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Nutritional value &

Health benefits of nuts

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Canine Pyometra

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Definition

Canine pyometra is the accumulation of purulent secretions in the uterine lumen of sexually intact bitches, with an open (open pyometra) or closed cervix (closed pyometra). Pyometra is recognized as one of the main causes of disease and death in the bitch, and Escherichia coli is the major pathogen associated with this disease (Agostinho *et al.,* 2014). Nulliparous bitches and bitches of more than 4 years of age seem to be predisposed (Chastain *et al*., 1999).

In the initial phase of the disease process the stimulation of the uterus by endogenous or exogenous gestagens over an extended period seems to play an important role. A canine uterus under the influence of progesterone is susceptible to bacterial infections, as progesterone stimulates the growth of the endometrial glands and their secretory activity, along with cervical closure and the suppression of myometrial contractions (Cox, 1970). In addition, gestagens have an inhibitory effect on the leucocytes in the uterus, adding support to a bacterial infection (Sugiura *et al.,* 2004). As progesterone is already the dominant hormone during the oestrusphase when the cervix is still open, there is at this time an increased risk for an ascending bacterial infection. Escherichia coli is the bacteria which is most often isolated, in up to 90% of cases. Certain serotypes are more often isolated and this is presumably correlated with the presence of certain virulence factors. One possible virulence factor is CNF (cytotoxic necrotizing factor), as the production of CNF is associated with extensive endothelial damage and enhanced inflammatory reactions. Bacteriological genotype examinations indicate that pyometra is most likely caused by E. coli originating from the normal flora of the affected bitch.

Predisposing Factors:

1. Age
   - Middle-aged or old bitches (> 4 years)
   - 8.2 years
   - 2.4 years
2. Parity - nulliparous, intact bitches
3. Prolonged diestrus

Clinical signs

1. **Open-cervix –** Vomiting, Polyuria or polydipsia, Vaginal discharge with slightly elevated or normal temperature
2. **Close-cervix -** Vomiting, Polyuria or polydipsia, absence of Vaginal

discharge, elevated/ sub-normal (toxemic bitch)

Diagnosis

Most bitches affected with pyometra are presented during the luteal phase of the cycle. Predominant clinical signs are purulent vaginal discharge in case of open pyometra and polyuria / polydipsia. Bitches suffering from a closed pyometra are often presented at a later stage of the disease, when endotoxins absorbed from the uterine lumen have already resulted in a generalised illness. Pyometra can be diagnosed by:

1. **Radiography** - tubular structures of fluid density/ opacity in caudal abdomen.
2. **Ultrasonography** -
   (i) Uterine wall - increased thickness
   (ii) Uterine lumen - anechoic fluid with small echogenic particles
3. **Clinical pathology:** **Leukocytosis,** Neutrophilia (degenerative left shift), Anemia with Hyperglobulinemia and Hypoalbuminemia

The preferred methods in establishing the diagnosis are ultrasonography and radiology.

TREATMENT OF OPEN-CERVIX PYOMETRA

1. Surgical - Ovariohysterectomy (OH) is **treatment of choice**

2. Transcervical Endoscopic Catheterisation (TECT)

3. Treatment with PGF2alpha - PGF_{2a} is the one which is most indicated for the clinical treatment of pyometra. Prostaglandin-based drugs which have been tested in the canine and for which safe dosages have been developed include:

(i) Natural PGF_{2a} (Dinoprost) - 0.02 mg/kg b.wt administered S/C b.i.d for 7-10 days

(ii) Synthetic PGF_{2a} (Cloprostenol and Alfaprostol) - 1–2 µg/kg b.wt administered S/C for 7-10 days

In order for a pus-filled uterus to be emptied prostaglandin administration should be continued as long as a vulvar discharge is present. Large amounts of pus may require up to 2-3 weeks of treatment. Length of prostaglandin treatment should be based on careful evaluation of uterine dimensions before, during and after therapy in order to confirm that uterine diameter has gone back to normal. Antibiotic treatment should be specific (start with ampicillin at 22 mg/kg 3 times/daily and change antibiotics after culture results) and should last at least for one week but it should continue for as long as a purulent vulvar discharge is present (which may persist for a few days after the uterine diameter has become normal again).

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Beneficial Effects of Probiotic Foods

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The role of probiotics in human nutrition has been increasingly recognized together with the growing public awareness of certain health benefits of fermented dairy products. Today, a broad variety of fermented and non-fermented dairy products containing micro-organisms with probiotic function are available on the market. Historically, fermented milks have been regarded as valuable and sensorically attractive foods, which positively influence the intestinal microbial balance of humans. Besides this long-term experience with this kind of traditional foods, numerous reports dealing with more or less proven evidence for certain prophylactic and therapeutic claims of probiotics have appeared in the last ten years and this has led to extensive discussions among experts from different disciplines. Several benefits are possible from probiotic cultures, including control of intestinal infections, control of serum cholesterol levels, beneficial influences on the immune system, improvement of lactose utilization in person who are classified as lactose maldigestors, and anticarcinogenic action.

Beneficial Effects of Probiotics:

i) Decreasing the pH by production of lactic acid, which suppress the putrefactive and other undesirable bacteria in the intestines.
ii) Production of specific antimicrobial substances, which prevent the entero-pathogens and other pathogens from causing diseases.
iii) Consumption of nutrients available to undesirable bacteria.
iv) Decreasing the redox potential and production of hydrogen peroxide (under aerobic condition).
v) Stimulating the immune system, thus contributing to a greater resistance to infections.
vi) Resisting colonization of undesirable micro-organisms in the intestines, urogenital tract, respiratory tract.
vii) Inhibition of carcinogenesis.
viii) Decreasing the levels of blood cholesterol.
ix) Increasing calcium absorption and hence inhibiting decalcification of bones.

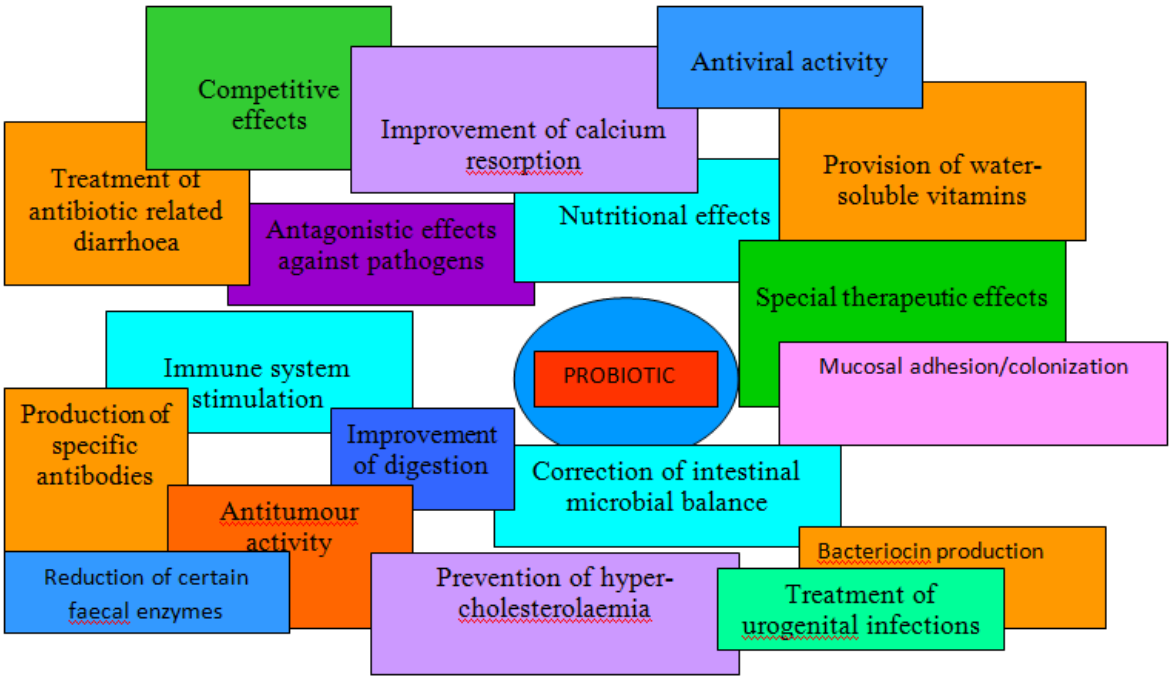

Figure 1: Beneficial Effects Attributed to Probiotics

x) Decreasing lactose intolerance to lactose deficient individuals.

xi) Synthesis of vitamins such as riboflavin, niacin, B_6, B_{12}, folic acid etc.

Most Important Characteristics of Probiotics:

a) Survival, proliferation and/or colonization on the location where it must be active.

b) No pathogenic, toxic, allergic, mutagenic or carcinogenic reactions.

c) No immune reactions against probiotic strains.

d) Genetically stable.

e) Easy and reproducible production.

f) Viable during processing and storage.

g) The cultures not only must be selected for their ability to produce desired organoleptic properties in the cultured product but factors related to their potential health or nutritional benefits must also be considered.

h) They must be selected for their ability to provide the targeted benefit for the consumer.

Quality Parameters and Selection of Probiotics Bacteria:

Probiotic bacteria have to fulfill several requirements because of safety reasons and order to ensure the desired effects. Most of the commercially used strains are the result of extensive systematic isolation and screening experiments. In general, probiotic bacteria have to meet six main criteria before they can be commonly applied.

i) They have to originate from the intestine of healthy humans.

ii) They should have a clear identity based on up-to-date differentiation and on molecular-biological methodology.

iii) They have to be '*generally regarded as safe*' and should have proven apathogeneity, atoxicity and defined antibiogramme pattern.

iv) They have to constitute a high resistance against gastric juice, bile acids and digestion enzymes to facilitate their passage to the desired segments of the intestine.
v) They should exert defined beneficial effects to the humans, which enable a clear distinction from *'conventional'* starter cultures.
vi) They have to meet several requirements, which are necessary for a convenient, large-scale industrial production of foods.

Organisms Used as Probiotic in the Food and Agricultural Industry:

Organisms	Comment
Lactobacillus acidophilus	As a supplement in fermented dairy products; numerous health claim.
L. plantarum	In dairy products, pickled vegetables and silage.
L. casei subsp. *rhamnosus* and *L. brevis*	In dairy products and silage.
L. delbruckii sub sp. *bulgaricus* and *Streptococcus thermophilus*	For production of yoghurt; numerous health claim.
Bifidobacterium bifidum	Components of new dairy products and in preparation for new born; health claim.
Enterococcus faecium	Introduced in certain health products; health claim.
Lactococcus lactis subsp *lactis* and *S. cremoris*	Used in production of curd, butter milk and certain cheeses;
	health claim.
Saccharomyces boulardii	Used for treatment of diarrhoea.

The Probiotics in Human Health:

Probiotics has antagonistic effect towards pathogens. They are useful in the treatment of many types of diarrhea, caused by rotaviruses. They preserve intestinal integrity and mediate effects of inflammatory bowel diseases, irritable bowel syndrome, constipation, colitis and alcoholic lever disease. They improve digestion of lactose, enhance immune response and resistance to infection. Probiotics are also believed to reduce risk of colon cancer, lower serum cholesterol level, treat allergies, synthesize certain nutrients and vitamins and improve their bioavailability.

(a) Microbial ecology of gut:

Colonization of gastrointestinal tract of newborn infants occurs within a few days of birth. The type of delivery, dietary constituents and gestational age influence the colonization pattern. The initial period of bacterial colonization in colon takes place over approximately a two-weeks period. During this period bacterial colonization is similar for formula and breast-fed infants.

(b) Nutritional benefits of probiotics:

The nutritional benefits of probiotics has been most extensively investigated in regard to the fermentation of food products with *Lactobacilli* to study the effect of fermentation on quantity, availability, digestibility and assimilability of nutrients. Alm (1982) reported that, as a result of bacterial proteolysis, yoghurt has higher level of free amino acids as compare to milk. Animal studies revealed

that a number of different fermented products such as acidophilus milk, *Lactobacillus lactis* fermented milk, kefir, yoghurt and cultured butter milk caused increased growth and feed efficiency in several different animal models when compare to unfermented dairy products (Friend and Shahani, 1984). Evidence has been presented indicating the bioavailability of calcium, zinc, iron, manganese, copper and phosphorus are increased in yoghurt when compare to milk (McDonough *et al*., 1983). Studies demonstrated an increase in riboflavin and niacin in yoghurt (Alm, 1982), B_6 in cheddar cheese and B_{12} in cottage cheese (Deeth and Tamine, 1981) and folic acid in a variety of products including yoghurt, bifidus milk and kefir (Shahani *et al*., 1979), riboflavin and thiamine had also been shown to increase during the preparation of *Lactobacillus* fermented products (Rajlakshmi and Vanaji, 1967).

(c) Therapeutic benefits of probiotics:

Probiotics has been reported to be effective in the treatment of a number of disorders including diarrhoea, constipation, colitis, gastric acidity, gastroenterititis, cholera, pathogenic recolonization of gastro intestinal tract, flatulence, hypercholesterolaemia, hepatic encephalopathy, carcinogenesis and increase immunity. Some of them are describe below:

i) Anti-carcinogenesis:

Anticarcinogenic or antimutagenic activities have been reported for several cultures used to manufacture various fermented milk products. Some of these have involved products containing probiotic bacteria expected to survive and grow in the intestinal tract.

ii) Effect of probiotics on colonization resistance:

The indigenous microflora on body surface inhibits the colonization of non-indigenous microflora. In different studies on humans beneficial micro-organisms are used to improve the colonization resistance on body surfaces, such as gastrointestinal, urogenital and respiratory tract.

iii) Treatment of intestinal infections:

For many years these have been claimed that various probiotics can be used to prevent or treat a variety of gastrointestinal disorders. This beneficial effect is due to the ability of probiotics to produce bacteriocins, lowering pH by lactic acid, decreasing redox potential, competition for nutrients with pathogens etc.

iv) Hepatic encephalopathy:

Hepatic encephalopathy is a neurological disorder associated with liver failure in which ammonia produced from urea in the intestines cannot be detoxified in liver, so blood ammonia level is elevated. Treatment with probiotics results in lowering of faecal urease and decreasing in ammonia level in blood.

v)Treatment of hyper-cholesterolaemia:

Elevated plasma cholesterol has been positively associated with a higher rate of coronary heart disease. Now a day a number of drugs are available to lower plasma cholesterol, however, non-pharmaceutical agents that could accomplish this reduction would be preferable. In this context there have been a number of studies were done by using probiotics in different forms and it have been proved that probiotics have cholesterol lowering properties.

vi) The ability of probiotics to increase the tolerance of lactose in lactose-deficient individuals:

Lactose, a milk carbohydrate, causes intestinal distress when consumed by people with a deficiency in the intestinal mucosal enzyme β-galactosidase (lactase). Such individuals must restrict their intake of milk and dairy products. During fermentation *Lactobacilli* produce lactase, which hydrolysed milk lactose to glucose and galactose.

vii) Effect of probiotics on the immune system:

The gastrointestinal tract is an important organ in host defence against potential pathogens and non-viable materials including carcinogens. It is suggested that immuno-competent cells are activated in the gut and transported to other mucosal sites such as respiratory and urogenital tract. Proboitic micro-organisms, or their antigens, can penetrate the epithelial barrier of the intestine, thus stimulating the immuno-competent cells.

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Gravity based sand filter for improving water quality

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The gravity sand filter could be used to improve water quality for human and animals drinking purpose by removing impurities like, pathogenic organisms and toxic chemicals. This system of water purification has been in continuous use since the beginning of nineteenth century and its proved effective under widely different places. It is simple, inexpensive and reliable method for water purification (Huisman and wood, 1974). Sand grains are having particle diameters of 0.0625–2 mm and their composition varies according to the rock strata from which they have been eroded but commonly sand grains are rich in silicates (Hynes, 1970).

Sand filter beds also trap potentially pathogenic micro-organisms from the water. These include various pathogenic bacteria (especially those causing diseases of the human gut), and the Protist Giardia lamblia and Cryptosporidium (Weber-Shirk & Dick, 1997). Viruses are also removed by slow sand filtration, especially in the first 20 cm of sand and viruses appear largely inactivated within the sand matrix (McConnell *et al*., 1984). Different types of sand filters are in vogue but when running water source like canal water is available at an elevated point purification can be hastened by gravity which is effectively used to improve the flow rate and quality of filtering process. Here we will discuss such a modified model of gravity based sand filter for improving water quality.

