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Backyard Japanese Quail Farming

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Production Technology for Papaya

[*1]S. P. Mishra, [2]A. K. Padhiary, [3]S. Behera and [4]S. N. Mishra

*[*1]Krishi Vigyan Kendra,Jagatsingpur, Odisha, India*
[2]Krishi Vigyan Kendra, RRTTS Campus (OUAT) Chiplima, Sambalpur 768026 Odisha, India
[3]Krishi Vigyan Kendra, kalahandi,Bhabanipatna, Odisha, India
[4]Dept of Agricultural Economics,College of Agriculture,OUAT, Odisha, India
**Corrosponding Author: sibahort@gmail.com*

Papaya (Carica papaya L.) a popular crop worldwide, is highly amenable for rural livelihood development programmes because of ease of its cultivation, quick returns due to short crop cycle, suitability to integrated aqua-horticulture, adaptability to diverse soil and climatic conditions and diverse usage of its raw and ripe fruits. Besides, it is a rich source of Vitamin A, Vitamin C, protein and minerals and can contribute significantly towards nutritional requirements of the rural and tribal masses. It improves digestion and cases chronic constipation, Papain, a valuable proteolytic enzyme extracted from unripe fruits also has medicinal and industrial use.

Climate and Soil

Papaya can be successfully grown under warm and humid tropical and sub-tropical climatic conditions at an altitude below 1000 meters. It can be grown in a wide range of temperature regime between 38-48^{0}C and above 10^0 C in winters. It is sensitive to temperatures below 10^0 C and frost. Well drained, medium black to red loamy soils are suitable for papaya. Calcareous and stony soils, and water logging are detrimental to papaya plants. In high rainfall regions, it should be grown on wide raised beds with suitable arrangements for quick drainage.

Propagation

Papaya should be propagated by pure seeds obtained from reliable sources. The seedlings have to be raised in nursery for better germination and seedling health. The papaya seedlings can be raised from middle of June to the end of October. For dioecious varieties, about 100g of seeds and in case of gynodioecious varieties 30 to 40g of seeds are required per acre. Seeds may loose viability quickly if stored with high moisture content or if sun dried. Soaking seeds with 100 ppm Gibberalic Acid (GA) solution for 8 hours enhances germination. Black polythene bags (size: 20 x15cm: 150 gauge thick) with drainage holes, filled with a mixture of farm yard manure, red soil and sand in equal proportions, should be used for raising seedling. Seeds germinate in about 2 to 3 weeks time depending on the temperature. Seedlings should be protected from diseases and insect pests, and irrigated regularly during the growth period. Generally, 45 to 60 days old seedlings of 15-20cm height are preferred to planting.

Spacing and Planting

Prior to transplanting, the main field should be well tilled by repeated ploughing and harrowing. Pits of 45 cm^3 dug at the spacing of 1.8m x 1.8m, should be exposed to sun and then filled back with mixture of top-soil and farmyard manure. Transplanting should be done in the evening or on a cloudy day. Seedling must be protected from excessive sunlight and heat and watered twice a day. In case of dioecious varieties, three seedlings are planted in each pit, 15cm apart and early flowering males among them are removed so as to maintain only one male plant for every ten female plants. In case of gynodioecious varieties like Coorg Honey Dew, Sunrise Solo, Pusa Delicious and Pusa Majestry, one seedling is planted in each pit.

VARIETIES

In India, there are two basic types of varieties – 'dioecious' that produce separate female and male plants and 'gynodioecious' that produce female and hermaphrodite plants. Coorg Honey Dew, Pusa Delicious, Pusa Dwarft, CO. 3, Pusa Nanha, Arka Surya and Arka Prabhath are important varieties of papaya grown in India.

Coorg Honey Dew	It is a gynodioecious, semi dwarf selection from Honey Dew made at the Chettalli Station of the Indian Institute of Horticultural Research. Plants are dearf and heavy yielder. The fruits are of excellent quality and are used for table purpose and papain extraction. It also yields high papain. Fruits are big weighing 2 to 3 kg dark green in colour with slight ridging skin surface, oval from hermaphrodite trees and avoid from female trees, with TSS 13.5^0 Brix yellow pulp, large cavity and less keeping quality *(Source: Central Horticultural Experiment Station, Chettalli, Karnataka).*
CO-3	This is a gynodioecious hybrid for table purpose from the cross of CO-2 x Sunrise Solo released from Tamil Nadu Agriculture University, Coimbatore. Fruits are abovate smooth, weighing about 800g and firm with medium cavity, red pulp, TSS 13.5^0 Brix and good keeping quality. It yields about 60 to 65 kg/plant during the bearing period of two years. *(Source: Tamilnadu Agriculture University, Coimbatore, Tamilnadu)*
Arka Surya	It is advanced generation hybrid from the cross Sunrise Solo x Pink Flesh Sweet. The fruits are medium sized weighing about 600-800g with good keeping quality. The pulp is deep pink and firm with TSS $13\text{-}14^0$ Brix. Fruit yield is 60-70 kg/plant for 28 months cropping period. *(Source: Indian Institute of Horticultural Research, Bengaluru, Karnataka.)*
Arka Prabhath	It is an advanced generation hybrid from the cross (Surya xTainung-1 x Local Dwarf). The fruits are big sized weighing 900-1200 g, firm and deep pink in colour with TSS $13\text{-}14^0$ Brix and good keeping quality. The average yield is 90-100kg/plant. (*Source: Indian Institute of Horticultural Research, Bengaluru, Karnataka.)*
Pusa Nanha	It is a dioecious dwarf mutant having 120 cm height, bearing fruit at 30 cm height suited for high density planting (6,400 plants per hectare) and pot cultivation and tolerant to water logging. Fruits are medium

	sized, round to ovate in shape with thin, yellow pulp having TSS 8^0 Brix and low cavity. It yields about 63 tons/hectare and about 25-30kg/plant. *(Source: Indian Institute of Agriculture Research, New Delhi.)*
Pusa Delicious	It is a gynodioecious, high yielding variety developed by sib-mating the variety Ranchi. Plants are medium sized with first fruiting at 80 cm height, 253 days after planting. Fruits weigh 1 to 2 kg and have distinct flavor and moderate keeping quality. Pulp is deep orange, 4cm thick with TSS 10-13^0 Brix while seed cavity 14 x 8cm. It yields about 40-45kg/plant. *(Source: Indian Institute of Agriculture Research, New Delhi.)*
Pusa Dwarf	This is a dioecious selection from the variety Ranchi developed by sibmating. Plants are dwarf in stature bearing fruit at the height of 40cm, hence suitable for high density planting and kitchen garden. Fruits are oval round, medium sized, weighing about 1 to 1.5 kg. Pulp is yellow, moderately firm, 3.5 cm thick and cavity 12 x 8cm. TSS is between 5-8^0 Brix. It yields about 30-40kg/plant. *(Source: Indian Institute of Agriculture Research, New Delhi.)*

IRRIGATION

Papaya needs regular irrigation for its normal growth and fruit development. The crop should be irrigated once in 3 to 10 days in winter and 6 days in summer in medium soils. Each plant should be given 20-25 liters of water during summer, while 10-15 liters per day may be given in winter from coming into direct contact with the stem thus preventing collar rot. Water logging should be strictly avoided. Drip irrigation with 80% replenishment of evaporation losses is recommended.

Nutrient Management

Fertilizer application in a particular region depends on the soil and leaf analysis. Fertilizers should be applied once in every two months. Generally 90g Urea, 250g of Super phosphate and 140g of Muriate of Potash (MOP) per plant are recommended for each application. The fertilizer should be put in the irrigation ring and mixed thoroughly. Application of 10 kg farm yard manure/plant every six months, is also recommended in addition to fertilizers. Earthing of in collar region should not be done to avoid collar rot.

Interculture and Inercropping

Different vegetables can be profitably grown as intercrops during the pre-bearing age of first sixth months after planting, when papaya is grown as the main crop. The papaya tree itself can be grown as intercrop in fruit plantations of mango, litchi, sapota, coconut and arecanut plantations, when there is no shade in the inter-space. Hand digging and weeding at the beginning of rainy season and during January-February, are necessary to keep the papaya plot free of weeds. Inter cropping of cucurbits should be avoided.

HARVESTING AND YIELD

Flowering and fruit set takes place in about five months from transplanting. The harvesting of ripe fruit starts in about 9-10 months from transplanting. Harvestin can be done by hand picking when mature fruits show streaks of yellow colouration. The fruits are damaged by birds if allowed to ripen fully on tree. At the time of picking, the fruits should not be allowed to drop on the ground or come in contact with the soil. The number of fruits harvested per tree in a year varies from 25 to 30 depending on soil, climatic conditions, varieties like Coog Honey Dew. Papaya may yield up to 75-100kg/plant in varieties like Coorg Honey Dew. Papaya yields for period up to three years.

Women's training & capacity building: Training and extension management in Kondhamal district of odisha

[*1]S. P. Mishra, [2]A. K. Padhiary, [3]S. Behera and [4]S N Mishra

*[*1]Krishi Vigyan Kendra,Jagatsingpur, Odisha, India*
[2]Krishi Vigyan Kendra, RRTTS Campus (OUAT) Chiplima, Sambalpur 768026 Odisha, India
[3]Krishi Vigyan Kendra, Kalahandi,Bhabanipatna, Odisha, India
[4]Dept of Agricultural Economics,College of Agriculture,OUAT, Odisha, India
**Corresponding Author: sibahort@gmail.com*

Farmwomen of small and marginal families constituted about 76 percent of the farm community and had a greater role to play in agriculture. Enhancing food production and improving farming skills of three groups though extension approach was the primary aim of the scheme. The lady agricultural worker (LAWs) posted at the village level would play the critical role to provide extension and capacity building support to the target group of farmwomen.

PERSONS TO BE TRAINED: LADY AGRICULTURAL WORKER

Through training, extension and field visits of farmwomen the extension activities will emphasize on:

- Awareness building of women to the messages of increasing agricultural production.
- Accessibility of local agricultural/allied extension staff to farmwomen and vice versa in their households and an otherwise conservative society where women hardly interacted with those officials.
- Adaptability of messages like seed testing, seed treatment, planting of paddy seedling, maintenance of plant population, plant protection measures, rising of backyard kitchen garden etc.
- Preparation and use of bio fertilizer and its benefits for soil and agricultural practices in terms of production and productivity.
- Spread of crop diversification practices from pilot experiments like sunflower,off season vegetable, flower and fruit cultivation, mushroom cultivation, dairying, poultry, fishery, farmwomen.

ACTIVITIES

- They will provide training and extension support to women in agriculture belonging to small and marginal farm households, first to the women members in the household and then in the family approach.

- They will organize demonstration activities of improved agricultural practices and technology.
- They will organize study tours for farmwomen.
- They will introduce farm mechanization practice including irrigation technology.
- They will facilitate saving and credit activities.
- They will help farmwomen to go for non-farm and off farm activities and will facilitate for market linkage.

LADY AGRICULTURAL WORKERS (LAWS) TRAINING

A training programme was organized to undertake above activities. The duration of the training was 5 days and refresher courses will be organized from time to time.

Farming skills to be imparted:

Seed selection

- Selection of quality seed by salt water treatment.
- Germination testing.

Seed Treatment

- Seed treatment of paddy and millets.
- Seed treatment of vegetable crops.
- Seed treatment of turmeric and ginger.
- Seed treatment of tuber crop.

Manure/bio-fertilizers/chemical fertilizers

- Preparation of enriched farmyard manure
- Application of rhizobium culture.
- Production of Azolla and its application.
- Urea blended with need cake.
- Band placement of fertilizer.
- Micro-nutrient application.

Plant protection

- Preparation of pesticide spray solution.
- Preparation of Bordeaux mixture.
- Root dip.

Agronomical Practices

- Erect and shallow transplanting of paddy.
- Line showing
- Row transplanting.

Technology for Storage, etc,

- Rodent control
- Fumigation of grains
- Storage practices
- Sprayer
- Winnower
- Thresher

Procurement

- Quality and grading, moisture level study;
- Cleaning of foreign materials.
- Pricing

Managerial Skill

- Credit Management
- Production planning;
- Procurement Planning;
- Review and monitoring;
- Conflict Resolution;
- Forward linkages.

CROP PLANNING AND PRODUCTION MANAGEMENT

- Providing extension and credit support to farmwomen.
- Share cropping
- Lease/contract farming.
- Networking with NGOs in various parts of India located in different agro-climatic conditions to grow crops organically and procure those crops from them like cumin seed, spices from Kerala etc.

The different practices are to be tried as demonstration to find the economics for future crop planning. Studies show that contract farming gives best economies but it may vary from place to place and crop to crop. The following crops will be cultivated adopting organic farming and other practices in different ways

Crops

- Rice (Basmati- indigenous)
- Wheat
- Maize
- Ragi
- Minor millets
- Blackgram (dehusked)
- Spices (termerc, ginger, chilli, pepper, coriander, cumin seed, etc. through self and networking.
- Pulses (arhar/kandul/razma/baila/bean/horsegram/greengram)
- Methi green
- Broccoli
- Mustard
- Tapioca
- Zinger

Nutritional management of goat for sustainable production

Dipak Dey[1], Bharti Sharma[1], Avinesh Sharma[2] and Zahid Bashir Khanday[2]

[1]Ph.D. Scholar, [2] M.V.Sc. Scholar
Animal Nutrition Division,
ICAR - National Dairy Research Institute, Karnal, Haryana-132001

Livestock contribute about 40% of global agricultural GDP. Contribution of livestock sector in Indian Agriculture and National GDP is 26.1% is 3.9% (Livestock Census, 2012). Contribution of Goat to nation's milk and meat production is about 4% and 19% (BAHS, 2015). Goat is called poor man's cow. Domestic goats (*Capra hircus*) are classified under small ruminant. Goat provides milk, meat, hair, pashmina, leather and mohair. Goat farming have many advantages than other livestock species. Goat can be reared in all types of climatic conditions, cold, tropics, arid and semi aried.

. The main aim of goat feeding is to feed as much forage as possible and satisfy the largest part of nutrient requirements. The higher the quality of the roughage, the higher the intake and performance with goats on all roughage diets Hegde, N. G. (2006). The voluntary intake of lactating goat is 50 to 100% higher than dry animals (Silanikove, N., 2000). Goats should be fed according to established nutrient requirements for proper growth of young animals and long-term maintenance of body weight, body condition. Body weight and condition of goats may vary considerably during different parts of the grazing and reproductive cycles .

FEEDING BEHAVIOUR OF GOAT

- Young kids start nibbling at hay or grass at 2 -3 weeks of age and by 3 -4 months of time their rumen is fully developed.
- Goats consume a wide variety of feeds and vegetation and are able to graze on very short grass.
- Goats can distinguish between bitter, sweet, salty and sour tastes.
- Goats will consume certain plants at definite stages of maturity and reject them at other times.
- Goats can take care of their maintenance, but there is slow rate of growth if allowed to browse for about 8 -9 hours a day.
- In order to produce large quantities of milk or to grow quickly and yield high quality meat, they must have additional leguminous forages as well as concentrate feeds as per recommendation.

DRY MATTER REQUIREMENT:

The dry matter intake is an important consideration since it reflects the capacity in terms of voluntary food intake. In meat type goat breeds the dry matter intake is on an average 3-4% of their live body weight. While in milch type goats it is 5-7% of their live body weight. On an average an adult goat needs about 3kg dry matter/100 kg body weight for maintenance, 3.5 to 4 kg for growth, 3-3.5 kg during pregnancy, 3.5-5.5 kg for lactation and 2.5 to 3.5 kg for meat and hair production (Pulina, *et al*., 2013).

ENERGY REQUIREMENT:

Energy plays a vital role is goat diets which affects the overall productivity and utilization of other nutrients. An average energy requirement for maintenance is 101 kcal ME/kg $W^{0.75}$/day. Energy requirement for growth have been found to be 7.25 kcal ME/g of gain in body weight. While for pregnancy it is 180 kcal ME/kg $W^{0.75}$/day. The daily energy requirement for milk production is found to be 1220 kcal/ME/kg 4% FCM. The diets deficient in energy causes growth retardation, delayed puberty, decrease in fertility rate and also lowers milk production. Prolonged energy deficiency in goat diet may lose the strength of resistance to infections and parasitic diseases. On the contrary excessive energy intake which leads to fat deposition is known to reduce quality of goat skin.

PROTEIN REQUIREMENT:

A minimum level of 6% total protein needs to be provided otherwise feed intake will be reduced. Additional protein is required in the diet for growth, pregnancy, lactation and mohair production.The daily average requirement of dietary proteins for maintenance is 20-30 g DCP/50 kg body weight and for milk production it is 60-70 g DCP/kg of milk produced. Adding concentrate to the ration will provide the additional protein needed. An excessive amount of protein in the diet of goats with light activity is also undesirable. The most commonly used protein supplements are linseed meal, soybean meal, brewers dried grains, and cotton seed meal. One of the most economical sources of protein is good quality *Lucerne* hay.A protein deficiency in goats diet results in anorexia loss of weight, poor hair growth, decreased milk yield, impaired reproduction, anaemia, digestive disturbances and oedema.

MINERAL REQUIREMENTS:

Goats have higher mineral requirement. Therefore, mineral mixture is added to the concentrate at 2% level. Salt should also be given liberally.

Mineral deficiencies rarely occur in goats as the common feeds and fodders used in goats feed provides adequate quantities of the important minerals. However some major minerals like sodium, chloride, calcium, phosphorus and sulphur are met while feeding the goats. Sodium chloride should be included in the concentrate mixture at the rate of 0.5%. Calcium requirement for maintenance is 4.7g/day while for milk production it is 1.3 g/kg of milk produced, whereas phosphorus requirement is 3.3

g/day for an adult goat. Provision of mineral licks/bricks in the shed is recommended to avoid occurrence of any deficiency.

VITAMIN REQUIREMENTS:

The goats are generally allowed 5-6 hours grazing which takes care of their vitamin A and vitamin D requirements. Therefore vitamin A and vitamin D deficiency rarely occurs in goats. However for stall fed goats these two vitamins should be necessarily supplied in their diet. The vitamin E and vitamin K requirements are satisfied from the browse, hence no additional care is needed in this regard. Vitamin B complex is not dietary essential as it is synthesized by ruminal micro-organisms. However this vitamin should be included in diets of very young kids nursed by their dams

FEEDING OF DIFFERENT CATEGORIES OF GOATS

Feeding of Kids

From 1.9 to 5 kg. From birth up to 3rd day, the kids are given mothers milk i.e. colostrum. Colostrum should be fed to the new born kids within 15 minutes after birth. After 3rd day the quantity of milk to be given to kids is reduced to about 100 ml/day. It is required to provide them a balanced starter feed known as 'creep ration' up to 60 days of age. The creep ration contains 14-18% DCP and 65-70% TDN. During 7th day to 40th day of age 4-5 times feeding is done and from 41st-60th day, 3 times creep feeding is done. At the end of 60th day i.e. weaning age the body weight of young one between 3-4 times more than the birth weight i.e. ranging to about 7-10 kg (Kumar, et. al., 2014).

Table 1. Milk feeding schedule of kids

Month	Amount of body weight	No of times fed
First month	1/6th of body eight	3
Second month	1/8th of body eight	2
Third month	1/10th of body eight	2

Feeding of Growers

After weaning period, the goats are fed with grower ration containing 9-10% DCP and 60-65% TDN. The grower period is of 1 year duration during this period goat attains about 1/3rd of its nature body weight. Thus expected body weight at the completion of 1 year is 18-20 kg.

Feeding of Finishers

The finishing period of goat, depends upon the market tendency, so as to sell it at different body weights. Generally goats are marketed at the overage body weight of 20-30 kg. The DCP content of finisher ration is 5-6% and TDN 60-65%.. For producing fatty carcasses, high-energy cereal grains should be included in the concentrate mixture.

Feeding of Replacement stock

Most of the male and female kids are selected for breeding purpose; those are called as replacement stock. Feeding of such stock is adjusted so as to reach the sexual maturity and desirable body weight at 1 year of age. The desirable body weight at 1 year of age

for smaller breeds is 15-18 kg, whereas for larger breeds it is 20-25 kg. When sufficient good quality pasture is available for grazing, no supplementary feeding with concentrates is desirable, whereas during lean period about 250-500 g of concentrate mixture with 10-12% DCP and 68-70% TDN should be given to replacement stock. The concentrate mixture should be necessarily supplemented with mineral mixture or otherwise mineral licks should be provided in shed.

Feeding of breeding Bucks:

- During the breeding season, the buck (breeding male goat) should be fed with the same concentrate mixture fed to the does at the rate of 450 to 900 g daily.
- They require about 3-3.5% concentrate mixture of total body weight. Averagely breeding bucks need 500 g to 1 kg concentrate and yearlings about 250 g.
- Provide roughage free of choice along With clean fresh water and minerals.
- Do not allow the buck to get too fat.
- To prevent this, reduce the intake of energy feeds. Make sure the buck gets plenty of exercise.

Feeding of Non-breeding bucks

Bucks may normally be fed with 1.35 kg of *berseem* or other legume hay, 0.5kg of silage and 750 g grain a day. During breeding season the grain mixture ration for mature bucks may be increased to about 900 g per head per day. When the bucks are on good pasture, no grain feeding is necessary.

FEEDING OF DRY GOATS

For the non-lactating i.e. dry goats, if sufficient grazing facilities are available, the maintenance requirements get satisfied by sufficient hours of grazing on good quality pasture. However, during shortage of pasture, 200 g to concentrate mixture with 5-6% DCP and 55-60% TDN should be fed. For milch type dry goats 30% of dry matter should be fulfilled by concentrate mixture.

Feeding of Pregnant goats

A ration containing 25% DCP and about 55-60% TDN should be given to about 300-500 g, however for pregnant but lactating goats 300-400 g of concentrate mixture/kg of milk produced should be given in addition to maintenance amount of 150 g/day. A free choice mineral licks should be made available. After kidding, feed bran mash for a few days, gradually bringing the doe to the full feed for milk production.

Feeding of Lactating goats

- For adult doe in lactation about 400 g of concentrate mixture must be given for every litre of milk produced and over and above that 150 g should be added for maintenance.
- A concentrate mixture for lactating goats should contain about 9-10% DCP and 60-65% TDN.
- To supplement more nutrients particularly of energy and protein, grain mixture should be given at the rate of 350 g for each litre of milk. A suitable grain mixture can be prepared by mixing 100 kg maize, 100 kg oats, 50 kg of bran, and 25 kg of oilcake.

- The protein per cent may vary from 14 to 16%, which may be fed in two lots at the time of morning and evening milking.
- Add one per cent trace mineralized salt and one per cent calcium-phosphorus mineral mixture to concentrate mixture.
- Molasses (5 to 7%) of concentrate mixture may be used to increase palatability and to reduce dustiness of feed.
- The concentrate should be fed on individual requirement basis of each doe. This can be done most easily by feeding the concentrate at milking time.

Feeding of fibre producing goats: The Pashmina and Angora goat breeds are well known for their quality hair fibre production. For Pashmina fibre and Mohair production the protein and energy content of the ration should be high. Their native tract is a hilly area which justifies more energy requirement for grazing. Also trace minerals like Cu, Zn, should also be provided in the diet in the required quantity. Fibre yielding breeds viz., Angora, Gaddi and Pashmina goats require more energy in the diets after shearing, especially during cold weather that can be facilitated by good quality roughages in the diet.

Water requirement of goats: Goats should be provided with *ad libitum* clean water. On an average an adult goat drinks about 400-700 ml. water/day. Environmental temperature, lactation level, amount of body fat, age, water content of forage, exercise, salt and mineral content of ration at influences the total water intake. The mean DM, free water intake ratio for goats should be 1:1.2.

CONCLUSION

Goat is a elite animal. Goat are able to maintain body condition at very low quality feed with very good feed conversion ratio. So goat can be maintained at low quality feed and fodder. The requirment of feed and nutrients should be ccording to standard suggestions. In goat rearing medical and maintain cost is also very low/ So goat is called blessing for people. The goat rearing through proper way can uplipt income of poor people to sustained livelihood.

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Remote sensing applications in precision Agriculture

S. Alagappan

Ph.D. Research Scholar
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003, India.
**Corresponding Author: alga.s@rediffmail.com*

DEFINITION OF PRECISION AGRICULTURE

"Precision Farming is the title given to a method of crop management by which areas of land/crop within a field may be managed with different levels of input depending upon the yield potential of the crop in that particular area of land. The benefits of so doing are two fold:

I. The cost of producing the crop in that area can be reduced and,
II. The risk of environmental pollution from agrochemicals applied at levels greater than those required by the crop can be reduced" (Earl et al, 1996).

