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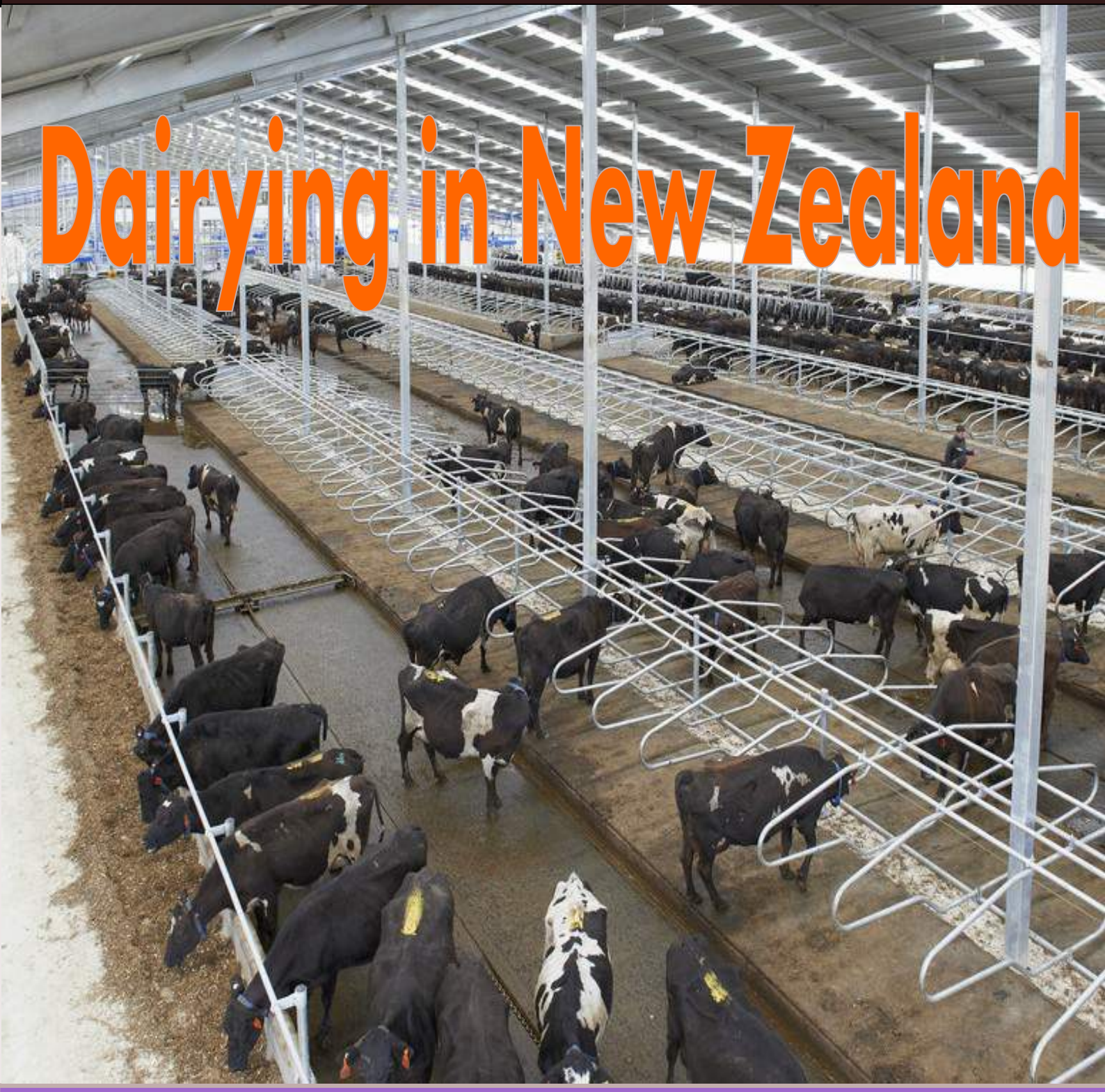

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Transgenic Animal Production: Methods and Scope in Biomedical Research

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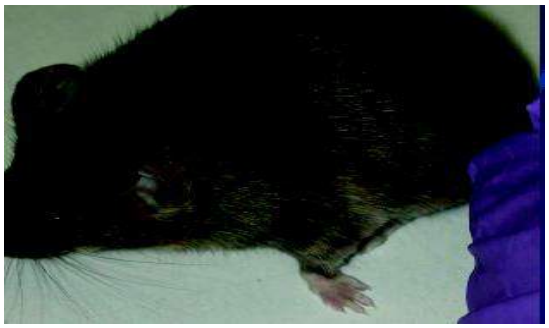
Transgenesis is the process of introducing foreign or exogenous DNA into an animal's genome or transgenic animal refers to an animal in which there has been a deliberate modification of the genome. The nucleus of all cells in every living organism contains genes made up of DNA. Genes can be altered artificially, so that some characteristics of an animal are changed. For example, an embryo can have an extra, functioning gene from another source artificially introduced into it, or a gene introduced which can knock out the functioning of another particular gene in the embryo. Animals that have their DNA manipulated in this way are knows as transgenic animals. The majority of transgenic animals produced so far are mice, the animal that pioneered the technology. The first successful transgenic animal was a mouse. A few years later, it was followed by rabbits, pigs, sheep, and cattle.

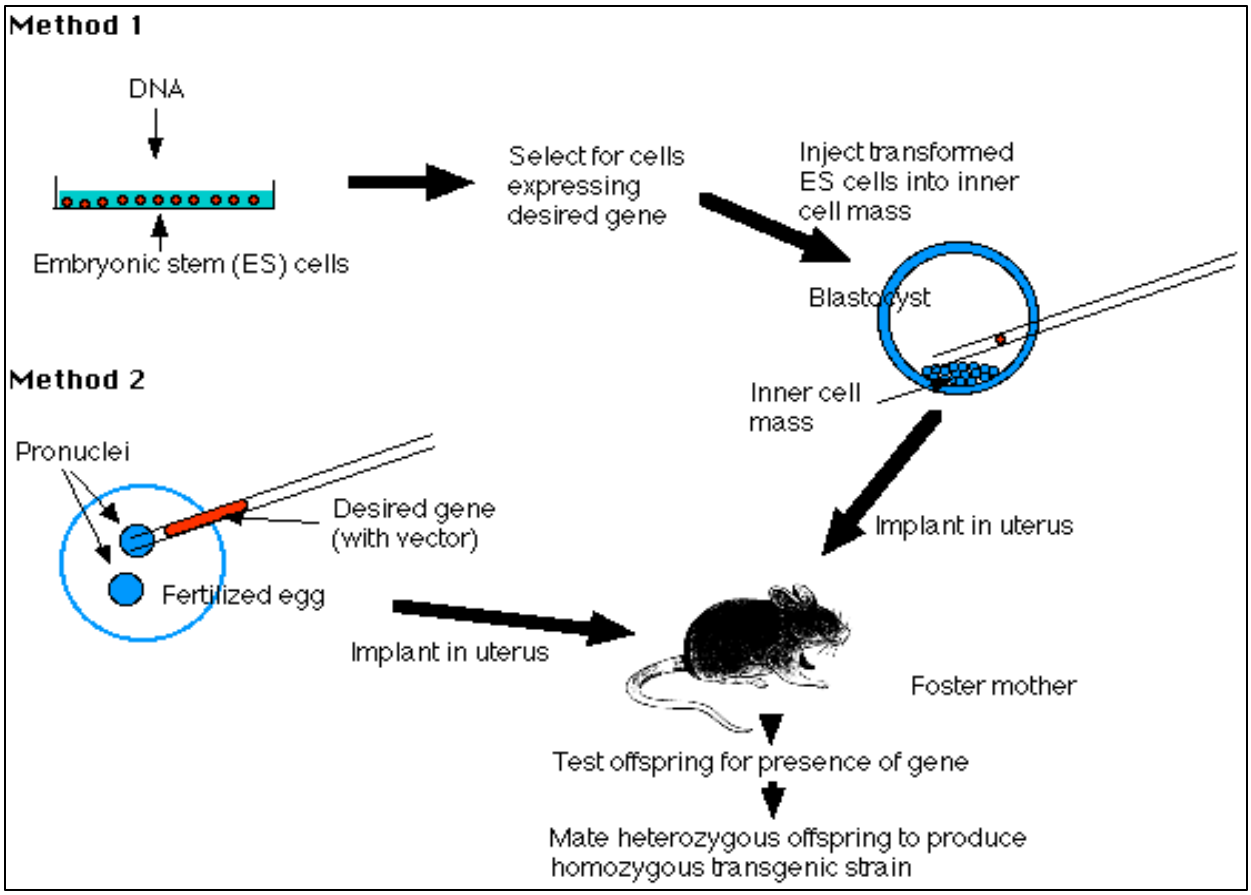
PROCEDURE

Following sequence is generally adapted for the development of transgenic animals irrespective of species :



Transgenic Mouse Produced By Embryonic Stem Cell Method

- Identification and construction of the foreign gene and any promoter sequence
- Introduction of DNA into the pronucleus of a single fertilized egg by various methods
- Implantation of these engineered cells into surrogate mother
- Bringing the developing embryo to term, proving that the foreign DNA has been stably and heritably incorporated into the DNA of atleast some of the newborn offspring
- Demonstrating that the gene is regulated well enough to function in its new environment



EMBRYONIC STEM CELLS TRANSGENESIS

Role of transgenic animals in biomedical research

- **Models for human disease**

1. Gene therapy: Models for obesity and immunological, neurological, reproductive and hematological disorders, providing future hope for a variety of human therapeutic interventions.

2. Genetic basis of human and animal diseases and the design, testing of strategies for therapy.

3. Disease resistance in humans and animals

4. Drug and product testing and/or screening.

5. Toxicological screening protocols using transgenic animal systems are already in trials. For preclinical drug development, a whole animal model for screening is essential to the understanding of disease etiology, drug pharmacokinetics and evaluating therapeutic efficacy and safety.

6. Novel product development through molecular pharming e.g; α-1 Antitrypsin for Hereditary emphysema, Cystic fibrosis. Calcitonin for Osteoporosis, 5G1.1 for Rheumatoid arthritis, Nephritis and Collagen for Rheumatoid arthritis.

- **Different models of transgenic animals for various diseases.**

1. HIV/AIDS: Tg26 HIVAN Mouse Model in 1991.
2. Alzheimer's disease: No animal models existed for the disease before transgenic technology was employed.
3. Cardiovascular disease: Gain and or loss of function of angiotensin, endothelin etc.
4. Diabetes Mellitus: Models of insulin secretion such as glucokinase and hepatic glucose production in type 2 diabetes are developed.
5. Angiogenesis: Mouse models of angiogenesis, arterial stenosis, atherosclerosis etc.
6. Cancer diseases: Oncomouse was first transgenic animal to be patented. Its germ cells and somatic cells contain an activated human oncogene sequence introduced into the animal at an early embryonic stage
7. Production of pharmaceuticals in transgenic animals

The production of therapeutic proteins from transgenic animals usually involves their expression from mammary-gland specific promoters to drive secretion of the transgene into milk or an alternative is the use of kidney- or bladder specific promoters that direct transgene expression to the urine e.g; Prolactin for Enhancement of immunity and Protein C for Blood coagulation

- **Transgenic expression of immunoglobulins**

Transgenic cattle harboring intact unrearranged human Ig heavy- and λ light-chain loci were created .These 'transchromosomic' cattle were shown to produce human Ig.

- **Xenotransplantation**

Primate-to-human organ transplantation is known as xenotransplantation. It was recognized early on that for physiological, anatomical, ethical and supply reasons the pig was the best choice as a donor animal for vascularized organs.

- **Identification of new drug targets**

Knockout' Technology: In which a specific gene function is removed. Knockouts therefore show huge promise for identifying & validating new drug targets among the tremendous number of potential targets revealed by the sequencing of the human genome.

Role of Transgenic cattle ,sheep and goat

A. If the mammary gland is to be used as a bioreactor, then dairy cattle are the likely candidates for transgenesis as they produce about 10,000 liters of milk/year with 35 gm protein/liter.
B. To change the constituents of milk. For example the amount of cheese produced from milk is directly proportional to the amount of k-casein

content of the milk so if a transgene is constructed to produce milk with higher amounts of k-casein, then the production of cheese will increase proportionally.

C. Production of transgenic cows with modified genes to produce lactose free milk could solve the problem of those who have lactose intolerance.

D. For livestock in general, attempts to produce animals with inherited resistance to bacterial, viral and parasitic disease is a goal. Example of major diseases that affect the livestock are mastitis in cows, neonatal dysentery in swine, fowl cholera.

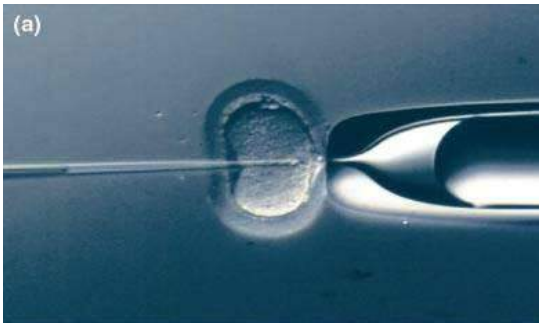
E. If the basis of each of these is a single gene that will be responsible for the resistance, then it might be possible to produce transgenic animals that carry this gene.

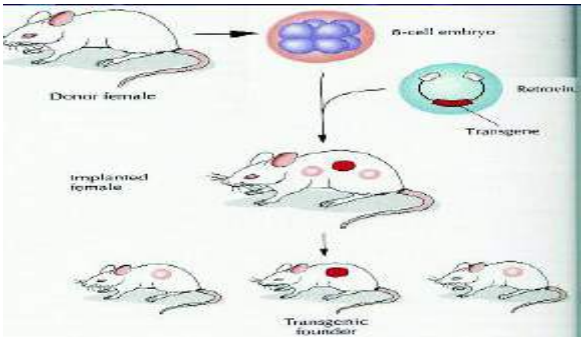
F. Transgenesis research with sheep, goat or pigs has concentrated in the most part on utilizing their mammary glands as bioreactors for production of pharmaceutical proteins.

Example; Production of transgenic sheep that produces anti-trypsin in their milk; This protein is a potential treatment for cystic fibrosis.

CONCLUSION

1. Transgenic in general is a rapidly advancing field, and within few years of its inception it has produced the first USFDA approved drug for transgenic animals.
2. The use of transgenic animals has the capacity to overcome the current and future needs in medicine and is now a necessity rather than a matter of choice
3. From research, pigs and transgenic animals derived products like milk, eggs seems to be promising in developments of therapeutics strategies
4. The regulatory aspects and ethics should be given due consideration while using transgenic animals.





Techniques	Microinjection	Retroviral infection of embryos	Embryonic stem cells
DNA vector	Any cloned DNA, preferably linear with vector	Recombinant or wild type retroviruses	Cloned DNA or retroviruses
Introduction of DNA	Microinjection into pronucleus	Injection after removal of zona pellucida	Electroporation or retroviral infection
Embryonic stage	One-celled stage	One-celled stage or later	Totipotent ES cells
Embryo transfers	Oviduct	Uterus	Into blastocoel, then into uterus
Genotype of founder mice	Usually non mosaic	Mosaic (two cell lines from same zygote)	Chimeric (two cell lines from different source or zygotes)
Screening of newborns	Dot blots, Southern blots or PCR	Southern blots or PCR	Visual coat color markers plus PCR or Southern blots
Copy number of integrated DNA	1-200	1	Can be varied by selection of method for introducing DNA
Percentage of potential founders that are transgenic	10-30%	5-40%	Upto 100%
Expression of the new DNA	Usually	Poor	Enhancer trap, gene trap (identification of disrupted gene)
Integration	Random, non-homologous, multiple copy	Apparently random using retroviral long terminal repeats (LTRs)	Random plus targeted, depending on method of introducing DNA

Applications Of Lateral Flow Immunoassay In Veterinary Practice

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One of the main challenges for a versatile application of monitoring technologies in the veterinary and food industry is to develop fast, quantitative and low cost devices that can be used with minimal expertise. Most of the diagnostic technologies in use today require laboratory facilities, expensive equipments and trained personnel. During the last decade, a few technologies have been proposed and developed that fulfill most requirements of versatility mentioned above. One of the most promising approaches is the lateral flow immunoassay (LFIA) technique.

Principle

Lateral flow immunoassay (LFIA) formats is the movement of a liquid sample, or its extract containing the analyte of interest, along a strip of polymeric material thereby passing various zones where molecules have been attached that exert more or less specific interactions with the analyte. A typical LFA format consists of a surface layer to carry the sample from the sample application pad via conjugate release pad to the absorbent pad.

LFIA technique

Lateral flow immunoassay (LFIA) was derived from the latex agglutination assay, which was developed in 1956 by Plotz and Singer. LFA is performed over a strip, different parts of which are assembled on a plastic backing. These parts are sample application pad, conjugate pad, reaction pad and absorption pad. Reaction pad is further divided into test and control lines.

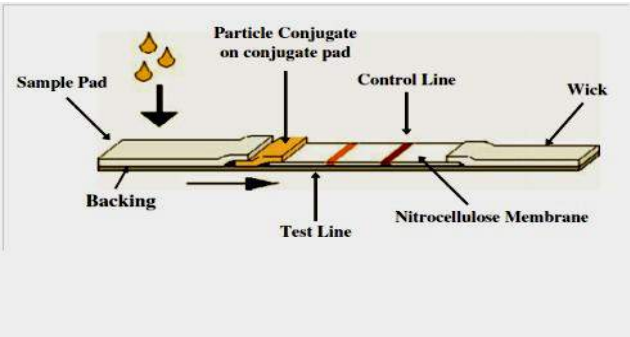

Figure 1: Configuration of a LFIA strip (courtesy-groeptms1316.wordpress.com)

The parts overlap onto one another and are mounted on a backing card using a

pressure-sensitive adhesive. When the sample is added to the sample pad, migrates through the conjugate pad, where a particulate conjugate has been immobilized. The particle can typically be colloidal gold, or a colored, fluorescent, or paramagnetic monodisperse latex particle. This particle has been conjugated to one of either antigen or antibody depending on the assay format. The sample re-mobilizes the dried conjugate, and the analyte in the sample interacts with the conjugate as both migrate into the next section of the strip, which is the reaction matrix. This reaction matrix is a porous membrane, onto which the other specific biological component of the assay has been immobilized. These are typically proteins, either antibody or antigen, which have been laid down in bands in specific areas of the membrane where they serve to capture the analyte and the conjugate as they migrate by the capture lines. Excess reagents move past the capture lines and are entrapped in the wick or absorbent pad. Results are interpreted on the reaction matrix as the presence or absence of lines of captured conjugate, read either by eye or using a reader. The assay formats can be either direct (sandwich) or competitive and should be able to accommodate qualitative, semi-quantitative and in limited cases, fully quantitative determinations.