PURIFICATION EFFECTIN SAND FILTER - PHYSICAL, CHEMICAL AND BIOLOGICAL

Initially pre-filtration is carried with shade net to remove physical impurities in water followed by this water enter into the filter bed. This water reservoir is about 1-1.5 m deep and the average time that the water will remain here varies from few minutes to few hours which depend upon filtration velocity. During day time, under the influence of sunlight growing algae absorbs carbon dioxide, nitrates, phosphates and other nutrients from the water to form cell material and oxygen. The oxygen thus formed dissolves in the water and enter into chemical reaction with organic impurities. These substances were assimilable by the algae. The most important property of the sand bed is

adsorption, a phenomenon resulting from electrical forces and chemical bonding which takes place at every surface at which water comes in contact with a sand grain. During the passage of the water through the bed every particle, bacteria and virus are brought into contact with the surfaces of the sand grains, to which they become attached by mass attraction or through the operation of electrical forces (Huisman and wood, 1974).

ELEMENTS OF SAND FILTERS:

Construction: Three meter pit was made on ground surface. Into the pit, Filter wall was parallelly arranged with twelve reinforced cement concrete (RCC) rings and the size of the RCC ring is 35 and 110cm in height and diameter respectively.

Fig. 1 A cross-sectional diagram of a sand filter

Pre-filtration: It is carried out to remove the physical impurities and large sized particles from the water.

Filter bed: Pre-filtered water is passed into filter bed, the principle function of which is to maintain a constant pressure that carries the water through the filter.

Filter Materials: This portion consist of white sand on initial segment and followed by metal stone, activated charcoal, small rubble and big rubble in subsequent segments (Fig 1).

Size and Quantity of filter materials: In the present model, volume of white sand, metal stone, activated charcoal, small rubble (size: 3 cm) and big rubble (size: 5 cm) were 20, 10, 10, 20, and 20 Kg respectively. These components were added into the filter tank.

Size of the Filter: Height and diameter of the filter assembly is 4.2and 1.10 m respectively. Pre-filter and lowest portion (Big rubble) are having 90 cm in height and remaining each four segments are having 60 cm in height in filter.

Back Washing: Backwashing could be effected by reversing the flow of water forcefully by a motor pump so that it enters from the bottom of the filter bed in four angles, the force of the water is such that it actually lifts the media bed, swirling and tossing the granular medium, then exits through the top of the filter tank (Fig. 2). Each filter material compartments were separated by plastic nets to prevent blending of the contents while backwashing process.

Fig. 2. A Diagram of backwash components of sand filter

APPLICATIONS OF SAND FILTER

- In these filters, regular flushing is not required. So, in water scarcity area it has the additional advantage that the wastage of wash water is minimum. In case of pressure or rapid gravity filters, which needs cleaning every few days, this wastage represents around 2-3 per cent of the total amount of treated water.
- Unskilled man power is sufficient to operate the filter.
- No compressed air and mechanical stirring are needed for the filter.
- High pressure water is needed only for backwashing process.
- Sand filter is an efficient method of removing particulate suspended matter from the water. Also, obviate the bad odour and taste from the water.
- The simple design of sand filter can be made by using locally available materials.
- Design of filter is easier except that special pipework and equipments are required for the backwash.
- No chemical substance is used in this method.

LIMITATIONS OF SAND FILTER

- Severe and sudden changes in quality of water, certain types of toxic industrial wastes, heavy concentrations of colloids will affect the functioning of biological filters.
- Sand filter can only reduce the Virus and Bacteria levels. For complete removal of the virus and bacteria, further treatments are required.
- Certain types of algae may interfere with the working of the filters that results in premature choking which require frequent cleaning. Other types of algae may actually improve the quality of the treated water and the efficiency of the filters by oxygenating the supernatant water during the hours of daylight.

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Application of Remote Sensing in Fruit Production

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Remote Sensing (RS) is the acquirement of information relating to an object or fact without making substantial contact with the object. The basic characteristic of RS is the recognition of radiant energy emitted by a variety of objects. The technology of remote sensing is ground, air or space-based platforms having a capacity of detailed spectral, spatial and temporal information on vegetation health and vigour with estimation crop yield applications. For Acquisition of information for ground, air, space based information various types of sensors is required which includes aerial photographs, airborne multi-spectral scanners, satellite imagery, low and high spatial spectral resolution and ground based spectrometer. There are two types of remote sensing namely active type and passive type. Active type having active sensor like LIDAR, RADAR, Scatteromater, Sounder, and Ranging instruments have own source of light or illumination. Passive type has passive sensors like Accelerometer and Hyperspectral radiometer, which is detected in presence of reflected sunlight. They can be used for a number of application like crop inventory, crop condition, crop production forecasts, crop classification, area estimation, yield prediction, fruit quality measurement, canopy management for detection of the growth and health of fruit crops and abiotic stresses like drought and flood damage assessment, irrigation scheduling and management of variable rate of fertilization. RS provides authentic source of information for monitoring, identifying, mapping, classifying, and planning of natural resources, disasters mitigation and its management. In addition, the technology will also provides information on site specific management and spectral, spatial and temporal- based fruit production to achieve the précised estimation of crop yield.

ADVANTAGES

Remote sensing high throughput technology provides images which are quick and capable to differentiate field crop, horticultural crop like fruit, vegetable, flower and forest tree easily. Multiple applications of satellite imagery allowing monitoring dynamic features of landscape, which detect major land cover changes and measure the rates of change.

Prior acquaintance and supplementary information obtained by RS .Sensor related to soil and plant can be used to design protocols that provide a suitable balance between statistical precision and cost.

Types of remote sensing

In remote sensing sensor generally measure the emitted light from the object, based on its measurement of different source of light it classify into two types passive type and active type. Passive type sensor can only used to detect energy that is naturally available. This can be only possible when sun is illuminating on the earth. In active sensor they are provided with their own source of light for illumination. Some examples of active sensors are a laser fluorosensor and synthetic aperture radar (SAR). Advantages for active sensors over passive sensor include the ability to obtain measurements anytime, regardless of the time of day or season.

Sensor

A device having capability of converting of any physical quantity into a signal which can be read, displayed, stored or used to control some other quantity. It involves sensing and recording of reflected or emitted energy and processing, analyzing and applying that information. Ultrasonic sensors, Optical and Thermal sensors, E-nose sensor/Gas sensor, Fluorescence-based optical sensor, Optical and microwave sensors, NDVI Greeseeker sensor, LIDAR sensor are basically used in fruit production eg. Light Detection and Ranging. Reflectometers can determine moisture content in oil palm fruits, Ultrasonic ranging sensors are used for analyzing apple tree canopies, Optoelectronic sensors for weed detection in wide row crops have been analyzed in terms of accuracy and feasibility, pH soil-based sensors allow measurements of variables in the soil oriented toward crop productivity, Fluorescence-based optical sensor for plant constituent assessment was used to monitor grape maturation by specifically monitoring anthocyanin accumulation, Optical and microwave sensors are suitable for characterizing olive grove canopies. Ultrasonic sensors measure the distance to the target by sending a pulsed ultrasound wave and then measuring the time for the reflection and return of the wave at the speed of sound. These are used for position measurements. Thermal Sensors measures emitted infrared radiations from the surface of the target object. Optical Sensor measure the amount of light reflected from the object. Healthy leaves absorbs red and blue wavelength of visible light and reflects green colour.

Spectral response of plant leaves and crop

As physiological and morphological changes occur in leaf at different stage of maturity which, affect their spectral properties. Interaction of radiation with plant leaves, depends not only on the wavelength but also on a range of physical (leaf thickness, leaf structure, leaf age, leaf water content), structural (tissue density, presence, absence, or distribution of waxes, hairs, or air spaces) and chemical characteristics such as chemical composition (proteins, lipids, starch, cellulose, nitrogen and oils. chlorophyll and water are two primary

visible and infrared absorbing components of plant leaves.

Applications in fruit productions

RS can be used for crop classification and crop area estimation. Based on spectral transmission major physiognomic types, such as forest, woodland, scrub, grassland, mixed vegetation, could be distinguished. Multispectral photography generally used to distinguishing each of these species from one another by the colour patterns exhibited by them. Crop area estimation is one of the major applications of remote sensing. The area under mango plantations that are more than five year old could be estimated easily but not the younger mango plantations due to overlapping spectral signatures. Mulberry has been found to be spectrally similar to many vegetable crops early in the season but later on showed some separation.

RS for canopy measurements

Canopy architecture of fruit crops is an essential factor for precise fertilizer application, irrigation, chemical applications, health assessment as well as fruit yield for tree crops. The amount of "canopy light interception" is a primary means of determining water and irrigation needs. Sensors were used to determine canopy cover in major crops for years, but studies have not included for most horticultural crops. Basically air based sensor platforms is generally used for canopy measurement.

RS for identifying harvest dates

With the global change in the market scenario, the need for reliable information based on harvest dates of fruit crop has gained more importance. By application of remote sensing estimation of harvest date can be easily predictable. Synthetic aperture radar (SAR)/interferometry synthetic aperture radar (InSAR) data set, using training areas selected in the thematic mapper (TM) image generally used for harvest date estimation. Temporal IRS AWiFS data were used to select 76 K optimum dates for its identification of apple orchards. Through RS it is possible to sense fruit dry matter, colour change, firmness which could be a good indicator for harvesting. Spectral transmission is recorded at different stage of maturity. Based on spectral transmission harvest date will be estimated.

RS for crop yield estimation

One of the major applications of remote sensing is yield estimation, but only limited research has been done for yield estimation in fruit crops. With the increased use of harvester-mounted yield monitors, intensive yield data can be collected from a field and RS imagery allows data to be evaluated more accurately. Currently, commercial yield monitors are available in developmental stages for only few crops like citrus, pistachio and tomato crops.

RS for detecting pest and diseases occurrence

RS techniques identifying and managing insect and nematode populations by detecting actual changes in green plant biomass, leaf skeletonising caused by pest damage, changes in plant pigments and identifying areas susceptible to infestation. RS technologies, it is unlikely that methods capable of detecting very low numbers of important arthropod or nematode pests will be developed soon. An airborne multispectral digital imaging

Fruit Crop	Disease	Method /Sensor
Pear	Fire Blight	NIR spectroscopy
Coconut	Root wilt	Multi-spectral and false colour infrared imageries
Avocado	*Phytophthora cinnamomi*	Aerial colour infrared (CIR)
Mango	Anthracnose	NIR model
Orange	*Alternaria citri, Diplodia natalensis* and *Botrytis cinerea*	Multiple Image Resizer (MIR) images
Citrus	citrus canker	Fluorescence spectroscopy
Citrus	Huanglong bing	Visible–NIR spectroscopy

system related crop canopy reflectance and canopy density under various degrees of phylloxera stress has been developed. Active radar systems have been used to monitor the dispersal and migratory flight behaviour of economically important insects, including honeybees, noctuid moths, and grasshoppers.

RS for detecting disease occurrence

Diseases cause major production and economic losses in horticultural industry. RS as tool for early detection of disease can help in taking measures to prevent damage by diseases. Pathogens can induce physiological stresses and physical changes in plants, such as chlorosis or yellowing, necrosis, stunting, abnormal growth, wilting and leaf curling *etc*. Incidentally, these changes can alter the reflectance properties of plants. Citrus foot rot foliage loses their chlorophyll and become chlorotic in contrast to the dark-green foliage of healthy trees. Various spectroscopic and imaging techniques have been studied for the detection of symptomatic and asymptomatic plant diseases. Some of the methods are: fluorescence spectroscopy, fluorescence imaging and NIR spectroscopy for detecting fire blight disease in the asymptomatic pear plants.

RS for nutrient management and irrigation scheduling

Based on the measurement of canopy spread, leaf evapotranspiration rate and leaf nutrient content through various sensors and multispectral imaging systems it is possible to manage an orchard precisely. Real-time canopy sensing before the appropriate dose of fertilizer is dispensed system must be capable of rapid on off transitions so that bare ground is not fertilized. Irrigation is used to schedule mainly based on the estimation of ET. Common sensors in use are thermocouple sensor or infrared thermometer. Principle- plants go into water stress; their stomata begin to close and stop to transpire, causing the plant to "heat up" and the canopy temperature to rise.Plant canopy air temperature is an indicator of plant water stress and an irrigation scheduling can be based on

plant as an indicator of water stress. A Low Cost Plant Leaf Temperature Sensor Based irrigation schedulung system has been developed for kinnow mandarin. The system used 8 % less water per month per plant compared to the conventional drip irrigation system.

Parameters	Plants Irrigated using developed automated sensor system	Plants Irrigated using Conventional Drip System
LAI	**1.55**	**1.57**
Canopy Diameter (cm)	**160**	**162**
Water applied (m3/ha/month)	**51.2**	**55.6**
Yield (t/ha)	**8.5**	**7.2**

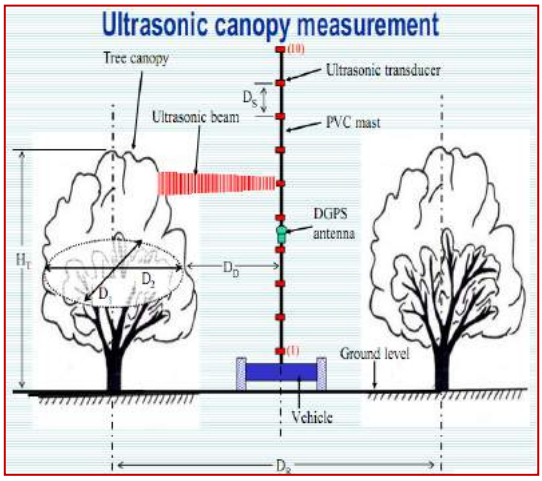
CONCLUSION

Improper land management practices had leads to decline in land quality and horticultural crop yields. An array of factors, including climate, soil properties and nutrients, water content, disease, insects and crop variety are responsible for variability in crop yields. These factors can be measured using diverse types of sensors and instruments such as field-based electronic sensors, spectral radiometers, machine vision, airborne multispectral and hyper spectral RS. RS is advancing rapidly and showed prospective for applications in crop biomass detection, soil properties and nutrient content, crop yield estimation *etc*. RS provides authentic source of information for identifying, classifying, mapping, monitoring, and planning of natural resources and disasters. It can provide data required for site specific management, precision horticulture, market planning and export.

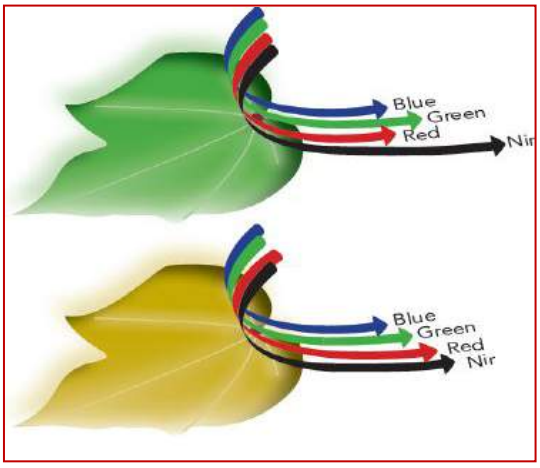
FUTURE PROSPECTS

Only a limited number of sensors are currently available for fruit crop production (Biosensors and Nano technology based Sensors). There is a need for developing an easy-to-use and low cost commercial VRT unit so that the growers could adopt them without too many difficulties. New sensor based technique to detect pest infestation in fruit crops, is needed. Overall, more reliable, accurate, and less expensive sensing systems in different aspects of crop production will be needed for better and efficient site-specific crop management.