Precision farming is an integrated agricultural management system incorporating several technologies. The technological tools often include the

a. Global Positioning System (GPS),
b. Geographical Information System (GIS),
c. Yield Monitor (YM),
d. Variable Rate Technology (VRT), and
e. Remote sensing (RS).

The *global positioning system* ("GPS") is a network of satellites developed for and managed by the U.S. Defense Department. The GPS constellation of 24 satellites orbiting the earth, transmit precise satellite time and location information to ground receivers. The ground receiving units are able to receive this location information from several satellites at a time for use in calculating a triangulation fix thus determining the exact location of the receiver.

A *geographical information system* ("GIS") consists of a computer software data base system used to input, store, retrieve, analyze, and display, in map like form, spatially referenced geographical information.

Yield monitors ("YM") are crop yield measuring devices installed on harvesting equipment. The yield data from the monitor is recorded and stored at regular intervals along with positional data received from the GPS unit. GIS software takes the yield data and produces yield maps.

Variable rate technology **("VRT")** consists of farm field equipment with the ability to precisely control the rate of application of crop inputs and tillage operations.
Remote sensing ("RS") image data from the soil and crops is processed and then added to the GIS database.

GOAL OF PRECISION FARMING

1. The goal of precision farming is to gather and analyze information about the variability of soil and crop conditions in order to maximize the efficiency of crop inputs within small areas of the farm field. To meet this efficiency goal the variability within the field must be controllable.
2. Efficiency in the use of crop inputs means that fewer crop inputs such as fertilizer and chemicals will be used and placed where needed. The benefits from this efficiency will be both economical and environmental. Environmental costs are difficult to quantify in monetary terms. The reduction of soil and groundwater pollution from farming activities has a desirable benefit to the farmer and to society.

APPLICATION OF REMOTE SENSING IN PRECISION AGRICULTURE

Soil and Drainage Maps

Soil maps are also sometimes used to determine management zones. Soil maps are becoming part of the GIS database.

The grid sampling technique takes separate soil samples from uniform sized grids laid out over the field. A problem with this type of sampling is the variability that can exist in soil types within each grid. This variability makes it much tougher to determine soil characteristics within the grid for crop input management purposes. To minimize this problem smaller grids are required which then requires many more soil samples to be take for a larger number of grids. Soil samples can become a major cost of precision farming.

An alternative to grid sampling is targeted or zone sampling. The soil samples are located in homogeneous management zones instead of uniformly spaced grids (Searcy, 1997). The zones are laid out using a process similar to computer based unsupervised image classification. Images obtained from multispectral remote sensors are taken of the vegetated areas of the field. The pixel digital numbers for each band are separated into statistically separable clusters that are classified into homogeneous zones. This cuts down on the soil, terrain, plant growth, and other variability within each area to be managed; thus fewer soil samples are needed for each area (Anderson et al, 1996).

Except for county soil surveys remote sensing has not gained wide acceptance as a mapping tool for soil characteristics. This is because "the reflectance characteristics of the desired soil properties (e.g., organic matter, texture, iron content) are often confused by variability in soil moisture content, surface roughness, climate factors, solar zenith angle, and view angle"(Moran et al, 1997).

Drainage Maps

Subsurface drainage tile lines that have been installed, as long as 50 or more years ago are still partially or totally functional today. Often the existence or location of older tile lines has been lost as landowners die or sell their property. Some states, including Iowa (Iowa Code, 1997), are now starting to require landowners to prepare and file drainage plats with county recorders when new tile lines are installed. It is desirable to have accurate drain tile maps for maintenance purposes or for the installation of new additional tile line systems. Installation of new tile lines may cut through old tile lines at unknown locations. Building livestock manure lagoons, which cut through old unknown and uncharted tile lines may cause environmental damage from manure leaking through the old tile lines.

Color infrared ("CIR") aerial photographs have been shown to be an effective tool in locating unknown subsurface tile lines. The image data is digitized for preprocessing and then geo-referenced using ground control points. The CIR photographs show different tones of gray depending on soil type and moisture. By filtering out spectral reflectance differences due to soil type, soil moisture content in dry soils that have a higher reflectance can be identified from lower reflectance wet soils. The resulting image shows were the tile lines are located and whether they are working properly (Verma et al, 1997).

Normal color aerial photographs can also be used to locate tile lines. Simple color photographs offer tile line images similar to CIR but at a lower cost. If the soil is too dry such as that shown in Figure 4.8 the tile lines will not be visible in the image. The images similar to Figure 4.9 must be acquired when the soil is bare and within a few days after an adequate rain. High resolution and on demand temporal availability make images acquired from aircraft platforms ideal for acquiring this kind of image data.

Variable Rate Technology (VRT)

One method of controlling variability within the field is VRT. VRT allows the grower to apply the quantity of crop inputs needed at a precise location in the field based on the individual characteristics of that location. Crop inputs that can be varied in their application commonly include tillage, fertilizer, weed control, insect control, plant variety, plant population, and irrigation. Typical VRT system components include a computer controller, GPS receiver, and GIS map database. The computer controller adjusts the equipment application rate of the crop input applied. The computer controller is integrated with the GIS database, which contains the flow rate instructions for the application equipment. A GPS receiver is linked to the computer. The computer controller uses the location coordinates from the GPS unit to find the equipment location on the map provided by the GIS unit. The computer controller reads the instructions from the GIS system and varies the rate of the crop input being applied as the equipment crosses the field. The computer controller will record the actual rates applied at each location in the field and store the information in the GIS system, thus maintaining precise field maps of materials applied. Although VRT can control inputs

applied to crops, it cannot control factors such as soil type, weather climate, and topography that are fixed.

Monitor Crop Health

Remote sensing data and images provide farmers with the ability to monitor the health and condition of crops. Multispectral remote sensing can detect reflected light that is not visible to the naked eye. The chlorophyll in the plant leaf reflects green light while absorbing most of the blue and red light waves emitted from the sun. Stressed plants reflect various wavelengths of light that are different from healthy plants. Healthy plants reflect more infrared energy from the spongy mesophyll plant leaf tissue than stressed plants. By being able to detect areas of plant stress before its becomes visible, farmers will have additional time to analyze the problem area and apply a treatment.

Water Stress

The use of remote sensors to directly measure soil moisture has had very limited success. Synthetic Aperture Radar ("SAR") sensors are sensitive to soil moisture and they have been used to directly measure soil moisture. SAR data requires extensive use of processing to remove surface induced noise such as soil surface roughness, vegetation, and topography. A crop evapo transpiration rate decrease is an indicator of crop water stress or other crop problems such as plant disease or insect infestation. Remote sensing images have been combined with a crop water stress index ("CWSI") model to measure field variations (Moran et al, 1997). Simple panchromatic aerial photographs have been used to spot irrigation equipment problems. Strips in the vegetation images point to problems with water application rates from defective water nozzles (Univ. of Georgia, 1995).

Weed Management

One goal of precision farming is to cut crop production inputs, which result in cost and environmental savings. Conventional farming methods apply herbicides to the entire field. Site-specific variable-rate application puts the herbicide where the weeds are. Aerial remote sensing has not yet proved to be very useful in monitoring and locating dispersed weed populations. Some difficulties encountered are that weeds often will be dispersed throughout a crop that is spectrally similar, and very large-scale high resolution images will be needed for detection and identification (Ryerson, Curran, P. and Stephens 1997). The use of machine vision technology systems to detect and identify weeds places remote sensors directly on the sprayer equipment. Being close to the crop allows for very high spatial resolutions. Machine vision systems have the ability to be used in the field with the real-time capabilities that are necessary to control sprayer equipment (Steward and Tian, 1998).

Insect Detection

Aerial or satellite remote sensing has not been successfully used to identify and locate insects directly. Indirect detection of insects through the detection of plant stress has generally not been used in annual crops. The economic injury level for treatment is usually exceeded by the time plant stress is detected by remote sensing. Entomologists

prefer to do direct in field scouting in order to detect insects in time for chemical treatments to be effective and economical.

Nutrient Stress

Plant nitrogen stress areas can be located in the field using high-resolution color infrared aerial images. The reflectance of near infrared, visible red and visible green wavelengths have a high correlation to the amount of applied nitrogen in the field. Canopy reflectance of red provides a good estimate of actual crop yields (GeopalaPillai, Tian, and Beal 1998).

Yield Forecasting

Plant tissue absorbs much of the red light band and is very reflective of energy in near infrared ("NIR") wavebands. The ratio of these two bands is referred to as the vegetation index ("VI"). The difference of red and NIR measurements divided by their sum is normalized difference VI ("NDVI"). For crops such as grain sorghum, production yields, leaf area index ("LAI"), crop height and biomass have been correlated with NDVI data obtained from multispectral images (Anderson et al, 1996). In order to get reasonably accurate yield predictions this data must be combined with input from weather models during the growing season (Moran et al, 1997).

Management Decision Support Systems

Just having information about variability within the field doesn't solve any problems unless there is some kind of decision support system ("DSS") in order to make VRT recommendations.

Russo and Dantinne (Russo et al, 1997) have suggested the following steps for a DSS:

1. Identify environmental and biological states and processes in the field that can be monitored and manipulated for the betterment of crop production.
2. Choose sensors and supporting equipment to record data on these states and processes.
3. Collect, store and communicate the field-recorded data.
4. Process and manipulate the data into useful information and knowledge.
5. Present the information and knowledge in a form that can be interpreted to make decisions.

Choose an action associated with a decision to change the identified state or process in a way that makes it more favorable to profitable crop production.

FUTURE PROSPECTS AND DEVELOPMENTS

Future satellite systems to be launched within the next year such as Ball Corporation's Quickbird will have a four-band multispectral pushbroom sensor with a resolution of .8 m panchromatic and 4.5 m multispectral. EarthWatch Incorporated of Longmont, Colorado will distribute Quickbird images. Future satellites will have better spatial and spectral resolutions. Launching more satellites will also improve temporal resolution. The delivery time of remote sensing data to the customer will improve. We will someday have real-time satellite remote sensing systems. University research will

concentrate more on the cause of soil and crop variability verses just being able to measure that variability. A greater emphasis will be placed on technology transfer from universities to commercial agribusiness industry.

Decision support systems will become the main link to convert the spatial data collected into detailed management recommendations at the farmer level. Decision support system is what will add the most value to remote sensing data for the farmer. The future of remote sensing in precision agriculture will depend upon meeting the needs of the end user, the farmer. Right now remote sensing for agricultural use is still in an early stage of commercial development with unproven economic benefits to the farm producer. The cost of remote sensing data and the other systems associated with precision agriculture will come down to be in line with the benefits received. This is likely to happen in the future as more agricultural information technology companies enter the marketplace.

Salt stress injury and resistance mechanism in plants

S. Alagappan

Ph.D. Research Scholar
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003, India.
**Corresponding Author: alga.s@rediffmail.com*

The term, 'salt-injury' refers to soils with substantial enough salt concentrations to affect mainly plant health, and subsequently affects soil properties, water quality and other land and soil resource uses.

Development of Salt-Affected Soils

A salt is a water-soluble compound that, in soil, may include calcium (Ca^{2+}) , magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), chloride (Cl^{-}), bicarbonate (HCO_3-), or sulfate (SO_4^{2-}). For example, Ca^{2+} and SO_4^{2-} form to make the salt gypsum ($CaSO_4 \cdot 2H_2O$). Salts in soil can develop from the weathering of primary minerals or be deposited by wind or water that carries salts from other locations. Salt-affected areas generally occur in semi-arid and arid climates where precipitation is not adequate to leach salts, causing them to remain in the soil profile. Salinization, the process of salt accumulation, most often occurs where surrounding soil or underlying parent material contains high levels of soluble minerals, where drainage through the soil is poor, where water ponds and evaporates, or where shallow water tables allow salty groundwater to move upward and deposit salts due to evaporation. Salinization can also occur when irrigation water containing high levels of soluble salts is applied to the land over a prolonged period. Additionally, certain fertilizers, amendments, and manure can contribute to salt accumulation in localized areas.

Effect of salt stress on crop growth and development

1. Germination

Seed germination in saline condition is affected by three ways. Increased osmotic pressure of the soil solution which restricts the absorption and entry of water into the seeds. Certain salt constituents are toxic to the embryo and seedlings. Anions like CO_3, NO_3, Cl^{-}, SO_4 are more harmful to seed germination. Salt stress hampers the metabolism of stored materials. Protease, enzyme catalyses the solubility of proteins to soluble nitrogen in seeds is inhibited by salinity. alfa - amylase activity is very much inhibited. Therefore starch to sugar conversion is prevented. Salinity delays the synthesis of nucleic acids and RNAase. Salinity exerts an inhibition of glyoxysomal catalase, malate

synthase and isocitrate lyase leads to reduction of glycerides and more of free fatty acids in oil seeds.

2.Vegetative growth

Due to accumulation of more ions in the soil as well as in the root zone, plants are unable to absorb water and thus water deficit stress condition is occurred in plants, which is termed as physiological drought. During vegetative stage, salt induced water stress causes closure of stomata leads to reduction in CO_2 assimilation and transpiration. Reduced turgor potential affects the leaf expansion. Because of reduction in leaf area, light interception is reduced, photosynthetic rate is affected which coupled with spurt in respiration, resulting into reduced biomass accumulation.

3. Photosynthetic

Accumulation of high concentration of Na^{2+} and Cl^- in chloroplast, photosynthesis is inhibited. Since photosynthetic electron transport appears relatively insensitive to salts, either carbon metabolism or photo phosphorylation may be affected. Photosynthetic enzyme or the enzymes responsible for carbon assimilation are very sensitive to the presence of NaCl.

4.Reproductive growth and yield

Under salt stress condition, the onset of flowing is delayed due to the limitations of source size. The quantum of reproductive structure such as number of flowers / panicle is very much reduced. Due to high deposition of salts in tissues, most of the metabolic processes such as synthesis of proteins, amino acids, sugars, starch and other organic compounds are altered. This disturbance in the normal metabolism affects the mobility of metabolites from the site of production to the site of utilization for reproductive growth. Therefore the development of reproductive structures and further maturation processes are very much affected which ultimately diminish the crop yield. Due to

imbalance of nutrients under salt stress, hormone synthesis is hampered leads to reduction in quantity as well as quality of crop produce.

CROP ADAPTATIONS TO SALT STRESS

Based on the responses to high concentration of salts, plants can be divided into two broad groups.

1) Halophytes
2) Glycophytes

Halophyte

Group of plants able to grow even in high saline conditions, which are otherwise called as salt tolerant types. They are native to saline soils.

Glycophytes (Literally "sweet plants") Nonhalophytes

They are sensitive plants and unable to grow under saline conditions. Most of the cultivated crop species belong to glycophytes. Glycophytes begin to show the signs of growth inhibition, leaf discoloration and loss of dry weight, when concentration of the salts reaches above the threshold level. Among the crops, maize, onion, citric lettuce and bean are highly sensitive to salt. Cotton and barley are moderately sensitive sugarbeet and date palms are highly tolerant.

MECHANISM OF SALT TOLERANCE

I. Avoidance: Avoidance is the process of keeping the salt ions away from the parts of the plant where they are harmful.

1.Salt Exclusion
2. Salt Extrusion
3. Salt Dilution
4. Compartmentation of ions

II. Tolerance

Osmotic adjustment

Hormone synthesis - ABA stress hormone, hardens plants against excess salts

Salt exclusion

The ability to exclude salts occurs through filtration at the surface of the root. Root membranes prevent salt from entering while allowing the water to pass through. The red mangrove is an example of a salt-excluding species.

Salt excretion/extrusion

Salt excreters remove salt through glands or bladders or cuticle located on each leaf. Salt bladders - eg) *Atriplex*, *Mesembryanthemum crystallinum L*. Salt glands - active process, selective for sodium and chloride(eg) Black and white mangroves Secretion through cuticle – eg) *Tamarix* Salt glands- dump sites for the excess salt absorbed in water from the soil; help plants adapt to life in saline environments.

Salt Dilution

By dilution of ions in the tissue of the plant by maintaining succulence. Plants achieve this by increasing their storage volume by developing thick, fleshy, succulent structures

Succulence is mainly a result of vacuoles of mesophyll cells filling with water and increasing in size. This mechanism is limited by the dilution capacity of plant tissues

a. Chenopodium quinoa salt gland, b. Salt glands of white mangrove. c. Close-up of epidermal bladder cells along the stems of M*esembryanthemum* Close-up of epidermal bladder cells along the stems of Mesembryanthemum

Compartmentation of ions

Organ level - high salts only in roots compared to shoots especially leaves. At cellular level- high salts in vacuoles than cytoplasm thus protecting enzymes

SALT TOLERANCE IN CROP PLANTS

1. Salt tolerance of cereal crops

Most of the major cereal crops exhibit high tolerance to soil salinity. In this group are sorghum, wheat, triticale, ripe, oats and barley. Only exceptions are corn and rice. All cereals tend to follow the same sensitivity or tolerance pattern in relation to their stage of growth. Seeding or early vegetative stage appears to be the most sensitive. With subsequent stages showing increased tolerance. The phenomenon has been reported for sorghum, wheat, barley, corn and rice. Salt stress can have a significant effect on the developmental process.

In the first phase: Leaf and spikelet primordial are initiated, leaf growth occurs and tiller buds are produced at the axils of the leaves. High salinity at this time reduces the no. of leaves per cubic the no. of spiklets per spike and no. of tillers per plant.

In the Second phase: Tillers grow, main stem and tiller culms elongate and the final no. of florets is set. Salinity stress during this phase affects tiller survival and reduces the no. of functional floats / spikelets. This phase ends with anthesis.

During the final phase: Carpet fertilization and grain filling occur during the final phase. At this time, salinity affects seed number and seed size. The effect of salinity on spikelet and tiller number established during phase I has a greater influence on final seed yield than the effects exerted on yield components in the latter two phases.

2. Salt tolerance of vegetable crops

Vegetable crops tend to fall into more sensitive salt – tolerant categories. The only notable exceptions are asparagus and red beet under marginal conditions of salinity, the growth of many vegetables is stunted without showing visible injury symptoms. At high salinity levels, some vegetables exhibit pronounced injury symptoms in the later stages of growth. Bean leaves develop a marginal chlorosis-necrosis with an upward cupping of the leaves. Onions have also been shown to develop a leaf necrosis. In addition to

growth suppression, some vegetable crops exhibit symptoms of nutritional imbalance of deficiency. Some lettuce cultivars develop calcium deficiency symptoms when SO_4 level in the soils is too high. Excess calcium may restrict the uptake of potassium which may be a factor in reduced yield of bean and carrot. Vegetable crops produced on saline soil are not of prime market quality. For e.g. smaller fruit size of tomato and pepper sand reduced petiole length of early misshapen potatoes. But in carrots and asparagus, the flavor is enhanced by a measurable increase in sugar content. When grows under saline conditions. Similarly in tomatoes total soluble solids is significantly increased as salt stress is increased.

3. Salt tolerance of fruit trees and vine crops

Most fruit trees are relatively sensitive to salinity. Stone fruits, citrus and avocado have all shown specific sensitivity to foliar accumulations of Cl^- and Na+. The accumulation of these ions to harmful levels contributes to the reduction in tree growth and fruit yield. Chloride toxicity in woody plants is more severe and is observed on a wide range of species than Na+ toxicity. The initial symptoms of excess chloride accumulation are leaf tip necrosis developing into marginal necrosis. With citrus, a chlorosis and bronzing of the leaves occur without a well defined necrosis. As Cl^- continues to accumulate, the effects become more severe with premature leaf drop, complete defoliation, twig dieback in extreme cases death of the vine. Injury by Na+ can occur of concentration as low as 5 mol m^{-3} in the soil solution. The injury symptoms are characterized as tip, marginal or interveinal chlorosis. Initially, Na+ is thought to be retained in sap wood of the stem. With the conversion of sap wood to heartwood, Na+ is released and then translocated to the leaves causing leaf burn. This may explain why stone fruits and grapes appear to be more sensitive to salinity as the plants grow older. With succeeding years, the Cl^- and Ha+ accumulate were rapidly in the leaves, causing leaf burn to develop earlier and with severity.

4. Salt tolerance of ornamentals, trees and flowers

A limited number of floricultural plants have been tested for salt tolerance. Chrysanthemum, carnation and stock are considered moderately tolerant to salt stress. Aster, poinsettia, gladiolus, gerbera, amaryllis, and African violet are considered somewhat sensitive. In woody ornamentals and trees, the type of injury is similar to damage recorded for fruits trees and vines.

Mitigation of Salt Stress

Seed hardening with NaCl (10 mM concentration)
Application of gypsum @ 50% Gypsum Requirement (GR)
Incorporation of daincha (6.25 t/ha) in soil before planting
Foliar spray of 0.5 ppm brassinolode for increasing photosynthetic activity
Foliar spray of 2% DAP + 1% KCl (MOP) during critical stages
Spray of 100 ppm salicylic acid
Spray of 40 ppm of NAA for arresting pre-mature fall of flowers / buds / fruits
Extra dose of nitrogen (25%) in excess of the recommended
Split application of N and K fertilizers

Seed treatment + soil application + foliar spray of Pink Pigmented Facultative Methnaotrops (PPFM) @ 106 as a source of cytokinins

The factors that determine the accumulation of salt in a soil are as follows:

Source of salt (local weathering, surface and subsurface waters, human activities);

Transporting agents accumulating salts from large areas to smaller deposits as well as from thick geological strata to thinner horizons (usually water, wind);

Limited vertical or horizontal drainage conditions;

Driving force for movement of solution, usually relief (surface runoff),

Hydraulic gradient (groundwater flow), suction (capillary transport) or concentration gradient (diffusion);

Negative water balance (evapo-transpiration greater than precipitation).

Continental salt accumulation due to intense weathering and arid climate or due to hydro-geological conditions (e.g. closed evaporative basins).

Human induced salt accumulation due to improper land use (e.g. irrigation, fertilizer application).

Major categories of salt affected soils:

Saline soil (Solonchak) with high amount of water soluble soils.

Alkaline soil (Solonetz), high alkalinity and high Exchangeable Sodium Percentage (ESP).

Magnesium soil: high magnesium content in the soil solution.

Gypsiferous soil: strong gypsum or calcium sulphate ($CaSO_4$) accumulation.

Acid sulphate soil: highly acidic iron or aluminum sulphate accumulation.

Black Alkali soils: contains high amounts of carbonates and bicarbonates of Sodium.

White Alkali soils: contains high amount of chlorides and sulphates of Sodium

Oxidative Stress Mechanism:

Green cells in plants functioning in aerobic environment are subjected to continuous threat from oxygen which due to partial reduction forms Toxic Reactive Oxygen Species(TROS) or Reactive Oxygen Species(ROS) like superoxide(O_2),hydrogen peroxide (H_2O_2) and hydroxyl radicals (OH) etc.

ROS degrades proteins, lipids, nucleic acids and distort biological membrane.

Plants have both enzymic and non enzymic antioxidants to fight against toxic oxygen species and protect them from oxidative stress

The best antioxidant produced by plant against ROS is ABA. (salt affected situation).

Salt tolerance crops:

Salt sensitive crops:

Maize ,Onion, Citric Lettuce and Beans.

Moderately Sensitive Crops:

Cotton and Barley.

Highly salt tolerant crops:

Sugar beet and Date palms.

Problem Soil Amendments:

Sulfuric Acid (H_2SO_4): In soils with free lime (calcareous), sulfuric acid is an effective amendment for correcting or preventing sodium problems: Can be applied to soil or water-run. Rates are commonly 1-3 tons/acre.

Sulfuric acid* can be used instead of gypsum on calcareous ($CaCO_3$ containing) soil only.

Elemental Sulfur: 97% Sulfur: Effective acid-forming amendment: soil microorganisms use S to produce sulfuric acid. The sulfuric acid reacts with $CaCO_3$ to release Ca. Requires microbial activity to react. May take months to react completely.

Elemental sulfur can also be used as an alternative to gypsum on calcareous soils

Nitro-Sul (Ammonium Polysulfide) : 20% NH_4-N, 40-45% sulfur

Causes release of acidity after microbial oxidation

In some, but not all, cases applications increase rate of water infiltration

Relatively expensive as a source of N or S.

Thio-Sul (Ammonium Thiosulfate) : 12% NH_4-N, 26% S

Releases small amounts of acidity. Is used mostly as a fertilizer.

N-Phuric (urea + sulfuric acid) : 10-28% N, 9-18% S

Safer way to use sulfuric acid, Releases acidity and Good for drip or micro sprinkler systems.

Conclusion

By adopting above soil amendments we can restore soil health and structure vegetation, Recreate ecological function of soils, Decrease bioavailability of toxic pollutants, Decrease erosion and improve soil drainage, Reduce costs compared to traditional remediation techniques and may abate acid mine drainage. and the main Threats to Indian agriculture in future is due to the Invasive Alien Species, Abiotic Stresses, Biotic Stresses, Market factors, Climate Change, Constraints in the exchange of genetic resources, Intellectual Property Rights (IPR) and access to technologies, Diminishing support to public on good research and Increasing population (By 2030 India will be World No.1) crossing the level of 130 crores.

