood management measure latest, reliable, accurate and timely information is required. India during last years caused immediate problems for Livestock owners and led to long-term issues in areas where infrastructure has been damaged. The floods have affected the most densely populated livestock. Shortfall of food to feed livestock which was the result of 90% of corps has been completely destroyed or highly damaged. One of the main reasons which caused so much loss of animals was the restriction to carry large animals to a safer place. If flood is suspected then it is advisable to untie the animals so that the animals can swim with the flood water and the loss of the life can be reduced.

INFRASTRUCTURE

Downed and damaged Infrastructure is likely after flooding. The damaged building walls can be temporarily replaced by poly wire fencing. One has to be careful about downed and damaged power (electric) lines and other hazards in and around the housing of the animals. Overcrowding of the animals should be avoided for extended

periods of time. Perimeter fencing is the first priority. Portable facilities can be shared with neighbors when available. Unwanted fighting of cattle and other livestock can create herd health and breeding issues, which is required to be taken care. Clean and Spray the buildings with a good disinfectant before animals occupy them again. Remove debris from cattle sheds. Scrub and disinfect walls, ceilings, floors and other dairy equipment's.

DRINKING WATER

Flood may come with lots of problem for livestock specially and pity situation is that plenty of water remains everywhere but one may not use it for any domestic purpose. Flood water having much of unwanted ingredients and polluted with dung, urine, debris and other wastes that may cause harm for livestock livelihood if use for drinking. So, during this condition first priority is that cattle must have an adequate supply of fresh water to survive. Providing fresh water is the first priority. Use water tanks, and ask for help from neighbors and local fire departments for immediate water needs.

FEEDING MANAGEMENT

Flood is the major devastating natural calamity leading to a heavy loss of vegetation so that produced scarcity of foods and feeds and every effort should be made to move stock to an area that is high and dry. Feeding management during disaster has to be given at most care to prevent starvation. There is a need to establish feeds and fodder banks at non-affected areas. These banks are necessary to meet the emergency needs of livestock during floods and other natural calamities. Livestock may refuse to consume forages in areas that have been contaminated by waste water because of palatability problems. One has to provide livestock with another source of forage or feed until pastures are cleansed by rains or other sources. Attempts need to be made to provide ready to eat feed blocks (urea molasses mineral block) particularly to the pregnant and lactating animals.Unconventional feeds and wastes also have the capacity to mitigate the challenge. Good quality hay is the preferred feed, as digestion of roughage generates heat that will help to keep the animals warm, particularly if they are still standing in water. Hypothermia (low body temperature) can develop rapidly in the entire stock of livestock standing in water even in summer. Livestock should be to move stock to an area that is high and dry. Moldy or otherwise unsafe feeding to livestock should be avoided. Hay and pasture exposed to the elements or completely submerged will spoil rapidly if not fed immediately. Uncovered pasture or hay is most likely a loss unless it can be quickly rewrapped. Make sure feed is not contaminated by chemicals as a result of the flood. Watch cattle closely for signs of distress and make sure plenty of forage or other roughage is available to cattle along with free-choice quality mineral supplements and clean water. Many a times, the feeds are donated in a larger context. But there may be problems with its quality, palatability and suitability for the livestock. Ideally any feed change needs to be as gradual as possible (often difficult in emergency situations). Use roughage to smooth the transition on to energy dense feeds like grains and add protein or urea supplements if your stock are going onto a feed with low nutritive value.

Prolonged flooding of pastures kills vegetation, therefore reducing the nutritional value of pasture to grazing animal so that should not be allowed to graze in water logged areas.

HEALTH CARE AND MANAGEMENT

There are certain diseases which are more common during flood periods so these diseases need more attention so as to prevent its outbreak. The most common diseases are foot rot, blackleg, leptospirosis, pneumonia, foot and mouth disease, haemorrhagic septicaemia, blackquater, anthrax, enterotoxaemia, coli bacillus, babesiosis, thelaeriosis, anaplasmosis, pox disease, mastitis, brucellosis, ring worm, fascioliasis, microfilariasis, tick infestation and mange etc. It's important to remove any dead animals as soon as possible and bury them at least three to four feet deep covered with lime. This protects the spread of any diseased animal by wildlife.All livestock are required to be observed individually to inspect for wounds and treat them immediately, watch for signs of diseases such as pneumonia, foot rot or leptospirosis, isolate sick animals from the herd and report any sign of disease to your veterinarian, make sure all livestock vaccinations are current, spray insect repellent's to protect from increased mosquito and fly populations. For control of ticks, flies, mosquitoes, lice etc. various insecticides like methrin, melathion, aldrin, etc. may be used for this purpose.

CARE FOR CARCASS DISPOSAL

Animal carcasses should be disposed of as soon as possible within 24 hours of death. Improper disposal increases the danger of disease to humans, livestock and contamination of surface and ground water. The following are acceptable methods for the routine disposal of carcasses including rendering, incineration, burial and composting. The choice of disposal options depends on location, availability of raw materials or equipment and services, affordability and limitations to properly protecting the environment. The overall goal of carcass disposal is to conduct these operations in a timely, safe, bio secure, aesthetically acceptable, and environmentally responsible manner. Burial is the most often utilized method of disposal of dead animals. There are some best management practices which are recommended when using this method. The burial pit is about 8-9 feet deep and width and length depended on number of carcasses. The bottom of the burial pit must be at least five feet above the high point of the uppermost groundwater table to ensure that carcasses do not come into contact with groundwater. Groundwater should not be able to enter the burial pit. Avoid wetlands, floodplains or areas along a stream bank. The burial pit should be at least 300 feet from any well and surface water. Also, carcasses should be initially covered with at least 6 inches of soil and ultimately with at least 30 inches of soil.Layers of lime or quicklime should be applied below and above the carcass to help accelerate decomposition of the waste. Organic waste material should be added to accelerate the decomposition process. Incineration is another method of disposal of a dead animal which can be very energy intensive. When using this method, the proper permits and following of local regulations are required.

Agro forestry: a way to increase fodder production

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ABSTRACT

In Indian agriculture, livestock plays a pivotal role in the development and progress of mankind with crop production program as a complementary enterprise. However, livestock productivity is constrained by an acute shortage of feed and fodder. A general agreement is that there is a shortage of 63.5% green fodder and 23.5% dry fodder against the requirement of 1097 and 609 million tons (Mt) for green and dry fodder, respectively. In India, there is a deficit of green fodder, particularly during the summer season. In India, only 4.4% of the cultivated area is under fodder crops with annual total forage production of 846 Mt. Besides having several benefits, agro forestry is an important source of fodder. Diversification of land use systems with agro forestry is a necessary strategy for providing a variety of products for meeting requirements of the people, insurance against risks caused by weather aberrations, controlling erosion hazards, and ensuring sustainable production on a long-term basis.

Key word- agro forestry, green fodder, silvi-pastoral System

INTRODUCTION

India is basically an agricultural country and nearly three-fourth population depends on agriculture, livestock and allied sectors for livelihood. Nearly 70 % of country's population lives in rural areas. Furthermore, of the 40.7 crore poor in the country, about 80% are rural poor. Livestock is a key source of supplementary income and livelihood especially for small land holders and landless rural poor households. Traditionally, in India, agriculture and livestock are intertwined in such a manner that it ensures sustainable livelihood to a large proportion of rural population even during sub-normal rainfall / scarcity years. Livestock is also an important asset for them which provide employment to millions of rural people. Rapid growth of livestock sector is therefore most desirable not only to sustain steady agriculture growth but also to reduce rural poverty especially when a majority of land holders are less than 2 hectares and about 30% of rural households are landless. Although India has very large population of livestock, the productivity of milk and other livestock products per animal is very low compared to other many countries in the world. One of the

main reason for the low productivity of our livestock is malnutrition, under-nutrition or both, beside the low genetic potential of the animals. The adequate supply of nutritive fodder and feed is a crucial factor impacting the productivity and performance of the animals. The country is highly deficient in respect of availability of green fodder, dry fodder and concentrates. Fodder deficit can mainly be attributed to our limitations in increasing the area under fodder crops, limited availability of good high yielding fodder varieties, lack of quality seeds of improved hybrids/ varieties, poor quality of dry fodder like paddy/wheat straw, changing crop pattern in favor of cash crops etc. Besides, low priority accorded to investment in fodder production, lack of post-harvest management for surplus fodder, poor management of grazing/pasture lands and inadequate research, extension and manpower support also aggravated the shortfall situation of fodders. Future development and growth of livestock are highly associated with the scope of availability of fodder from cultivable land, forest, pastures and grazing lands. Therefore, it is important to put more emphasis on fodder development programmes for augmenting fodder /feed supply, while formulation of livestock development strategy.

Scenario of Feed and Fodder Availability and Future Requirement

There is tremendous pressure of livestock on available feed and fodder, as land available for fodder production has been decreasing. Scenario of feed and fodder availability till 2025 is as below.

Table: 1 Scenario of Feed and Fodder Availability and Future Requirement (in million tones)

Year	Supply (In million tones)		Demand (In million tones)		Deficit as % of demand (actual demand)	
	Green	Dry	Green	Dry	Green	Dry
1995	379.3	421	947	526	59.95 (568)	19.95 (105)
2000	384.5	428	988	549	61.10 (604)	21.93 (121)
2005	389.9	443	1025	569	61.96 (635)	22.08 (126)
2010	395.2	451	1061	589	62.76 (666)	23.46 (138)
2015	400.6	466	1097	609	63.50 (696)	23.56 (143)
2020	405.9	473	1134	630	64.21 (728)	24.81 (157)
2025	411.3	488	1170	650	64.87 (759)	24.92 (162)

Source: Report of the working group on Animal Husbandry and dairying for the Eleventh five year plan (2007-2012), Planning Commission, Government of India

It is obvious from table 1 that deficit in green and dry fodder is increasing every year. However, this gap is critical and is going to determine the type of animals and husbandry practices to be followed. Scarcity of feed and fodder resources (both quantity and quality), low production potential of animals, non-availability of critical inputs or services in time along with access to capital and markets, are primary reasons for low productivity of dairy animals (Mishra *et al*., 2009).

Agro forestry: Concept and Definition

Agro forestry is not a new system or concept. The practice is very old, but the term is definitely new. Agro forestry means practice of agriculture and forestry on the same piece of land. Bene *et al*. (1977) defined agro forestry as a sustainable management system for land that increases overall production, combines agricultural crops and animals simultaneously. Nair (1979) defines agro forestry as a land use system that integrates trees, crops and animals in a way that is scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farmers. Another widely used definition given by the International Center for Research in Agro forestry (ICRAF) Nairobi, Kenya, that, "agro forestry is a collective name for all land use systems and practices where woody perennials are deliberately grown on the same land management unit as agricultural crops or animals in some form of spatial arrangement or temporal sequence" (Nair, 1993).

Agro forestry models for fodder production

- Silvi-pastoral System
- Agri-silvipastoral system
- Agri-horti-silvicultural system
- Horti-pastoral system

Silvi-pastoral System

Silvi-pasture implies sustained and combined management of the same land for herbaceous fodder, top feeds and fuel wood, thereby leading to optimization of production. Himalayan rangelands exhibited enormous gain in forage production over existing situation due to multi-tier silvi-pasture techniques amalgamated with an adaptable complementary plant species. Silvi-pastoral systems are most important for increasing fodder production from marginal, sub-marginal and other wastelands. It comprises about 50 % of total land area.

It involves planting of multipurpose trees in existing pastures / grazing lands or planting such trees on wasteland / denuded lands followed by sowing / planting of grasses and or legumes in between the inter-spaces of trees. Atul (1996) obtained 5-7 t/ha green fodder under silvipastoral system, where as it was only 3-4 t/ha without a tree component. Sharma and Koranne (1988) found that maximum production of 300 g/m^2 /annum under existing grasslands, while under modified network of silvipastoral system of *Digitaria*

decumbens + *Bauhinia pupurea* / *Quercus incana* / *Grewia optiva* / *Celtis australis* production varied from 1800- 2450 g/m^2 /annum.

Adoption of Agri-silvipastoral system: Under agri-silvicultural system multipurpose trees including fodder cum fuel trees can be grown in association with crops. Trees are pruned annually, yielding fodder as well as fuel wood. In addition to 9 annual pruning, few trees are also cut down in order to allow light penetration and minimization of competition with the crops. Under alley cropping system multipurpose trees like *Leucaena leucocephala* and even perennial pigeon pea etc. are pruned frequently to provide leaf fodder to get better crop production.

Agri-horti-silvicultural system: Under this system besides growing fruit trees and fodder crops, fast growing NFTs like *Leucaena leucocephala* can be lopped two to three times in a year to provide fodder (2.5-3.0 t/ha) and fuel wood (1.8-2.5 t/ha). These fodder trees also provide some protection to fruit trees during summer and cold winters.

Horti-pastoral system: In this system forage are grown in wide inter-row spaces of fruit trees for economic utilization of orchard lands. Horti-pasture up to an elevation of 2000 m is catching up with the orchadist. Forage from horti-pasture is consumed fresh and is also conserved as hay for winters. Sharma and Jindal (1989) found that introduction of Fescue in apple orchard gave 83.50 % higher fodder yield over local grasses in Shimla hills of Himachal Pradesh. There is considerable area under orchards in temperate regions. Inter spaces between fruit trees could be utilized for the production of fodder by growing perennial grasses and legumes. In U.P hills (Singh, 1995) reported that Rye grass and orchard grass are the best perennial grasses for introduction in apple orchards. Soil nitrogen build up was maximum with white clover introduction.

CONCLUSIONS

Importance of forage production in maintaining food security as well as nutritional security has been felt since long. The overall scene of forage production is very alarming and corrective measures have to be taken to improve this problem. A comprehensive grazing policy needs to be formulated and both grazing and forage cultivation has to be 11 considered complementary to each other and simultaneous efforts are required to improve both. Fodder tree improvement programmes for higher leaf fodder have to be initiated. For the improvement of grasslands, its management needs to be considered holistically promoting interaction between grassland, livestock and grazing communities. Therefore, the vast natural resource can serve human society substantially, more particularly grazing communities. A favorable policy environment in terms of access to micro-credit and assured market will have to be provided and simultaneously there is need to address the socio-economic and technical constraints.