Advantages of LFIA technique

LFIA based rapid tests are

- ❖ Quick results, available in just a few minutes.
- ❖ Requires no instrumentation.
- ❖ Easy to use.
- ❖ No or low capital expenditure.
- ❖ Able to execute the test and read result in the field itself.
- ❖ Does not require refrigerated storage.

Applications of LFIA in Veterinary Practice

- In companion animal diseases diagnosis
- In farm animal diseases diagnosis
- Avian diseases diagnosis
- Food and feed testing
- Drug and toxic compounds testing

1. In companion animal disease diagnosis

These patient side rapid tests are commonly used for diagnosis of canine infectious diseases like Canine distemper, Canine Parvovirus, Canine Adeno virus, Corona virus, Canine brucellosis, Ehrlichiosis, Giardia and Heartworm. In case of Canine Distemper, nasal or ocular discharge can be used for virus detection. Fecal swabs are the specimen of choice for canine Parvovirus detection. In antibody tests like *Ehrlichia* and *Brucella canis*, whole blood or serum can be used depending on the test format. Similar antibody tests are also available for distemper and parvovirus which are helpful for assessing the vaccination status of animals. These tests usually measure IgG response in the serum. Another important application of these rapid tests is detection of rabies virus in suspected cases. The virus can be detected in saliva or brain samples without much exposure to rabid specimens.

2. In Farm animal disease diagnosis

The most important application of these rapid tests in farm animal practice is for screening and surveillance. Tests for Brucella and TB antibody can be used for herd screening and elimination of infected

animals. Non-structural protein (NSP) antibodies in bovine serum can be detected by these rapid tests. This test helps in assessing the Foot and Mouth disease status of the herd. This NSP test can also be used for effective and rapid screening of animals at border check posts and to certify animals imported from other areas as disease-free. Similar tests are also available for Rota virus, anthrax, swine fever and many parasitic diseases.

3. Avian disease diagnosis

All avian screening tests can be produced in this format. However the most widely used tests for poultry farms are avian influenza tests. Throughout the world this test is accepted as a screening method. Other diseases which can diagnose by this technique are Newcastle disease (ND), Infectious bursal disease (IBD) etc.

4. Food and feed testing

Aflatoxin B1 is a severe problem in cattle and poultry feeds affecting the health and productivity of these animals. A rapid screening test which can detect Aflatoxin B1 in feed is of critical importance in farms and feed manufacturing plants. Lateral flow assays can be designed for quantification of Aflatoxin B1 using a competitive immunoassay format. These tests are supplemented with an easy and rapid extraction procedure using ethyl acetate. By this method Aflatoxin B1 levels as low as 2ppb can be detected in feed. This test is easier and cheaper compared to HPLC or TLC methods and there is no need to handle toxic Aflatoxin standards and solvents.

5. Drug and toxic compounds testing

Some of the drugs and toxic compounds which can test by this technique are carboryl and endosulfan in extracts of cereals and vegetables, botulinum neurotoxin in horse feaces, streptomycin in raw milk, nicarbamizine residue in poultry feeds, sulfadimidine in urine and milk, sulfamethazine in urine etc.

Assay methodology

These rapid tests are designed so that even a technician with limited expertise can perform the test easily. The veterinarian or the technician draws blood (or other suitable sample depending on the test) from the animal using a syringe or a vacutainer, optionally coated with a clot-activator for faster serum separation. The syringe is kept till the serum separates, and then, 3 drops of serum/sample are added to the sample hole on the test card using a dropper. The results can be read within 5-10 minutes. After the test is complete and result recorded. The used kits should be disposed of according to standard disposal procedure followed for clinical specimens in veterinary hospitals and labs.

CONCLUSION

Lateral flow immunoassay technology is evolving rapidly. Novel approaches driven by market needs are leading to improvements in performance and utility to a vast array of new application areas. With the integration of new reading, labeling, sample-handling and device designs comes as a requirement for a new approach to system development and manufacturing. The development of highly sensitive and reproducible/quantitative

next-generation point-of-need diagnostic assays requires a different, more multidisciplinary approach than has been the case with standard lateral flow immunoassays. Input is required from a range of disciplines, including materials science, chemistry, biology, optics, software and hardware engineering, as well as process design, equipment design and project management. For this reason, more collaborative approach is required and companies such as Diagnostic Consulting Network are established with the purpose of fulfilling the many needs of developers in this complex area.

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Foodborne Intoxication Due to Mycotoxins and Its Prevention and Control

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Foodborne pathogens are responsible for food intoxication (ingestion of preformed toxin), toxicoinfection (toxin is produced inside the host after ingestion of food). Mycotoxins are one of the example of food intoxication and may be describe as the toxic substance formed during the growth of fungi. 'Myco' means fungal (mold), and 'toxin' represents poison. In contrast to the bacterial toxins, which are mainly proteins with antigenic properties, the mycotoxins encompass a considerable variety of low molecular weight compounds with diverse chemical structures and biological activities. Like most microbial secondary metabolites, the functions of mycotoxins for the fungi themselves are still not clearly defined. In considering the effect of mycotoxins on the animal's body, it is important to distinguish between mycotoxicosis and mycosis. Mycotoxicosis is used, in general, to describe the action of mycotoxin(s), and is frequently mediated through a number of organs, notably the liver, kidney and lungs, and the nervous, endocrine and immune systems. On the other hand, mycosis refers to a generalized invasion of living tissue(s) by growing fungi. Mycotoxins and mycotoxicoses are an especially significant problem for human and animal health, because under certain conditions crops and foodstuffs can provide a favorable medium for fungus growth and toxin production. Mycotoxins are highly stable and are difficult to destroy by traditional food processing conditions. Under UV light, some mycotoxins emit fluorescence thus can be used for screening of contaminated food/feed stuff. Mycotoxins can cause acute disease manifested by kidney or liver failure or chronic disease including carcinoma, birth defects, skin irritation, neurotoxicity, and death. Three general mechanisms of mycotoxin action are described as mutagenic, teratogenic, or carcinogenic. During the mutagenic action, toxin binds to DNA, especially the liver mitochondrial DNA resulting in point mutation or frame shift mutation due to deletion, addition or substitution in DNA and affect liver function (hence hepatotoxic). Teratogenic action leads to birth defects and the carcinogenic effect cause irreversible defects in cell physiology resulting in abnormal cell growth and metastasis. In recent years,

the importance of mycotoxins has been highlighted for their potential use as weapon for bioterrorism. There are different types of mycotoxins produced by fungus such as:-

Aflatoxin

Aflatoxin (*Aspergillus flavus* toxin) is produced by *Aspergillus flavus* and *A. parasiticus*. Aflatoxins occur in different chemical forms; B1, B2, G1, G2, and M1. Aflatoxins are found in nuts, spices, and figs and produced during storage under hot and humid conditions. Aflatoxin contaminated feed causes high mortality in farm animals. Cows fed with aflatoxin contaminated feed convert aflatoxin B1 into hydroxylated form called aflatoxin M1 and the toxin is released through milk and the allowable Limit in milk is 0.5 ppb. Allowable limit in meats, corn, and wheat is also 0.5 ppb. The acute lethal dose for adult human is thought to be 10–20 mg. The primary target organ for aflatoxin is the liver. Mitochondrial cytochrome P450 enzyme converts aflatoxin into reactive 8,9-epoxide form which binds to DNA and results in GC to TA transversions, leading to carcinogenesis. Aflatoxin causes gross liver damage, resulting in liver cancer (hepatocarcinogen). It can also cause colon and lung cancer. The International Agency for Research on Cancer (IARC) has classified aflatoxin B1 as a group I carcinogen.

Ochratoxin

Aspergillus ochraceus and several other species including *Penicillium* spp. produce seven structurally related secondary metabolites called ochratoxin. Ochratoxin is found in a large variety of foods including wheat, corn, soybeans, oats, barley, coffee beans, meats and cheese. Barley is thought to be the predominant source. The toxin is analyzed by using high performance liquid chromatography (HPLC) technique and mass spectrometry. Ochratoxin is hepatotoxic and nephrotoxic and a potent teratogen and carcinogen. Nephropathy and renal pathology are predominant consequences of ochratoxin poisoning. It inhibits cellular function by inhibiting the synthesis of phenylalanine–tRNA complex, and ATP production. It also stimulates lipid peroxidation. The LD50 value in rats is 20–22 mg kg−1. The IARC considers ochratoxin as category 2B carcinogen.

Fumonosins

Fumonosins are synthesized by the condensation of amino acid alanine into acetate derived precursor and the most abundant form is Fumonosin B1. These are produced by *Fusarium verticillioides, F. proliferatum*, and *F. nygamai. Fusarium verticillioides* under ideal conditions can infect corn causing seedling blight, stalk rot and ear rot, and are present virtually in all matured corns. Corns, tomatoes, asparagus, and garlic are the major source of fumonosins. Fumonosins are highly water soluble and they do not have any aromatic structure or unique chromophore for easy analytical detection; however, HPLC with fluorescence detector has been used for detection. Fumonosins are highly stable to a variety of heat and chemical processing treatments. In animals, fumonosins cause varieties of diseases including leukoencephalomalacia, pulmonary edema, and hydrothorax. The toxins are reported to cause esophageal cancers in humans.

Tricothecenes

Over 180 tricothecenes are reported and they produced by number of fungal genera including *Fusarium, Trichoderma, Myrothecium, Stachybotrys, Tricothecium*, and others. The most common tricothecenes are; DON (deoxynivalenol), 3-acetyl DON, and T-2 (Tricothecene-2) toxin. These toxins are associated with several different cereal products, meat and dairy products. They cause hemorrhage in gastrointestinal tract, and vomiting. They are cytotoxic, immunotoxic, and direct contact may cause dermatitis. Tricothecenes inhibit protein synthesis and results in cell death. The toxins can be detected by HPLC and thin layer chromatography.

Patulin

Patulin is produced by *Penicillium clariform, P. expansum, P. Patulum* and by *Aspergillus* spp. Bread, sausage, fruits (apricots, grapes, peaches, pears, and apples), and apple juice are the major source for this toxin. However, patulin does not survive the apple cider making process. Patulin is needed in high dosage to show pathogenesis. The LD50 value in rats is 15–25 mg kg−1. It is a carcinogenic toxin and is reported to be responsible for subcutaneous sarcoma. The allowable daily intake limit is 0.4 mg /kg body weight.

Penicillic Acid

Penicillic acid is produced by *Penicillium puberulum*, and *A. ochraceus*. The biological properties of penicillic acid are similar to Patulin. It is known to cause liver and gastric cancer. The LD50 value in rat is calculated to be 60–65 mg /kg. Wheat, oats, cheese, and coffee beans are reported as source for this toxin.

Zearalenone

Fusarium graminearum and other *Fusarium* species produce zearalenone and it has strong estrogenic properties and resembles 17β-estradiol, the principal hormone produced by human ovary. Zearalenone is classified as nonsteroidal estrogen or a mycoestrogen. Thus the toxin designation does not appear to be appropriate for zearalenone. Occasional outbreak of mycotoxin in livestock results in infertility. Zearalenone concentrations of 1.0 ppm can cause hyperestrogenic syndrome in pigs and even higher concentrations can cause abortion and other fertility related problems. Reproductive problems are also reported in cattle and sheep. The major concern is that zearalenone can disrupt sex-steroid function in humans. It has been used to treat postmenopausal problems in women and has been patented as oral contraceptives. Zearalenone promote estrus in mice and LD50 in rat is reported to be 10,000 mg kg−1. Corn, wheat, oats, and barley are known source for this toxin. The safe allowable limit in human is 0.05 µg /kg day−1.

Citrinin

Citrinin is produced by *Penicillium citrinum*, and *P. viridicatum* and it has been also produced by several species of *Aspergillus*. The major source of this toxin is rice, moldy bread, ham, wheat, oates, rye and barley. Citrinin is a nephrotoxin and causes nephropathy in animals. The LD50 for citrinin in chicken is 95 mg /kg; in rabbits, 134 mg /kg and its significance in human health is unknown.

Alternaria Toxin

Alternaria toxin is produced by several species; *Alternaria citri, A. solani*, and *A.*

tenuissima. This toxin is generally associated with apples, tomatoes, and blueberries.

Ergot Alkaloids

Claviceps purpurea produces a toxic cocktail of alkaloid, which is not considered a typical mycotoxin. Ergots grow on the heads of grasses such as wheat and ryes and the disease is known as St Anthony's Fire because of severe burning sensations in the limbs and extremities of the victim. Two forms of ergotism are reported: gangrenous and convulsive. In the gangrenous form, the blood supply is affected causing tissue damage. In the convulsive form, the toxin affects the central nervous system. The ergotism is a serious problem in animals including cattle, sheep, pigs and chicken resulting in gangrene, convulsions, abortion, hypersensitivity and ataxia. In cattle, ergotism spreads around the hooves and animal may loose hooves and are unable to walk and die by starvation.

Prevention and Control of Mycotoxins

Good agricultural practices (GAP) and good manufacturing practices (GMP) to control molds in preharvest and postharvest crops should be employed. Those include soil testing, crop rotation, irrigation, antifungal treatments, appropriate harvesting conditions, drying, and storage. Traditionally mold control was achieved by controlling the temperature, pH and moister levels of the stored grains, cereals and fruits. In modern day HACCP is employed to reduce mold and mycotoxins in products. Implementation of HACCP is aided by improved analytical techniques for sensitive detection of mycotoxins and stringent regulatory standards to exclude products for human consumption that contain mycotoxin levels over the allowable limits. In addition, development of transgenic plants that are able to increase the insect and mold resistance may aid in reduced levels of mycotoxins in products. Except supportive therapy, there is no treatment currently available for foodborne mycotoxin poisoning.

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Conservation Agriculture: One Step towards Food Security

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Abstract

Conservation agriculture is a slower-evolving agricultural revolution that began at the same time as the Green Revolution, gradually transforming agriculture in most of the countries. The Green Revolution of the late 1960s and 1970s is considered incomplete by some as it concentrated on improving yields without a focus on environmental sustainability and thus it paved the way for conservation agriculture. The innovation of conservation agriculture is to avoid ploughing of the soil, which saves time, energy and labour while conserving water and nutrients in the soil to support crop production. Research evidence illustrates that conservation agriculture gives at least the same yields as conventional tillage, often more, with less time and energy input and better environmental sustainability.

INTRODUCTION

Attaining food security for an ever growing population while conserving the natural resources and without any negative impact on climate is the major challenge before most of the countries. Humanity will be challenged to produce more food from shrunken cultivable land by making more efficient use of natural resources and with minimal impact on the environment in the next decade. In order to face the changing weather driven by climate change and the increasing demand for food, 'Conservation Agriculture' is an alternative whose aim is to achieve sustainable and profitable agriculture.

Conservation Agriculture (CA)

Conservation agriculture is a management system that maintains a soil cover through surface retention of crop residues with no till and/or reduced tillage. CA is described by FAO as a concept for resource saving agricultural crop production which is based on enhancing the natural and biological processes above and below the ground. Conservation agriculture aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It contributes to environmental conservation as well as to enhanced and sustained agricultural production. It can also be referred to as resource efficient or resource effective agriculture (FAO). Conservation agriculture is not, "business as usual", based on maximizing yields while exploiting the soil and agro-ecosystem resources. Rather, CA is based on

optimizing yields and profits, to achieve a balance of agricultural, economic and environmental benefits.

Principles of conservation agriculture

Conservation agriculture basically relies on three principles, which are linked and must consider together for appropriate design, planning and implementation processes. These are as follows:

a. Minimal mechanical soil disturbance

A reduced mechanical tillage facilitates biological tillage (biological soil structuring processes). This lack of soil disturbance serves to maintain overall soil structure, including aggregate stability and porosity, both of which promote the exchange of water and gases and provide habitat to an abundant and diverse population of soil biota. At the same time it limits the re-exposure of weed seeds and their germination in soil.

b. Permanent organic soil cover

A permanent soil cover is important to protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of "food"; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots. In turn it improves soil aggregation, soil biological activity and soil biodiversity and carbon sequestration.

c. Diversified crop rotations

The rotation of crops is necessary to explore different soil layers for nutrients as well as to offer a diverse "diet" to the soil micro organisms. Also it helps in minimal rates of build-up of population of pest species through life cycle disruption.

Management Practices followed in Conservation Agriculture

1. **Reduced mechanical tillage and/or Zero tillage:**

Conservation tillage leave at least 30% of the soil surface covered by plant residues in order to increase water infiltration and cut down on soil erosion and runoff. Whereas, no till/zero till simply involve the absence of tillage/ploughing operations on the soil and special equipments (e.g. NT drill) are used for planting seeds directly into crop residues left on the soil surface without preparing a seedbed beforehand.

2. **No burning of crop residues:**

Since crop residues are the principal element of permanent soil cover, they must never be burnt or otherwise removed from the soil surface. Rather, plant residues should be left on the soil surface in order to protect organic matter enriched topsoil from erosion while also adding fresh organic matter upon decomposition.

3. **Regular crop rotation:**

An appropriate crop rotation is helpful in avoiding disease and pest infestation by interrupting their life cycles and by increasing the diversity and abundance of beneficial organisms in their habitat. Also inclusion of leguminous crop in crop rotation can improve the soil fertility status by nitrogen fixation.

