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Its Production and Export

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Agronomic Biofortication Of Crops

–An Effective Strategy to Combat Malnutrition

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During 1960's when our country was striving hard to fill the empty belly of our burgeoning population, "Green Revolution" turns out to be a magic bullet against it with which our country was able to achieve food security but despite this, achieving nutritional security is still a daunting task for developing country like India which is a home to about 240 million undernourished people, which is about one fourth of the world. Thirty years since India has achieved food security, but still it is unable to provide nutritional security to millions of its people. 'Green revolution' which is synonymously known as seed cum fertilizer revolution has been successful in boosting food supply on one hand and on the other hand it has pose a challenge in terms of combating the threat of soil degradation and decline in soil fertility which has rendered our soil deficient in micronutrients particularly in Zn and Fe which are essential for maintaining animal, plant and human health which itself reveals from the report of UNSSCN, 2004. They projected that malnutrition of zinc and iron affects more than one half of the world population, mostly women and pre-school children. Zn and Fe deficiencies are a growing public health and socio-economic issue particularly in the developing world (Welch and Graham, 2004). According to a WHO report on the risk factors responsible for development of illness and diseases, Zn deficiency ranks 11th by among the 20 most important factors in the world and 5th among the 10 most important factors followed by the developing countries. Zinc and iron deficiencies together with vitamin A deficiency have been identified as the top priority global issue to be addressed to achieve a rapid and significant return for humanity and global stability

(www.copenhagenconsensus.com).

Keeping all the above statistics and findings in mind, biofortication seems to be the only possible outcome to combat malnutrition which was even supported by the leading economist of the world in the Copenhaegen Consenses, 2008. Agronomic biofortification of feed and fodder crops will help in maintaining soil-plant-animal-human continuam.

Biofortication is the practice of deliberately increasing the content of an essential micronutrient viz. Zn, Fe, vitamins and in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health, which involves different fortification strategies *viz.,* Agronomic biofortification ,Conventional biofortification and Transgenic (genetic) biofortification out of which agronomic biofortification seems to be a simple, viable and sustainable strategy which aims at enhancing Zn and Fe content in the edible portion of the crop through optimization of the rates, sources, method and time of application of micronutrients, integrated use of mineral fertilizers and organics, use of crop rotations and intercropping (Rengel *et al*, 1999).

Fertilizer strategy could be a rapid solution to the problem and as be considered an important complementary approach to the ongoing breeding programmes. It focuses specifically on increasing zinc concentration of grain (or other edible part) and thus yields increment by their application via soil or foliar spray. Zinc can be directly applied to soil as both organic and inorganic compounds among Which $ZnSO_4$ is the most widely used inorganic source of zinc on account of its high solubility and low cost. Zinc can also be applied to soils in the form of ZnO. The agronomic effectiveness of zinc fertilization is higher with ZnEDTA in comparison to inorganic zinc fertilizers. (Mortvedt 1991) however in lieu of its higher cost, its use is limited.

Need of agronomic biofortification

Deficiencies of essential elements in Indian soils and crops started emerging during 1950's after the initiation of the government of independent India, A five-year plant to give fillip to food production through crop intensification. As food production increased with time, the number of elements particularly micronutrients in soils and crops also increased on account of use of hybrid cultivars which are heavy nutrient feeder, Ignoring or minimising the use of organic manures like FYM, which help in supplying these nutrients and use of high

analysis fertilizers devoid of micronutrients and toady the situation is so alarming that about 49% and 13% of Indian soils are deficient in Zn & Fe respectively, resulting in low uptake and concentration of these nutrients in food crops particularly in cereals, i.e. rice and wheat. At present they account for about 83 % of the total cereal produced in the country and are the backbone of the country's food security (Prasad *et al*, 2012) and contribute 60 % to national calorie intake (Laxmi et al, 2011) of the people residing in developing countries where it afflicts over 2 billions, if they are being biofortified, it will be specifically fruitful for the low income country people which are undergoing the hardships of malnutrition which is a major global challenge in today's context.

Requirement of zinc and iron in food for human being is 15 mg day^{-1} (NRC 1989) and food grains contain 15-35 mg kg^{-1} (Cakmak *et al*. 2004). However to ensure required amount of zinc and iron, food grains must contain 40-60 mg kg^{-1} (Pfeiffer and McClafferty, 2007) of these nutrients, So to fill this gap in short run, biofortication seems to be an alternative approach

Biofortified crops and their role in improving food and nutritional security

Increasing seed concentration of zinc by soil or through foliar application play a dual role in impoving nutritional security on one hand and food security on the other, as the better agronomic characteristics posses by theses micronutrient dense crops and seeds helps in achieving higher yields. Cakmak, 2008 believes that in addition to improving human health, micronutrient dense seeds and crops also improves tolerance to abiotic stresses, gives higher yield on micronutrient deficient soils and increase resistance to insects, pests and diseases.

Cakmak, 2008 in Istanbul,Turkey reported that blending of zinc fertilizers together with NPK resulted in increased yield and leaf zinc concentration of bean plants over control which might be due to the less reaction of zinc with soil constituents. Increased straw yield and seed yield over control was recorded by the combined application of @ 10 kg $ha^{-1}$of Fe via soil and 0.1 % via foliar spray in green gram at Hisar by Debroy *et al*, 2013

Seeds with low zinc concentration might not be viable despite their normal appearance. Welch, 1999 reported that sowing of seeds with low zinc concentration are liable to be susceptible to various environmental stresses at early growth stages. It is therefore

important to maintain sufficient amount of zinc in soils during seed germination and early seedling development. Cakmak (2008) belives that in addition to improving human health, micronutrient dense seeds and crops also improves tolerance to abiotic stresses, gives higher yield on micronutrient deficient soils and increase resistance to insects, pests and diseases.

CONCLUSION

In order to counteract the widely spread micro-nutrient malnutrition, agronomic biofortication or ferti-fortification is the most viable and simple strategy which plays a dual role in improving food and nutritional security of the country. This is the high time to bite on bio- fortified food and to focus on translating food security into nutritional security. This is time when we have to keep the following notion in our minds "Focus on better food not only more food, the expected rewards are higher"

FUTURE THRUST

- In future, new research programs should be initiated focusing on development of most efficient zinc application methods for promoting zinc uptake and maximizing zinc accumulation in grain
- Development of "improved techniques for micronutrient enrichment" in grain through external or native supply of micronutrients and enhancing bioavailability of micronutrient in human and animals is very much needed.
- Creating mass awareness about malnutrition and remedial measures is needed.

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Table 1: Grain yield and leaf Zn concentrations of bean plants as affected by application method of $ZnSO_4$ together with a granular NPK fertilizer

Method of zinc application	Yield (kg ha^{-1})	Leaf zinc concentration (mg kg^{-1})
No application	1230	20
Blended	1660	40
Incorporated	1640	31
Coated	1670	34

Table 2: Effect of iron application on seed yield (g/pot) of greengram genotypes

Genotype	Fe level(Kg/ha)		Foliar (0.1% Fe)	10 Kg Fe/ha+ Foliar (0.1% Fe)	Mean
	Control	10			
Asha	7.47	8.91	8.26	11.65	9.1
Basanti	6.52	8.60	7.85	9.44	8.1
Satya	7.14	10.56	8.24	11.77	9.4
MH 421	4.47	6.35	5.73	7.39	6.0
MH 318	5.51	6.72	6.22	7.74	6.5
MH 565	4.76	6.73	7.48	7.75	6.7
Muskan	5.21	7.22	7.48	8.12	7.0
Mean	5.9	7.9	7.3	9.1	

CD (P = 0.05) Treatment = 0.58, Genotype = 0.69 Treatment × Genotype = NS

Table 3: Effect of iron application on straw yield (g/pot) of greengram genotypes

Genotype	Fe level(Kg/ha)		Foliar (0.1% Fe)	10 Kg Fe/ha+ Foliar (0.1% Fe)	Mean
	Control	10			
Asha	52.5	61.8	58.8	62.0	58.8
Basanti	45.2	58.7	55.7	62.1	55.4
Satya	49.3	72.6	58.4	72.8	63.3
MH 421	31.9	45.2	42	47.6	41.7
MH 318	30.5	48.6	38.2	48.9	41.6
MH 565	31.1	46.9	49.3	47.2	43.6
Muskan	37.9	56.8	51.9	58.4	51.3
Mean	39.8	55.8	50.6	57.0	

CD (P=0.05) Treatment = 4.4, Genotype = 5.1 Treatment × Genotype = NS

Footrot and Its Management in Sheep

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Ovine (sheep) footrot is a serious disease which has long been dreaded by sheep owners. Foot rot is a common hoof infection found in sheep, goat and cattle. It is a disease which causes severe economic loss due to lameness, decreased wool production and disruption to normal farm operations. It is extremely painful and contagious.

Etiology

Footrot is an infectious disease caused by the bacteria, *Dichelobacter nodosus* (*D. nodosus*). It was previously known as *Bacteroides nodosus* and before that as *Fusiformus nodosus.* This organism may also infect goats and occasionally cattle.

D.nodosus requires warm, moist conditions for ideal multiplication. The bacteria can only survive away from the foot for a maximum of 7 days, even in ideal conditions. In less favourable dry conditions, the bacteria die rapidly. Bacteria are readily killed by dry heat, sunlight, cold, dry environment and a number of different chemicals..

The virulence describes its ability to digest the connective tissue between the horn and flesh of the hoof of foot. The virulence varies widely between the various strains of bacteria.

Benign footrot : Bacteria of low virulence have poor ability to under-run the hoof horn and therefore, mostly affect the skin between the toes; this is benign footrot.

Virulent footrot : Bacteria rapidly under-run and separate the hoof horn from the foot. Most bacteria fall somewhere between the benign and virulent extremes. Virulent footrot is a specific, chronic, necrotizing disease of the epidermis of the interdigital skin and hoof matrix that begins as an interdigital dermatitis and extends to involve large areas of the hoof matrix. Because the sensitive lamina and its network of capillaries are destroyed by the infection, the hoof wall (corium) loses its blood supply and anchorage to the underlying tissue and becomes detached. Footrot is extremely contagious and, under suitable conditions and susceptible genetics, morbidity may approach 100%.

Susceptibility

Sheep that have been infected with or exposed to footrot do not develop any significant natural immunity or resistance. Short term immunity can be achieved using vaccines.

When assessing virulence by examining feet it is important to consider the environment of the sheep's foot and the time since infection occurred.

- Foot shape and structure affect susceptibility.

- Goats are usually less severely affected, and may exhibit different symptoms to sheep infected with the same strain of bacteria.
- Merinos are often the most susceptible and severely affected.
- Low virulence strains are most severe in Merinos but are also seen in goats and cattle.

Spread

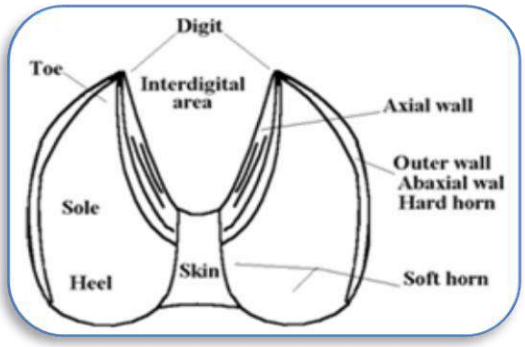
Spread is primarily from foot to foot via pasture or mud. Goats, cattle and possibly vehicles can act as carriers. However moist pasture and muddy yards are the main areas where footrot is spread. Footrot will therefore spread most rapidly when it is warm and moist, as in winter.

Clinical signs

The signs of infection vary from mild reddening of the interdigital skin to complete separation of the horn of the hoof. Infection commences when bacteria lodge on the interdigital skin causing inflammation, the skin horn junction then begins to erode and the horn starts to lift. From this point, the bacteria move under the horn causing separation of horn around the heel, sole, toe and eventually to the outer wall.

Sheep infected with footrot become progressively more lame and exhibit the following signs in progressive order

- Inflamed, red and moist skin between the digits
- A grey pasty scum between the digits
- Lifting of skin-horn junction between digits
- Under-running or separation of horn around heel, sole, toe and finally to the outside hoof wall.
- Infected feet may also have a characteristic foul smell



Factors affecting signs of footrot

The rate of spread of footrot through a flock, extent of under-running and speed of development of footrot signs in individual feet all depend on the four factors listed below. All must be considered in assessing any footrot outbreak;

- Environment - moisture and temperature in the pasture.
- Virulence of infecting bacteria.
- Type of sheep - Breed and soundness and shape of feet.
- Stocking rate and proportion of infected sheep.

After infection, the horn continues to grow and often encapsulates a pocket of infection inside the hoof. This makes detection difficult. New horn growth is often deformed by underlying infection and this provides a diagnostic sign.

During dry periods, the disease naturally regresses in a flock, lameness will decrease accordingly, but infection will survive in many feet. During dry times spread is absent, therefore interdigital signs are minimal.

The succulent nature of footrot affected feet attracts flystrike. Consequently flystruck feet and associated body strike are a common feature of footrot outbreaks. Severe pain and lameness are always associated with flystruck feet and this causes animal welfare problems.

Diagnosis

- In flocks with virulent footrot, underrunning and separation of the hard horn of the hoof of one or more feet, complete with the characteristic odor, is diagnostic.
- If the problem is discovered early when interdigital dermatitis is the only sign, it should be assumed that the condition is an early stage of contagious footrot, and treatment should be initiated immediately.
- An early and precise diagnosis will assist in designing the best treatment program, reducing costs and avoiding treatment failures.
- Many feet must be examined. Examining only one or two sheep can be misleading and may result in unnecessary or incorrect treatment.
- An assessment of virulence should also be made. This may require observing development of the infection in individually marked sheep over several weeks.

Differential diagnosis

The conditions that can appear similar to footrot includes

- Foot abscess - usually only one foot affected with swelling and pus.
- Scabby mouth - affects skin above the hoof and has dark scabs.
- Shelly hoof (toe) - is a natural and dry separation of the outside of the hoof horn beside the toe. The resulting cavity may contain mud, faeces or stones and may become flystruck.
- Bruising - lameness in soft feet without other signs.
- Ovine Interdigital Dermatitis (OID) - inflammation of interdigital skin during warm wet weather. There is no under-run and OID heals quickly if feet are kept dry, such as overnight on battens. This condition is not uncommon, creates an ideal environment for footrot bacteria to infect, appears similar to the early stages of virulent footrot and is very similar to benign footrot.
- Strawberry footrot - scabs on skin at back of foot above the hoof, hot and swollen foot

Treatment

- Treatment may be directed toward temporary control of the disease or total eradication. At certain times, eg, during a wet season, temporary control may be the only realistic goal.
- Traditionally, treatment consisted of **foot bathing** using **antibacterial solutions** after careful hoof trimming to remove all dead horn and expose infected tissue and bacteria to air. However, foot soaking for 30–60 min has been shown to be more effective even when trimming is not done. The most effective solution is **10% w/v zinc sulfate with 0.2% v/v of laundry detergent containing nonionic surfactants such as sodium lauryl sulfate**.
- The advent of long-acting antibiotics used in combination with topical foot treatments has improved recovery and reduced carrier animals. Parenteral treatment using a long-acting antibiotic gives a duration of effect in cattle of 7–8 days and probably a similar duration of effect in sheep. However, sheep must be placed in a “clean” area (ie, one in which no sheep have been kept for at least 3 wk) or in a completely dry lot after they are run through a foot bath and given the antibiotic.
- Sheep will become reinfected as soon as the antibiotic is cleared if returned to a contaminated environment. The feet of treated sheep should be examined once a

week to identify those not responding to treatment. Sheep that do not respond should be isolated and preferably culled. *D nodosus* is extremely difficult to eradicate from animals that have relapsed numerous times. Furthermore, subclinical or relapsing cases take valuable time to handle, identify, and isolate, and they remain a source of infection for other animals.