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Use of botanicals herbicide in crop diversification

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The Plant world comprises a rich storehouse of bio-chemicals which could be more tapped as pesticides. The total number may exceed 4 million. Of these, only 10,000 are secondary metabolites. Allelopathy, the term coined by Prof. Hans Molisch, a German Plant Physiologist in 1937, is a new field of science. Plants have acquired a complex eco- physiological strategy that allows them to directly or indirectly modify the growth and development of other plants by releasing chemicals into the environment, this phenomenon is known as allelopathy. Allelochemicals inhibit the growth and development of the plants primarily in two ways- Autotoxy (allelochemicals of the same plant inhibit the growth and development of the seedlings of same plant e.g., *Parthenium hysterophorus*) and Teletoxy (allelochemicals of some plants inhibit the seedling germination and development of other plants e.g *Lantana camera*). Plants typically biosynthesize these compounds as secondary metabolites, which, in addition to act as ecological factors that regulate the composition and dynamics of plant communities, can also be used directly to control the growth of weeds or in other words can serve as a source of natural herbicides. Weeds constitute a major obstacle to the productivity of numerous crops. Because of easy availability & less costlier than traditional hand weeding, the chemical weed management, since last few years, have been more accepting by the farmers. In spite of knowing that synthetic pesticides cause ecological and health hazards as hardly 0.1% enter the target pests and rest 99.9 % are released to the environment. Contamination of synthetic chemical pesticides with soil and water bodies causes detrimental effect on macro and micro flora & fauna. However, the large-scale use of synthetic herbicides has led to the development of a number of environmental problems, including risks to human health and the induction of weed resistance (Jabran *et al.* 2010). Nowadays in respect to the ill effects of synthetic pesticides to the human health & environment, some safer pesticides (blue & green labeled) are available in the market. But the urgent need is, to aware the farmers about the use of these pesticides. Natural phytotoxins derived from plants may represent an alternative to the use of synthetic herbicides. These compounds are advantageous because they are biodegradable, have great structural diversity and complexity, demonstrate diversity in their sites of action and are safer for non-target organisms (Koul and Walia, 2009). Furthermore, these phytotoxins have

different levels of action, and the combination of different modes and multiple levels of action make these substances effective for the control of weeds. Biological management is more eco safe and lesser costly than chemical herbicides and would be more acceptable in system intensification (Ghosh *et al.* 2014). But the availability of botanical herbicides at the rural market with proper formulation along with improved thinking of stake holders and farmers through awareness and training programmes is urgently needed to exploit the potentiality of ecosafe botanical herbicides.

Need of botanicals products for weed management

The management of weeds has been a major problem since the inception of agriculture. In fact, unmanaged weeds cause greater reduction in crop yields than the presence of any other agricultural pest. Manual labour came down as a skill from ancestral farming and is still practiced. Not surprisingly, modern agriculture relies heavily on the use of synthetic herbicides for managing weeds. This has been possible because synthetic herbicides are highly effective (active ingredient application rates can be as low as a gram per hectare). Many of these compounds have very good selectivity toward crops and are relatively inexpensive to manufacture. While their use has become increasingly controversial, most currently used herbicides have low impact on the environment and wildlife. Today, herbicides account for more than half of the volume of all agricultural pesticides applied in the developed world and the public has expressed concern about the potential health and environmental impact of these compounds. Partly due to this, organic agriculture has received a recent surge in popularity.

Bioagents with their allelopathic effects

The botanicals leaf kill the weed pests either through phytochemical based herbicides (Aromatic compounds like phenolic acids, coumarins, flavonoids, tannis, alkaloids, quinones etc.; Terpenoids like camphor, cineole etc.; Steroids like tetracyclic triterpenoids, steriod alcohols, essential oils, hormones gibberellic acid, abscisic acids, carotenoids etc. and other compounds like non protein amino acids ALA-δ-aminolevulinic acid, dipyridyl; photodynamic compounds hypercin, allelochemicals trihydroxycyclopentylcarbooxylic acid, hydroxycyclopentenone, chrycorin, benzyl isothiocyanate, caprolactum etc.) or by exhausting the plant food reserves through destruction of photosynthetic parts (insect bioagents). The bioagent control is depending on the condition of the plant, its competing ability & environment, and the damage depends on the intensity of attack. The classical example is the plant bioagent *Cassia tora* controls the *Parthenium hysterophorus* through its allelochemical effects.

Microbial herbicides (Bioherbicides) involves application of indigenous plant pathogens such as **Mycoherbicide** (fungi based - nucleated, heterotrophs, usually filamentous, mostly evolves from algae, spore bearing & reproducing both sexually & asexually), **Phytopathogenic bacteria** (similar to phytopathogenic fungi based mycoherbicide- the bacterium *Pseudomonas syringae*); **Rhizobacteria** (DRB-Deleterious Rhizo Bacteria or exopathogens - the bacteria exists in rhizosphere having negative effect on plant growth but do not parasitize the plants e.g. Plant suppressive

Pseudomonas fluorescens), **Microbial chemical based herbicides** (Chemicals producing from microorganisms like Anisomycin from Streptomyces spp. to control *Echinochloa crusgalli*).Several plants are directly used to control many pests particularly weed pests and inhibit the germination and restrict the invasion of many weed pests in surrounding areas through natural allelochemicals but having no detrimental effect on the cultivated crops. (See following table).

Table 1 Allelochemical activities of some natural plants (Botanicals)

Name of plant	Allelochemical	Action
Eleocharis spp.	Trihydroxycyclopentylcarbooxylic acid, Hydroxycyclopentenone, Chrycorin	Plant inhibiting effects
Xanthium strumarium	Carboxyatractyloside	Plant inhibiting effects
Parthenium hysterophorus	Sesquiterpene lactones -Parthenin / Hymenin / Ambrosin & Phenols	Skin disease / pesticide effects
Sorghum halepense	High prussic acid	Poison to animal / herbicide effects
Lantana camera	Lantradene –A	Jaundice to animal
Calotropis gigantea / procera	Calotropin / Mudarine	Pesticide effects
Astragalus spp.	Swainsonine	Abortive effect on cattle
Melilotus alba / indicus	Dicumarin	Antiblood coagulant
Ageratum conyzoides/ haustonianum	Chromoneme derivative precocens	Anti allelotropic i.e. prevent JH synthesis
Artemisia absinthium	Absinthium, a dimeric sesquiterpene	Antifeedent activity against insects
Datura stramonium (Thronapple)	Xanthoxyletin	Antifeedent activity against insects
Physalis minima (Ban makao)	Imperatorin	Antifeedent activity against insects
Tephrosia purpurea	Hildecarpan, a Pterocarpan and Rotenoides & Rotenone	Antifeedent against legume pod borer / Lepidopteran
Argemone mexicana	Sanguinarine / 11-Oxotriacontanoic acid	Blindness
Blumea lacera	Fenchane, δ- Fenchone, Monoterpene Citral a	Pesticide effects
Echinochloa colona	Cumaric acid, Apegenin	Pesticide effects
Cyperus rotundus	Valencene, Noolkatone	Pesticide effects

Bambusa vulgaris	Rutin, Tricin, Luteoalin	Pesticide effects
Jasminum officinale (Jui phul)	Oleuropein	
Papaya	Benzyl isothiocyanate	Herbicide effects *on Abutilon theophrasti* (Velvet leaf) *Cassia obtusifolia* (Sicklepod) *Sorghum bicolor* etc.
Tectona grandis	Phenol compounds, Salicyclic Acid	Pesticide effects
Hibiscus sabdariffa (Roselle-Tak Bhindi)	β-Sitosterol	Pesticide effects

Mode of action of botanicals

I. Protein Synthesis / Microtubule assembly inhibitors**:**

It inhibits the assemblification of microtubules, polymerization of tubulin (the major protein content) which is very much essential for formation of cell wall. As a result arrestation of cell division, formation of polynucleate cells and eventually inhibition of root and plant growth.

II. Fatty acid (Lipid) Biosynthesis:

ACEase (Acetyl Elongase) inhibition (Very long fatty acid chain inhibition). The chemicals inhibit the cell division and elongation in seedling shoots before they emerge above ground.

III. Uncouplers (Membrane Disruption):

Inhibition of Oxidative Phosphorylation. Botanicals are having very weak phenolic acids but these will be recognisably acidic properties particularly in moist soil. A Hydrogen ion can break away from the - OH group and transfer to a base. The position of equilibrium lies well to the left.

IV. Phenolic acid biosynthesis:

Phenolic acids may lose a hydrogen ion because the phenoxide ion (and Hydroxonium ion) formed is stabilized to some extent The negative charge on the oxygen atom is delocalised around the ring through resonance action. The more stable the ion is, more likely it is to form. One of the lone pairs on the oxygen atom overlaps with the delocalised electrons on the benzene ring. Formation of stable phenoxide ion triggers its acidic nature which attacks the long chain and causes ACEase inhibition (Ghosh *et al.* 2016).

Aqueous method of botanicals extract

These are used to control weed pest through the allelochemical activities (Ghosh *et al.* 2015) and are normally called as *'Botanicals 'e.g.* aqueous extracts of *Parthenium hysterophorus,* Calotropis gigantean and *Tectona grandis* etc (Chen, 2009). To enhance the bioefficacy, these botanicals can also be used in mixture e.g.

mixture of aqueous extracts of *Bambusa vulgaris + Parthenium hysterophorus.*

Table 2: Plant parts used for Aqueous extraction from Botanicals

Plant parts used		
Whole plant	**Stem/ Leaf**	**Fruit & Leaf/ Leaf/ Root**
Parthenium hysterophorus, *Cyperus rotundus* *Cyperus difformis*	*Calotropis procera / gigantean,* *Melilotus alba /indica ,* *Echinochloa colona,* *Sorghum halepense,* *Ageratum conyzoides/ haustonianum,* *Blumea lacera,* *Physalis minima,* *Datura stramonium*	*Xanthium strumarium* *Tephrosia purpurea* *Jasminum officinale* *Papaya,* *Hibiscus subdarifa* *Bambusa vulgaris* *Tectona grandis*

Procedure for Aqueous extraction of Botanicals

a) Collect the required natural plants and separate the necessitated plant parts
b) Dry these plant materials and dried up plant parts grind in grinder machine
c) 100 g powder placed into the glass container and adds 900 ml water in the glass container
d) Overnight soak this container and then boil this for two hours at 60° C
e) After proper boiling, the plant parts are separated by filter paper and keep the aqueous extract in a safe container
f) Measure this amount and find out the conversion factor

{Initial raw material (100 g + 900 ml)×(conversion factor of actual extract)= Actual extracts}

Preparation of spray solution and spraying it in suitable field as pre emergence

- Select a fresh field with sufficient moist condition and measure area to be sprayed
- Fixed spraying sites of minimum 100 nr^2 in this field. Then sites are demarcated with pegs
- Identify weed flora of the demarcated area and make density list of weed flora species wise
- Measure the raw or aequeous extracts for spraying @ 100 ml litre of water ^{1} for the area to be sprayed and water must be @ one litre of water for 20 nr^2
- Before spraying add 0. 25% non ionic surfactant (e.g. Tween- 80, Tween- 20, S - 145 etc.) with the ready spray sample
- Spray in moist soil as PE (within 1 DAS/DAP/DAT) and Spay at earliest after preparation (within an hour after preparation)
- After two weeks take observation about bioefficacy on weed plants

CONCLUSION

For maintaining global food security, system intensification is the best low cost eco safe methodology that deals with the best management practices of the available resources by farmers' improved thinking. Biological management for the enhancement of soil and plant health is the basic concept for maintaining sustainability in environment and agriculture. Keeping in view the detrimental effects of chemical herbicides towards mankind and environment, the natural phytotoxins derived from plants may represent an alternative to the use of synthetic herbicides. The botanicals are advantageous because they are biodegradable, have great structural diversity and complexity, demonstrate diversity in their sites of action and are safer for non-target organisms. Plant extracts potentially possess multiple phytotoxic components; hence multiple modes of herbicidal actions make it more difficult for weeds to develop herbicidal resistance and thus most of the products show wide windows of crop safety. Hence botanicals can be ushering in a new regime to promote sustainability in agriculture and fostering safe environment. But availability of botanical herbicides at the rural market with proper formulation along with the improved thinking through awareness and training programme of stake holders and farmers is urgently needed to exploit the potentiality of ecosafe botanical herbicides.

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Advanced options for rice residue management in North-West Indo Gangetic Plains of India

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The rice-wheat cropping system (RWCS) is a major production system in the Indo-Gangetic Plains of India covering nearly 10.5 million hectares including 4.1 million hectares of the northwestern (NW) states comprising Punjab, Haryana, Uttarakhand and western Uttar Pradesh. RWCS in NW states produces about 34 million tonnes of rice residues of which Punjab alone contributes about 65%. The mechanized harvesting and threshing of rice using combine harvesters is a common practice in NW India. In the process, residues are left behind the combine harvesters in a narrow strip (windrow) in the field. Disposal or utilization of the leftover residue in the short window of ten to twenty days for timely planting of wheat crop is a difficult task (Lohan *et al*., 2018). Therefore, the farmers commonly opt for burning of rice residue in the combine-harvested fields due to lack of access to user-friendly, cost- and time-effective options. Estimates indicate that up to 80% of rice residues are burnt by farmers in Punjab. In other NW states also, rice burning is practiced in a sizeable area. It is estimated that in NW states of India about 23 million tonnes of rice residues are burnt annually. Collection and storage of such a huge quantity of residue is neither practically feasible nor economical. Therefore, the need for providing a cost-effective and farmer friendly option for the management of rice residue is both a major challenge as well as an opportunity for the sustainability of the intensive RWCS in NW India.

ADVERSE IMPACT OF RICE RESIDUE BURNING

The problem of crop residue burning has been intensifying over time and spreading across the Indian Sub-continent. Crop residue is contributing to atmospheric pollution that has serious environment, soil, and human health as well as economic implications due to release of large amounts of air pollutants. Therefore, a concerted collective action to solve the problem of crop residue burning is urgently required.