Water Management in Rice in Indo-Gangetic Plains

*Balwinder Singh Dhillon, A.P.S. Dhaliwal and J. S. Brar

Krishi Vigyan Kendra, Bathinda (Punjab)
**Corresponding Author: kvkbtd@pau.edu*

Abstract

Rice-wheat (RW) is the dominant cropping system of the Indo-Gangetic Plains (IGP) regions. It covers approximately 13.5 million ha of arable land which provides food to about 400 million peoples. There are groundwater-level variations, groundwater quality and groundwater storage within the top 200 meters of the IGP aquifer system. It found that the water-table within the IGP alluvial aquifer "is typically shallow (less than five meters below ground level) and relatively stable since at least 2000 throughout much of this regions, with some important exceptions." In areas of high groundwater extraction – in northwest India – the water table can be more than 20 meters below ground level and is falling at rates of more than one millimeter every year.

INTRODUCTION

Rice is a semi-aquatic plant requires near submergence. Submergence helps in suppressing weed growth and more availability of certain nutrients. This crop is strongly influenced by water supply. Water should be kept standing in the field throughout the growth period. Excess/limited/no water leads to reduction in yield of paddy. The daily consumptive use of paddy is 6-10 mm. Total water requirement of paddy is 1200-1400 mm. Finally, 2000-3000 litres of water required to produce one kg of rice. Highly saline and brackish water not good for irrigation.

Table 1. Water requirement of rice crop at different growth stages

Stages of growth	Avg. water requirement (mm)	% of total water requirement (approx.)
Nursery	50-60	5
Main field preparation	200-250	20
Planting to Panicle initiation (PI)	400-550	40
P.I to flowering	400-450	30
flowering to maturity	100-150	5
Total	**1200-1460**	**100.0**

Table 2. Depth of water to be maintained during different crop growth stages of rice

Stage of crop	Depth of water (cm)
At transplanting	2-3cm (Shallow)
After transplanting (5 to 20 days)	4- 5cm
During tillering (22 to 42 days)	2-3cm (Shallow)
Reproductive stage, panicle emergence, booting, heading & flowering	4 -5cm
Ripening stage (21 days after full flowering), milk stage, dough stage & maturity	Drain the field gradually to Saturation Withdraw water 12 days before Harvesting

CRITICAL STAGES OF WATER REQUIREMENT

Critical stage refers to a stage when water scarcity or deficit of water causes comparatively greater reduction in yields which cannot be made by favourable water supply at earlier or later stages. Hence, water deficit during these stages should be avoided. Following are the important critical crop growth stages for water stress.

The growth stages of rice are tillering, panicle initiation, boot leaf stage, heading/panicle emergence and flowering/anthesis (reproductive phase). During these stages, soil moisture level should be maintained at saturation level. If soil moisture stress at active tillering phase, then there is 30% yield reduction and if moisture stress at reproductive phase, then 50-60% reduction in yield of paddy.

RECOMMENDATIONS OF EFFICIENT WATER MANAGEMENT IN RICE

- **Ploughing**

Summer ploughing minimizes water requirement for land preparation. One ploughing by mould-board plough and puddling twice by disc harrow gave the best result in terms of crop establishment, water use efficiency and yield.

- **Genotype**

Rice genotype having crop duration of 120 days requires 100-120 cm of water for normal yields.

- **Levelling and puddling**

Seepage and percolation reduced to considerable extent by puddling and perfect levelling (with laser land leveller). Thorough puddling creates impermeable layer which reduces deep percolation losses. Evaporation losses can be minimized by 50% when the soil is kept at saturation under levelled field conditions.

- **Fertilizer management**

Application of FYM or compost or green manures reduces evaporation, percolation and seepage losses in paddy crop. Application of FYM or incorporation of green manures reduces adverse effects of excess salts. Application of FYM or compost or green manures increases water holding capacity of light textured soils and thus saving of water. Split application of potassium 50% at basal and 25% each at tillering and panicle initiation stage along with *Azospirillum* (seed inoculation, seedling dipping or soil application)

alleviates harmful effects of the soil moisture stress. Drain the field to saturated stage before top dressing with N and re-flood next day to reduce N-loss. Addition of clay or tank silt (to light textured soils only) @ 150 m^3/ha reduce the percolation loss by 20-25%.

- **Irrigation management**

Irrigation schedules of alternate wetting and drying or saturation till tillering followed by maintenance of 5 to 8 cm water thereafter could save 50% of water as compared to continuous submergence without affecting the yield of rice. Providing drainage in lowland rice at early tillering stage is essential. Life irrigation should be given on 3rd day and up to 7 days, 2 cm water level should be maintained. Gradually raise water level to a depth of 5 cm up to maturity of rice. Moisture stress during rooting and tillering stage cause poor root growth leading to poor crop establishment and low yield of crop. Higher the transpiration results higher the yield of rice crop. A normal crop of yield 4.5 t/ha with irrigation period of 100 days consumes 6 mm/day by transpiration. When figure declines to 1.4 mm/day the yield decreases to 1 t/ha when it increases 10.5 mm the crop yield will increase to 7.5 t/ha.

It should maintenance of water depths in field as recommended for high water use efficiency and yield. High bicarbonate levels in irrigation water can cause Zn deficiency. High sodium water causes de-flocculation of soil particles leading to increase stickiness and compactness and decrease permeability. Studies conducted for evolving design criteria for different methods of irrigation for efficient use of water indicated that maximum water-use efficiency for rice can be obtained with check basins with size in between 250-300 m^2 area. Recycling run-off water in flood-irrigated rice can irrigate 10% additional area. In command areas, where field to field irrigation is common cost effective recycling structures may be constructed for reusing drainage water. A mixture of fly ash and clay with 50% cement was found to be a suitable lining material for field channels.

Precautions for application of irrigation

I. Withhold water for few days till the seedlings have established.
II. Field to field irrigation should be avoided.
III. Drain-off water for about 2 days prior to the application of fertilizers.
IV. Small bund may be formed parallel to the main bund of the field at a distance of 30 to 45 cm within the field to avoid leakages of water through main bund crevices.
V. To minimize percolation loss, the depth of stagnated water should be 5cm or less.
VI. In water logged conditions provide open drains about 60cm in depth and 45cm width across the field. Care should be taken not to allow development of cracks.
VII. In canal command area, conjunctive use of surface and ground water may be resorted to for judicious use of water.
VIII. Where irrigation facilities are not available, store all the rain water in paddy fields by making 25 to 30 cm raised bunds.

IX. Maintain about 8-10 cm of water level in the fields at puddling time and subsequently depth of ponded water may be maintained throughout the growing period.

X. Drain-off water completely for 5 to 7 days following tillering and flowering stages. This helps to remove the toxic substances like sulphides and regulates oxygen supply to root.

Isotopes in soil and plant studies

Priyal Pandey*[1] and Toshiba Pandagare[2]

[1]Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P. -221005
[2]Department of Agronomy, Indira Gandhi Krishi Vishwavidhalya ,Raipur ,C.G. -492001
**Corresponding author: piu.pandey89@gmail.com*

Agriculture is dependent on soil for a variety of reasons, one of the most important being the fact that soil contains the elements which are essential to plant growth and can store nutrient elements (fertilizers)added from outside. Besides, soil provides a medium which can store water and make it available to plants without submerging the roots completely. Study of soil characteristics and of processes by which plants take up nutrients from the soil is therefore extremely valuable in devising effective methods of farming. For example, such study can determine which fertilizer and how much of it should be applied to a particular soil, or when and how it should be applied. Similarly, a study of soil moisture can indicate the exact irrigation needs of a particular area.
Radioisotopes have greatly facilitated such investigations and are now being widely used in soil plant nutrition research.

Radioisotopes

The isotopes having unstable nuclei are known as Radioisotopes. There radioactive atoms are unstable because certain combinations of neutrons and proton produced nuclei of latent instability. Specific average life time will be characteristic of each unstable combination. The disintegration of a given radioactive atom is a matter of chance conditioned only by a set of many requirements being completely fulfilled simultaneously. They disintegrate spontaneously at a characteristic decay rate.

Type of Radioisotopes

(i). Stable Isotope: - No disintegration and no radioactivity
(ii). Unstable Isotope: - Radioactive disintegration and emitted alpha, beta and gamma radiation. These unstable nuclei have excessive energy and this is released by their disintegration into stable forms of lower energy, the excess being released in the forms of radiations, mainly alpha (α), beta (β) and gamma (¥) and they are called radioactive.

Stable Isotopes in Agriculture

Stable isotopes are used in the same way as radioactive isotopes in soil/plant studies. Whereas radioactive isotopes emit particles which are captured in photomultiplier tubes and counted stable isotopes are separated from each other by passing a gas

containing them through a strong magnetic field, which deflects them differentially according to their mass.

The most common stable isotope used is ^{15}N but a large number of other stable isotopes are produced which are increasingly being used in agricultural studies Nitrogen is one of the main limiting factors for plant growth. There are twelve isotopes of nitrogen, many with extremely short half-lives. Of the radioactive isotopes only ^{13}N with a half-life of 9.97 minutes has been used mainly in plant nitrogen translocation experiments.

USE IN SOIL FERTILITY EVALUATION

Tracer technique

Tracer technique is based on the assumption that if a plant derives a particular nutrient from the soil as well a fertilizer added to it, the amount available from soil in terms of a standard fertilizer can be calculate if that derived from the fertilizers is known. The latter is possible by using with the fertilizer a radioactive or stable isotope of the nutrient in the question. Some plants are grown in soil to which is an added a phosphatic fertilizer mixed with a very small amount of phosphate having radioactive ^{32}P. The soil originally contains a known amount of non-radioactive phosphorus, so also does the bulk of phosphatic fertilizers, excepting the small amount of ^{32}P added deliberately. After a suitable period of growth, the plants are harvested and the total P as well as ^{32}P contents is determined.

Table 1. Isotopes used in agriculture

Element	Isotope	stability	Half life	Uses
Oxygen	^{18}O	Stable	-----	Hydrology study, photosynthesis
Hydrogen	^{3}H , ^{2}H	Radioactive, Stable	12.43 year	Water movement, water cycling
carbon	^{13}C , ^{14}C	Stable, Radioactive	5370 year	Soil organic matter studies, soil salinization, photosynthesis
Cesium	^{137}Cs	Radioactive	30 years	Soil erosion study
Cobalt	^{60}Co	Radioactive	5.3 year	Soil aggregation study
Chlorine	^{36}Cl	Radioactive	301000 years	Solute movement study
chromium	^{51}Cr	Radioactive	27.8 days	Sewage study
Calcium	^{45}Ca	Radioactive	165 days	Soil Ca , plant Ca movement

Organic Residues studies

(i) ^{15}N direct labeling techniques: Crop residue or green manure studies using the direct method are relatively simple. Green manures can be easily obtained by growing crops fertilized with ^{15}N tracer; the aboveground or belowground material is then harvested and added as residue to unlabeled soil where the next crop is grown.
(ii) Indirect techniques: Indirect techniques have been used to study plant N uptake from organic residues. ^{15}N tracer is added to the soil and treatments with and without residues (no-residue controls) are set up. The no residue controls will have a 15N enrichment that reflects the soil 15N pool and the residue treatments should have lower 15N enrichment due to the input of the unlabeled N coming from the decomposing residue.

Carbon-14 dating

carbon dating is a method of obtaining age estimates on organic materials. This is often used for dating buried soils. Although a few measurements has been made on the contemporary soils. Radiocarbon dating estimates can be obtained on wood, charcoal, marine and freshwater shells, bone and antler, and peat and organic-bearing sediments.
Carbon (C) has three naturally occurring isotopes. Both ^{12}C and ^{13}C are stable, but ^{14}C decays by very weak beta decay to nitrogen-14 with a half-life of approximately 5,730 years.
Naturally occurring radiocarbon is produced as a secondary effect of cosmic-ray bombardment of the upper atmosphere. Plants transpire to take in atmospheric carbon, which is the beginning of absorption of carbon into the food chain. Animals eat the plants and this action introduces carbon into their bodies. After the organism dies, carbon-14 continues to decay without being replaced. To measure the amount of radiocarbon left in an artifact, scientists burn a small piece to convert it into carbon dioxide gas. Radiation counters are used to detect the electrons given off by decaying ^{14}C as it turns into nitrogen. The amount of ^{14}C is compared to the amount of ^{12}C, the stable form of carbon, to determine how much radiocarbon has decayed, thereby dating the artifact. The turnover of soil organic matter is usually too rapid for age measurement by using ^{14}C dating technique particularly in the soils where the turnover is not restricted by desiccation, water logging and low temperature.

NUTRIENT UPTAKE BY FOLIAR ABSORPTION

Radio isotopes permit tracing the path of nutrients in plants when they are applied as sprays to leaves, stems and fruits. The rates of absorption and transport of nutrients in sprays and their contributions in plant metabolism can be resolved by labeling the foliar applied nutrients and then distinguishing them in the plant from there which are absorbed by the roots.
P-32, K-42, S-35 and stable isotope N-15 are rapidly taken up by all arial plant tissues if there is active growth, within a few hours, and significant contribution to the nutritional needs of distant plant organs may be made after a single spray.

CONCLUSIONS

Radioisotopes are used to improve the quality and productivity of agricultural products as well as optimum utilization of fertilizers without harmful effect to plants and mankind. The radiolabelled fertilizer has been used to study the uptake, retention and utilization of fertilizers. It is felt that in addition to the marathon efforts of scientists and engineers engaged in developing nuclear science and technology the sincere efforts of media in popularizing and propagating the beneficial uses of radioisotopes for national development are going to play a major role in realizing the full potential of atom.

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Soil Health Card- A way forward towards sustainable Agriculture

M. L. Jat[1], B. C. Dhayal[2] and S. S. Kadam[3]

[1,3] Ph.D. Scholar, Rajasthan college of Agriculture (MPUAT), Udaipur
[2]M.Sc. Scholar, S.K.N. College of Agriculture (SKNAU), Jobner
**Corresponding author: mldhayal@gmail.com*

Soil Testing is well recognized as a sound scientific tool to assess inherent power of soil to supply plant nutrients. The benefits of soil testing have been established through scientific research, extensive field demonstrations, and on the basis of actual fertilizer use by the farmers on soil test based fertilizer use recommendations. Soil testing was initiated in the country in the beginning of planning era by setting up of 16 soil testing laboratories during 1955. Government of India has been supporting this programme during different pazlan periods to increase the soil analyzing capacity in the country. The numerical strength does not, however, decisively indicate the quality and success of the programme. Planners and agriculturalists have recognized the utility of the service fully but it suffers due to inadequate scientific support in its execution.

The SHC scheme centrally sponsored scheme was launched by the Hon'ble Prime Minister on 19 February 2015. Integrated Nutrient Management (INM) Division of the DACF&W has been mandated to implement this schemewith logo and tagline - swasthdhara, khethara. This scheme has been approved for implementation during the XII Five Year Plan with an outlay of Rs. 568.54 crore (Rs. 5.6854 billions). It aims at issuing SHCs to each one of the 140 million farmers of the country once in a cycle of 3 years on a continuous basis. This will facilitate building up of the soildatabase of the country and monitor the changes occurring in the soil health status periodically. The scheme is further built on the principle of soil sample collection at decentralized level and analysis for 12 parameters *viz*., pH, EC, OC, N, P, K, S, Fe, Mn, Zn, Cu and B. Based on such comprehensive soil diagnostics, the SHC will recommend to the farmer the estimated dosage of nutrients that the soils need for producing optimum crop yield; and other soil amelioration interventions needed to be taken up to maintain the soil health. Such test-based recommendations will bring in rational and regulated use of fertilizers.[1] Twin benefits to the farmer, as a consequence, are improved per unit yields on a sustainable basis and reduced cost of cultivation. The Department has also combined optimally in the scheme guidelines, the level at which sample should be collected for accurate results and the time and cost factors for nation-wide coverage. It lays down a grid of 10 ha in rainfed and 2.5 ha in irrigated areas for collection of soil samples. Based on the soil test results of a grid-generated composite sample, each farm holding will get a SHC. This translates into a total of about 253 lakh (25.3 million) soil samples to be

tested in the laboratories. Though each cycle would be of three years, the maiden cycle is being squeezed to 2 years to facilitate quick soil test based health management practices. Accordingly, the target has been split into 100 lakh (10 million) and 153 lakh (15.3 million) number of samples, respectively for the years 2015-16 and 2016-17 to generate 14 crore (140 million) SHCs over these two years. The subsequent cycle will, however, run over a period of 3 years each with objective to issue soil health cards every 3 years to all farmers of the country, so as to provide a basis to include deficient nutrients in fertilizer practices, to diagnose soil fertility related constraints with standardized procedures for sampling uniformly across states and analysis; and design Taluka/Block level fertilizer recommendations in targeted districts, to develop and promote soil test-based nutrient management in the districts for enhancing nutrient use efficiency, to build capacities of district and state level staff and of progressive farmers for promotion of nutrient management practices and to strengthen functioning of Soil Testing Laboratories (STLs) through capacity building, involvement of students agricultural and science colleges and effective linkage with Indian Council of Agricultural Research (ICAR)/State Agricultural Universities (SAUs).

Proper maintenance of the soil health, which is necessary from agricultural point of view, refers to the capacity of the soil to ensure proper physical, chemical and biological activities/processes for sustaining higher crop productivity. A productive soil would ensure proper retention and release of water and nutrients, promote and sustain root growth, maintain soil biotic habitat, respond to management and resist degradation.[2] Farmers all over the country endorse the government's Soil Health Card scheme that provides them with information about soils and the kind of crops to be grown in various regions. It goes on further to add, “Based on free in-depth soil studies, the Soil Health Cards list the vital components of a particular patch of land. They provide detailed information on various minerals present on the land, suitable crops, fertilisers to be used, and also whether the land is acidic or alkaline. The cards, which are based on the principles of the ration card, provide permanent identification and status of the land to farmers. They are made out after a detailed analysis of samples of soil collected from land held by individual farmers.”[3] Soil sample collection and analysis to determine soil health is an integral part of soil improvement for increasing crop production, " the scheme states.[4]

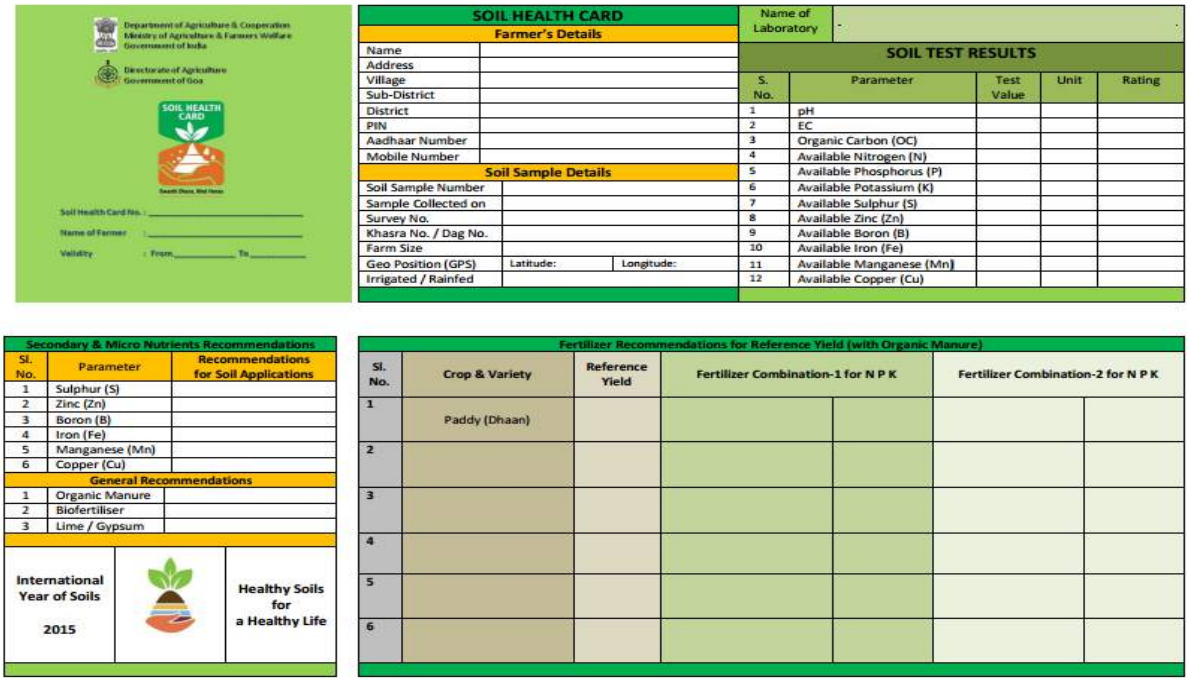
1. TESTING OF THE VARIOUS PROPERTIES OF THE SOIL

In order to strengthen the agriculture infrastructure, the state governments have decided to issue Soil Health Cards. It aims at helping the cultivators get better agricultural yield. These cards apprise the farmers of the various properties of the soil.The State Government will collect samples through the staff of their Department of Agriculture or through the staff of an outsourced agency. The State Government may also involve the students of local Agriculture / Science Colleges.Soil samples will be drawn in a grid of 2.5 ha in irrigated area and 10 ha in rain- fed area with the help of GPS tools and revenue maps.Soil Samples are taken generally two times in a year, after harvesting of Rabi and Kharif Crop respectively or when there is no standing crop in the

field. Soil Samples will be collected by a trained person from a depth of 15-20 cm by cutting the soil in a "V" shape. It will be collected from four corners and the centre of the field and mixed thoroughly and a part of this picked up as a sample. Areas with shade will be avoided. The sample chosen will be bagged and coded. It will then be transferred to soil test laboratory for analysis. Soil samples collected as per prescribed protocols will be analyzed for the following 12 comprehensive parameters, fertilizer recommendations will be generated for 6 crops (3 *rabi* and 3 *kharif*) of farmer's choice predominantly practiced in the area using Soil Test Crop Response (STCR) equations or State General Fertilizer Recommendations (GFR). The STCR equations for different crops and GFR have already been loaded in the Soil Health Card Portal. On entering the soil sampling details and soil test results, the soil health card can be automatically generated online.

Basic parameters	pH, EC and organic carbon
Major nutrients	Nitrogen (N), phosphorus (P) and potassium (K)
Secondary nutrients	Sulphur (S)
Micronutrients	Zinc (Zn), boron (B), iron (Fe), manganese (Mn) and copper (Cu)

The soil analysis has to be completed in the Soil Testing Laboratory within 3 weeks of receipt of soil samples. In addition to distribution of SHCs through post/extension staff, online delivery will also be facilitated. The nodal soil test laboratory shall prepare timelines for scheduling the soil health cards in the district in phases. The year-wise coverage of number of Taluks/Blocks will be prepared, so that continuous soil analysis takes place every three years. This rigour is essential so that the time gap between the previous and subsequent card that a farmer gets is not more than 3 years.Further, it is not a one-time affair, but is meant to be a continuous affair, helping thereby to track the changing status of soil health over time. Since the soil sample collection will be based on GPS coordinates, one can return to the same location for sampling in the subsequent cycles.Soil samples from farmer's fields are collected and analyzed in the soil testing laboratories for major nutrients, free of cost. Soil health cards are issued with recommendation of fertilizers. Analysis of soil is also done for micronutrients on village basis and use of micronutrients is recommended. The soil health card also provides soil pH for determining the nature of soils. The expenditure on collection of soil sample, chemicals, reagents and equipment is incurred by the agriculture department. The soil conditioners like rock phosphate, lime etc. are provided at 75% subsidy limited to Rs. 4, 500 per ha for maximum of 4 ha per farmer. ST/SC farmers are be provided 90% subsidy limited to Rs. 5400 per ha. The subsidy will be released to the farmer after the purchase and use by him of the soil conditioner. Micronutrients like zinc, boron, magnesium sulphate and other micronutrients are provided at 75% subsidy limited to Rs. 6000 per ha for maximum of 4 ha per farmer. ST/SC farmers are provided 90% subsidy limited to Rs 7200 per ha.[5]



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

Directorate of Agriculture
Government of Goa

SOIL HEALTH CARD

Soil Health Card No. : _____
Name of Farmer : _____
Validity : From_____ To_____

SOIL HEALTH CARD

Farmer's Details	
Name	
Address	
Village	
Sub-District	
District	
PIN	
Aadhaar Number	
Mobile Number	

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

Name of Laboratory : -

SOIL TEST RESULTS

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

Secondary & Micro Nutrients Recommendations

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

General Recommendations

1	Organic Manure	
2	Biofertiliser	
3	Lime / Gypsum	

International Year of Soils 2015

Healthy Soils for a Healthy Life

Fertilizer Recommendations for Reference Yield (with Organic Manure)

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

2. SHCS BENEFITS TO FARMERS, AGRICULTURAL SCIENTISTS & DECISION TAKERS

SHCs help farmers know the condition of his agriculture land and get crop-specific prescription for the amount of manure and fertilisers needed. The agriculture department had also started an SMS service to inform farmers to collect the cards after they were prepared. The department has also undertaken measures to treat saline and alkaline land. Also, it has made soil-fertility maps for its entire agriculture land in the state. These maps are global positioning system enabled and are available with the state agriculture department. The soil-fertility maps reveal fertility condition of the land and disclose deficiencies of minerals and micro nutrients. The Soil Health Card System contains agricultural information of all districts of each state which isused for the benefit of not only farmers, but also agricultural scientists and decision makers.