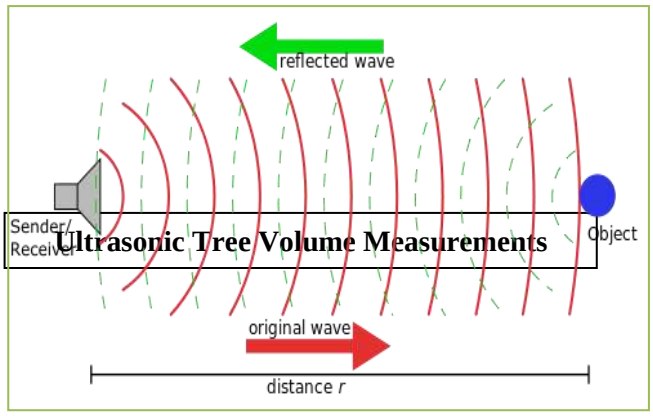
Ultrasonic Tree Volume Measurements



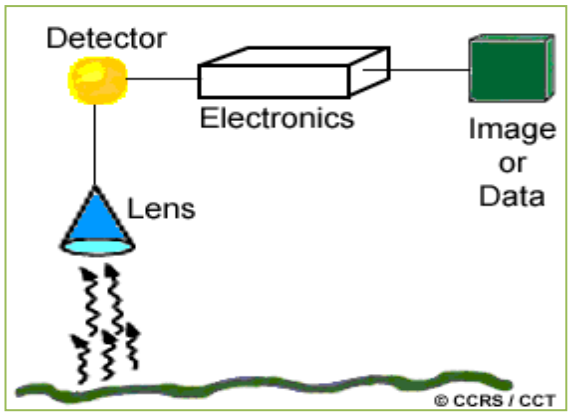
Normalized Difference Vegetation Index

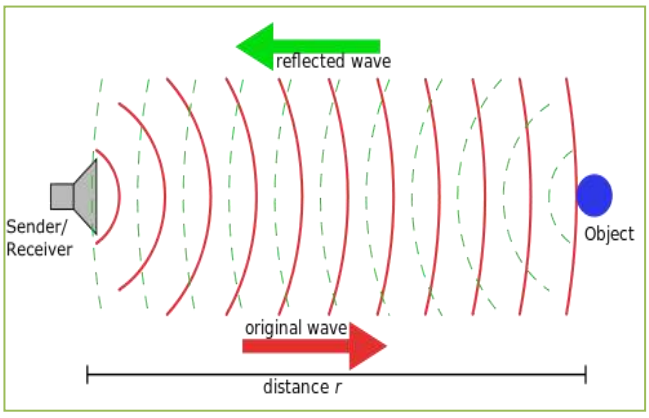


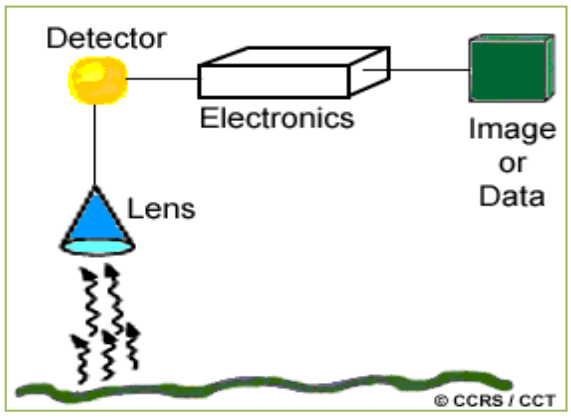
Ultrasonic Sensing



Thermal Sensing







Agricultural Land Utilisation in India

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Abstract
India holds the second largest agricultural land in the world. Agricultural land in India is about 157.35 million hectares which is next to the United States. Around 60.3 per cent of land area is agricultural land in India. But agricultural land holding is declining day by day because of many factors. So this study analyses the agricultural land use in India. The per cent (straight-line) growth rate method was used in this study. The results reveal that cropping intensity was increased over the decades in healthy manner. Net area sown, total cropped area and cultivated land were having positive annual percentage growth rates except few years. Agricultural cultivable land had more number of negative annual percentage growth rates. Area sown more than once had all positive annual percentage growth rates. The positive annual percentage growth rate implies that the growth rates are in increasing direction when they have increasing land uses and vice-versa. Advanced technological changes have brought high yielding, cost minimising and profit maximising output level which increases the cropping intensity. At the same time, agricultural lands are also shrinking day by day because of increase in population, bifurcation of agricultural lands, real estates, rainfall deficiency, financial, production and marketing problems etc. So Government has to make decisions to solve these types of problems.

Key words: Agricultural land use, cropping intensity, cultivable land

INTRODUCTION

India holds the second largest agricultural land in the world. As per India Brand Equity Foundation (IBEF), the Ministry of Commerce and Industry, agricultural land in India is about 157.35 million hectares which is next to the United States. Around 60.3 per cent of land area is agricultural land in India (World Bank Data). The workforce involved in agriculture and allied sector in India is about 50 per cent in total work force. India is the second largest country in farm output in the world. India is the seventh largest agricultural exporter in the world and the sixth largest net exporter. But the economic contribution of agriculture to India's GDP is gradually declining since Independence. Agriculture and allied sectors in India accounted for 17.4 per cent only of the GDP (gross domestic product) in the year of 2015-16 which is next to Manufacturing and Service sector (GoI, 2016). Agricultural land holding is also declining day by day because of many factors. Some of those are increase in population, bifurcation of agricultural lands, real estates, rainfall deficiency, financial, production and marketing problems etc. So there is a need to study about agricultural land use in India.

ANALYTICAL TOOLS

Per cent (Straight-Line) Growth Rate:
The annual percentage growth rate:
It is the per cent growth rate divided by N, the number of years. Here 10 years time period is used.
Where,

Growth rate in per cent = (Ending Value - Beginning Value) x 100 / Beginning Value

RESULTS

Table 1 gives the land use classification in India over the decades from 1950-51 to 2010-11. This table implies that cropping intensity had increased over the years from 111.1 to 141.0 per cent in the year from 1950-51 to 2010-11. As per PhilFSIS, "Cropping intensity is the number of times a crop is planted per year in a given agricultural area. It is the ratio of effective crop area harvested to the physical area."

Table 1 also shows that agricultural cultivable lands were showing declining trend over the decades. From 1950-51 to 1960-61, it had reduced tremendously and next three decades it had increased slightly and last two decades once again it had reduced. Cultivated land was also increasing trend till 1990-91, and thereafter it had reduced. Net area sown had increased over the decade since 1950-51. It had reached highest in 1990-91 and started to decline but not much. Total cropped area had increased over the decades except 2000-01 where it had reduced little bit. Area sown more than once had increased over the decades in larger manner mainly because of advanced technological changes in agriculture.

Table 2 gives the annual percentage growth rate from 1950-51 to 2010-11. This table states that Net Area Sown has negative in period of 1980-81 and 2000-01 which are -0.04 and -0.11, respectively. This implies that in these two decades Net Area Sown was decreased as compared to their previous decades. In this way, those values having positive annual percentage growth rate implies that they are in increasing direction as compared to their previous decades. Net sown area of 1.22 per cent in the year 1960-61 represents that Net sown area grew 12.2 per cent between 1950-51 and 1960-61 or at a rate of 1.22 per cent annually. In the year 1980-91, this was -0.04 per cent which implies that

Net sown area decreased 0.4 per cent between 1970-71 and 1980-91 or at a rate of 0.04 per cent annually.

Total cropped area of 1.58 per cent in the year 1960-61 represents that Total cropped area grew 15.8 per cent between 1950-51 and 1960-61 or at a rate of 1.58 per cent annually. In the year 2000-01, this was -0.02 per cent which implies that Total cropped area decreased 0.2 per cent between 1990-91 and 2000-01 or at a rate of 0.02 per cent annually. Area sown more than once have all positive annual percentage growth rates show that they are in increasing direction as compared to their previous decades but in different manner.

The table also states that agricultural cultivable land have negative annual percentage growth rates in period of 1960-61, 2000-01 and 2010-11 which are -0.52, -0.09 and -0.08, respectively. This shows that agricultural cultivable land declined 5.2 per cent between 1950-51 and 1960-61 or at a rate of 0.52 per

cent annually. Cultivated land has negative annual percentage growth rates in period of 2000-01 and 2010-11 which are -0.04 and -0.02, respectively. This implies that in these two decades cultivated land was decreased as compared to their previous decades.

The table shows that agricultural cultivable land has more number of negative annual percentage growth rates which implies that agricultural land areas were decreasing over the decades for more times.

CONCLUSION

Cropping intensity was increased over the decades in healthy manner. Net area sown (except 1980-81 and 2000-01), total cropped area (except 2000-01) and cultivated land (except 2000-01 and 2010-11) were having positive annual percentage growth rates when we compare between 1950-51 and 2010-11. At the same time period agricultural cultivable land had more number of negative annual percentage growth rates (1960-61, 2000-01 and 2010-11). Area sown more than once had all positive annual percentage growth rates. The positive annual percentage growth rate implies that the growth rates are in increasing direction when they have increasing land uses and vice-versa. Advanced technological changes have brought high yielding, cost minimising and profit maximising output level which increases the cropping intensity. At the same time, agricultural lands are also shrinking day by day because of increase in population, bifurcation of agricultural lands, real estates, rainfall deficiency, financial, production and marketing problems etc. So Government has to make decisions to solve these types of problems.

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Table 1. Land Use Classification in India (10 years time period) (1950-1951to 2010-2011) (In '000 Hectare)

Year	Net Area Sown	Total Cropped Area	Area Sown More than Once	Agri. Land/ Cultivable Land/ Culturable Land/ Arable Land	Cultivated Land	Cropping Intensity
1950-51	118746	131893	13147	189641	129425	111.1
1960-61	133199	152772	19573	179689	144838	114.7
1970-71	140863	165791	24928	182056	151461	117.7
1980-81	140288	172630	32342	185156	155114	123.1
1990-91	142870	185742	42872	185187	156710	130.0
2000-01	141336	185340	44005	183455	156113	131.1
2010-11	141579	198969	57390	182032	155847	141.0

(Source: www.indiastat.com)

Per cent (Straight-Line) Growth Rate:

Table 2. The annual percentage growth rate (in per cent)

Year	Net Area Sown	Total Cropped Area	Area Sown More than Once	Agri. Land/ Cultivable Land/Culturable Land/Arable Land	Cultivated Land
1950-51	-	-	-	-	-
1960-61	1.22	1.58	4.89	-0.52	1.19
1970-71	0.58	0.85	2.74	0.13	0.46
1980-81	-0.04	0.41	2.97	0.17	0.24
1990-91	0.18	0.76	3.26	0.0017	0.10
2000-01	-0.11	-0.02	0.26	-0.09	-0.04
2010-11	0.02	0.74	3.05	-0.08	-0.02

(Source: Author's computation)

Geographical Indications to Enhance Market Potential

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Since liberalisation, the efforts to polarize the consumers across globe towards their products became an activity of high priority for individual countries. The perception of consumers towards a produce get influenced by composite factors like the area of origin, quality, the trust on the producers etc. A category of consumers are ready to purchase such speciality products having distinct characteristics by paying a premium price. This fact has led to the concept of protecting the products by using various Intellectual Property Rights (IPR) tools. IPR tools are now very effectively used by the product manufacturers to distinguish their produce in their market. Trade secrets, Patents, Semi-conductor IC, Plant Variety Protection, Design, Trademark, Copyright and Geographical Indications (GI) are the commonly used IPR tools in the world

GEOGRAPHICAL INDICATIONS

At several instances, a product is distinguished among its competitors based on its distinct characteristics which are connected to its place of origin. These products are thus known among the people by the identity of the geographical location from which they originate. These geographical names add value to the produce and demand premium price from the consumers. WTO defines GIs as the tools that help in recognising a produce as originating with in the geographical boundary of a member or region, wherein the geographical origin of the produce is attributed with the characteristics that attract premium from the consumers. The importance of GIs stems from the fact that they can be of multiple benefits. They protect the producers by preventing the misuse of brand and consumers by ensuring the quality of the produce. The registration of products as GIs helps maintain the tradition and more importantly enhance the market profile.

NATIONAL SCENARIO

The importance for framing GI Act emerged in India primarily to protect the identity of Indian Basmati rice and Darjeeling tea. Our policy makers soon realised that a mechanism to safeguard the domestic product within country is indispensable if we need to protect these products overseas. Protectionist policies were also gaining popularity at the global stage since the induction of WTO, and India, being a member of the body, was supposed to frame a national law to protect the product originating within its geographical boundary. The Geographical Indications of Goods (Registration and Protection) Act, was enacted in India in

the year 1999 and came into force later with effect from 15 September 2003. The GI Act since then has been playing crucial role in the registration and improved safeguarding of Geographical Indications of products in our country. The producers of the GI goods are the primary beneficiaries since the act targets their triumph. The huge consumer population of the country are the second beneficiaries, since the act protects them from betrayal. Finally the interest of our country as a whole is also protected by the act through its impact on the global export market (Niranjan, 2003). A set of rules are also being notified by the Indian Government in the year 2002 to effectively implement the GI act. The controller General of Patents, Designs and Trademarks is the officer in charge of proper implementation of the act and maintenance of Geographical Indications Registry.

REGISTRATION OF GI GOODS

The registration process of GI goods in India starts with the filing of application for GI. Application can be filed by the producers of goods or any association or organization of producers or else by organizations or associations established to protect the producers' interest. Agricultural, natural and handicraft goods are eligible to be applied for GIs. The GI application prepared by the producers or associations should clearly mention the nature and character of the product and why it is unique and how the product character is linked with the place of origin. Registered agents or lawyers can submit the application to the Registrar of GI. An expert panel will scrutinise the application, and the producers will be informed in case of any objection or in need of further clarification. All the GI applications will be published in the GI Journal and citizens can object the application if the claims or any other details provided in the application are found incorrect. Finally, if the applicant is able to pass all the clarification and objections, the good will be registered in the GI registry and a certificate of 10 years validity will be issued.

CREATING AND PROTECTING NICHE MARKET FOR GIS

Similar to the importance of enforcement mechanism to any other act, GI act also requires a strong post-GI enforcement system. Enforcement mechanism should be capable of protecting the producers of GIs not only in the domestic market, but also in the foreign market. Implementation in foreign markets even though can be complicated, but once done opens a huge potential (Kasturi Das, 2006). The government should take lead in implementing this and should be alert enough to identify and fight any infringements. Another key issue is the establishment of a premium market for the GI goods. Unless a premium price is made available for such goods, the producers may not find it a viable enterprise, due to the complex production process to maintain the unique character involving considerable investment. Proper branding and product placement in suitable market is crucial and cannot be done by the producers alone. For example the producers of GI goods in agriculture are farmers and they may not be qualified enough to identify potential market and brand their product. The role of government in formulating an effective

marketing strategy by finding the potential market segment or niche and implementing placing the product with a good brand value is crucial. Also the involvement of intermediaries in the process should be regulated in order to save the deserving benefits to the real producers. The bargaining power of the producers should be enhanced through collective operations in the supply chain. In the process, at least some of the higher grade firms in the supply chain with profit motives can be automatically excluded to ensure distribution of proportionate benefits among the producers (Ragnekar, 2004).

PROS AND CONS

The foremost advantage of protecting GIs and marketing such products with GI tags are that the real producers can get the much deserving premium for their efforts in protecting a national wealth or indigenous knowledge. Higher level of employment generation with improved wage rates is also ensured in the process. GIs can also help prevent the erosion of technical skills of producer groups involved in production of such goods. The consumers worldwide will also benefit by getting the quality product to the price that they pay, since GI complies with the trades standards set internationally. The problems in GIs are also however plenty. Maintaining the GIs is a herculean task and money is also involved in it. The most shocking point is that the real producers may not always be the actual beneficiaries of GIs. Firms with better bargaining power can benefit from the scene by avoiding the producers from the higher levels of supply chain. Also protecting the GIs in foreign countries requires huge investments. The support from a financially strong body is must to undertake such exercise. For the establishment of a successful GI, strong organizational back up to explore the market and maintain GI is the requirement at the first stage. At the second level opportunity should be given for equal participation for each member of the producer group in production operation, decision making and profit as well as loss sharing. At the final stage backing from good market players for commercialisation along with system for effective legal protection in domestic and foreign markets could positively place the GI brands in potential markets.

CONCLUSIONS

The means of protection of products through GIs are evolving and the target of the government should be to explore all possible options. The importance of a strong and effective post-GI mechanism should be understood in promotion of such products. Financial back up should be made available to the associations or groups promoting GIs in the form of GI funds. The extension workers also have a key role to play in the form of community sensitization towards better role play in the supply chain of GI products. Finally, the potential benefits of GIs for different sectors like agriculture, handicraft etc needs to be proved through scientific studies, without which the rural areas will be excluded from its benefits.