Environment

The major pollutants emitted by crop residue burning - CO_2 , CO, CH_4 , N_2O, NO_x, SO_2 , black carbon, non-methyl hydrocarbons (NMHC), volatile organic compounds (VOC) and particulate matter (PM2.5 and PM 10), contribute enormously to global warming. It

is estimated that one tonne rice residue on burning releases 13 kg particulate matter, 60 kg CO, 1460 kg CO_2 , 3.5 kg NO_x, 0.2 kg SO_2 (Bakker *et al*., 2013) . The black carbon emitted during residue burning warms the lower atmosphere and it is the second most important contributor to global warming after CO_2.

Soil health

Burning of rice residue also results in loss of soil organic matter and plant nutrients and adversely affects soil health. About 90% of N and S and 15-20% of P and K contained in rice residue are lost during burning. Burning of 23 million tonnes of rice residues in NW India leads to a loss of about 9.2 million tonnes of C equivalent (CO2 -equivalent of about 34 million tonnes) per year and a loss of about 1.4×10^5 t of N (equivalent to Rs 200 crores) annually. In addition, in-field burning of crop residues also destroys the beneficial micro-flora and fauna of soil causing adverse impact on soil health.

Human health

Increase in the concentration of PM 2.5 and PM10 during the large scale burning of rice residues is a major health hazard. For example, the children are more sensitive to air pollution (smog), as rice residue burning poses some unrecoverable influence on their pulmonary functions (Kumar *et al*., 2015) . The emission of high levels of PM2.5 and PM10 in the air causes chronic diseases like cardiopulmonary disorders irrecoverable lung capacity or asthma in human population of NW India. These health-related expenditures tend to be higher for children, older people and farm workers who are directly exposed to rice residue burning. The human health costs from rice residue burning in rural areas of Punjab are estimated at Rs. 7.61 crores annually.

PRACTICES IN CURRENT USE FOR RICE RESIDUE MANAGEMENT

The practices in current use, for utilizing rice residue, include livestock fodder, livestock bedding, in-situ incorporation, composting, generating electricity, mushroom cultivation, roof thatching, biogas (anaerobic digestion), furnace fuel, biofuel, and paper and pulp board manufacturing. Presently these options together utilize <15% of the total rice residue produced in NW India. Of the various available options, electricity generation, production of bio-oil and on-farm utilization of rice residue are the major practices in current use.

Electricity generation

Generation of electricity is an attractive option but, at present, only seven-biomass energy plants have been installed in Punjab and six more are in the pipeline. However, these biomass energy plants together can consume only about 10% of the rice residues in the state. A 12 MW rice residue power plant requires 1.20 lakh tons of residues in a year which needs a large dumping ground. In addition, these biomass energy plants produce large amount of ash and there is a serious challenge for its disposal. For the time being, it is dumped in landfills or depressions created by brick kilns.

Bio-oil and gasification

Technologies to produce bio-oil (pyrolysis) and gasification are still under research and development to make them economically viable. Most of the furnaces in the Punjab use 25-30% of rice residue mixed with 70-75% of other biomass and the present utilization

of rice straw is only 0.5 million tonnes annually. Limited utilization of this technology is primarily due to high silica content in rice straw, which causes clinker formation in the boilers.

On-farm management of rice residue

Surface retention, incorporation (in-situ) and composting (ex-situ) are the promising on-farm management options to address the issue of burning as well as maintaining soil health and long-term sustainability of RWCS. However, in situ incorporation and composting (ex-situ) are energy and cost intensive, and time limitation options. For example, residue incorporation requires 2-3 extra tillage operations in addition to the use of chopper to reduce the size of residue, and one additional irrigation as well as extra dose of urea to hasten its decomposition. That's why the rice residue incorporation and composting have not been adopted at large scale by the farmers. Furthermore, time needed for decomposition of rice residue is a major limitation, because of little turn-around time (10-20 days) available between rice harvest and optimal wheat sowing time. The delay in sowing due to time needed for residue decomposition adversely affects wheat productivity.

INNOVATIVE VIABLE SOLUTION TO RICE RESIDUE BURNING

Rationale of concurrent use of super straw management system (SMS)-fitted combines and Turbo Happy Seeder in rice-wheat cropping systems

In NW India, combines are used for harvesting rice in 70-90% of the area under RWCS, leaving huge quantities of residues and stubbles on the field. Efficient and economic management of 8-10 t/ha rice residues and seeding of wheat crop on time is a daunting task for the farmers, due to the availability of a short window of about 15 days to complete these operations. Loose residue in combine harvested rice fields interfere with the tillage and seeding machinery. Until recently, non-availability of suitable machinery was a major constraint to direct drilling of wheat in combine harvested fields. This constraint has been resolved by the innovative latest version of the Turbo Happy Seeder, which is recognized as a significant technological innovation for in-situ residue management. It was a step forward for developing viable solution to rice crop residue burning. For efficient sowing of wheat using Turbo Happy Seeder, the loose rice residue need to be uniformly spread across the field, but the traditional combine harvesters put the loose residues in narrow swath. Manual spreading of residues is a cumbersome, uneconomical, inefficient and laborious process, compounded by the acute shortage of labour.

Therefore, a straw management system (SMS) named as Super-SMS has been developed to equip the combine harvesters with mechanized straw spreaders, which help in uniformly spreading the rice residue as a part of the process of harvesting rice. Harvesting of rice by super SMS fitted combine harvesters allows concurrent sowing of wheat, which saves time, energy and one irrigation by utilizing the residual moisture of rice fields. Most importantly, it dispenses the need for crop residue burning. This valuable eco-friendly innovation is an attractive option for adoption by the farmers.

Advantages of concurrent use of SMS-fitted combines and turbo happy seeder

Concurrent use of SMS-fitted combines and turbo happy seeder for wheat sowing has distinct production, economic, environmental and societal advantages. Some of the major advantages are:

- Increase in average yield of wheat by 2-4% compared to conventional till wheat.
- Economical cost of production, through savings in the cost of labour, fuel, chemicals, etc.™
  - ❖ Saves about 20 liters of fuel per hectare due to sowing of wheat in a single operation. A total saving – 20×4.3 Mha = 86 million liters of diesel fuel per season.
- Increase in nutrient use efficiency, by continuous recycling of residues using Turbo Happy Seeder for over 3-4 years results in producing same yield with 30-40 kg ha^{-1} less nitrogen use and hence significantly higher (10-15%) nutrient use efficiency.
- Produces more crop per drop of water, by saving up to 1.0 million liters of water per hectare due to elimination of pre-sowing irrigation . Moreover, residue mulch reduces evaporation loss equivalent to about 45 mm (0.45 million liter) during the wheat season.
- Reduces risk of biotic and abiotic stresses, by reducing weed growth, crop lodging, karnal bunt infestation and termite attack. Wheat yields were nearly 16% more than farmers who followed conventional practices, when heavy rains fell late in the wheat season at grain filling stage in 2014-15 (Aryal *et al*., 2016).
- Improves soil health, by improving soil organic matter over time, which enhances soil health, productivity potential and soil biodiversity.
- Improves environment by : ™ Reduction in greenhouse gas emissions. It significantly reduces fossil fuel requirement, thus further reducing CO_2 emissions.
  - ❖ Reduces terminal heat effects, as straw mulch lowers canopy temperature in wheat and helps in adapting to terminal heat.
  - ❖ Reduction in air pollution by PM2.5 and PM10 particles, black carbon and obnoxious gasses, by preventing burning of crop residues.
- Improves health of on-farm and off-farm workers.
- Saves depletion of N, P, K and S in soil. It is estimated that one tonne of rice residue contains about 400 kg of C, 5-7 kg N, 1-1.7 kg P, 15-25 kg K and 1.1-1.4 kg S in addition to the significant amounts of micronutrients. Total amount of N, P, K and S (NPKS) in 23 million tonnes of rice residue (currently burnt in NW India annually) is about 7 lakh tons N, P, K, S valued at >Rs. 1000 crores. Whole of organic carbon and about 2.8 lakh tons of NPKS (equivalent to about Rs. 250 crores) is lost during burning. Thus, rice residue recycling offers an important source for meeting the nutrient requirements of crops and improving soil health.
- Inclusion of this effort in carbon credit program would help in farmers actually receiving incentives and additional income, which will further encourage adoption of Happy Seeder technology.

- The estimated gross additional income from the adoption of Turbo Happy Seeder technology package : Even if the 50% of the wheat seeding in RWCS of NW India is targeted; the benefits from 2.0 million ha alone would be about Rs. 1430 crores per year against the total one time investment of Rs. 470 crores. The input costs include, Rs. 325 crores for the purchase of 25000 Turbo Happy Seeders and Rs. 145 crores for 12000 super SMS. The benefits include increased wheat yield @ 200 kg/ha (Rs. 600 crores), reduced production costs of Rs. 2500/ha (Rs. 500 crores), eliminating loss of N and S during burning (Rs. 20 crores), saving in pumping cost due to saving in pre-sowing irrigation (Rs. 200 crores), reduction in environmental costs @ Rs. 250/t of CO2 eq (Rs. 100 crores) and another benefits equivalent to Rs. 10 crores (soil health improvement, accidents, loss of biodiversity, etc.).

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Fertigation - Modern Technique of Fertilizer Application

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ABSTRACT

Fertigation is a recent innovative cultural method, by which fertilizers are applied along with irrigation water through irrigation system like drip to get higher fertilizer use efficiency as well as increasing the crop yields. Nutrient solutions are injected in the irrigation water using an appropriate injection device. Fertigation provides essential elements directly to the active root zone, thus minimizing losses of expensive nutrients, which ultimately helps in improving productivity and quality of farm produce and reduce the risk of environmental pollution. Fertigation involves specific equipment's according to the crop type and irrigation system and precise selection of suitable fertilizer and its combination. The present article is an attempt to make understanding on various aspects of fertigation technology.

INTRODUCTION

Plant nutrition is an important aspect for enhancing production. Realization of higher crop yield required intensive use of fertilizers. After green revolution, the fertilizer use was increased with the introduction of high yielding varieties. But at present, application of fertilizer is not able to give higher yield and the fertilizer use efficiency is decreasing day by day. There is a need to explore new methods and sources for plant nutrition for getting higher yield and improving input use efficiency. Fertigation is the application of plant nutrients through the irrigation system. In this systems chemical fertilizers dissolved in water in irrigation system and the plant roots receive water and nutrients at the same time and location, effecting saving both costly inputs of water and fertilizers.

In a fertigation system, the timing, amount, concentration and ratio of the nutrients are easily controlled. Due to this improved control, crop yields and quality are higher than those produced by a simple fertilizer application. According to Hagin *et al.* (2002), fertigation is a modern agro-technique, which provides an excellent opportunity to maximize yield and minimize environmental pollution. Fertigation can be practiced under any irrigation system. However, fertilizers applied with open irrigation system can lead to uneven nutrient distribution in the field. The pressurize irrigation systems like drip, sprinkler and micro sprinklers are well suited for the fertigation.

In India, since last two decades drip irrigation has received greater attention of both the farmers and the government. Drip irrigation shown encouraging result in both water scarce and sufficient areas which is reflected in the area increase in the micro irrigation systems. In year 2005-06, only 0.31 mha was covered under micro irrigation systems, but it is increased upto 8.63 mha in 2015-16. Drip irrigation and fertigation go hand to hand in order to improve efficiency of water and nutrients in crop production. Drip irrigation permits application of fertilizers through irrigation water directly at the site of high concentration of root activity and cause for improving the fertilizer use efficiency in crop production.

HISTORY OF FERTIGATION

The first reported example of fertigation dates back to ancient Athens (400 B.C.) where city sewage was used for the irrigation of tree groves. The practice of fertigation started commercially in the mid - 20th century. Liquid ammonia was probably the first commercially produced liquid fertilizer but in modern fertigation the use of ammonia as the nitrogen source is negligible.

Since the early 1950s, in The Netherlands, the fertilizers were applied with the irrigation water in the glasshouses. In mid 1950s, in the United States, mixing of fertilizers with irrigation water was used on a limited scale, in surface, flood and furrow irrigations. The fertilizers used were gaseous ammonia, aqua ammonia and ammonium nitrate. In the early 1960s, in Israel, the development of fertigation technology was parallel to the development and introduction of micro-irrigation. Electrical pumps and mixing tanks were developed for the precise application of nutrients. Initially, nutrient distribution by fertigation was relatively uneven when fertilizer tanks were used. Later, a more uniform distribution was achieved when venturi suction pumps and fertilizer injectors were used. Further considerable improvements were achieved by fully computerized fertigation units.

NEED OF FERTIGATION

When pressurized irrigation systems are used, fertigation is not optional but absolutely necessary. In drip irrigation, without fertilization only ~30% of the soil is wetted by the drippers so fertilizer efficiency decreases because the nutrients will not be dissolved in the dry zones where the soil is not wetted. Thus, the benefits of irrigation and fertilizer will not be expressed. Therefore, fertigation is the most suitable method to apply fertilizers to micro irrigated crops.

Type of irrigation and fertilizer application also affects the nutrient distribution pattern. In surface irrigation systems where nutrients applied by broadcasting method, due to uneven distribution of both water and nutrients, the leaching loss of nutrients especially nitrogen can be happen. In the drip irrigation system where nutrients applied with soil application the nutrient distribution will be localized due to localized availability of water near the root zone only. In comparison to both above, when fertigation practiced with drip irrigation the plant root receives uniform distribution of

water and nutrient at the same time and location, which resulted into more availability and the uptake of nutrients.

Table1: Fertilizer use efficiency of NPK with different methods.

Nutrient	Fertilizer use efficiency (%)		
	Surface irrigation + Soil application of fertilizer	Drip	Drip fertigation
Nitrogen	30-50	65	95
Phosphorus	20	30	45
Potassium	50	60	80

Fertilizer Marketing News, 2010

Advantages of Fertigation

- High nutrient availability due to maintenance of soil moisture near root zone under drip irrigation.
- Minimum loss of nutrients through leaching to around 10 per cent as compared to 40-55 per cent in the traditional system, which further help in reducing environmental pollution.
- Unlike in traditional system, there is no damage to crop while top dressing of fertilizers.
- Fertilizers can be applied as frequently as possible in the needed amounts according to plant requirements.
- About 25-50% reduction in the quantity of fertilizer that resulted in higher fertilizer use efficiency.
- As small amounts are provided at regular intervals rather than giving in one or two big doses only, uptake and utilization of nutrients is very high with fertigation.
- Uniform application of nutrients can be done over the field.
- Considerable saving of labour and energy in the application of fertilizers.