The focus under the scheme is not only preseason soil testing, but also on desired fertilizer recommendations by using well developed and verified STCR equations. Although these equations are more scientific compared to general fertilizer recommendation (GFR), the same are presently not available for all crops and growing conditions. The STCR equations also give absurd recommendations for high yield targets due to their inbuilt limitations. The scientists should, therefore, work on other modern approaches like site-specific nutrient management (SSNM), and come out with tools for achieving this goal in pursuance ofhigh yield targets.There is need to develop popular literature on aspects like importance of soil testing, balanced fertilizer use/integrated nutrient management, compost preparation *etc*. in local languages, and made available to the StateDepartments of Agriculture for multiplication and distribution for enhancing awareness of farmers and extension functionaries. Effective and innovative deployment of ICT (Information, Communication and Technology) will

aid transfer of knowledge. With increasing number of smart phones in rural areas, mobile based applications canbe developed.

The Soil Health Card System is an only one of its kind information project prepared and initiated by the Government of different states for the benefit of farmers at the grass-root level. A large database contains farmer details from the district/taluka/village levels. This project is able to provide specific type of output to the farmer, so that the farmers can get information easily and precisely when needed.

3. EFFECTIVENESS OF THE SOIL HEALTH CARDS SYSTEM:

With about 12 crore farm holdings in the country, soil analyzing capacity of 4 crore samples annually is required to enable analysis of each holding once in three years. This requires a massive expansion in soil testing programme in the States. The focus under the scheme is not only preseason soil testing, but also on desired fertilizer recommendations by using well developed and verified STCR equations. Although these equations are more scientific compared to general fertilizer recommendation (GFR), the same are presently not available for all crops and growing conditions. The STCR equations also give absurd recommendations for high yield targets due to their inbuilt limitations. The scientists should, therefore, work on other modern approaches like site-specific nutrient management (SSNM), and come out with tools for achieving this goal in pursuance ofhigh yield targets and also develop popular literature on aspects like importance of soil testing, balanced fertilizer use/integrated nutrient management, compost preparation *etc*. in local languages, and made available to the State Departments of Agriculture for multiplication and distribution for enhancing awareness of farmers and extension functionaries. Effective and innovative deployment of ICT (Information, Communication and Technology) will aid transfer of knowledge. With increasing number of smart phones in rural areas, mobile based applications can be developed.

Several States including Andhra Pradesh, Gujarat, Haryana, Karnataka and Uttar Pradesh have made commendable progress in soil testing programme in various ways such as expansion of soil testing facilities, popularization of the programme in campaign mode, development of soil fertility maps and use of information technology in delivering soil nutrient status and appropriate recommendation to farmers.

4. CONSTRAINTS/CHALLENGES IN EFFECTIVELY IMPLEMENTING THE SHC SCHEME

For effective implementation of the SHC project however there are certain hurdles putting bottlenecks on the way of the progress of this scheme. A few of such handicaps are given below:

1. There is a severe shortage of trained/skilled manpower.
2. Many of the equipment's in the soil test laboratories are old and non-functional and need immediate replacement.
3. There is similar type of cases where soil is not worth agriculture productivity.
4. Frequent transfer of officers

5. Delay in transporting samples from collection centres to labs.
6. Interruption in power supply
7. Lack of availability of Funds for this purpose
8. Need of IT trained manpower for interpretation of analysis reports and preparation of recommendations and their online communication.
9. There is ban on creation of new posts.
10. Short term hiring and out sourcing is one of the ways to carry out work. Such persons would need intensive training before undertaking the task.
11. SHC scheme not included biological parameters soil
12. Most of STLs are functioning in Govt. buildings, many of which are in dilapidated conditions and need proper maintenance.

CONCLUSION

The present SHC scheme is an improvement over various attempts made so far for nurturing the country's soil health. For the first time, it is based on uniform protocol, comprehensive parameters, science based fertilizer recommendations and other soil amelioration interventions. Further, it is not a one-time affair, but is meant to be a continuous affair, helping thereby to track the changing status of soil health over time. Since the soil sample collection will be based on GPS coordinates, one can return to the same location for sampling in the subsequent cycles. Some scientists find the present SHC incomplete until a few biological parameters are included. As fresh soil is needed for analysis of mostof the biological parameters, it is difficult to reach out such samples to the STLs and therefore, inclusion of these parameters is not feasible at this stage. Development of simplified test methods and establishing implications of biological (and even physical) parameters on fertilizer use decisions would help inclusion of some biological parameters, if essentially needed. Another important issue is the quality of SHC that depends on the quality of soil analysis carried out in the STLs. At present the condition and functioning of several STLs is below mark. With inadequate facilities/infrastructure and poor technical skills of the manpower engaged in these STLs, quality of soil analysis is a concern. There is urgent need to revamp the soil testing services and infuse necessary professionalism. Along with extension of STL network by establishing new labs, what is needed is to strengthen the existing labs with necessary equipments/support services, train human resource and assigning some accountability. Establishment of referral labs and samples exchange programmes are some measures to ensure quality of analysis. As most of the STLs operate under State Departments of Agriculture, any revamping of the service is possible only with the support of the State Governments.

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Remote sensing and GIS application on Forest fire detection and management

S. Alagappan

Ph.D. Research Scholar
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003, India.
**Corresponding author: alga.s@rediffmail.com*

Abstract

India, with a forest cover of 20.55% of geographical area, contains a variety of climate zones, from the tropical south, north-western hot deserts to Himalayan cold deserts. Enriched with ample diversity of forests bloomed with a rich array of floral and faunal life forms. With increasing population pressure, the forest cover of the country is deteriorating at an alarming rate. Along with various factors, forest fires are a major cause of degradation of Indian forests. According to a Forest Survey of India report, about 50 per cent of forest areas in the country are prone to fire. It is estimated that the proportion of forest areas prone to forest fires annually ranges from 33% in some states to over 90% in others. While statistical data and geospatial information on forest fire are very weak or even not available. About 90% of the forest fires in India are started by humans. The degree of forest fire risk analysis and frequency of fire incidents are very important factors for taking preventive measures and post fire degradation assessment. Geospatial techniques are proving to be powerful tools to assess the forest fire risk and degradation assessment. The present paper describes the present state of forests, methodology, models and case studies of forest fire risk and degradation assessment in context to Indian forests.

INTRODUCTION

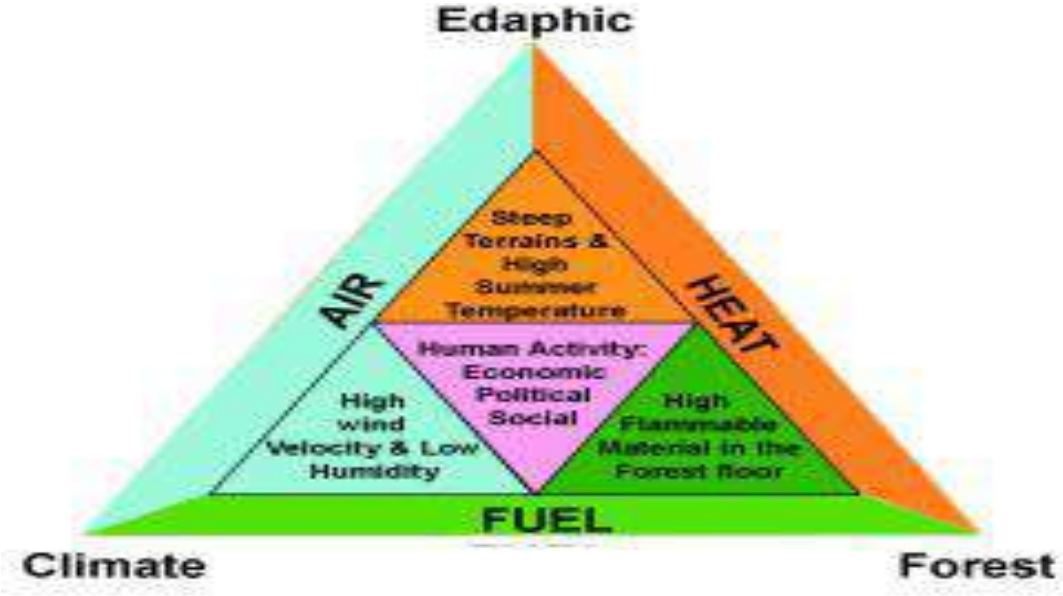
Forest fire is a major cause of degradation of India's forests. While statistical data on fire loss are weak, it is estimated that the proportion of forest areas prone to forest fires annually ranges from 33% in some states to over 90% in others. About 90% of the forest fires in India are started by humans. Forest fires cause wide ranging adverse ecological, economic and social impacts. In a nutshell, fires cause: indirect effect on agricultural production; and loss of livelihood for the tribals as approximately 65 million people are classified as tribals who directly depend upon collection of non-timber forest products from the forest areas for their livelihood.

A combination of edaphic, climatic and human activities account for the majority of wild land fires. High terrain steepness along with high summer temperature supplemented with high wind velocity and the availability of high flammable material in the forest floor accounts for the major damage and wide wild spread of the forest fire. The contribution of natural fires is insignificant in comparison to number of fires started by humans. The vast majority of wild fires are intentional for timber harvesting, land conversion, slash – and-burn agriculture, and socio-economic conflicts over question of property and landuse rights. In recent years extended droughts (prolonged dry weather), together with rapidly expanding exploitation of tropical forest and the demand for conversion of forest to other

land uses, have resulted in significant increase in wild fire size, frequency and related environmental impacts.

Recent wild fires have an immense impact in Indonesia, Brazil, Mexico, Canada, USA, France, Turkey, Greece, India and Italy. Large-scale fires and fire hazards were also reported in eastern parts of the Russian Federation and in China north eastern Mongolia autonomous region Recent wild fires have an immense impact in Indonesia, Brazil, Mexico, Canada, USA, France, Turkey, Greece, India and Italy. Large-scale fires and fire hazards were also reported in eastern parts of the Russian Federation and in China north eastern Mongolia autonomous region. There has been a continuous increase of application of fire in landuse system in forest of South East Asian region. This has resulted in severe environmental problems and impacts on society.

TRIANGLE OF FOREST FIRE



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assess the current status of application of satellite remote sensing for fire detection, monitoring and assessment. According to a classification of forest fires by type and causes, three types of forest fires prevalent;

a)Ground Fires:

Ground fires occur in the humus and peaty layers beneath the litter of un decomposed portion of forest floor with intense heat but practically no flame. Such fires are relatively rare and have been recorded occasionally at high altitudes in Himalayan fir and spruce forests

b)Surface fires:

Surface fires occurring on or near the ground in the litter, ground cover, scrub and regeneration, are the most common type in all fire-prone forests of the country.

c) Crown fires:

Crown fires, occurring in the crowns of trees, consuming foliage and usually killing the trees, are met most frequently in low level coniferous forests in the Siwaliks and Himalayas (NCA Report, 1976).

Impact of the Forest Fire on the Global Environment

Forest fires controlled or uncontrolled have profound impacts on the physical environment including: landcover, landuse, biodiversity, climate change and forest ecosystem. They also

have enormous implication on human health and on the socio-economic system of affected countries. Economic cost is hard to quantify but an estimate by the economy and environment can be provided. The fire incidence problem for South East Asia put the cost of damages stemming from the Southeast Asian fires (all causes) at more than $4 billion. Health impacts are often serious. As per one estimate 20 million people are in danger of respiratory problems from fire in Southeast Asia. Most pronounced consequence of forest fires causes their potential effects on climate change. Only in the past decade researchers have realized the important contribution of biomass burning to the global budgets of many radiatively and chemically active gases such as carbon dioxide, carbon monoxide, methane, nitric oxide, tropospheric ozone, methyl chloride and elemental carbon particulate. Biomass burning is recognized as a significant global source of emission contributing as much as 40% of gross Carbon dioxide and 30% of tropospheric ozone (Andreae, 1991). Most of the world burnt biomass matter is from savannas, and because 2/3rd of the earth savannas are in Africa, that continent is now recognized as "burnt center" of the planet. Biomasss burning is generally believed to be a uniquely tropical phenomenon because most of the information we have on its geographical and temporal distribution is based on the observation of the tropics. Because of poor satellite coverage, among other things, little information is available on biomass burning in boreal forests, which represent about 29% of the world's forests. Global estimates of annual amounts of biomass burning and resulting release of carbon into the atmosphere.

Source of burning (Tg dry matter/year)	**Biomass burned**	**Carbon released (TgC/year)**
Savannas	3690	1660
Agricultural waste	2020	910
Tropical forests	1260	570
Fuel wood	1430	640
Temperate and boreal forests	280	130
Charcoal	20	30
World total	**8700**	**3940**

Main causes of forest fire:

1. deforestation activities (conversion of forest to other land uses, e.g.agricultural lands, pastures, exploitation of other natural resources); traditional, but expanding slash-and-burn agriculture;
2. grazing land management (fires set by graziers, mainly in savannas and open forests with distinct grass strata [silvopastoral systems]);
3. use of non-wood forest products (use of fire to facilitate harvest or improve yield of plants, fruits, and other forest products, predominantly in deciduous and semi-deciduous forests);
4. wild land/residential interface fires (fires from settlements, e.g. from cooking, torches, camp fires etc.);

5. other traditional fire uses (in the wake of religious, ethnic and folk traditions; tribal warfare) and socio-economic and political conflicts over questions of land property and land use rights.
6. Loss of timber, loss of bio-diversity, loss of wildlife habitat, global warming, soil erosion, loss of fuel wood and fodder, damage to water and other natural resources, loss of natural regeneration. Estimated average tangible annual loss due to forest fires in country is Rs.440 crore (US$ 100 million approximately).
7. The vulnerability of the Indian forests to fire varies from place to place depending upon the type of vegetation and the climate. The coniferous forest in the Himalayan region comprising of fir (*Abies* spp.), spruce (*Picea smithiana*), *Cedrus deodara, Pinus roxburghii* and *Pinus wallichiana* etc. is very prone to fire. Every year there are one or two major incidences of forest fire in this region. The other parts of the country dominated by deciduous forests are also damaged by fire.

Present Studies on Forest Fire Assessment:

1.Early warning of forest fires through Risk modeling
2.Development of fire alerts and monitoring systems
3.Proper fire mitigation and monitoring system
4.Developing web based systems to detect fire
5.NRSC developed a web based system called INFRASS to detect fires and used in different State forests departments.

Major governing factors for forest fire:

Fuel Loading (type and its moisture level), Temperature, Humidity, Wind(both speed and direction), Slope of the forest cover, Aspects and accessibility, Deforestation and controlled burning Fire wood burning Shifting cultivation, Lack of manpower to control fire, resource constraints and time effective control mechanisms.

Assessment Principle: A general rapid assessment of the forests for their proneness to fire could be worked out using a combination of information generated from remote sensing and field data which was reported by Jaiswal et al 2002. Remote sensing and Geographical Information System based forest fire risk zonation study of Goma sub-watershed (MP) an area regularly subjected to forest fire matched the burnt scar areas with mapped through RS derived indices.

Impacts on forest fire in India:

More than 55% of the forest is prone for fire in India.
Adversely affects on the ecological economical and sociological aspects of India.
Leads to high carbon emission
Emissions of large amounts of trace gases and aerosol particles
Emissions of black carbon
100 million tonnes of smoke aerosols into atmosphere leads to biomass burning.
Loss of biodiversity, effects on atmospheric chemistry and increase in surface albedo and water runoff due to biomass burning, Estimated loss Rs.440 crore annually due to forest fire in India.

Different stages of wild land fire analysis:

1.Determining fire potential risk
2.Detecting fire starts
3. Monitoring active fires
4.Conducting post fire degradation assessment.
5.Technological advancement in space remote sensing has been widely experimented in last three decades to obtain the desired information.

Forest Fire Assessment:

Class and Type of Information
a)alpha type Fire *: start and end dates, location, size and cause*
b) *beta type* *Fuels biome classification and fuel loading forest* inventory (number), age class, size class
c) *gamma type* *Fire characterisation (crown, surface etc.), fuel* consumption and structural involvement (wild land urban interface)
d) *delta type* *Number of fires, areas burnt (by forest type),cause of* fires (number)
e) *epsilon type* *Gas and aerosol emission data*
f) *eta type* *Total expenditure of fire programme, total fire* suppression costs and total direct losses of merchantable timber, structure losses.
Different sensors used for forest fire detection:
Sensors and its Potential Applications
Video Images : Fire characterisation, burnt area estimation, fire propagation, estimate of fire density and burnt scars.
IRS PAN : Exact location of forest fires, extent of fires and types of land cover of fires, impact of human activities on incidence of forest fire.
IRS LISS III Land sat TM : Land cover characterisation and forest non forest mapping
IRS WiFS AVHRR-HRPT : Fire characterisation, land cover characterisation and monitoring.
AVHRR-GAC : Characterisation, land cover characterisation, seasonal variations in land cover, inter annual variation in land cover, land cover change and burnt area estimation
ERS-ATSR : Burnt area estimation.
Parameters used for forest fire risk zone modeling:

- Fire occurrence maps for three or more seasons
- Classified vegetation map (two seasons)
- Road network (Proximity analysis)
- Maximum temperature
- Relative humidity
- Rainfall data
- Forest block compartments
- Rivers, streams and water bodies
- Settlements location map (Proximity analysis)

Area (sqkm) under different forest and non-forest categories in Sonitpur

Land cover	1994	1999	2001	Net change

Moist deciduous	743.00	656.76	513.36	(-)229.64
Semi-evergreen	59.71	59.19	57.15	(-)2.56
Rive rain	7.65	7. 65	7. 65	No change
Grassland	249.03	251.07	250.56	(+)1.53
Tea garden	383.24	385.28	384.77	(+)1.53
River	658.80	658.80	658.80	No change
Non-forest	3001.58	3084.25	3230.71	(+)229.13
Total	5103.00	5103.00	5103.00	No change

Forest canopy density mapping Stratification:

1.Different Period: in years TI=1998, T2=1999, T3=2002
2.Image Segmentation
3.Visual Interpretation
4.Shadow Index (SI)
5.Bare Soil Index(BI)
6.Thremal Index (TI)
7.Advanced Vegetation Index (AVI)

Forest Canopy Density model usage in forestry operations:

- To plan afforestation and reforestation activities
- Identification of forest canopy gaps for enrichment planting
- Rehabilitation of encroached and logged over areas
- Planning of operational silvicultural systems
- Preparation of Working Plans (Maps at beet / coupe level)
- Regeneration or Gap filling
- Wildlife habitat management
- Planned timber extraction
- Can be used as a base line data for scientific work
- Detection of disease affected areas. Change detection in forest and non-forest.
- Predictive analysis of change in forest canopy density.

Susceptibility and vulnerability of Indian forests to wildfire (IFFN,2002)

Type of Forests	**Fire Frequent (%)**	**Fire Occasional (%)**
Coniferous	8	40
Moist Deciduous	15	60
Dry Deciduous	5	35
Wet/Semi-Evergreen	9	40
North-Eastern Region	50	45

Fire Policy and Legal Aspects

The issue of a fire policy and relevant legislation and regulations are the most important prerequisites for any fire management activities. A fire policy, P.S. Roy 369 which would be a basic commitment to the fire problem and the definition of a national concept of policies to encounter fire-related problems, needs to embrace the following basic considerations (if not at national level, a policy may also be formulated at the regional or district level):

a. A general statement on the role and impacts of fire in the most important forests and other vegetation of the country (or management unit).
b. A general statement regarding how to counter the negative impacts of fire.
c. Definition of an overall fire management strategy. Definition of fire management policy in the various geographic regions in accordance with vegetation type, demographics and land uses.
d. Definition of the role of the population in participating in fire management activities, especially in fire prevention.A variety of legal aspects needs to be considered for the implementation of a fire policy and for coherent fire management planning, in general e.g.
a. Clear definition of landownership and availability of a landownership register.
b. Development of a landscape plan in which clear definitions are given of the land uses permitted or practiced on a defined area of land.
c. Regulations concerning construction in forests and wildlands, especially on burned areas.
d. Clear definition of fire management responsibilities as related to the various types of land ownerships and different tasks in fire management, e.g. fire prevention, fire detection, and fire suppression (including coordination and cooperation).
e. Rehabilitation of burned lands.
f. Law enforcement.

Regional Co-operation in Forest Fire Management

Beginning in 1992, as a consequence of the regional smog problems caused by land-use fires, member states of the Association of South East Asian Nations (ASEAN) created joint activities to encounter problems arising from 370 Forest Fire and Degradation Assessment transboundary haze pollution. ASEAN workshops held in Balikpapan (1992) and Kuala Lumpur (1995) summarized the problems and urged appropriate initiatives. The ASEAN Conference on “Transboundary Pollution and the Sustainability of Tropical Forests” is one of the first important steps to materialize the conceptual framework proposed during the past years. Most important in future regional ASEAN-wide cooperation in fire management will be the sharing of resources. The focus will be :

- predicting fire hazard and fire effects on ecosystems and atmosphere;
- detection, monitoring and evaluating fires; and
- sharing fire suppression technologies.

The ASEAN Fire Forum during this meeting will provide important recommendations on joint future actions. The ASEAN region will potentially serve as a pilot region in which resource sharing will be based on the fact that two distinct fire problem seasons exist within the region. While within Indonesia the fire season is mainly during the months of September to November (southern hemisphere dry season), the fire season in monsoon-influenced SE Asia is between January and May. Sharing resources means that hard and software technologies and required personnel can concentrate on the hemispheric fire problems, and even costly fire suppression equipment, e.g. airplanes, can be used more economically throughout the whole year.

Forest fire Management:

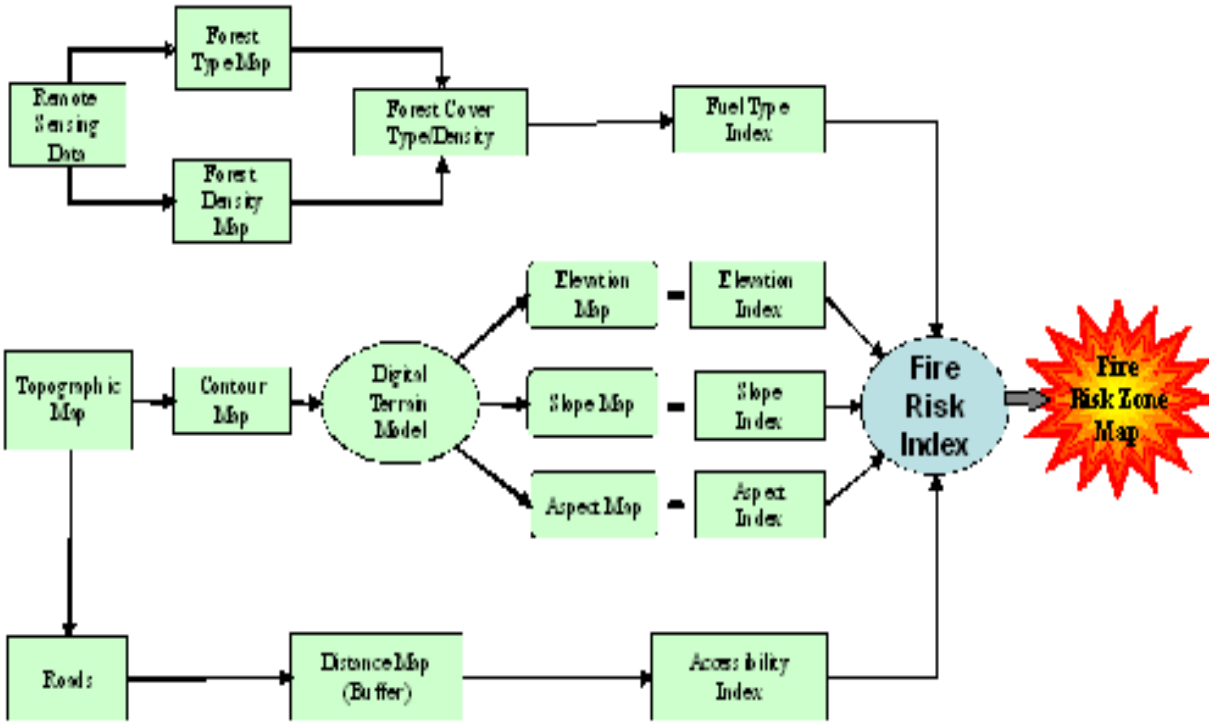
Policies developed by Ministry of Environment and Forest towards reforestation and forest rejuvenation programs nationwide. State Forest Departments activities towards forest reserve protection and forest rejuvenation programs .Government of India policy enforcement on maintaining the afforestation projects on turnkey basis in fertilizer complexes, cement factories, oil refineries, and other pollution creating industries by establishing green belts with varied tree species as prescribed by GOI. Establishing social forestry, afforestation projects in all the states by state forest department.