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Organic Poultry Farming- An Overview

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The poultry farming in India has transformed from backyard rearing to commercial organized industry. Recent days consumers are being more aware of safety and quality of the food products consumed by the. Further as purchasing power of common people is increasing and they are interested to consume safer product without bothering to pay more. So, the production of safer poultry products without any chemical and microbial residues diverts the mind towards organic poultry production. According to FAO/WHO codex alimentarius commission-organic farming is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical method in exclusion of all synthetic off-farm inputs.

In organic farming preference shall be given to local breeds of poultry. Food animals for organic meat production must be the progeny of organically reared parent stock. In addition maximum care should be taken to provide an environment where the poultry get ample chance to exhibit their natural behavior. The establishment of organic poultry farming requires a conversion period, the time taken between start of the organic management on farm and certification of the poultry farm and its product.

AIM OF THE ORGANIC FARMING

The main aim of organic farming is to establish and maintain soil-plant, plant-animal and animal-soil interdependence and to produce sustainable agro ecological system based on local resources. It does not require external inputs like fertilizer, antibiotics etc., but prominently rely on ecosystem management. Organic farming directed towards to

- Reducing health risks
- Protecting the earth environment
- Help the small farmers
- Creating a harmonious balance between crop production and animal husbandry
- Minimize all forms of pollution
- Produce fully biodegradable organic products
- Produce food of high quality in sufficient quantity
- Maintain the genetic diversity

ORGANIC CERTIFICATION STANDARDS

Certification is essentially a seal of approval to assure consumers that the production methods used by organic

farmers follow strict quality standards. A lot of organic standards exist at present but only some standards got world wide acceptance like

- EU regulations (1804/1999)
- Organic food product act of USA
- Draft guidelines of codex/WHO/FAO
- The codex alimentarius committee on Food Labeling is discussing a new draft guideline for organic livestock, which will be considered in Ottawa, Canada.
- United Kingdom Register of Organic Food standards (UKROFS)
- International federation of organic agricultural movements (IFOAM). It adopted their standards at the General assembly in Argentina, 1998. The Indian standards of organic animal husbandry/poultry farming is largely based on the IFOAM basic standards.

In India, standards for organic agriculture were announced in May, 2001, and the National Programme on Organic Production (NPOP) is administered under the Ministry of commerce. The Agricultural produce export development agency (APEDA) under the ministry regulates the certification of organic products as per NOP. The NPOP standards for production and accreditation system have been recognized by European Commission and Switzerland as equivalent to their country standards. Similarly, USDA has recognized NPOP conformity assessment procedures of accreditation as equivalent to that of US. With these recognitions, Indian organic products duly certified by the accredited certification bodies of India are acceptable to the importing countries

BASIC REQUIREMENTS FOR ORGANIC POULTRY FARMING

- Appropriate housing that permits natural behavior, including outdoor access
- Certified organic feeds
- No antibiotics, drugs or synthetic pesticides
- Organic processing of meat and eggs
- Record keeping system to allow tracking of poultry and products'
- Organic system plan including description of practices to prevent contamination, monitoring practices and list of inputs
- Production that does not contribute to contamination of soil or water
- No genetically modified organisms, ionizing radiation or sewage sludge
- Pasture management
- Grazing management
- Stress management
- Seasonal breeding
- Access to environment
- Avoidance of synthetic substances
- Rearing of birds without cages
- Organic feeds
- Natural treatments

Breeding

The choices of breeds of poultry should be based on their adaptability to the local conditions. Breeding goals should not be contrary to the animal behavior and should be directed towards good health. The use of genetically engineered species or breeds is not allowed for organic farming. reproduction techniques should be natural and hormonal treatment for better egg production is contradicted. The sex ratio should be one male for about 4-6

hens in a flock like in case of the wild birds.

Housing

The birds should be housed in such a way as to provide opportunity for the birds to exhibit all its normal behavior patterns and experience minimal stress. Cages should be avoided and birds should be reared under deep litter system. They must have easy access to an outside grazing area, fresh air, clean water, balanced ration, dust bathing facilities and an area for scratching. Debeaking and beak trimming are usually prohibited practices but some certifying agencies still permit debeaking if done more than 5 mm of the upper beak should not be removed. In the organic meat sector birds must be grown for the period of 81 days of age usually.

Feeding and watering

Birds should be fed 100% organically grown feed of good quality. All ingredients must be certified as organic except vitamin and mineral supplements making up to 5 per cent of the diet. The diet should be offered in a form so that the birds can exhibit natural feeding behavior and digestive needs. Concentrated balanced feed ration produced organically should given. The largest component of any organic poultry diet is maize and high quality roughages, particularly legumes can be supplemented to the diet. Home grown protein sources like peas, beans and rapeseed can also be utilized. Peas can be included at the rate of 250-300g/Kg for the table chicken and 150-200g/Kg for laying hens. Since sprouted pulses are good source of vitamins they can be preferentially used to replace synthetic aminoacids. Limestone and rock phosphate in general and lime stone grit and rock phosphates particularly for layers can be included as mineral source. Trace minerals incorporated in the diets should be organic or ayurvedic in nature. The quota of essential amino acids can be met through feeding organic soya bean, skim milk powder, potato protein, maize gluten etc. Balanced ration should be given and overfeeding must be avoided.

A continuous access and ample supply of drinking standard quality water free from residues should be assured. Water should be regularly tested for ground water contamination.

Health care

The principles of healthcare and management in the organic farming concept is that when all the management practices are directed towards the well being of the birds they will achieve maximum resistance against diseases and overcome many infections. Clean grazing and dry litter would ensure prevention of almost all health related problems. Use of antibiotics should be avoided. However vaccinations are permitted only when diseases are expected to be a problem. Use of natural medicines and homepathy and ayurveda should be encouraged.

Record keeping

Record keeping with respect to the overall management practices is the most important factor. It should be systematic documentation of activities , observations and inferences from time to time for future reference. Records include breeding records, registers indicating source of animals purchase, source of organic feed ingredients, feed supplements and feed additives

purchased, organic feed formulation record, organic poultry pasture record, inventory of health care products, sanitation products, monthly flock records of organic egg layers, organic meat poultry, organic poultry slaughter/ sales summary and monthly organic egg packing/sales records.

ADVANTAGE OF ORGANIC POULTRY FARMING

- Ensure strict animal welfare measures
- Recognize poultry comfort and behavior
- Enhances agro ecosystem health
- Provides high quality products
- Exercise reduced abdominal fats and favored muscle development in broilers
- Help us to produce safer poultry products
- Plays a significant role in improving the socio-economic condition of rural masses

BENEFITS OF ORGANIC CHICKEN

1. Have less fat: Organic chicken tends to be less fatty that its commercially raised chicken. Organically fed chickens that are free to peck at grass and bugs are the best birds to buy as their meat will be leaner. Leaner cuts of meat make chicken an even healthier protein choice and also speed up cooking time by adding a little fat during cooking organically raised chicken

2. Have fewer chemicals or toxins: Chickens raised by conventional methods often contains hormones, antibiotics and trace amounts of pesticides, all of which can be a potential health hazards to the consumers. Antibiotics used in commercially raised chicken may be one of the factors that cause germ resistance in some people, and even small amounts of hormone can have a big effect, possibly increasing the risk of cancer and early-onset of puberty. Antibiotics in chicken meat may help create resistant "super bugs" in humans that thrive after building a tolerance to common antibiotics, so organic chicken all these harm compare to conventional chicken.

3. Have more flavour and taste: Another benefits of organic chicken is the flavour and taste better. Other healthier composition of organic chicken is that they have higher in vitamins(200% more vitamin E, vitamin B6, niacin and B12), minerals, beta-carotene and cancer fighting fats (conjugated linoleic acids) than its conventional chicken. Meat products from organic chickens has 21% less fat, 30% less saturated fat, 28% fewer calories, 50% more vitamin A and 100% more omega-3 fatty acid than conventional one, making them healthier for your heart.

Benefits of organic eggs

Organic chickens fed only organic feed and grass (a cocktail of worms and grubs). Eggs from these grazing chickens have twice as much vitamin E, 40% more vitamin A, and 3 times as many omega 3s, plus they taste better.

CONCLUSION

The organic is more or less a symbol of purity and quality of food products. This means organic farming has to be paid attention to boost organic production to meet the growing demand for such products to increase the contribution of organic poultry product in to total organic product exported by India it is necessary to take appropriate steps towards the development of organic poultry farming

in India. The ill effects of conventional farming are compelling the consumers to shift to the organic products and organic foods are a smart choice for healthier living. Therefore, laying greater emphasis on organic poultry farming can help us to produce safer poultry products without compromising the poultry welfare.

Pre harvest Fruit Drop: A Severe Problem in Apple

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Abstract

Preharvest fruit drop (PFD) is an important cause of fruit loss in apple industry and has been a recognized as severe problem in apple production for many years. Pre harvest fruit drop (PFD) in which fruits are shed from the tree before ripening phase prior to horticultural maturity can occur in several apple cultivars. The severity of drop is cultivar specific and cultivars have been categorized according to propensity to drop: less prone, intermediate and more prone. Studies in the early part of the 20th century were concerned with the physiology of fruit abscission as it occurred in the orchard. However, with the discovery of plant bio regulating chemicals (PBRs), the research priorities changed drastically from physiology of abscission to the efficacy of PGRs. The discovery of the abscission delaying properties of PBRs with auxin-like activity opened the new vistas for the development of chemical horticultural tools to reduce preharvest drop losses. Since the use of stop-drop materials became a common practice, research on preharvest apple fruit abscission has focused on development of better ways to use chemicals with commercial registrations. Unfortunately, chemicals used as horticultural tools have limited life spans and are primarily governed by regulatory and economic variables which are outside the control of apple growers.

INTRODUCTION

Apple (*Malus domestica* Borkh.) is a most popular temperate fruit, consumed both fresh and processed, and ranked third for global fruit production. Global production is centered on the high-value fresh market which requires harvesting at optimum maturity to maintain fruit quality during long-term storage and shipping (Greene et al., 2014). After fruit setting in apple, there is a period of fruit let (immature fruits during the cell division phase) drop that occurs 5–6 weeks after full bloom; this is referred to as 'June drop'. A second period, called preharvest fruit drop (PFD) begins approximately four weeks before harvesting and will be the focus of this article.

One of the greatest problems that apple grower's face is the drop of fruits before it can be harvested. Some cultivars, such as 'McIntosh', are particularly prone to this problem. Drop on many cultivars can exceed 20%, but on the drop-prone cultivars it is not uncommon to have losses exceed 50%.In areas where one or two cultivars are dominant, growers are frequently faced with the challenge of harvesting a large portion of their crop in a short period of time before fruit condition declines and fruit are lost due to drop. Apple preharvest fruit drop frequently results in severe economic

losses. Cultural control of preharvest drop has so for been only relied upon the use of plant growth regulators (PBRs), but the loss of daminozide (Alar) and 2,4,5-TP has severely limited the choices of effective stop-drop compounds. A more complete understanding of factors involved in preharvest drop is therefore imperative. Fruit shedding is caused by a surge of endogenous ethylene which is generally considered to be the main factor controlling fruit drop (Kende 1993). Chemicals inhibiting ethylene biosynthesis and signal cascade, sprayed during the late part of the fruit developmental cycle, have been proved to efficiently reduce preharvest drop and delay ripening. In fruit species the preharvest drop is a consequence of the onset of ripening which, in climacteric fruit, is a syndrome developmentally regulated and strictly controlled by ethylene. The biosynthetic pathway of this hormone is mainly controlled by two enzymes: ACS (1-aminocyclopropane-1-carboxylate synthase) and ACO (1-aminocyclopropane-1-carboxylate oxidase) (Bleecker and Kende 2000), which in apple as in other species are encoded by multigene families, whose different members are involved in the regulation of several physiological processes besides ripening (Dal Cin et al. 2006).

Factors affect Pre-harvest Drop

The severity of pre-harvest drop is related to several orchard and climatic factors including tree mineral nutrition, summer pruning, and insect or disease severity, water availability and growing season temperature which are discussed.

1. Mineral nutrition. Fruit drop is variable among orchards, suggesting that cultural management can influence fruit drop. The nutrient imbalance is a stress factor that can contribute to apple PFD. For example, a deficiency in boron is suspected to cause cell deterioration and reduce carbohydrate transport, which are likely to promote abscission. During severe boron deficiencies of pome fruit, excessive fruit drop occurs. The effect of nutrient concentrations on apple PFD has not been thoroughly investigated, although the effect of nutrient supplementation during other developmental stages has demonstrated improvements in fruit retention and quality. Furthermore, foliar boron. When magnesium was applied in the form of magnesium sulphate (i.e., Epsom salts) as foliar sprays, it reduced PFD of the apple cultivar 'Tydeman's Late Orange'. High nitrogen nutrition status of the tree has also been thought to be associated with greater preharvest drop. 'McIntosh' trees that received nitrogenous fertilizer dropped a higher percentage of their crop (the harvested crop was also larger for the fertilized trees (Hoffman, 1940). When fertilizer and moisture conditions were both high, the effect was more pronounced. Apparently conditions leading to high nitrate availability near harvest time cause increased drop of 'McIntosh'. Phosphorus followed the same trend. If correcting nutrient deficiencies does indeed manage fruit drop, nutrients should be included along with PBRs in the management of PFD

2. Summer Pruning. Pre-harvest fruit drop is frequently more severe in orchards which are heavily pruned during summer. This problem is likely associated with a limitation in carbohydrate supply when too many of the leaves are cut off

leaving older less functional leaves. If summer pruning reduces leaf-fruit ratio below 20: 1 then drop will be increased. It is recommended that moderate summer pruning should be performed if needed where only a small fraction of the functional leaves are cut off.

3. Insects and diseases. Pre-harvest drop severity can be increased by heavy infestations of mites, tentiform leaf miners, and other insects or diseases that significantly reduce the photosynthates produced by the leaves. Severe mite and tentiform leafminer infestations have been shown to reduce photosynthetic capacity of leaves resulting in a limitation of carbohydrate supply to the fruits late in the season. IPM mite and insect control thresholds have been designed to not surpass the leaf damage that will result in increased Pre-harvest drop. Thus, strict adherence to these thresholds will not normally result in any increased risk of drop. However, if substantial insect or mite damage is combined with summer pruning or low Mg or drought stress the combine effects of each stress can increase the severity of pre-harvest drop.

4. Moisture Availability. Pre-harvest drop will be more severe in dry seasons than in seasons with adequate or more-than adequate rainfall. In dry years irrigation becomes an essential management tool for the control of pre-harvest drop.

5. Growing season temperatures. Growing season temperatures also influences pre-harvest drop of apples. Hoffman showed that in hot growing seasons the period between bloom and fruit ripening is shorter than in cool growing seasons. Thus in hot years var., McIntosh ripening and harvest are often pushed earlier in the season when temperatures are warmer. The higher the temperatures at the time fruits begin to ripen (begin to produce ethylene) the more severe and earlier is pre-harvest fruit drop. Walsh (1977) showed that the higher the daily temperatures when ethylene began to be produced the shorter was the interval between the beginning of the ethylene rise and fruit drop (Table.1). Fruit internal ethylene can be estimated to begin when starch-iodine index is in the range of 3.5-4.5. Thus, the data in table 1 can be used to estimate the number of days until drop of sound McIntosh fruits will being once apples reach a starch index of 3.5. If forecasted weather for the next week was cool (i.e. 50°F) drop of sound fruit would not start for 13 days but if forecasted weather for the next week was hot (i.e. 70°F) then drop of sound apples would begin in 4 days.

Table 1. Relationship between mean daily temperaures and elapsed days between start of ethylene rise and abcission of McIntosh apple

Mean daily Temp. (°F)	**Days from start of ethylene rise to abcission**
40	25
45	18
50	13
55	9
60	7
65	5
70	4
Source: christpher S. Walsh, 1997.	