Prevention and Control

- Animals from unknown premises or auction houses should not be purchased.
- Any sheep to be added to the flock should be q**uarantined** for several weeks to prevent the spread of footrot and other chronic diseases.
- During the quarantine period, the animal's feet should be lightly trimmed and examined closely for *D.nodosus* infection. Vehicles (eg, trucks, trailers) or facilities in which unknown or infected sheep have been held should be thoroughly cleaned and disinfected before placing uninfected sheep in them. If it is not possible to thoroughly disinfect transport vehicles, zinc sulfate can be liberally scattered over the floor to reduce viable bacteria.
- Because the incubation period of footrot is ~14 days, foot bathing at 10-day intervals will control spread of the organism in affected flocks during periods of the year when the sheep are in wet conditions.
- Footrot has been controlled by placing foot baths with 10% w/v zinc sulfate solution around water troughs, forcing sheep to walk through them and stand in order to drink.
- Addition of zinc to trace mineral salt, reportedly effective in reducing hoof rot in cattle, has not been shown to be particularly helpful for sheep footrot. However, zinc is important for immunity and skin/hoof health. Providing it in a well-balanced trace mineral mix may be helpful in locations deficient in zinc.

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Nanotechnology and its role in efficient fertilizer development and delivery

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There are many technological gaps regarding nutrient supply system in Indian soils. Indian soils have low status of soil organic carbon and soil degradation due to high salinity, sodicity, acidity, water logging and low nutrient use efficiencies owing to both macro and micro nutrients having adverse effect on below-ground biodiversity, especially of agriculturally-important micro-organisms and this is leading to an inadvertent, detrimental impact on the environment and on ecosystem services. These all are evidences that present agricultural practices require amendments.

Changes in agricultural technology have been a major factor shaping modern agriculture. Among the latest line of technological innovations, Nanotechnology occupies a prominent position in transforming agriculture and food production.

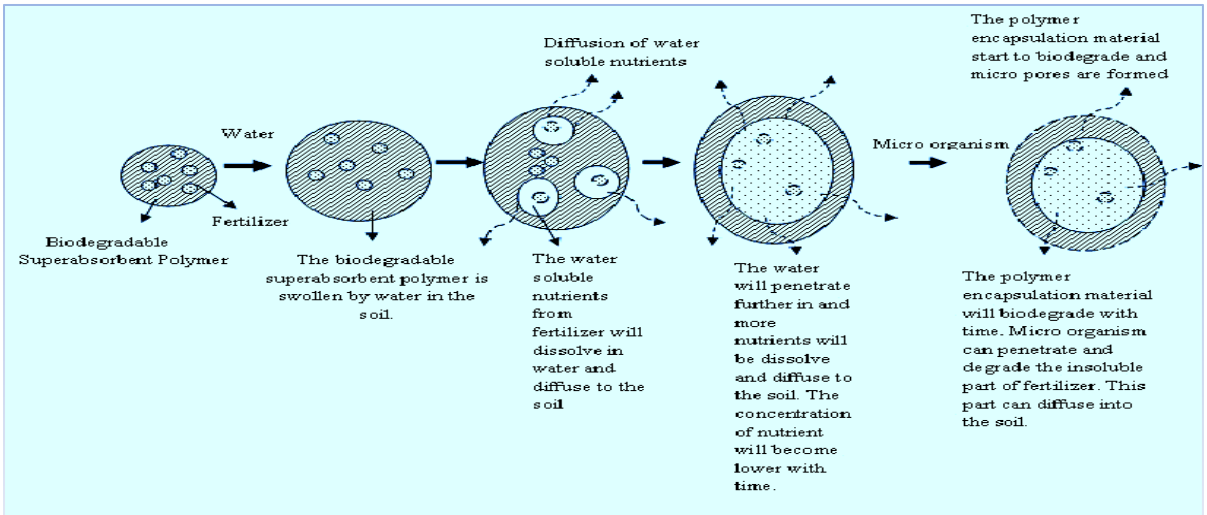
Nanotechnology is the understanding and manipulating the matter at scales measured in nanometers (1-100 nm) at least in one direction. Nanotechnology is a new techno-scientific platform, where range of exiting techno-scientific disciplines like as chemistry, physics, biology, biotechnology, neurology , and engineering are able to shift down to the molecular level.

Concept of Nanotechnology

Nanotechnology works on concept that at nano scale, the surface area of particles is very large relative to their small size, the fundamental properties of matter at nano scale may also differ from that of corresponding bulk materials which can make even a small particle very reactive. Thus, these novel properties help in development of revolutionary technologies. Example Carbon in form of graphite is relatively soft but nano form of carbon nanotubes is 117 times stronger than steel.

Nanotechnology and its application in fertilizer development

Fertilizers have an axial role in enhancing the food production in developing countries especially after the introduction of high yielding and fertilizer responsive crop varieties. In spite of this, it is known that yields of many crops have begun to depression as a result of imbalanced fertilization and decrease in soil organic matter. Moreover, excessive applications of nitrogen and phosphorus fertilizers affect the groundwater and also lead to eutrophication in aquatic ecosystems. Such cases along with the fact that the fertilizer use efficiency is about 20-50 percent for nitrogen and 10-25 percent for phosphorus fertilizers implies that



(Source- Munusamy et. al, 2013)

food production will have to be much more efficient than ever before . According to this and limited availability of land and water resources, development of agriculture can be achieved exclusively through increasing productivity by effective use of modern technologies. Among these, nanotechnology has the potential to revolutionize the agricultural systems. This includes the fine tuning and more precise micromanagement of soils; **the more efficient and targeted use of inputs** in order to enhance productivity and for sustainable agriculture management as modern approaches of nanotechnology.

Nanotechnology and efficient fertilizer use system

This can be achieved by adapting -

- Nano-porous materials *e.g*. hydrogels and zeolites
- Fertilizers encapsulated in nanoparticles
- Nano-based smart delivery system (use of nano biosensors)-

Nano-porous materials *e.g*. hydrogels and zeolites- these are naturally obtained biodegradable polymeric materials that have swelling and water retaining properties. The fertilizers (like urea, DAP etc are broken on nanoscale and are stablised) are encapsulated under nano porous materials and used as smart delivery system as mentioned in the diagram.

These nano drugs can be equipped with nano-biosensors which mainly consist of aptamers which are synthetic stretches of DNA that can fold into nano-sized shapes capable of binding to molecular targets. The biosensor is incorporated into a very thin film of polymer, the signals in form of stress hormones, exudates etc. are received by receptor, thus, obtained by transducer which is then processed, and recommendations are made. Interaction of root exudates (released in case or water or nutrient stress) changes the permeability of polymer film and release nutrient according to crop demand.

Potential benefits of Nanotechnology applications in efficient use of fertilizers

Currently the research and development pipeline has the potential to make agriculture more efficient, increase yields and product quality, and thereby increasing nutritional benefits. Developed

countries are using or testing nano-sensors and nano agricultural chemicals, nano-particles for efficient and smart fertilizer use and delivery system.

There are several reports on the great potential of agricultural nanotechnology in developing countries. Promising nanotechnology applications address low use efficiency of agricultural production inputs and stress of drought and high soil temperature. Nanoscale agrichemical formulations can increase efficiency use and decrease environmental losses. Nanoporous materials capable of storing water and slowly releasing it during times of water scarcity could also increase yields and save water

CONCLUSION

Indian fertilizer system needs a relook as traditional fertilizer use techniques are facing stagnation in terms of its response on production. And recent research in field of nanotechnology in agriculture has emerged as ecologically feasible and clean environment techniques that deliver the nutrients smartly.

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Causes of formation of saline and sodic soils and its reclamation

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Soils are the most valuable natural resources. It takes thousands of years to produce an inch of soil. It is therefore important thing to conserve and manage the soil. Salinity and alkalinity of soils are most serious problems. In the world about 952 million ha area is under soil salinity and alkalinity condition, whereas in India it is about 7421 thousand ha. Soils in which concentration of salts is so high as to adversely affect plant growth and crop productivity are called as salt affected soils from agricultural point of view. In arid and semi-arid regions, the annual rainfall is not sufficient to leach down salts to lower layers of soil. This results in the accumulation of large amounts of salts in root zone of soil. The intensity of soil salinisation increases with increase in dryness of the climate.

The major salts which lead to the formation of saline and sodic soils include chlorides, sulphates, carbonates and bicarbonates of calcium, magnesium and sodium. The contents of potassium salts are generally low. Under dry arid conditions, large amounts of salts of boron, nitrates and fluorides can also accumulate.

Area of salt affected soils in India

State	Area (thousand ha.)
Andhra pradesh	394
Bihar	85
Goa	17
Gujrat	1649
Haryana	555
Punjab	480
J&K	80
Karnataka	179
Kerala	45
M .P.	242
Maharastra	127
Orissa	135
Rajasthan	1183
Tamil nadu	470
U.P.	958
Andaman&N.Island	1
Delhi	0.6
Pondichery	0.3
Total	**7421**

Causes of Formation of Saline and Alkali Soils

1- **Weathering of Rocks and Minerals**

Weathering results in release of neutral soluble salts i.e. Ca^{++}, Mg^{++} and Na^{+}. These

salts moves downward but due to little amount of rainfall moves upward due to high temperature and accumulate on surface .

2- **Hydrolysis of Sodium Saturated Soil Complex**

Soluble salts in process of leaching of ca^{++} ions are replaced by Na^{+}. Soil micelle is then saturated with sodium resulting formation of sodium carbonate. Sodium carbonate undergoes hydrolysis to form sodium hydroxide which dissocited to increase concentration of hydroxyl ions in soil solution.

3- **Arid and Semi arid Climate**

Poor rainfall and high temperature in arid and semiarid regions are very favorable condition to formation of saline and alkali soil. Due to low rainfall salts can not leach down and accumulate on surface.

4- **Salty under ground Water**

Ground water of arid region contains considerable amount of soluble salt. These salts moves upward.

5- **Quality of Irrigation Water**

If Water available for irrigation contains excessive amount of Ca^{++}, Mg^{++}, Na^{+}, Cl^{-}, $SO4^{--}$, HCO_3^{-}, CO_3^{--}, $Bo_3^{--}$and NO_3^{-} their continuous application is reflected on quality of soils. Beside this

a) A rise in ground water level due to excessive irrigation.

b) Poor drainage which prevent leaching of salts are also lead to formation of salt affected soils.

6- **Use of Basic Fertilizers**

Use of basic fertilizers like Sodium nitrate, Basic Slag may develop soil alkalinity.

Classes and Characteristics of Salt affected Soils

Name of Soil	pH	Ece	SAR	ESP
Saline Soil	<8.5	>4	<13	<15
Saline alkali Sosil	<8.5 (usually)	>4	>13	>15
Alkali Soil	>8.5	<4	>13	>15
Degraded alkali Soils	>8.5	>4	>13	>15

COMMON SOURCES OF SALTS

1- **Rocks and Minarals**

- Geochemical and geohydrological process at exposed rocks and minerals in surface of earth crust is direct source of salts in soil.
- Salts Originates as result of hydrolysis, hydration, carbonation, oxidation and reduction of minerals *viz.* Halite, Gypsum, Sulphides, Calcite, Dolomite, Apatite, Feldspathoids, Olivine, Feldspar (Albite, Anorthite,Orthoclase) and Primary layer Silicates(Biotite, Glauconite).

2- **Ocen Water**

- Contains about 42x1015 tonnes of dissolve salts (of which 85.6% is NaCl).
- Primary source of salt in low lying costal areas.
- Salts from ocean can also be transported to the inland area with rainwater and by wind.

3- **Atmosphoric Accession of Salts**

Can Occur as result of falling dried droplets of ocen wate from atmospheres (aerosol) along with rain water or as dry salt dust.

4- **Marine Rocks and Evaporites**

Developed with upliftment of many part of contents from sea/ocean.

Solublity of Different Salts

Sr. No.	Salt	Solublity (g/L)
1	Carbonate of Ca	0.013
2	Carbonate of Mg	2.5
3	Chloride of Na	264
4	Sulphate of Na	161
5	Carbonate of Na	178
6	Sulphate of Na	1.9
7	Sulphate of Mg	262
8	Chloride of Ca & Mg	>400

RECLAMATION:

For the proper reclamation of saline and sodic soils we should adopt the following steps.

1. Providing proper drainage to the land.
2. Use of salt free irrigation water.
3. Use of organic manures and acidic fertilizers.
4. Application of amendments like gypsum, iron pyrite, sulphur shows better results in the reclamation of saline and sodic soils.

CONCLUSION:

It is therefore concluded that the factors responsible for the formation of saline and sodic soils are low rainfall, salty irrigation water, poor drainage facilities, use of basic fertilizers.

Biochar for Soil and Environment Management

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What is Biochar

Biochar is a fine grained charcoal high in organic carbon and largely resistant to decomposition. It is produced from pyrolysis of plant and waste feedstock.

Back ground of Biochar

- Biochar is a relatively new term, it is not a new substance. Soils throughout the world contain biochar deposited through natural events, such as forest and grassland fires.
- It is produced from pyrolysis of plant and waste feedstock.
- As a soil amendment, biochar creates a recalcitrant soil carbon pool that is carbon negative, serving as a net withdrawal of atmospheric carbon dioxide stored in highly recalcitrant soil carbon stock.
- The enhanced nutrient retention capacity of biochar – amended soil not only reduces the total fertilizer requirements, but also the climate and environment impact of crop lands."

Importance of Biochar

- Improves soil fertility
- Prevents soil erosion
- Improves soil quality by raising soil pH
- Traps moisture, attracting more beneficial fungi and microbes
- Improves cation (positive ion) exchange capacity

Table:1 Properties of biochar

Material used for producing biochar	pH	Total C (%)	Total N (%)	Ca	Mg	P	K	CEC
				mg/kg				
Waste wood chip	8.2	52.0	0.48	6.2	1.20	-	0.22	9.0
Green wastage	9.4	36.0	0.18	0.4	0.56	-	21.0	24.0
Eucalyptus biochar	-	82.2	0.57	-	-	1.87	-	4.69
Poultry litter	13	33.0	0.85	-	-	5.81	-	-

- Helps the soil hold nutrient
- Improves water quality by retaining agrochemicals and metals
- Helps mitigate greenhouse effect by trapping carbon for thousand of years!
- Improves soil quality for better food production

What make biochar works?

- During formation, the porous, crystalline biochar structure adsorbs bio-oils, nitrogen, phosphorus, other nutrients.
- Very high surface area.
- In soil, biochar is extremely recalcitrant to decomposition.
- Nutrient leaching and volatilization are inhibited, but nutrients are bio available to plants.

Atmospheric benefits

- Carbon capture.
- Reduced N2O soil emissions.
- Reduced methane soil emissions.
- Carbon negative energy.
- Reduced odor.

Soil benefits

- Decreased nutrient run off.
- Increased soil carbon.
- Improved soil fertility.
- Improved soil tilth.

Benefits of biochar in agriculture

- As soil amendment.
- Enhancement of carbon sequestration.

How biochar is better than compost

Biochar is a more stable nutrient source than compost and manure. Biochar, therefore, as a soil amendment can increase crop yields, reduce the need for chemical fertilizers, and minimize the adverse environmental effects of agrochemicals in the environment.

Identification of best biochar type for soil application

- Near- neutral pH.
- High ion exchange capacities (CEC & AEC).
- Moderate hydrophobicity to retain organics.
- High stability to oxidation.
- Low volatile content.
- Pre-treated with NH4+ to avoid induced N deficiency.

Functions of Biochar

1. Biological functions

- Habitat for microbs.
- Increased nutrient use efficiency.
- Increases recalcitrant C pool (C sequestration).

2. Physical functions

- Decreases bulk density.
- Influences water retention.
- Alter soil thermal properties.

3. Chemical functions

- Increases pH.
- Increase Cation exchange capacity.
- Absorbs toxic elements.

Table 2. Effect of biochar on different soil properties

Factor	Impact
CEC	50% increase
Fertilizer use efficiency	10-30 % increase
Liming agent	1 point pH increase
Soil moisture retention	Up to 18 % increase
Crop productivity	20-120% increase
Methane emission	100% decrease
Nitrous oxide emission	50 % decrease
Bulk density	Soil dependent
Mycorrhizal fungi	40 % increase
Biological nitrogen fixation	50-72% increase

Effects of biochar on soil physical properties

- Lowers bulk density.
- Improvement in water holding capacity.
- Better soil aggregation.
- Increase in Soil Porosity.
- Improvement in infiltration rate.
- Lowers albedo value.