The turnkey afforestation project promoted by National Dairy Development Board by its subsidiary unit named Rastriya Vriksha Mitra Shayog Limited (RVMS) in various states in India in collaboration with Ministry of Environment and Forests. Lots of NGO's are engaged in afforestation activities in various states in India. Centralized forest nursery developments in each district maintained by state forest department to supply and maintain the green cover in the respective districts at panchayat levels. Paper industries like BILT, ITC, TNPL are engaged in the development of larger tree plantations in various states in India to meet their raw material requirements.

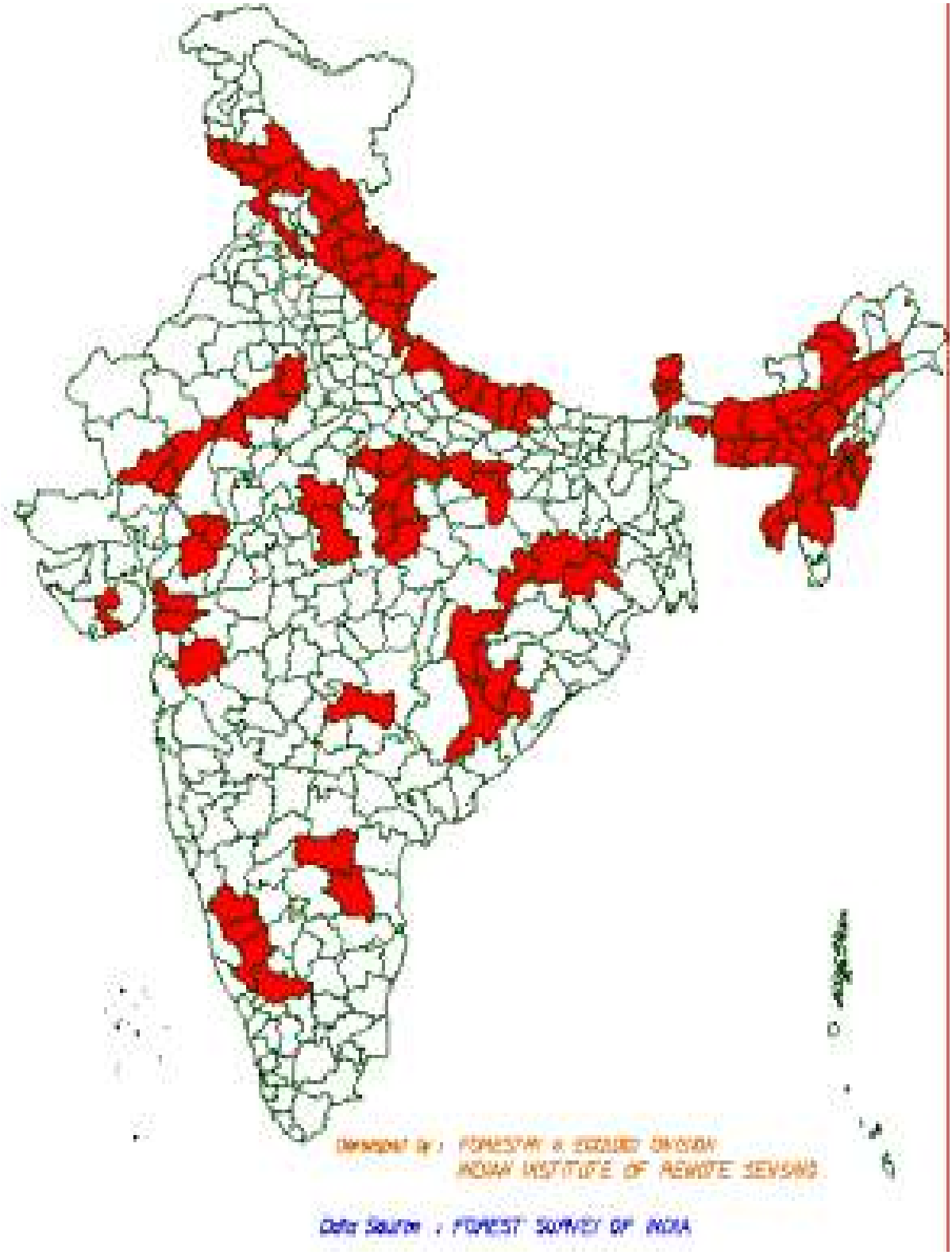
Institutions involved in Forest Decision Support System:

1. Department of Space
2. State Forest Departments
3. Forest Survey of India
4. National Informatics Centre
5. Bureau of Economic and Statistics
6. State Animal Husbandry Departments
7. Indian Meteorological Department
8. Local weather Stations
9. Forest Research Institute
10. NBSSLUP
11. Survey of India
12. University Departments
13. Panchayats / Voluntary bodies / Tribal society
14. Ministry of Environment and Forests
15. Wildlife Institute of India

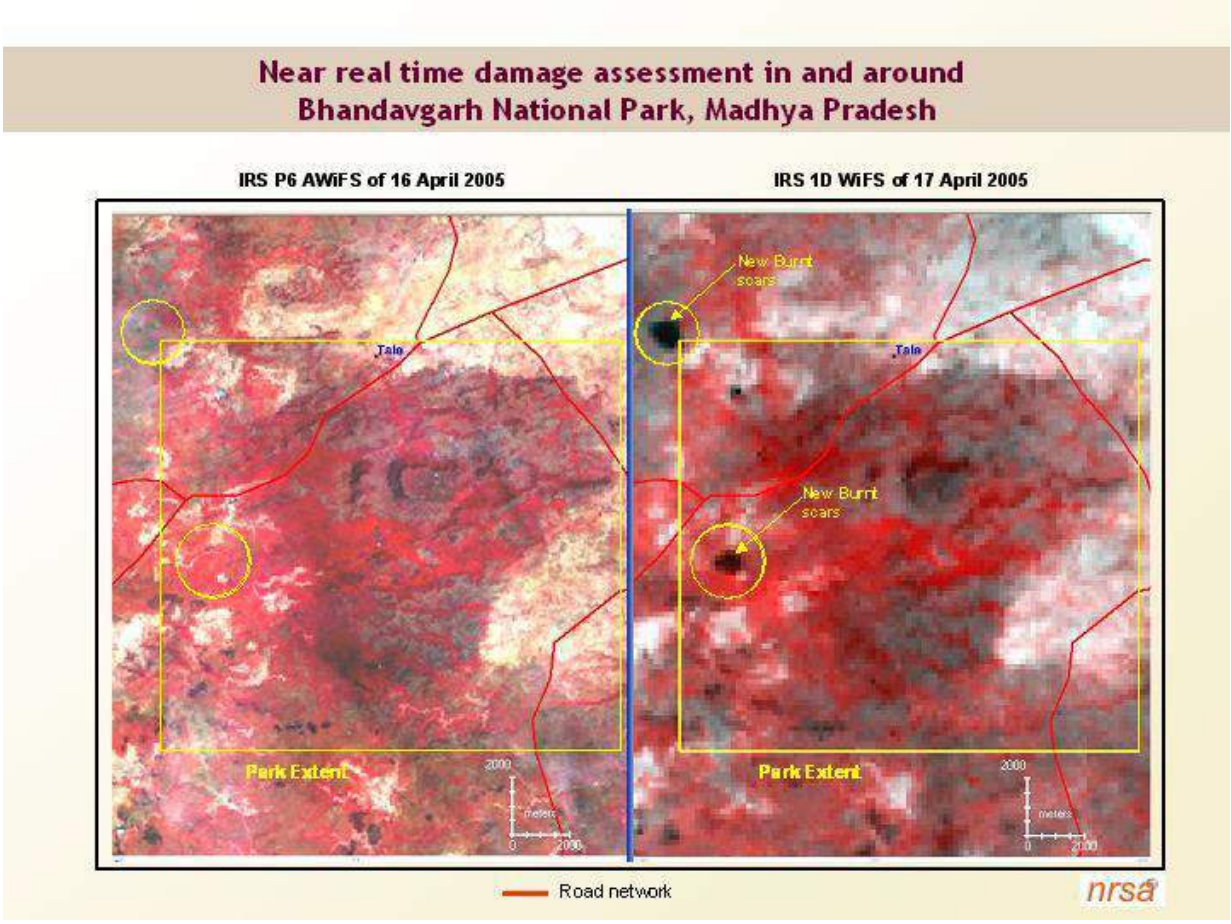
Fire Risk Zonation Model



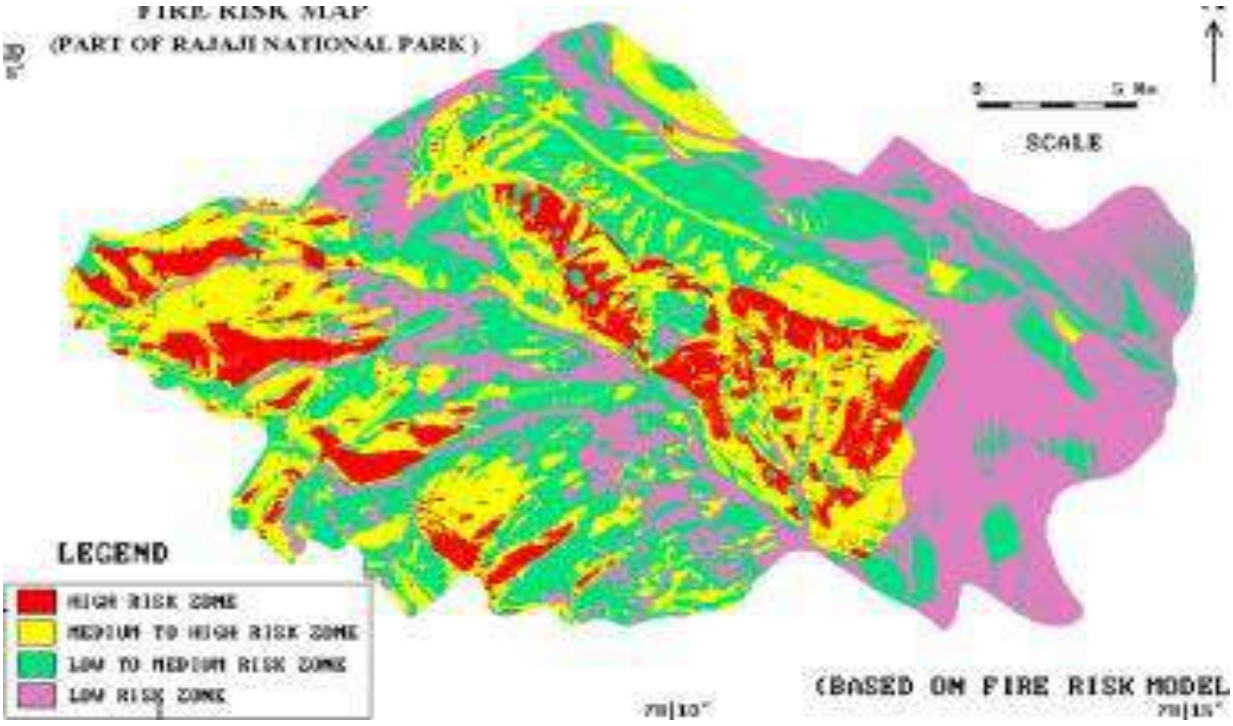
Map showing forest fire on regular intervals in different districts in India



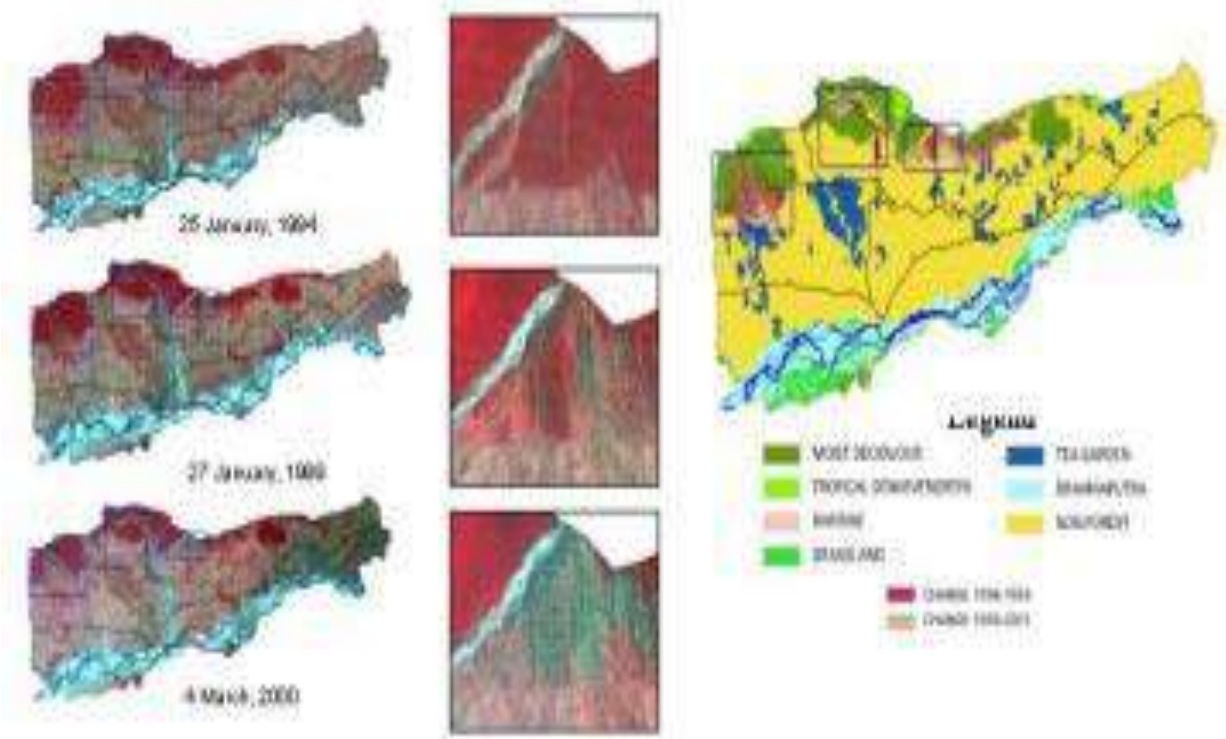
Near –real time damage assessment in and around Bhandagarh National Park (MP) based on multi resolution data sets.



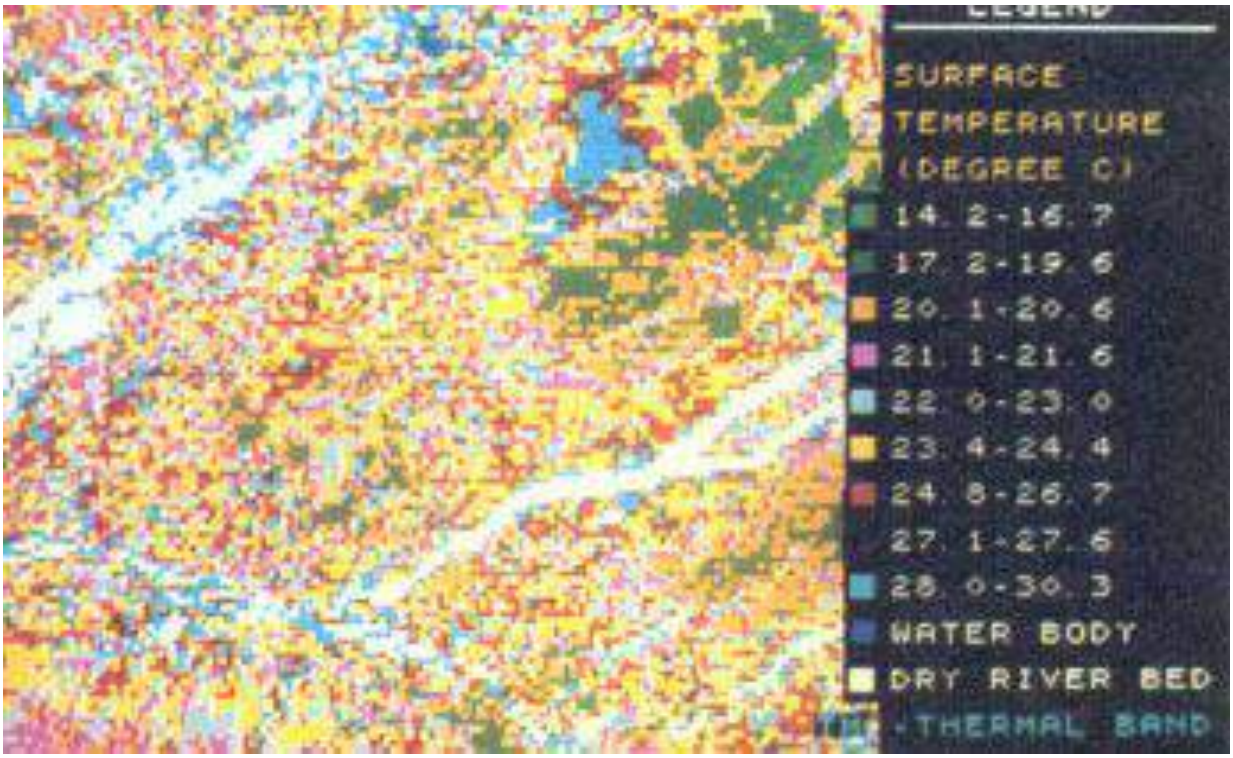
FOREST RISK MAP - PART OF RAJAJI NATIONAL PARK



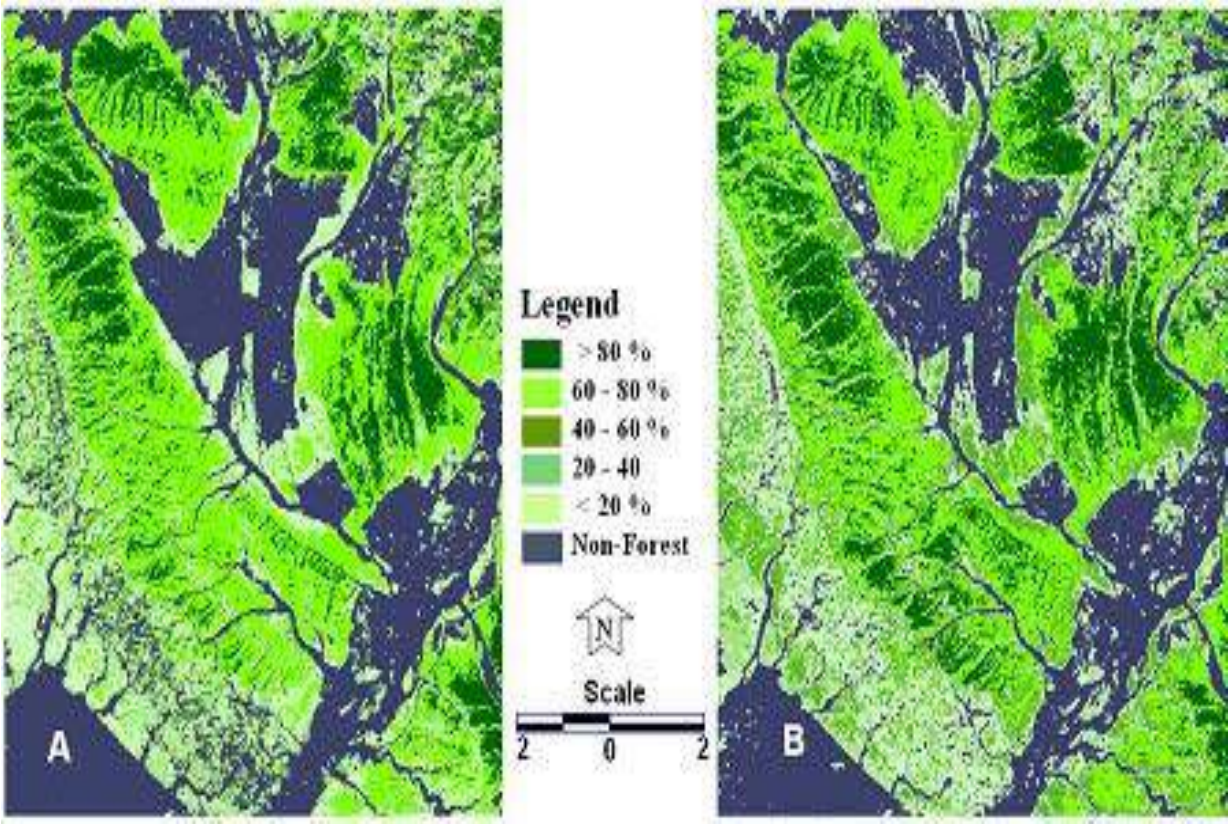
Deforestation monitoring in Soniput District of Assam



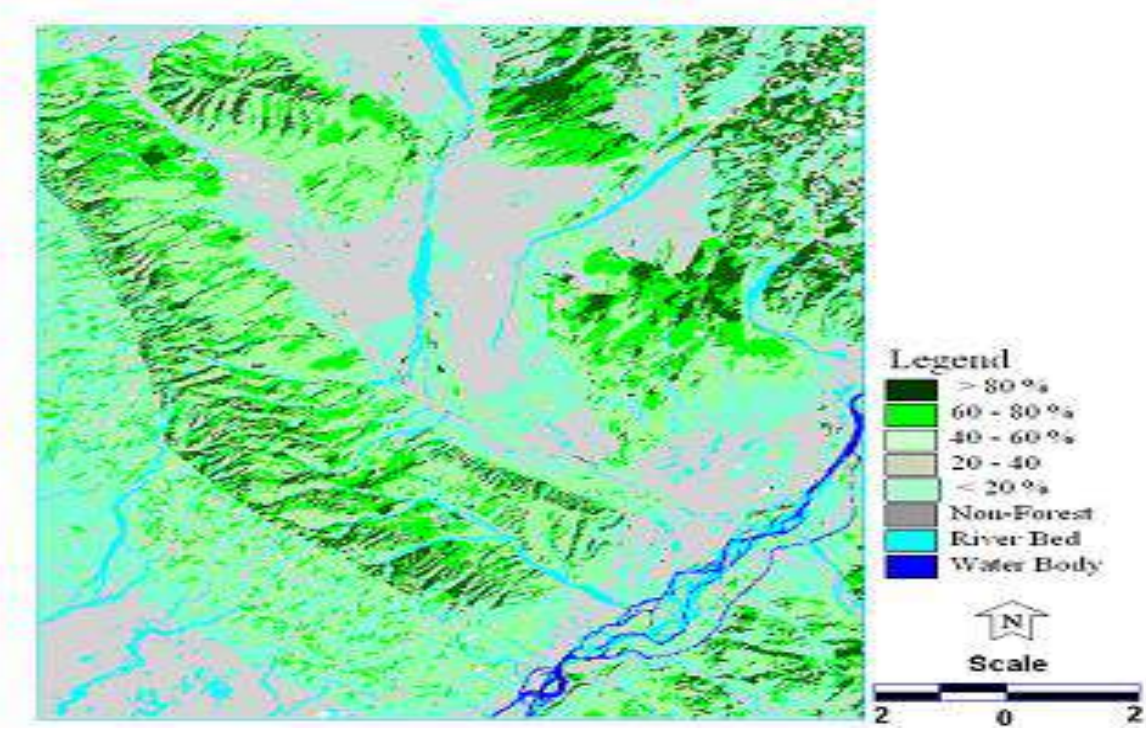
SOIL TEMPERATURE IMAGE DEVELOPED BY LANDSAT-TM
DOON VALLE, DEHRADUN



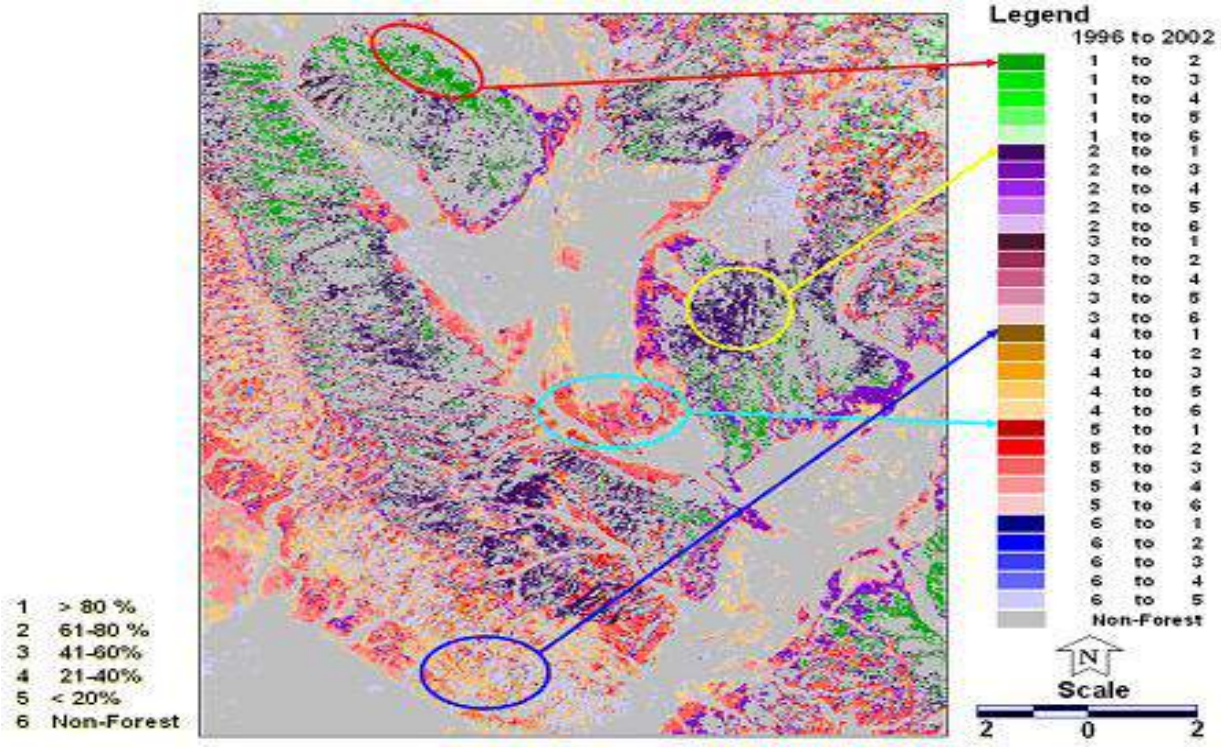
FCD MAP DERIVED FROM LANDSAT TM AND ETM+ (A: 14 SEPT 1996 AND 8:16 OCT 2002)