Common practices for managing apple pre harvest fruit:-

Control of pre-harvest drop has relied upon plant bio regulators (PBR's) for almost 50 years. Daminozide (Alar) was discovered in the 1960's and it provided excellent pre-harvest drop control and also increased flesh firmness (Southwick and Lord, 1969). Since it delayed ripening it provided a means for growers to retard ripening of a portion of their crop to allow a more orderly and timely harvest of extensively planted cultivars. The registration of daminozide for use on apples was withdrawn in 1989 leaving orchardists with NAA as the only pre-harvest drop control option. Various PBRs have been tested from time but only few have been commercially used due various reasons (Table 2).

Control of preharvest drop by Auxins

Over a half a century ago, it was found that naphthalene acetic acid (NAA) could retard preharvest drop (Batjer and Thompson, 1948). It has been known for over a half a century that auxins can inhibit abscission. Many synthetic auxins inhibit preharvest drop and several of these have been used commercially. NAA, however, is the only auxin registered for control of preharvest drop. NAA is used at rates between 5 and 20 mg l_1 and it should be applied before significant drop begins. Many of the failures or poor response of NAA to retard drop can be attributed to late application, when drop is already under way. Normally 1–2 days are required for NAA to become effective. If drop has started, it may require up to 5 days for NAA to slow drop. NAA is effective for 7–12 days and a second application will be necessary, therefore, to reliably retard drop after 10 days. Fruit softening and reduced storage life are likely if warm weather follows application or if harvest is delayed until ripening has been substantially advanced.

Control of preharvest drop with AVG

Aminoethoxyvinylglycine (AVG) which was discovered in the early 1970's is a naturally occurring compound which blocks ethylene synthesis and limits pre-harvest drop. Delays fruit color development which is a negative side effect for many growers (Robinson et al., 2006). As apples ripen, they produce ethylene in large amounts, which moves through the intercellular spaces in the fruit and through the pedicel to the abscission zone, where it stimulates the synthesis of enzymes, which ultimately break down the cells in the abscission zone. It is believed that the mode of action of AVG is to inhibit ethylene biosynthesis in the fruit. In the fruit treated with AVG, ethylene production will be reduced, synthesis of enzymes responsible for the destruction of cells in the abscission zone will be delayed and the fruit will remain on the tree for a longer period of time. The suggested time of application of AVG is 4 weeks before anticipated normal harvest. Applications made earlier than this may have the risk of losing drop control before harvest and, if application is delayed, fruit effects will be diminished, some drop may occur before drop control is effective and harvest may be unnecessarily delayed, because a preharvest interval of 28 days is required between application and harvest. The silicone- based surfactants 'Silwet' and 'Sylgard' should be included at 0.05–0.1% to improve the effectiveness.

Table 2. Common names and chemical names of compounds effective at reducing preharvest drop

NAA	naphthaleneacetic acid
NAAm	naphthalene acetamide
Fenoprop, 2,4,5-TP	2-(2,4,5-trichlorophenoxy) propionic acid
Daminozide, SADH	butanedioic acid mono(2,2-dimethylhydrazide)
Dicamba	3,6-dichloro-2-methoxybenzoic acid
Dichlorprop , 2,4-DP	2-(2,4-dichlorophenoxy) propanoic acid
AVG	Aminoethoxyvinylglycine hydrochloride N-(phenylmethyl)-1H-purine-6-amine
2,4-D	(2,4-dichlorophenoxy) acetic acid
lactidichlor ethyl	benzoic acid 3,6-dichloro-2 methoxy, 2-ethoxy,1-methyl, 2-oxoethyl ester
triclopyr	[(3,5,6-trichloro-2-pyridinyl) oxy] acetic acid
fenclopyr, CPPU	[(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid
No common name	triethanolamine salt of 2-(2,4,5-trichlorophenoxy) propionic acid
No common name	2-methyl, 4-chlorophenoxyacetic acid
No common name, 2,4,5-TA	triethanolamine salt of 2,4,5,-trichlorophenoxyacetic acid
No common name, 2,4,5-TAA	2,4,5-trichlorophenoxyacetamide
MCPB	4-(2-methyl-4-chlorophenoxy)butyric acid

Control of Pre harvest fruit drop with 1-mcp

Application of 1-MCP to maintain quality of horticultural produce, especially apples, is now well established. In apples, 1-MCP inhibits perception of ethylene by competing for the binding sites for ethylene in the fruit, thereby slowing ethylene-dependent stimulation of fruit ripening, tissue softening, scald development, loss of acids, volatile production, and fruit breakdown during storage. The effects of Harvista on fruit drop and on the maturity and quality of fruit at harvest and after storage has been studied using 'Delicious', 'Empire', 'Gala', 'Jonagold', 'Macoun', 'McIntosh' and 'Honeycrisp'. The results show that responses among cultivars can vary depending on the normal levels of preharvest drop, but overall, Harvista markedly delays fruit drop in susceptible cultivars. Harvista results in lower internal ethylene concentrations and starch indices, and firmer fruit at harvest, although the specific harvest indices affected differ by cultivar. The effects of Harvista on quality factors such as firmness can be maintained during air and controlled atmosphere storage, but the persistence of these effects are related to harvest maturity.

CONCLUSION & FUTURE PROSPECTS

Preharvest fruit drop has been a recognized as severe problem in apple production, and a big challenge for apple industry, in which fruit abscise from the tree prior to horticultural maturity. The pre harvest drop is affected by various horticultural and climatic factors, but the role of these factors has not been fully investigated. The control measures have

been only relied upon the use of PBR, s Inspite of efficient control measures available for controlling this problem a well organized research is needed to investigate the affect of various factors, new PBR's management strategies and breeding solutions to reduce the incidence of pre harvest apple fruit drop, which may improve the profitability of drop prone cultivars and ultimately reduce crop loss

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Importance of Vitamins and Minerals on Reproduction in Dairy Cattle

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An animal requires energy, protein, minerals, vitamins and water in the correct levels and balance to optimize lactation, growth and reproduction. Micronutrients are nutrients required by organisms throughout life in small quantities to orchestrate a range of physiological functions. Micronutrients are needed only in minuscule amounts; these substances are the "magic wands" that enable the body to produce enzymes, hormones and other substances essential for proper growth and development. As tiny as the amounts are, however, the consequences of their absence are severe. Under nutrition results in the loss of body weight and body condition, delays the onset of puberty, increases the post-partum interval to conception, interferes with normal ovarian cyclicity by decreasing gonadotropin secretion and increases infertility.

Vitamin A:

Vitamin A is the most commonly deficient vitamin in cattle. Vitamin A is necessary in maintaining the health and integrity of epithelial tissue (tissue that lines the reproductive tract, intestinal tract, urethra, kidney, mouth, respiratory tract, salivary glands, eyes, and tear glands). These tissues become hard and crack during a vitamin A deficiency. The recommended daily supplementation for dairy cows is 30,000-50,000 units. Supplementation with vitamin A should be considered when feeding poor quality forages or low amounts of forage and corn silage. Beta-carotene is a precursor of vitamin A. Vitamin A may be supplied by green forages that contain carotenoids. Carotenoids are broken down in the body to vitamin A. Vitamin A deficiency results in reproductive disorders such as delayed onset of puberty. Low conception rates and abortions in late pregnancy may be seen in deficient situations. An increased incidence of retained placenta is indicative of a vitamin A deficiency. Severe deficiency will result in resorption of the fetus. Gestation length is normally reduced in deficiency situations with calves born weak or dead. Calves born to vitamin A deficient dams have higher incidence of mortality and may have eye abnormalities. Reproductive problems associated with a vitamin A deficiency include delayed sexual maturity, abortion,

birth of dead or weak calves, retained placenta, metritis, and shortened gestation periods.

Vitamin D:

When cattle are exposed to sunlight, they manufacture their own vitamin D. Vitamin D is necessary for normal calcium and phosphorus metabolism and, thus, affects reproduction indirectly. Most commercial concentrates contain supplemental vitamin D in amounts sufficient to meet the cow's requirement of 10,000 IU/day. Deficiency leads to anestrum, milk fever, metritis and retained placenta in dairy cows and impotentia coeundi in bulls. This vitamin is found in sun-cured forages. Animals kept outdoors or fed sun-cured hay does not usually suffer a deficiency, whereas animals kept indoors and fed silage may do so. Vitamin D deficiencies result in suppression of the signs of estrous and delayed puberty. This will have an indirect effect on reproduction. It should be supplemented to provide 1,600-1,700 IU/kg dry matter of the diet.

Vitamin E:

Alpha-tocopherol is the most biological active form of vitamin E and is the compound normally found in feedstuffs. It has a role in the immune system. Vitamin E and selenium supplementation have been known to decrease the incidence of retained placenta, metritis and cystic ovaries. The time for uterine involution to occur in cows with metritis is also decreased with supplementation. Vitamin E will reduce the incidence of retained placenta in fresh cows but its exact role on reproductive performance has not been determined. This vitamin should be supplemented to provide 25-35 IU/kg dry matter in lactating diets.

Vitamin D and Vitamin E also play a role in reproduction. These vitamins are antioxidants and often work in conjunction with other trace minerals to ensure sound reproductive performance. Therefore, it is harder to explain the direct impact of deficiencies of these nutrients on reproduction.

Minerals:

Calcium is an important mineral for bone growth and development. Its role on reproduction is indirect; animals that have calcium deficiency while they are growing may have retarded growth and impaired skeletal development. These animals may have reproductive difficulty because of their poor growth and development.

Phosphorus has long been linked to reproductive performance. An extreme deficiency can lower conception rate, decrease ovarian activity, and increase the risk of cystic ovaries. This level of deficiency will only occur in animals with restricted dry matter intake. Cattle grazing a pasture during a drought year when there is insufficient forage is an example. Otherwise, the forages in the diet will supply enough phosphorus to prevent deficiencies that will impair reproductive function. Feeding excess phosphorus has not been shown to have a positive impact on reproduction.

Insufficient **selenium** is most often associated with retained placentas. Cows that have retained placentas are at a greater risk for reduced reproductive performance. Metritis, early embryonic death, poor fertility and the birth of dead calves are also associated with selenium deficiencies. Marginally selenium deficient animals will abort, or calves will be weak and unable to stand or suckle.

Research indicates that selenium supplementation reduces the incidence of retained placentas, cystic ovaries, mastitis and metritis.

Copper, zinc and cobalt impact reproductive performance. Copper deficiency has been linked to early embryonic death, reduced ovarian activity, delayed estrus activity, lower conception rates, increased risk of retained placenta and dystocia. The recommendation is to feed 20 mg/kg of added copper to the diet. Symptoms of a copper deficiency include early embryonic death, resorption of embryo, increased retained placentas and necrosis of the placenta [34, 29]. Weak and silent heats have been reported. Zinc deficiency may be related to fetal abnormalities. A zinc deficiency can result in delayed sexual maturity. It can also cause fetal abnormalities. Zinc should be added at 75 mg/kg of the diet. Cobalt deficiency is related to increased incidence of silent heats, stillbirths, delayed onset of puberty, non-functional ovaries, and abortion. Deficiencies can result in the increased incidence of silent heats, delayed onset of puberty, nonfunctional ovaries and abortion. Cobalt should be added at 0.5 mg/kg of the diet.

Iodine may indirectly impact reproduction. Iodine has an effect on the thyroid gland. If the thyroid is not performing correctly then there is an increased risk of early embryonic death, abortion, stillbirths, and abnormally long gestation. Deficiencies will result in poor development of the follicles, delayed ovulation, more silent heats and lower conception rates. Manganese should be added at 50 mg/kg of the diet.

Potassium (K) Limited research suggests that feeding high levels of potassium may delay the onset of puberty, delay ovulation, impair corpus luteum (yellow body) development and increase the incidence of anestrous in heifers. Smith and Chase reports lower fertility in cows fed with high levels of potassium or diets in which the potassium-sodium ratio was too wide.

Chromium (Cr) Chromium potentiates insulin action, resulting in increased uptake of glucose and amino acids by cells in the body. A chromium deficiency in lactating cows may result in increased incidence of ketosis and decreased milk production. Improved energy balance in early lactation may improve reproduction. Salt (Sodium and Chloride) Salt deficiencies can affect the efficiency of digestion and indirectly the reproduction performance of cows. Sodium and chloride normally do not appear in feedstuffs in adequate amounts to meet animal requirements and should be provided free choice at all times.

CONCLUSION

The key to getting cows to milk to their genetic potential and to getting them bred back is to provide them with a well balanced diet composed of quality forages, grain, and a mineral and vitamin mix and to maximize consumption of that diet. Requirements of vitamins and minerals need to be met to ensure optimal reproductive performance.

Nickel Essentiality and Toxicity in Plants

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Abstract

Nickel (Ni^{2+}) contamination in agricultural soils due to atmospheric deposition and industrial pollution constitutes a risk to food security for increasing population. Ni^{2+} is an essential micronutrient for most of the plant species to complete their life cycle but its higher concentrations are toxic and severely interfere with many physiological and biochemical processes leading to reduced productivity and product quality. This paper gives an overview of the occurrence and sources of Ni^{2+} in environment, as well as Ni^{2+} essentiality and toxicity in plants.

INTRODUCTION

Heavy metal ions such as Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), Nickel (Ni), and Zinc (Zn) are considered essential/beneficial for optimal plant growth, development and productivity. However, these metal ions adversely affect functions of many enzymes/proteins, alter metabolism and exhibit phytotoxicity at higher concentration (Li *et al.*, 2013). The present levels of heavy metals (HMs) in the atmosphere are up to several folds higher than the primitive atmosphere and lead to the greater exposure of the biotic components of the ecosystem to HMs. Among above metals, Ni^{2+} exhibits widespread distribution in the environment and is essential constituent of almost 100 minerals. Excess Ni^{2+} is toxic to plants and cause a number of morphological and physiological/biochemical consequences that subsequently limit the plant growth, development, and productivity. Natural (weathering of rocks) and anthropogenic activities like mining operations, metal smelting, electroplating, gas exhaust, energy and fuel invention power lines, intensive agriculture are some of the numerous human activities that add toxic quantities of Ni^{2+} to the environment.

SOURCES AND OCCURRENCE

Ni^{2+} occurs naturally in soil and surface water at concentration lower than 100 and 0.005 ppm, respectively. Ni^{2+} concentrations in agricultural soils may range between 3.0–1000 mg kg^{-1}, with a mean range of 20.0 - 40.0 mg kg^{-1}. Polluted soils may exhibit Ni^{2+} concentrations in the range of 200 to 26,000 mg kg^{-1} which is 20 to 30 fold higher than the overall range, i.e., 1–1000 mg/kg (Izosimova, 2005). Serpentine soils developed on ultramafic rocks naturally contain high concentrations of Ni^{2+}. Ni^{2+} is released into the environment from various anthropogenic activities, like smelting, metal mining, vehicle emissions, fossil fuel burning, disposal of household, municipal and industrial wastes,

application of fertilizer and organic manures. Inorganic fertilizers particularly phosphate fertilizers have variable levels of Ni^{2+} depending on their resources/raw materials.

PHYSICOCHEMICAL PROPERTIES OF Ni^{2+}

Ni^{2+} is the 24th most abundant element in the Earth's crust, comprising about 3% of the composition of the earth. It is hard, silvery-white and lustrous, and found in nature as a component of silicate, sulfide or arsenide ores. Its atomic number is 28, atomic weight is 58.71, and specific gravity is 8.9 with the melting and boiling points of about 1.455°C and 2.732°C, respectively. It has high electrical and thermal conductivity and is resistant to corrosion at ambient environmental temperatures between -20°C and +30°C and is therefore often electroplated as a protective coating. It is a member of the transition series and belongs to group VIIIth B of the periodic table along with Iron. It is found in several oxidation states (+1 to +4) in the environment, but it is present predominantly in divalent form [Ni (II); Ni^{2+}] and the same is most prevalent in soils and available to plants.