Effects of biochar on soil chemical properties

- Increased soil pH.
- Liming effect.
- Increased soil nutrient availability.
- Enhanced sorption of organics.
- Increased cation exchange capacity.
- Greater surface area.
- Reduced nutrient leaching.

Effects of biochar on soil biological properties

- The large porosity of biochar provides surfaces for soil microbes to colonize and grow, where their predators cannot access them. it is generally adequate for a range of soil microorganisms to colonize (Thies and Rillig, 2009).
- These surfaces absorbs inorganic nutrients as well as organic substances and gases might provide ideal environments for microbes.
- Adding biochar to soil reduced the severity of Fusarium root rot.
- Biochar may have been beneficial to plants in the presence of pathogens through the effect of phytotoxic compounds found in biochar.

Environment benefits of biochar

- 12 percent of global GHG (green house gases) emissions could be offset with biochar.
- Enhances soil fertility, increases crop productivity, preserves agricultural lands and reduces agro-chemicals usability.
- Retains soil water, prevents nutrients from leaching and preserves groundwater resources.
- Sustainable use agricultural wastes (plants & animals biomass) to generate bio energy, soil fertility management and reduce Carbon.
- Discourages deforestation by enhancing degraded croplands.
- Removes heavy metals on soil/or water.

IMPACT OF BIOCHAR ON CROP PRODUCTIVITY

- The effect of biochar on crop productivity has been observed to vary, but is generally positive.
- In general, large yield improvements were obtained when biochar was applied on low fertile soils, up to 300% over controls.

Limitations of biochar

- Soil salinization.
- Does not contribute readily decomposable SOM pool.
- Risk of soil contamination.
- Soil compaction if applied by heavy machinery.

CONCLUSIONS

- Biochar additions to soil have the ability to retain nutrients and enhance C sequestration while they may otherwise be depleted in similar systems without the addition of biochar.
- Biochar has the ability to change the biodiversity of an agro-ecosystem without negatively impacting crop yield.

- It has potential to improve physical, chemical, and biological properties of soil, enhance crop yield significantly and mitigation the climate change.
- More research is needed to understand the impact of original biomass material (feedstock) and pyrolysis conditions (i.e. high or low temperature production) upon soil physical, chemical and biological properties.

Value addition of vegetable waste through microbial processing

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Abstract

A large amount of vegetable waste is generated throughout the supply and processing chain. Globally, more than 30 % of the wastage is related to the post-harvest and processing level wastages. The wastes so generated pose negative impacts on human and environment. There is need for the ecofriendly utilization for value addition and thus, minimization of its potential environmental risks. Utilization of processed vegetable waste as substrate for microbial growth and value addition is an alternative green approach. Microorganisms are suitable contender for reprocessing and eventual utilization of vegetable processing residues. These wastes can be used as raw material/substrate for the growth of various microbes which in turn used for production of biofuel (Biomethane, bio hydrogen, bioethanol and biobutanol), organic compost, single cell protein, biopolymer and biomass. Generation of renewable energy by bioconversion of vegetable wastes is gaining importance as it has proved to be a proficient means of utilizing the perishable vegetable residues. The present article deals with the microbial utilization of vegetable wastes for production of various value added products.

Vegetable waste

Vegetables being perishable in nature get easily spoiled at farm during harvesting, postharvest handling, transportation, storage and marketing. Apart from post-harvest losses due to lack of storage capacity, processing and packaging of vegetables according to customers' specifications also plays a major role in waste generation. Vegetable waste is a biodegradable material generated in large quantities, much of which is dumped on land to rot in the open, which not only emits a foul odor, but also creates a big nuisance by attracting birds, rats, and pigs—vectors of various diseases. Disposal of the vegetable matter creates economic and environmental problems due to lack of proper utilization. These wastes can be treated for biofuel production through fermentation under controlled conditions or else used for composting or production of microbial metabolites.

Vegetable waste: Physical and chemical characteristics

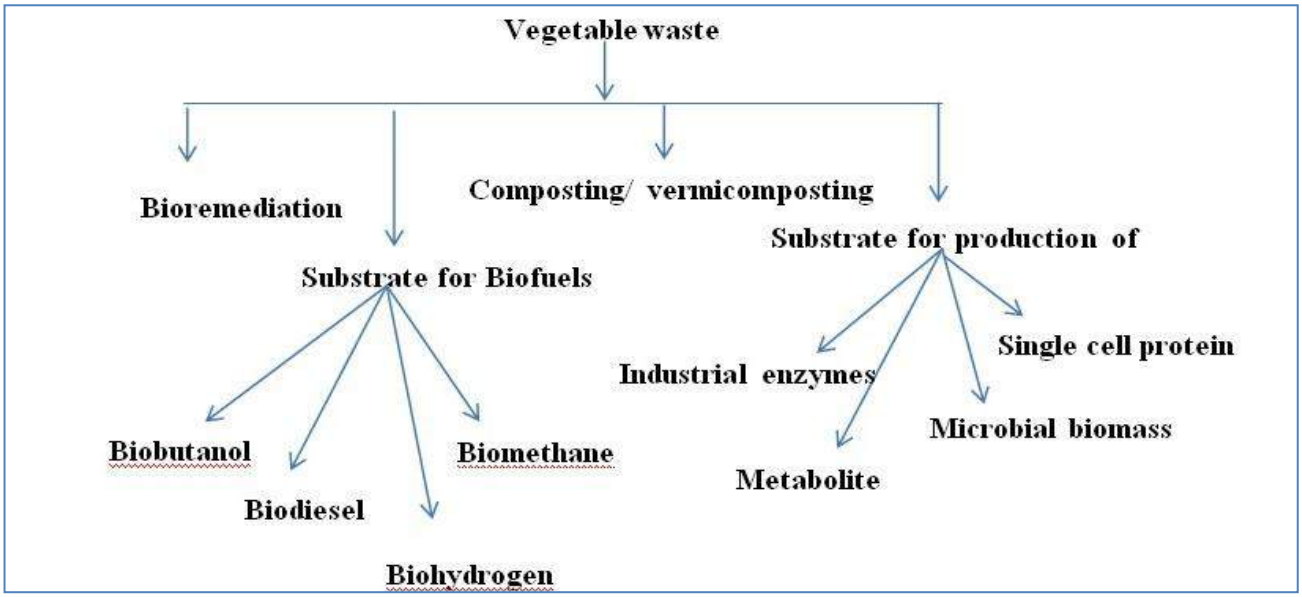

Figure 1: Microbe mediated value addition to vegetable processed wastes (Modified from Singh et al, 2011).

Evaluation of various characteristics of waste is essentially required for the management of waste and residues. Vegetable waste is generally characterized for various physical, chemical, or biological properties. Physical characterization of tomato wastes include estimation of weight, volume, moisture, ash, total solid, volatile solid (VS), color, odor, temperature, etc., while Chemical studies include the measurement of cellulose, hemicellulose, starch,

Table 1 Physical characteristic of various types of vegetable waste.

Vegetable waste	Moisture (%)	Ash (%)	Total solid (%)	Volatile solid (%)
Potato	87.6	11.7	19	95
Tomato	4.3	3.1	11.9	93.2
Onion	50-60	4.7		-
Pea	88.8	-	11.11	91.2

reducing sugars, protein, total organic carbon, phosphorus, nitrogen, BOD, COD, pH, halogens, toxic metals, etc..

Characterization of vegetable waste residue is an essential step to review the potentials of the waste whether it should be disposed or recycled for developing various value-added products.

Table 2 Chemical characteristics of various types of vegetable waste.

Vegetable waste	**Starch (%)**	**Cellulose (%)**	**Hemicellulose (%)**	**Protein/ amino acid (%)**
Potato	37	17	14	4
Tomato	-	31.5	17.8	17
Carrot	-	51.6	12.3	-
Apple	-	43.6	24.2	-

Vegetable waste utilization: Role of microorganisms

Biodegradable nature of vegetable wastes makes the component easily accessible to microorganisms and provides a viable solution to detrimental environmental effects. Microbes are potential candidate for reprocessing and eventual utilization of

vegetable processing residues. Microbial system possesses several hydrolytic enzymes and has become a potential candidate for the treatment of vegetable wastes. Bioconversion of vegetable residues to valuable products is highly dependent upon the biochemical composition of the left-over material. These wastes can be used as raw material/substrate for the growth of various microbes which in turn used for biofuel (Biomethane, bio hydrogen, bioethanol and biobutanol) production through fermentation under controlled conditions or else used for composting. The natural decomposition of wastes by microbes generates products with high humus content which is natural soil fertility enhancer. Besides this, tomato waste can be used for the production microbial biomass, microbial enzymes, polysaccharides/polymer or/and single cell proteins.

Production of bioenergy from waste: source of renewable energy

The wastes from fruit and vegetable processing waste being rich in polysaccharides (cellulose, hemi-cellulose and lignin) can be subjected to solid state fermentation for the production of various bioenergy such as biomethane, biodiesel, ethanol and butanol. Biomethane, obtained during anaerobic digestion by the microbial community, is a cheap form of renewable energy that is environmentally friendly. Normally, biogas is composed of 45–70 % methane, 30–45 % carbon dioxide, 0.5–1.0 % hydrogen sulfide, 1–5 % water vapor, and a small amount of other gases (hydrogen, ammonia, nitrogen, etc.). Biomethane production is a three-step process involving hydrolysis, acidogenesis, and methanogenesis which is accomplished by a series of microbial interactions. Use of various vegetable wastes for biogas production not only solves the problem of residual disposal and indoor pollution, but also reduces dependency on fuel wood.

The microbes involved in various stages of biogas are given below table.

Table 3 List of different microorganisms involved in the stages of biomethane production

Stages involved	Anaerobic Microorganism involved
Hydrolysis	Facultative anaerobic bacteria including *Cellulomonas, Eubacteria, Clostridium, Ruminococcus*
Acidogenesis	Facultative anaerobic acidogenic bacteria such as *Escherichia coli, Clostridium, Actinomyces, Corynebacterium*
Methanogenesis	Methanogens i.e. Methane producing anaerobic bacteria like *Methanobacterium, Methanococcus, Methanosarcina*

Vegetable waste can be a potential substrate for bioethanol and biobutanol production due to its abundant availability and rich in cellulose and starch content. The potential microorganisms such as *Saccharomyces cerevisiae*, *Zymomonas mobilis*, thermocellum, and recombinant *Escherichia coli* and *S. cerevisiae* have been widely used for industrial ethanol production because of its ability to produce

high concentrations of ethanol from hexoses and high tolerance to ethanol and other inhibitory compounds.

Vegetable waste as raw substrate for single cell protein

Single cell proteins are cell or whole microorganism used as source of protein for human, animal feed or supplements. Several vegetable wastes waste is used as raw materials for the single cell protein (SCP) production. Compared to conventional methods, microbial production of SCP has several advantages such as high protein content and short growth times leading to rapid biomass production, which can be continuous and is independent of the environmental conditions. Numerous microbial groups such as

- ✓ Filamentous fungi (*Aspergillus, Fusarium, Rhizopus, etc.*),
- ✓ Alga (*Spirullina, Chlorella* etc.) and
- ✓ Many bacterial species (*Bacillus, Lactobacillus, Pseudomonas* etc.)

are extensively used in SCP production.

Vegetable waste as raw substrate for production other valuable microbe based products microbial biopolymer, biomass enzymes and numerous valuable metabolites.

Vegetable waste can be used as raw material for the production of microbial biomass (Biofertilizers, Biopesticides), microbial endo and exopolymers (For e.g. Poly-hydroxybutyric acid (PHB) production) which finds application in food packaging, medicine and agriculture industry, polysaccharides from waste and production various microbial extracellular industrial important enzymes (amylase, cellulase etc.) with use of fermentation technology. Some selected extremophilic bacteria have shown enhanced production of microbial biomass, enzymes and biopolymers when grown on tomato and other vegetable waste (Donato *et al*, 2014)

Vegetable waste to compost: as organic fertilizer and soil conditioner

Composting is the conversion of organic material, such as plant material, vegetable waste and household foodstuffs, to a material having a soil-like consistency. The composting process, which is one of decomposition, relies upon living microorganisms. Bacteria and fungi are of fundamental importance in composting process. The solid, fibrous component (referred as compost) of the anaerobically digested material of vegetable waste can be used as a soil conditioner to increase the organic content of soils. Organic compost prepared from vegetable waste can be used as a fertilizer to supply vital nutrients to soils instead of chemical fertilizers that require large amounts of energy to produce and transport. Compost application offers numerous benefits over chemical use in agriculture

Benefits of compost	
Benefits to crop plant	**Benefits to soil ecosystem**
• Boosts plant growth • Helps plants resist pests and disease • Supplies a variety of macro and	• Improves the soil structure, porosity, and density, thus creating a better plant root environment • Supplies organic

micronutrients to plant • May control or suppress certain soil-borne plant pathogens • Supplies beneficial micro-organisms to rhizospheric soils	matter • Improves cation exchange capacity (CEC) of soils and growing media • Increases moisture infiltration and permeability of heavy soils • Improves water-holding capacity and reducing water loss Improves aeration • Increases soil fertility

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Aromatic Rice in India:

Its Production and Export

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India is an important centre of rice cultivation. India ranks first in area and second in production of rice at global level. Rice has shaped the culture, diets and economics of thousands of millions of people. For more than half of the humanity "Rice is life". Because of the importance of this crop for the survival of mankind, United Nation declared 2004 as 'International Year of Rice'. Aromatic rice constitutes a small but special group of rices which are considered best in quality. Aromatic rice is known for its nut like scent and taste which is caused by the chemical compound 2-acetyle-1-pyrroline. Nowadays, the aromatic rice is becoming more popular in Middle East, United States and Europe. Broadly speaking, aromatic rices can be classified into three categories- (1) Basmati (2) Jasmine and (3) Non-basmati/Non-jasmine. The aromatic basmati rice of Indian Subcontinent clinches a good premium and gets higher price than high quality non-basmati rices. India, Pakistan and Thailand are the major exporters of aromatic rice. Among these, India and Pakistan are the major suppliers of Basmati rice. Thailand is the major supplier of Jasmine rice. Foot-hills of Himalayas are considered to be the origin of aromatic rice. Although immense aromatic rice diversity is existing in India, not all aromatic types are recognized as basmati.

Basmati rice

Basmati, the unique aromatic quality rice is a nature's gift to Indian sub-continent. In Hindi, basmati means "**queen of fragrance**" and the nutty, sweet smell of basmati rice is unmistakable. Basmati is a necessary element in **Biryani** dishes and is the preferred type of rice served with north Indian meals. Typically, the delicately curved, long grained, highly aromatic rices which elongate and cook soft and fluffy were the ones which were traditionally categorized as basmati. They enjoyed privileged treatment both in domestic and international markets, generating three times higher price. In the export markets, still the traditional tall basmati variety Taroari Basmati followed by Basmati 370 and Type 3 (Dehraduni) has supremacy over other varieties due to their exclusive quality

Table 1. List of evolved varieties of basmati rice in India

Varieties	Date of notification	Name of Institutions
Punjab Basmati 1(Bauni Basmati)	1984	Punjab Agricultural University, Ludhiana
Pusa Basmati 1	1989	The Indian Agricultural Research Institute, New Delhi
Kasturi	1989	Directorate of Rice Research, Rajendra Nagar, Hyderabad, A.P.
Haryana Basmati 1	1991	CCSHAU, Rice Research station, Kaul, District Kaithal, Haryana
Mahi Sugandha	1995	RRS, Banswara, Rajasthan
Pusa Basmati 1121	2005	The Indian Agricultural Research Institute, New Delhi
Pusa Basmati 1(Pusa 1460)	2007	The Indian Agricultural Research Institute, New Delhi
Vallabh Basmati 22	2009	Sardar Vallabh Bhai University of Agriculture and Technology, Modipuram
Pusa Basmati 6 (Pusa 1401)	2010	The Indian Agricultural Research Institute, New Delhi
Punjab Basmati 2	2010	Punjab Agricultural University, Ludhiana
Basmati CSR 30 (Yamini)	2012	The Central soil Salanity Research Institute, Karnal, Haryana
Pusa Basmati 1509	2013	The Indian Agricultural Research Institute, New Delhi
Malviya Basmati Dhan 10-9 (HUBR 10-9)	2013	Banaras Hindu University, Varanasi, UP
Vallabh Basmati	2013	Sardar Vallabhai Patel University of Agriculture and Technology, Modipuram UP
Basmati 564	2015	Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu
Vallabh Basmati 23	2015	Sardar Vallabhai Patel University of Agriculture and Technology, Modipuram UP
Vallabh Basmati 24	2015	Sardar Vallabhai Patel University of Agriculture and Technology, Modipuram UP

features. The high yielding quality rices derived from traditional basmati are regarded as evolved basmati. Quality rices are characterized not only by aroma but by several other traits like grain length and width, elongation after cooking, amylose content, gelatinization temperature, etc. Some of the evolved

varieties of basmati rice in India are listed below in Table 1.