FOREST CANOPY DENSITY MAP DERIVED FROM OBJECT ORIENTED IMAGE SEGMENTATION



CHANGE DETECTION LOGGED OVER AREA REFORESRED AREA FROM 1996 TO 2002



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Green Manuring on crops

S. Alagappan

Ph.D. Research Scholar
Department of Agronomy, Directorate of Crop Management,
Tamil Nadu Agricultural University, Coimbatore - 641 003, India.
**Corresponding author: alga.s@rediffmail.com*

I. INTRODUCTION

The practice of green manuring involves incorporation of plant material into the soil with a view to augmenting soil fertility. The plant material is mostly of leguminous plants. They are either grown in the same field where they are intended to be turned down or collected from outside and used in the stipulated field. Sometimes, the effect of green manure crop may not be recognized in the first instance. But its effect is definitely noticed on succeeding crops in crop rotation. It supplies plant nutrients and humus to the soil and helps conserving native plant nutrient. Humus keeps the soil particles knitted together thereby resisting loss of soil erosion. As green manure possess a narrow C:N (carbon & nitrogen) ratio, great care must be taken in the planting of the main crop. the main crop has to be transplanted (e.g. paddy) or sown (eg. cereals) soon after the application of green manure crop. An interval of less than a week under assured water supply will be the optimum for the planting of the crop. Otherwise loss of nitrogen as ammonia will take place during the initial stages of decomposition.

It is often complained that a farmer loses a valuable season by growing the green manure crop. This problem can be easily solved by suggesting to grow green manure as a mixed crop of green manure and main crop is not feasible, the growing of green manure on bund or field boundaries is recommended. To supplement this, the green leaves from suitable plants can be collected and incorporated into the field directly. Thus the fanner need not sacrifice a cropping season for growing a green manure crop. By making suitable adjustment in cropping technique and selecting the right green manure crop he can be sure of reaping rich dividends from the soil. In short, green manuring is a good practice to the soil as it stimulates crop growth.

II. Importance of Green Manuring

The importance of green manuring can be understood from the points given below.

1. Green manuring contributes 40 to 80 kg nitrogen per hectare to the field. Green manuring of high yielding rice variety with *dhaincha* increases the rice yield from 20-30% depending on the soil type and other conditions.
2. Besides supplying nitrogen, green manure also prevents loss of nitrogen by leaching and erosion.

3. Vigorous root system of green manure keeps the soil particles bound together. Dhaincha is found to mobilize soil phosphorus and potassium and oilier trace elements likely to be deficient in surface layers and leaves them there in a readily available form.
4. Green manuring reclaims saline and alkali soils. Decomposing manure releases a large amount of organic acid which neutralizes the soil reaction.
5. Certain green leaf manure crops serve the dual purpose of nutrient supply and fodder supply. Green leaves of perennial legume plants can be used for green leaf manuring. In the off season, green leaves can be fed to the cattIe.
6. The growth of green manure crops (especially, dhaincha and sunnhemp) is very fast. Within 40-50 days they accumulate 6-10 tonnes of biomass per hectare. However, decomposition is also very fast due to richness of nitrogen.

III. Crops for Green Manuring

Green manuring is of two types (1) green manuring in situ and (2) green leaf manuring. As is obvious from the name, green manuring in situ is carried out by growing green manure crops in the field itself where their use is intended. In the latter type, green succulent leaves of leguminous or non-leguminous plants are collected, carted to the field and incorporated by ploughing. The crops which are grown for green manuring are also, therefore, grouped into two categories according to the type of green manuring. The following are the commonly grown green leaf and green manure crops.

A. Green leaf manuring crops

Many types of leguminous and non-leguminous plants are grown on bunds or wastelands for the purpose of utilizing their foliage as green manure.

1*. Gliricidia maculata:* This plant thrives well in a variety of soils. Under certain climate it grows to a height of about 4.5 meter. During a year two cuttings can be taken; first at the beginning of the monsoon and the second in December. The fresh weight contains 0.49% nitrogen and 8.5% carbon. The yield of leafy material per plant according to the various observations, is about 22.5 kg after 10 years of planting. Leaves can be obtained for several years. The drawback with this plant is that it very often gets infested with mealy bugs.

2. Pongamia glabra: The average yield of green matter per tree about 130 kg. On fresh weight basis it contains 81.5% moisture, 7.2% carbon and 0.57% nitrogen.

3. Calotropis gigantia: This plant grows wild on fallow lands and road sides under different soil and climatic conditions of the country. The leaves are quite succulent and the yield of the green matter per plant is about 5 kg.

4. Tephrosia perpuria: It is a freely branching and spreading annual shrub found growing in fallow lands. It grows well on well drained loamy soils. The average yield of green-matter per plant is about 0.7 kg.

5. Tephrosia candida: This is an eruct shrub, resistant to pruning and is used extensively for green manuring and as a hedge. It is a shady plant and grows largely in tea gardens. The average yield of leafy matter per plant is 2.5 kg.

6. Sesbania speciosa: The practice of growing this plant around the borders of the rice fields, when the crop is standing, was experimented for three years at Cuttack. On an average it produces about 3450 kg of green matter per hectare within four months to be incorporated into the soil for the use of the second crop of paddy in January.

8. Ipomea carnea: This is another important plant which can be grown under varied soil and climatic conditions for green manuring. In the heavy rainfall areas its loopings can directly be used for green leaf manuring, whereas in the dry areas it can be composed before use.

9. Cassia tora: One hectare crop of this plant yield about 4000 kg of green leaves and twigs. Most of the species of Cassia yield even greater amount of manurial material. Cassia is largely used in paddy fields.

B. Green manuring crops.

Following are the crops which can be grown in the field for in situ turning.

1. Crotalaria juncea: It is used as a green manure in practically all the states of the country except the areas prone to water logging. It is sown with the break of the monsoon. It grows very fast and attains a height of 1-2 meter. It grows well even in poor soils. The plant contains a large proportion of herbage and does not become woody soon hence it is rapidly decomposable. About 20000 to 25000 kg of green matter can be obtained from a hectare in duration of eight weeks. In addition to being a valuable green manure crop, it provides strong fibre for rope making.

2. Crotalaria maculata: It is a useful green manure crop for coconut gardens. It grows wild in waste and uncultivated lands in almost all the major coconut tracts. It is hardy and herbaceous and grows to the height of 1.5 meters or more under favourable conditions. It thrives in a variety of soils including slightly saline ones. When it is well established it can withstand extremes of rainfall and drought It bushes out well under coconut shades. It is not relished by cattle and even goats.

3. Crotalaria anagyroids: This plant has come from Sri Lanka. The plant is a branching shrub, attaining a height of 2.3 m. In Maharashtra, it is cultivated as cover crop and as green manure in coconut estates.

4. Sesbania aculeata: As a green manure crop *sesbania* or *dhaincha* is a widely used in Bangladesh. It can tolerate water logging and alkalinity to a fair extent. It can also tolerate drought if germination has been sound. It is an ideal green manure crop for rice growing soils. In waterlogged fields it grows to a height of 1.5 to 1.8 meters in a very short time. The resistance of the crop to water logging could be appreciated by the fact that the dhaincha crop survives even after being submerged to a depth of about 60 cm for a week. This crop also grows well in alkaline soil and, therefore, can be used for the reclamation of saline and alkaline soil.

5. Sesbania speciosa: This is commonly used in paddy. It is similar to dhaincha in appearance and performance. The crop is raised by broadcasting 17 kg of seeds per hectare. Sometimes when it is not possible to raise a full crop of *sesbania*, the seeds are sown in small plot and the seedlings are then transplanted on bunds at a distance of about 1 m between plants. Seeds are available at the end of the fifth month when the

crop has matured. During ! the first crop itself, the seedlings can be planted at an interval of 5 to 8 cm between plants. It yields 2200 to 3200 kg of green leaf per hectare. The one redeeming feature of Sesbania speciosa is that it is not relished by cattle. Sesbania rostrata is yet another highly promising species which contains nodules on stem which also fixes atmospheric nitrogen. It grows well in waterlogged soil.

6. Phaseolus mungo: This is an annual herbaceous plant cultivated mainly for edible seeds. Mung T -} is a short duration crop maturing within 60-70 days. If sown with the start of monsoon i.e. first week of July, it matures by the fIrst week of September enabling two pickings of the ripe pods and yields on an average 3-4 quintal per hectare. The entire crop after picking the pods, is succulent enough to be turned under as a green manure for wheat. unlike other green manure crop it does not require the use of heavy soil turning plough. An average farmer with bullocks can easily turn it in.

7. Phaseolus trilobus: This is also known as pillipesara. This is comparatively a new green manure crop but is now widely used in Tamil Nadu and Andhra Pradesh. It is also an important pulse crop, because of the creeping and spreading habit. Pillipesara affords a good cover and thus prevents weeds from coming up. It also decomposes quickly. It can be grown either in a standing rice crop in autumn or winter or after ploughing the soil in summer. Pillipesara leaves are relished by cattle and hence can be grown as fodder-cum-green manure crop. Among the other kharif pulses belonging to the genus *phaseolus*, moth (*Phaseolus aconitifolius*) and urd *(Phaseolus mungo*) are used as green manure to a limited extent.

8. Melilo/us spp: Melilotus indica or sweet clover is a commonly grown green manure crop in the United States for sugarcane crop.

9. Trifolium alexandrium: Berseem is a popular fodder crop. However, it can be grown as green manure crop also. In south, it is used as a poultry feed. It is very rich in protein and, therefore, used as poultry and cattle feed. It belongs to clover family. It was introduced in the beginning of twentieth century form Egypt. It yields about 25000 to 37000 kg of green fodder in four to six cuttings per acre. Besides being a good fodder and poultry feed, it builds up soil fertility by increasing the nitrogen content of the soil.

1*0. Cyamopsis tetragonoloba:* *Cyamopsis* or guar is used as a green manure crop in the dry and low rainfall areas. This plant grows well even on poor soils and make very good fodder and manure. Besides these crops, certain other crops are also used as green manure crops in one region or the other. Some varieties of *Vigna* grow very fast, establish quickly in both the seasons i.e. rabi and kharif and make a very good green manure.. It is annual and mostly grown in winter I and establishes itself even when sown on standing rice before harvest. *Desmodium* is sown as both cover and green manure crop. Cowpea which is mostly grown as a fodder crop, is a promising green manure crop. Other leguminous plants such as kulthi (*Dolichos biflorus*) and Lupinus spp are used to certain extent as green manures.

IV. Technique of Green Manuring

All the operations involved from sowing till turning in of green manures depends on the kind of crop. Green manuring will yield rich dividends only when the cultural practices involved in the process are properly understood and practised. Sowing time of the green manure crop, as it differs, depending on the season and crop type, should be so arranged as to bury it at a time when it furnishes its nutrients to the subsequent crop and the time the latter needs it. This, would also help checking the loss of nutrients from the soil. The unique ability of dhaincha (*Sesbania aculeata*) to flourish in a variety of soil and climate has made it adaptable throughout the country. Therefore, the technique described is biased towards dhaincha. However, the basic principles involved are applicable other green manure crops after suitable modification.

1. Soil

Green manure crops can be grown on any type of soils, provided there is sufficient rainfall or alternative irrigation facility. Poor sandy soils, in particular, benefit most by these practices. The heavy soils are also opened up with the incorporation of the organic matter. Dhaincha can tolerate alkalinity to a level of pH 9.5. It can grow in soils having salt concentration of more than 1 % which is hazardous for all other commonly grown crops. In case where pH and salt content are higher than 9.5 and 1 % respectively, leaching of the soil should be done before sowing the seeds. Dhaincha gives out lateral i roots from the stem to have a firm grip in the soil so as to stand against strong winds.The land is given one or two ploughings for its preparation. In case if green manuring is followed by application of gypsum in alkaline soils, leveling of the field is necessary.

2. Sowing or the seeds

Sowing may be undertaken from early June-July. In these regions, wheat is harvested in March and the field is ploughed, harrowed and leveled in the first week of May. Fine soil tilt is required due to the small size of seed. The advantage of establishing the crop earlier than the onset of monsoon is to resist damage from the subsequent heavy rains.

In case of *dhaincha*, it should be sown 45-50 days before the stipulated date of rice transplanting. The amount of seeds required for one hectare vary form 45 to 60 kg. Higher dose is required for saline and alkaline soils in the wake of lower germination due to excess salts. Before sowing, seeds of dhaincha should be soaked overnight in water. For seeds, intended to be grown in alkaline soil, a little salt should be added in the water. However, the treatment of seed with Rhizobium culture has been found to give a good growth of crop. The culture for the various green manure crops is available with local agriculture universities. The process of treatment involves dissolving 125 g of jaggery in 500 ml of water and boiling the solution for half an hour. After cooling, the contents of the packet of Rhizobium culture are transferred and mixed into slurry. To this slurry are added the seeds required for one acre and then the contents are mixed well. The treated seeds are then dried in shade on a sheet of paper. The treated seeds

should not be dried in the sun on any account. The treated, dry seeds are sown either immediately or later, but the storage period should not exceed 48 hours.

The addition of jaggery solution causes an effective stickiness of the Rhizobium on the seeds, and the sugar content of the jaggery serves as an excellent medium for the multiplication of the Rhizobia so that the load of their population on seeds and rhizosphere of soil is in requisite number. Such treatment has been found to increase the yield of green manures by 10-25 per cent.

3. Fertilizer use

As most of the green manure crops are legumes, they have got nodules in their root system. In these nodules Rhizobium bacteria, exist which fix atmospheric nitrogen. Therefore, green manure crops do not require any nitrogenous fertilizer as the nature itself has gifted them with the capacity to utilize atmospheric nitrogen. However, when the plant is young, root nodules are not so active. Therefore, application of 10-15 kg of nitrogen per hectare helps the crop to grow faster.

Application of phosphorus is essential for sound growth of green manure crops. As the applied phosphorus is not completely utilized and as considerable portion of it is fixed in the soil, several attempts have been made to assess the best form in which phosphates can be applied to the crops. The placement of phosphate at the root zone has been tried. All the dose of phosphatic fertilizer intended for main crop was applied to dhaincha and no phosphorus was given to the main crop of paddy. A good crop of dhaincha was obtained which increased the rice yield significantly. Therefore, the phosphorous applied to dhaincha is not lost, rather meets the phosphorus requirement of both green manure and paddy. Certain impurities mixed with phosphatic fertilizer, serve as the source of micronutrients which are needed for the growth of crop. Dhaincha often does not need any additional dose of potassic fertilizer as its extensively grown root system absorbs enough potash from the soil to meet its requirement.

4. Irrigation

Usually 5-6 irrigations are required for raising a 45 days old crop in summer. During germination, sufficient moisture in the soil at 5-10 cm depth is required. If possible one presowing irrigation is desired for good germination. The first irrigation after sowing is given to one week old crop subsequent irrigations are given as and when needed depending on rainfall. Where annual precipitation is less than 65 cm, alternative arrangement of irrigation is necessary.

INCORPORATION OF THE GREEN MANURE CROP

The best results are achieved when a dhaincha crop of 45- 50 days old is incorporated into the soil just before transplantation of paddy. At this age dhaincha is in its pre-flowering stage and quite succulent A 50-day old crop furnishes about 20-24 tonnes of biomass per hectare and supplies 95-115 kg of nitrogen in the same area. The crop should be ploughed in with the help of soil turning or disc plough. Ploughing buries the crop in 15-20 cm deep surface soil. Dhaincha for green manuring purpose should not be allowed to grow for more than 50 days or else the crop becomes fibrous. It takes longer

time for a fibrous crop to decompose and liberate nutrients timely because of its high lignin content. A thumb rule for turning the crop of green manure is at the time when flowers have just started to emerge.

DECOMPOSITION

Countless microorganisms participate in the decomposition of organic matter. The factors conducive to complete decomposition are the stage of maturity of the crop and the moisture level of the soil. Desired results will follow if moisture content is high in the beginning, producing semi-aerobic conditions and low afterwards for inducing aerobic condition under which nitrification can take place. Decomposition, besides depending on moisture content of the soil, is also dependent on the composition of the green matter and the presence of available inorganic nutrients. In light soils, crop should be buried deeper than in heavy soils.

There is no need to allow any time for the decomposition of the green matter. After incorporation, the field is flooded and transplanted with 30-40 days old rice seedlings. Being succulent and having narrow C:N ratio (25:1), it decomposes easily and quickly on incorporation into the soil. The standing water in rice field, hastens the decay rather than hampering without causing any harm to the rice crop. About 50% of the nitrogen becomes available within 4- 6 days of incorporation, the rest, within 20 days of application under the temperate conditions prevailing in the main rice growing fields. Ammonia is released during decomposition which is directly utilized by the paddy roots.

In the normal well-drained soil, the end products are mainly carbon dioxide, nitrate, sulphate and other resistant residues. The decomposition of green manure under waterlogged conditions, as in rice field, takes an entirely different course. It differs from the well drained aerated soil where it is slower and produce different end products. The principal gas produced by green manure decomposition under water logging condition is methane. Small amount of carbon dioxide, hydrogen and nitrogen are also formed. However, the major portion of methane is again convened by the microorganisms on soil surface into carbon dioxide. Blue green algae, which is very often found floating on the water of paddy fields absorbs this carbon dioxide and in return liberate oxygen. This oxygen is dissolved in water and ensures adequate oxygen supply to the paddy roots. Thus, green manuring stimulates the growth of the algae and the production of oxygen in the rice soils resulting in greater aeration or oxygenation of the roots. Green manure also produces some growth hormones and other bio-chemicals which stimulates the growth of paddy. A growth period of 45 days without much time for decomposition results in good yield and saving of longer growth period renders the plant hardy resistant to decomposition. The time saved thereby can be adjusted in favor of grain crop in the rotation.

VI. Place of Green Manure in Crop Rotation

Having seen the response of crops to green manuring, we are now in a position to discuss its place in rotations of wheat, sugarcane, paddy and other crops. Green manure-wheal/sugarcane/paddy rotations have been more remunerative than fallow wheat-sugarcane- paddy rotation, but utilization of a leguminous crop for fodder on grain and moderate fertilization of subsequent crop with inorganic nitrogen has been more remunerative than rotations having green manure. With the availability of short duration, high yielding varieties of cereals, farmers are now adopting multiple cropping rotations where green manure does not have any place, because the cost of growing green manure in wheat rotation comes very high. With high prices prevailing in the country, more and more farmers are adopting double and even triple cropping in a year. After the harvest of main crop, short duration catch crops of legumes like *Lobia* could be grown which could be utilized for green manuring. Even here, farmers prefer to feed a part of the crop to their cattle.

The main drawback existing with the green manure in situ, which is more beneficial than green-leaf manuring is that, the green manure crop occupies the cultivable field for at least 50-55 days, at the cost of cereal crop. Increased food grain requirement due to the increase in population, leads the farmers to keep his field occupied by cereals and cash crops. On the other hand, the expansion of fertilizers use technology, gave another setback to green manuring. Yet the increasing costs of the inorganic sources of nitrogen, their undesirable impacts on the physical condition of the soil and the popularization of the concept of 'sustainable agriculture' which is taking place in the country today to keep up their pivotal position in sustaining soil fertility. To get significant response from green manuring, sufficient dose of green manuring should be given to the crop. It is better reduce the area required for adequate green manuring rather than spreading a little green manure in a extensive field. Certain doses which can be recommended for different crops are shown in Table-

Table. 1: Dosage of green manure or green leaf for different crops and the type of green manure recommended.

Sl.No	Name of crop recommended	Green manure	Doses in kg/ha
1	Paddy	Sesbania (dhaincha) or sunnhemp	2300
2	Sugarcane	Sunnhemp	5000
3	Cotton	-	Green manuring not recommended
4	Wheat	Sunnhemp	7000
5	Banana	Glyricidia	25 kg per pit
6	Grape	Green leaf manuring	100 kg per pit before onset of monsoon
7	Potato	Lupin or buck wheat	1000

VII. Effect of Green Manuring on Soil

Green manuring exerts multiple beneficial impact on the soil which can be discussed under the following headings.

1. Soil fertility

The literal meaning of the word 'fertility of soil' is the ability of a soil to supply plant nutrients in and available form. The availability of nutrients greatly depends upon the total content of nutrients present in the soil. Green manures supply nitrogen to the soil and consequently make it available to the plants. As most of the green manure crops are leguminous, they fix atmospheric nitrogen in their root nodules. ft is also observed that some fixed form of nitrogen diffuses out from the nodules to the soil, thereby, benefiting other plants growing along with the Legumes. On the other hand when a green manure crop is turned in, all the nitrogen fixed in the plant body is liberated , in the soil in the form of ammonium. To sum up, leguminous green manures convert unavailable nitrogen of the atmosphere into available ammonium of the soil. Ammonium form of nitrogen can be easily converted into nitrate form by microorganisms. The over dry weight of leguminous plants contain on an average 2.5 to 3.0 % nitrogen. The roots of annual legumes may contain 5 to 20% of the total nitrogen found in the plant. Table-5 gives an idea about the amount of nitrogen fixed by some important leguminous green manures.

Table. 2: Amount of nitrogen supplied by selected crops

Sl.No	Crop	Nitrogen supplied (kg/ha)
1	Senji	80
2	Guar	60
3	Libia	55
4	Dhaincha	75
5	Mung	40
6	pillipesara	55

At the decomposition of green manure begins immediately after turning in, nitrogen of the soil is utili7.cd by the micro-organisms, and thus are saved from leaching losses. Decomposing organic matter has a solubilizing effect on phosphorus, potassium and trace elements. There are several mechanisms through which phosphorus becomes available to the plants. The increased solubility of phosphorus might be owing to the production of a large quantity of carbon dioxide during decomposition of organic matter, resulting in lowering the pH of the soil solution. Carbon dioxide dissolved in water, helps in the conversion of mineral phosphate into organic phosphate which becomes available to the subsequent crops. Some of the phosphorus which is strictly fixed with iron and aluminum is also liberated for the crops' use.

2. Soil structure

The effect of green manuring on soil structure has been controversial. In some of the experiments conducted in this respect it is found that, tinder tropical conditions which

are existing in our country, the green manures added is rapidly oxidized before it can be dispersed into the soil colloids.