4. **Reduction in fossil fuel use and greenhouse gas emissions:**

Zero till or conservation till significantly reduces the use of farm machinery and thus fuel. Also increased soil organic matter content greatly limits the use of synthetic fertilizers, many of which require significant fossil fuel energy for their production. Thus consumption of fossil fuel for agricultural production is significantly reduced under CA and

burning of crop residues is completely eliminated, which also contributes to a reduction of GHG release.

5. Integrated disease and pest management:

Conservation agriculture depends heavily on enhanced biological activity to control pests and other disease causing organisms. Integrated pest management (IPM) entails the judicious use of crop rotations and other beneficial plant associations as well as chemical pesticides to control pest and disease problems. On long run, the enhanced biological activity and abundance brought on by no till and other CA technologies results in decreased applications of agrochemicals.

Some Misconceptions regarding the adoption of CA

1. Whether conservation agriculture leads to compaction of soil?

No, in long run conservation agriculture reduces the compaction issues because of reduced tillage and use of heavy farm implements. At the same time it improves the soil quality by retaining high crop residues and thus the organic matter.

2. Whether there are increased pest and disease problems under conservation agriculture?

Conservation agriculture addresses the problem of pests and diseases by integrating crop rotation and diversification, which breaks the cycles that perpetuate crop pests and pathogens. The practice also promotes biological pest control as the first option to try. Besides these, we can go for integrated management for pests and diseases control.

3. Whether conservation agriculture only works for growing grain crops?

Although most of the area currently being cultivated under the rubric of conservation agriculture is devoted for cultivation of basic grain crops such as rice, wheat, maize and millet, CA has been successfully adapted to work for cultivating a wide variety of crops such as soybean, groundnut, pigeon pea, sugar cane, potatoes, beets, cassava, other vegetables and pulses, and several perennial fruit and vine species. The principles of minimal soil disturbance, permanent soil cover and rotations work for all crops.

4. Whether conservation agriculture only works for large scale mechanized farms?

This is a common misconception. The vast majority of farmers practicing no till conservation agriculture are small-scale farmers from both developed and developing countries alike. These farmers rely on family or manual labour and animal traction as their primary energy inputs. CA technologies can use direct seeders/planters that have been successfully adapted to work with animal or manual labour as well as with modern farm machinery. Increasing farmer access to this equipment is critical for ensuring greater success in the field. Service providers of CA technologies can accomplish this by making their equipment more readily available to resource poor and small-scale farmers in developing countries on hire.

5. Whether yield obtained from conservation agriculture is less as compared to that from conventional agriculture?

In properly managed zero-till planted crop, yields are invariably higher compared to traditionally prepared fields

for comparable planting dates. CA has been reported to enhance the yield level of crops due to associated effects like prevention of soil degradation, improved soil fertility, improved soil moisture regime (due to increased rain water infiltration, water holding capacity and reduced evaporation loss) and crop rotational benefits.

CONCLUSION

Conservation agriculture offers a new paradigm for agricultural research and development which differs from the conventional methods. Ultimately it aimed at achieving specific food grains production targets in India. A shift in paradigm has become a necessity in view of widespread problems of resource degradation, which accompanied the past strategies to enhance production with little concern for resource integrity. Integrating concerns of productivity, resource conservation and soil quality and the environment is now fundamental to sustained productivity growth. Developing and promoting CA systems will be highly demanding in terms of the knowledge base. At the same time, development of appropriate equipment to allow these systems to be successfully adopted by farmers is a prerequisite for success. Overcoming traditional mindsets about tillage by promoting farmer experimentation with this technology in a participatory manner will help accelerate adoption.

Onion Yellow Dwarf Virus: a new foe for Onion Growers

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Abstract

Onion yellow dwarf virus (OYDV) is member of the Family potyviridae, a flexuous, rod shaped, monopartite, linear, positive sense, single-stranded RNA virus. Total genome of OYDV is 10kb and encodes a 3403 amino acid polyprotein. OYDV has been reported to cause injurious and colossal effect on bulb or seed production. Yield losses have been reported to be heavy on dry bulb and grave on seed crop. The quality of the bulb and seeds produced can be significantly affected by infection of mother plants with OYDV. In onion, OYDV causes yellow striping or yellowing, dwarfing of plants. In seed crops, flower stems remain turgid and round, but show yellowing, distortion and curling.

Onion is used as a spice and food in most parts of the world (Do *et al* 2004). However, it has been valued for millennia also for medicinal properties (Griffiths *et al* 2002).The health benefits of onion are due to presence of organosulphur compound allylpropyl disulphide, flavonoid querctin and bioactive phytochemicals saponin (Corea *et al* 2005). Onion is attacked by fungi, bacteria, virus and phytoplasma. Among these virus disease is of great importance due to vegetative propagation of this crop. Viruses belong to genera *Potyvirus*, *Allexivirus* and *Carlavirus* are common in *Allium* species. Among potyviruses, OYDV causes yellow dwarf disease in onion. In India, a serious outbreak of a virus-like disease was observed in onion seed crop in villages around Delhi and at the Farm of Associated Agricultural Development Foundation at Nazafgarh in Haryana State in December 1993. At Nazafgarh, 65% plants of onion cv. Agrifound Light Red in a three acre seed crop were affected. Similar disease was again observed in seed as well as main crop onion with equally high incidence during 1994 and 1995 (Ahlawat and Verma 1997). A high incidence of OYDV (85-90%) was observed in seed crop in Hisar, Haryana (Dhawan and Rishi 1997). Recently in 2010-11, a survey was conducted in 12 states to determine the presence of OYDV on garlic and related *Allium* spp. The highest percentage of OYDV positives

were recorded from Maharashtra (96%) followed by Gujarat (75%) and Madhya Pradesh (75%). The lowest percentage of OYDV positives were recorded from Rajasthan (25%) followed by Delhi (40%) (Gawande *et al* 2013). Since the onion is propagated both by seed as well as bulbs. The accumulation and multiplication of virus in crops propagated by bulbs increase over the years resulted in drastic yield reduction.

About OYDV and its genomic organization

OYDV is member of the Family *potyviridae*. OYDV have restricted host range that is mainly limited to several species of *Allium* and *Narcissus*. The virus has a flexuous, rod shaped particle reported to be between 720-833 nm and 13-16 nm in width. This virus is monopartite, linear, positive sense, single-stranded RNA. Genome of OYDV is 10,538 nucleotides long and is predicted to encode a 3403 amino acid polyprotein (Chen *et al* 2003). OYDV is having a P3 that is significantly larger than any other member of the genus, or indeed the entire family *Potyviridae.* The function(s) of the potyvirus P3 gene are not very well understood. Because as P3 antibodies reacted with inclusions, so it has been suggested that the P3 might be involved in the replication of the RNA (Langenberg and Zhang 1997, Rodriguez *et al* 1993) and this is supported by *in vitro* studies of protein-protein interactions (Guo *et al* 2001). There is also evidence that the P3 has a role in pathogenicity and symptom determination (Dallot *et al* 2001). OYDV is usually very serious and often reaches an epiphytotic level that leads to considerable yield losses (Conci *et al* 2003). The disease has been reported to cause injurious and colossal effect on growth of onion plants and consequently on bulb or seed production. Yield losses have been reported to be heavy on dry bulb and grave on seed crop. The quality of the bulb and seeds produced can be significantly affected by infection of mother plants with OYDV. It produces pinwheel and scroll-shaped inclusion bodies that may be seen in ultra thin section in the electron microscope. Information regarding the variability of populations of OYDV has been obtained through molecular techniques, and genetic studies have provided data mainly on garlic isolates, whereas less information is available on onion isolates (Celli *et al* 2013). Complete nucleotide sequences of OYDV isolates showing mild and severe symptoms in onion were determined and genomes consisted of 10,459 and 10,461nt (nucleotide) and were 92.2 % identical. In both isolates, the AUG initiation codon and the stop codon (UGA) are likely to be located at nt position 109-111 and 10252-10254, respectively. Therefore, the predicted ORF for each isolate was 10,143 nt, encoding a polyprotein of 3,381 aa (amino acid). Comparison of the individual protein regions of the two onion isolates showed that the CP-encoding region was the most conserved (nt and aa sequence identities of 95.8 % and 97.7 %, respectively). In the entire CP sequence (257 aa), there were six aa changes, four of which were located in the C-terminal region (Celli *et al* 2013). The DAG motif that is involved in transmission by aphids was found in the N-terminal region of both isolates at the same

position (3,150-3,152). By contrast, the P1-encoding regions were the least conserved, sharing only 86.2 % nt identity. P1 was the most variable protein (80.8 % identity), with 84 aa changes being distributed along the protein and corresponding to 45 % of all changes in the whole polyprotein. P1 protein would affect the development of symptoms caused by potyvirus (Lee and Wong 1998). In the field, the host range of OYDV is restricted to the genus *Allium*, mainly onion and garlic. It also infects *Allium scorodoprasum* L., but not leek. The virus was not detected in wild *Allium* species such as *A.Vineale* L., *A.Oleraceum* L., *A.ursinum* L. and *A. Scorodoprasum* L. Except from the presence of OYDV in onion, there are also other host specific strains that infect garlic (OYDV-G), and *A. ampeloprasum* var. *holmense* L. (OYDV-GhG). These strains are strictly host specific and they do not infect onion and leek. OYDV is transmitted by over 50 aphid species in a nonpersistent manner with *Myzus ascalonicus*, *M. persicae*, *Rhopalosiphum maidis* and *Acyrthosiphon pisum* being the most important virus vectors. The virus could be mechanically transmitted under lab conditions (Kumar *et al* 2009).

Numerous surveys and epidemiological studies regarding the garlic strain of OYDV, named OYDV-G (Katis *et al* 2012) have been carried out in many countries where the virus causes severe damage to garlic and other minor *Allium* spp. (shallot, leek and scallion), frequently found in mixed infections with other viral species of the genera *Potyvirus, Carlavirus* and *Allexivirus* (Katis *et al* 2012, Mohammed *et al* 2013).

Symptomatology

Symptoms depend on virus strain and host genetic background. In onion, OYDV causes yellow striping or yellowing, dwarfing of plants (Fig.1, 2). In seed crops, flower stems remain turgid and round, but show yellowing, distortion and curling (Fig.3). In addition, they are shorter than normal, and produce smaller flowers with reduced numbers of seeds that are often of poor quality (Kumar *et al* 2010). Severely affected plants do not develop flower and bud resulting in a heavy loss to seed production.

Figure 1: Yellow stripping on leaves, flattening and stunting of onion plant

In garlic, symptoms of OYDV infection include yellow stripes covering most of the leaf surface. Diffused chlorotic stripes with little yellow stripes, yellowish dots on leaves and whitish leaf margin or twisting of leaves on a few cultivars. Generally, symptoms are mild on young leaves than on mature leaves. Bulbs harvested from mosaic affected matured plants are much smaller in size and cloves are fewer in number (Ghosh and Ahlawat 1997). Lot *et al* (1998) reported that on Messidrome cultivars, plants exhibited severe yellow and light green striping on

most leaves with premature drying of the leaf tips. Striping was clear on older leaves but less distinct on young leaves. In combination with infection by other viruses, symptoms may be aggravated (Diekmann 1997)

Figure 2 Dwarfing and stunting of infected plant

Figure 3: Twisting of infected flower stalks

Incidence and yield losses

The incidence of disease in onion was reported up to 95% from USA. In Argentina, 56-92% of onion plants were infecetd in field (Conci *et al* 1992). In garlic, incidence of OYDV up to 52% was reported from Europe and up to 86% in Asian countries. In samples of garlic sold for human consumption, infection rate was usually close to 100%. In garlic, due to exclusive vegetative propagation, a mixed infection of viruses in planting material is a common phenomenon; Infection with OYDV in garlic has been reported to cause a 3 to 45% reduction in bulb yield in Czechoslovakian cultivars (Havranek 1972). In a field trial in France, virus infection reduced the yield of garlic cv. Germidodour (a cultivar produced from infected plants cv. Violet de cadour by meristem tip culture) by 25% and in variety Thermidore upto 50%. OYDV was also reported to cause a 20 to 30% loss of yield in unspecified French cultivars (Delecolle *et al* 1985). According to Lot *et al* (1998) report, losses in bulb weight due to OYDV on Messidrome and Printanor (garlic cultivars) were about 55 to 65% and in variety Germidour from 10 to 48%.

Incidence of onion yellow dwarf disease in shallot ranged from 0-10% in Dutch samples, but was usually 100% in French and Spanish samples. Infection of leek by OYDV has been reported from many countries. In India, Onion yellow dwarf disease was first observed in onion seed crop (Dhingra and Nariani 1963). About 65 per cent incidence was recorded in seed crop of onion cv. Agrifound Light Red from Haryana state of India. Severely affected plants do not develop flower resulting in a total loss in seed production (Ahlawat and Varma 1997).

Management

Some onion varieties are tolerant and can help reduce losses from this disease. The use of true seed for onion production results in virus-free plants since the virus is not seed-borne. The use of virus-free bulbs and sets, and producing crops in an area where the virus is absent are also effective. Rouging out infected plants helps to reduce the incidence of this virus.

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Fatty Liver Haemorrhagic Syndrome (FLHS) In Commercial Layers - A Case Study

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Abstract

Fatty liver- haemorrhagic syndrome (FLHS) is a metabolic disorder due to failure of liver function, characterized by a very fatty liver, accompanied by haemorrhages. This condition is mostly seen in good peak laying and older laying hens kept in cages, particularly in hot weathers in most of commercial farms. A clinical case study carried out in Guntur district area during summer, on post mortem examination there are about 15-20% of farms in this area of above 52 to 72 weeks age, in most of layers observed Fatty liver-haemorrhagic syndrome (FLHS) characterized by pool of blood or large blood clots in the abdomen. The body weights increases from 20% - 25% of standard levels were observed. The mortalities were varied from 2 to 8% in these farms. On the results of diagnosis, treatment was given by various nutritional supplements in feed formulations and addition of Choline chlorides, Vit.E, Vit.B12, Ionsitol helped in reduction of FLHS condition in the flocks.

***Key words**: Fatty liver, haemorrhagic syndrome, older layers, Choline*

INTRODUCTION

Poultry industry in india has to always face challenges due to feed contaminants. In spite of best care, due to environmental conditions, poultry feed is found to be invariably contaminated with low levels of mycotoxins. Liver is the largest internal organ In poultry, plays a major role in body metabolism, fat synthesis, detoxification and excretion etc. Relatively larger liver of poultry when compared to other animal species itself indicates its major role in body metabolism. It is also the body's most important site for detoxification of potentially dangerous compounds that have been ingested or administered accidentally or unintentionally.

Fatty liver- haemorrhagic syndrome (FLHS)** is* a non-infectious (metabolic) disorder*** of current concern and a major cause of mortality in high producing commercial white-egg laying flocks reared in cages during warm, summer months., characterized by excessive accumulation of fat in the liver and abdominal cavity, liver rupture and haemorrhage, and sudden death (Crespo and Shivaprasad, 2003). It is a major cause of mortality in caged commercial laying hens, resulting in great economic losses to the poultry industry, not only from bird mortality but also from decreased egg production in affected flocks (Squires and Leeson, 1988). Birds affected by FLHS are difficult to distinguish from

healthy birds; however decreased egg production, increased body weights (BW) and flock mortality can be ―signals‖ of the presence of this metabolic condition in a layer flock (Leeson, 2007)

Aetiology of FLHS

Important factors that have been considered as contributors into the aetiology of the FLHS are

- **Nutritional (high energy diets):** especially maize or wheat diets produce higher incidences of FLHS
- **Hormonal factors (Oestrogens):** high oestrogen levels result in increased feed intake and subsequently in a positive energy balance. Oestrogens influence lipid synthesis which is required for the yolk. The haemorrhage score in liver was markedly increased when excess energy intake was combined with exogenous oestrogen treatment. The possibility of a hormonal imbalance has been suggested by the observation of greatly elevated serum calcium and cholesterol in chickens from flocks with FLHS
- **Toxicological factors (feed toxins):** Dietary factors other than excessive caloric intake, such as toxins and rapeseed products have been shown to stimulate lipogenesis (Pearson et al., 1978b). There is evidence that mycotoxins (aflatoxin in particular) which may contaminate cereals induce liver lipid accumulation (Bryden et al., 1979). Rapeseed meal in the diet increases the incidence of FLHS because erucic acid or other toxic metabolites affect the strength of the connective tissue in the liver
- **Housing conditions (*in multi-tier* cages):** A high prevalence of FLHS in caged birds is thought to be related to the lack of exercise combined with a high feed intake in this cage housing system
- **Environmental temperatures (heat and cold stress):** The factors that have been considered to influence the prevalence of FLHS in caged birds, especially temperature. Most investigators have shown that increased lipogenesis occurs partly due to an excessive intake of carbohydrate brought about by hot weather
- **Genetical heavy & higher producing breeder hens-WL:** There is little proof of the genetic strain influencing the occurrence of FLHS in a layer flock. Moreover, a strain of single comb white leghorn laying hens (UCD- 003) has been shown to be highly susceptible to FLHS.
- **Stress:** stressful conditions (physical, chemical and biological stresses) activate a coordinated neuroendocrine response associated with increased levels of stress hormones, including catcholamines and ACTH; the stress associated with high temperature and humidity of the environment affect the liver of hens and predisposes them to FLHS.
- ***Bacterial endotoxins :*** The possibility of implication of bacterial endotoxins in the pathogenesis of fatty liver haemorrhagic syndrome in the laying hen

Under the influence of these various factors, excessive fat can accumulate in the liver, and the liver capsule can rupture so that haemorrhage occurs and causes death of the bird, and this condition is diagnosed as FLHS. The exact cause of FLHS is still unknown (Julian, 2005; Leeson, 2007) and the pathophysiological background of this complex metabolic condition is still to be outlined.

Hypothesis of the pathogenesis :

The vacuolar swelling of hepatocytes distrupts the reticuln structure of the hepatic plates due to mechanical stress leading to haemorrhages from sinusoids. Excessive lipid metabolism – in overfed laying hens- facilitates O2 radical mediated destruction of reticulin fibres.

In field - Case Study – the incidences of FLHS observed in 20-25% farms in surrounding area of Guntur district of Andhra Pradesh, mostly > 50- 72 weeks of age layer flocks affected, mortalities ranges from 5-8%. The egg production drastically reduced by 10-20% with complications of egg bound conditions. The abdomen and internal organs were fully covered with fat.