Limitations of Fertigation

- Uneven nutrient distribution when the irrigation system is faulty.
- Chemical reactions of fertilizer with Ca and Mg may leads to chemical clogging.
- Phosphatic fertilizers and some micro nutrients may precipitate in micro-irrigation systems.
- Corrosion resistant fertigation equipment's are needed.
- Potential chemical backflow in to water supply source.
- The major factors limiting its large scale adoption are high initial cost and lack of information on various aspects such as crop water requirement, scheduling of irrigation and fertigation.

Precautions to be taken during fertigation

- Every emitting point must deliver the same amount of water, so fertigation can be done uniformly.

- The fertilizer used must be free from deposits or residues and must not cause corrosion of the irrigation system.
- Constant operating pressure is required to facilitate uniform mixing of water and fertilizers.
- Selection of most appropriate fertilizer and injection system play crucial role.
- Fertilizer injection should not begin until all lines are filled with water and emitters are working.
- Drip irrigation system should be allowed to its working pressure prior to fertilizer injection.
- Different chemicals like, fertilizers, pesticides, chlorine should not be injected at the same time.

METHODS OF FERTIGATION

When using fertigation, the fertilizer solutions are prepared in advance in stock tanks and the solution is then injected into the irrigation water. The type of fertigation chosen depends on the crop grown, the soil type and the farm management system. There are mainly two types of fertigation.

1. **Quantitative fertigation**

It is the application of the plant nutrients in predetermined concentrations to the irrigation system. e.g. 20 lt to block A, 40 lt to block B. This method is commonly used in soil. The fertilizer is applied in a pulse after a certain water sheet without fertilizer using a fertilizer tank. Advantages of this method are the low cost and the low maintenance required. Some limitations are also there like, the system is affected by water pressure changes and the concentration of the fertilizer varies during its application.

2. **Proportional fertigation**

Nutrients applied in a constant and proportional ratio to the water discharge rate, so that the irrigation water takes a fixed concentration of the applied fertilizer. e.g. one litre of fertilizer solution is mixed in, 1000 litres of irrigation water. In this case the fertilizers are applied by direct injection through fertilizer pumps. This method is mostly used in the soil less media and sandy soils. Advantage of this method is precise control of the quantity and the injection moment and disadvantages are high cost, maintenance and complicated operation.

BASIC REQUIREMENTS FOR FERTIGATION

The incorporation of fertilizers into the irrigation system demands the following basic requirements:

A. Fertilizer Injection Equipment

The selection of correct injection equipment is as important as the selection of correct nutrient. The pressure of injected fertilizer solution has to be greater than that of the internal pressure. A filter should be there to prevent dripper clogging by any solid particles of fertilizer solution to reach to the dripper. A back-flow preventing valve is also needed to prevent the chemical backflow to the water source. Fertilizer injectors

are most important part of the fertigation unit. There are three types of injectors as under:

1. Pressure differential (by-pass tank)

This system works on the principle of a pressure differential created by valve and pressure regulation. The pressure difference forces the water to enter through a by-pass pipe into a pressure tank which contains the fertilizer and to go out again, carrying a varying amount of dissolved fertilizer. The application of nutrients is quantitative and inaccurate, therefore is adapted for perennial crops like citrus and fruit trees.

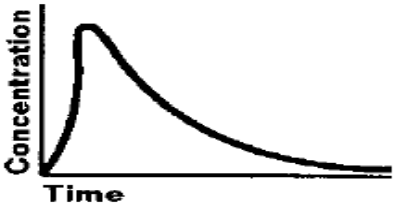
(a)  (b)  (c) 

Fig. 1. (a) Fertilizer tank picture (b) Working of fertilizer tank and (c) Fertilizer solution delivery graph

Advantages:

- Very simple to operate, the stock solution does not have to be pre-mixed.
- Easy to install and requires very little maintenance.
- Easy to change fertilizers.
- Ideal for dry formulations.
- No electricity or fuel is needed.

Disadvantages:

- Tank must be able to withstand irrigation line pressure.
- Concentration of solution decreases as fertilizer dissolves.
- Accuracy of application is limited.
- Pressure loss in main irrigation line.
- Proportional fertigation is not possible.
- Limited capacity.
- Not adapted for automation.

2. Vacuum injection (Venturi)

This is based on the principle of venturi tube. A pressure difference is needed between the inlet and the outlet of the injector which cause a reduced pressure (vacuum) that sucks the fertilizer solution into the line.

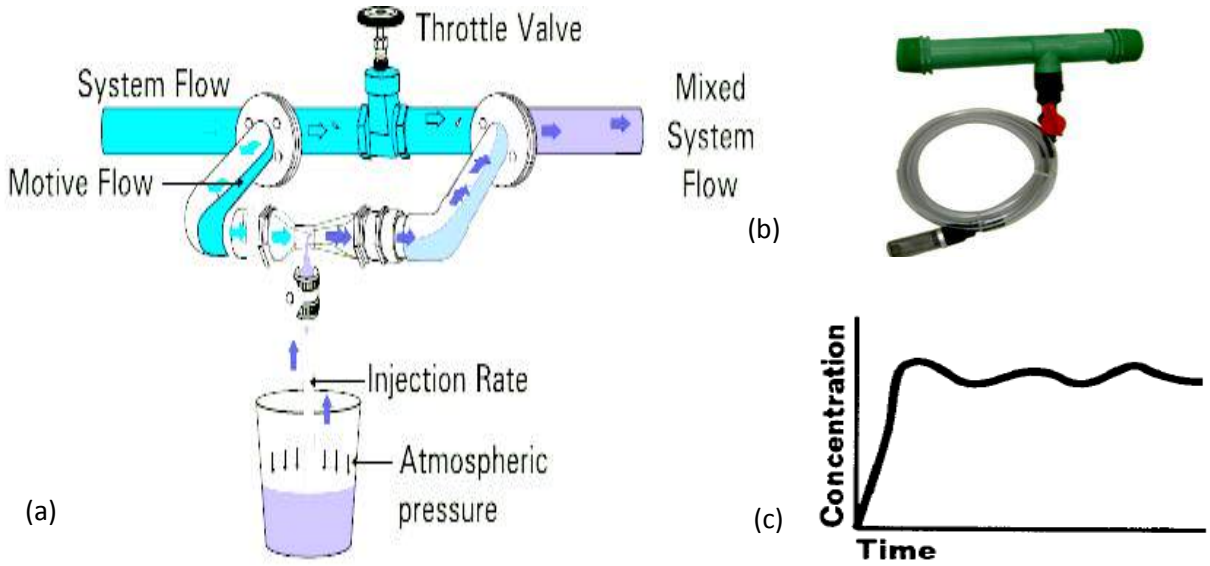


Fig. 2. (a) Working of venturi (b) Venturi picture and (c) Fertilizer solution delivery graph

Advantages:

- Very simple to operate and no moving parts.
- Easy to install and to maintain.
- Injection can be controlled with a metering valve.
- Suitable for both proportional and quantitative fertigation.

Disadvantages:

- Pressure loss in main irrigation line.
- Quantitative fertigation is difficult.
- Automation is difficult.
- Very sensitive to pressure variation.

3. Pump injection

Pumps are used to inject the fertilizer solution from a supply tank into the line. Injection energy is provided by electric motors or hydraulic motors.

Advantages:

- Very accurate for proportional fertigation
- No pressure loss in the line
- Easily adapted for automation

Disadvantages:

- Expensive
- Complicated design, including a number of moving parts, so wear and breakdown are more likely.

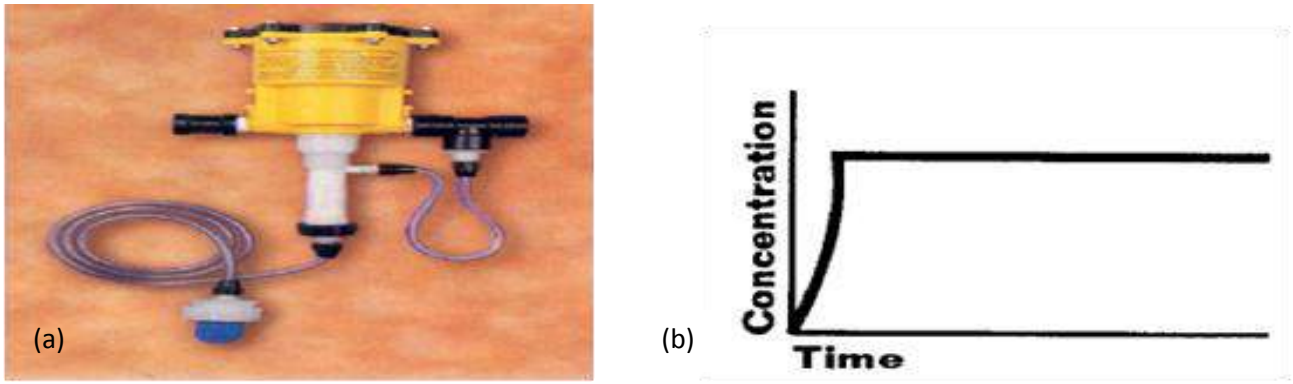


Fig. 3. (a) Pump injection picture and (b) Fertilizer solution delivery graph

Table 2: Comparative performance of fertigation equipment

Property	Fertilizer Tank	Venturi Injector	Fertilizer Injector
Ease of operation	High	Medium	Low
Use of solid fertilizer	Yes	Solution needed	Solution needed
Discharge rate	High	Low to medium	High
Concentration control	None	Medium	Good
Volume control	Good	Medium	Good
Head loss	Low	High	No loss
Automation	Low adoption	Medium adoption	High adoption
Price	Low	Medium	High

B. Fertilizers

Fertilizers are the second basic requirement for fertigation. While selecting the fertilizers for fertigation mainly two important things should be considered; 1. Solubility of the fertilizers in the indigenous water source, irrigation water may contains various chemical constituents, some of which may interact with dissolved fertilizers with undesired effects and 2. The degree of acidity of the fertilizer solution, in relation to its corrosiveness to the irrigation system components. Nitrogen and potassium based fertilizers are the most commonly applied nutrients by fertigation. Some formulations of phosphorus and micro-nutrients can also be used, if compatible with the irrigation water (pH should be less than 6.5). In addition, because of precipitation problems, special precautions must be made not to mix P fertilizers with calcium nitrate and iron.

Table 3: Characteristics of fertilizers used for fertigation

• High nutrient content readily available to plants	• Minimum content of conditioning agents
• Fully soluble at field temperatur conditions	• compatible with other fertilizers
• Fast dissolution in irrigation water	• Minimal interaction with irrigation water
• No clogging of filters and emitters	• No drastic changes of water pH
• Low content of insolubles (<0.02%)	• Low corrosives for control head an system

	Urea	Ammo-nium nitrate	Ammo-nium sulfate	Calcium nitrate	Potas-sium nitrate	Potas-sium chloride	Potas-sium sulfate	Ammo-nium phosphate	Fe, Zn, Cu, Mn sulfate	Fe, Zn, Cu, Mn chelate	Magne-sium sulfate	Phos-phoric acid	Sulfuric acid	Nitric acid
Urea	√													
Ammonium nitrate	√	√												
Ammonium sulfate	√	√	√											
Calcium nitrate	√	√	x	√										
Potassium nitrate	√	√	√	√	√									
Potassium chloride	√	√	√	√	√	√								
Potassium sulfate	√	√	R	x	√	R	√							
Ammonium phosphate	√	√	√	x	√	√	√	√						
Fe, Zn, Cu, Mn sulfate	√	√	√	x	√	√	R	X	√					
Fe, Zn, Cu, Mn chelate	√	√	√	R	√	√	√	R	√	√				
Magnesium sulfate	√	√	√	x	√	√	R	x	√	√	√			
Phosphoric acid	√	√	√	x	√	√	√	√	√	R	√	√		
Sulfuric acid	√	√	√	x	√	√	R	√	√	√	√	√	√	
Nitric acid	√	√	√	√	√	√	√	√	√	x	√	√	√	√

√ = compatible x = incompatible R = reduced compatibility

Fig. 4. Fertilizer compatibility chart (Roddy, 2006)

Selectivity and compatibility of fertilizers

- Liquid fertilizers are best suited for fertigation as they readily dissolve in irrigation water.
- When preparing fertilizer solutions for fertigation, some fertilizers must not be mixed together.
  - ➢ Calcium nitrate with any phosphates or Sulfates
  - ➢ Magnesium sulfate with di- or mono- ammonium phosphate
  - ➢ Phosphoric acid with iron, zinc, copper and manganese Sulfates

Table 4: Suitable fertilizers used for fertigation

Nutrients	Fertilizers	% Nutrient
N	Urea	46% N
	Ammonium sulphate	21% N
	Urea ammonium nitrate (L)	32% N
	Ammonium nitrate	34% N
N & P	Mono ammonium phosphate	12% N, 61% P_2O_5
	Urea Phosphate	17% N, 44% P_2O_5
P	Phosphoric acid	52% P_2O_5
P & K	Mono potassium phosphate	52% P_2O_5, 34% K_2O
K	Potassium chloride	60% K_2O
	Sulphate of Potash	50% K_2O, 17.5% S
	Potassium nitrate (Multi K)	13% N, 46% K_2O
	Potassium thiosulphate	25% K_2O, 17.5% S
N, P & K	Poly feed	19-19-19 % NPK
	Urea Phosphate with SOP	18-18-18 % NPK
Mg & Ca	Magnesium nitrate	11% N
	Calcium nitrate	16% N, 19% Ca

CONCLUSION

Fertigation is an efficient tool for providing plant nutrition for the field crops. Fertigation provides variety of benefits to users like high crop productivity and quality, resource use efficiency, environmental safety, flexibility in operations, effective weed management and successful crop cultivation on fields with undulating topography. It is considered eco-friendly as it avoids leaching of nutrients especially N-NO_3. Different methods of fertigation can be used for different situation. There are various types for fertigation equipment's, which can be selected according to the crop type and irrigation systems. Water soluble fertilizers or liquid fertilizers are most suitable for fertigation. Compatibility chart should be referred before mixing of the two or more fertilizers. The initial cost of establishing the fertigation system is higher but in long term basis it is economical as compared to conventional methods of fertilization as it brings down the cost of cultivation by decreasing fertilizer requirement and increaseing the farm income by enhanced production.