Materials that are resistant to decomposition have little, effect upon the size distribution of soil aggregates but are effective over a longer period by mechanically loosening the soil. In sandy soils, where the amount of silt and clay in proportion to the sand is often very small to produce other than single grain structure, the application of organic material will have little effect on the aggregation of the soil.

3. Organic matter

Green manure in most parts of the world has been applied more successfully for increasing the available nitrogen supply than the humus content of the soil. As a matter of fact, green manuring can either increase the humus content or the supply of available nitrogen in the soil, but it can rarely replenish both at the same time. There they differ from the effect of well decomposed farmyard manure fairly resistant to decomposition resistant plant material which is If typically low in nitrogen. The available nitrogen supply is only increased if readily decomposable material, high in nitrogen content such as young plants -are added to the soil.

4. Reclamation of saline and alkali soils

Green manures play an effective role in the reclamation of saline and alkali soils. During decomposition of these manures, considerable amount of organic acid is liberated which brings down the pH of the soil, besides forming number of salts with the sodium of the exchangeable complex. This reduces the sodium content of the clay of the soil. Dhaincha has been found to be an ideal green manure crop for reclaiming saline and alkali soils. Saline soils mend themselves if copiously irrigated with good quality water which washes down the salts to the lower horizons of the soils profile. Growing a green manure crop in saline soil brings out a rapid transformation of the soil to a cultivable land.

CONCLUSION

In any scheme of reclamation of alkali soil, gypsum and dhaincha are necessarily involved. In the process of reclamation, gypsum is applied followed by leaching of the treated soil. The cultivation of any crop in the leached land begins with dhaincha. An experiment, involving the use of 10 tonnes per acre of gypsum, with frequent flooding and draining, followed by green manuring with dhaincha, resulting in the reclamation of clayey alkali soil and gave higher yields of crops thereafter. Green manuring also imparts buffering capacity to the soil which helps in keeping down the harmful effects of excessive salt concentration. To get the maximum benefit from green-manuring, the crop should be ploughed at a time when the moisture content of soil is low, so that the initial desiccating reactions may fix the organic complexes, and a highly buffered humified organic residues will help in reducing the concentration of sodium on clay colloids.

green manure -cum-fibre crop

SUNNHEMP (*Crotalaria juncea*

Fig 1. *Sesbania rostrata* Root and Stem nodulating green manure (manila agathi).
Fig 2. *Crotalaria juncea* Green manure cum fibre crop.
Fig 3. *Glyricidia maculata* a green manure crop

Fig 4. *Sesbania rostrata* with stem nodules
Fig 5. Green manure *in-situ* incorporation (in wetland)
Fig 6. Green manure trampling and land preparation with rotavator

Animal welfare during natural calamities and disaster management

Santosh S. Pathade and Vijay D. Domple

Ph.D. scholar, Division of Extension Education, IVRI
**Corresponding author:vijaydomple@gmail.com*

The world health organization (WHO) defines a disaster as any occurrence that cause change destruction, ecological disruption, loss of human life, human suffering, deterioration of health and health serves on a sale sufficient to warrant an extra ordinary response from outside the affected community or area.

CLASSIFICATION OF DISASTERS

Nature, timing, predictability and type of impact. (Thapliyal, 2003)

Slow	Quick	
	Predictablev	Unpredictable / sudden
Drought	Cyclone	Earthquake
Famine	Flood	Landside
Food shortage	Typhoon	Avalanche

Strategies for management of live stock in disaster prone areas

Main problems which are seen during disaster are spoilage of food or water supply, zoo noses, reduced dairy and livestock production due to scarcity of feed and water, high livestock mortality rates, physical injury and spread of diseases.

BASIC RULES FOR ANIMAL PROTECTION DURING DISASTERS

1) Veterinarians and animal protection expert should be included in disaster assessment teams and heir advice used in community disaster planning.
2) Involvement of animal care groups like (IWGASD) international working group on animals in disasters to provide shelter, rescue and veterinary care.
3) Provision of basic stray animal awareness training to humanitarian aid workers for safety reasons.
4) Joint training between animal care and humanitarian relief works to ensure an approach to disaster management that saves both people and animals at least cost.
5) Policy makers should take into account practical indigenous techniques and economic, trade or social restrictions.

II) Housing Management :

a) Animals should be kept under shade of tress.

b) No overcrowding of animals in hard.
c) Iron sheet proof should be covered with thatch or asbestos sheet.
d) Upper layer of Kachha floor should be replaced with new and at every six months interval, so that load of organism can be reduced.
e) Spots closer to temple, churches, masjids are generally ideal for temporary drought relief camp.

III) Feeding Management :

a) Animals Should be allowed to graze and feed in early morning or late evening only.
b) Management of good stocking rates in pasture land.
c) Grow drought resistant plants and rear drought resistant livestock.
d) Application of fodder conservation technique e.g. molasses treatment

IV) Water Management :

1) Lactation & pregnant animal must be given priority over young and bullock, crossbreed over local breeds & sick animal over healthy.
2) Avoid wastage of water
3) Restrict salt intake
4) Water show be mixed with gur/jaggery as it satisfy the thirst.
5) Provided water in small quantity and move frequently.
6) Water conservation during rainy season (dams and ponds)

V) Caring for Livestock during disaster

First priority should be personal safety & welfare followed be the safety and welfare of other people & finally animals & property. first logical steps in caring for livestock and other animal is to locate, control and provide for these animals. If difficult to find, contact local law enforcement for information. Shifting of animals during flood.

VI) Sensitivity :

Very often disaster temporality after the behavioral state of livestock as they get agitate, nervous so follow some technique.

1) Handle with quietly, calmly manner in which they are familiar
2) Wear clothing and use vehicles that are familiar.
3) If possible clean the animal (wipe out eyes, mouth, nostril)
4) Move animals away from the residue of disaster
5) Treat wounds of injured animals so their comfort level improves.

VII) Feed, Safety & Shelter

Over the last few years the major calamity prevailing was drought in central portion of India, Rajasthan, Gujarat, Maharashtra & Deccan plateau due to deficient of monsoon rainfall, also in some southern states like Karnataka & Tamilnadu.
Feed scarcity is major problem during last few years so to overcome this

1) Drought resistant vegetations in combination with NPN source of protein and byproducts of sugar industry molasses as source of energy could be used for meeting immediate nutritional requirement.
2) Tree leaves and cakes of inedible oilseeds could be used to meet the essential requirement of intact protein in ruminants.
3) Cattle relief camps were set up around sugarcane factories in drought affected zones
4) Large scale feeding of bagasse, molasses in combination with urea and mineral supplements were adopted.
5) Feed formulations developed.

VIII) Proper animal evacuation policy rules

1) Provision of adequate resources to evacuate animals
2) Sanitation and safety considerations to restrict animals from camps
3) Animal welfare professionals should co design with humanitarian community policies and procedure

IX) Disease prevention and control

1) Provision of advice on basic health and hygiene requirements for livestock management and movements
2) Transfer of knowledge from trained professional to other people
3) Slaughter of infected animal carried out humanely
4) Vaccination schedule should be followed

X) Proper carcass disposal

1) Burying : Deep pit of 8-9 feet, use of quicklime, common salt and other disinfectant
2) Burning : 4 cm diameter and 1M tall pit should be used
3) Cross trench pit : Gallon of kerosene or old rubber tyres are used.

Artificial insemination technique in dairy animals

Hanuman Prasad Yadav[1]*, Nadeem Shah[2], Uma Kant Verma[3], Shabir Ahmad Lone[1], Jitendra Kumar[4] and Deepak Kumar[5]

Veterinary Gynaecology & Obstetrics[1], Artificial Breeding Research Centre[2], Animal Genetics & Breeding[3], Animal Biochemistry[4] and Animal Biotechnology[5]
ICAR- National Dairy Research Institute, Karnal, Haryana- 132001, India
**Corresponding Author: drhanumanndri@gmail.com*

ARTIFICIAL INSEMINATION

- ❖ It deals with the science and techniques of collection, evaluation, dilution and preservation of the semen and its deposition in the female reproductive tract, at the appropriate time during later part of the heat period.
- ❖ It is most important that female inseminated at right stage of cycle i.e. shortly before ovulation.

ADVANTAGES

- ✓ **Genetic improvement**: Through artificial insemination (AI), genetic improvement in a herd is faster than natural service.
- ✓ **Control of venereal disease**: In AI programme, the bull does not come in direct contact with female. So, incidence of transmission of venereal disease is very less.
- ✓ **Economical**: Small and marginal farmer cannot keep a genetically superior sire for breeding purpose but through AI, they can get semen from a genetically superior bull. It saves labour, time as well as money of farmer.
- ✓ **Quality of semen:** AI programme assures best quality of semen because semen is evaluated before and after processing which is not possible in natural services.
- ✓ **Correct breeding record:** The correct breeding records can be maintained in AI programme in comparison to natural services.
- ✓ **Monitoring of reproductive soundness of female:** During AI each female is examined per rectally which reveals any anatomically, morphological and pathological defect.
- ✓ **Overcome physical inability of bull:** Some bulls are genetically superior as well as semen is good quality but they are unable to mount due to physical difficulties. Example: Disease of joints, muscle, nerve, bone and tendon. But semen can be collected with the help of electro-ejaculation method.
- ✓ **Overcome size difference of animals:** If female is small in size and a bull is heavy, in this condition natural service is not possible but by AI, there is no such problem.

- ✓ **Genetically superior sires can be used very effectively**: The greatest advantages of AI technology are that semen from an elite bull can be used very effectively. Ordinarily, under natural mating system, one bull can be bred about 100 female in one year where as with AI about 30000 female may be served in one year.

DISADVANTAGES

- ✓ It requires the knowledge of structure and function of genital tract of both male and female.
- ✓ Selection of sire should be very rigid in all respect.
- ✓ Time involved - Restraining and inseminating cow.
- ✓ It requires well trained operators of AI and good equipments.
- ✓ Estrus detection must be good of female animals.

CONSTRAINTS

- ➢ Inconsistent semen quality
- ➢ Proper accessories for A.I. generally not available
- ➢ Improper procurement and distribution of LN_2
- ➢ Post AI infection, repeat breeding and other reproductive problems quite common.
- ➢ Insufficient AI centers and trained person to cover the entire livestock population.

Important Points before Insemination

- ❖ Heifer should be about weight > 250 kg in cattle and >300 kg in buffalo.
- ❖ No any abnormal discharge from female genitalia.
- ❖ Gap- 60 days post partum in normal calving, 90 days post-partum in abnormal calving (Dystocia, ROP, abortion etc).
- ❖ Type of semen used (Liquid / Cryopreserved).

Artificial insemination technique in cattle

- ✓ Restrain the estrus animal in crate**.**
- ✓ Ready all necessary instruments before opening liquid nitrogen container.

Care in handling of the semen

- Remove frozen semen from the container with the help of a forceps.
- Tips of the forceps should be pre-cooled by dipping it in liquid nitrogen (LN_2) till the boiling of LN_2 ceases.
- The canister should not be lifted above the frost line inside the container.
- Canister handle should have a label indicating identification of semen. A thick paper slip with the details of semen must be kept in the canister for identification.
- Raise canister to the neck of container, keeping the straws in goblet as deep as possible.

- Take out desired straw as quickly as possible and shake them in air to remove any liquid nitrogen inside and put immediately in water bath for thawing.
- Thawing of semen at 37°C for 30-60 sec.
- Remove straw from water bath and wipe out all water from outer surface of straw by tissue paper or cotton after ascertaining the bull number printed on the straw.

Loading of AI gun

- Bring the A.I. gun to the proper temperature by rubbing it with a piece of clean cloth/cotton or tissue paper. This is important in the winter months.
- Hold straw vertically with factory seal end towards downward side and shake air bubble from middle of straw to lab seal end.
- Withdraw piston of gun and place straw in barrel of AI gun.
- Factory seal end should be inside gun and lab seal end should face outside.
- Cut straw at right angle by straw cutter or BP blade.
- Fix A.I. sheath over A.I. gun from its broad end.

Recto-vaginal or cervical fixation method of AI

- A.I. in cattle is done in standing position.
- Wear full arm sleeve and lubricate it with liquid paraffin or soap water.
- Insert hand inside rectum in cone shape manner **Fig. 1**.

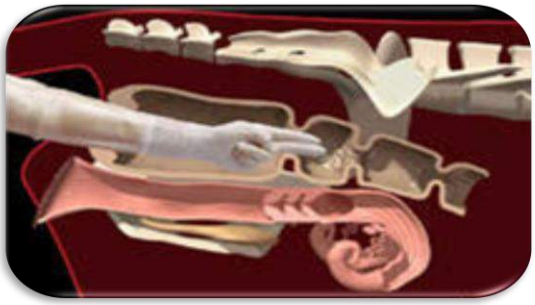


Fig. 1: HAND INSERTED INTO RECTUM IN CONE SHAPED MANNER

- Remove dung by back racking and care should be taken to prevent ballooning.
- Wipe exterior of vulva and vulvar lips with clean cotton.
- Vulvar lips opening by assistant before inserting AI gun in female genitalia to check external contamination **Fig. 2**.

Fig. 2: VULVAR OPENING BY ASSISTANT IN COW TO PREVENT COTAMINATION BEFORE AI

- Locate cervix and palpate entire genitalia before AI for reproductive soundness.

- Grasp cervix with palm and fingers, palpate external end of cervix with thumb. **Fig. 3 (A), (B) and (C)**.

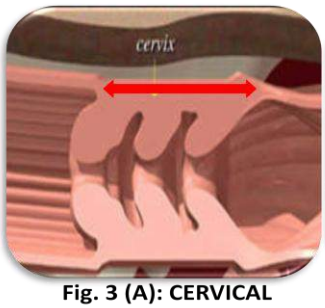
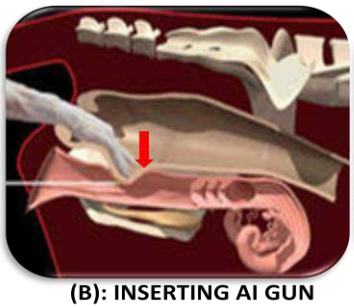
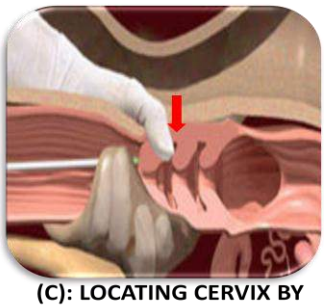


Fig. 3 (A): CERVICAL RINGS OF CERVIX



(B): INSERTING AI GUN INTO VAGINA



(C): LOCATING CERVIX BY FEELING WITH TIP OF AI GUN

- Pull vulvas lips apart and AI gun is passed at an angle of 45° through vagina.
- In case vaginal folds create problem and put hindrance for passing AI gun, cervix may be pushed forward in order to abolish vaginal folds.
- Manipulate AI gun so as it strikes thumb placed over external end of cervix and then AI gun is passed into cervix.
- Intra uterine inseminations are more efficient than intra cervical.

Artificial Insemination with liquid semen

- ✓ AI in cattle and buffaloes is done in standing animal.
- ✓ Sterilized catheter of 40 to 42 cm in length, outside diameter of 5-6mm, inside diameter of 1 mm is fitted to a clean and dry plastic syringe (2-5ml) with rubber connector is required.
- ✓ After sucking some air (0.5-1.0 ml) about 1ml semen is sucked in the pipette.
- ✓ AI is done with recto-vaginal method.

Semen deposition site:

1) Proper placement of AI gun at internal Os of cervix: Fig. 4 (A), (B) and (C)

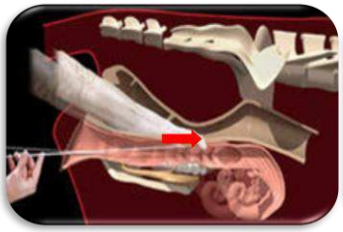
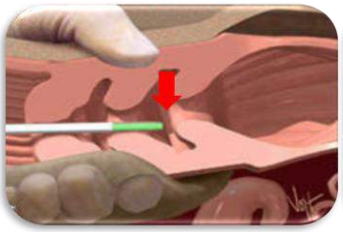
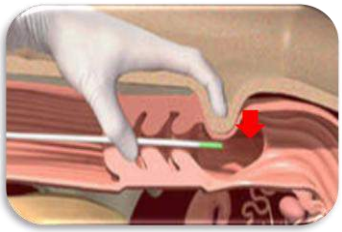


Fig. 4 (A): LOCATING OS CERVIX BY AI GUN



(B): AI GUN PASSED SECOND CERVICAL RING



(C): FEELING TIP OF AI GUN BY FINGER

2) Semen deposition at internal Os of cervix Fig. 5.

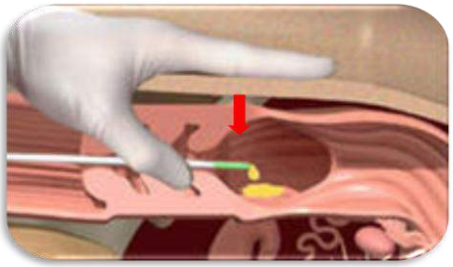


Fig. 5: SEMEN DEPOSITED IN INTERNAL OS OF CERVIX

3) Placement of AI gun in uterine horn: Fig. 6 (A) and (B)

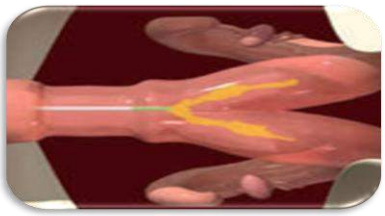
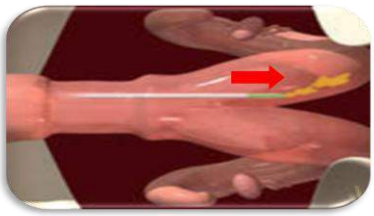


Fig.- 6 (A): PROPER SEMEN DEPOSITION IN BOTH UTERINE HORN WITH AI GUN



(B): IMPROPER SEMEN DEPOSITION IN ONE UTERINE HORN WITH AI GUN

Insemination technique in buffaloes: (Same as cattle)

- Difficulty in detecting heats in buffaloes
- **More sensitive**: To touch and vaginal contractibility
- **In India**: About 80% of total number of estrus periods recorded in buffaloes were from October to March and only 20% from April to September
- **High temperature and humidity**: Coincide period of lower sexual activity
- **Oestrous cycle length**: Average - 21 days
- **Duration of oestrus**: Less than 24 hours varies as wide as 18-30 hours (mostly 24 hours)
- **Ovulation time**: 10-48 hour after end of oestrus (mostly 12-18 hours)

Heat stress: Major threat for poultry in summer

Poorna Chandhar. I*[1], Madhu Swamy[2], Yamini Verma[3] and [4]Amita D.

[1]Postgraduate Scholar, [2]Professor and Head, [3]Associate professor, [4]Assistant professor
Department of Veterinary Pathology
College of Veterinary Science and Animal Husbandry, Jabalpur
**Corresponding Author: anroop14c@gmail.com*

ABSTRACT

Birds in production are particularly susceptible to high temperatures, when accompanied by increased humidity. Summer season associated with thick layer of feathers on the body of chickens and absence of sweat glands; make them highly prone to heat stress. Birds affected with heat stress suffers, Panting(open mouth breathing), drooping wings, listlessness, increased thirst, reduced appetite, decreased egg production, inferior shell weight and quality, poor shelf life of eggs, decreased growth rate, excreta in consistency of soup, decreased dry matter intake, at last prostration and death. Immediate administration of cold drinking water, provision of adequate Ventilation by fans, use of sprinklers and foggers, administration of vitamins like vitamin E and C in increased amounts, administration of electrolytes and drugs like virginiamycin can help to alleviate the condition of bird.

INTRODUCTION

Birds are 'heat stressed' if they have difficulty achieving a balance between body heat production and body heat loss. This can occur at all ages and in all types of poultry. Summer season associated with thick layer of feathers on the body of chickens and absence of sweat glands; make them highly prone to heat stress. Birds in production are particularly susceptible to high temperature and increased humidity. If temperature rises, birds become exhausted of heat losing mechanisms and die from respiratory, circulatory or electrolyte imbalances (Vegad J.L., 2007)

Heat is produced by metabolism within the body, which includes maintenance, growth and egg production. Heat production is affected by body weight, species, breed, level of production, level of feed intake, feed quality and, to a lesser extent, by the amount of activity and exercise. Heat can be lost in a variety of ways. Birds modify their behaviour to stay in the 'Thermo neutral zone'.

The normal mechanisms by which bird dissipates body heat are by radiation, convection and conduction. After a bird can no longer maintain its body heat balance by one of these three methods reaches its upper critical temperature, then it must use "evaporative heat loss", or panting for managing excess heat to dissipate (Aengwanich *et al*., 2009).

Evaporative heat loss, whilst essential to the bird, does not contribute to heating the house. Evaporation is very important at high temperatures as poultry do not sweat but depend on panting. This is only effective if the humidity is not too high. Hot, humid conditions are therefore much more stressful than hot dry conditions.

Normally, the body temperature of an adult chicken is 41 - 42°C. There is a diurnal temperature variation of about 1.5 °C depending on the activity of birds (Reddy., 2000). Under heat stress condition, when the heat loss from the body is less than heat gained, the body temperature tends to rise (Mehta and Shingari, 1999).

The body temperature of the broiler must remain very close to 41°C (106°F). The ideal temperature range for layers is between 18-24°C. Above this level, the birds employ different mechanisms to get rid of excessive body heat. Up to 30°C, the hen can regulate body temperature by reducing feed intake (at the cost of egg output, because energy is used for cooling the body). Chickens can adapt to high temperatures to some extent, but from 41°C drastic measures must be taken to avoid mortality due to heat stroke. The baseline consumption of water which is 1.8 times the amount ingested may increase by 6 % for every 1° raise in temperature above 27°Celsius (Muiruri and Harrison, 1991).

Adult birds take about five days to acclimatise to high temperatures. Birds are more susceptible to sudden, large changes in temperature. The very hot days after a cool spring often result in increased incidence of heat stress. Some of this will be due to poor acclimatisation, but some will be due to managers being less well prepared than later in the summer. Heat stress not only affects production performance but also inhibits immune functions.

In laying hens, heat stress depresses body weight, egg production, egg weight, and shell quality and is generally accompanied by suppression of feed intake, which could be the cause of the decline in production (Mashaly *et al*., 2004).

Apart from direct losses flock may also suffer from number of infectious diseases on account of lowered immunity and resistance from heat, this in turn may further increase the losses. Laying hen and male broiler are more prone for heat stress (Vegad J.L., 2007).

CAUSES OF HEAT STRESS

The prime cause of heat stress are high environmental temperature coupled with high humidity, maintenance of inadequate ventilation, overcrowding of birds (increased stocking density), low ceiling of poultry house, heavy protein rich diet during hot climate which precipitate the heat production by metabolism, other stress factors like vaccination, frequent handling, roof materials which conducts heat, improper litter materials, may also predispose to heat stroke (Holik., 2009).

CLINICAL SIGNS

Birds affected with heat stress show, Panting(open mouth breathing), drooping wings, listlessness, increased thirst, reduced appetite, decreased egg production, inferior shell weight and quality, poor shelf life of eggs, decreased growth rate, excreta in consistency

of soup, decreased dry matter intake, at last prostration and death (Aengwanich et al., 2004).

POST-MORTEM EXAMINATION

The bird carcasses affected with heat stress are usually dehydrated and congested. Mucoid like exudate seen in nostril and mouth, carcass has haemorrhages on the abdominal fat, ovarian follicles misshaped and haemorrhagic. Pathognomonic lesion of cooked meat appearance of breast muscle which is pale to white in colour is noticed in affected birds (Chandra et al., 2004).

TREATMENT

The treatment regimen for affected birds should be carried out as soon as possible. Immediate administration of cold drinking water, provision of adequate ventilation by fans, sprinklers and foggers, administration of vitamins like vitamin E and C in increased amounts, administration of electrolytes and drugs like virginiamycin can help to alleviate the condition of bird (Vegad J.L., 2007).

MANAGEMENT

Management is effective in preservation of birds from heat stress, the most important measures are:

- Special care should be taken in designing new houses (location and position, roof construction, insulation), special equipment for cooling (pad cooling, ventilators, foggers, roof sprinklers) should be used in poultry houses
- Roof should be insulated and painted white outside for preventing absorption of radiation
- Wetting of floors, ceilings and gunny bag curtains will reduce the temperature inside the poultry houses
- Bird density at housing should be reduced
- Sufficient floor space should be provided
- Cool drinking water in *ad-libitum* quantity must be provided in hot seasons
- Feeding should be carried out in cooler period of the day like early morning and evening
- Special feed formulation with higher energy (added oil) and lower total protein (balanced amino acids) and higher levels of minerals and vitamins C, A, K, Thiamine, riboflavin, pyridoxine, choline and cyanocobalamine should be followed.
- If necessary stimulation of feed intake (midnight snack) can be carried out
- Avoid unnecessary activity, summer heat places enough stress on birds. Take care not to disturb them during the hottest time of the day.