OTHER AROMATIC RICES

Although the basmati type aromatic rice has dominated the domestic and international markets for its long and slender grain size, it is surely not a king of fragrant rice. Majority of the indigenous aromatic rices are small and medium grained excel equally as far as aroma and cooking qualities are concerned. But, unfortunately, these have somehow not got the attention of rice scientists and traders, including exporters, to the extent that Basmati has got. As a result, most of this valuable wealth has either already vanished or is on a decline. The cultivation of non-basmati scented rices (their number still runs into hundreds) is now confined to limited pockets where farmers grow them either for self-consumption or for special occasions, like for making "kheer" or sweet rice. Only a few of these aromatic rices are traded domestically, and probably none in the international markets. The quality features of these rices may be far more acceptable than that of long-grain ones. That is where lies the scope for pushing non-basmati scented rice in the domestic as well as the global markets.

Some of the outstanding examples of short-to-medium grain indigenous aromatic rices are Kalanamak (popularly called, the "black pearl of eastern Uttar Pradesh"), Shakarchini and Hansraj of UP; Jau Phool, Vishnu Bhog, Sheetal Bhog and Do Dana from Chhatisgarh, Kalajoha of North-east; Ambemohar of Maharashtra, and Randhunipagal of Orissa and West Bengal region.

Indian exports for aromatic rice

The steady increase in production, availability of buffer stocks and the growing demand for aromatic rice in the international market, made India an important rice exporting country of the world (Tables 2 and 3). India is the leading exporter of the basmati rice to the global market. The country has exported 40,45,796.25 MT of basmati rice worth Rs. 22718.44 crores during 2015-16. Major export destinations include Saudi Arabia, Iran, United Arab Emirates, Iraq and Kuwait (Fig 1).

Table 2: Area, production and yield of basmati rice

	Year 2013-14	Year 2014-15
Area (kha)	37681	38063
Production (kmt)	90418	88756
Yield(t/ha)	2.406	2.340

Source: Edelweiss Agri Research

Table 3: Exports of basmati rice

	Year 2013-14	Year 2014-15	Year 2015-16
Quantity (mt)	37,57,271.44	37,57,271.44	40,45,796.26
Value (in crore Rs.)	29299.93	27597.89	22718.43

Source: APEDA

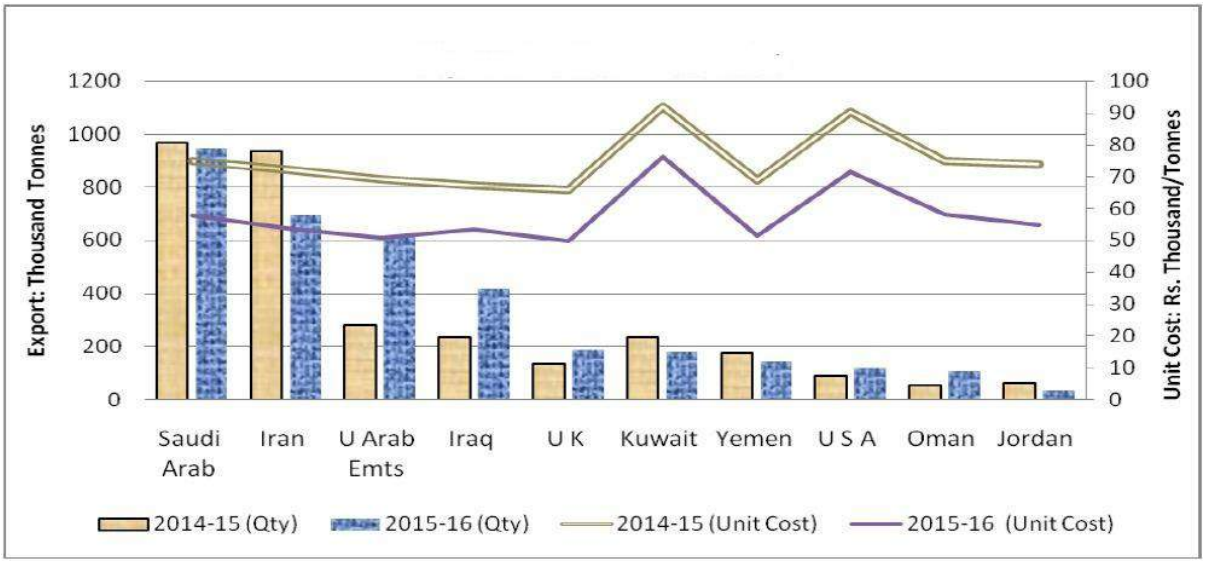

Figure 1:Major export destination of basmati rice in 2014-15 and 2015-16 (Source: Dept.of Commerce, GOI)

Areas under basmati cultivation in India

The cultivation of basmati in India is confined to traditional basmati growing areas in North-west Indian states including Haryana, Punjab, Uttarakhand and western Uttar Pradesh and to some areas of Delhi, Himachal Pradesh and Jammu and Kashmir. Major Basmati growing areas in India are shown in Table 4.

Problems with aromatic rice

The main problem with high quality long grain aromatic genotypes is that they are low yielders when compared with the other rice varieties because of (i) lack of technology advancement regarding efficient harvest of basmati rice and control of insects, pests and diseases, (ii) lack of irrigation facilities, and (iii) lack of access to information on basmati rice export potential and price trends. Solution for such problems is greater appreciation of the genetic diversity contained in the aromatic rice (both basmati and non-basmati) gene pool. This is necessary for the classification, proper maintenance, conservation of these rice varieties and their effective utilization in the breeding programmes. Such studies are essential for initiating genetic

Table 4: Major basmati growing areas in India.

State	District
Punjab	Amritsar, Gurdaspur, Kapurthala, Jalandhar, Patiala, Ropar, Nawan Shehar, Fatehgarh Sahib, Hoshiarpur
Uttarakhand	Haridwar, Dehradun, Nainital, Udhamsingh Nagar
Uttar Pradesh	Pilibhit, Saharanpur, Rampur, Bijnor, Moradabad, Muzzaffarnagar, Badaun
Haryana	Panipat, Karnal, Kaithal, Kurukshetra, Jind, Ambala, Sonipat, Yamunanagar

improvement efforts of aromatic rice, as meager attention has been paid for their improvement till now.

POLICY IMPLICATIONS

In the international market, rice is traded under two main groups, fragrant and non-fragrant. The fragrant rice in India dominates the trade with its basmati rice. For promoting rice export, policy requirements to be implemented include, disseminating information to farmers on export potential and price trends, encouraging advanced irrigation facilities, facilitating technology advancement for managing insects, pests and diseases, enhancing quality milling capacities to improve the yield per ton, promoting Indian Basmati rice brand in the international market and so on.

Mite resurgence its causes and management

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Resurgence is defined as an abnormal increase of pest population often exceeding the economic injury threshold, following insecticide treatment (Chelliah, 1979). Resurgence' or 'flare back' of target pests following insecticidal applications has become a widespread phenomenone. The rapid increase of the target pest population following application of an insecticide, often to a level higher than existed prior to the control measure (Bottrell, 1979). Mankind has gained spectacular benefits from the usage of pesticides in the loss to yield and optimisation of productivity.The over reliance on pesticides with indiscriminate use over last four decades has resulted in many negative consequences like 3 Rs viz., Resurgence, Resistance and Residual aspects. Maximum cases of resurgence of pests belong to the orders Homopterous (44 %) followed by phytophagous mites (26 %) and Lepidopterous (24 %) .

Metcalf (1986) recognized two types of resurgence:

Primary pest resurgence

Pest populations which were initially suppressed by insecticide application bounce back to excessive levels within short time. The resurgence may occur after first application or after several application of the pesticides. Petroleum oils applied on Avocado in California to control mites, destroy their natural enemies and causes resurgence of Persea mite , *Oligonychus perseae (USDA-ARS/CSREES,2003a)*

Secondary pest resurgence

It is also known as secondary pest outbreak or replacement. Economically unimportant or non target pests developing into serious pests. It also refers to the replacement of a primary pest with a secondary pest, it occurs when non target but injurious pest population increases in a crop after application of pesticides to control primary pests. Spraying of Sulphur in a long term basis to control Powdery mildew in grapes cause resurgence of Red spider mite , *Tetranychus pacificus* McGregor

Some reports of mite resurgence

Use of Synthetic Pyrethroid to control boll worm complexes in cotton causes resurgence of red spider mite . According to Trichilo and Wilson (1993) Simulation of a pyrethroid induced spider mite

outbreak on cotton indicated that change in fecundity had least effect, duration of the development time had intermediate effect but increase survival had most significant effect for resurgence development. Propargite kills spider mite more slowly than Dicofol at temp. 29^0C and mites lay eggs before they die leading to resurgence in hot summer month. During 2005 , Spider mite resurgence in cotton due to Abamectin is also reported by Stevensson and Motocha. Foliage feeding spider mite commonly cause resurgence after application of Synthetic pyrethroid and Organophosphate as cypermethrin and Fenvalerate like chemicals are more toxic to predatory mite than host mite (Wong and Chapman, 1979). Pesticides sprays to control codling moth, apple maggot and plum curculio on apple lead to resurgence of population of white apple leafhopper and European red mite. Imidacloprid drench, imidacloprid foliar application and acetamiprid treatments significantly increased spider mite numbers where as treatments with spinosad or with emamectin either alone or in combinations with imidacloprid and acetamiprid resulted in significantly fewer spider mites compared with the untreated control. The fecundity experiment indicated that the imidacloprid drench and foliar treatments significantly increased the number of egg production of mite **.** So it is suggested, synthetic chemicals in combinations with biorational product can be incorporated into the integrated pest management of the two-spotted spider mite. (Garima Gupta, 2015)

The effects of insecticides on the resurgence of the red spider mite *T. cinnabarinus* was investigated on Pusa Purple Red Round in Jammu and Kashmir, India, in 1995. The treatments were: carbaryl 50 WP at 01%; malathion 50 EC at 0.05%; dichlorvos at 76 EC at 0.05%; endosulfan 35 EC at 0.07%; deltametrhin 2.8 EC at 0.0025%; fenvalerate 20 EC at 0.005%; combinations of the different insecticides and a control treatment. Insecticide sprays were applied 4 times at 2-week intervals . The infestation of mites 24 h before, and 3, 7 and 14 days after spraying was assessed. Mite numbers rapidly decreased in sprayed plots 3 days after spraying at different growth stages. but mite populations was increased after 7 days of spraying .The mite numbers at resurgence was higher than pretreatment counts.

So all the chemical cause resurgence of *T. cinnabarinus* .(Abrol and Singh) Neonicotinoid Insecticide Imidacloprid Causes Outbreaks of Spider Mites *Tetranychus schoenei* (Acari: Tetranychidae)on Elm Trees in Urban Landscapes of Central Park in New York City, USA . It is due to the adverse effect of this chemical on natural enemies *(Stethorus punctillum* and *Chrysoperla rufilabris*) of this mite and enhancing the fecundity of *Tetranychus schoenei* (Adrianna Szczepaniec *et al*).

Causes of Resurgence Reduced biological control

Mite resurgence occurs when a chemical destroy the mite population as well as kills, repels , irritate or other wise deters the natural enemies of the mite. The residual activity of the chemical when expires the mite population is able to increase more rapidly and to a higher abundance when natural enemies are absent or low in abundance.

pest	Scientific name	Chemicals causing resurgence	Mode of application
Cotton spider mite	*Tetranychus cinnabarinus*	DDT, Carbaryl, Cypermethrin, Fenvalerate, Fluvalinate	Foliar
Musk melon and water melon red spider mite	*T . cinnabarinus*	fluvalinate	Foliar
Okra mite	*Tetranychus urticae*	ethion	Foliar
Chilli yellow mite	*Polyphagotarsonemus lactus*	Monocrotophos,fenvalerate, deltamethrin,permethrin Cypermethrin,acephate, phosphamidon,methyl demeton	foliar
Mango mite	*T. cinnabarinus*	carbaryl	Foliar
Citrus false rust mite	*Phyllocoptruta oleivora*	malathion	Foliar

Suppression of natural enemies Croft and Brown (1975) noted that adult parasitoids are usually more susceptible to pesticides than the host they attack. Natural enemy mortality following broad-spectrum pesticide application is an important factor for resurgence development . eg-- pyrethroid application repel the phytoseiid mite and other predators that feed or prey upon the spider mite and also affect different phytophagus competitors resulting its resurgence following pyrethroid application .

Direct stimulation of the pest

Some chemicals have direct effect on mite for inducing resurgence. A dose response phenomenon called hormesis can occur in pest populations exposed to sublethal doses of pesticides .this can cause an increase in fecundity (physiological hormoligosis) or oviposition behaviour (behavioural hormoligosis) of the pest leading to abnormal increase in its abundance . E.g- DDT act as an resurgence causing chemical for European Red mite, *Metatetranychus ulmi Koch* as it increases the egg production or fecundity of this mite after application (Hueck *et al*, 1952).

Improved plant growth

Some chemicals affects the nutritional status, biochemistry, architecture, resistance level of host plant after application. It makes the host plant more suitable for mite attack.

Some chemical factors like rate, method of application, type of chemical, number of applications are also playing major role for occurance of resurgence.

Resurgence management

Monitoring of pest population through traps should be done to determine proper time for chemical application. Spraying of recommended insecticides at proper intervals should be done. Identification of resistant genotypes -It reduces the development of pest outbreak so ultimately reduces the use of chemicals as a result resurgence development is also less.

Recommended dose of chemical application

Plant extracts and new insecticides should be identified for effective control of pests, which are economically feasible and environmentally safe. Microencapsulation of insecticides may provide means of slow release, thus increasing residual toxicity The use of chemicals that are selectively more toxic to the target species than their natural enemies will reduce resurgence Evaluation of insecticides should be made through standard techniques and only insecticides that do not cause resurgence must be recommended Formulation and use of plant products

Insecticide resistance monitoring: Development of resistance to insecticides by insects will hasten resurgence Regular monitoring of the populations across geographical boundaries is essential. Appropriate steps are to be taken up through national programmes to keep the pests under check (Chelliah and Uthamasamy, 1986)

Conservation of Natural enemies: By using selective pesticides the natural enemies can be conserved. The prime cause of resurgence is the mortality of natural enemies with the use of insecticides. Assess the role of natural enemies complex in a cropping system before insecticidal application . Selection of chemicals which are safe to natural enemies. Maintaining of natural enemies complex in cropping system can reduce resurgence with the use of insecticides

Recommendation of proper agronomic practices Agronomic practices like date of sowing, judicious use of fertilizer and irrigation water can help in reducing the insecticide induced resurgence Early sowing of crop helps in escaping the damage of insect pests and requires less number of insecticide application The higher use of fertilizer and irrigation makes the crop more suitable for pest multiplication . So adopt proper agronomic practices.