ROLE IN PLANTS

Ni^{2+} is currently considered to be a plant micronutrient and is found in the vegetative organs of most plants in the range of 1-10 $mg.kg^{-1}$. Plant`s Ni^{2+} requirement is the lowest of all essential plant micronutrient elements at < 0.5 $mg.kg^{-1}$ of dry weight. In plants, Ni^{+2} naturally occurs in a few beans and functions as an essential component of some enzymes like ureases, and participates in some important metabolic reactions such as hydrogen metabolism, phytoalexin synthesis under biotic and abiotic stress (Wood and Reilly, 2007). It is also found in several other enzymes namely carbon monoxide dehydrogenase, glyoxalase I, peptide deformylase, acetyl-S-coenzyme A synthase, methylcoenzyme M reductase and superoxide dismutase (NiSOD). Ni^{2+} is required for iron absorption and seed germination too and its deficiency leads to the production of nonviable seeds in plants. Ni^{2+} deficiency in soybean (*Glycine max* L.) leads to decrease in urease activity and accumulation of toxic levels of urea in the leaflet tips which results in necrosis of leaf tips (Fig. 1). Low levels of Ni^{2+} supply may limit the symbiotic hydrogenase activity of *Rhizobium leguminosarum* and consequently influence the symbiotic N_2 fixation directly (Ureta *et al.*, 2005). Ni^{2+} also acts as a biocontrol agent for microbial pests. It is a key factor inducing the production of secondary plant metabolites and thus enhances plant resistance to diseases. Ni^{2+} deficient plants show delayed nodulation which leads reduction in efficiency of N_2 fixation. In Ni^{2+} deficient pecans (*Carya illinoinensis*), a key morphological symptom of Ni^{2+} deficiency is the development of "mouse-ear" (Fig. 2) leaves (Liu et al., 2014).

Ni^{2+} TOXICITY IN PLANTS

The toxic level/concentrations of nickel in plants vary from 25 to 246 $\mu g \cdot g^{-1}$ dry weight (DW) of plant tissue, depending on the plant species and cultivars. The key sources/routs of heavy metals in plants are their growth media, soil nutrients and agro inputs (pesticides and fertilizers). Relative uptake of Ni^{2+} (through passive/active transport) depends on

plant species, its oxidative state and concentration, soil pH and presence of other metals in the soil/nutrient solution. The increasing Ni^{2+} contamination of soil has become a worldwide problem, leading to losses in agricultural yield and hazardous health effects on both wildlife and human beings through food chains. High doses of Ni^{2+} negatively affect plant growth and induce visible symptoms of toxicity such as stunted growth, chlorosis and necrosis of leaves (Fig. 3 and 4). During studies on the effect of $NiCl_2$ on

Figure 1:Necrosis of leaf tips in Ni2+ deficient Soybean

various growth related parameters, Kaveriammal and Subramani (2013) treated groundnut (*Arachis hypogaea* L.) seedlings with $NiCl_2$ (0, 100, 150, 200 and 250 $mg.kg^{-1}$ soil) and observed significant reduction in length and dry mass of root and shoot, number of nodules, area of leaves, photosynthetic pigments (chlorophyll, carotenoid), amino acids, protein and proline content of leaves. The reduction of leaf area in response to Ni^{2+} treatment is also related to accumulation of Ni^{2+} in leaves.

Relatively high concentrations of Ni^{2+} may cause deficiency of essential divalent cations such as K, Zn, Mn, and Cu with increasing level of Ni^{2+}. High affinity

Figure 2: Development of "mouse-ear" leaves in Ni2+ deficient Pecans

Figure 3: Symptoms of Ni2+ toxicity Sugar Beet leaves

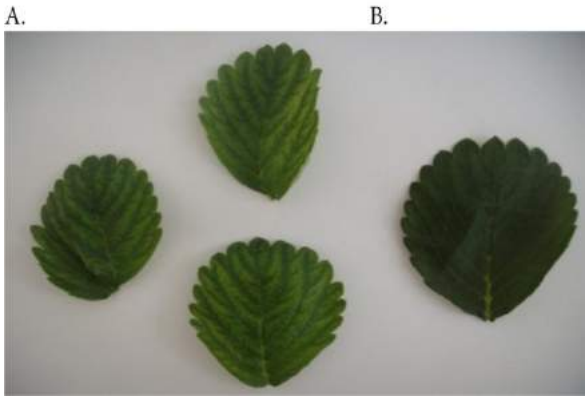

Figure 4: Leaflets of strawberry with symptoms of Ni toxicity (A); Healthy leaflets (B)

of Ni^{2+} to sulfhydryl (-SH) groups and disulfide bonds may cause damage to the secondary structure of proteins and activity of metabolic enzymes. Enzyme activity is also compromised in the presence of higher Ni^{2+} due to competitive binding with their central metal ion

(Kucharski et al., 2009). Excess Ni^{2+} adversely affects germination of seeds by hampering the activity of hydrolytic enzymes such as amylases and proteases. During germination, Ni^{2+} also inhibits all energy dependent cellular processes resulting in slow radicle and plumule emergence. Several studies in plants including maize have confirmed that Ni^{2+} toxicity can result in inhibited lateral root formation and development. Ni^{2+} was also found to affect the photosynthesis, cell division and act as a mutagen to plants. The decline in photosynthesis in plants exposed to Ni^{2+} stress is caused due to the inhibition of important enzymes, such as δ-aminolevulinic acid dehydratase (ALA dehydratase) and protochlorophyllide reductase, associated with chlorophyll biosynthesis. At higher concentrations Ni^{2+} leads to oxidative stress in plants by increasing the amount of hydroxyl radicals, superoxide anions, nitric oxide and hydrogen peroxide (Boominathan and Doran, 2002).

Plants such as *Assyllum, Streptanthus, Berkheya, Thlaspi* species accumulate higher levels of Ni^{2+} in above ground tissues. These hyperaccumulators tolerate high levels of nickel due to free histidine in the xylem sap, which also provides a defense mechanism against herbivory. Other potential cellular mechanisms available for nickel detoxification and tolerance in higher plants include: 1. Restriction of nickel movement to roots by mycorrhizas. 2. Binding to cell wall and root exudates. 3. Reduced influx across plasma membrane. 4. Active efflux into apoplast. 5. Chelation in cytosol by various ligands. 6. Repair and protection of plasma membrane under stress conditions. 7. Transport of PC-Ni complex into the vacuole. 8. Transport and accumulation of nickel in vacuole. A team of Philippine researchers have discovered a new "Ni^{2+} eating plant" species, *Rinorea niccolifera* growing in Ni^{2+} rich soils which stores more than 18,000 ppm Ni^{2+} in leaves. Ni^{2+} hyperaccumulation in plant tissues may provide "elemental defense" against some natural enemies, such as pathogens and herbivores (Boyd, 2004).

CONCLUSION

Plants require micro/differential level of Ni^{2+} (>0.5 $mg.kg^{-1}$) to maintain their optimal growth and development. However, Ni^{2+} readily impact function of many enzymes and proteins that halt metabolism and exhibit phytotoxicity at supra-optimum concentration. The direct effect of Ni^{2+} toxicity may be lead to over generation of ROS in stressed plant which subsequently causes impairment of photosynthesis and source-sink relationship and limits crop productivity. Considering sensitivity of crop plants to Ni^{2+}, efforts should be made to unravel mechanisms of Ni^{2+} tolerance (various genes, transcription factors, enzymes/proteins and metabolites such as osmolytes, phytohormones, polyamines, lipids, etc.) and produce transgenic Ni^{2+} tolerant plants.

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Effect of residual feed intake and nutrient utilisation in animal production

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Feed is a major expense in livestock production systems accounting for 60–80% of the total costs across the most common farm animal species. Therefore, improvements in the efficiency of feed utilization by farm animals could bring economic benefits to the livestock industry and also make it more environmentally sustainable. Feed efficiency traits have been receiving greater emphasis in large animal breeding programs, especially since the concept of residual feed intake (RFI) was re-introduced (Schenkel *et al.,* 2004). However, measuring individual feed intake is costly and laborious, which are barriers for a wider scale utilization of RFI or other feed efficiency measures by the livestock industry. Thus, it is desirable to search for reliable feed efficiency predictors to substitute or alleviate the need for individual feed intake measurements.

Residual feed intake

Residual feed intake (RFI) or net feed intake (NFI) is a measure of efficiency which was first proposed by Koch *et al*. (1963) and they suggested that feed intake could be adjusted for body weight (BW) and weight gain, effectively partitioning feed intake into two components, the feed intake expected for a given level of production and a residual portion. RFI is the difference between actual feed intake and the feed an animal is predicted to consume based on its body size and growth rate.

FEED CONVERSION EFFICIENCY

Feed conversion efficiency of animals is an important component of the profitability of livestock enterprise, given that the cost of feed accounts for much of total farm expenses. A significant improvement in profitability could be achieved through a reduction of production costs via implementation of selection strategies to improve feed efficiency, independent of growth rate and body weight. Genetic variation in maintenance energy requirements of cattle is moderately heritable which provides, an opportunity to select for more efficient cattle.

Feed conversion ratio

Feed conversion ratio (FCR) is defined as the ratio of inputs (feed) to outputs (product). The most common measure of feed efficiency is FCR or its inverse, gross efficiency (GE). FCR is negatively correlated with growth and mature size. Selection for better FCR would most likely result in increased mature cow size and thereby increased feed requirements for maintenance.

Measurement of RFI

RFI can be used to identify those animals that deviate from their expected level of feed intake and they can be of high efficiency (negative residual intake) or low efficiency (positive residual intake). The units of RFI are in amount of feed eaten adjusted to mean production rather than feed per unit production, which is common for other efficiency measures. The computation of RFI requires the estimation of expected feed intake. Residual feed intake (RFI) as the difference between actual feed intake and the feed an animal is expected to consume based on its body size and growth rate. The computation of RFI requires the estimation of expected feed intake. The DMI over the testing period was calculated from the remaining records. Residual feed intake was calculated using the general linear model described by Koch *et al*. (1963).

$y = \beta 0 + \beta 1 (ADG) + \beta 2 (WT) + RFI$

Where y is daily feed intake, β0 is the regression intercept, β1 is the partial regression of daily intake on average daily gain (ADG), and β2 is the partial regression of daily intake on mid test metabolic body weight (Wt.0.75). The above equation was designed for young and growing cattle.

Thus, RFI is a measure of the variation in feed intake beyond that which is needed for maintenance and growth requirements. An efficient animal would have a negative RFI and an inefficient animal would have a positive RFI. Cattle with low RFI eat less than expected for their weight and growth rate, and are, therefore, more efficient than cattle with high RFI the lower feed intake of cattle selected for low RFI contributes to the direct environmental benefits in terms of reduced methane and nitrous oxide emissions (Nkrumah *et al*., 2006). Cattle selected for low RFI produced 15% less enteric methane per day than those selected for high RFI.

Relation of residual feed intake with dry matter intake

Variation in feed intake is associated with variation in maintenance requirements of ruminants. As feed intake increases, the amount of energy expended to digest the feed increases, in part because of an increase in size of the digestive organs and increase in energy expended within the tissues themselves. This heat increment of feeding (HIF) has been known for considerable time and in ruminants is approximately 9% of ME intake. Cattle of low RFI consumed 0.335 kg/day less DM than medium RFI animals and when compared to the animals of high RFI it was lesser by 0.705 kg/day. When a feedlot situation is considered and around 80% of costs are spent on feeding (Basarab *et al.,* 2003), the identification of the animals which consume less with no impairment to production would bring large reductions of costs of system.

Relation of residual feed intake with activity of animals

Variation in heat production and thus energy available for maintenance and growth occurs as a result of differences in energy expenditure associated with activity. In cattle, the energetic costs associated with eating, chewing and ruminating can account for 10 to 33% of the total metabolizable energy derived from forages. In cattle, total energy expenditure was positively correlated with time spent standing and energy

expenditure was 19% greater when cattle were standing compared with lying. Based on pedometer measurements in cattle, Herd *et al.* (2004) estimated that approximately 10% of the variation in RFI of growing cattle was due to differences in energy expenditures related variation in physical activity.

Relation of residual feed intake with Heat production

Physical activity of animal is strongly associated with heat load and heat production. Divergence in HP between lines could be accounted for by changes in physical activity is about 30 to 50%. The principal route for energy loss in ruminants is evaporative heat loss. Postural change and other adaptations such as wetting, seeking shelter, and huddling do not by themselves constitute a large proportion of variation in heat loss except in extreme situations. However, the large difference in body size between these species indicated that the contribution of thermoregulation to variation in energy expenditure could differ markedly. More efficient beef steers (low-RFI) had lower heat production than medium or high-RFI steers (Castro Bulle *et al.,* 2006).

Relation of residual feed intake with growth and milk production

In general, the impact of selection for RFI on dairy cattle will be less than for beef cattle because a higher proportion of feed energy will be expressed in milk than is retained in low weight gain. The energy in a product cannot be affected by variation in RFI (i.e., conservation of energy), and product composition is largely independent of RFI (Lancaster *et al.,* 2009). Residual feed intake was about 3% lower for lactating cows identified as most efficient as growing calves and no negative effects on production.

Relation of residual feed intake with reproductive efficiency

Reproductive efficiency is a key component to cow enterprises because it is a primary determinant of profitability. Nutritional status has been identified as an important mediator of reproductive events. Therefore, differences in feed intake may affect the age of puberty for heifers as well as the length of the anoestrous period for cows. There was a negative linear relationship between RFI and age at puberty in beef heifers (Shaffer *et al.,* 2010). Each 1-unit increase in RFI corresponded to a decrease of 7.5 d in age at puberty, but did not affect pregnancy or conception rates. Differences in body fat and rate of metabolism associated with RFI could delay reproductive maturity in low RFI group.

CONCLUSION

Residual feed intake (RFI) as the difference between actual feed intake and the feed an animal is expected to consume based on its metabolic body size. The computation of RFI requires the estimation of expected feed intake. Cattle with low RFI eat less feed than expected for their weight and growth rate, and are, therefore, more efficient than cattle with high RFI the lower feed intake of cattle selected for low RFI contributes to the direct environmental benefits in terms of reduced methane production and heat production. Therefore, low RFI animals have utilisation of nutrient is more efficient and better production potential.

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Nutritional value and health benefits of nuts

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Abstract:

Nuts play a very significant role in human health and prevent many diseases. The nuts are rich source of unsaturated fatty acids, protein, vitamins, minerals and antioxidants. No doubt they are important part of our diet but the overeating of nuts in an undesirable form will led to serious health hazards. This article along with the nutritional and health benefits of consuming nuts also covers the recommended quantity of nuts to be consumed and the form in which the nuts should be included in daily diet.

Introduction

Nuts form a significant part of everyday diet for most of us and many public health organisations recommend daily intake of nut as part of an overall healthy diet. They are not just delicious but are powerhouse of energy, as they are loaded with calories. They are rich in healthy monounsaturated and polyunsaturated fats, protein and dietary fibre. Monounsaturated fatty acids helps to lower low density lipoproteins (LDL) or "bad cholesterol" and increase high density lipoproteins (HDL) or "good-cholesterol" in the blood. Nuts are also a good source of vitamins especially E and B-complex group along with minerals like calcium, potassium, phosphorus, magnesium, iron, zinc and antioxidant minerals such as manganese, copper and selenium, plus other phytochemicals such as antioxidant compounds and plant sterols. Nuts contain a wide variety of health benefits, they improve heart, blood, mental, eye, skin, bone and oral health, further, they improve digestive function, memory and metabolism, boost immune system, aid in weight loss, help manage diabetes, prevent different type of cancer, lower the risk of formation of gallstones, protect against viral and fungal infections.Thus we can say nuts are little factories of good health or are a "complete package" type of food. But you can enjoy too much of a good thing. Despite a number of health benefits, overindulging of nuts also can have adverse effects.

Why we have to go for nuts?

Almonds:

Can a high fat food be good for you? Almonds challenge this oxymoron perfectly well. Almonds are known as an all-rounder. They are high in heart protective monounsaturated fats, which are also good for brain and skin health.

The high amount oleic acid, a monounsaturated fatty acid reduce blood pressure and helps to fight against coronary diseases. Almonds contain more **fibre** (12.5g/100g; about 33% of DRA), **protein** (21.15g/100g), **Vitamin E** (alpha-tocopherol-25.63mg/100g; about 170% of DRA of Vitamin E), **riboflavin** (1.138/100g; 87.5% of DRA) and **Ca** (269mg/100g; about 27% of DRA) compared to other nuts. Fibre seems to reduce the risk of developing diabetes, heart disease, diverticular disease, colon cancer and constipation. Protein helps in growth and repair of body organs. Vitamin E, is a strong lipid-soluble antioxidant with so many cancer-fighting properties and is reduce risk of heart diseases, further it helps in maintaining and protecting the skin from harmful oxygen-free radicals. Riboflavin in almonds is necessary for proper iron absorption. Apart from riboflavin they also contain phenylalanine and these two substances improve neurological function. In other words, almond boost brain power, and that is why it is the most beneficial for growing children. It is also a component of several antioxidant enzymes that prevent free radical damage in body and for that reason, they are known as best nut for disease prevention.