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Micropedological Features of Alfisols

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Soil micromorphology is the study of undisturbed soils, sediments and unconsolidated rock in their natural environments. Soil is formed by the interaction of climate, living organisms, parent material, and relief over a period of time (Harper *et al.,* 1969). The environment in which a soil is formed greatly affects the formation of that soil and its respective horizons and profile.The larger features are best seen and described in the field. Detail, significance, and interpretation of these features can be increased at a microscopic level of investigation called soil micromorphology. It is an invaluable tool for examining small-scale pedogenic processes and determining the sequence of those processes, using cross-cutting relationships and ghost structures. The thin section studies of soils have become an important tool for the pedologists in understanding the genesis of soils and their management. The preparation of the thin sections (about 20-25 µm thick), involves impregnation, polymorisation, cutting and grinding. The thin section study playa vital role in the soil classification, genesis, geomorphology, archeology, soil fertility, mining effects, etc.

Alfisols is a soil order in USDA soil taxonomy. Alfisols form in semiarid to humid areas, typically under a hardwoodforest cover. They have a clay-enriched subsoil and relatively high native fertility. "Alf" refers to aluminium (Al) and iron (Fe). Because of their productivity and abundance, the Alfisols represent one of the more important soil orders for food and fiber production. In the FAO soil classification, most Alfisols are classified as Luvisols or Lixisols, but some are classed as Nitosols. Alfisols have undergone only moderate leaching. By definition, they have at least 35% base saturation, meaning calcium, magnesium, and potassium are relatively abundant.

MICROMORPHOLOGY OF ALFISOLS

Sehgal *et al.* (1972) studies 54 pedons from different parts of Punjab, Haryana, Himachal Pradesh of north-western India covering Aridisols, Alfisols and Inceptisols

and brought out various pedological aspects through soil thin section studies. The thin sections for the dominant pedons occurring in the region were studied for the micromorphologicalcharacterisations and interpretations especially for soil classifications as per Soil Taxonomy.

Red and laterite soils of Peninsular India comes under Alfisol soil order. They represent relict but polygenetic soils (Pal *et al.,* 1989). The soils of Bangalore plateau derived from Archeans are cited as a common example of these soils.

Micromorphological studies by several workers have indicated the presence of ferri-argillans to a depth of two meters or more. The soils from the Bangalore plateau show the presence of papules and argillans in the surface suggesting complete removal of surface horizons through enormous erosion of the landscape exposing 'Bt' horizon. The biorelicts, welded faecal pellets, papules and pedo-tubuIes observed indicate the change in environment and biological activity. The soils have a porphyroskelic related distribution pattern and different forms of quartz form the bulk of the skeleton grains.

Alfisols are soils of old landscapes characterised by colours redder than 10YR, have an argillic, kandic or natric horizon; or with a fragipan in or underlying an argillic or candic horizon. The main diagnostic criteria of argillic horizon are the high clay content, which should not decrease significantly to a great depth, and the strong fine blocky structure with shiny ped faces. The blocky elements are in fact neither subangular (i.e."round") nor angular (i.e. "scaloped"), but square-edged ("nutty" or "polyhedral"). Kaolinite or meta-halloysite is dominant and there is more than 5 percent dithionite-extractable iron.

An account of the complexity in the identification of argillans in many soils of Indo Gangetic alluvium, the nature and distribution of the Alfisols is yet not properly understood. However, those which have been classified as Alfisols are included under Haplustalfs as these soils are characterized by the absence of lithic contact within 50 cm, have CEC of 24 meq or more per 100 gm of clay, have an argillic horizon at least 20 cm thick and base saturation of 75 per cent or more in some part. Further, these soils have colours of 10 YR or redder up to 5 YR. The colours are more redder in Peninsular India which are due to iron oxyhydroxides (mainly haematite and goethite). The yellowish hues are related to more hydrated forms of iron minerals. The illuviatedcutans are redder in Peninsular India while yellowish brown in Indo-Gangetic plains. The skeleton grains of Haplustalfs mainly consist of quartz of varying sizes and weatherable minerals like mica, feldspar, hornblende which are moderate to strongly altered. The plasma is generally light yellowish brown with low content of oxides and hydroxides of iron. Argillans are strongly birefringent and laminated. The soils are characterised by porphyric related distribution and skelsepic to weak lattisepicplasmic fabric. Individual, clustered and welded mineral excrements suggest high faunal activity. The Ap horizon of an Haplustalf generally is gefuric grading to poro-granostriated to weak reticulate b-fabric and porphyric B horizon, grading to grano-porostriated to weak reticulate C horizon. The elementary structure is pedal, cutanic, pedotubulic, porphyric. The skeleton grains predominate over plasma in Ap horizon is reverse with depth. The

calcium carbonate accumulation in some of the soils is considered as the result of current processes.

Based on the study of Haplustalfs in northern plains, Sehgal (1970) observed that the skeleton grains consists mainly of quartz, micas, felspars which are fairly weathered. The colour of the plasma is bright yellowish .brown to dark brown rich in iron oxyhydrate and low organic matter. The plasmic fabric of Ap horizon range from silasepic to agglomeroplasmic, grading to vo-skel-mosepic in the ' B' horizon and silasepic, intertextic to porphyroskelic in the 'c' horizon. The skeleton grains predominate over plasma and voids throughout the pedon depth. These soils are characterised by ferri-argillans, iron oxyhydrates as microglaebules and clay humus complex nodules. The insitu weathering of biotite forming papules and aggrotubules are of common occurrence in these soils. Sehgal*et al.*(1976) reported the occurrence of thick, continuous strongly oriented ferri-argillans resulting from low mobility of clay in UdicHaplustalfs of northwestern India. They concluded that birefrigentargillans with inclusion of isotropic specks in the udic soils are not the definite proof for the present day illuviation but could be taken as an indication of past illuviation features. Pal *et al.* (1994) reported void argillans typically of the type "impure clay pedofeatures" (Bullock *et al.,* 1985) which seems to have resulted by dispersion of both clay and silt sized layer silicates, in some sodic soils developed in quaternary alluvium of northern India. Manchanda*et al.* (1983) attempted to redefine argillic horizon in soils of Indo-Gangetic alluvial plain on the basis of micromorphological characteristics.

Several micromorphological studies have been conducted with aims to the characterization of the soil material of argillic horizons. Thin sections of the B horizon of many soils, occurring in different countries have been investigated. This includes the impregnation of the samples with an unsaturated polyester resin. After hardening, the specimen were sawed, ground, and polished to a thickness of 20 µm. Investigation was carried out with a LeitzOrthoplan polarizing microscope, using transmitted and incident light, and magnifications ranging from 100:1 to 1000:1. This horizon is characterized by a specific set of following micromorphological properties. Tentatively, this includes the combination of the following features:

1. The s-matrix consists of homogeneous red or yellowish red plasma with common very fine particles of organic material, showing Munsell hues of 2.5 YR to 7.5 YR in plain light and 10 R to 2.5 YR between crossed polarizers. There are only few sand-sized and very few silt-sized skeleton grains. The mineralogy of the sand is mostly quartz, but some feldspars or other weatherable minerals may be present. The related distribution is invariably porphyroskelic.
2. Macroscopic inspection of the thin sections reveals the very strong influence of animal activity. Abundant pedotubules indicate that the soil material has almost completely been reworked by soil animals, such as termites.

   The microstructure is characterized by the occurrence of weakly to strongly developed micropeds, with a size of 100 to 250 µm. This type of structure has been described by various authors who studied strongly

weathered red tropical clays (e.g. see Beaudou, 1972; Verheye and Stoops, 1975; Pedro *et al.,* 1976; Muller, 1977; Buol and Eswaran, 1978; Stoops, 1981).

3. Skins of oriented clay (micro-laminated ferri-argillans) have been found in all argillic horizons. Most thin sections show well developed, moderately thick (up to 50 µm), strongly oriented argillans on the walls of voids, either occurring throughout the whole thin section, or, more often in a few isolated clusters only. Commonly the colours of these ferri-argillans, if observed in plain transmitted light, are lighter and have yellower hues than those of the s-matrix, suggesting a lower content of iron compounds.

   It should be noted that argillans not necessarily are the result of clay illuviation, i.e. translocation of silicate clay from the A into the B horizon (Fitzpatrick, 1984).
4. Very thin ferri-argillans (lepte-coatings) are common to abundant throughout the horizon. This seems to be the most characteristic of the argillic horizon.

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Dietary Management of Prepartum Cow for Prevention of Milk Fever: A Review

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Basic biochemical defect in milk fever include reduction in the levels of ionized calcium in tissue fluids. It occurs most commonly in high producing adult lactating dairy cow within the first 48 h after calving. Almost in all cases of milk fever cows become recumbent and are unable to rise even after great efforts (Goff 1999). Presently there are number of methods available for the control of milk fever in ruminants which include dietary management before and after calving, oral administration of calcium gels during parturition and administration of vitamin D and its analogs just before parturition etc. A specific control program should follow when incidence of milk fever is more than 10% but it may not be economical during low incidence of milk fever in such cases careful monitoring of cow during and 48 hours after calving and treatment of affected cow is the only effective and economical way to control milk fever in herd. Besides these, composition of prepartum diet has a significance role in the incidence of milk fever in dairy cow. Level of calcium, phosphorus, acidifiers, dietary cation anion difference plays crucial role in prevention of milk fever in dairy cow.

Level of calcium and phosphorous in diet

High calcium diet during prepartum period increases the incidence of milk fever and diets low in calcium will reduce the incidence of milk fever in dairy cows. During dry period if daily calcium intake is more than 100 gram then it will leads to increased incidence of milk fever**.** If animal is fed to low calcium diet (20g/day) during last 15 days before calving then it will leads to decrease incidence of milk fever. Low level of calcium in prepartum diet activate the calcium homeostatic mechanisms before calving, making the cow able to mobilize the large quantities of calcium for the colostrum production. Negative calcium balance is created when dietary calcium availability is below calcium requirements which lead to secretion of parathyroid hormone which in turn increases renal reabsorption of calcium (Goff, 2008). stimulates calcium resorption

from bone and stimulates production of 1, 25-dihydroxyvitamin D (Calcitriol) in kidney. Calcitriol stimulates the active transport of calcium across the intestinal epithelial cells. Use of intestinal calcium binder such as sodium aluminum silicate or zinc oxide is also another common practice for prevention of milk fever**.** Addition of sodium aluminium silicate in dry cow ration at the rate of 1.4 kg of pellets per day for the last 15 days of pregnancy results in an increase in plasma calcium during calving**.** Feeding soya bean oil to pregnant dairy cow during the transition period is another effective in preventing milk fever and increases milk solids production in early lactation.

Dietary phosphorus >80 g/head per day increase the incidence of milk fever because of inhibitory effect of increase level of phosphorous on renal enzymes which catalyze the production of 1, 25- $(OH)_2$ D, which is responsible for intestinal calcium absorption. So in case of increased level of phosphorous intestinal calcium absorption becomes inefficient during colostrum production which leads to increased chances of milk fever.

Calcium and phosphorus ratio in diet

Maintenance of proper ratio of calcium and phosphorous in prepartum diet is also a prime requirement for prevention of milk fever. Low Ca:P ratio result into negative calcium balances which stimulate activity of the parathyroid gland so that calcium is maintained to normal level during colostrum production.

Dietary cation anion difference (DCAD)

Maintenance of proper dietary cation anion difference in prepartum diet is another method for controlling milk fever in dairy cow. High content of cation like Sodium and potassium increases the chances of milk fever while the diet, containing high amount of anion like chloride and sulfur make the animal less prone to milk fever (DeGaris and Lean 2009). Since most of the prepartum diets are rich in cation they cause metabolic alkalosis which causes hindrance in bone resorption of calcium making the cow more prone to milk fever. Addition of anion in prepartum diet induces metabolic acidosis which enhances renal synthesis of 1,25-dihydroxyvitarnin D and facilitates bone resorption and intestinal calcium absorption during colostrum production hence cow become more resistant to milk fever and hypocalcaemia**.** The DCAD is expressed in mEq/kg DM using the equation DCAD= (Na +K) - (CI + S). Previous studies indicate that a DCAD of - 50 to 100 mEq/kg DM is optimal for the prevention of milk fever**.** Addition of anionic salt in prepartum diet during last three week before parturition upto a level sufficient to reduce DCAD upto -15 mEq/kg DM is another method of choice to prevent milk fever in dairy cow**.** Main problem with addition of anion is reduced palatability which affects appetite of cow thus decreasing dry matter intake. Most common anions which are commonly added in prepartum diet are chloride and sulfate. The incidence of milk fever was reduced by the addition of chloride and sulfur in excess relative to sodium and potassium in the diet**.** Maximum limit of adding anionic salt in prepartum diet is 300 mEq of anions/kg diet DM without affecting dry matter intake**.**

Now a day number of anionic salts are available in market for addition in prepartum diet but the most common salts are ammonium chloride and ammonium sulfates. Out of these two, ammonium chloride is preferred because it is more potent acidifier than ammonium sulfate. Recommended quantity of supplementation of ammonium chloride in prepartum diet is 100 g/head per day 21 days prior to parturition

Vitamin D and its metabolites

1,25-dihydroxyvitamin D, which is produced in the kidney with the help of parathyroid hormone, regulate Intestinal Ca absorption and bone Ca resorption (Horst et al. 1994) thus involve in calcium homeostasis (Goff et al. 2004). When blood Ca is within the normal range, parathyroid hormone secretion is decreased (Taylor et al. 2008**).** So, oral administration of vitamin D (20 million IU) continuous for five days prior to calving is an advantageous for controlling milk fever in dairy cow.