Integrated pest management tactics: Application of insecticides only when the insect pest populations reach economic threshold levels should be done. Proper decision should be taken to apply insecticides based on the population dynamics of the natural enemy complex, the stage of the crop and the weather conditions All the available and compatible pest control methods are integrated and utilized as a complementary package

CONCLUSION

Need to understand the possible causes for resurgence of pests and devise means to overcome these factors . Problems of insecticide-induced resurgence are due to indiscriminate use of insecticides Long-term strategy is to evolve resistant/tolerant varieties , exploiting use of botanical and natural enemies complex Shift to Biointensive IPM .Educate the farmers through live demonstration about the risks of resurgence with use of insecticides Long-term studies of resurgent pest populations are necessary to identify clearly the mechanism of resurgence

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Citrus Fruits - A Source of Antioxidants

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Fruits are important source of various vitamins, minerals, and fibres for humans. However, they differ in many aspects, including the contents of vitamins, minerals, and fibres as well as their antioxidant capacity. It is well known that fruits are rich in various antioxidants, including ascorbic acid, carotenoids, and phenolics. Fruits are rich in antioxidants that help in lowering incidence of degenerative diseases such as cancer, arthritis, arteriosclerosis, heart disease, inflammation, brain dysfunction and acceleration of the ageing process. Antioxidants are substances which when present at low concentration are able to prevent or delay oxidative damage of lipids, proteins and nucleic acids by reactive oxygen species. These reactive oxygen species mainly are reactive free radicals such as superoxide, hydroxyl, peroxyl, alkoxyl and non-radicals such as hydrogen peroxide, hypochlorous. They scavenge radicals by inhibiting initiation and breaking chain propagation or suppressing formation of free radicals by binding to the metal ions, reducing hydrogen peroxide, and quenching superoxide and singlet oxygen. The most abundant antioxidants in fruits are polyphenols, Vitamin C, Vitamins A, B and E whereas, carotenoids are present to a lesser extent in some fruits. These polyphenols, most of which are flavonoids, are present mainly in esterand glycoside forms. The three major groups: vitamins, especi ally vitamin C; phenolics; and carotenoids, especially β-carotene is responsible for the defensive effect of antioxidants in fruits and vegetables. Vitamin C and phenolics are known as hydrophilic antioxidants, and carotenoids are known as lipophilic antioxidants. A number of researches have been made in the antioxidant capacity of fruits.

Citrus fruits are the main fruit trees grown throughout the world and are well appreciated for their refreshing juice and health benefits. Numerous therapeutic properties have been attributed to citrus fruits, like anticancer, antiviral, anti-tumor, anti-inflammatory activities, and effects on capillary fragility as well as an ability to inhabit platelet aggregation. More recently, therapeutic values related to cardiovascular diseases and age related macular degeneration have been reported. These numerous health benefits of citrus fruits are linked to the high amounts of photochemical and bioactive compounds such as flavonoids, carotenoids, vitamins and minerals available in citrus fruits. These phytonutrients may act as antioxidants, stimulate the immune systems; induce protective enzymes in the liver or block the damage of the genetic materials. The phytonutrients and vitamins may be responsible for the antioxidant, anticancer and anti-inflammatory properties of the citrus species. Protective effects of citrus flavonoids and carotenoids against cancer, tumor growth, cardio diseases and mascular degeneration along with various healing benefits. The flavonoids have strong inherent ability to modify the body's reaction to allergens, viruses and carcinogens. They show anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activity. Quercetin, myricitin, rutin, tangeritin, naringin and hesperidins are found amongst the common flavonoids in citrus fruits. These flavonoids are responsible for the bitter taste of some grape fruits, lemons and oranges. Quercetin is a flavonoid and more specifically a flavonol that constitutes the aglycone of the glycoside rutin. Quercetin is found to be the most active due of the flavonoids and many medicinal plants owe much of their activity due to their high quercetin content Quercetin has demonstrated significant anti-inflammatory activity because of direct inhibition of several initial processes of inflammation. For example, it inhibits both; the production of histamine and other allergic/inflammatory mediators. In addition, it also exerts potent antioxidant activity and ascorbic acid sparing action.

Quercetin also shows remarkable anti-tumor properties. Quercetin may have positive effects in combating or helping to prevent cancer, prostatitis, heart diseases, cataracts, allergies/inflammations and respiratory diseases such as bronchitis and asthma. Hesperidin is a flavonoid glycoside found abundantly in citrus fruits. Its aglycone form is called hesperetin. Hesperidin is believed to play a role in plant defence. The best way to take advantage of the many medicinal virtues of lemon, lime, grapes and other citrus juice is to consume them just after they have been squeezed from the fruit.

Role of Body Condition Scoring In Herd Health Management

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Body condition scoring (BCS) is an index to evaluate the degree of fatness or thinness of dairy animal. It is an excellent management tool for maximizing milk production and reproductive efficiency while reducing the incidence of metabolic disorders like milk fever, ketosis etc.

INTRODUCTION

Every dairy producer has cattle that are too fat or too thin at their stage of lactation. Failure to recognize these cows and take action costs in terms of treatment cost, lost milk production, and impaired reproduction. Thinness or fatness can be a clue to nutritional deficiencies, health problems or improper herd management. Body condition scoring can be used to encounter the problems and improve the health, reproduction and productivity of the dairy herd. Overconditioning may result from poor nutrition, prolonged dry periods or overfeeding during the dry period. A fat cow is more prone to metabolic problems and infections, and is more likely to have difficulty at and after calving. Underconditioning or thinness, can results into lower production because of insufficient energy and protein reserves to maintain production. Thin cows often do not show heat or conceive until they start to regain body weight. In feeding these animals, care must be taken to maintain production while increasing body condition. Research and field experiments validates the classical relationship of body condition to dry matter intake, milk production, reproduction, and health. The observations on body condition status of animal will help the manager to adopt corrective management actions, thus enabling to improve the production profile of an animal. The cows can be categorized in three categories viz. average or good condition, under condition and over condition cows. Various point scoring system is developed to measures the relative amount of this subcutaneous fat. The most commonly used system ranges from 1.0 to 5.0 for dairy cattle. 1 to 5 which is

the Scottish or Canadian scoring system or can refer as the dairy cattle scoring system. 1 to 9 which is the American scoring system or can refer this as the beef cattle scoring system.

Why body condition scoring?

This is very important because the monthly changes in body condition is highly correlated with health, production and reproduction than a cow's actual body condition on any particular day.

The information collected by body condition scoring of cows helps to determine:

- Whether there is need of adjustment of the feeding program of groups of cows within a herd or not
- Body condition indicates how much stored energy a cow has for future use.
- Body condition can help to achieve a balance between economic feeding, good production and good welfare.
- It is useful to track energy balance and evaluate production and reproductive performance.

How to body condition scoring?

Stand behind the cow to score both areas and always handle the animal quietly and carefully using the same hand. Cows should be scored both by looking at and handling the backbone, loin and rump areas. Since the pin bone, hip bone, the top of the backbone and ends of the short ribs do not have muscle tissue covering them, any covering see or feel is the combination of skin and fat deposits. The tailhead is scored by feeling for the amount of fat around the tailhead and the prominence of the pelvic bones. Press the fingertips against the backbone, pin bone and hip bone. The loin is scored by feeling the horizontal and vertical projections of the vertebrae and the amount of fat in-between. Grip the loin of the cow where the short ribs project from the backbone, just ahead of the hips, with fingers on top of the loin and the thumb curved around the ends of the short ribs. Fingertip pressure will help a good indication of the amount of fat cover. For accurate scoring, both visual and tactile appraisals are necessary.

On a five-point scale, a score of 1 denotes a very thin cow, while 5 denotes an excessively fat cow. These are extreme scores and should be avoided. The average, 3, is the most desirable for the dairy herd.

Ranges of Ideal Body Condition Scores	
Stage of Lactation	**Score**
Dry period	3 - 3.5
Calving	3 - 3.5
Breeding	2.5 3.0
Early lactation	2.5 3.0
Mid lactation	2 – 2.5
Late lactation	3 - 3.5

Score 1

Bones of the chine, loin, and rump regions are prominent. Hook and pin bones protrude sharply, with a very thin covering of flesh and deep depressions between bones. Tail head – deep cavity with no fatty tissue under skin. The ends of the short ribs are sharp. The individual vertebrae (spinous processes) of the backbone are prominent.

Score 2

Individual bones of the chine, loin, and rump regions are not visually distinct but are easily distinguished by touch. Hook and pin bones are prominent but the depression of the thurl region between them is less severe. Tail head – Cavity

evident but less prominent. Individual short ribs can be felt but are not prominent. Ends of short ribs are sharp to the touch, but individual ribs can no longer be seen. This cow is thin.

Score 3

Hook, pin, and back bones have lost angularity and appear smooth. Area between pin bones and around tail head appears smooth, without signs of fat deposit. The short ribs can be felt by applying slight pressure. Loin – end of horizontal process can only be felt with pressure; slight depression in loin. A cow in average body condition

Score 4

Loin and rump regions appear flat. Short ribs cannot be felt even with firm pressure appear, flat or rounded. Area of tail head and pin bones is rounded, no depression visible in loin between backbone and hip bones. Loin – cannot feel processes and will have completely rounded. A cow in heavy condition.

Score 5

Hooks, pins, and backbone almost disappear. Subcutaneous fat deposit very evident. The bone structure of the topline, hook and pin bones and the short ribs is not visible. Area between pins and tailbone rounded, skin distended. The thighs curve out, the brisket and flanks are heavy.

When to score dairy cattle?

Dry period

Lactation performance of any milch cow depends on body reserve during dry period. The dry cow need sufficient body reserves to support early lactation milk production. Many studies suggested optimal body condition score of dry cow should be above 3 and below 3.75 (i.e., 3.25 to 3.50), also risk of post parturient problems may be avoided when the dry cows scored between 3.25 and 3.50. The optimal body condition score for dry period of a cow is 3.0-3.25

Early lactation

About 30 percent of body tissues accounts for milk production during 1st month of lactation. Therefore, diets should always be properly formulated to meet energy and protein requirements for high levels of milk production. Studies revealed that body condition loss during first month of calving is related to post-partum reproductive performance, as the body condition loss increases the no. of days open, days to first estrous and service per conception significantly increased .it has been also reported excessive loss of body condition associated with lowered reproductive performance and reduced milk production as well thus cow in early lactation should be above 2.5 in condition.

Mid lactation

If cows become over-conditioned during mid-lactation (3.5 to 4.0), energy intake should be reduced, and crude protein levels should be checked. If cows become under-conditioned (2 to 2.5 range), the ration is probably low in energy. Generally, the body condition replenishment begins when animals shift to positive energy balance. Cow in 1st 100 to 120 days of lactation should score between 2.5 to 3.5

Late lactation

Late lactation is the optimum time to manipulate body condition. Cows should be in a positive energy balance and confirmed pregnant by this time and changes in body condition can be made very efficiently. Failure to replenish

energy reserves will hamper milk production in successive lactation. If BCS exceeds 3.75, energy intakes are too high and should be reduced to avoid excessive fattening. Extended calving intervals may also contribute to high BCS in late lactation. The body condition score between 200 days of lactation and the date of dry off should be between 2.75 and 3.50. However, the cows should be dried between BCS of 3.25 to 3.50. For dairy cows, most of the increase in body condition must occur during late lactation

Health

Sudden changes in body condition scores help to detect health problems in herd. Body condition at calving and in early lactation is associated with the incidence of important metabolic disorders in dairy cows, particularly ketosis. The risk of ketosis has been shown to be two times greater for cows calving at BCS > 3.5 compared to those calving at BCS 3.25, and the rate of both clinical and subclinical ketosis is greater in cows with high BCS. Cows with high BCS at calving or excessive loss of condition in early lactation are more prone to displaced abomasum and body condition score can drop from 4.0 to 2.0. Retained placenta has been found to be more common in cows with excess body condition. Lameness is associated with both fat and thin cows. In cows that are overconditioned at dry-off, lameness may arise due to stress from carrying extra weight or from reduced dry matter intake at calving that leads to excessive BCS loss as lactation progresses.

SUMMARY

Body condition scoring can be a useful management tool for dairy producers to manage the nutrition of herd. In scoring a cow, the tail head and loin are the major areas to evaluate. If perform on a regular basis, body condition scoring can improve milk production of the cow as well as reproductive performance and health of the animals.

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BCS 1


BCS 2


BCS 3


BCS 4

BCS 5

Ingestive Behaviour: An Overview in Dairy Animals

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In domesticated livestock production systems, animals rely on people to provide them with sufficient food, water and shelter to promote growth, productivity, health and welfare. The importance of understanding the feeding behaviour and knowledge in this area can help improve the dairy producers to manage and design their dairy production systems in ways that will allow their livestock to fully maximize the potential of the ration provided, thereby improving the health, production and welfare of their animals.

Physiology of ingestive behaviour

Ingestive behaviours encompass all eating and drinking behaviours. This relationship is characterised by the physiological, psychological and social forces that are integrated in the brain and determine not only how much to eat, but also what, when and how to eat. These mechanisms exist to control and establish homeostasis within the animal body. Hunger is the predominant physiological signal to seek for or initiate an eating episode or meal. During the consumption of a meal, hunger subsides and satiation increases up to the point at which a meal is terminated. The homeostatic control of food intake takes place in the brain, responds to peripheral signals and is activated to counterbalance any drift in adiposity below a certain set point.

Signalling of ingestive behaviour

The gastrointestinal system, particularly the stomach, releases a peptide hormone called ghrelin. This peptide stimulates thought about food in hunger, and is suppressed after food is ingested. Hunger is the result of a fall in blood glucose level or depriving cells of the ability to metabolize fatty acids. There are several sets of receptors located in the head: eyes, nose, tongue and throat. The most important role of head factors in satiety is that taste and odour can serve as stimuli that permit learning about caloric contents of different foods. Neural circuits in the brain stem are able to control acceptance or rejection of sweet or bitter foods. Signals from the tongue, stomach, small intestine and liver are received by the area postrema and nucleus of the solitary tract, which then send information to many regions of the forebrain that control food intake.

Factors affecting metabolism and ingestive behaviour

I. Genetic factors

The variation in the capacity for ruminants to consume feed has a genetic basis. Animals with higher potential for feed consumption exhibit enhanced tissue metabolism as indicated by a higher basal metabolism and maintenance requirement. Many studies indicate a significant voluntary consumption advantage of *Bos taurus* cow over *Bos indicus* cow under conditions of minimal environmental stress. Voluntary feed consumption is affected by genotype interactions with type of diet and various components of the environment. Age has a pronounced effect on basal metabolism. As the animal gets older, the basal metabolism goes down. Younger animals require more protein and energy to maintain condition and growth, so basal metabolism is high. The expenditure of energy is different between sexes. The basal metabolism rate is higher for males than in female.

II. Physiological state

Energy needs for most species during pregnancy are most critical during the last trimester. Maintenance requirements of livestock are increased by activity. Cows that are required to graze over wide areas or on steep slopes require additional energy, so adjustments are necessary to maintain energy requirements. All nutrient needs are increased during lactation. In cows peak lactation occurs in mature animals from 30 to 45 days after parturition and then gradually tapers off. This is why the peak demands for nutrients follow the typical milk flow characteristics for the species concerned. Limiting water or energy intake during lactation results in a marked drop in milk production.

III. Environmental factors

The climatic conditions of browsing and grazing animals exposed to can significantly affect the animal's intake. Animals lose heat by conduction, convection and radiation from the body surface and evaporation of water from the body surface, lungs and oral surfaces. The rate of heat loss from the body is determined by the difference between body surface temperature and the surrounding environmental temperature. Temperatures below zone of thermoneutrality could stimulate or depressed feed intake rates depending upon precipitation. Rain, snow and muddy conditions depress feed intake because of decreased grazing time. Dry and cold conditions generally stimulate feed ingestion. Voluntary consumption has been reported to decrease by 50 percent in the first 8 days after exposure to heat loads and decreases to only 10 percent reduction after 17 to 24 days as the animal adjusts to the high temperatures.

Foraging behaviour: Is it an experience or inheritance?

Diet selection theories propose that food preferences and aversions are based on experiences within the life of the animal. Animals must either be born knowing what to eat and avoid or learn appropriate dietary habits from others or through individual experiences. It therefore makes sense that learning plays a major role in the foraging habits of livestock.

On the other hand, heritable aspects of diet selection should be evident because natural selection favours animals that are good foragers. Because foraging efficiency influences reproductive success and survival, it contributes directly to "Darwinian" fitness. Many ecologists

argued that foraging attributes are targets of natural selection and must therefore be inherited. In other words, herbivores inherit their ability to learn. Therefore, diet preferences could be genetically passed from parents to offspring.

How do they eat?