Clinical signs:

Early symptoms depending on the severity are usually - Fast decrease in egg production,

- Low mortality, but the usually % of the farms is increased. - "Pale combs" may appear.

Gross Pathology :

- The liver is usually enlarged, putty colored(light greyish brown to yellow colour), and very friable, showing varying degrees of hemorrhage with subcapsular, parenchymal haemotomal & hemorrhages and with a large blood clot overlaying liver capsule.
- The abdominal cavity often contains large amounts of oily, unsaturated fat.
- Affected birds often have pale combs, likely as a consequence of reduced egg production.
- The ovary is usually active, at least in the early stages of FLHS, and the metabolic and physical stress associated with oviposition may be factors that induce the final fatal hemorrhage.

Histology: Hepatic lipidosis with hemorrhage.

Prevention:

FLHS is best prevented by not allowing an excessive positive energy balance in older birds. Body weight can be monitored and, when potential problems are seen, remedial action taken to limit energy intake through the use of lower energy diets and/or change in feed management. A wide energy:protein ratio in the diet will aggravate FLHS.

TREATMENT:

When a farm has a history of FLHS, the diet should contain at least 0.3 ppm selenium, ideally as organic selenium, up to 100 IU vitamin E/kg diet, and appropriate levels of an antioxidant such as ethoxyquin, also Choline Chloride, Vitamin-B12, and inositol in the feed. These various additives collectively help to limit the occurrence of tissue rancidity, and hence hemorrhage of the excess fat in the liver.

Finally, it will not be possible to develop strategies to reduce the incidence of FLHS

until the factors that predispose birds to the condition are fully understood.

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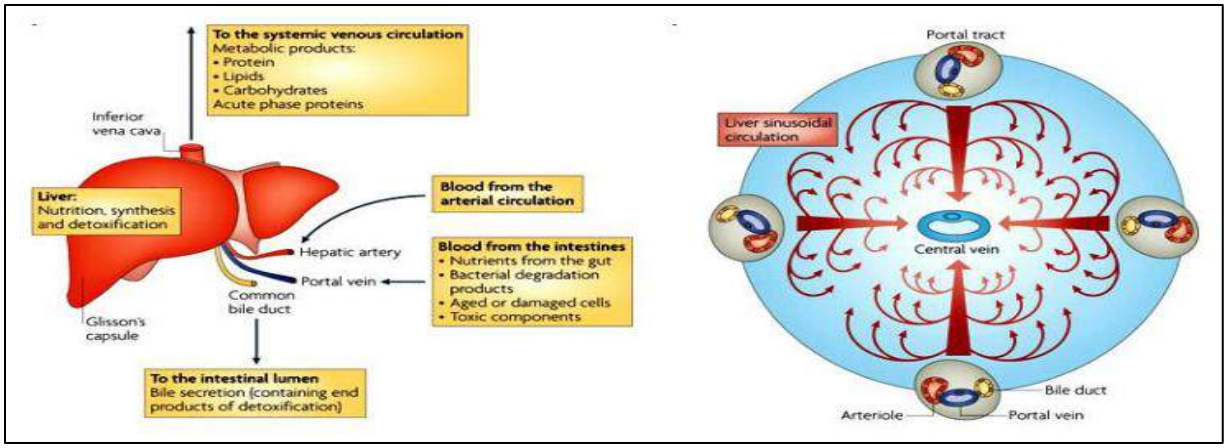
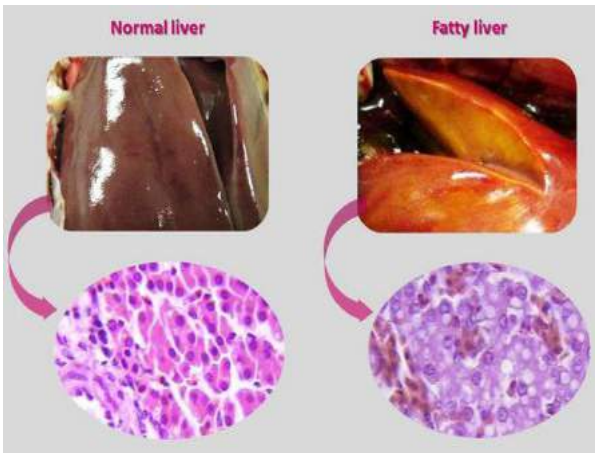
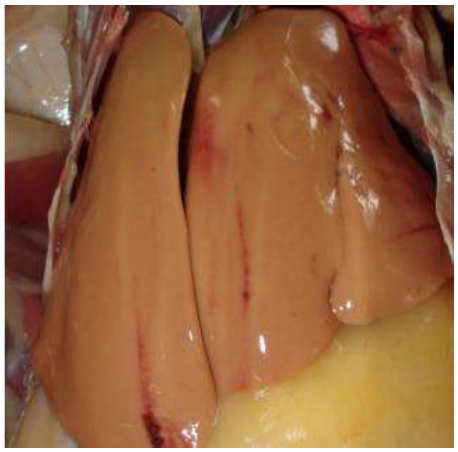
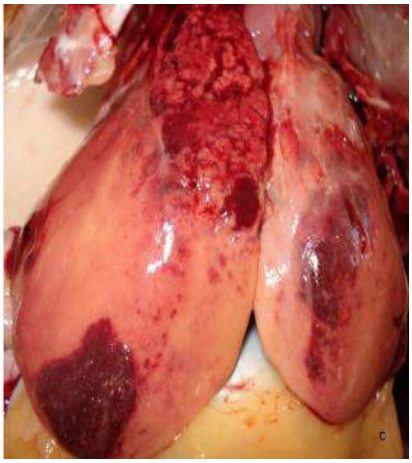




Pictures from post-mortem examinations of hens showing various stages of haematomas and haemorrhages and fat accumulation in abdominal cavity.



Estrus Detection Methods and their Economic Importance of In Dairy Animals

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India is the play major in world dairy industry contributing 17% of total world milk production. As per an assessment made by the Planning commission of India, the domestic demand for milk by 2021-22 is expected to be 172.20 million tonnes. However, so far the country has not been able to keep pace with the domestic demand for milk. Reproductive disorders and associated infertility (transient loss of fertility) among cattle and buffaloes pose serious economic loss to farmers in terms of low returns and veterinary expenses. Among many components of reproduction management, estrus detection is the crucial one, as it contributes towards the ultimate pregnancy rate and survival of the embryo (Layek *et al*., 2011, Layek *et al*., 2013). Each missed heat represents the loss of a complete estrus cycle of approximately 21 days that in a seasonally calving herd represents 21 days of lost potential production, so each missed heat has a significant financial loss. After mastitis, the reason for largest loss is improper estrus detection in dairy animals. In Indian condition, about Rs. 5000-7000 loss (in term of cost of feed, labour, milking, medicine and veterinary expanses, parallel keeping breeding bull) if one heat is missed without insemination and conception. Animals are diagnosed to be in estrus based on the appearance of mucus discharge, mounting or standing to be mounted and other physical activities. However, there exist a lot of variations regarding the actual time of onset of estrus. It has been reported that 11.05 % of cattle and 20.75 % of buffaloes are inseminated at improper time (Kumaresan et al., 2001), which clearly indicates that the cow were wrongly detected as in estrus and insemination of these cow incurs heavy loss in term of wasteful expenditure of quality male germplasm, production loss and increased risk of introducing genital infection in female. Thus, the estrus detection efficiency and accuracy are the most important parameters for improving both the individual animal as well as overall herd fertility as pregnancy is achieved for each cow within a determined period (Boyd, 1984). Several tools for estrus detection in dairy animals are available with varied success rate. Several tools ranging from visual

appraisal to sensor based automated instruments have been developed and employed for estrus detection in dairy animals but with varied success rate. The bases of these equipments are change of behaviour of animals. Restlessness and general physical activity increased markedly during estrus The use of specific estrus detection aid depends upon the scale of operation, availability of man power, type of animals etc, but, a single aid cannot always be used everywhere. Keeping above points in view present article address the basics of estrus cycle, advancement in its detection and future prospects in this field.

Proper estrus detection is the biggest bottleneck in achieving high conception rate with artificial insemination in dairy animals. Understanding of correlation of the hormonal, behavioural and other changes during estrus period of dairy animals and development of precision based heat detection technology will help in improvement of herd reproductive performance and herd efficiency.

Estrus cycle and characteristics of estrus period

Estrous cycle of cow can be divided into estrus, met estrus, diestrus and proestrus (Senger, 2005). Among this estrus is the period which needs to spot at correct time of its occurrence for successful insemination. Estrus period is the restricted period of sexual receptivity, characterized by intense sexual desire. It is the behavioural strategy of the female to ensure, mating close to the time of the ovulation to achieve a successful conception (Gordon, 1996).

The estrus period is characterized by following are the most commonly reported behavioral characteristics:

- Standing to be mounted
- Mounting other cows
- Rubbed rump and tail-head
- Chin resting
- Restlessness
- Increase in agonistic interactions (e.g. head to head fights)
- Sniffing of the vagina of herd-mates
- Flehmen reaction (wrinkling of the nose and curling of the lip)
- Frequent micturition
- Tail rising
- Bellowing
- Mounted but not standing

Number of authors were described the occurrence common behaviors by dairy animals when in estrus are given in table 1.

Duration and intensity of estrus

The duration and the intensity of estrus are observed were extremely variable. Van Vliet and Van Eerdenburg (1996) found a range of duration of 4–38 h. Several factors affects the duration of estrus , number of cows in estrus at time ,parity ,body condition, milk per unit metabolic body weight, days post-partum and weight changes associated with calving.

Table: 2 Duration of estrus in different breeds of bovine

Breed/ Species of the animals	Duration of estrus (h) (Range)	Reference
Sahiwal cows	15.52±0.21	Dash, 1980
Hariana cows	14.53±0.43h	Dash, 1980
HF cows	11.8 ± 4.4	Roelofs et al., 2005

Since the duration and intensity of estrus is extremely variable it is difficult to spot the correct time of onset of estrus. To manage this problem many heat detection aids are introduced by many workers.

Estrus detecting tools

Several tools ranging from visual appraisal to sensor based automated instruments have been developed and employed for estrus detection in dairy animals but with varied success rate. The bases of these equipments are change of behaviour of animals. Restlessness and general physical activity increased markedly during estrus (Farris, 1954; Van Eerdenburg et al., 1996, Layek et al., 2011, Gunasekharan, et al. 2008).

Figure 1: Visual Observation (Standing to be mounting)

Visual Methods of heat detection

1) **Visual Observation** - This method involves the visual appraisal of the cardinal symptoms of heat and for this animals have to be regularly observed
2) **Record keeping** - This can maximize the accuracy of estrus detection provided if the records are kept in daily basis.
3) **Heat Expectancy chart** – Animals are expected to show heat during a given period, based on heat expectancy chart prepared from previous records.
4) **Marker Animals** - This method is most effective in stall tied herd where a bull parading is the most effective way of detecting a heat.
5) **Pressure Sensing Devices** - The animals, standing to be mounted, show the symptom of rubbed off chalk or paint. Several commercially available devices are also evolved based on the above principle of heat detection such as capsule embedded on fabric patch, colour patch covered with scratch off surface, device containing audible signal emitter.
6) **Activity monitoring by Pedometry** - Pedometer is generated to record the increased activity. Pedometers are devices that contain motion switches to detect increased activity and a recorder to quantify activity.
7) **Video cameras and Recording** – the animals are continuously monitored through video cameras for behavioural signals of estrus. It is a most economical viable system of heant detection in commercialized dairy.
8) **Recording and Evaluation of Vocalisation** - A radio microphone system harnessed in neck of the animals can record and transmit the signals to a stationary receiver which can be further analysed by recording algorithm. Recently a work has been carried out in NDRI, Karnal showed clear difference between the vocalisation pattern of estrus and non estrus cows.

Non-Visual Methods of heat detection:

1) **Changes in intravaginal and vulvar electrical impedance** - There are different commercially available probes which can be inserted to measure

resistance twice daily 2-3 days prior to approaching oestrus.

2) **Rectal palpation of the genitalia** - The stage of the oestrus cycle can easily be detected by rectal palpation if the detector has a sound knowledge of the tract and ovary characteristics at different stage of the cycle.

3) **Elevation in intravaginal and milk temperature** - The stage of the oestrus cycle can easily be detected by rectal palpation if the detector has a sound knowledge of the tract and ovary characteristics at different stage of the cycle.

4) **Rheological properties of cervical mucus** - The most important characteristics of the cervical mucus includes the colour, appearance, pH and other rheological properties like spinnbarkeit value, flow elasticity, viscosity, thixotrophy, arborisation pattern and the sperm receptivity and these properties are used for detection of heat.

5) **Milk and Plasma Progesterone detection** - There is sharp decline found in milk progesterone from ≥10 ng/ml to ≤ 3 ng/ml and plasma progesterone from ≥ 7 ng/ml to ≤ 0.05 ng/ml during estrus. Therefore it can be a good aid to oestrus detection but the main constraint is the cost involve with the kit.

6) **Chemical characterisation of Urine and faeces** - As some of the chemicals are presenboth in blood and urine, chemical analysis of urine can serve as a good indicator of estrus.

CONCLUSION

Senger (1994) proposed a standard model of an electronic system for detection of estrus, with the following characteristics

1. The system must allow, through electronic, chemical, or visual means, continuous surveillance of quantifiable behavioral or physiological changes occurring during estrus.
2. The technology should provide automatic animal identification, capable of storing information related to the estrus event for future data retrieval. This identification should be permanent, allowing for monitoring throughout the animal‘s lifetime.
3. The system should be cost-effective and reduces labour cost
4. The monitoring device should measure a parameter that is highly correlated with the time of ovulation, ensuring high specificity.

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Table: 1 Occurrence of different behaviours during the estrus in bovine

Estrous signs	Roelofs et al. (2005)	Gunasekaran et al. (2008)	Mangal (2009)	Layek et al., (2011)
	HF cows	Crossbred cows	Sahiwal cows	Sahiwal cows
Mucus discharge	--	99.26%	85.45%	100
Hyperemia of vulval mucosa	--	100%	--	100
Swelling of vulva	--	94.12%	74. 54%	100
Rub/sniff/ Lick	100%	61.03%	81.81%	91.38
Restlessness	--	70.59%	76.36%	68.96
Chin resting	100%	47.79%	52.72%	89.65
Tail raising	--	23.53%	47.27%	41.38
Bellowing	--	19.85%	21.81%	18.96
Nervousness	--	11.76%	--	-
Standing to be mounted by herdmates	58%	45.59%	80%	98.27
Mounting on herdmates	90%	40.44%	74.54%	96.49
Frequent micturition	--	16.18%	14.54%	17.24

Livelihood Security through Lac Integrated Farming System

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Abstract

In view of shrinking natural resources and increasing population pressure, integrated farming systems(IFS) can be effective means for vertical expansion of land for fulfilling the diverse needs of people in terms of food, fodder and fuel wood. In India, marginal and small farmers constitute more than 84 percent of the 115 million operational holdings which are cultivating only 29 percent of the arable land. IFS provides an opportunity to these farmers to increase economic yield per unit area per unit time by virtue of intensification of crop and allied enterprises. Lac is a commercial crop which can be well integrated in agro forestry systems in central and eastern parts of India. Since returns through lac are higher than agricultural crops, introduction of lac hosts in the farmer's field can contribute towards income security while other components crops like paddy, vegetables and fruit tress provide food and nutritional security.

INTRODUCTION

There is no further scope for horizontal expansion of land for cultivation owing to fragmentation and subdivision of land to fulfill the need of food security for growing population. A large chunk of the total farm holdings fall in the category of small and marginal with an average holding of less than one hectare. Most of the holdings are not only small but also fragmented. The only option left is vertical expansion by encouraging scientific agro forestry to combat the challenge of sustained food security and meet the energy requirements for domestic purpose on available land resources. In fact, integrated farming system will play very effective role in the utilization of the natural resources in most rational manner or sustained crop diversification of farm enterprises which have less demand on space and time with very limited resources especially in rain fed area. Lac has good potential to be included in Agro-forestry as it is relatively low cash and labour input crop with high returns; compatible with existing rural livelihood activities in terms of its labour requirement and encourages conservation of host trees and leads to a re-greening of land. Conventional tree hosts of lac like *ber* and

palas can easily be integrated in farming system models and other quick growing bushy hosts like *Flemingia semialata* also hold the potential for integration. *F. semialata* is quite promising for production of winter *kusmi* (*aghani*) lac under rain fed conditions and for raising summer crop (*jethwi*) lac under irrigated conditions. Since returns through lac are higher than agricultural crops, introduction of lac hosts in the farmer's field leads to overall improvement in returns. Thus, lac integrated farming system can contribute towards income security due to lac while other components crops like paddy, vegetables etc provide nutritional security. Besides, it has high potential for generating employment for both men and women particularly in the off agricultural season in lac growing regions of the country.

The main objectives of integrated farming system are

- Crop diversification resulting in multiple products and minimizing the risk associated with crop failure in case of monoculture.
- Nutritional and economic security.
- Sustainable soil fertility and productivity.
- Modification of soil microclimate.
- Bio-diversification leading to change in insect pest equilibrium, soil micro fauna, soil health and nutrient dynamics.
- Year round income and employment even in an off season when virtually no agricultural crop is ready for harvesting in the field.

1. Selection and geometrical arrangements of components

Model- Lac Integrated Farming System (LIFS) Model developed at IINRG is multi tier hortilac system in an area of 50x 50 square meter comprising of lac host plants (*Flemingia semialata* and *ber, Ziziphus mauritiana*) and *fruit* trees aonla (*Emblica officinalis* syn. *Phyllanthus emblica*), guava (*Psidium guajava*) and lime (*Citrus aurantifolia* Swing). There are nine paired rows of *semialata* alternating with fruit trees. The components integrated in LIFS have synergistic relationship with each other and complementary in growth characteristics and nutritional requirement. Aonla and *ber* have been selected as the top canopy trees as their crown is open, avoiding any inhibition of light to the lower plants and less competitive for moisture being the native of dry sub tropical climate. Guava and lime are next in vertical hierarchy followed by *semialata*. Guava and lime are short statured trees and have narrow canopy, hence do not interfere with growth of *semialata*. Vegetables are used as live mulch underneath *semialata* for retaining soil moisture for longer time and lowering the soil temperature in summer season for lac crop sustainability.