CONCLUSION

Thus we can conclude from above discussion that prepartum diet play an important role in prevention and control of milk fever in dairy cow. Proper quantity of calcium, magnesium, phosphorous and vitamin D, maintenance of optimum Ca: P ratio, addition of dietary acidifiers and proper maintenance of dietary cation anion difference in prepartum diet are some of the common feeding practices for prevention of milk fever in dairy cow

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Integrated nutrient management

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Modern agriculture largely depends on the use of high cost inputs such as chemical fertilizers, pesticides, herbicides, improved seeds, assured irrigation, scientific management and labour saving but energy intensive farm machinery. The application of such high input technologies increased the production but there is growing concern over the adverse effects of the inputs on soil productivity and environmental quality. When population pressure was low, mono-cropping was a rule; however with increase population various multiple cropping systems have become popular. The basic concept underlying Integrated Nutrient Management (INM) is the maintenance or adjustment of soil fertility/ productivity and of optimum plant nutrient supply for sustaining the desired level of crop productivity through optimization of the benefits from all possible sources of plant nutrients including locally available ones in an integrated manner while ensuring environmental quality. In practical term, a system of crop nutrition in which plant nutrient needs are met through a pre-planned integrated use of mineral fertilizers; organic manures/fertilizers (e.g. green manures, recyclable wastes, crop residues, FYM and bio fertilizers.

Meaning of Integrated Nutrient Management (INM):

Integrated nutrient management is the combined application of chemical fertilizers along with organic resource materials like, organic manures, green manures, bio-fertilizers and other organic decomposable materials for crop production. The basic concepts of IPNS is the maintenance or adjustment of soil fertility and supply of plant nutrients to an optimum level for sustaining desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner.IPNS is ecologically, socially and economically viable and environment friendly which can be practiced by farmers to derive higher productivity with simultaneously maintaining soil fertility.

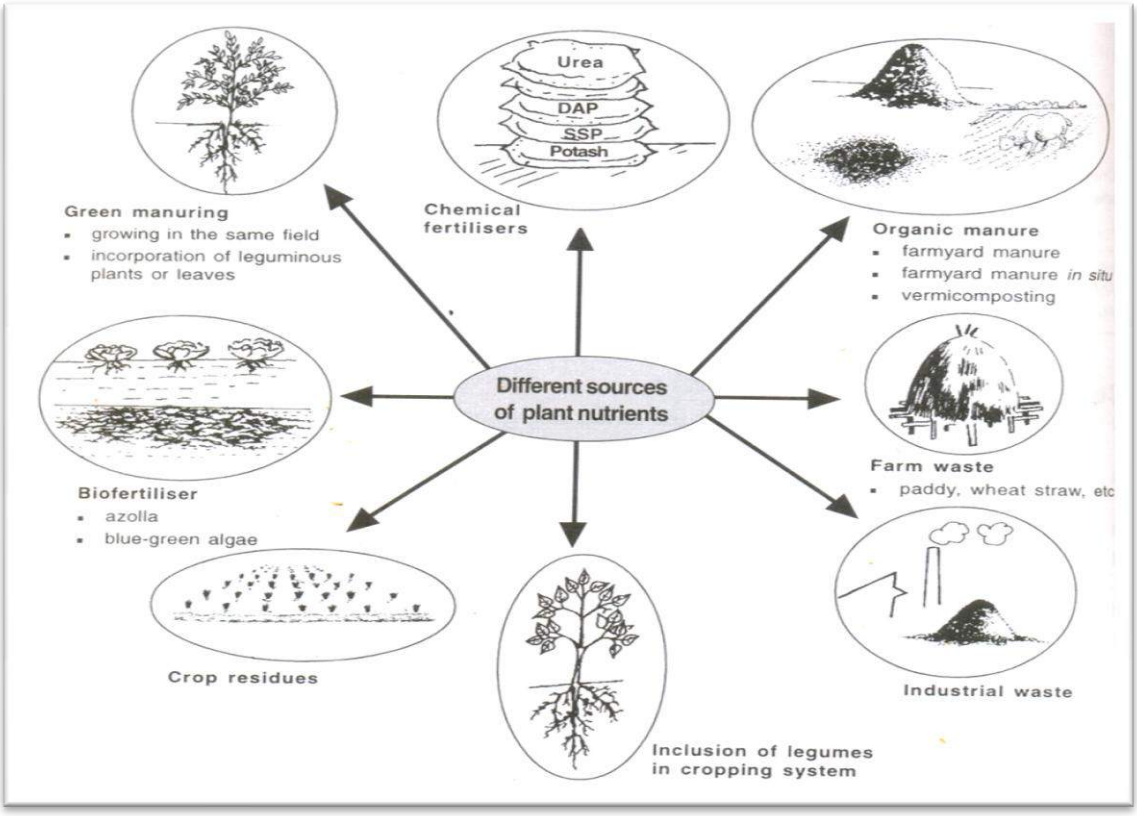
Approach/components in INM

Components of INM and their use: Major components of integrated nutrient management are:

i. Integration of soil fertility restoring crops like green manures, legumes etc.
ii. Recycling of crop residues and crop rotation
iii. Use of organic manures like FYM, compost, vermicompost, biogas, slurry, poultry manure, bio-compost and press mud cakes.

iv. Utilization of Bio fertilizers
v. Efficient genotypes
vi. Balanced use of fertilizer nutrients as per the requirement and target yields

Different components of INM



Green Manuring

It is a practice of ploughing in the green plant tissues grown in the field or adding green plants with tender twigs or leaves from outside and incorporating them into the soil for improving the physical structure as well as fertility of the soil. It can be defined as a practice of ploughing or turning into the soil, un-decomposed green plant tissues for the purpose of improving the soil fertility. The object of green manuring is to add an organic matter into the soil and thus, enrich it with 'N' which is most important and deficient nutrient.

Types of green manuring: There are two types of green manuring:

1. Green manuring in-situ: When green manure crops are grown in the field itself either as a pure crop or as intercrop with the main crop and buried in the same field, it is known as Green manuring In-situ. E.g.: Sunhemp, Dhaincha,Cowpea, Berseem, Senji, etc.

These crops are sown as:
i) Main crop,
ii) Inter row sown crop,

iii) On bare fallow, depending upon the soil and climatic conditions of the region.

2. Green leaf manuring: It refers to turning into the soil green leaves and tender green twigs collected from shrubs and trees grown on bunds, waste lands and nearby forest area. E.g.: Glyricidia, wild Dhaincha.

Crop rotation: - Crop rotation is the systematic planting of different crops in a particular order over several years in the same growing space. This process helps maintain nutrients in the soil, reduce soil erosion, and prevents plant diseases and pests.

There is no universally accepted rotation schedule as the types of plants in a farm or garden depend on the local soil, climate, and resources available. The length of rotation time between different plants will also vary depending on the needs of the gardener.

Organic Manure: -The word "organic" pertains to the use of non-chemical fertilizers as manure and compost and the word "manure" refers to any natural substance for fertilizing the soil, especially dung or refuse. Plants are built up from the food they get, either through the chlorophyll process or from the soil. During their growing process, plants take out many elements from soil. Hence, new food must be added from time to time.No organic matter may be burnt or thrown away but must be put back into the field. This is the way nature restores and improves itself. Organic matter is the most important constituent of any soil because it is in organic matter that all the microbes and other minute forms of life exist. It releases plant food slowly and steadily, the way plants need to be fed. It will not leach away.

Bio-fertilizers: Bio-fertilizers are micro-organisms which bring about nutrient enrichment of soil by enhancing the availability of nutrients to crops. The micro-organisms which act as bio-fertilizers are bacteria, cyanobacteria (blue green algae) and mycorrhizal fungi. Bacteria and cyanobacteria have the property of nitrogen fixation while mycorrhizal fungi preferentially withdraw minerals from organic matter for the plant with which they are associated.

(i) Free Living Nitrogen Fixing Bacteria:

They live freely in the soil and perform nitrogen fixation. Some of them are saprotrophic, living on organic remains, e.g., Azotobacter, Bacillus polymyxa, Clostridium, Beijerinckia.

(ii) Free Living Nitrogen Fixing Cyanobacteria:

Several free-living cyanobacteria or blue-green algae have the property of nitrogen fixation, e.g., Anabaena, Nostoc. Therefore, they add organic matter as well as extra nitrogen to the soil.

(iii) Symbiotic Nitrogen Fixing Bacteria:

They form a mutually beneficial association with the plants. The bacteria obtain food and shelter from plants. In return, they give a part of their fixed nitrogen to the plants. The most important of the symbiotic nitrogen fixing bacteria is Rhizobium (pi Rhizobia). It forms nodules on the roots of legume plants. There are about a dozen species of Rhizobium which form association with different legume roots, e.g., *R. leguminosarum*, *R. trifolii*, *R. meliloti*, *R. phaseoli*.

Advantages of INM

1. Enhances the availability of applied as well as native soil nutrients
2. Synchronizes the nutrient demand of the crop with nutrient supply from native and applied sources.
3. Provides balanced nutrition to crops and minimizes the antagonistic effects resulting from hidden deficiencies and nutrient imbalance.
4. Improves and sustains the physical, chemical and biological functioning of soil.
5. Minimizes the deterioration of soil, water and ecosystem by promoting carbon sequestration, reducing nutrient losses to ground and surface water bodies and to atmosphere.

Soil Health Card Scheme for Farmers

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Soil Health Card Scheme is a very beneficial scheme for farmers. There are so many illiterate farmers in India and they do not know which types of crops they should grow to get maximum yield. Basically, they do not know the quality and the type of their soil. They might know by experience what crops grow and what crops fail. But they don't know what they can do to improve the condition of the soil. So, the Soil Health Card Scheme is an initiative by Prime Minister for the welfare of farmers. Under the scheme, the farmers will get a soil health card. This card will contain details about what kind of soil is there in the farmers land. Also, it will list what crops they can grow in their land to get maximum profits. And what corrective measures the farmers can take to improve the yield.

KEY FEATURES OF THE SOIL HEALTH CARD SCHEME

1. The government is planning to cover as many as 14 crore farmers under the scheme.
2. The scheme will cover all the parts of the country.
3. In the form of soil card, the farmers will get a report and this report will contain all the details about the soil of their particular farm.
4. A farm will get the soil card one in every 3 years.

The Soil Health Card Scheme will do a proper review of the sample of the soil. After the review, a soil health card will be prepared which will contain below details.

1. Health of the soil.
2. Functional characteristics of the soil.
3. The content of water and various nutrients in the soil.
4. If the soil has any additional properties, the card would list those.
5. The corrective measures which a farmer can take to improve the flaws of his soil.

Why was the Soil Health Card Scheme Needed?

Some of the states were already providing their farmers a regular report of their soils. And some of the farmers were educated enough to understand their soil. So, what was the need of such a scheme on a national level?

1. No uniform norm was there to test the samples and provide the results. Some of the uneducated farmers did not know whom to approach and what to do.
2. This is why, government has launched soil health card portal.
3. Now, along with the knowledge of the nature of the soil, the farmers will know what fertilizers they need.
4. They can take help from the experts if they are unable to understand anything. Or, if they are unable to implement the suggested corrective measures.

BENEFITS OF THE SOIL HEALTH CARD SCHEME

1. The scheme will monitor the soil of the farmers well and will give them a formatted report. So, they can decide well which crops they should cultivate and which ones they should skip.
2. The authorities will monitor the soil on a regular basis. One in every 3 years, they will provide a report to farmers. So, farmers need not worry if the nature of the soil changes due to certain factors. Also, they will always have updated data about their soil.
3. The work of the government does not stop at listing down measures required to improve the quality of the soil. In fact, they will also employ experts to help farmers in carrying out the corrective measures.
4. Farmers will get a proper soil health record, thanks to the Soil Health Card Scheme. Also, they can study the soil management practices. Accordingly, they can plan the future of their crops and land.
5. Generally, in government schemes, the person carrying out the study for a particular farmer gets changed. But in the Soil Health Card Scheme, the government is paying attention that the same person carries out soil analysis for a farmer. This will further enhance the effectiveness of the scheme.
6. The soil card will give the farmers a proper idea of which nutrients their soil is lacking and hence, which crops they should invest in, they will also tell which fertilizers they need. So, ultimately, the crop yield will see a rise.
7. The main aim behind the scheme was to find out the type of particular soil and then provide ways in which we can improve it. Even if a soil has some limitations, we can do something to get the most out of it,and that is what the government is trying to do with the help of this scheme.

How will the Soil Health Card Scheme Function?

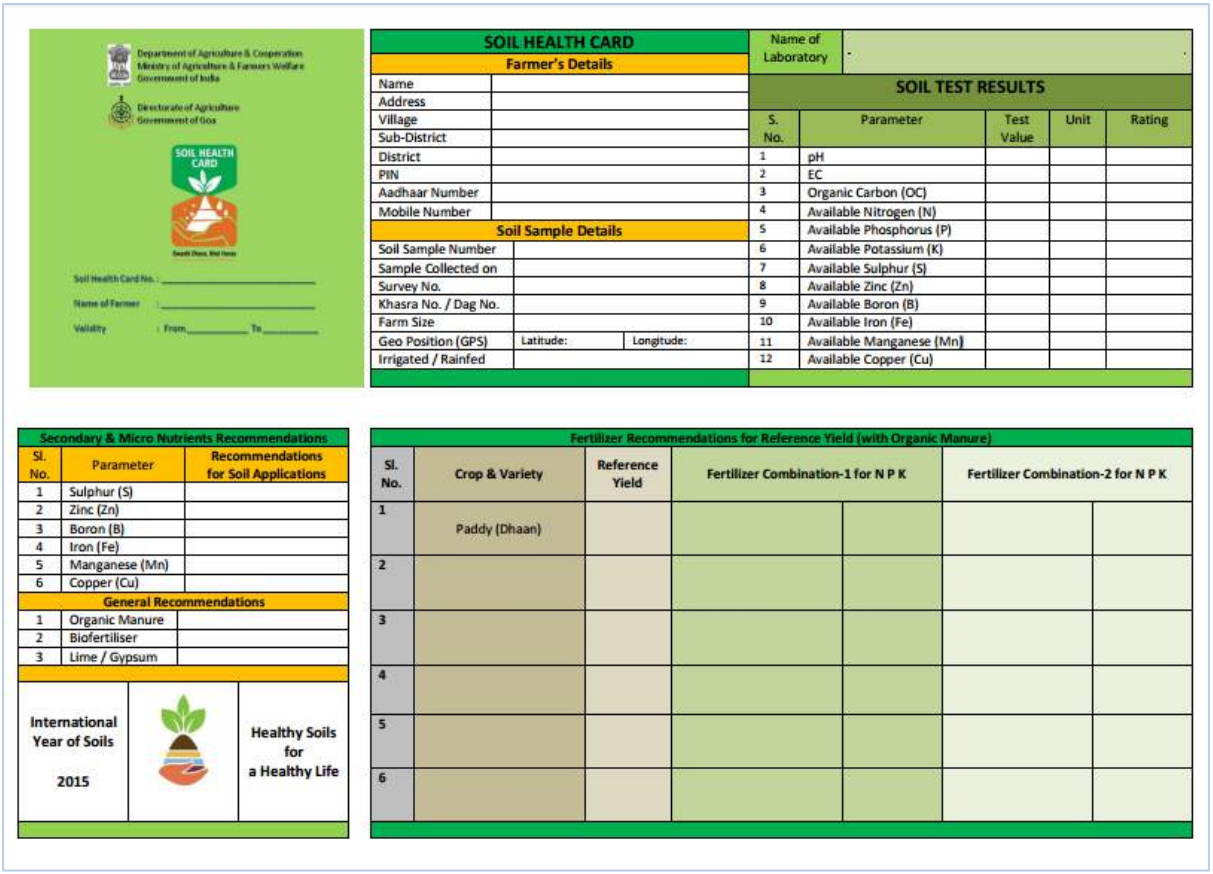
1. First of all, the authorities will collect the various samples of the soils.
2. Then, they will send the samples to the testing laboratories, and inside the labs, experts will test them.
3. After the testing, experts will analyse the test results of the soils.
4. They will list down the strengths as wells as the weaknesses of the various soil samples.
5. If the weakness of the soil is such that we can improve it somehow, experts will list down suggestive methods too.