Under natural grazing condition dairy cow engage in foraging behaviour for around 4 to 9 hours per day. This feeding time would be split into a number of smaller meals occurring throughout the day, with the largest meals occurring in the early morning and late afternoon. Cows with less overall time feeding and increase rate of feed consumption, reduced daily salivary secretion thereby decreasing the buffering capacity of the rumen and reducing rumen pH. Alternatively, when cows slow down their rate of DM consumption, and have more frequent, smaller meals throughout the day, rumen buffering is maximized, depressions in pH are avoided, and the risk of sub-acute ruminal acidosis is decreased. Thus, to maximize rumen health, efficiency and productivity, it is important to utilize feeding management strategies that promote frequent consumption of feed in small meals throughout the day.

When do they eat?

It has typically been accepted that dairy cow exhibit a diurnal feeding pattern, where the majority of feeding activity occurs during the day, particularly around sunrise and sunset. It was clear that the most dramatic peaks in feeding activity occur around the time of feed delivery and the return from the milking parlour. The diurnal feeding patterns of free-stall housed dairy cows was mostly influenced by the time of feed delivery, feed push-up and milking.

What do they actually consume?

Dairy cow are commonly fed their feed components in the form of a total mixed ration (TMR). This are designed as a homogenous mixture with the goal to help minimize the selective consumption of individual feed components by dairy cows, promote a steady-state condition conducive to continuous rumen function and ingesta flow, and ensure adequate intakes of fibre. However, even when providing feed as a total mixed ration, dairy cow have been shown to preferentially select for the grain component of a TMR and discriminate against the longer forage components. Sorting of a TMR can also reduce the nutritive value of the TMR remaining in the feed bunk, particularly in the later hours past the time of feed delivery. Thus, overall, there is a large body of evidence to suggest that the way cows eat, when they eat and what they eat has a significant impact on rumen digestion, health and efficiency.

Feeding behaviour in group

When grazing, cow often synchronizes their behaviour such that many animals in the group fed, ruminate and rest at the same times. Curtis and Houpt (1983) reported that group-housed dairy cows housed indoors also synchronized their behaviour particularly at feeding. It was also reported that when cows are fed in groups, the act of one cow moving towards feed bunk stimulates others to feed.

Ingestive behaviour and feed bunk design

One of the specific objectives of cow housing is to provide a comfortable environment that will allow cows to meet their behavioural and physiological needs. Reduced space availability has been shown to result in increased aggressive behaviour in cow, which limits the ability of some cows to access feed at times when feeding motivation is high, particularly after the delivery of fresh feed.

The feeding behaviour of group-housed dairy cows is influenced by managemental practices at the feed bunk and factors associated with the physical and social environment. Reducing overcrowding at the feed bunk increases feeding time, particularly during periods of peak eating activity, reduces the time cows spend standing idle waiting to gain access to the feed bunk and reduces aggression in the feeding area.

The use of headlock feed barriers may reduce aggression at the feed bunk and enable subordinate cows more equal access to feed, mainly if cows are overcrowded at the feed bunk. Cows clearly prefer to stand on softer flooring surfaces such as rubber mats than concrete.

Ingestive behaviour and frequency of feeding

The delivery of fresh feed is a substantial stimulus to get cows to eat, and they increase their feeding time during the hour after fresh feed has been delivered. Thus, it is possible that the frequency of providing fresh feed to dairy cows significantly contribute to the distribution of intake over the course of the day, with potential implications for rumen microbial stability. Research has shown that increasing the frequency of feed delivery can reduce the diurnal fluctuations in rumen pH.

Social effects and ingestive behaviour

Social rank is often closely related to factors such as age and body size, for example heifers probably often have lower positions in a group's dominance hierarchy than older cows. On pasture, mixed group of multiparous and primiparous cows grazed for less time than either multiparous or primiparous cows grouped alone. It was also observed that heifers housed separately from older cows increased eating time and had a higher DMI when housed in free stalls.

Effect of overcrowding the feeding bunk

The amount of bunk space provided and a cow's position within the social dominance hierarchy may influence whether cows are able to gain access to feed at the times they want to eat. Overcrowding at the feed bunk has deleterious effects on feeding behaviour and reduced feeding time. Increased aggression in the feeding area due to overcrowded could have consequences for hoof lesion development and lameness. High ranking cows may be completely unaffected, while low ranking cows may struggle to eat when they wish. Providing increased feed bunk space will improve access to feed and reduce competition at the feed bunk, particularly for subordinate cows.

Effect of disturbances

Feeding behavior is affected by the presence of predators, insects and competitors. Animal tends to eat less during high temperature, heavy rain and high wind velocity. Animal hesitate and

stop feeding if detect predator and is around them. They produce panic reaction when attacked by warble fly hypoderma (cow) and bot fly *oestrus* (sheep). They tend to synchronize their feeding in the presence of fellow friend. Stronger animal are able to eat more while the weaker animal cannot fight them.

CONCLUSION

There is a large body of evidence to suggest that the way cows eat, when they eat and what they eat has a significant impact on rumen digestion, health and efficiency. The amount feed consume are governed by bunk space provided and genetic constitute, physiological stage and environmental condition. The presence of disturbances and a cow's position within the social dominance hierarchy may influence whether cows are able to gain access to feed at the times they want to eat. The importance of understanding the feeding behaviour and knowledge in this area can help improve the dairy producers to manage and design their dairy production systems in ways that will allow their livestock to fully maximize the potential of the ration provided, thereby improving the health, production and welfare of their animals.

Phytoremediation of Agrochemicals: A sustainable strategy

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Abstract

Agrochemicals are excessively used for crop production and still as an important strategy for the commercial farming. However, the widespread use of chemicals has resulted in both point sorce and non point source contamination of shallow ground water and surface waters, which became issue and a serious environmental problem. Phytoremediation is an alternative technique to effectively cleanup toxic substances from soil and groundwater, since plant posses highly efficient systems for the removal and transformation of these elements. Plant based remediation cam accelerate natural attenuation processes from contaminated sites by taking up significant quantities of water, may be transformed in to less toxic forms.

PHYTOREMEDIATION

Phytoremediation is a word formed from the Greek prefix "Phyto" means plant and suffix "remedium" meaning to clean (or) restore (Cunningham et.al.,1996). It is a cost-effective plant-based approach of remediation that takes advantage of the ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. It refers to the natural ability of certain plants called hyperaccumulators to bioaccumulate, degrade, or render harmless contaminants in soils, water, or air. Toxic heavy metals and organic pollutants are the major targets for phytoremediation. Knowledge of the physiological and molecular mechanisms of phytoremediation began to emerge in recent years together with biological and engineering strategies designed to optimize and improve phytoremediation. In addition, several field trials confirmed the feasibility of using plants for environmental cleanup.

PROCESS OF REMEDIATION

There are several ways in which plants are used to clean up, or remediate, contaminated sites. To remove pollutants from soil, sediment and/or water, plants can break down, or degrade, organic pollutants or contain and stabilise metal contaminants by acting as filters or traps. The uptake of contaminants in plants occurs primarily through the root system, in which the principal mechanisms for preventing contaminant toxicity are

found. The root system provides an enormous surface area that absorbs and accumulates the water and nutrients essential for growth, as well as other non-essential contaminants. Deep-lying contaminated ground water can be treated by pumping the water out of the ground and using plants to treat the contamination. Plant roots also cause changes at the soil-root interface as they release inorganic and organic compounds (root exudates) in the rhizosphere. These root exudates affect the number and activity of the microorganisms, the aggregation and stability of the soil particles around the root, and the availability of the contaminants. Root exudates, by themselves can increase (mobilise) or decrease (immobilise) directly or indirectly the availability of the contaminants in the root zone (rhizosphere) of the plant through changes in soil characteristics, release of organic substances, changes in chemical composition, and increase in plant-assisted microbial activity.

TYPES OF PHTOREMEDIATION

Phytoextraction: Phytoextraction or phytoaccumulation uses plants or algae to remove contaminants from soils,sediments or water into harvestable plant biomass. The plants absorb contaminants through the root system and store them in the root biomass or transport them up into the stems or leaves (fig.1). A living plant may continue to absorb contaminants until it is harvested. After harvest, a lower level of the contaminant will remain in the soil, so the growth/ harvest cycle must usually be repeated through several crops to achieve a significant cleanup. After the process, the cleaned soil can support other vegetation. The process of phytoextraction is known to occur either continuously (natural) using hyperaccumulators or induced through the addition of chelates to increase bioavailability. Continuous phytoextraction relies on the ability to accumulate contaminants in the shoots of the plants over extended periods. To achieve this, plants must possess efficient mechanisms for the detoxification of the accumulated contaminants. Poplar tree is able to uptake, hydrolyze and deakylate atrazine, isoproturon, linuron, carbaryl etc. In order to develop hypertolerant plants capable of accumulating high concentrations of toxic compounds, it will be vital to understand the existing molecular and biochemical strategies plants adopt to resist toxicity.

Fig:1 Nickel is removed from soil by moving up into plant roots, stems, and leaves.

Rhizofiltration:

Rhizofiltration is concerned with the remediation of contaminated groundwater rather than the remediation of polluted soils. The contaminants are either adsorbed onto the root surface or are absorbed by the plant roots. Plants used for rhizofiltration are not planted directly *in situ* but are acclimated to the pollutant first. Plants are hydroponically grown in clean water rather than soil until a large root system has developed.

Once a large root system is in place, the water supply is substituted for a polluted water supply to acclimatize the plant. After the plants become acclimatized, they are planted in the polluted area where the roots uptake the polluted water and the contaminants along with it. As the roots become saturated, they are harvested and disposed off safely.

Mechanism of rhizofiltration most likely depends upon physicochemical processes (e.g., ion exchange, chelation) and can even take place on dead roots. Besides its reliance on surface absorption as the primary mechanism for removing contaminants from waste streams, it is also related to the process known as bio sorption, in which microbial, fungal or other biomass, living or dead, is used to absorb large quantities of materials. A number of plants such as mustard, rye, corn, and sunflower have intrinsic ability to absorb and precipitate contaminants from solution. It is particularly effective and economically compelling when low concentrations of containments and large volume of waste are involved.

Phytostabilisation

Phytostabilization focuses on the long term stabilization and containment of the pollutant. For example, the plant's presence can reduce wind erosion; or the plant's roots can prevent water erosion, immobilize the pollutants by adsorption or accumulation, and provide a zone around the roots where the pollutant can precipitate and stabilize. Unlike phytoextraction, phytostabilization focuses mainly on sequestering pollutants in soil near the roots but not in plant tissues. Pollutants become less bioavailable, and livestock, wildlife, and human exposure is reduced. An example application of this sort is using a vegetative cap to stabilize and contain mine tailings. It is the use of certain plant species to immobilise contaminants in the soil and groundwater through absorption and accumulation by roots, adsorption onto roots, or precipitation within the root zone of plants (rhizosphere). This process reduces the mobility of the contaminant and prevents migration to the groundwater or air, and also reduces bioavailability for entry into the food chain. This technique can be used to re-establish a vegetative cover at sites where natural vegetation is lacking due to high metal concentrations in surface soils or physical disturbances to surficial materials. Metal-tolerant species can be used to restore vegetation to the sites, thereby decreasing the potential migration of contamination through wind erosion and transport of exposed surface soils and leaching of soil contamination to groundwater.

For phytostabilization, plants with fibrous root systems are mostly used such as many grasses, herbaceous species and wetland species. Typical rooting depths for these species are about 30-60 cms for upland species and < 30 cm for wetland species138. Therefore, phytostabilization covers are simply soils or sediments that are planted with vegetation selected specifically to control bulk soil migration and/or prevent contaminant migration through phytosequestration. In addition to phytosequestering contaminants in the rhizosphere, other plants such as halophytes and hyperaccumulators can be selected based on their ability to

phytoextract and accumulate contaminants into the aboveground tissues.

Phytodegradation

Phytodegradation, also called phyto-transformation, is the breakdown of contaminants taken up by plants through metabolic processes within the plant, or the breakdown of contaminants surrounding the plant through the effect of compounds (such as enzymes) produced by the plants. Complex organic pollutants are degraded into simpler molecules and are incorporated into the plant tissues to help the plant grow faster (Figure 2). Plants contain enzymes (complex chemical proteins) that catalyse and accelerate chemical reactions. Some enzymes break down and convert ammunition wastes, others degrade chlorinated solvents such as trichloroethylene (TCE), and others degrade herbicides.

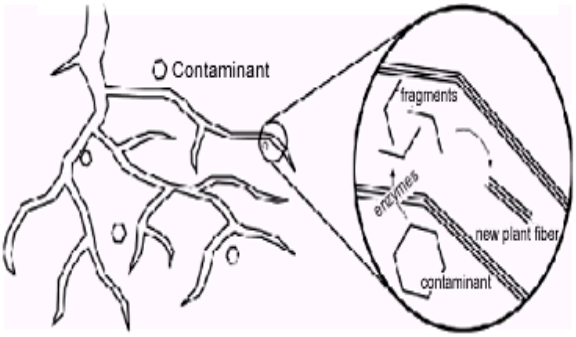

Fig:2 Destruction of Organic Contaminants by Phyotodegradation

Some of the enzymes produced by plants capable of degrading pesticides were identified by Husian *et al*. (2009). These were aromatic dehalogenase for DDT, nitrilase for herbicides, O-demethylase for alachlor as well as metalachor and phosphatase for organophosphates respectively.

Phytovolatilisation

Phytovolatilisation is the uptake and transpiration of a contaminant by a plant, with release of the contaminant or a modified form of the contaminant from the plant to the atmosphere. Phytovolatilisation occurs as growing trees and other plants take up water and the organic contaminants. Some of these contaminants can pass through the plants to the leaves and evaporate, or volatilise, into the atmosphere. Poplar trees at one particular study site have been shown to volatilise 90% of the trichloroethylene they take up. There are two other applications of phytoremediation that can be applied on specific sites:

Ripariancorridors

Riparian corridors (the term 'riparian' means 'located on the bank of a river') or buffer strips are applications of phytoremediation that may also incorporate aspects of phytodegradation, phytovolatilisation, and rhizodegradation to control, intercept, or remediate contamination entering a river or groundwater plume. In a riparian corridor, plants may be applied along a stream or river bank, while buffer strips may be applied around the perimeter of landfills. Applications of these systems prevent contamination from spreading into surface water and/or groundwater.

Vegetativecover

Vegetative cover (or a vegetative cap) is a long-term, self-sustaining cap composed of soil and plants growing in and/or over waste in a landfill. This type of cover is an alter-native to composite clay or plastic layer caps. Plants control erosion and minimise seepage of water that could otherwise percolate through the landfill

and form contaminated leachates. In addition, a vegetative cap can be designed not only to control erosion and seepage of water, but also to enhance the degradation of underlying materials in the land fill.

ADVANTAGES

1. Phytoremediation is less expensive than the old "pump and treat" method for the treatment of contaminated water.
2. Phytoremediation is also much less expensive than digging out the contaminated site.
3. Phytoremediation takes no maintenance once instituted.
4. Since phytoremediation uses plants, it is aesthetically pleasing.
5. After plants are introduced, wildlife is able to flourish at the once uninhabitable site.
6. Solar energy is used to drive the cleansing activity.

DISADVANTAGES

1. Phytoremediation requires a large surface area of land for remediation.
2. If contaminant concentrations are too high, plants may die.
3. The success of phytoremediation may be seasonal, depending on location. Other climatic factors will also influence its effectiveness.
4. The success of remediation depends in establishing a selected plant community.

Introducing new plant species can have widespread ecological ramifications. It should be studied beforehand and monitored. Additionally, the establishment of the plants may require several seasons of irrigation. It is important to consider extra mobilization of contaminants in the soil and groundwater during this start-up period.

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Insect Management Recommendations for On Farm Stored Grain

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Abstract

Maintaining the quality of grain in storage requires an integrated approach that incorporate a number of tools and practices. Storing only clean grain at the proper moisture content and temperature, sanitizing the bin before loading, checking the grain condition regularly and correcting problems before they get out of hand are critical management strategies that must be implemented to prevent grain deterioration and possible economic losses.

The following summary includes a list of labelled insecticides, use rates and labelled uses.