Lay out

***Semialata*:** The plant to plant distance is 1m and row to row 0.75m. There are 9 paired rows of *semialata* in LIFS, each consisting of 81 plants, totaling 729 plants

Ber: The plants are arranged at 10x10m geometry in lac integrated farming system. There are 20 plants of ber in LIFS model.

Lime: Plant to plant distance and row to row distance in LIFS model is kept 5x5m, comprising 18 plants

Guava: In case of guava distance between plant to plant and row to row in LIFS is 5x5m, comprising of 27 plants.

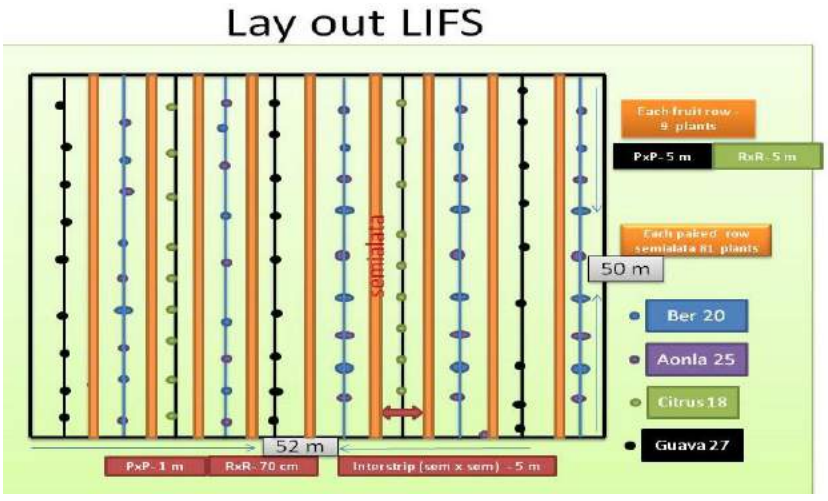
***Aonla*:** *Aonla* plants are arranged in the geometry of 10mx10m, totaling 25 plants in LIFS model.

Semialata: plant to plant distance in a row - 1m, row to row 0.75 m and between two paired rows – 5 m. (81 plants in each of the nine paired rows totaling 729 plants).

Guava: plant to plant in a row - 5m, row to row in - 5m, (9 plants in each of the three rows totaling 27 plants).

Lime: plant to plant in a row - 5m, row to row in - 5m, (9 plants in each of the two rows totaling 18 plants).

Ber and *Aonla* (mixed row) - plant to plant in a row - 5m, row to row in - 10m, (4 plants of *ber* and 5 plants of *aonla* in each of the five rows totaling 20 plants of *ber* and 25 plants of *aonla*).



1. *Semialata* (*Flemingia semialata*), a leguminous plant is a potential quick growing bush suitable for lac cultivation as the plantations of *semialata* can be raised within a year and lac crop can be raised in second year of planting. Management of lac crop on *semialata* is easy as all activities can be carried out from ground itself. The gestation period between two crops is only six months. The management of *semialata* in LIFS is done to cultivate winter season (*aghani)* as well as summer season (*jethwi)* crops of *kusmi* strain of lac insect to generate income and production of broodlac from the same field in both the seasons. Five alternate rows of *semialata* are inoculated for raising *aghani* whereas *jethwi* crop is harvested from four rows of *semialata.*

2. *Ber* (*Ziziphus mauritiana)* grows in wild, semi wild and cultivated forms all over the country in sub-tropical and tropical areas. It is a gregarious spiny shrub / tree, medium sized with a round crown as well as a lateral root system. It tolerates a wide range of temperature (-5^{o}C to 45^{o}C) and requires little rainfall. *Ber* is a good host for both *rangeeni* and *kusmi* strains of lac insect.

3. *Guava* (*Psidium guajava*) is successfully grown under tropical and sub- tropical climate. In areas with distinct winter season, the yield tends to increase and quality improves. It can be grown upto an altitude of 1500 m above mean sea level. Older plants can tolerate drought.

Fig 2. LIFS Model

Fig 3. Lac Integrated Farming System Model

4. Guava trees are very hardy and can thrive on all types of soils, but are sensitive to water logging.

5. *Lime* (*Citrus aurantifolia*) is a light loving crop. Fruits thrive well in deep, loose, well aerated soils with the pH of 5.5 to 6.2 devoid of any hard pan layers of calcium carbonate in the rooting zone up to 150 cm. High water table and poor drainage system is quite unsuitable for lime fruits which cause drying of roots and nutritional imbalance, respectively.

6. *Aonla* (*Emblica officinalis* syn. *Phyllanthus emblica*)is one of the most important minor fruits and a crop of commercial significance. Its importance lies in its high content of vitamin C. Owing to its hardy nature, it is suitable for sub-tropical waste lands. Aonla is a sub-tropical fruit and is grown upto 1800 m altitude. Young plants should be protected from desiccating wind in summer and frost in winter, at least upto the age of 3-4 years. Aonla can be grown in light as well as heavy soils except in very sandy ones. The plants have capacity for adaptation to rainfed areas and can also grow in moderately alkaline soils. However, its production is high in deep and fertile loamy soils.

Lac cultivation on *semialata* and *ber*

a. Broodlac inoculation

Semialata can host only *kusmi* strain of lac insect. The first lac crop on *semialata* is raised in the following July after one year of planting. Approx. 25-30 gm of broodlac should be inoculated in the first year of lac inoculation. Thereafter 45-50 gm broodlac is inoculated for raising *aghani* crop in July in consequent years. The leaves in *semialata* up to ¼th of the shoot should be removed to avoid overcrowding for proper ventilation after one month of inoculation during *aghani* (winter *kusmi*)crop. The broodlac should be inoculated in 60 mesh sieve for summer crop and without mesh for raising winter crop. 25-30 gm broodlac is inoculated in the month of January-February for raising *jethwi* crop because plant cannot sustain more number of lac insect in summer due to high temperature and low moisture. It is desirable to inoculate early maturing strain of lac insect for raising *jethwi* (*kusumi* summer crop) so as to harvest the lac crop before temperature reaches its peak in summer season. The overall initial

Fig 5: Lac inoculated shoots of semialata

settlement on plant should not exceed 35% of available shoot length. As *ber* tree remains without leaves during summer, hence raising of *kusmi jethwi* crop on *ber* is not recommended. Winter (*aghani*) crop is inoculated in July-August on *ber* and the crop is harvested in February - March only when emergence of larvae starts from mature lac encrustation. As February - March is suitable time of pruning *ber* trees, the late variety of *kusmi* broodlac (lac insect emerging in February - March) is to be utilized so that pruning and harvesting time coincides. About 20g of broodlac per pruned point or 1-2kg broodlac, depending on its size is inoculated on full grown tree. The broodlac should be inoculated in 60 mesh sieve for summer crop and without mesh for raising winter crop.

***b. Phunki* removal**

Larval emergence takes place till about 20 days from inoculated broodlac in January to March for summer (*jethwi*) crop whereas it takes 10-15 days in June-August for winter(*aghani*) crop. *Phunki* should be removed after insect settlement accordingly for *aghani* and *jethwi* crop.

c. Harvesting

When yellow spot starts appearing in female cells during summer and few lac insect crawlers are seen moving on the shoot during winter season, harvesting should be done with secateurs / tree pruner. Winter lac crop is generally harvested in January-February in *semialata* and in February-March in *ber* whereas summer crop on *semialata* is harvested in June-July. The shoots with broodlac are harvested 8-10 cm from above the soil surface in *semialata*. Lac crop is generally harvested in June-July in *semialata* and July-Aug in *Ber* . Average broodlac yield in *semialata* is 250g / plant for winter and 150g / plant for summer crop, and 6-10kg / plant in *ber* . The lac bearing shoots are sorted into broodlac and sticklac

Training and pruning of fruit plants

In guava, the plant should be trained to a low headed system of open centre or delayed open centre keeping scaffold limbs having wide crotch angles. Pruning is not generally required every year; however, terminal shoots may be headed back to stop overcrowding of trees. The plants are trained as low headed trees to facilitate multiple hand pickings. Pruning is usually recommended after harvesting or in spring. Summer pruning is generally avoided as the plants get damaged due to sun burn.

Thinning out of branches in young nursery plants of lime should be done at least once a month during the year following planting and once in two to three months during the first three years just for avoiding very low

Fig 6: Lac on ber

headed trees. Training should be done to develop mechanically strong trees with well spaced scaffold limbs at the early years before fruiting. In bearing trees, ground touching, diseased or dead branches should be removed after harvesting of fruits. Aonla plant should be encouraged to develop a medium-headed tree. Aonla tree does not require regular pruning. However, pruning in early years for giving proper shape and development of strong framework may be necessary for which tree should be trained to single stem upto the height of about 1 m and then primary branches can be allowed at regular space all around the trunk. The pruning of bearing plants can be done after the termination of the crop each year. While pruning, dead, diseased, broken, weak and crossing branches and suckers appearing from root-stock should be removed

Harvesting and Yield of fruit plants

Grafted plants of guava come into bearing at the age of 3 years and peak harvesting periods are August-September for rainy season crop and Jan-Feb. for winter season crop. Guava develops best flavour and aroma only when they ripe on tree. The fruits produced in the rainy season are not of high quality because of poor shelf life. 10 per cent urea or 600 ppm NAA should be sprayed during April-May when maximum flowers have opened. This eliminates rainy season crop so that winter crop is heavy and of superior quality. A ten year old guava tree gives a yield, up to 100 kg of fruit. Lime fruits should be harvested when they attain full size and ground colour. The fruits are harvested generally between December to February. The fruits should be clipped from the tree retaining a non-protruding short fruit stalk but not by pulling from the branches. Average yield of lime is 500 fruits /tree/year.

Fig 7: Guava in LIFS

Fig 8: Aonla plant under LIFS

Fig 8 & 9: Lime in LIFS

Aonla plants come in to bearing quite late. Generally, vegetatively propagated tree starts bearing commercial crop after 3-4 years of planting, while seedling tree may take 8-10 years to come into bearing. Productive life of tree is estimated to be 50-60 years under good management conditions. Change in seed colour from creamy-white to brown is an indication of fruit maturity. Generally, aonla fruits are ready for harvest in November-December. The fruits are light green at first, but when they mature, the colour becomes dull greenish yellow, or rarely brick red. Maximum vitamin C content is observed immature fruits, while immature fruits are acrid and low in vitamin C content and minerals. As far as yield is concerned, the production varies from cultivar to cultivar. *Banarasi* is a poor yielder as compared to *Chakaiya* and *NA7*. On an average, a grown up tree should yield 150 to 200 kg fruits per annum.

Economics of LIFS model (area 50mx 50m)

Economics: In the first year of establishment of LIFS, none of the components except bittergord started yielding. Therefore net expenditure exceeded net income by Rs 31,084. While

lac crop on semialata was raised in the following July after one year of planting, net income of Rs 19,722 was earned in second year from lac component . Lac crop on ber was raised after five years, so income from lac on ber started only after fifth year. Whereas fruit trees guava, lime and aonla came into bearing after 3rd, 5th and 8th years respectively. Over all net income increased from 19,722 in second year to 1,68,774 in eighth year from an area of 50 X 50 m, suggesting LIFS to be a highly profitable, diverse out-put more sustainable system than mono cropping system. Integrated farming system models developed in different parts of the country by various research worker have been found to increase net profit significantly as compared to mono cropping . These IFS systems were also found more sustainable and employment generative.

Table1: Year wise cost and income from different components in LIFS

Year	*Semialata*		*Ber*		Fruit trees (guava, lime, aonla)		Vegetables	
	Expenditure	Total Income	Expenditure	Total Income	Expenditure	Total Income	Expenditure	Total Income
1st	12036	-	3741	-	17807	-	1500	4000
2nd	21665	46640	451	-	7302	-	1500	4000
3rd	24865	77380	751	-	9780	3000	1500	4000
4th	24865	77380	863	-	12200	6000	1500	4000
5th	24865	77380	11920	42400	13989	24800	1500	4000
6th	24865	77380	11920	42400	16940	28000	1500	4000
7th	24865	77380	11920	42400	18580	32000	1500	4000
8th	24865	77380	11920	42400	20221	72000	1500	4000
9th	24865	77380	11920	42400	20221	103500	1500	4000

Table 2: Yearwise net income from different components in LIFS

Year	Net Income from lac		Net Income from fruits	Net income from vegetables	Total Net income
	semialata	*ber*			
1st	-12036	-3741	-17807	2500	-31084
2nd	24975	-451	-7302	2500	19722
3rd	52515	-751	-6780	2500	47484
4th	52515	-863	-6200	2500	47952
5th	52515	30480	10811	2500	96306
6th	52515	30480	11060	2500	96555
7th	52515	30480	13420	2500	98915
8th	52515	30480	51779	2500	137274
9th	52515	30480	83279	2500	168774

Care and Management of Postpartum Dairy Cow

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Animal husbandry or dairy farming is an important occupation of farmer community as well as landless poor villagers. Economic output of dairy farming based on various factors like milk yield of the cow, production length, calving interval, cost of feed, labor and proper management. Fact of dairy industry is that maximal production potential can be harvested with optimal fertility only (Lucy, 2007), thus we can say reproduction plays a vital role in production performance of dairy cow. For optimal reproduction and production, health care and nutrition of dam is imperative. Time immediate after calving is crucial and it determine further reproduction and production performance of dairy cow. The relief that accompanies with delivery of a calf following dystocia should not divert attention away from the cow, which should be the object of primary economic concern to the herdsman or rancher. Consequences of dystocia as well as mismanagement in this period is caused by regrouping, diet change can reduce the difference between profit and loss. The veterinary obstetrician bears the responsibility for evaluation of the dam and for initiation of therapy when it is needed to maximize subsequent fertility and lactation. Therefore proper care and management in terms of health, feeding and milking of postpartum dairy cow is unavoidable to economy of any dairy farm or individual animal owner. Care and management in this period is imperative to evaluate, identify and cure of postpartum complications.

General postpartum Care

Following parturition, the dam should be allowed to lick and nurse her young one. Postpartum dairy cow should be guarded from both extreme end of temperature in winter and summer season. Any kind of excitement, noise or any unusual disturbance should be eliminated. The soiled hind quarters and perineum including udder should be cleaned with water and its better to use potassium permanganate with water. When fetal membranes expelled, prevent cow from eating because it cause acidosis and

digestive disturbance which leads to affect feed intake during early lactation. Regular light to moderate exercise is beneficial after parturition. Following a dystocia, the genital tract should be examined properly and ruled out presence of an invaginated uterine horn, lacerations and another foetus in the uterus. If cow after parturition is unable to rise, further examination should be made to determine any impairment related to obturator paralysis, hip dislocation, spinal injuries or milk fever.

Care regarding feeding

After calving lukewarm water and gruel should be offered to dam and initially provide bran mash moistened with crude sugar or molasses for laxative effect. Some green grass may also be given. Once lactation commences the nutrient demand in high producing animals increases substantially so the first two months postpartum are the most crucial period for meeting body and lactation requirement. Some extra care with feeding systems is necessary during early lactation to bring postpartum cow up to full appetence. Proper nutrition is imperative to sustain postpartum fertility and production of animal. Feeding of concentrates must be increased gradually until dairy cow reached at appropriate intake or appetite but for prevention of ketosis in high yielder dairy cow it may have to increase more rapidly. Milk production rises rapidly and reached at peak around 4 to 6 weeks while voluntary feed intake reached at its optimal around 8 to 10 weeks (Grummer, 2007). The lag in feed intake behind high milk production leads to development of negative energy balance (NEB) and therefore maximum lactation is achieved and maintained at the expense of body reserve. This initial depletion of nutrients creates the need for adequate replenishment of reserves in further lactation. If we provide balanced and palatable ration, than about at 10 to 12 weeks postpartum animal comes at stage of adequate voluntary feed intake to fulfill nutrient requirements. Substantial concentrate feeding in first-third of lactation helps in mitigating effect of NEB with resumption of postpartum ovarian activity at appropriate time.

First and second lactation animals should receive an additional 20% and 10% ration respectively, over maintenance-production requirements for the fact that they are still in growing phase. Feed should be mild laxative, palatable and use of conditioning feeds like wheat bran, oats, and linseed meal is beneficial. Moistening of 2 kg bran with gur or molasses (1 kg) and warm water may be adopted as grains supplement. DCP and TDN in ration of postpartum dairy cow must be 16-18 % and 70 % respectively. Concentrate mixture containing gram, bran and oil cake in equal parts with additional 40 gm. common salt can be fed to dairy cow. Succulent green, palatable fodders containing 50-60% legumes are suitable and quantity of concentrate feed should be increased gradually in three weeks.

Care during milking

First milking of postpartum dairy cow should paid attention and milker must ensure free drainage of milk without any blockage in teats. If any mild hardness or

inflammation is appeared on udder there is no need to be alarmed so long milk can be obtained from each quarter freely. The cow should be milked three times a day until the inflammation disappears from the udder. In high yielding dairy cows complete milking at a time should avoid for prevention of milk fever. Introduction of dairy cow to the milking herd should avoid for 3 to 5 days postpartum.

Care and management of postpartum disorders

In normal case the fetal membranes expelled within 5-6 h. within calving, if it does not expelled out till 8-12 h. than get the help of veterinarian and treat as per requirement. VanDieten reported that cow facing problem of RFM are subject to comparatively lower conception rate subsequently.

Occasionally in first lactation agalactia is noticed accompanied with a greatly congested, oedematous and painful udder. Primarily it's an endocrine problem which is localized to mammary tissue. Oxytocin (20-30 IU) intravenously or intra muscularly can be used to combat this situation because it causes rapid and complete milk let-down. In some cows repeated injection at each milking is required.