Walnuts:

Walnuts are very high in **polyunsaturated fats** (47.174g/100g) and are a good source of proteins, vitamin B-6 and folate. They are only nuts that have omega-3 fatty acid in high amount and because of that it is very good for vegetarians, as it is almost absent in a veggie diet. It provide anti-inflammatory benefits in asthma, rheumatoid arthritis, and other skin disease related to inflammation like eczema and psoriasis, and therefore, they are known as an Inflammation fighters. Moreover, because of high in omega-3 they are also known as a brain food as nearly 60 per cent of our brain structures are primarily omega-3 fatty acids. Apart from this omega-3 fatty acid prevents erratic heart rhythms and regulates plaque formation in blood vessels, meanwhile amino acid arginine from walnut, makes arteries more flexible thereby reduce the chances of developing blood clots and for that reason walnuts are known as best nut for heart. Walnuts can lower the cholesterol level and boost the immune system as they contain antioxidants nutrients like phenols, Vitamin E, gallic acid and ellagic acid. Eating of walnuts soaked in water before sleep induces a good night's sleep as they contain melatonin-antioxidant.

Cashew nuts:

Cashew nut are highest in **cupper** (2.195mg/100g; about 244% of DRA) iron **Fe** (6.68mg/100g; about 83.5% of DRA) among nuts. Both copper and iron are active compound of red blood cells and are required for the proper functioning and creation of red blood cells. Copper helps in the metabolism of iron and iron helps prevent microcytic-anemia. Further, copper is vital in energy production and to increase flexibility in blood vessels, bones and joints. Cashew nuts prevent cancer as it is rich source of antioxidant that helps in elimination of free radicals. Moreover, they have lower fat content than most other nuts.

Pistachio nuts:

Pistachios are symbol of wellness and they are known as the skinny nut because they are the lowest calorie nut. They are excellent source of vegetable protein. As

compared to most of nuts pistachios contain higher protein and lower fat. They are rich source of many anti-oxidant phyto-chemical substances such as carotenes and polyphenolic antioxidant compounds as well as amino acid arginine. Among the nuts pistachios are richest in **potassium** (1025mg/100g; about 22% of DRA), **vitamins A** (516IU/100g) and **vitamin B-6** (1.7mg/100g; about 130% of DRA). Potassium helps to maintain the correct water balance in the nerves and muscles cells thus it is important to keep muscles and the nervous system functioning normally. Further, Potassium helps counter hypertensive action of sodium, lower heart rate and blood pressure.

Pecan nuts:

Pecans are excellent source of phenolic anti-oxidant, thiamine, zinc, copper and richest among nuts in **vitamin E** (gamma-tocopherol-24.44mg/100g; about 163% of DRA of Vitamin E). In addition pecans are rich in phyto-chemical substances including antioxidant ellagic acid, zea-xanthin and beta-carotene. Research studies suggest that these compounds help to the body to remove toxic oxygen-free-radicals and as a result, protect body from diseases and cancers. They are good for men's health as they are rich in beta-sitosterol, a plant steroid that may help relieve symptoms of benign prostatic hyperplasia or enlarged prostate.

Hazelnuts or filberts:

Hazelnuts are highest in **folate** (113µg/100g; about 28% of DRA) among nuts and hence, hazelnuts help to reduce the level of homocysteine, which causes fatty plaque build-up in arteries. Furthermore, folic acid is essential in preventing any kind of abnormalities in infants.

Macadamia Nuts:

Macadamia nuts contain highest **fat** content (75.77mg/100g) among nuts, yet are known as the superior nut as they are lowest in polyunsaturated fatty acids (1.502mg/100g) and richest in **monounsaturated fatty acids** (58.877mg/100g) compared to other nuts. They are highly anti-inflammatory nuts. Moreover, they are very low in anti-nutrients like phytic acid and perhaps low in lectins. Additionally they are richest source of **thiamine** (1.195mg/100g; about 99.5% of DRA) among nuts. Thiamine from macadamias strengthens your immune function, contributes to cardiac health, and studies have lately linked its supply to improved eye health as well as improved mental health.

Brazilnuts:

Among the nuts, brazilnuts are an excellent source of minerals like **phosphorus** (725mg/100g; about 103.5% of DRA), **magnesium** (376mg/100g; about 89.5% of DRA) and exceptionally rich in **selenium** (1917µg/100g; about 3485% of DRA). Magnesium helps the body to cope with stress, improve memory and protects against age-related memory loss. Moreover, it can help avoid heart attacks and vital for healthy development of muscles, tissues, bones and organs in body. Phosphorus increase strength and durability of bones and teeth. It also aids in protein synthesis, absorption of fats and carbohydrates. Selenium is very important nutrient that is lacking in diet of many people's. It is crucial antioxidant, which play an important role in the functioning of thyroid gland and adequate

selenium in the diet help prevent coronary artery disease, prostate cancer and liver cirrhosis.

Pine nuts:

Pine nuts are richest source of **zinc** (6.54mg/100g; about 59.4% of DRA), **manganese** (8.802mg/100g; about 382.6% of DRA), **niacin** (4.387mg/100g; about 27.4% of DRA) and **vitamin K** (53.9µg/100g; about 45% of DRA). Zinc is critical to immune health and healthy vision. Further, it is very important during pregnancy for the growth of the baby and the developmental years of childhood to maintain stable state of the body. Manganese contributes to bone health and strength, and is valuable antioxidant preventing free radical damage. It is also play important role in absorbing other nutrients such as thiamin, biotin or ascorbic acid.In addition they are also very good source of arginine amino acid.

Chestnuts:

Chestnuts stand out from other edible nuts for their distinctive nutrition profile. They are considered as real nut and are starchy instead of fatty. They are very low in fat (2.26g/100g) and beneficial as a source of carbohydrate (45.54g/100g). Carbohydrate helps in growth and development of body tissue. Moreover, they are exceptionally rich in Vitamin C (43mg/100g, about 72% of DRA). Which is a strong anti-oxidant and is needed for matrix formation in blood vessels, bones and teeth. On the other hand chestnuts are low in anti-nutrients like phytic acid.

Reasons to say no to nuts:

Nuts are healthy, tasty, delicious, packed with nutrition, easy to carry and it is easy to go nuts over nuts. But it is best to proceed with caution when it comes to nuts because of a few reasons:

1. Bad omega-6 to omega-3 ratio

The problem comes to most nuts is the high amount of polyunsaturated fat (PUFA) especially omega-6 fatty acid, as in high amount any kind of PUFA even omega-3s become highly reactive and toxic. Among the different nuts walnut and pine nuts are very high, brazilnuts and pecans are high, almond and pistachios are moderately high, hazelnuts and cashews are moderately low, macadamia is low and chestnut are very low in PUFA content. Omega-6 and omega-3 are essential fatty acids and are necessary for health, but the body cannot make them, meaning we must get them from foods we eat. It is impossible to say that omega-3 is better than omega-6, because both are essential, however omega-6 is by far the easiest nutrient to consume, but omega-3 found very low in nuts and other food. Fish and seafood are only a good source of omega-3 fatty acid, they gets it from an algae diet and up the food chain, somewhat omega-3 we can get from grass fed ruminants.

Table:1 Nutritive values of nuts per 100 gram.

Nutrients	Almonds	Walnuts	Cashews	Pistachio	Pecans	Hazelnuts	Macad-amias	Brazil-nuts	Pine nuts	Chest-nuts	RDA/d (31-50 yr.)
Water (g)	4.14	4.07	5.20	4.37	3.52	5.31	1.36	3.42	2.28	48.65	3.7 L
Energy (kcal)	579	654	553	560	691	628	**718**	659	673	213	-
Protein (g)	**21.15**	15.23	18.22	20.16	9.17	14.95	7.91	14.32	13.69	2.42	56 g
Carbohydrates (g)	21.55	13.71	30.19	27.17	13.86	16.70	13.82	11.74	13.08	**45.54**	130 g
Dietary fiber (g)	**12.5**	6.7	3.3	10.6	9.6	9.7	8.6	7.5	3.7	8.1	38 g
Total Sugars (g)	4.35	2.61	5.91	7.66	3.97	4.34	4.57	2.33	3.59	-	-
Total lipids (fat) (g)	49.93	65.21	43.85	45.32	71.97	60.75	**75.77**	67.10	68.37	2.26	-
SFA (g)	3.802	6.126	7.783	5.907	6.180	4.464	12.061	**16.134**	4.899	0.425	-
MUFA (g)	31.551	8.933	23.797	23.257	40.801	45.652	**58.877**	23.879	18.764	0.780	-
FUFA (g)	12.329	**47.174**	7.845	14.380	21.614	7.920	1.502	24.399	34.071	0.894	-
Phosphorus (mg)	481	346	593	490	277	290	188	**725**	575	93	700 mg
Potassium (mg)	733	441	660	**1025**	410	680	368	659	597	518	4.7 g
Calcium (mg)	**269**	98	37	105	70	114	85	160	16	27	1000 mg
Magnesium (mg)	270	158	292	121	121	163	130	**376**	251	32	420 mg
Iron (mg)	3.71	2.91	**6.68**	3.92	2.53	4.70	3.69	2.43	5.53	1.01	8 mg
Zinc (mg)	3.12	3.09	5.78	2.20	4.53	2.45	1.30	4.06	**6.54**	0.52	11 mg
Manganese (mg)	2.179	3.414	1.655	1.200	4.500	6.175	4.131	1.223	**8.802**	0.952	2.3 mg
Copper (mg)	1.031	1.586	**2.195**	1.300	1.2	1.725	0.756	1.743	1.324	0.447	900µg

Selenium (µg)	4.1	4.9	19.9	7.0	3.8	2.4	3.6	**1917.0**	0.7	-	55 µg
Nutrients	**Almonds**	**Walnuts**	**Cashews**	**Pistachio**	**Pecans**	**Hazelnuts**	**Macad-amias**	**Brazil-nuts**	**Pine nuts**	**Chest-nuts**	**RDA/d (31-50 yr.)**
Sodium (mg)	1	2	**12**	1	0	0	5	3	2	3	1.5 g
Vitamin A (IU)	2	20	0	**516**	56	20	0	0	29	28	900 µg
Vitamin C (mg)	0.0	1.3	0.5	5.60	1.1	6.3	1.2	0.7	0.8	**43.0**	90 mg
Thiamine (mg)	0.205	0.341	0.423	0.870	0.660	0.643	**1.195**	0.617	0.364	0.238	1.2 mg
Riboflavin (mg)	**1.138**	0.150	0.058	0.160	0.130	0.113	0.162	0.035	0.227	0.168	1.3 mg
Niacin (mg)	3.618	1.125	1.062	1.300	1.167	1.800	2.473	0.295	**4.387**	1.179	16 mg
Vitamin B-6 (mg)	0.137	0.537	0.417	**1.700**	0.210	0.563	0.275	0.101	0.094	0.376	1.3 mg
Folate, DFE (µg)	44	98	25	51	22	**113**	11	22	34	62	400 µg
Vitamin E (alpha-tocopherol) (mg)	**25.63**	0.70	0.90	2.86	1.40	15.03	0.54	5.65	9.33	-	15 mg
Vitamin E (gamma-tocopherol) (mg)	0.64	20.83	5.31	20.41	**24.44**	0.00	0.00	9.56	11.15	-	
Vitamin K (phylloquinone) (µg)	0.0	2.7	34.1	-	3.5	14.2	-	0.0	**53.9**	-	120 µg

SFA: Total saturated fatty acid, MUFA: Monounsaturated fatty acid, FUFA: Polyunsaturated fatty acid.
(Source: USDA National Nutrient Database; RDA: Food and Nutrition Board, Institute of Medicine, National Academies)

Along with omega-3 fatty acids, omega-6 fatty acids play an important role in brain function, and normal growth and development. Omega-6s help, maintain bone health, regulate metabolism, maintain the reproductive system and hair growth. Whereas, omega-3 fatty acids may be important in preventing many health problems, including heart disease, rheumatoid arthritis, and cancer. Furthermore they are also play a role in improving mood, sharpening memory and improving night and color vision. But massive consumption of omega-6 promotes cancer, heart disease, autoimmune disorders including arthritis, diabetes, allergy and asthma. Omega-6 fats are primarily converted into a range of pro-inflammatory hormones and omega 3 into anti-inflammatory hormones, therefore, too much omega-6 and too little omega-3 can lead to excessive inflammation and for that reason, a healthy balance between omega-6 and omega-3 fatty acids in needed to bring these diseases under control.

In an effort to optimize health and longevity, one should strive to keep a total PUFA intake under 4 per cent of total calories. However, in respect to ideal ratio of omega-6 and omega-3 scientists have different view some suggest it should be 5:1, whereas some suggest 4:1 and some even say it should be 1:1. Almost all nuts are known for their bad omega-6 and omega-3 ratio. Most nuts contain very high amount of omega-6 and very low amount of omega-3. Among nuts walnuts often praised for their high omega-3 content, but are way too high in total PUFA and still have a bad omega-6 to omega-3 ratio. And even nuts contain appreciable level of omega-3 fat are not necessarily a good source of omega-3 as the form of omega-3 found in nuts is alpha-Linolenic acid (ALA) which is a short-chain form that needs to be elongated ALA to DHA to be useful for body. ALA can be elongated to eicosapentaenoic acid (EPA) and docosahexaenonic acid (DHA), but the process is very inefficient.

Table:2 Comparison of omega-6 and omega-3 fatty acids in nuts

Nuts	Omega-6 (g)	Omega-3 (g)	Omega-6/Omega-3 ratio
Almonds	12	0.006	2000:1
Walnuts	38	9	4.22:1
Cashew nuts	7.78	0.06	129.6:1
Pistachios	13.2	0.25	52.8:1
Pecans	20.6	1	20.6:1
Hazelnuts	7.8	0.1	78:1
Macadamias nuts	1.3	0.2	6.5:1
Brazilnuts	20.5	0.018	1138.8:1
Pine nuts	33.6	0.11	305.45:1
Chestnuts	0.776	0.093	8.23:1

(Source: http://paleoleap.com/are-nuts-and-seeds-healthy/)

2. High in phytic acid

The other problem when it comes to most nuts is the presence of phytic acid in them. Phytic acid is the storage form of phosphorus and, especially found in skin of nuts. Phytic acid is a strategy employed to prevent nut from sprouting before the ideal conditions are present

but human's body are not able to digest phytic acid and is known as anti-nutrient as in our digestive system. It has the ability to bind to certain minerals like calcium, iron, zinc, manganese and magnesium and prevents us from absorbing them. Here it is important to know that phytic acid does not leach minerals that are already stored in the body; it only inhibits the absorption of minerals from food in which it is present. This means that you would not necessarily get high amount of a mineral even if you eat a nut high in that mineral and, because of that diet with high in phytate cause mineral deficiencies (when phytic acid is bound to a mineral in the nut, it's known as phytate). Moreover, phytic acid interferes with enzyme required for digestion of food, including amylase (needed for the breakdown of starch), pepsin (required for the breakdown of protein in stomach), and trypsin (required for protein digestion in small intestine). However, these same anti-nutrient properties of phytic acid can also help in the prevention of chronic disease. Now question is arise how much phytic acid we eat. According to Kresser (2016), human can tolerate phytic acid in the rage of 100 mg to 400 mg per day.

Table:3 Comparison of phytic acid present in some most popular nuts

Nut	Phytic acid (mg/100g)
Black walnuts	1977
Cashews	1866
Hazelnuts	1620
Almonds	1280
English walnuts	760
Chestnuts	47

(Source: *http://www.phyticacid.org/phytic-acid-in-nuts/)*

3. Lectins in nuts

Lectins are a type of protein that can bind to cell membrane and are meant to protect the plants. Lectins generally found in the part of the nut that becomes the leaves when the plant sprouts, but also on the skins. They are resistant to human digestion and they enter the blood unchanged. Lectins can irritate gut lining and create inflammation.