Steps to Successful Insect Management in Farm-stored Grains

BEFORE HARVEST

SANITATION:

Thoroughly clean all grain residues from bins. Remove all residues from areas around the bins and any nearby feed bunks or feed storage areas. Remove all grain residues from combines, trucks, and augers. These residues will be the main sources of insect infestations for farm stored grain. This is a very important part of a good grain management program and can prevent many stored grain insect problems.

RESIDUAL SURFACE SPRAYS TO EMPTY BIN:

After all debris and grain residues have been removed, a residual insecticide should be sprayed to the entire inside of the bin. This insecticide should also be applied around the exterior and to all areas where residues were removed. Spray all surfaces until wet; usually one gallon will cover 1,000 square feet. Use a course spray at a pressure of at least 30 psi. Insecticides are most effective if temperatures are 60F or higher. The labelled effective compounds are:

Beta-Cyfluthrin (Tempo SC Ultra - 0.27 to 0.54 fl oz per 1 gallon of Water) for application to empty bin surfaces only, not to grain.

Chlorpyrifos-methyl and deltamethrin (Storcide II – 1.8 fl oz per 1 gallon of water) Warning-This insecticide should only be applied from outside the bin using automated spray equipment. Do not enter the bin until all sprays have dried.

Malathion (Malathion 5E - several products by various formulators, check specific application rates.) The efficacy of

this product is questionable although labelled. Some stored grain insect populations, such as Indian meal moth, have developed resistance to this insecticide. Note: Malathion 5 E not labelled for rice.

AT HARVEST GRAIN PROTECTANTS

PROTECTANTS FOR APPLICATION TO GRAIN:

If grain is to be held in storage into the summer months of the year following harvest or longer, then a grain protectant applied at harvest is recommended. Formulated sprays, drips or dusts are typically applied to moving grain stream as it goes into storage vessel.

Chlorpyrifos-methyl + deltamethrin (Storcide II) – dilute labeled rate of Storcide II in 5 gallons of water and apply formulated spray into grain stream

Malathion (Malathion 6% Dust – 10 lbs/1,000 bushels of grain.) Insecticide dust best applied through dust applicator into grain stream. Labelled for barley, corn, oats, rye, and wheat. Malathion not labelled for use on rice.

SURFACE TREATMENTS OR TOPDRESSING AFTER BIN FILL IS COMPLETE:

- Fill bins only to height of side walls and level grain prior to applying surface or top-dress insecticide treatments.
- Bacillus thuringiensis (Biobit HP and Dipel DF – 1 lb/ 10-20 gal/1,000 square feet). Most often used for Indian meal moth larval control. See label for specific instructions and target pests.
- Diatomaceous earth (Insecto at 4 lbs/1,000 square feet and Protect-It at 40 lbs/1,000 square feet if grain not previously treated with this protectant). See label for specific instructions and target pests.
- Pirimiphos-methyl (Actellic 5E – 3.0 fl oz per 2 gallons of water per 1,000 square feet of grain surface. Note: Labelled for corn and sorghum only.)

MONITORING FOR INSECT PESTS IN STORED GRAIN:

Bins should be monitored every one to two weeks when grain mass temperature is above 60F and every two to four weeks when grain temperature is below 60F. Monitoring is best achieved using plastic tube traps which are inserted into the grain mass for a certain period of time and then retrieved (see trap label for specific instructions). This type of trap will attract insects and help determine the kind and number of insects present in the grain mass. Be sure to cool grain mass in fall to 60F or less to prevent insect activity. In the spring the grain mass should be warmed to average outside temperatures to prevent condensation and subsequent moisture damage to grain in contact with bin walls.

Grain masses should be monitored a minimum of once each month during the winter months of November through April and at least twice per month during the summer months of May through October. Areas of the grain mass most frequently infested include the grain surface and central core. Special attention should be given to these areas when sampling, but other areas of the grain mass should not be ignored.

Scouting methods differ by location in the bin and the specific type of insect present. To determine if insects are present,

producers should visually inspect the top of the grain mass by looking through the roof access door. A sour smell, grain clumped together, condensation present on the inside surface of the bin roof, webbing on the grain surface, or the presence of insect larvae, adult beetles or moths all indicate the presence of an insect infestation. If an insect infestation is found on the surface of the grain mass and webbing is present, this usually indicates the presence of Indian meal moth. As this insect only damages the upper 12-14 inches of the grain mass, removal of the webbing and damaged grain along with an application of an appropriately labelled insecticide are recommended. Pest strips containing (dichlorvos or DDVP) hung above the grain mass inside the storage structure may help prevent Indian meal moth infestations by controlling the moths of this common pest as they enter the storage structure. If no insects, webbing or foul grain odours are found during the inspection, then it is unlikely that Indian meal moths are present in high numbers. If the grain was properly levelled and the grain surface treated (capped) with an insecticide after filling of the storage structure the previous fall, it is best not to break or disturb the protective cap of insecticide previously applied at that time. It is best not to enter or walk on the treated grain surface as insects may establish in the disturbed areas unless these area are retreated.

Similarly, an inspection of grain from the interior of the grain mass is also needed. Monitoring of the grain mass is best achieved through the side access panel by using plastic tube traps, probe traps, and sticky pheromone traps. These traps are inserted into the grain mass for a certain period of time and then retrieved. These types of traps will attract insects and help determine the kind and number of insects present. If traps are unavailable, a quick but less accurate method of sampling the grain mass for insects can be accomplished by direct observation of grain removed from the side door using a grain probe. Deep probes should be collected from several locations in the bin with the collected grain placed in a quart glass jar, plastic bag, or some other container through which insects can be seen if they are present in the grain. These containers of grain should be placed in a warm area to allow the grain to warm to at least 60 degrees F or higher in order to stimulate insect activity. Although there are no reliable thresholds for most insects found in stored grains, it is usually considered that if insects are found in the 1 quart samples of collected grain, the grain content of the bin should be either quickly used before grain quality is diminished by insect activity or treated (fumigated) to kill insects present in the grain and prevent excess loss of grain quality when stored at summer temperatures.

Rescue Treatments

If infestations of various flour beetles, grain weevils, or other stored grain beetles are found infesting the cold grain mass, then the immediate use of grain for livestock feed or some other use where the insects do not cause problems in the end product is recommended. The grain should be fed to livestock prior to the arrival of summer temperatures when insect activity increases. If the grain is to be retained into the summer, then fumigation of the entire grain mass is a

second, but less attractive management option. Producers can legally fumigate grain bins in Missouri providing they possess a valid private pesticide applicator license when purchasing and using the fumigants. However, due to the extreme hazard associated with the very poisonous gases emitted by the fumigation pesticides and the extreme danger if used improperly, it is strongly recommended that a professional fumigator be contracted to fumigate grain bins and other grain storage structures. A third option would be to move the grain out of the storage facility immediately after the grain has been warmed in the spring. The grain would be moved to another storage structure with the grain being treated with a recommended insecticide as the grain is moved. Be sure to consider whether the grain was previously treated with and insecticide when placed in the bin the prior fall to avoid excessive insecticide residues. This method of insecticide application should provide satisfactory insect control on a short term basis. Of these three options, immediate use of the grain as livestock feed is generally the best option. Once the grain in removed from the bin, sanitation procedures should be implemented and the empty bins treated with an approved insecticide both inside and out.

GRAIN FUMICANTS

Recommend use of commercial pest control specialist when using grain fumigants for stored grain insect control. Special safety equipment including a self-contained breathing apparatus is required for this insecticide application.

1. Aluminum Phosphide (phosphine gas - restricted use)

Phostoxin, Fumiphos, Fumitoxin, Phoskill, Phosteck, Phosfume, Weevil-cide and other formulations. See specific labels for rates of pellet or tablet use).

All insecticides for stored grain insects have very specific labelled uses so special attention must be given when selecting an appropriate insecticide. Some insecticides are labelled for use in empty grain bins, but are not labelled for use on grain. Some insecticides are labelled for wheat only or corn only, whereas others may be labelled for both. Be sure to read and follow all insecticide label instructions, restrictions, and precautions when using insecticides for management of stored grain insect pests.

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Present Scenario of Dairy Industry In India

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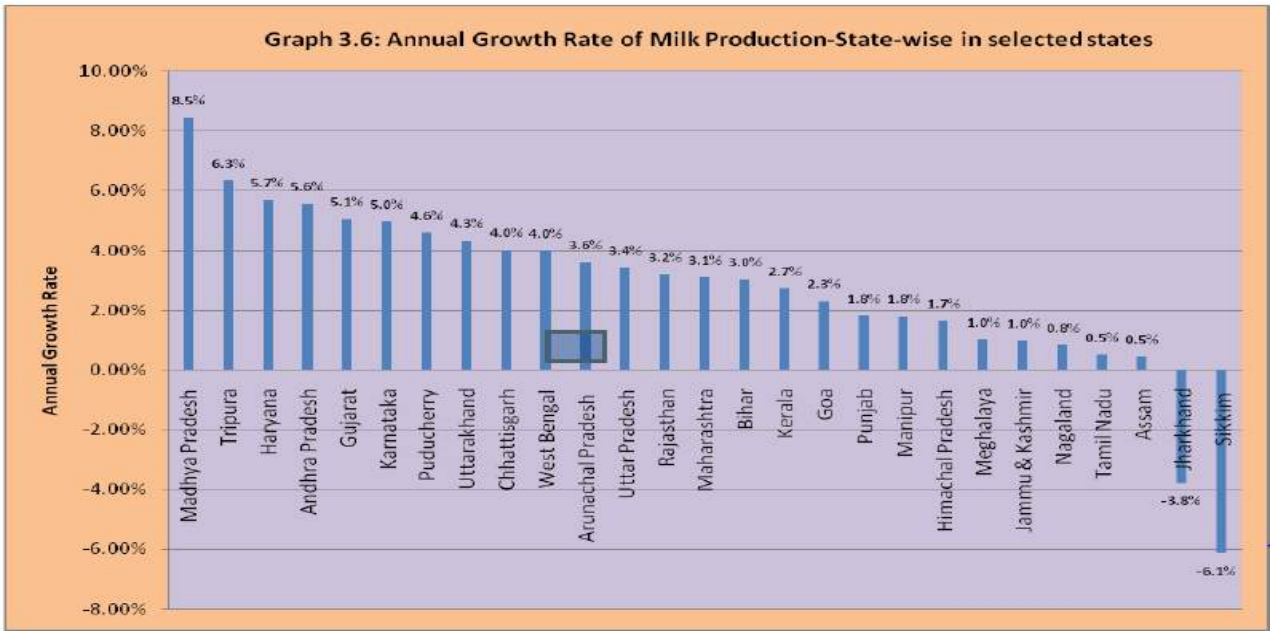
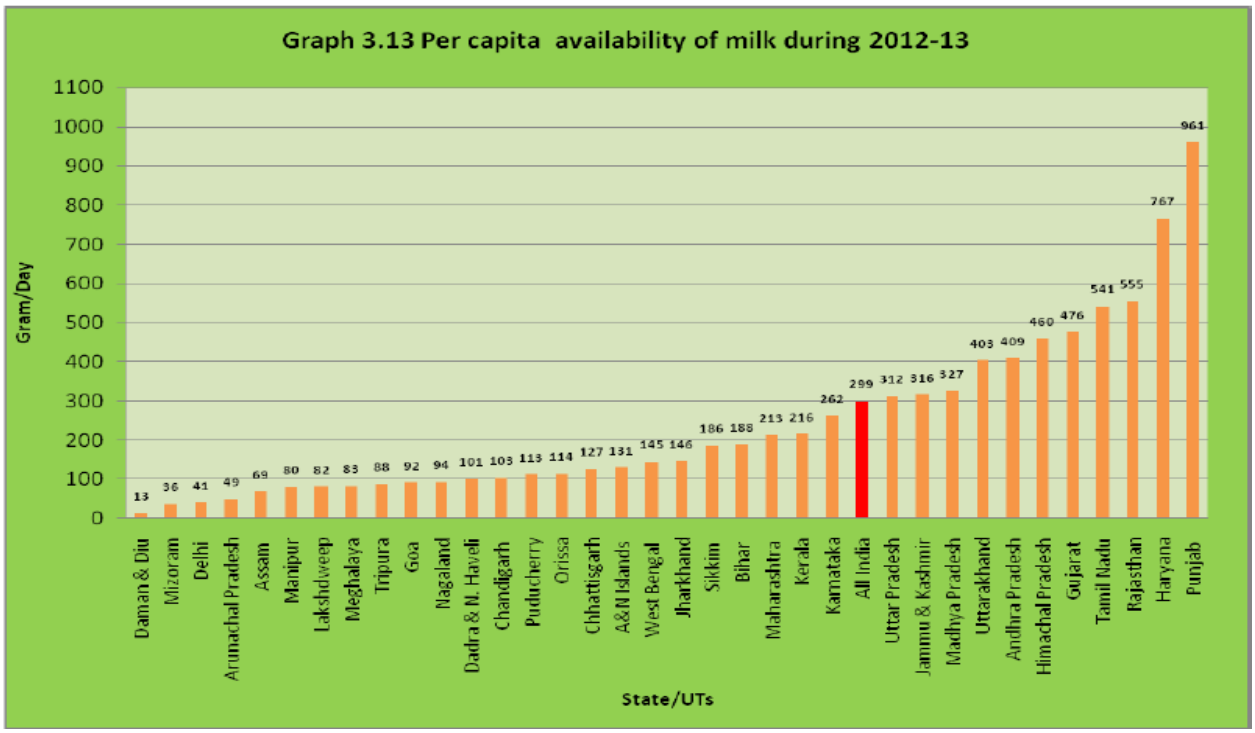
Dairy is business enterprise that operates for harvesting milk manly from cows or buffalo but also from sheep, goat, horses or camels for human consumption. A dairy is typically located on a dedicated dairy farm or in a section of a multi-purpose farm (mixed farm) that is concerned with the harvesting of milk. Along with harvesting of milk some dairy farms also have the sections for processing of milk and its products. Dairy industry gives a secure source of income and provides livelihood that leads to





upliftment of rural areas of country. It adds to growth of economics of an country and provides source of employment that acts as sector of entrepreneurship. Most importantly provides source of employment to women's in society making them self dependent. Many illiterate as well as well educated people of society are benefited.

Today total milk production in India is 146.3 million tones per year that includes total milk of cow milk, buffalo milk, goat milk, sheep milk and camel milk. Posses the dual crown of two things. Ist is largest milk producer and 2nd is largest milk consumer. It has largest share of 15% of worlds milk production. Nearly 70% of Indian population lives directly or indirectly on dairy sector. Largest employment providing sector after agriculture, one of largest sector that contributes to GDP.

Indian milk export

Key Players	Brand
GCMMF	Amul
Nestle India	Nestle
Punjab State Cooperative	Verka
Hatsun Agro	Anun, Komatha, Hatsun Cooking Butter, Hatsun Curd
Britannia Industries Ltd	Britannia
Kwality	Kwality Walls
Heritage Foods	Heritage, Heritage Golden
Parag Milk Food	Parag
Modern Dairy	Modern Dairy
Rajasthan State Cooperative	Saras
Vadilal Industries	Vadilal
ADF Food	Ashoka
Himalaya International	Himalaya Fresh (Paneer)

Even tough India might be the largest producer of milk it does not have the same adjective of "highest exporter". The total export of Indian milk is even "less than 1%". There are several reasons for this fact to be true. Foreign policies, our own necessities and clean milk production are the primary reasons.

Key players of Indian dairy industry

Operation flood

It's a project of National Dairy Development Board. It made India the world largest milk producing country. Increased milk production by 100 MT in 4 decades. "MASS PRODUCTION BY MASSES" was its motto and reason for its success. "Dr. Varghese kurian" is considered as father of Indian white revolution aka operation flood. Started in 1970 had 3 phases and was completed in 1989. Operation flood phase 1 was financed by EEC, started in 1970. Mother dairies were established in metro cities namely Delhi, Kolkata, Mumbai and Chennai. In operation flood phase II milk sheds were increased from 18 to 236 and 43000 village cooperatives and 425000 milk producers were covered, "RAKSHYA" vaccine developed. In operation flood phase III infrastructure added, veterinary aids given, 40000 cooperative societies added, vaccine for theileriosis developed.