6. Government will then put all these details into the soil cards for farmers in a formatted manner. The details will be in such a manner that the framers can easily understand them.

Performance of the Soil Health Card Scheme

1. As per the data of July 2015, government has covered 34 lakh farmers under the scheme.
2. Since it is an important step for the farmers, this scheme has the potential to revolutionize the world of farmers.
3. The state of Andhra Pradesh has issued most number of soil cards to its farmers.
4. And the states of Punjab and Tamil Nadu are way forward in collecting the soil samples.

What does the Soil Health Card look like?



Department of Agriculture & Cooperation
Ministry of Agriculture & Farmers Welfare
Government of India

Directorate of Agriculture
Government of Goa

SOIL HEALTH CARD

Soil Health Card No. : _____

Name of Farmer : _____

Validity : From _____ To _____

SOIL HEALTH CARD

Farmer's Details

Name	
Address	
Village	
Sub-District	
District	
PIN	
Aadhaar Number	
Mobile Number	

Soil Sample Details

Soil Sample Number		
Sample Collected on		
Survey No.		
Khasra No. / Dag No.		
Farm Size		
Geo Position (GPS)	Latitude:	Longitude:
Irrigated / Rainfed		

Name of Laboratory : -

SOIL TEST RESULTS

S. No.	Parameter	Test Value	Unit	Rating
1	pH			
2	EC			
3	Organic Carbon (OC)			
4	Available Nitrogen (N)			
5	Available Phosphorus (P)			
6	Available Potassium (K)			
7	Available Sulphur (S)			
8	Available Zinc (Zn)			
9	Available Boron (B)			
10	Available Iron (Fe)			
11	Available Manganese (Mn)			
12	Available Copper (Cu)			

Secondary & Micro Nutrients Recommendations

Sl. No.	Parameter	Recommendations for Soil Applications
1	Sulphur (S)	
2	Zinc (Zn)	
3	Boron (B)	
4	Iron (Fe)	
5	Manganese (Mn)	
6	Copper (Cu)	

General Recommendations

1	Organic Manure	
2	Biofertiliser	
3	Lime / Gypsum	

International Year of Soils 2015

Healthy Soils for a Healthy Life

Fertilizer Recommendations for Reference Yield (with Organic Manure)

Sl. No.	Crop & Variety	Reference Yield	Fertilizer Combination-1 for N P K		Fertilizer Combination-2 for N P K	
1	Paddy (Dhaan)					
2						
3						
4						
5						
6						

Nutritional strategies to prevent fatty liver in dairy cattle

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Fatty liver is defined as an accumulation of fat, mainly Triacylglycerol (TAG) in liver. Fatty liver is one of the important metabolic diseases of post parturient dairy cows occurring due to negative energy balance. It usually develops before and during parturition. Fatty liver at calving is commonly associated with ketosis. Negative energy balance, hormonal changes (that accompany parturition) and lactogenesis contribute to development of fatty liver. It is an important economic disease because cows that develop fatty liver are affected by multiple metabolic and infectious diseases. It usually develops after calving with peak incidence at about 10 days in milk.

Energy balance and fatty liver

In states of negative energy balance mobilization of body fat reserves is triggered, results in the release of nonesterified fatty acids (NEFAs) from adipose tissue. The liver retains approximately 15%–20% of the NEFAs circulating in blood and thus accumulates increased amounts during periods when blood NEFA concentrations are increased. At calving, plasma concentrations of NEFAs are often increased (>1,000 µEq/L). Blood flow to liver and concentration of NEFAs in blood is related to hepatic uptake of NEFAs.

In liver NEFAs completely oxidized to CO_2. Excess NEFAs in liver may partial oxidized to form ketones or esterified to form triglycerides (TGs).When blood glucose concentrations are low, NEFAs are generally oxidized to form Ketone. Ketones upto some level can serve as an energy source for many tissues but excessive production adversely affect animal behavior and performance. Esterification to form TGs is acceptable if they are exported as very low-density lipoproteins (VLDLs). Excessive intracellular triglyceride accumulation in liver cells results in disturbed liver function and cell damage. Fatty liver can develop within 24 hr of an animal going off feed. Although lipid accumulation in the liver is a reversible process, the slow rate of triglyceride export as lipoprotein causes the disorder to persist for an extended period. Depletion of the liver lipid content usually begins when the cow reaches positive energy balance and may take several weeks to fully subside.

Categories of fatty liver: Fatty liver in dairy cows is categorized into following types-

- Mild type: When liver triacylglycerol (TAG) 1-5% wet weight and total lipid 5-20% of volume
- Moderate type: When liver TAG 5-10% wet weight and total lipid 20-40 % of volume.
- Severe type: When liver TAG > 10% wet weight and total lipid >40% of volume.

Even mild fatty liver is associated with decreased health status and reproductive performance of dairy cows.

Clinical finding of fatty liver: Fatty liver is likely to develop concurrently with another disease. There are no pathognomonic clinical signs of fatty liver disease in cattle. The typically disorders that are seen at or shortly after calving are-

- Metritis
- Mastitis
- Abomasal displacement
- Hypocalcemia
- Impaired reproductive ability
- Lameness

The condition is often associated with feed intake depression, decreased milk production, and ketosis.

Approaches to prevent or treat fatty liver:

Approaches to prevent or treat fatty liver can be subdivided into three main categories:

a) Reduce blood NEFAs by decreasing TG lipolysis in adipose tissue
b) Increase complete hepatic oxidation of NEFAs
c) Increase the rate of VLDL export from the liver.

The drawback of the first strategy is that it impedes a process that is intended to support lactation. The second strategy has limitations as well. Complete oxidation of NEFAs yields ATP, the energy currency of cells, of which there is a finite requirement. If complete oxidation is to continue beyond that necessary to provide energy for maintenance of the liver, it must be uncoupled from ATP production, whichresults in energy being lost as heat. The third strategy of increasing VLDL export is the most logical but little is known about what limits VLDL export in ruminants.

Nutritional strategies to prevent or treat fatty liver

Different nutritional practices to prevent or treat fatty liver canbe divided into two main categories:

(1) Diet formulation to increase energy density

(2) Inclusion of feed additives to modify metabolism in a way to reduce the likelihood of liver TG accumulation.

Diet formulation to increase energy density is typically done to minimize the magnitude of negative energy balance and reduce fatty acidmobilization from adipose tissue.

1. **Increasing nutrient density of transition diets:** Grain feeding during the dry period is a means to enhance papillae growth in the rumen. Increased papillae growth in rumen provides more surface area for absorption of volatile fatty acids

and minimize the risk of ruminal acidosis post-partum when grain feeding increases dramatically. Besides this grain feeding during dry period has been promoted as a means to reduce lipid-related metabolic disorders such as fatty liver. This could occur by a couple mechanisms.

Firstly, feeding additional grain leads to greater propionate production in the rumen. Propionate is an insulin secretagogue; insulin is antilipolytic and has the potential to decrease adipose tissue lipolysis. Increasing grain in the diet could increase its digestibility and, therefore, increase DM and energy intake. During 3–4 week pre-fresh transition period, grain feeding should be increased to prevent fatty liver in dairy cattle.

Supplementation of dietary fat to increase dietary energy density: Energy density of transition diets can be increased by fat supplementation. Mobilization of fatty acids reduced after supplementation of fatty acids in diets of transition cows. These dietary fatty acids are incorporated into intestinally synthesized lipoproteins that are metabolized predominantly by tissues other than the liver. Dietary supplemental fat helps in increasing adipose tissue lipolysis rather than decreases it Liver uses fatty acids which gets mobilized from adipose tissues. Dry matter intake (DMI) depression is common problem in postpartum period. Feeding fat in transition period acclimatize the dairy animals to fat, reduced the chances of DMI depression.

2. Role of feed additives for prevention or treatment of fatty liver:

Depending on the basis of intended mode of action feed additives can be classified into different categories: reduce adipose lipolysis, enhance hepatic VLDL secretion, or increase hepatic fatty acid oxidation.

i. **Reduction of adipose lipolysis:** Compounds that decrease adipose tissue lipolysis include propylene glycol (PG), monensin, chromium (Cr), niacin, and conjugated linoleic acid (CLA).

ii. **Propylene glycol**: Oral drenches of propylene glycol @ 1 L/d in last 10 d prepartum period have been demonstrated to prevent fatty liver and ketosis by increasing plasma glucose and insulin concentrations and decreasing plasma BHBA and NEFA concentrations. The effectiveness of propylene glycol to increase plasma glucose concentrations depends on the dosage and the mode of administration, since drenching of PG is difficult, it should be added in diet of animals. But addition of PG in total mixed ration is not effective.

iii. **Niacin:** In most of the recent studies oral administration of niacin or nicotinic acid failed to prevent fatty liver. The proposed mode of action was that supraphysiological concentrations of niacin decrease NEFA mobilization from adipose tissue; however, achieving supraphysiological plasma concentrations by oral administration is difficult, because niacin is degraded in the rumen.

The supply of niacin to the ruminant comes from three main sources: dietary niacin, conversion of tryptophan to niacin and ruminal synthesis of niacin. Niacin is widely distributed in feedstuffs of plant as well as of animal origin. The by-products of animal and fish origin, distiller's grains, yeast, various

distillation and fermentation solubles and certain oilseed meals are good sources.

iv. **Propionate salts:** Administration of ammonium and calcium propionate orally and administration of 1 kg/d of glycerol to the diet in the periparturient period decrease the plasma BHBA and NEFA concentrations, respectively.

v. **Monensin :** Feeding monensin during the last month before parturition has prevented fatty liver**.** The primary mode of action of monensin is that it improves the glucose supply to cows by changing ruminal fermentation and VFA production in favor of propionate

vi. **Chromium**: Chromium is an essential nutrient for animals. It acts to potentiate the action of insulin as part of the glucose tolerance factor. Since insulin is antilipolytic and its action during the periparturient period may be diminished due to insulin resistance, Cr may have potential to moderate plasma NEFA concentrations and reduce hepatic TG accumulation. In dairy animals inorganic Cr sources are poorly absorbed; organic forms are more available.

vii. **Suppression of milk fat synthesis:** Suppression of milk fat synthesishas been suggested as a mechanism to improve energy balance of fresh cows and, therefore, indirectly reduce adipose tissue lipolysis. Specifically, fatty acids with a trans-10 double bond, particularly trans-10, cis-12 CLA are known to inhibit mammary lipid synthesis.

viii. **Enhancing hepatic VLDL secretion:** Choline and methionine are feed additives that have the potential to enhance VLDL export from the liver. Phosphatidylcholine is a constituent of VLDL and for its synthesis Choline serves as a substrate. Methionineacts as a methyl donor for Phosphatidylcholine synthesis and also it is required for synthesis of protein (a constituent of VLDL).

During the periparturient period, if the choline supply is limited when feed intake is low, synthesis of VLDL could be limited and fatty liver could result. Supply of choline to ruminants should be in protected form because the microbial population in the rumen quickly degradesdietary choline.

ix. **Altering hepatic fatty acid metabolism:** Recent research has shown that dietary fats high in stearic acid2 (C18:0) and low in palmitic (C16:0), oleic (C18:1) and linoleic (C18:2) acids may reduce liver triglyceride accumulation in early lactation cows. Stearic acid appears to be preferentially used by either the liver for oxidation (energy) and/or by the mammary gland for milk fat secretion.

Minimizing stress is also important for prevention of fatty liver. Sudden changes in environment should be avoided. For example, changes in ration, housing, temperature, herdmates etc. may cause a reduction in feed intake and trigger catecholamine-mediated increases in fat mobilization

CONCLUSIONS

Fatty liver disease is an important metabolic disease of transition period due to negative energy balance which directly affects health and productivity of animal without showing any particular clinical symptom. Increased NEFA concentration in blood

change metabolic activities and immunophysiological conditions in animal which can be prevent through dietary manipulation of energy intake, slowing lipolysis and enhancing hepatic VLDL secretion by using additives like propylene glycol, monensin, chromium, niacin, conjugated linoleic acid, choline, methionine and dietary fats.

Glomalin: A miracle protein for soil sustainability

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ABSTRACT

Glomalin is the most abundant gylcoprotein in soil which produces by arbuscular mycorrhizal fungi in symbiosis with plant roots. It improves soil physical, chemical and biological properties and as stable glue has an important role in soil aggregate stabilization. The glomalin produced from some crop rotation cropping system could promote aggregate stability. Glomalin binds to soil, producing a uniform aggregated structure composed of minerals and humus. Increasing organic matter increases cation exchange capacity of soils. Primarily, these aggregates permit the soil to retain water better and facilitate root penetration. In addition, the aggregates reduce soil erosion and compaction while facilitating root hair adhesion, enhancing nutrient and water uptake.