Udder health

Udder edema is common in high yielding dairy cattle. Udder edema is the excessive accumulation of watery constituents of blood and lymph in interstitial space of tissue and the swelling is extending half the way along the belly in front of udder. First calf heifers are prone to such incidence (Schmidt and Schultz, 1959). Reducing the amount of feed just after calving does not help in reducing udder congestion. Gentle massage using camphorated oil as lubricant may help in getting some relief in udder edema. Frequent milking and use of diuretics (e.g. Frusemide) helps to render further relief over it.

To avoid mastitis proper hygiene should be maintain regarding bedding material, suckling and milking with regular examination of udder and milk. If any abnormality is appear in consistency of milk such as flaks and clots in milk than it is prime concern of veterinary intervention with suitable intra mammary infusion or parenteral antibiotic.

Incomplete milking is a usual practice at dairy farm to prevent milk fever but In Jersey and Guernsey breed of cattle it may become allergic and develops urticaria around the udder because of antigenic reaction of α-casein of their own milk. Protein α-casein is synthesized in the udder and it does not express any unwanted outcome if the animals are milked regularly. In any circumstances, milking is delayed or incomplete, than increased intra-mammary pressure force milk protein back into the blood stream and creates allergic reaction. In allergic cattle, this may cause mild discomfort with urticarial skin lesions but in some cases acute systemic anaphylaxis leads to death of cow. The condition can be address by prompt and complete milking. Some seriously affected cows may have to go for several lactations without drying off due to severe reactions that occur on cessation of milking.

Milk fever

Jersey breed is more prone to milk fever and it's usually occurs within first 48 hrs. of calving. About 2.3 gm. calcium is drained through one kg colostrum in postpartum dairy cow. Serum calcium level reduced to below 8 mg/dl, and further decrease in calcium level decide the severity of milk fever. Incidence of milk fever in India is 7.2 per cent. Feeding large doses (1 million IU/45 kg body weight) of Vitamin D one week before calving is surest way of guarding cow against milk fever. Provide enough minerals specially calcium and phosphorus through bone meal in diets as it will be helpful in preventing milk fever after calving because it occurs in high yielding cows. If animal develops milk fever than as general rule 1 gm. calcium per 45 kg body weight should be administered half dose through slow intravenous and remaining by subcutaneous route.

Ketosis

Ketosis or acetonemia is common metabolic disorder of postpartum dairy cow. NEB due to inadequate nutrient intake is major cause for ketosis. It causes incomplete utilization of body fat which leads to increased concentration of ketone bodies in blood, milk and urine of animal. It normally occurs within 4 to 6 weeks after calving. It characterized by sudden drop in milk, inappetance, drowsiness and rapid decrease in body weight. Animal usually consume roughages but refuse concentrates. Cow resembles woody appearance with sweetish smell of breath. Usually rothera test of urine sample is use for diagnosis. Feeding of sodium propionate during this period helps in reducing incidence of ketosis.

Avoid excessive fatness of cattle. Provide rising plane of nutrition during late pregnancy and early lactation. Use glucocorticoids if any adverse effect persists then prevent it by giving injection of insulin @ 0.5 units per kg body weight (Im/Sc). Intravenous infusion of 50% dextrose (500 ml) helps to counter hypoglycemia. Injection of vitamin B_{12} and phosphorus are effective. Intravenous chloral hydrate (40 ml/100 kg) can also be used.

Uterine infection

Dairy cow become more sensitive to infections after calving. Provision of comfortable housing and hygienic dairy practices certainly reduce incidence of postpartum infections. The calving pen should be disinfected properly. After parturition, discharge and tissue waste should be disposed off properly by burying with lime. There is a normal vaginal discharge in dairy cows after parturition for about 2-3 weeks due to regeneration and cleaning of reproductive organs. Such discharge is called as lochia or secundus. Initially lochia is blood stained for first 3 days after calving and there after it becomes yellowish in colour. It is again mixed with blood between day seven to fourteen and then becomes clear and stops by third week. A casual attention should be paid to lochial discharge. It should not be foul smelling because foul smell is sure indication for infection of reproductive tract. At first instance, such animals should be separated from other healthy animals and their discharges should be buried properly to avoid spread of infection. Prompt action should be taken for

examination and treatment of such cases by veterinary doctor. To avoid possible genital infections tetracycline (1 g.) can be used for uterine infusion just after expulsion of fetal membranes at least for 5 days.

Sometimes, acute puerperal metritis develop causing septicemia within 24 to 48 hours post-partum. In Severe cases signs of systemic illness appear and sometime death of animal may occur. Any illness occurring immediately after parturition should be treated promptly in veterinary supervision. It is desirable especially in valuable cows to examine the genital tract about 30 days postpartum even when calving and postpartum period is apparently normal.

CONCLUSION

Postpartum period of dairy cattle has drastic homeostatic challenges due to stress of calving and increased metabolic demands for lactation. Mismanagement during this period certainly has some unfavorable impact over subsequent fertility and production. Scientific management and care of postpartum dairy cow in form of proper hygienic environment, balanced feeding, proper milking, strengthen the production as well as economy of farmer or dairy. Prevention as well as appropriate treatment measure should adopt for postpartum infection and metabolic disorders.

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Azolla - As Bio-fertilizer and Animal Feed

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Azolla is a very small free floating fern that spread quickly on water bodies. It is also called as mosquito fern. Most commonly occurring species in India is *Azolla pinnata.* It has been used as a bio-fertilizer and animal feed supplement. The special feature of this aquatic fern is that it fixes nitrogen due to anabaena species which presents in the lobes of *Azolla* leaves. Anabaena is blue green algae (BGA) which has symbiotic relationship with *Azolla*. The rate of Nitrogen fixation of this symbiont is about 25-30 kg/ha. As a green manure it is grown alone for 2-3 weeks in flooded field. Afterwards, water is drained out and *Azolla* is incorporated in the field before transplanting of paddy. Otherwise 4-5 q of fresh *Azolla* is applied in standing water one week after planting. Dry *Azolla* fakes can be used as poultry feed and green *Azolla* is also a good feed for fish. It can also be used in the preparation of salads and as a bio-scavenger as it takes away all heavy metals.

How to grow *Azolla*

The biomass production under natural condition is only 50 g/sq.m/day as against optimum production of 400 g/sq.m/day. The production efficiency can be increased by reducing contamination and competition with other algae. This can be achieved by growing *Azolla* in pits lined with synthetic polythene sheet. For this purpose make an earthen pit having 2m x 1m spacing with 15cm depth. It is desirable to make pit under the shade of a tree that can retain the atmospheric temperature within 25°C. After making the pit, with maximum of 10 cm height, 5 kg of cow dung, collected within 3 days, to be mixed with the water and soil with an addition of 20 grams of Azofert powder of rock phosphate. By this time when these preparatory works are done, at least 200 grams of *Azolla* culture should be sprayed in the pit. This culture multiplies and spread over within 10-15 days. Harvesting is needed to be done every day with removal of at least 25% available stock from the pit. The plant should not be allowed to enter at maturity stage or sporulation stage. Every day the biomass should be removed from the pit in order to avoid overcrowding which adversely affect the growth of *Azolla*. *Azolla* cultivated for fish feed, is grown in-situ in the pond. a part of the pond is earmarked and is cordoned off by rope made up of straw

once the mat is formed *Azolla* is released

Fig. 1: Azolla cultivation in pit with polythene sheet

slowly to the pond by lifting of the rope. Setting up of *Azolla* fodder plot does not require expertise and farmers themselves can handle it with ease. If set up in backyard, the area should be leveled and lined with bricks. The side of the plots should be raised to enable the water to stand. The fodder plot can be in a pit with depth of 0.2 m. Width of the bed is maintained at 1.5 m to enable the cultural operation from both sides. Length may be varied depending upon the fodder requirement of the unit. For two cows, two units of beds of length 2.5 m each with an area of around 8 sq m can meet 50% of the green fodder requirements.

Azolla as a feed supplement

Azolla is considered as the most economic and efficient feed substitute and a sustainable feed for livestock. It is a potential source of nitrogen and thereby a potential feed ingredient for livestock**.** Azolla is rich in protein. On a dry weight basis, it contains 25-35 per cent protein, 10-15 per cent minerals and 7-10 per cent of amino acids, bio-active substances and bio-polymers. The carbohydrate and fat content of *Azolla* is very low. Its nutrient composition makes it a highly efficient and effective feed for livestock. The comparative analysis of the nutrient content of azolla vis-à-vis other fodder source is depicted in the following table.

Table: Comparison of biomass and protein content of *Azolla* with other fodder

S.No	Item	Annual production of biomass (MT/ha)	Dry matter content (MT/ha)	Protein content (%)
1	Hybrid Napier	250	50	4
2	Kolakattao grass	40	8	0.8
3	Lucerne	80	16	3.2
4	Cowpea	35	7	1.4
5	Subabool	80	16	3.2
6	Sorghum	40	3.2	0.6
7	**Azolla**	**1,000**	**80**	**24**

(Source: Kamalasanan et al. 2004 "Azolla -A sustainable feed substitute for livestock", Spice, India)

In addition to their farming activity, small and marginal farmers are generally capable of rearing 2 to 3 units of cow/ buffaloes. For traditional methods of rearing, the feed requirements are met out from agriculture residues and very rarely the farmers can afford to provide green fodder and oil cakes. In rare cases, green fodder is provided to the animals in the form of grass collected from the field or in few cases fodder is grown in the backyard. Even then the supply of green fodder is restricted to 5 to 6 months when water is available. *Azolla* fodder plot, if set up by these small farmers can cater to the fodder requirements of remaining part of the year. The animals are fed in restricted quantities (250 g/goat/day and 1 kg/cow/day) with a mixture of commercial feed and local

fodder. For poultry birds it is fed with commercial feed in 1:1 ratio. Inclusion of *Azolla* as feed component will save the cost on purchase of concentrate feed significantly in livestock enterprises.

Fig.2: Azolla as an animal feed supplement

Fig. 3: Azolla as a poultry feed

Azolla culture in paddy farming

Azolla is best in fixing atmospheric nitrogen. The plant multiplied vegetatively. This will ensure soil fertility improvement by helping the farmers to cut off higher external input. Once *Azolla* established in rice field rapidly, it suppresses weed growth drastically. *Azolla*, if used for more than 3 seasons as the natural vegetation, it turns rice cultivation an organic.

Benefits of azolla

Azolla works as biological herbicide which reduces light penetration to soil surface. Therefore, occurrence of aquatic weeds in rice fields is depressed.

Fig. 4: Azolla cultivation in paddy farming

Azolla's nutrient accumulation is amazing. The plant accumulates nutrient from floodwater and transfer these after decomposition. Under the mat of *Azolla*, floodwater pH does not turn alkaline. Prevention of alkaline generally reduces ammonia loss *Azolla* has been extensively used as feed for pig, duck, fish, poultry birds and cows. *Azolla pinnata* is strongly recommended to be use as dual culture in rice field because of its higher biomass yield. *Azolla* cultivation as an agricultural technology alternative proves to be efficient in reducing the use of expensive chemical inputs, arresting agricultural pollution and helping to revive farmer's organization that could provide inoculums for rice cultivation.

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Ruminal Acidosis In Sheep and Its Management For Small Scale Farmers

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Ruminal acidosis in sheep is caused by ingestion of readily fermentable carbohydrate diet in excess amount. Over feeding of carbohydrate rich diet favors the lactic acid production in rumen and leads to the clinical symptoms like reduced feed intake, distended stomach, depression, dehydration, pasty diarrhea or constipation, weakness, limping, frequent water intake, passing less or no urine etc. If it is not treated promptly, it may die due to dehydration and shock. There will be a huge loss to the small scale farmers.

Reason for occurrence of acidosis in small ruminants

Grains like Rice and wheat, oats, barley, tapioca tubers, sugar beets, grapes etc., are rich in carbohydrates, so more acid producing bacteria will produced. Lactic acids are normally produced in the rumen (part of stomach responsible for digestion of green fodders) by lactic acid producing microbes and it is metabolized by lactic acid utilizing bacteria. The lactic acid level in the rumen will increase and it will absorbed into the blood and produce the clinical symptoms. These carbohydrate rich diets are classified into fast fermentable diet and slow fermentable diets. The processing of feed such as cooking, grinding, crushing, soaking, are classified under the fast fermentable diets. These processed feed can be easily fermented by the bacteria and large amount of lactic acid will be produced at short period of time. For fast digestible feed, the symptoms will be appeared within six to twelve hours after ingestion. The symptoms will aggravate very quickly and the prognosis will be poor, so intensive care is needed. In case of slow fermentable diets such as raw feeds, the time for fermentation will be around twelve to twenty four hours. The symptoms will be appeared after twelve hours, which includes anorexia, pasty diarrhea or constipation, lethargy and weakness. The prognosis for slow digestible diets will be good when compare to fast digestible carbohydrate rich feeds.

After ingestion of the carbohydrates rich feeds, the lactic acid producing gram positive bacteria in the rumen (*streptococcus bovis* and *lactobacillus*) will digest the carbohydrates into lactic acid. So the energy producing bacteria will die eventually. The lactic acid will be absorbed

into the blood from the rumen and produce the clinical symptoms. Meanwhile the racemase (vit B1 degrading protein) producing bacteria proliferate at acidic pH in the rumen leads to thiamine deficiency (Nervous symptoms). The distention of the stomach is due to the lactic acid which can absorb the water from the blood into rumen. So the water content in the blood decreased followed by dehydration. The affected animals always used to drink more amount of the water and reduced urine output will be seen commonly. If affected animals are allowed to drink water, more amounts of lactic acids will be produced, ultimately leads to accumulation of the water in the rumen and aggravate the symptoms. Once the symptoms appear, the animals should be preventing from the drinking water at least 12 to 24 hours. Dehydration should be corrected by using intravenous fluids.

SYMPTOMS

The foremost symptom will be the distention of the stomach and animal unable to take the feed, dull and depressed, pasty diarrhea or constipation and reduction in urine output or no urine. Animals used to drink water more frequently and accumulation of water leads to distention of rumen. The animal will be lethargic and be isolated from the flock. The limping will be noted after 24 to 48 hours of ingestion. The limping is due to the release of allergic chemicals in the body. Clinicopathologically, the rumen pH will be decreased to less than 5, protozoan load will be reduced abruptly.

TREATMENT

Animals should be preventing from feeding of concentrate (Rice, wheat, etc.,) until recovery. Grazing may be allowed. At initial stage of acidosis, animals should be preventing from drinking water, since it will aggravate the symptom. Moderate exercise like walking or allowing moving with other animals will facilitate the intestinal movement. To restore the pH, sodium bicarbonate 5% at a rate of 2 ml/kg body weight should be given by intravenous route. Antacids such as Gelusil, Digene or Ulgel will be given orally for the treatment during mild / moderate acidosis. Oral sodium bicarbonate (baking soda) may be given instead of antacids to correct the rumen pH. Antibiotics like oxytetracycline may be given orally to prevent further acid production. Veterinarian should be assisted during acute cases. Usually the animal will not take feed for 2 to 3 days during acidosis. After recovery, animals may drench with rumen fluids (gud transplant) at the rate of 100ml twice daily, which can be collected from healthy slaughtering animals. Rumen fluids can stimulate the appetite in affected animals. After collecting from slaughtering animals, rumen fluid should be drenched to affected animals immediately; orelse, the microbes load will be reduced.

SUMMARY

Acidosis can be prevented by feeding lesser amounts of carbohydrate rich diets. The mild and moderately affected animals can be treated successfully by using antacids

like Gelusil or Ulgel followed by rumen fluid from slaughtered animals.

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Total Mixed Ration Feeding (TMR) for Dairy Cows: Getting Started

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Providing proper nutrition to dairy cows is important for health and optimal milk production. Dairy cow rations must contain good quality forages, a balance of grains and protein sources plus minerals and vitamins. These feed sources provide the nutrients needed by the dairy cow for milk production, growth and reproduction. Feeding a total mixed ration (TMR) that contains all the feeds and nutrients required by the cow is an effective, efficient and profitable way to feed dairy cows. It is now the most adopted method for feeding high producing, indoor housed dairy cows. This is accomplished by feeding a nutritionally balanced ration at all times, allowing cows to consume as close to their actual energy requirements as possible and maintaining the physical or roughage characteristics, which we now refer to as feed particle size, required for proper rumen function.

What is a Total Mixed Ration (TMR)?

A total mixed ration (TMR) is composed of forages, commodities/byproducts (such as whole cottonseed), grains, protein supplement(s), minerals, and vitamins that have been mixed together to make a balanced ration in which the weight of each ingredient is known. This mixture is then offered to cows as their sole source of feed. By blending together all the forages, grains, commodities, and

protein and mineral-vitamin supplements, cows are less able to selectively consume individual ingredients. Ideally, each bite of feed a cow consumes will contain the same proportion of forages and concentrates.

Potential Advantages of a TMR Feeding System:

1) Each mouthful of feed that the cow consumes contains the proper amount of ingredients for a balanced ration, resulting in a more stable and ideal environment for the rumen microbes and providing adequate carbohydrates and nitrogen sources that vary in their ability and rate of rumen breakdown.
2) A 4% increase in feed utilization can be expected when using a TMR compared to a conventional ration of forage and grain fed separately, twice daily.

3) Farmers can also utilize a variety of byproduct feeds with a TMR, thereby allowing for possible ration cost savings. The incidence of digestive and metabolic problems often decreases when a TMR is fed, and milk production has been shown to be as much as 5% higher with a TMR compared to conventional rations as a result of these benefits.
4) A TMR provides greater accuracy in formulation and feeding if managed properly. Using feed scales both on mixing equipment in a feed area allows the quantity of each ingredient fed to be closely controlled.
5) Selective feeding can be discontinued or limited to token amounts to facilitate cow movement, unless specific milking systems such as robotic milking systems are being used. The TMR system is well adapted to mechanization with a mixer wagon or a stationary mixer with conveyors or mobile feeders.
6) It is most always recommended to chop long forage as a separate commodity before adding it to the TMR mixer and mix for a limited amount of time as recommended by the manufacturer. This generally is no more than 4 to 5 minutes—just long enough to achieve a good mixture.
7) Blending of all the feeds together in a TMR is that it can mask the flavour of less palatable feeds. Feeds such as urea, limestone, fats, and some by-pass protein sources may be less palatable.
8) Milk production improves: Although increase in milk production depends on how well the previous feeding system met the cows' nutritional and management needs, some farmers who have switched from feeding grain in the milking parlour to feeding a TMR have seen production increase by 5 pounds or more per cow.