4. Selenium Poisoning:

Selenium is a trace mineral and our body only needs in small amounts. The excess of selenium intake will led to serious health issues. The common symptoms of selenium poisoning are hair fall, nails become brittle, breath stinks and muscles and joints pain. According to Braba (2015) 8 whole pieces of brazilnuts, has 10 times recommended daily amount of selenium (55 micrograms).

5. Oxalates in nuts:

Almonds and cashews both contain oxalates, which interfere with the absorption of calcium and, the accumulation of calcium can result in kidney stones. People with kidney or gallbladder stone problems should avoid eating almonds.

6. Medication Interaction:

Pine nuts, hazelnuts, pecans, macadamias and walnuts are fairly high in manganese (about 382.6, 268, 195, 179 and 148 per cent of DRA/100g respectively) and if we consume too much these nuts on top of a manganese rich diet, this might trigger drug interactions. High quantities of manganese in blood can interfere with

some antipsychotic drugs, as well as antacids, laxatives blood pressure medications and certain antibiotics.

7. Allergy:

Sometimes tree nuts (especially cashews, walnuts, pistachios and chestnuts) incline to be an extremely allergenic substance and it can be manifested in a variety of ways. Being allergic to nuts varies from one another so you must be careful whenever you add new type of nut in your diet. Allergic reactions caused by these nuts can be mild to severe and include heart arrhythmia, respiratory malfunction, skin and facial irritation, gastrointestinal discomfort etc. For example allergy from cashews can lead to one or more of the complications like contact dermatitis, vomiting, nausea, diarrhea, gastric discomfort, runny nose, coughing, shortness in breath and more severe reactions can result in a fatal condition like glottis edema or anaphylaxix.

8. Weight gain

Nuts are high in fat and high fat means high calories. However, most of the fat is unsaturated and helpful in lowering cholesterol and many research studies have shown that nut can help to lose weight if eat in moderate amount. But, if you eat more than daily recommended, you can gain weight more rapidly than you might by over-eating other food.

9. Gastrointestinal Problems:

Some time people felt gassy and bloated after eating nuts, it is a common side effect of overeating of nuts as compounds in nut called phytates and tannins make them difficult to digest. Moreover, according to Alan R. Goby, author of Nutritional Medicine, eating too much fat found abundantly in nuts at one time can lead to diarrhea. Further, nuts are high fibre food and we need fibre to aid digestion but consuming large quantity of fibre also can lead to bloating, gas and diarrhea. For adult the recommended dietary allowance of fiber is 38 grams.

Table: 4. Presence of fibre content in different nuts

Nuts	Total dietary fibre (g/100g)
Almonds	12.5
Walnuts	6.7
Cashews	3.3
Pistachio	10.6
Pecans	9.6
Hazelnuts	9.7
Macadamia nuts	8.6
Brazilnuts	7.5
Pine nuts	3.7
Chestnuts	8.1

(Source: USDA National Nutrient data base)

10. Blood Pressure:

Nuts are often served salted. This improves taste, but also adds salt to your diet. Too much salt can contribute to high blood pressure.

Step should be taken to make nuts safer to eat:

- Polyunsaturated fatty acids (PUFA) are easily oxidized when comes in contact with oxygen, light and heat, and oxidized PUFAs are bad for our health because they create many kind of toxic reactions with sugars and proteins in our bodies. For this reason nuts are much better eaten unroasted and should be refrigerated in an air-tight container.
- Many studies suggest that at least some of phytate can be broken down

by soaking, roasting and cooking. Soaking and cooking also reduce lectins content in them. According to Gargi Sharam the brown peel of almonds contains tannin which inhibits nutrient absorption and once you soak almonds the peel comes off easily and allows the nut to release all nutrients easily. Meanwhile, soaking almonds releases enzyme lipase which is beneficial for digestion of fats. Soaking of nuts for sixteen to eighteen hours in normal or salty water is an easy way to get rid of most of the phytic acid and other anti-nutrients. After the nuts have soaked for number of hours, rinse the thoroughly and dry them at very low temperature (either in a food dehydrator or at low temp. oven) and then roasting or cooking the nuts would likely eliminate a large portion of the phytic acid. You don't absolutely need to dry the soaked nuts, but the moisture still make it easy for mold to grow, so they should be eaten quite quickly.

- Remove skin of nuts before eating or eat blanched nuts for proper digestion of them as fair amount of lectins and phytic acid present in skin of nuts.
- Before adding any new nut in your diet make it sure that you do not have any allergy from that particular nut.
- If you add nuts in your diet, the equivalent amount of calories elsewhere should be subtracted, otherwise you will gain weight more quickly.

How much is too much

Too much of anything is bad. How much is too much depends on context. It depends on several factors such as body weight, overall health, mineral status, metabolic health. It also depends upon in which form the nuts are consumed, whether soaked, dehydrated and roasted. Most studies recommended 28-30 g nuts per day or even 2-5 times in a week. Recommended nuts (28-30g) contain approximately 20-24 almonds, 8-12 walnuts (halves), 30-45 pistachios, 5-7 Brazilnuts, 16-20 pecans (halves), 14-18 cashews, 18-20 hazel nuts, 14-16 macadamia nuts, 3-4 chestnuts and 140-160 pine nuts. However, it is better to consume mixed nuts to avoid adverse effect of consuming one nut and to get proper balance of different nutrients in your diet and by doing so you can enjoy variety of different kinds of nuts, further, some nuts better than others when it comes to health benefits. Sharma (2016) has recommended 4 to 5 cashew nuts and 8 to 10 soaked almonds every day". Whereas, Makhija (2015) recommended 4-7 almond and 3-4 halves walnut per day. Further, Francis (2016) mentioned that consuming 5-7 pistachios per day are healthy. Joel Fuhrman has recommended eating 4 Brazilnuts per day.

CONCLUSION

Even if nuts are often loaded with vitamins and minerals, most nuts should be kept to a minimum in a healthy diet for a few reasons. Most of the nuts contain high amount of PUFA and very bad ratio of omega-6 and omega-3. They also contain phytic acid that binds certain mineral and block their

absorption in the body. Further they contain lectins that can irritate the gut lining. Among different nuts Brazilnut is extremely high in selenium and too much eating of Brazilnuts leads to selenium poisoning. Furthermore, overeating of nuts can increase weight and create gastrointestinal problem. However, by some extent we can reduce the toxic load of most of nuts by storage of nuts in air tight containers and by soaking, roasting, cooking and removing skin of nuts before consuming. Eat nuts because they have lot to offer, but, it is best to proceed with caution and stick to the recommended daily serving size.

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Care and Management of Livestock during Flood

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

INFRASTRUCTURE

Downed and damaged Infrastructure is likely after flooding. The damaged building walls can be temporarily replaced by poly wire fencing. One has to be careful about downed and damaged power (electric) lines and other hazards in and around the housing of the animals. Overcrowding of the animals should be avoided for extended periods of time. Perimeter fencing is the first priority. Portable facilities can be shared with neighbors when available. Unwanted fighting of cattle and other livestock can create herd health and breeding issues, which is required to be taken care. Clean and Spray the buildings with a good disinfectant before animals occupy them again. Remove debris from cattle sheds. Scrub and disinfect walls, ceilings, floors and other dairy equipment's.

Drinking Water:

Flood may come with lots of problem for livestock specially and pity situation is that plenty of water remains everywhere but one may not use it for any domestic purpose. Flood water having much of unwanted ingredients and polluted with dung, urine, debris and other wastes that may cause harm for livestock livelihood if use for drinking. So, during this condition first priority is that cattle must have an

adequate supply of fresh water to survive. Providing fresh water is the first priority. Use water tanks, and ask for help from neighbors and local fire departments for immediate water needs.

Feeding Management:

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

HEALTH CARE AND MANAGEMENT:

There are certain diseases which are more common during flood periods so these diseases need more attention so as

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

CARE FOR CARCASS DISPOSAL:

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

Maize as emerging source of oil in India

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Maize or corn (*Zea mays*) is a plant belonging to the family of grasses (*Poaceae*). It is cultivated globally being one of the most important cereal crops. Maize is the third most important food grain in India after wheat and rice. In India, about 28% of maize produced is used for food purpose, about 11% as livestock feed, 48% as poultry feed, 12% in wet milling industry (for example starch and oil production) and 1% as seed. Dry kernels of grain corn contain low levels of oil (about 4%), but most of the oil is contained in the embryo or "germ" portion of the kernel. Corn germ is a co-product that is produced when corn is processed by either wet milling (a process developed to remove the starch from corn kernels efficiently) or dry milling (a process developed to remove the germ and bran from corn to increase the stability of corn grain products for food uses). Corn germ obtained from wet mills usually contains about 40–50% oil, and corn germ from dry mills usually contains about 20–25% oil (both yields expressed on a dry weight basis).

BENEFITS OF MAIZE OIL

The maize oil is easy to digest, beneficial to human heart, reduce risk of chronic diseases, prevention macular degeneration and can be used for hair treatment. It can also be used for making of biodiesel, for wood conditioning and giving stainless steel a shine. Maize oil is high in polyunsaturated fat, which is a heart-healthy fat, and low in saturated fat. The American Heart Association suggests replacing saturated fat in one's diet with unsaturated fat in order to reduce cholesterol as well as reduce your risk of developing heart disease. Maize oil is comprised of about 86 % unsaturated fats and about 13 percent saturated fat, according to the Corn Refiners Association (2004), maize oil is a good source of vitamin E, providing 15 % of the daily value per tablespoon. Vitamin E is an essential nutrient that acts as an antioxidant in the body, protecting it from free radical damage. Maize oil is a good choice for high-heat cooking.

APPLICATIONS

Maize oil has many applications, including its use in pharmaceutical industry, manufacture of resins, plastics, lubricants and fuels. However, majority of oil produced is refined for direct consumption and for use by food industry. The reason for this is not far-

fetched. Maize oil when refined has neutral flavour; relatively high smoking point and can therefore withstand heat.

It is well documented that de-oiled kernel or meal of corn is better than that of whole grain of corn for poultry feed. If the oil remains in kernel, it is disintegrated in glycerin and free fatty acids; free glycerin acts as purgative in the stomach and intestine of poultry birds and cattle. Free fatty acids are also equally harmful for stomach and intestine. So extraction of oil from corn gives a harmless grain for cattle and poultry feeds.

IMPORTANCE OF MAIZE OIL PRODUCTION

Indian share's in the world production of oilseeds has been around 10%. Although, India is a major producer of oilseeds, per capita oil consumption in India is only 10.6 kg/annum, which is low as compared to 12.5 kg/annum in China, 20.8 kg/annum in Japan, 21.3 kg/annum in Brazil and 48.0 kg/annum in the USA. Vegetable oil consumption has increased following a rise in household incomes and consumer demands. India imports half of its edible oil requirement, making India, the world's third-largest importer of edible oil and third largest consumer of edible oil due to ever growing population. Currently, India accounts for 11.2% of vegetable oil import and 9.3% of edible oil consumption (India Law offices). India is the largest importer and third largest consumer of edible oils. The sources of edible oil are palm, soybean, mustard, sunflower, groundnut, cottonseed, coconut and olive oil. Among industrial oils, rice bran oil and cotton seed oil are gaining importance. The corn oil emerged in the USA. The large scale production of corn oil began in the 1910s. Since 1950s, developed countries have taken up the production of corn oil. Presently, corn oil makes a major proportion of edible oil consumption. Corn oil is used in margarine, soup, soap, in emulsions and paints as rust preventative and in many more products.

In India, most of the corn is used for feed industry and starch extraction. Germ used to be a waste product obtained after starch extraction from seed. Currently, germ is in demand because of its high oil content and utilization as a byproduct. Refined corn oil is considered to be the best edible oil used internationally. Considering the large planting area under corn and high unit production, commercial interest is now arousing in corn oil production. Cost benefit ratio in maize is highest due to its high productivity.

Over many decades maize has been meeting the requirements of human population for food, fodder, fuel and other innumerable number of industrial products such as oil, protein, starch, ethanol, etc. Due to ever-growing and increasing human population and its demands, the necessities and demands of oil is increasing at an alarming rate. In India, maize oil is used to blend with other oils, because of vast nutritional quality embedded in it such as vitamin E (tocopherol), sitosterol and linoleic acid which are indispensable essential fatty acids. Maize has the highest productivity as compared to other crops. Therefore, the target of attaining self-sufficiency in oil can be fulfilled through this crop.

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Pre-cooling of Fruits and Vegetables

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Development of modern storage structures has made possible long term storage of fresh fruits and vegetables. Storage helps in orderly marketing, controlling market glut and preservation of quality of horticultural produce for much longer time. Storage aims to control various physiological and biological processes and keep the produce in maximum usable form. Hence, pre-cooling plays an important role to prolong the storage life of fruits and vegetables by removing the field / respiratory heat and by reducing the metabolic activities.

Field heat can cause rapid deterioration of some horticulturalcrops and, therefore, it is desirable to remove this heat asquickly as possible after harvesting. Delay between harvesting and cooling can result indirect losses shelf life and quality of fruits. Numbers of techniques such as pre-cooling, storing atvarious temperatures and coating with different edible/non-edible materials are applied to prolong the shelf life. Temperature is the most important environmental factor that will influence the deterioration of harvested fruits, hence its management during various postharvest operations like pre-cooling, handling and storage plays a major role for extending the shelf-life. Precooling can immediately lower the field heat of commodity following harvest, and slow down metabolism and reduce deterioration prior to transport or storage. Pre-cooling of fruits harvested in temperate regions has been observed to be useful in extending the storage life and maintaining the qualities, thereby getting better market price. Similarly, low-temperature storage has been one of the most effective methods for maintaining the quality of most of the fruits and vegetables. This method reduces the rate of respiration, ethylene production, ripening, senescence, undesirable metabolic changes and further decay.

PRE-COOLING TEMPERATURE

Generally, horticultural produce are cooled to their storage temperature i.e., For example, grapes are cooled to1-4°C, potato to 5–9°C, and (Do not wash with water).Mango, tomato & banana to be cooled to > 10 °C. All fruits and vegetables are mostly cooled by room cooling and or mechanical refrigeration.

ADVANTAGES OF PRE-COOLING

- Inhibition of the growth of decay causing organisms,
- Restriction of the enzyme activities,
- Reduction of water loss from the harvested produce,
- Reduction in rate of respiration and ethylene(C_2H_4) liberation, and
- Rapid wound healing.

METHODS OF PRE-COOLING

Several effective methods for rapid removal of heat from produce are in commercial use. The choice of method depends largely on the perishability and refrigeration equipment of the produce its adaptability to a specific method and the availability of facilities.

Air cooling: Horticultural produce is placed in a room and allowed to cool by cold air. Room is insulated and air is cooled by refrigeration unit.It is a slow method and also called room cooling**.**Its cost is relatively low. Here heat transfer takes place by conduction.Allfruits and vegetables can be cooled.

Hydro-cooling: Produce is cooled by cold water either by immersion or showering water. Heat transfer takes place by conduction and convection. Heat transfer is faster than air - cooling but it is more expensive method than room cooling. Producedoes not dehydrate but get clean by reducing the primary inoculum load. Stem, leafy vegetables, some fruits and fruit type vegetables can be cooled by this method.

Forced - Air cooling: Here, cold air is forced through the stacked product and it allows more rapid heat removal. It is generally 75 – 90% faster than room cooling.But it causes dehydration of fresh produce; to avoid this humidified air is used.Desert cooler can be used.It is most appropriative in dry climate and for chilling sensitive produce. Fruits and fruit type vegetables, tubers and cauliflower can be cooled by this method

Vacuum cooling: Vacuum cooling is based on the principle of latent heat of vaporization of water. It is very rapid and energy efficient pre-cooling method. Vacuum is created in an airtight chamber by evacuation of air. Atreduced pressure (4.6 mm Hg) water on the surface of the produce rapidly evaporates, which removes the field heat. Vacuum coolers are expensive to purchase and to operate; hence it can only be used on a limited range of produce. Some stem, leafy and flower type vegetables can be cooled by this method.

Packaged –icing: Here, boxes of the produce are cooled by keeping the crushed or flaked ice on top of the produce. Ice melts and cold water runs down through the produce, which cools the produce. Produce is cooled faster than air forced but product and packaging must tolerate the contact with water and ice. There should be appropriate holes in packages for water drainage.Root, stem, some flower type vegetables, green onions and Brussel's sprouts can be pre-cooled with this method.

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