Key Words: Glomalin, Soil organic matter, Nutrient availability, Soil aggregation,

Agricultural practices such as adding lime, inorganic fertilizers, and pesticides can change the physical and chemical nature of the soil environment, there by altering the number of organisms and the ratio of different groups of organisms. Since plant health is intimately linked to soil health, managing the soil in ways that conserve and enhance the soil biota can improve crop yields and quality. Unfortunately, soil biological responses were often overlooked or not recognized, so the rapid changes also resulted in unintended consequences, especially with regard to soil health and long-term agricultural sustainability.

A diverse soil community will not only help prevent losses due to soil-borne pests and diseases but also speed up decomposition of organic matter and toxic compounds, and improve nutrient cycling and soil structure. Microorganisms are the most abundant members of the soil biota. They include species responsible for nutrient mineralization and cycling, antagonists (biological control agents against plant pests and diseases), species that produce substances capable of modifying plant growth, and species that form mutually beneficial (symbiotic) relationships with plant roots. The rhizosphere is the zone under the direct influence of the plant roots and with high populations of active microorganisms. In the rhizosphere plant roots influence microbial communities by depositing photosynthate into the rhizosphere and organisms growing up plant growth and development (Napoli et al., 2008).

The major fungal group found in the roots of 80% of terrestrial plant species is the arbuscular mycorrhizal fungi (AMF). AMF live in mutualistic symbiotic associations

with host plants, increasing nutrient uptake thus enhancing plant productivity. AMF produce a glycoprotein in soil known as ''glomalin''. Glomalin is operationally identified as glomalin-related soil protein (GRSP). It contributes to the formation of stable soil aggregates (Borie et al., 2008). Increased soil aggregates stability may protect adsorbed nutrients within soil aggregates (Emran et al., 2012). Moreover, soil aggregates increase the potential of metal nutrients sustainability and the exchangeable cations and micronutrients they contain may be good indicators of soil health. Therefore, glomalin can be considered as a stabilizing agent, in the formation of soil aggregates, and a binding agent of soil minerals promoting the formation of organomineral complexes (Gispert et al., 2013). Many studies have shown high variability in cations bound to GRSP among different soils (Chern et al., 2007; Vodnik et al., 2008). In addition, GRSP showed a high potential sequestration capacity for Pb, Cd, Zn, Cu, Fe and Mn thus influencing their mobility in the soil (Vodnik et al., 2008, Cornejo et al., 2008).

WHAT IS GLOMALIN ?

Glomalin, a stable and persistent glycoprotein, is released by hyphae and spore Arbuscular mycorrhizal fungi in the taxon Glomales, including fungi of the genera *Acaulospora, Entrophospora, Gigaspora, Glomus, and Scutellospora*. Glomalin appears to have properties and functions similar to fungal hydrophobins, which is small, self aggregating, hydrophobic proteins found on hyphae of many types of fungi, including ectomycorrhizal fungi (Nichols and Wright,2004). The glomalin protein some molecular properties contain iron, appear to have N-linked oligosaccharides and are insoluble and possibly hydrophobic in its native state. Soil structure is important for facilitating water infiltration, biogeochemical cycling processes, resistance against erosional soil loss, and soil carbon storage (Jastrow and Miller,1997). Glomalin is a stable compound, insoluble in water and resistant to heat degradation. Because it is a glue like in nature attaches to horticultural film and soil surfaces, glomalin is likely hydrophobic in its native state. Apart from the *Glomeromycota*, no other fungal group produces this glycoprotein in significant amounts. Glomalin is found in agricultural, grassland, forest, desert and non-cultivated soils (Wright and Upadhyaya, 1996).

Glomalin, through still not biochemically defined, is an N-linked glycoprotein composed of 3 to 5% N, 36 to 59% C, 4 to 6% Hydrogen, 33 to 49% Oxygen, and 0.03 to 0.1% P. Glomalin also contains 0.8 to 8.8% Fe, which may be responsible for the reddish color of glomalin. Iron concentrations of 0.8 to 8.8% protect glomalin from degradation by as proposed for the role of Fe in organic matter and may increase the thermal stability and antimicrobial properties of glomalin (Fokom et al., 2012).

ROLE OF GLOMALIN FOR SOIL SUSTAINABILITY

Mycorrhizal fungi are important factors of soil quality through their effects on host plant physiology, soil ecological interactions, and their contributions to maintaining soil structure. They improve soil structure stability with production soil organic components like as glomalin related soil protein (GRSP). GRSP is generally well correlated with soil aggregate water stability, and may hence be a useful integrative

indicator of soil quality. Other positive effects are the interactions of arbuscular mycorrhizal fungi (AMF) with other beneficial bacteria, which may cause a synergistic beneficial effect for the host plant (Biro et al., 2002).

Soil organic matter

AMF contributes to numerous ecological advantages like influencing microbial and chemical environment of the mycorrhizosphere, stabilizing soil aggregates. In the soil, plant - mycorrhizae produced organic carbon are found in two pools: (I) the labile, "light" or particulate organic matter (POM) fraction and (II) the recalcitrant, "heavy" or humic fraction. A large fraction of soil carbon is labile and can be easily decomposed when exposed to microbes, especially under high temperature and moisture. However, when these labile Carbon fractions are stored in soil aggregates, they are better protected and decompose less than when in bulk soil. Generally, all attributes of AMF facilitate carbon storage; while the intraradical mycelium enhances CO2 fixation and rhizo-deposition by plants, the extraradical mycelium promotes the storage of the acquired carbon in aggregates. Additionally, because erosion is a main channel of soil organic carbon (SOC) losses, AMF can reduce carbon lost via erosion through the formation of water stable aggregates. A well structured soil is less susceptible to wind and water erosion compared with a poorly structured soil (Smith and Almaraz, 2004). Soil organic matter is of great significance in determining or influencing numerous aspects of soil quality, including nutrient storage capacity and water -holding capacity. Thus, AMF are not only a factor but also key determinants of soil quality.

The recently discovery of soil organic matter (SOM) component 'glomalin' is a ubiquitous and abundant glycoproteinaceous molecule. However, unlike particulate organic matter (POM) or humic substances, glomalin is not derived from the decomposition of plant or microbially produced material. Glomalin forms a hydrophobic sheath on hyphae that may keep material from being lost from across the hyphal membrane and/or may protect the hyphae from microbial attack. Its presence in soil helps to stabilize aggregates. Glomalin appears to be highly correlated with aggregate stability and with carbon sequestration in the soil by helping to physically protect organic matter within aggregates (Rillig et al., 1999).

Nutrient availability

Arbuscular mycorrhizal symbiosis is possibly the oldest and the most abundant plant - microbe association on earth. The symbiosis also plays a role in nutrient cycling in soil, in ecosystem productivity, and plant variety (Koch et al., 2006). In AMF-plant symbioses, AMF translocate nutrients from soil to plant through the extraradical mycelium, and in return, the plant supplies AMF with carbon in the form of photosynthates; about 5 to 85% of Carbon depending on the plant species. Apart from nutrient uptake, the extraradical mycelium also is involved in spore formation and initiation of root colonization. Spores, hyphae, and colonized root and organic matter are propagules of AMF (Treseder and Allen, 2000). The significance of mycorrhizal symbiosis in the nutrition and well- being of the individual plant is well established. The

major benefit for plants when being mycorrhizal is an increase in plant nutrient uptake from the soil. Inorganic and organic nutrients are absorbed by extraradical hyphae from the soil through specific transporters of phosphate, ammonium, nitrogen, amino acids, zinc, and copper. All of these are subsequently moved to the plant roots (Cappellazzo et al., 2008). Enhancements in the acquisition of K, Ca and Mg are often observed in VAM colonized plants grown on acidic soils than neutral or alkaline soils (Harrier and Watson, 2003). Zinc and Copper have been taken up by mycorrhiza in a deficient condition to increase plant yield. Paradoxically, there is evidence that VAM can inhibit Zinc and Manganese (Mn) uptake at toxic concentration in soil thus reducing adverse effect on host.

Soil aggregation

Soil aggregation is a complex process that glues together of soil particles (minerals, organic matter, etc.) together into pellets. These pellets are rich in nutrients and resist erosion. Aggregation processes in soil are influenced by a large number of factors such as changes in soil organic matter (SOM), moisture content and microbial activity, tillage and fertilization.

The structural stability is dependent on particle size distribution, soil organic matter, vegetation and soil micro-organisms and its stability is influenced by exchangeable cations. One of the most important binding agents for forming stable aggregates is soil organic matter (glomalin). Organic materials are important soil additives to improve soil physical properties (Grandy et al., 2002).

Glomalin contributes to the stabilization of aggregates by sloughing off hyphae onto the surrounding organic matter, binding to clays and providing a hydrophobic coating. This is demonstrated in a number of experiments, where total and, especially, immunoreactive concentration of glomalin are positively correlated with percent water-stable soil aggregates in both agricultural and native soils. (Rillig et al., 2003; Wright and Anderson, 2000). Glomalin is an important molecule in aggregate stabilization. When aggregates are not stabilized, they break apart with rainfall. Organic matter and nutrients within disrupted aggregates may be lost to rain and wind erosion. The chemistry of glomalin makes it an ideal stabilizing coat.

Stress management

AMF symbiosis protects host plants against detrimental effects caused by drought stress. Drought stress is a major agricultural constraint in the semi-arid tropics. It is known to have a considerable negative impact on nodule function. Several mechanism have been proposed to explain the protection of AMF symbiosis, such as changes in plant hormones, increased leaf gas exchange and photosynthetic rate; direct hyphal water uptake from the soil and transfer to the host plant, enhanced activity of enzymes involved in anti-oxidant defence, (Ruiz-Lozano et al.,1999) nitrate assimilation, enhanced water uptake through improved hydraulic conductivity and increasing leaf conductance and photosynthetic activity, (Dell-Amico et al.,2002) osmotic adjustment

and changes in cell-wall elasticity. Often mycorrhizal improvement of drought tolerance occurs via drought avoidance.

Researches revealed that GRSP-induced aggregate stability is more conspicuous under drought (Wu et al., 2008) than under salinity (Kohler et al., 2009). Nichols (2008) proposed that GRSP aided in conserving the loss of water and nutrients from the soil exposed to abiotic stress, due to formation of hydrophobic layer on the surface of aggregate by GRSP. Studies further indicated that easily extractable- GRSP(EE-GRSP)and total- GRSP (T-GRSP) were, to some extent, increased by drought stress within rhizosphere of trifoliate orange seedlings (Wu et al., 2008; Zou et al., 2014), because drought-stress-induced death/senescence of mycorrhizal hyphae released more GRSP into soils (Driver et al., 2005). Correlation studies showed that T-GRSP but not EE-GRSP had a significantly negative correlation with soil and leaf water potential in the mycorrhizosphere of potted trifoliate orange (Zou et al., 2014), suggesting that T-GRSP was more active under drought stress than EE-GRSP. As revealed by earlier studies (Wu et al., 2008; Zou et al., 2014), mycorrhizal inoculation improved soil WSA distribution and WSA stability in terms of GRSP and mycorrhizal hyhae, beneficial for the host plants to drive soil water. In addition, soils with higher GRSP contents are less susceptible to soil erosion (Haddad and Sarkar, 2003).

Carbon sequestration

Soil carbon sequestration is an important function of terrestrial ecosystems. It is recently coming to light that mycorrhizal fungi may play an important role in maintaining this pool in soil (Treseder, and Turner, 2007). Measurements of plant carbon allocation to mycorrhizal fungi have been estimated to be 5-20% of total plant carbon uptake and in some ecosystems the biomass of mycorrhizal fungi can be comparable to the biomass of fine roots. Recent research has shown that mycorrhizal fungi hold 50 to 70 percent of the total carbon stored in leaf litter and soils of forest lands (Rillig, and Steinberg, 2002). Based on the magnitude of mycorrhizal fungal inputs to the soil carbon pool, some have suggested that variation in the recalcitrance of mycorrhizal biomass may be important for predicting soil carbon storage, as it would affect the rate at which the contribution of mycorrhizal fungi to soil carbon is returned to the atmosphere.

The glomalin, a glycoprotein produced only by arbuscular mycorrhizal fungi, has been found to accumulate in some soils, and may be a substantial fraction of the soil carbon pool in these ecosystems (Purin, and Rillig et al., 2007). It may be hiding place for up to 30% of soil organic carbon. Glomalin as a recalcitrant glycoprotein with half life of about 50 years, persist in soil for a long time. By this way, the key role of glomalin in carbon sequestration in terrestrial ecosystems is well obvious (Cameron et al., 2008).

MANAGEMENT OF GLOMALIN IN SOILS

Soil management to increase aggregation must aim at increasing primary plant production, increasing the amount of C input into the soil, decreasing disturbances and decreasing the rate of C loss by processes such as decomposition and erosion. In this

regard, improved management practices include tillage methods, residue management, amendments, soil fertility management and nutrient cycling (Filho et al., 2002).

(i) **Minimum or no-till to reduce disruption of hyphal network:** Use no-till management practices to allow AMF to grow during the cropping season. Tillage disrupts the hyphal network that produces glomalin. Disruption of the hyphal network also decreases the number of spores and hyphae to start the process again on the next crop.

(ii) **Cover crops to maintain living roots:** Use cover crops to maintain living roots for the fungi to colonize.

(iii) **Reduced inputs, minimum Phosphorus:** Maintain adequate phosphorus level for crops, but does not over-apply P because high levels depress the activity of these fungi.

CONCLUSION

Arbuscular mycorrhizal (AM) fungi are key organisms of the soil-plant system, fundamental for soil fertility and plant nutrition. Arbuscular mycorrhizal fungi, found living on plant roots around the world, appear to be the only producers of glomalin which has the potential to increase soil carbon (C) and nitrogen (N) storage and is mainly involved in soil aggregation. These glues are carbon-containing compounds that protect microorganisms from exposure to air out. Glomalin protects hyphae during transportation of nutrients from the plant to the hyphal tip and from soil to the plant. Glomalin enhance soil aggregation competence in soil which increases the water holding capacity and nutrients in soil. At present, it is possible that the greatest benefit of high AMF colonisation in crop plants is non-nutritional, via the effects on soil structure and function, and on plant defences. As such, future work should focus on optimising AM effects on nutrient uptake so that yield is maintained while improving the sustainability of output. By identifying and optimizing those traits associated with AMF receptivity, functionality and climate resilience within modern crop cultivars, significant progress can be made towards achieving future food security in more sustainable agricultural systems.

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