9) Feed costs decrease: When going to a TMR, some farmers are able to do one or both of the following: Include feeds they previously could not feed easily (for example, whole cottonseed). Decrease the cost of purchased concentrates when byproducts are purchased in bulk and included in the mixed ration.
10) Cow health and reproductive performance improves: This is especially true for early-lactation cows. The biggest improvements in performance are usually seen when cows are switched from a feeding program where they are fed more than 6 pounds of grain within a six hour time period. Switching to a TMR may decrease the incidence of subclinical ruminal acidosis.

General Approach to Formulating TMR:

The key for formulating TMR is to optimize dry matter intake. Total dry matter intakes should be consistent with production and breed. Intakes may be depressed when ensiled materials undergo abnormal fermentation. Forage dry matter should consist of good- to excellent-quality forages, especially for high-producing animals. Palatability of forages, the presence of certain weeds,

and water quality can affect intake. Dry matter intake during the first two weeks post calving may average 2% of body weight. The ration differences between groups should be minimal, otherwise cows will decrease milk yield significantly when they are moved to a different group. Limit differences in concentrate dry matter proportions to not over 10 to 15% between groups. The level of concentrate dry matter and protein depends to a certain extent on the production level and the type of forage used.

Grouping Guidelines for TMR Feeding:

Dairy herds feeding a TMR should have a minimum of 3 milk production groups and preferably 2 dry cow groups. Suggested groups for a TMR fed herd include the following:

1) **Pre-Fresh or close-up dry cows (2 to 3 weeks before calving):** These cows have a low dry matter intake (about 10 kg/day). They need a ration that is high in fiber and contains all the nutrients required to prepare for the impending birth of the calf, the initiation of lactation and help prevent metabolic problems. Dry cows, in particular, may need at least five pounds of long-stem hay along with a TMR to provide sufficient "effective fiber." Dry cows placed on a close-up TMR should be kept on the ration until the day they freshen. This ration should contain about 3 kg of grain, 2 to 3 kg of good quality hay plus forage like corn silage and the proteins, minerals and feed additives needed to make the ration very palatable and help prevent metabolic disorders.
2) **Fresh cow group (1 to 21 days after calving):** These cows have a low dry matter intake, but a high nutrient requirement as they begin the lactation. The ration should contain adequate fiber (2 to 3 kg of good quality hay) to help promote good rumen function plus other forages and concentrates to get the cow off to a good start towards high milk production and moving into the high production group.
3) **High producing older cow (2nd lactation and greater) group (21 to 180 days in milk):** This group is where peak milk production and peak dry matter intake occur. The goal in feeding this group is to maintain a high milk production to get cows bred back for next lactation. This group can also be considered a reproduction group where heat detection and breeding occurs.
4) **First lactation or first calf heifer group**: First lactation cows generally do better if they stay in a group of their own. This is good for social as well as nutrition reasons. They are slower to reach peak dry matter intake and milk production than are older cows, but more persistent in maintaining milk production than older cows. This group can stay together for 250 days in milk or more before moving to a late lactation group.
5) **Mid-lactation cows (180 to 250 days in milk):** Cows in this group should be pregnant and milk production should average 75 to 85% of the high group. The ration fed to this group should be higher in

forages and slightly less nutrient dense than the high group ration.

6) **Late lactation pregnant cow group (250 days in milk to dry off):** This group is where first lactation cows, over 250 days in milk, can be mixed with older cows if barn space does not allow keeping first lactation cows in their own pen(s) for the entire lactation. The ration will be high in forage with emphasis towards maintaining milk production and avoiding over conditioning or fattening cows.
7) **Far-Off dry cows (220 to 260 days pregnant):** The goal of the dry period should be to prepare the cow for the next lactation. The TMR should contain mostly good to medium quality forages to promote maximum rumen fill and rumination. Adequate protein and proper mineral balance in the ration is required.

Moving Cows Between Groups:

1) After calving, cows should be moved first to the fresh cow group. Between 14 and 21 days after calving, healthy cows should be moved into the high production group. Cows should remain in a high production group until they are pregnant, milk production drops to 10 percent or more below the average production of the group, and/or body condition score of the cows are greater than 3.
2) Cows will usually drop in milk production when moved between groups. To minimize milk production drops, follow these guidelines:

3) Move cows in groups of 4 or more. Individual cows are more affected by social changes and fighting in the groups than are groups of cows.
4) Move cows at feeding time to minimize fighting and social disruptions.
5) Move cows on a regularly scheduled basis. This helps cows get accustomed to moving and social changes.
6) If within about 5 weeks of moving into the high cow group or before 60 days in milk the cow does not reach the average milk production of the group, she should be moved to a lower production group.
7) Try to avoid large changes in ration nutrient content between groups. Drops in milk production resulting from nutritional changes can be minimized as cows move between groups by formulating rations for no more than a 9 kg milk production difference.

Day to Day TMR Feeding:

The success of a TMR feeding program requires the person feeding or the dairy manger pay close attention to the following points.

1) Knowing the correct dry matter (100% moisture) of ensiled forages,

and all other wet grains and feeds fed in the TMR is critical to the mixing and feeding of a balanced ration.

2) Under estimating the dry matter content of a feed, assuming more moisture is present than there is, results in the feed being fed in a larger quantity than required. Over estimating the dry matter of a feed, assuming less moisture is present than there actually is, results in feeding less of the feed than required.
3) Feeders and dairy managers feeding a TMR can be alerted to changes in the dry matter content of feeds through changes in the size or volume of the TMR mixed.
4) Cows having larger than normal amount of feed remaining the next day (usually indicates feeds have increased in dry matter). Cows having no feed remaining the next day (usually indicates feeds have decreased in dry matter content or increased in moisture).
5) Know the correct number of cows in the group every day and feed for that number. Daily counts of the number of cows in a group before feeding is necessary so the correct amount of feed fed per cow is attained.
6) Increase or decrease the amount of TMR mixed according to daily variations in feed intake. Cows do not eat exactly the same amount of feed every day. Weather conditions and environmental temperatures have a big effect on daily feed intakes.
7) Add feeds to the TMR mixer in the proper order. In mixers with augers, grains and other concentrate mixes are generally added first followed by ensiled forages and dry forages last. With auger mixers, dry forages are best chopped or ground coarsely before being added to the mixer.
8) Do not over mix the TMR. Mixing times will vary with the type of mixer, auger or vertical, amount of feed in the mixer, size of the tractor running the mixer and the condition, new or old, of the mixer. In general, mixing 5 minutes after the last feed ingredient has been added should be sufficient time to mix the load thoroughly. With vertical mixers, final mixing time after all ingredients are added often is only 3 to 5 minutes. If the TMR is overmixed, the particle size is reduced and no long physical fiber remains in the TMR. This will lead to rumen upsets, low cud chewing and acidosis.
9) Number of times and when to feed the TMR per day. A TMR can be fed once per day, but twice per day is preferable especially during hot, humid summer months. Feeding twice per day, once in the early morning and once in the evening keeps the feed fresher and encourages feed intake.
10) Push feed in several times per day. The TMR should be pushed in towards the pen 6 or more times per day. Cows eat the feed closest to them first. They can only reach out about 72 centimeters from the pen to get feed.

11) Check particle size of the TMR. Every two to four weeks, the particle size of the TMR should be checked. Most forage particles in silage and haylage should range from 3/8 to 3/4 inch in length. Forage particles that are very fine, or grain that is too coarse or whole, should be avoided in the ration.
12) The goal is to have 6 to 10% of the TMR feed on the top screen, 30 to 50% on the middle screen, 30 to 50% on the lower screen and less than 20% of the feed in the bottom pan. Having a lot of long particles in the TMR or more than 10% on the top screen allows cows to sort the TMR easier.

CONCLUSION

The benefits of using a TMR far outweigh the disadvantages, but each farm has different goals and facilities that may or may not adapt well. Each case should be analysed to find the most profitable alternative. A carefully designed and well thought-out system will pay off in the long run. Advantages and disadvantages of any feeding system, however, must be weighed before choosing a TMR. Remember with a true TMR, cows have no other option for a diet and depend solely on the ration for a balanced diet to achieve production and health.

Pollination without emasculation: An efficient approach of hybridization in soybean (*Glycine max* (L.) Merrill)

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Success of hybridization in soybean is historically low owing to its small, delicate and injury-sensitive flowers. On global basis, the success rate of hybridization varies from 2-3% to 11-15% depending upon crossing approach followed. Usually, there are two approaches that are followed for hybridization in soybean, (i) emasculation in the afternoon followed by pollination in the next-day morning and (ii) pollination immediately after emasculation during morning hours (Agrawal *et al*., 2001). In both the approaches, emasculation is an essential activity. However, both the approaches are tedious, time consuming and poorly efficient as most of the flower buds dry and fall off due to injury during the process of emasculation and pollination. Here, we report an approach that is devoid of emasculation. It ensures less damage to the flower buds and hence more success.

Why non-emasculation method is adopted

The soybean has protogynous flower where stigma becomes receptive 24 hours before anthesis and remain so for about 48 hours. Therefore, if a flower bud is identified before its pollen grains are shed, the emasculation step can be avoided. So, pollination can be done without emasculation through careful selection of flower buds. Using this technique, the success rate of soybean hybridization was raised from usual 2-3 to 39 per cent.

Procedure

For making successful crosses, it is essential to know the flower. Soybean belongs to the family Fabaceae and sub-family Papilionoideae. It has a complete flower, i.e. all the four parts, viz. calyx, corolla, androecium and gynoecium are present in a single flower (Figure 1). The five petals - standard (one), wings (two) and keels (two) enclose the pistil and the 10 stamens. Nine stamens develop in a tube around the pistil, the tenth stamen remains free. Pollen from the anthers is shed directly on the stigma. Often, pollen is shed shortly before or immediately after

the flower opens (anthesis). It ensures a high degree of self-pollination and less than 1% natural cross-pollination.

The various steps and special considerations are explained below-

Soybean flowers are very small and need extra care. Therefore, for effective crossing, it is necessary to use forceps with fine tips. Moreover, head-mounted (or hands-free) magnifying glass has proven to be useful. It makes every part of the flower clearly visible ensuring little or no damage during pollination.

It is critical to identify a flower bud that would bloom the next day morning. It is generally identified by the size and colour of the buds. The buds ready to open are larger in size and relatively lighter in colour than the immature buds. The petals are not exposed out of the bud. Usually, 1-3 such buds appear in each cluster. Once identified, rest of the buds, *i.e.* those already opened and immature buds should be removed from the cluster.

The selected buds should be held softly between the first finger and the thumb. With a fine forceps, the sepals are to be removed carefully. The petals should be opened (or removed) to expose the ring of stamens that surrounds the pistil. Locating the pistil makes pollination easy and effective.

Choosing anthers at the proper stage of development is crucial for obtaining high seed set. It is therefore important to use mature pollen to pollinate the flower buds. Pollen should be collected from fully opened fresh flowers only. The mature pollen comes out of the anthers as yellow dust.

Once the flower bud is prepared and the pollen grains are collected, pollination should be done immediately by distributing the pollen on the stigma. Care should be taken to ensure that the pollen falls on the stigma. To prevent drying of the stigma, the buds may be covered with a thin layer of moist cotton.

Time for effective hybridization may vary with the growing season and the weather conditions. During kharif, it can be performed between 8.30 and 10.30 a.m. However, during cold season, flower opening and pollen shedding is delayed by about half to one hour.

After crossing, proper tagging should be done. The plants should be given proper water and fertilizer to avoid stress. The uncrossed flowers and young buds should be removed from the plants. Success of crossing can be judged 4 days after pollination. Upon successful crossing, the bud remains green and starts growing; otherwise it dries up and drops off the plant. The plants need to be monitored every week to remove newly grown buds.

Future aspects

Currently, large scale hybridization program has been undertaken at the Directorate of Soybean Research (DSR), Indore to develop two next-generation mapping populations called multi-parent advanced generation intercross (MAGIC) and nested association mapping (NAM) populations.

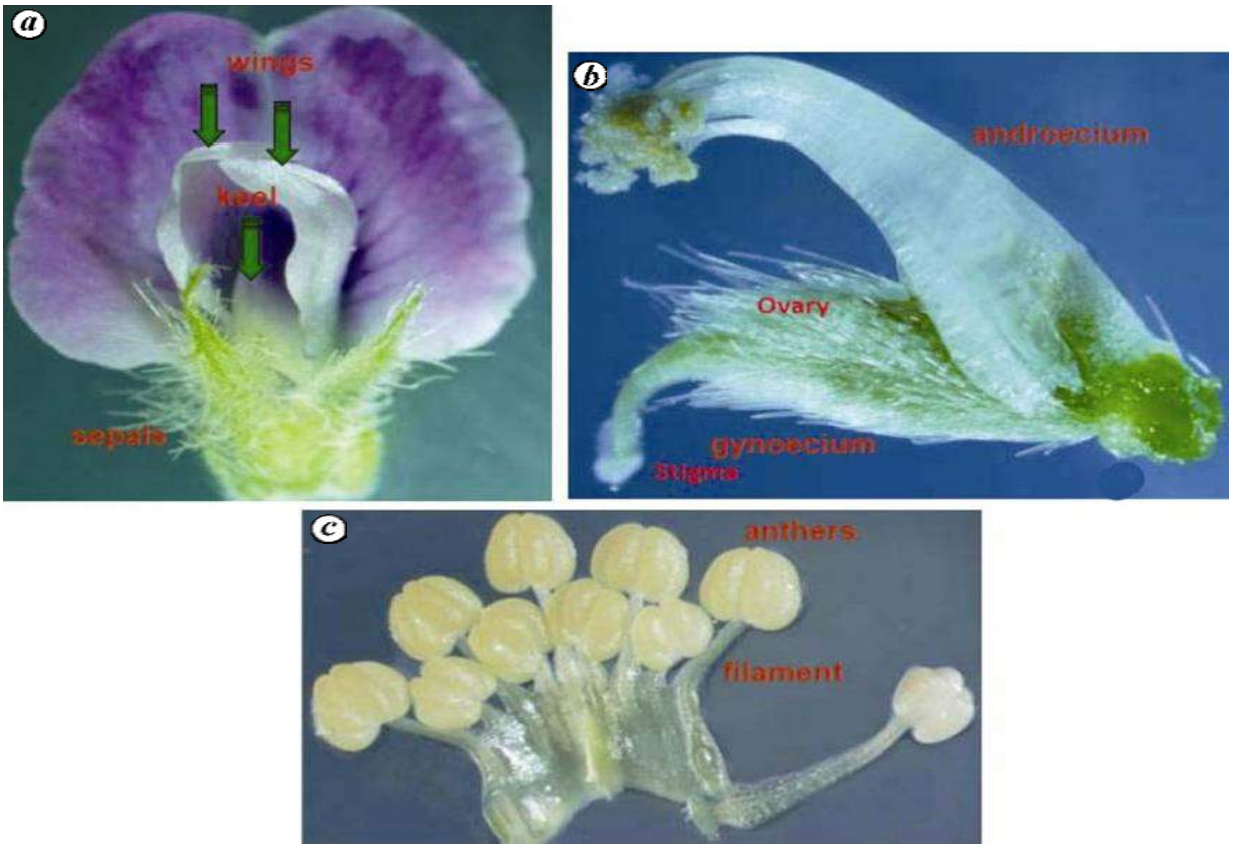

Figure 1. (a) Five petals of soybean flower (b) Androecium and Gynoecium (c) Filaments and Anthers

Further, hybridization program has been initiated involving wild type soybean *Glycine soja* with an aim to broaden the genetic base of soybean (Singh and Hymowitz, 1999). The higher rate of success achieved can be attributed to the longer cool and humid weather prevailing in the locality during the period of soybean hybridization. All these factors contributed significantly towards 15-20% increase in hybridization success in soybean.

CONCLUSIONS

This technique of hybridization not only decreased flower drops but also decreased the number of self fertilized buds significantly. In the hybridity test, only 2-3% plants were found as self fertilized. The hybrids so developed are being successfully used to develop 4-ways and 8-ways crosses in MAGIC and NAM populations. This study thus convincingly demonstrated the utility and efficiency of non-emasculated method of hybridization technique in large scale soybean improvement programs.

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Dairy Sector in New Zealand: Lessons to Be Drawn

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The dairy industry is New Zealand's biggest export earner, with exports totaling NZ$13.7 billion. It contributes 29 per cent to the country's merchandise export earnings and approximately 7-8 per cent to GDP. New Zealand dairy exports account for over a third of the world's dairy trade. The dairy processing industry is dominated by Fonterra Cooperative Ltd, the world's largest dairy processor and New Zealand's largest company. Fonterra collects an estimated 95 per cent of the domestic milk supply and controls an estimated 40 per cent of the world trade in dairy products. The New Zealand dairy industry is predominantly pasture-based, with a temperate climate ensuring adequate feed for herds year-round. Dairy farming occupies 1.6 million hectares out of a total of 12 million hectares of pastoral land. Dairy has been three times more profitable per hectare than other pastoral land use, encouraging conversions from other farming systems, such as sheep and beef, to dairy – especially in the South Island of New Zealand.

New Zealand is famous in the world for its full-flavored, distinctive natural taste and quality products. Strict hygiene and quality standard is followed coupled with advance technology. It also upholds a reputation for clean, safe products complying with rigorous health and safety standards. Products range from high quality basics such as milk powders, butter and cheese, as well as specialty foods such as ice cream, and to highly specialized ingredients like spray-dried milk proteins, protein hydro lysates, freeze-dried biologically active proteins and functional foods.New Zealand is not only technologically advanced in terms of production and process but also its advancement in healthcare, hygiene and maintenance of dairy animals helped in achieving international quality standards (Hill *et al.*, 2012).