Amul model founded in 1946. Made India rank 1 in milk production in world surpassing USA. Managed by Gujarat cooperative milk marketing federation limited. Now jointly run by 3 million milk producer in Gujarat. Acquired a "THREE TIER" working. i.e. village cooperatives then to milk unions in district levels and finally to federation of milk unions at state level.

Strength of dairy industry

Large number of small and marginal farmers involved in dairying**.** An

effective marketing channel helps to meet the demands of the urban consumer. Very large number of animals and huge scope to enhance productivity. Self-sufficiency in medicine production and do not have to rely on exports. Strengthen economic viability of dairy farms by interventions on the input side as well as ensuring more fair farmer prices. Increase the link between rural production areas and urban markets. Focus on strengthening the indigenous breed to help significantly enhance productivity. Ensure availability of quality medicines by strengthening regulatory framework for quality. Policies related to dairy industry are IRDP (Intensive Dairy Development Programme), ACPS-(Assistance To Cooperative Scheme)-revive sick dairy cooperative, NPCBB-(National Programme For Cattle And Buffalo Breeding) – genetic up gradation via AI, DVCFS-(dairy venture capital fund scheme), NDP-(National Dairy Plan 2021-2022)- To Increase Dairy Output By 6 Mt Anually.

WEAKNESS OF INDUSTRY

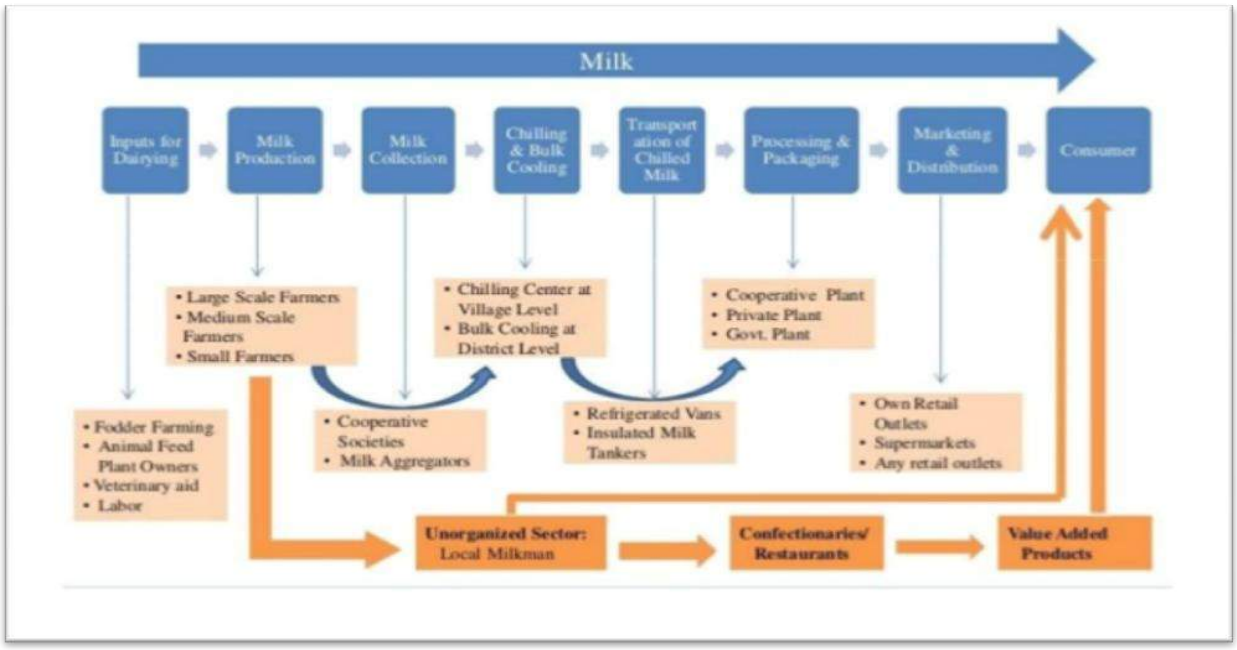
Large amount of milk almost 75% goes through informal channel where quality is compromised. Farmers do not share in the benefits of high demand because of poor governance of cooperatives. Milk production is scattered over a large number of farmers producing minuscule quantities. Milk distribution is limited. Low milk prices because of lower prices declared by cooperatives, which results in low prices of milk paid by all players. Ban on ad hoc milk export. Ad hoc export policies and a ban on exports. Quality of milk and milk products are a barrier to entry to the export market, especially the EU and the USA. Lack of policy focus on strengthening indigenous breeds. Non-existent extension facilities. Because of low access to credit and risk-taking ability, farmers cannot increase their herd size.

HOW TO OVERCOME

Focus on quality issues even in the informal channel by training traders and by enforcing food quality regulations. Develop infrastructure and training for clean milk production. Support a fair playing field for the private sector. Support to dairying as an enterprise to encourage commercial dairy farming and encourage production and productivity by extension and breed development. Enhance packaged milk distribution in more areas. Strengthen dairy farmer cooperatives to enable farmers to get a higher price for milk. Create rational export policy to enable farmers to take advantage of higher prices. Strictly implement quality regulations and improve infrastructure and training for quality. Strengthen the breed development programmes. Strengthen extension facilities. Create policy regulations to make mandatory testing as a basis for setting milk price. Increase access to credit through dairy farmer organizations and other agencies.

Opportunities in dairy sector

Increased farmer income by exploiting the high demand. Increased consumer sophistication and awareness of quality reception of quality packaged products (though slowly). Entry of large



corporations in retailing, which can lead to more investment. Immense scope to enhance governance of dairy farmer organizations and thus enable dairy farmers to demand higher prices. Potential for exports due to low cost of production. Overall positive growth environment, which is triggering the Government to enhance infrastructure. Create policies and activities geared towards enhancing dairy farming activity by increasing, production, productivity and ensuring fair farmer price of milk. Establish enabling policy environment to enhance investment. Create policy support to enhance governance of producer companies. Focus on quality issues that are a barrier to exports. Encourage private sector to increase investment in dairying.

DAIRY PROTOCOL IN INDIA

Large portion of the population does not care about quality issues in milk. Because of high price sensitivity for dairy products, people are not willing to pay for quality. Significant increase in maize prices can increase feed prices. Large informal markets that extend credit are constraining farmers. Low productivity and scattered production leading to high cost of transportation. Emphasis on milk fat and not on SNF content maintaining relatively lower prices of milk. So to avoid them initiate consumer education about the negative health impacts of unpackaged products. Develop packaging in small quantities to meet the needs of the poor. Increase milk prices in accordance with feed prices. Support expansion of dairy farmer organizations. Enhance productivity by breed improvement and extension. Enforce price setting of milk based on fat and SNF content to encourage production of cow milk

Management of High Yielding Dairy Animals

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India leads the world in milk production with an annual production of 146MT. Still India is far behind the developed countries in terms of per capita milk production and average milk yield per cow. The reason for less productivity per animal is less milk yielding potential of indigenous breeds of cattle. Buffalo is the main dairy animal and contributes about 54% of total milk production in India. In India, dairy mainly lies in the hands of small and marginal farmers who keep one or two cows/ buffalo for milk production that buffers the income. The indiscriminate crossbreeding from last few decades has resulted in increased milk production but at the same time it has lead to significant loss of indigenous germplasm. The exotic breeds under tropical conditions of India failed to perform well due to environmental stress and deficiency of feeds and fodders. The country and the states need a defined breeding policy so that there can be increase in milk production and at the same takes care of conservation of indigenous breeds. To improve the milk productivity of milch animals and also the availability of milk at par with the developed countries, the following managemental practices should be followed

FEEDING MANAGEMENT

The feeding costs alone accounts for more than 60% of production cost in cattle. The proper feeding is most important for optimum production in milch animals. The cow with high genetic merit will fail to produce at its maximum if feeding is not proper. The high yielding animals (cross bred and exotic) remain in negative energy balance during the first five months of lactation. There is a mobilization of nutrients from body reserves to compensate the nutrient deficit caused by nutrient drainage in milk which results in weight loss. The appetite is also reduced during the early lactation. To meet the nutrient requirement of such animals, feeding of high energy diets is advisable. So the

milch animals during the early lactation should be fed with high quality feed and forages so that there occurs no or less weight loss. Challenge feeding can be adopted 2 weeks before parturition which encourages feeding of concentrates to the high yielders so that they can produce at their maximum. The feeding of bypass proteins and bypass fat also gives encouraging results in high yielders. Green grass (e.g,hybrid napier/ para grass) about 25 kg can be used as maintenance ration. 10 kg green grass, 6 kg leguminous green fodder and 3 kg paddy straw can support the dairy cattle maintenance ration. The dairy cattle should be given ration containing 30-40 % from grains and 60-70% from forages. The greens should be conserved for the lean season in the form of hay and silage. Good quality green forage can support the milk production up to 10 kg. But high yielding cows needs ration based on scientific ration formulation. Scientifically the animal ration should be computed on body weight basis but the farmers under field conditions find it difficult to feed their animals on bodyweight basis. For them the thumb rule can be a better option. Cross bred cattle consume about 2.5-3 kg of dry matter (DM) per 100kg of body weight. 2/3 of dry matter should be fed as roughage and 1/3 in the form of concentrate. The feeding of crossbred and exotic cattle by thumb rule is given in table.

Maintenance ration	
Straw	4-6 kg
Concentrate mixture (14-16 % DCP, 68-72 % TDN)	2Kg
Pregnancy ration (Above maintenance ration)	
Concentrate mixture	1.75 kg
Milk production ration (Above maintenance ration)	
Concentrate mixture	1kg/ 2kg milk production

The pregnancy ration is to be fed during the last trimester of pregnancy. The Bureau of Indian standard (BIS) recommends two categories of cattle feeds viz., Type I and Type II for cows yielding more than 10 litres of milk. The specifications of type I and type II cattle feeds prescribed by BIS are given in table given below.

Item	Type I	Type II
Max. moisture %	11	11
Min. crude protein %	22	20
Min. ether extract %	3	2.5
Max. crude fibre%	7	12
Max. acid insoluble ash %	3	4
Max. common salt %	2	2
Min. calcium %	0.5	0.5
Min. phosphorus %	0.5	0.5
Min. vitamin A (IU/kg)	5000	5000

REPRODUCTIVE MANAGEMENT

For profitability and sustainability of dairy farm, reproductive efficiency is most important. The animals of high genetic merit should be selected. The selection of cattle breed depends on the climatic conditions and height above the sea level. Not only the genetic merit but also the plane of nutrition is important for optimum production of cattle. The heifers should be well managed so that they reach the puberty at early age. The

dairy cattle should be well managed so that they produce their young ones at appropriate age, get inseminated in time that maximizes the profitability of the farm. The animals should be fed good quality forage especially leguminous. The pregnant animals should be steamed up in the last month of pregnancy so that there is no metabolic problem at the time of parturition and successive lactation. Dry period of 60 days is important in high yielding cows. The animals at the beginning of lactation should be well managed so that service period is shortened. If the animals are not well fed, they suffer from nutritional anestrum which results in lengthening of service period. The animals in shed should be closely watched for estrus (heat) so that they get inseminated and conceived in time. The dairy animals should be inseminated with the semen from bulls of high genetic merit. The repeat breeders which don't conceive in 3 inseminations should be examined for any reproductive diseases like pyometra. Buffalo are shy breeders and remain in anestrum during the scorching heat periods of summer. The heat stress has negative impact on reproduction but if managemental practices are modified, they get conceived easily. There should be provision of wallowing tank and free access of shade to reduce the heat stress in buffalo. Sprinklers, fans, foggers and exhaust fans can be used in commercial dairy farms.

Water supply

The dairy cattle should be provided with fresh and wholesome water. The water troughs should be cleaned regularly. The water troughs should be checked for any algal growth and should be white washed with lime at regular intervals. During the summer months, sufficient cold water should be given to the dairy cattle but it should also be kept in mind that the water should not be too cold. Water being a major constituent of milk should be sufficiently supplied to dairy animals. During the winter months, provision of lukewarm water is essential which encourages sufficient water intake. Dairy cattle and buffalo require on an average of 45-55 kg water per day. The watering space per 100 animals should be 600-750 cms in length as BIS specifications.

Health management

The dairy herd is very susceptible to metabolic diseases like ketosis and milk fever during the first few months of lactation. If there are some signs of illness in dairy cattle, a qualified veterinarian should be called immidiately. Proper deworming and vaccination scheldule should be followed. Vaccination is essential as it protects the animals from fatal diseases. Deworming gives protection against harmful parasites. The parasites cause weight loss which diminish the production potential and at times proves fatal. So, dairy animals should be dewormed regularly so that their production is not compromised. The animal that is suffering from any disease should be isolated from others to prevent the spread of disease to other animals. The purchased animals should also be kept under observation i.e, quarantine for atleast30 days.

Housing management of cattle

Good housing being an important factor for optimum production that prevents the dairy cattle from inclement weather. The heat stress and cold stress results in drop in production of dairy cattle. The erection of livestock building should be well

planned so that there are no additional labour costs to dairy farmer that will result in less profit. The building for dairy cattle should be at higher elevation so that there is proper drainage of waste. The land around the dairy farm should be fertile so that good fodder and forages can be harvested to feed the cattle. The direction of building depends on the location. In temperate conditions like some northern parts of India, maximum exposure of sunlight should be considered. Long axis of animal building should be in north- south direction so that sunlight directly comes into the animal house. In south the temperature remains high, so the animals should be less exposed to sunlight. So building should have long axis in east west direction so that there is minimum exposure to sunlight. There should be comfortable space to each animal in cattle shed. The floor space for each animal should be as per BIS standards. The floor of the dairy cattle shed should be concrete, non slippery preferably made of cement concrete. The animal floor should have a slope so that it is easy to clean the animal shed. The mangers and water trough should be at appropriate height so that it doesn't get contaminated with animal waste. The dairy cattle shed should have proper ventilation which results less spread of air borne diseases.

Record keeping

Proper record of the dairy farm is an important tool for successful running of a dairy. It should include all the records from date of birth to date of disposal. All the necessary records should be maintained viz. Date of birth, Identification number of animal, Date of deworming and vaccination, Date of service/ insemination, Date of calving, Daily milk yield, Lactation yield, Lactation length, Dry period, Record of culled and replacement herd. Proper record keeping helps in better economic returns.

Cleaning , sanitation and disinfection of animal house

Proper cleaning prevents the spread of diseases. The left over feed in animal mangers should be regularly removed; the animal bedding should be changed daily. The dung should be removed daily and should be disposed off properly. The animal floor should be cleaned regularly with running tape water. Water troughs should be cleaned and white washed with calcium carbonate at periodical intervals so that algal, bacterial and fungi growth is checked. Through cleaning and sanitation of animal shed checks the nuisance caused by flies and arthropods. The arthropods results in spread of many diseases as these are carriers of many disease causing microorganisms. Sanitation is the elimination of disease causing microorganisms. The cheap and most potent sanitizer is sunlight which kills most of the disease causing microorganisms. The gutters should have direct sunlight that prevents spread of diseases. Animal shed should be disinfected at regular intervals. Disinfection is must after disease outbreak. The are many chemicals which are used as disinfectants, the common disinfectants used are viz sodium carbonate, bleaching powder, boric acid, Iodine and lodophor, Washing soda, Slaked Lime (Calcium hydroxide), Quick Lime (Calcium oxide) and phenol. 5 percent sodium hydroxide is used against anthrax and black quarter outbreak. Four percent Sodium carbonate is used as

disinfectant against many bacteria and viruses but is most effective against Foot and mouth diseases virus (Aptho virus). The dairy farm should have a foot bath at the gate to prevent entry of infection to dairy farm from outside.

Other points of consideration

- The full hand method/ fist method should be used for milking.
- For quality milk production, cleanliness of animal, surrounding and hygiene of milk man is prerequisite.
- The udder should be washed with mild antiseptic solution before milking which helps in clean milk production and prevention of mastitis.
- The calf should be allowed to suckle the dam in the beginning which causes milk letdown.
- The animals should be fed good quality forage especially leguminous. Plant some trees to provide shade to dairy cattle during the hot summers.
- The dairy cattle should be sprinkled with cold water during hot summers to reduce the heat stress.

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