The success of dairy in New Zealand has been attributed to efficient vertical

integration by large-scale cooperatives upto the grassroot level dairy farmers; economies of scale in processing; research and development; quality control and aggressive yet creative marketing. Value addition has been at the very core of dairy industry in New Zealand. Most dairy cooperatives in country have invested heavily in expanding their product lines to launch newer and more innovative dairy products. There has been a growing trend among dairy firms towards production of high-value added functional foods like low fat, high calcium and protein milk, and biomedical foods like colostrums-based health supplements and products made from organic milk.

The New Zealand dairy industry has undergone a wave of mergers. In 1935 there were over 400 cooperatives whereas, in 1960/61 there were 180 (Dobson, 1990) and by 2001 only two large and two small cooperatives remained. The large ones, The New Zealand Dairy Group (NZDG) and Kiwi, merged in 2001 to form Fonterra, while Tatua and Westland remained independent.

Fast facts

- The dairy production has increased by 77 per cent during the past 20 years in New Zealand.
- New Zealand produces approximately 3 per cent of total world production of milk.
- New Zealand dairy farms produced 21.8 billion milk and 1882 billion kg milk solids in 2014.
- The dairy sector directly accounts for 7 per cent of GDP
- New Zealand dairy farms processed 20.7 billion litres of milk in 2014.
- New Zealand's cow population is rapidly growing, at a rate faster than the country's population.
- Approximately 95 per cent of all New Zealand dairy production is exported.
- Main dairy exports are concentrated milk, butter, cheese, whey and milk products and not-concentrated milk.
- 42 per cent revenue came from whole milk powder 16 per cent from butter 14 per cent from skim milk powder 12 per cent from cheese 12 per cent from casein, protein products and albumins rest of 4 per cent from other dairy products.
- Dairy exports were NZ$13.7billion in calendar year 2014, accounting for around 25 per cent of NZ's total goods exports and 35 per cent of the world trade in dairy products.
- Major dairy export markets are China, the US, Japan, the European Union, Malaysia, Australia, Philippines, Taiwan, Singapore, Belgium, Algeria and Saudi Arabia.
- Dairy breeds for New Zealand are Holstein-Friesian/Jersey crossbreed 40.8per cent followed closely by Holstein-Friesian38.2 per cent, Jersey 12.1 per cent, Ayrshire 0.7per cent, Others 8.1per cent.
- The average herd size in New Zealand is 413 in the year 2014.

NZ DAIRY INDUSTRY AND ITS INNOVATION

A number of innovations resulted from the activities of New Zealand's dairy

industry. Examples of these efforts include:

- Refrigerated sea transport, electrification, and scientific herd quality management techniques
- Formation of partnership between Fonterra's Anlene bone nutrition group and a leading healthcare company, GE Healthcare, to work on bone health issues using Anlene products and GE's bone mineral density technology.
- Achieving a world-first by breeding cows that produce low-fat milk that is also high in omega3 oils and polyunsaturated fat. The cows were bred from a single female discovered by researchers to have a particular genetic mutation during a routine milk screening programme.
- Dairy Goat Co-operative (New Zealand) Ltd developed the world's first commercialized infant formula from goat milk and the world's first long-life goat milk, and continues to develop and make a range of premium specialty formulations based on goat milk.
- A long-term collaboration between Fonterra's ingredients business and Industrial Research Ltd has led to the world's first processing plant to produce complex lipids from milk. In a purified form, these lipids can be worth thousands of dollars a kilogram. They have a variety of applications in nutritional and cosmetic applications.

On the other hand, organic production in New Zealand is expected to be worth more than $130 million within five years. In 2000, Fonterra had just seven farms supplying organic milk. Fonterra produces more than 25 organic dairy ingredients, including a range of cheese, butter, fluids, proteins, blends and milk powders. Numerous smaller companies produce organic cheeses, milk powders and niche dairy products.

ROSIE'S WORLD (<u>Interesting feature of NZ Dairy)</u>

Rosie™ is DairyNZ's 'Cowbassador'. DairyNZ's aim is for her to become the face of New Zealand's 4.4 milllion dairy cows, and to help promote dairy farming to those of the 4.4 million New Zealanders who are not familiar with it. Rosie was officially launched at the 2011 National Agricultural Fieldays at Mystery Creek. She was a huge hit with everyone from children to their grandparents.

Plate 1. Rosie

Rosie is a Friesian-Jersey cross who leaves her farm to discover what makes the New Zealand industry one of the best in the world. Rosie has been created for Dairy NZ by King St Advertising and Flux Animation. At the Fieldays she was accompanied by members of her VIB (Very Important Bovine) protection squad. Along with her own website, children of all ages can follow Rosie on her very own Facebook and

YouTube pages. Rosie also has been appearing throughout 2011 in the children's educational newspaper, Go Zone, for years 3 and 4, that is distributed via schools. Rosie is also a feature on a new primary school education website: www.GoDairy.co.nz/education. It contains curriculum-related teaching units, digital texts, and digital learning objects, all of which use dairying as a context for learning.

ZERO GOVERNMENT SUBSIDIES

The New Zealand's economy is heavily dependent on the dairy industry in terms of both output and employment, but the NZ government does not provide subsidies for the dairy sector at all. In 1984 New Zealand's Labour government took the dramatic step of ending all farm subsidies, which then consisted of 30 separate production payments and export incentives. Prior to the reform, subsidies in New Zealand accounted for more than 30 per cent of the value of production and New Zealand farming was also marred by issues including overproduction, environmental degradation and inflated land prices. Yet the subsidy elimination in New Zealand was swift and sure. New Zealand's government simply offered one-time "exit grants" to those who wanted to leave farming when subsidies ended. This plan was initially met with protest marches on parliament and organized resistance by farmers, and the government predicted that 10 per cent of all the country's farms would go out of business.Forced to adjust to new economic realities, New Zealand farmers cut costs, diversified their land use, sought non-farm income opportunities and altered production as per market signals.

SWOT Analysis of NZ Dairy Industry

Strengths	**Weakness**
Integrated and co-ordinated structure	Dependent on the world market
Ability to produce milk at a low cost	Dependent on foreign exchange rates
Low costs for feeding, housing, machinery	Dependent on weather & pasture
High output of MS per labour unit	Heavy workload for labour units at times of year
Seasonal system	Inefficiencies in use of processing factories
Long distance from other cow populations	Short lactations, low yields (kg MS/cow)
Share milking options	Extremely high price of dairy land
	Distance from most markets and costs of freight

Opportunities	**Challenges**
Rising middle class in Asia	Changing market volatile commodity prices
Dairy demand continues to grow	Public perception ruralurban connection
US and EU dairy industries are changing	Enhance image e.g. sustainability
Large brands need milk as a base	Making dairying a preferred occupation
Little Government involvement in NZ dairying	Erosion of NZ's low cost base
A bright future	Imperatives for lifting productivity remain
	Still capital constrained

COMPARISON BETWEEN INDIAN AND NEW ZEALAND DAIRY INDUSTRY

The New Zealand dairy industry is held in very high regard in India. The Indian co-operative approach was derived from a visit to New Zealand by the father of the Indian dairy industry, Dr. Kurien. The market in dairy in New Zealand is very well organized, as compared to the unorganized, informal dairy markets in India. About 96 per cent of the milk production in New Zealand is handled by the cooperatives and the rest 4 per cent by small private entrepreneurs that look at production of very specific niche varieties of dairy products especially cheese and yogurt. Mergers and acquisitions have been common in dairy industry in New Zealand, primarily to obtain economies of scale. In the past 20 years, there has been a large reduction in the number of independent dairy cooperatives – from 36 in 1983 to only 3 large cooperatives in 2001. The largest dairy cooperative Fonterra was formed in 2001 following industry reform and legislative change to unite the once-fragmented dairy industry in New Zealand. This was done to provide the critical mass and efficiencies needed for competing in the global economy. The entire population of dairy farmers in New Zealand (around 14000) is vertically integrated with either the cooperative or the private dairy firms.

The picture in India is much different than what exists in New Zealand. Given the sheer number of dairy farmers in India, it is not possible for any dairy cooperative or private firm to vertically integrate with all of them. Also, the in absence of the necessary financial wherewithal and other support services, most dairy firms in India have struggled to attain large volumes and scale economies. The Indian dairy market as a result has remained cluttered with large number of unorganized players with sub-optimal capacities, thereby putting considerable constraint on value addition.

The MMPO (1992) had also put barriers to installing capacity or mergers and acquisitions in dairy industry, thus affecting the scale-economies of dairy units in the country. However, with the amendment in the MMPO in 1999, such restrictions on capacity or mergers and acquisitions have been removed, which is a positive step in the consolidation of dairy units in the country. New Zealand exports over $NZ5.7 billion worth of dairy products each year. Fonterra, the largest dairy company in New Zealand, represents more than 20 per cent of total New Zealand's exports and 7 per cent of the country's GDP. The major export markets for New Zealand are USA, UK, Japan, Singapore, Taiwan, Hong Kong and Belgium. It is important to note that not only New Zealand exports value-added dairy products, but also to nations which have high quality and SPS standards. Around 36 per cent of New Zealand's dairy exports are high value added, and there is an increasing trend on the same.

India, on the other hand, finds it difficult to export its dairy products to the affluent nations of the West primarily on account of lack of adequate exportable surplus, and also its inability to meet the stringent quality norms of the importing nations. Thus, much of Indian dairy exports

are confined to the Gulf and the SAARC nations, where quality norms are not very stringent.

Cluster development has been the approach for dairy development in New Zealand. North Island accounts for 85 per cent of dairy production in New Zealand. Within North Island, clusters for dairy have been developed in South Auckland region. Clusters have also been developed in Otago and Southland focusing on specialized areas like producing sheep milk for cheese plants, milk products for biotech applications and a dairy education and innovation centre at Manawatu.

Invention and innovation are the major drivers of growth in New Zealand's dairy industry, both in domestic and export markets. For instance, a break-through project by Fonterra with researchers at Massey University's Riddet Centre aims to pioneer a novel food delivery system called POSIFoods or "point-of-sale individualized foods". Such fast, nutritious snacks, tailored to individual's dietary needs and taste preferences, all at the touch of a button, are going to be the convenience foods of the future. The only way in which any dairy unit could hope to compete is to invest in R&D and innovation, and come out with more customer-centric offerings.

LESSONS DRAWN

Despite there being a world of difference between the nature of dairy industry in India and New Zealand, there are a few lessons that Indian dairy firms, as well as the government, can learn from their counterparts in New Zealand. First of all, vertical integration is important for maintaining efficiency in the procurement supply chain, and this is best demonstrated by the cooperatives. Vertical integration also helps in reducing wastage, ensuring quality standards and attaining scale economies in dairy processing. Development of cooperatives has to be promoted, and reckless government intervention in management of cooperatives should be checked.

Secondly, consolidation of dairy units is important to help these dairy plants attain economies of scale, reduce costs and become competitive. In this respect, cluster development can be looked at as an alternative for development of dairy processing in India. By cluster development, all dairy units shall be able to consolidate their procurement base and production structure, share the infrastructure costs among themselves (for instance power, cold storage, refrigerated rail transport *etc*.), and add value to the produce at lower costs. This shall put them in a position to compete with the informal players in the price sensitive market by offering higher quality at affordable prices.

Thirdly, innovation and invention is the crux for surviving and competing in the market place. A tie-up of dairy units with research institutions can give a fillip to market-oriented R&D, which is essential in today's competitive market place.

CONCLUSIONS

Even though the NZ dairy industry is just over a century old, but the lessons that any organization or country could learnt are vast starting from methods of rearing, management to processing and marketing in short from farm to fork. The main emphasis laid by the industry co-operation

and vertical integration not only gives it the power to bargain in the market but to maintain hygiene and standards as per requirement indirectly helping it to establish its brand worldwide. Co-operation and integration helped the NZ dairy industry to reach economies of scale both in production and processing and it is at comparative advantage to other countries in dairy farming. This is coupled with the benefits obtained by emphasizing on Zero subsidy farming which not only make the farming communities to strive for efficiency and optimum production but also indirectly helps in reduction of the environmental hazards of livestock rearing thus helps the industry moves toward sustainability.

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Focusing Biotic Stress in Livestock

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Biotic stress are the stress caused by direct and indirect effects of other living organisms such as fungi, bacteria, viruses, nematodes, insects, mites, animals or any biotic factor. A biotic factor is any living component that affects the population of another organism, or the environment. Biotic factors also include human influence, pathogens and disease outbreaks. In the animal sector, biotic stresses emerging out of parasitism and commensalism between microorganisms and higher facultative/obligatory organisms have taken toll in the productivity of commodities in the organized sectors for commercial exploitation. Biotic stresses that emanated from intensive animal husbandry practices were primarily due to anomalous use of cross bred cattle which are less resilient to diseases and tropical climate of India compared to our native *Zebu* breeds. The loss in production of milk, meat and other animal products due to various biotic stresses could be to the tune of 35-46% worth about 1000 K Indian Rupee per annum. Global population is estimated to reach 7 billion by 2025 and 10 billion by 2050 also the climate change scenario will make environment much more hostile for animal productivity than what is experienced today. The demand for nutrition and food of animal origin to human population in the country is expected to rise. In order to keep animal production in pace with increasing demand, at the same time dealing with biotic stress, for sustainable animal husbandry from dwindling resources, needs a well orchestrated biotic stress management strategy.

Cause of Biotic Stress

Diseases causing pathogens are the commonest causes of biotic stress. These microorganisms are divided into four Risk Groups (Advisory Committee on Dangerous Pathogens, 1995) representing increasing risks to human and animal health. Group 1 have organisms that are unlikely to cause human or animal disease and are disease-producing organisms in animals that are enzootic but not subject to official control. Group 2 have organisms that may cause human or animal disease but are unlikely to be spread in the community or animal population and for which effective prophylaxis and treatment are available. Group 3 have organisms that can cause

severe human or animal disease and may spread in the community and/or animal population but for which there is usually effective prophylaxis and treatment. Organisms that cause severe human or animal disease may represent a high risk of spread in the community or animal population and for which there is usually no effective prophylaxis or treatment. Evidences also suggest that the climate change will expand the host range of these pathogenic microorganisms, with increased chances of virulent strain development. Therefore, research in biotic stress-tolerance in animals has to be geared up in preparedness for climate change, which is likely to increase the incidence of zoonotic diseases. Assessment of risks caused by an organism and finding out the epidemiological background of the organism, it's infectivity for humans and animals, stability in the environment, ability to infect by different routes of exposure, and susceptibility to specific treatments or prophylaxis, needs to be well documented.

Need for Biotic Stress Management

Biotic stress causing losses due to mortality and morbidity have a major impact on the profitability of the livestock operation. Infections – regardless of their severity – will exercise a tax on the nutritional status and reduce nutrients available for productive functions. Recent stimulating papers, show that biotic stress can trigger a transgenerational epigenetic response in plants, where DNA methylation seems to play a central role and this could very well happen in animals too. The evidence that the immune system have critical implication in the major physiological events in the animals life, especially at high levels of production, could be well exploited to significantly decrease, biotic stress by improved management and nutrition. Feed additives like direct fed microbials, yeast cell wall components, can effectively stimulate the GIT immune modifying the microbial population, ulvans (polysaccharides from green algae), carrageenans and agar (polysaccharides from red algae), exert immunomodulating properties by activating expression of some cytokines and chemokines involved in innate and adaptative immune response. Also feed containing herbs of medicinal importance boosts immune system to positively affect the overall growth and resistance to biotic stress in animals.

The emerging issues on biosafety and biosecurity in animal husbandry, particularly in the light of emerging and re-emerging new diseases as well as possible introduction of exotic organisms to a region could bear economic burden on Indian agriculture. Animal diseases that enter through world-trade corridors as well as through porous/vulnerable land-locked borders have been threatful to the agricultural biosecurity of the country. Biosafety is connoted for various contexts of hazard-perception on animal biodiversity, risks on environment, animal and human health. So the risk assessment of agro-chemicals, Living modified organisms (LMOs) and other technological products and scientific tools should me mandatory.

Measures to be Taken

Futuristic research in the management on emerging new pathogens could address certain aspects of agricultural biosecurity of the country. Certain biological agents like bacteria, virus, fungi, parasites etc, which can be cause of biotic stress can enter environment when conducting laboratory animal experiment. Biosafety programs reduce or eliminate exposure of individuals and the environment to potentially hazardous biological agents. Biosafety can be achieved by implementing various degrees of laboratory control and containment, through laboratory design and access restrictions, personnel expertise and training, use of containment equipment, and safe methods of managing infectious materials in a laboratory setting. In the animal industry, the term biosecurity relates to the protection of an animal colony from microbial contamination. They should based upon risk assessment and management methodology; personnel expertise and responsibility; control and accountability for research materials including microorganisms and culture stocks; access control elements; material transfer documentation; training; emergency planning; and program management.

Indian agriculture is spread across more than fourteen agro-climatic regions and under each there are several sub-regions that have typical weather patterns and edaphic factors that influence the biotic factors causing stress. For examples, certain areas are endemic for some nematodes and cestodes infesting ruminants, fly vectors for parasites and viruses, ticks, mites and mosquitoes etc, as a carrier for some pathogens. In fact, these arthropod vectors are themselves a cause of biotic stress to livestock as their biting causes discomfort to animals. Therefore, biotic stress management strategies should be area centric, keeping in view the agro-climatic conditions of the particular region.

It is a fact that still farmers from remote parts of the country are unable to use various modern tools to manage biotic stress in their animals, which creates more pressure to sustainability of resource poor, less knowledgeable farmers. Farmers need to be trained in all possible manners to save his livestock from diseases due to biotic factors. Accessibility of tools and products of animal health management should be increased.

CONCLUSION

Commercial animal husbandry has to sustain the biotic stress factors to offer profitability. Scientific tools and techniques would ease the biotic stress endured by livestock and shall provide better initiatives amongst entrepreneurial initiative to continue with productive animal husbandry practice. Ventures and investments in animal farming shall shoot up if mitigation of biotic stresses is contained and reduce the loss of animal products to acceptable levels. Funding and management of research in the areas of managing biotic stresses in animal husbandry is mandatory to enhance sustainable and responsible animal production based on the animal's well-being as a primary consideration.