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A Brief Note on Antibiotic Residues in Milk

Priyanka[1], Monika Rani[2*] and Maninder Singh Sheoran[3]

[1]Ph.D.Scholar, Veterinary Public Health & Epidemiology,
[2]Assistant Professor, Dairy Extension, CoDST,
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, 125004
[3]Haryana Veterinary Surgeon, Animal Husbandry & Dairying Department, Haryana
**Corresponding Author: vermamonikaluvas@gmail.com*

Milk is defined as the physiological secretion of the mammary gland of mammals to provide nourishment to their young ones. Consumption of milk is necessary for new born of all mammalian species because it is primary source of nutrition for them before they are able to digest other types of food. More than 6 billion people worldwide consume milk and milk products; the majority of these people live in developing countries. India ranks first in milk production in the world (18.5%) with a total annual production of 165.4 million tones and per capita availability 355 g/day (DAHD&F). It is therefore important to provide due attention to the quality of milk produced and distributed to the consumers. Various harmful chemical substances contaminate the milk due to various reasons. Amongst, an array of such substances, veterinary drug residues in general, and antimicrobials in particular, pose major milk and milk products' food safety issue.

Cause of antibiotic residues

Increased demand of milk can only be met by implementing widespread animal husbandry practices. Use of veterinary drugs for curing of variety of ailments in farm animals is an integral component of such extensive animal husbandry practices. Antimicrobials are considered as the vital medicines to treat animal infections. They are also used at sub-therapeutic levels to increase feed efficiency, promote growth and prevent diseases (Ronquillo, 2016).

The most possible cause of occurrence of drug residues in milk is the failure to observe prescribed withdrawal times (Van Dresser and Wilcke, 1989). But, In India, the extra label use of antibiotics, mainly dosages deviating from recommendations of the drug manufacturer fall under the main reason for occurrence of antibiotic residues in milk after the end of the withholding period in cows. The inappropriate and abusive use of veterinary drugs and negligence regarding withholding periods of milk can lead to the presence of residues of these compounds or their metabolites. Usage of antibiotics as feed additives is reported to be another mean of antibiotic residue prevalence in milk. It has been projected that usage of antibiotic as feed-additive has become an integral part of this intensive animal-production technology.

Effects of residues on health

Indians are developing resistance to antibiotics and, hence, falling prey to a host of otherwise curable ailments.Antibiotic residues in milk are of great public health concern since milk is being widely consumed by infants, youngster and adults throughout the globe. The residues of antibacterial drugs may present pharmacological, toxicological, and microbiological and immunopathological health risks for humans. Possible acute and chronic adverse effects of antibiotics residues have been suggested like transfer of antibiotic resistant bacteria to the human and some other possible effects include autoimmunity, carcinogenicity (sulphamethazine, oxytetracycline), mutagenicity, nephropathy (gentamicin), hepatotoxicity, reproductive disorders, bone marrow toxicity (chloramphenicol), allergy (penicillin). These hazards can be categorized in to two types as direct-short term hazards and indirect-long term hazards, according to duration of exposure to residues and the time onset of health effects. Antibiotics like beta-lactam group of antibiotics in spite of being in low concentration in milk causes allergic hypersensitive reaction in sensitized individual immediately after consumption which may be leads to direct health hazard while prolonged exposure to low levels of antibiotics leads to chronic toxic effects including carcinogenicity, teratogenicity, reproductive effects, development of antibiotic resistance bacteria in treated animals and disruption of normal healthy flora in the intestine. Chronic exposures to oxytetercycline include blood changes such as leucocytosis, atypical lymphocytes, and lung congestion, toxic granulation of granulocytes and thrombocytopenia purpura and brown discolouration of the teeth. Some antibacterial agents are used as feed additives in cattle feed like tetracycline, nitro furans and sulphonamides which may excrete in milk and may cause toxicological effects in human.

Control of antibiotic residues in milk

In order to tackle the menace of antimicrobial residues in foods of animal origin such as milk, meat and their products, a number of international organizations such as the Codex Alimenterius Commission (CAC), European Economic Community (EEC), World Health Organization (WHO) and the Food and Agricultural Organization (FAO) are involved in regulating the use of drugs in animal production activities. For this purpose, these organizations have proposed maximum residue levels (MRLs) for livestock products based on regular monitoring, controlling and surveillance programmes with the aim of minimizing the risk to human health.

CONCLUSION

Noticeable concentrations of antibiotic residues in milk supplies higher than the MRLs are illegal which should be checked to avoid public health hazard. People should ensure strict adherence to the prescribed withdrawal time of the drugs. One practical approach to cut down the residues in milk would involve good hygiene and good management practices at farm and the milk processing units. For ensuring human food safety, establishment of regulatory standards and good management practices are essential components to reduce the risk of antibiotic residues in milk supply.

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Effect of climate change on livestock in temperate regions of India

Asma Altaf, Nazish Rizwan, Aqeel Yousuf Wani, Muzamil Abdullah*, H M Khan, T A Banday and R Patoo

Division of Livestock Production and Management, Faculty of Veterinary Science and Animal Husbandry, Shuhama, SKUAST-K

**Corresponding Author*: *mabhatndri@gmail.com*

Climate plays an important role in agriculture and livestock production systems. Diversity of livestock and plant species depends on the type of climate in that region. The climate change is an area of concern in terms of negative impact on livestock and agricultural sector. Climate change has both direct and indirect effect on livestock. India is more prone to negative impacts of climate change as 55% of the population is directly dependent on agriculture and livestock sectors for livelihood. Climatic extremes and seasonal fluctuations in herbage quantity and quality will affect the well-being of livestock, and will lead to declines in production and reproduction efficiency (Sejian, 2013). Various climate model projections suggest that by the year 2100, mean global temperature may be 1.1–6.4 °C warmer than in 2010. The climate change is expected to have far-reaching consequences for dairy, meat and wool production mainly via impacts on grass and range land productivity (Kumar et al., 2015). Animal can adapt to the extreme temperatures by the compensatory mechanisms in its body but only at the cost of its production performance thereby causing economic loses. In this article, we try to elaborate on the detrimental effects of changing climate on livestock. The temperate area is more prone to climate change. The water availability is going to reduce due to recession of glaciers and decrease in rainfall which is affecting livestock, their feed and fodder availability and has threatened food security.

DIRECT EFFECT ON LIVESTOCK

The most significant direct impact of climate change on animals is the heat stress which has negatively affected the productivity of animals thereby causing financial losses to farmers and other stakeholders. Heat stress causes decrease in milk yield, changes in composition of milk, decrease in average daily gain, reduced fed conversion efficiency, reduced feed intake and reduced reproductive ability. The heat stress has multifaceted negative effects on livestock production systems affecting almost all the physiological, biochemical and behavioural patterns.

The first reproductive alteration occurs through adrenal-pineal-hypothalamic interaction in heat stressed animals and manifested in altered follicular development. Reduced feed intake causes lesser pulses of luteinising hormone resulting in longer

follicular wave due to altered follicular dynamics. The occurrence of silent ovulations or silent heat increases in cattle and buffalo during periods of heat stress. The high body temperature and increased uterine temperature affect embryo development thereby causing poor embryo implantation and increased embryo mortality. In males, quality of semen and fertility is also affected due to the elevated temperatures.

The negative impact of direct temperature rise on total milk production of cattle and buffaloes for India has been estimated about 1.6 million tonnes in 2020 and more than 15 million tonnes in 2050 (Upadhyay et al., 2009).

Another important impact of climate change on animals is the cold stress. Excessive cold and dry weather leads to outbreak of diseases and decreases productivity in animals. The phenomenon is observed when temperature in winter falls below critical temperature. Mild hypothermia occurs when rectal temperature falls below 30'C, moderate when temperature falls below 29'C and at 20 'C severe hypothermia is seen. When rectal temperature falls below 28'C cow is not able to return to normal temperature without assistance. Blood is diverted from extremities to vital organs thus extremities become prone to frost bite.

INDIRECT EFFECT ON LIVESTOCK

Most of the production losses are caused due to indirect impacts of climate change which occur due to reduction and non-availability of fodder. Irregular and insufficient rains cause water shortage which affects land productivity leading to crop failure. Indirect impacts are also associated with the attempt of animals to adapt to heat and cold stress. Variations in temperature and rainfall are the most significant climatic variables affecting livestock disease outbreaks. Warmer and wetter conditions will favor the survivability of vectors for longer periods of time thus increasing the risk and incidence of vector borne diseases year round. Also spread of vectors and other disease causing agents to areas where they could not have survived earlier due to cold climate has increased the prevalence of diseases in such areas. Outbreaks of diseases such as foot and mouth disease or avian influenza affect very large numbers of animals and contribute to further degradation of the environment and surrounding communities' health and livelihood.

EFFECT OF CLIMATE CHANGE IN KASHMIR

The Indian Meteorological Departments monitoring testifies that temperatures are increasing in both Jammu region and the Kashmir valley, with a significant increase in maximum temperature of 0.05 degrees Celsius per year. The negative impact on water availability has occurred due to recession of glaciers and decrease in rainfall which has threatened food security. September 2014 floods in Jammu and Kashmir were the result of climate change which lead to the loss of livestock and agricultural produce. In Kashmir division 42.6% respondents said that they witnessed loss of livestock compared to 7.5% in Jammu division. 73.5% respondents in Kashmir said that availability of fodder for livestock has been severely affected (J &K Floods 2014).

CONCLUSION

Climate change is a serious issue with life threatening consequences. It drastically affects the economy by hampering growth and development of livestock and agricultural sector. Experts of livestock and Government agencies needs to come with certain policies to cope up with climate change. There is need of hour to generate species/breed specific information about impacts of climate change and immediately put in place appropriate adaptation strategies addressing mitigation of feed scarcity situations arising due to climatic variability and cost effective appropriate shelter management strategies. So policy makers should implement programs in livestock sector, improvement of feed and fodder production and its storage such as opening fodder banks and ultimately to raise and optimize productivity while keeping in mind future challenges.

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Pseudopregnancy in dairy Goats

L. Kipjen Singh[1*], M.K Patra[2], G.K Mishra[3], Aamrapali bhimte[4] and Rojita Yengkhom[5]

[1]PhD Scholar, Animal Reproduction, Gynaecology & Obstetrics, [4]PhD Scholar, Animal Physiology Division, ICAR- National Dairy Research Institute, Karnal-132001, Haryana*
[2]Scientist, [3]PhD Scholar, Animal Reproduction Division, [5]PhD scholar, Animal Nutrition Division, ICAR- Indian Veterinary Research Institute, Izatnagar- 2431 22, U.P. India;
**Corresponding Author: laishramkipjen04@gmail.com*

ABSTRACT

Pseudopregnancy affects the fertility of dairy goats. The incidence of pseudopregnancy ranged from 3-20% in dairy goats. Clinical signs showed bilateral distension of abdomen. Ultrasonography is the only tool to diagnose pseudopregnancy from pregnancy on day 40 post-breeding. Single or double dose of prostaglandins is normally used for the treatment of pseudopregnancy.

Keywords: Pseudopregnancy, dairy goats, prostaglandins

INTRODUCTION

Pseudopregnancy is one of the major reproductive disorder causing infertile condition in goats. It occurs due to persistence of corpus luteum in the absence of conceptus (viable) in the uterus (Hesselink, 1993; Pieterse and Taverne, 1986; Taverne *et al*., 1995). It is also a uterine pathological condition of mated and non-mated goats in breeding and non-breeding season characterized by the accumulation of aseptic fluid in the uterine lumen (Moraes, 2014). Synonyms include hydrometra, mucometra and cloud burst (East 1983; Guss 1977). The exact etiology and pathophysiology is still not clear although it is shown to associate with high plasma progesterone concentration (≥2 ng/ml), fertilization failure, disturbances in either luteotrophic or luteolytic mechanism during the ovarian cycle activity and variable degree of abdominal distension (Taverne *et al*.,1995; Noakes *et al.,* 2009). Higher prolactin concentration are responsible for the onset of intrauterine fluid accumulation in pseudopregnant does (Taverne et al., 1995). On the contrary, it is reported that no existence of increased prolactin concentration in the onset of fluid accumulation in the uterus in pseudopregnant does (Hesselink *et al.,*1995 and Kornalijnslijper *et al.,* 1997). Therefore, the present article is to describe about the incidence, clinical signs, diagnosis and treatment of pseudopregnancy.

Incidence

Pseudopregnacy are more prone to older goats compared to younger goats (Mialot *et al*., 1991; Hesselink, 1993b). Purohit and Mehta, 2012 reported that the goats aged

between 3-6 years of age are more commonly affected with pseudopregnancy. Different incidence of pseudopregnancy in goats were documented by several authors (Table.1)

Table 1.Various incidence of pseudopregnancy in dairy goats

Incidence	References
3.0% and 20.8%	Hesselink, 1993; Souza *et al.,* 2013
2-6%	Malher and Younes, 1987
0-20%	Mialot *et al.,* 1991
14.3%	Purohit 2006
8.7%	Khunmanee *et al*., 2017

Clinical signs

No common clinical signs are reported but in few cases bilateral distension of abdomen. Animals affected with pseudopregnancy showed copious watery or mucoid discharge in the absence of fetuses.

Diagnosis

Diagnosis is best made with ultrasonography to differentiate pseudopregnancy from pregnancy (Hesselink, 1993; Taverne *et al*., 1995; Moraes, 2014). Sonographic (Real-time B-mode) examination is based on the recognition of enlarged anechoic fluid-filled uterus at least 40 days after mating in the absence of fetuses and placentomes (Haibel,1990; Hesselink and Taverne 1995; Kahn, 2004). Early pregnancy in does on day 20-30 post-breeding using ultrasonography is difficult to differentiate from pseudopregnancy because of barely discernible embryos at early stage of pregnancy and accumulation of uterine fluid in pseudopregnancy can be mistaken as allantoic fluid (Taverne, 2010).

Treatment

Treatment of the pseudopregnancy involves luteal regression by administering a single or double dose of prostaglandins (Souza *et al*., 2013; Murugavel and Antoine, 2014). Post-treatment showed relaxation of cervix and contraction of uterus occured to discharge the fluid within 1-2 days (Hesselink, 1993; Wittek *et al*., 1997). Pseudopregnancy can prevail until day 120-150 before it could resolve spontaneously (Taverne, 2010). Several authors treated pseudopregnancy using prostaglandins with varying results (Table 2).

CONCLUSION

In conclusion, dairy goats affected with pseudopregnancy causes a great economic loss as kids were not born and reduction of milk yield. Diagnosis of pseudopregnancy on day 40 post-mating should be carried out through ultrasonography and followed treatment by using prostaglandins.

Table 2. Treatment of pseudopregnancy by using Prostaglandins

	Generic name/ brand name	Dose	Result	References
Prostaglandins	Cloprostenol	125 µg IM once a day	fluid discharge within 34 hrs post-treatment	Almubarak *et al.,* 2016
	Prostodin	125 µg IM once a day	fluid discharge within 24-48 hrs post- treatment	Purohit and Mehta *et al.,* 2012
	Estrumate	Two doses (187.5 µg each) IM at 12 days interval	fluid discharge occur within 2 weeks post-treatment	Farliana and Yimer *et al.,* 2016
	Dinoprost	Two doses(5mg each) IM at 12 days interval	Improvement of reproductive performance after treatment	Hesselink, 1993

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Plant growth promoting Rhizobacteria: A sustainable approach

Manica Tomar

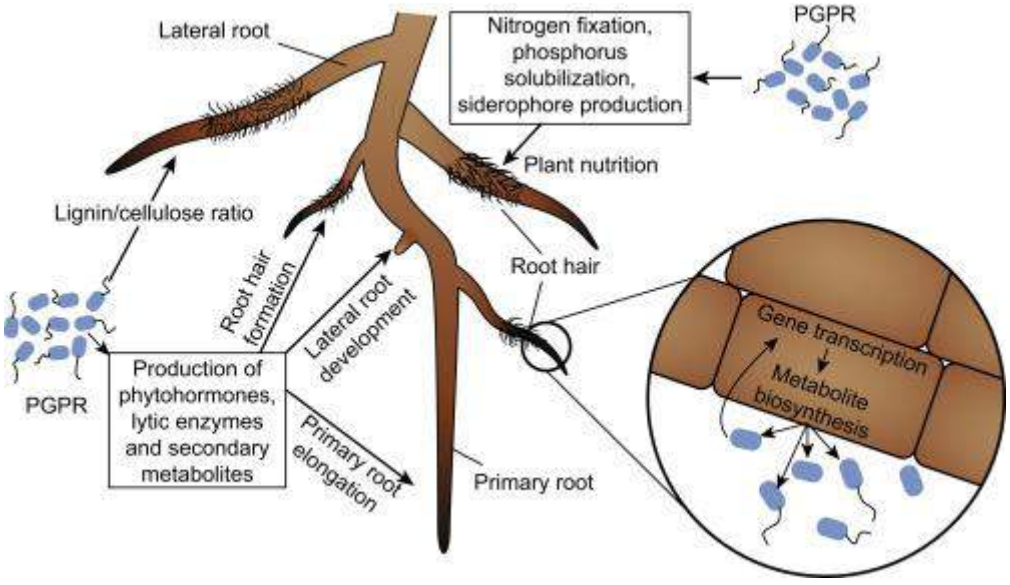
Plant Pathologist, Directorate of Extension Education,
Dr.YSP University of Horticulture and Forestry, Nauni, Solan H.P. 173230
**Corresponding Author: manicatomar22@gmail.com*

Agriculture is one of the human activities that contributes most to the increasing amount of chemical pollutants via excessive use of synthetic chemical fertilizers and pesticides, which cause further environmental damage with potential risks to human health. Nitrous oxide (N2O) is an example of chemical pollutant produced by excessive use of nitrogen fertilizer and is a major source of greenhouse gases causing global warming. Apart from that, nitrogen fertilizers reduce biological nitrogen fixation in the soil. Farmers apply a high concentration of nitrogen fertilizers in the form of ammonium nitrate to fertilize their soil to grow crops. Due to the influx of ammonium, plants no longer need the symbiotic microbes to provide ammonium and this leads to the degree of symbiosis being diminished. Furthermore, nitrifying bacteria also take advantage of this excess ammonium and utilize it to produce nitrate. This high amount of nitrate is then utilized by denitrifying bacteria to produce N2O and excess nitrate leaches into the groundwater.

Towards a sustainable agricultural vision, crops produced need to be equipped with disease resistance, salt tolerance, drought tolerance, heavy metal stress tolerance, and better nutritional value. To fulfil the above desired crop properties, one possibility is to use soil microorganisms (bacteria, fungi, algae, etc.) that increase the nutrient uptake capacity and water use efficiency [Armada et al ,2014]. Among these potential soil microorganisms, bacteria known as plant growth promoting rhizobacteria (PGPR) are the most promising. In this sense, PGPR may be used to enhance plant health and promote plant growth rate without environmental contamination [Calvo,et al , 2014]. without environmental contamination [Calvo,et al , 2014]. For decades, varieties of PGPR have been studied and some of them have been commercialized, including the species *Pseudomonas, Bacillus, Enterobacter, Klebsiella, Azobacter, Variovorax Azosprillum, and Serratia* [Glick et al 2012]. However, the utilization of PGPR in the agriculture industry represents only a small fraction of agricultural practice worldwide [Bashan et al 2014]. This is due to the inconsistent properties of the inoculated PGPR, which could influence crop production. The successful utilization of PGPR is dependent on its survival in soil, the compatibility with the crop on which it is inoculated, the interaction ability with indigenous microflora in soil, and environmental factors [Martinez-Viveros et al 2010]. Another challenge is that the modes of action of PGPR are

diverse and not all rhizobacteria possess the same mechanisms [Dey et al 2004; Choudhary et al ,2011]. These disadvantages limit the application of PGPR. Therefore, the competition between synthetic chemical fertilizers and PGPR as a bio fertilizer is deemed redundant in the face of the global agricultural productivity needed to feed the booming world's population, which is predicted to escalate to 8 billion people by 2025 and 9 billion by 2050.

The utilization of bacteria to stimulate plant growth in agriculture has been practiced for millennia, and the idea of using bacteria in land stewardship to sustain land productive for future generations is not new. The Middle Eastern farmers practiced crop rotation in 6000 BC without understanding the chemistry or the important roles played by the bacteria, alternately planting legumes and cereal. More recently in human history, Hellriegel and Wilfarth (1888) studied the rhizosphere root colonization and suggested the ability of soil bacteria to convert atmospheric N_2 into plant-usable forms, and the establishment of legumes on cultivated lands resulted in improved soil fertility (Chew, 2002). Besides crop rotation and intercropping, the mixing of different soils as a means of remedying defects and adding 'heart' to the soil is a well-known process (Tisdale & Nelson, 1975). It was Kloepper and Schroth (1978), who coined the term 'plant growth promoting rhizobacteria (PGPR)' for these beneficial microbes. Since then, the research on PGPR has made great strides and PGPR now represent a wide variety of soil bacteria which, when grown in association with a host plant, result in stimulation of growth of the host. PGPR thus constitute an indispensable part of the rhizosphere biota.



The possible mode of actions used by plant growth promoting rhizobacteria (PGPR) towards growth promotion in plants. (Adapted from Vacheron et al., 2013).

PGPR as Bio fertilizers:

Next to water and temperature, nutrients are the environmental factor that most strongly constrains terrestrial plant growth. PGPR promote the plant growth by increasing the accessibility or uptake of nutrients from a confined nutrient pool in the soil/rhizosphere. Free-living PGPR have shown promise as bio-fertilizers. Many studies

and reviews have reported plant growth promotion, increased yield, solubilisation of phosphorus (P) or potassium (K), uptake of nitrogen (N) and some other elements through inoculation with PGPR.

A huge amount of artificial fertilizers is used to replenish soil N and P, resulting in high costs and increased environmental pollution. Most of P in the form of insoluble compounds is unavailable to plants. N2-fixing and P-solubilizing bacteria may be important for plant nutrition by increasing N and P uptake by the crop plants, and playing a crucial role in bio-fertilization. N2-fixation and P-solubilisation, production of antibiotics, and other plant growth promoting substances are the principal contribution of the PGPR in the agro-ecosystems. More recent research findings indicate that the treatment of agricultural soils with PGPR inoculation significantly increases agronomic yields as compared to uninoculated soils.

Nitrogen Fixation

Nitrogen is an essential element for all forms of life; a basic requisite for synthesizing nucleic acids, proteins and other organic nitrogenous compounds. Although, there is about 78% N_2 in the atmosphere, it is highly inert and unavailable to growing plants. Atmospheric N_2 is converted into plant-usable forms by a process called biological N_2fixation (BNF) in which nitrogen fixing microorganisms transform elemental nitrogen into ammonia using a complex enzyme system known as nitrogenase (Kim & Rees, 1994).

Mechanisms of Plant Growth Promotion by PGPR

Several mechanisms have been suggested by which PGPR can promote plant growth such as production of growth stimulating phyto hormones (like indole-3-acetic acid (IAA), gibberellic acid (GA3), zeatin, ethylene and abscisic acid (ABA), phosphate Solubilisation and siderophore production (microbial Iron-chelating low molecular weight compounds).

PGPR as Biocontrol Agents

PGPR produce substances that also protect them against various diseases. By this capability, PGPR may protect plants against pathogens by direct antagonistic interactions between the biocontrol agent and the pathogen, as well as by induction of host resistance. In recent years, the role of siderophore-producing PGPR in biocontrol of soil-borne plant pathogens have created great interest. Microbiologists have developed techniques for the introduction of siderophore producing PGPR in soil system through seed, soil or root system. PGPR that indirectly enhance plant growth via suppression of phytopathogens do so by a variety of mechanisms. These include:

- The ability to produce siderophore (as discussed above) that chelate iron, making it unavailable to pathogens.
- The capacity to synthesize anti-fungal metabolites such as antibiotics, fungal cell wall-lysing enzymes, or hydrogen cyanide, which suppress the growth of fungal pathogens.

- The ability to successfully compete with pathogens for nutrients or specific niches on the root; and the ability to induce systemic resistance.

The PGPR and bacterial endophytes play a vital role in the management of various fungal diseases. But one of the major hurdles experienced with biocontrol agents is lack of an appropriate delivery system.

Phosphorus Solubilisation

Phosphorus (P) is one of the major essential macronutrients for plant growth and development, and low availability of P to crop plants is a worldwide issue and on 30–40% of world arable lands crop yield is reduced due to P availability. Solubilisation and mineralization of P by phosphate-solubilizing bacteria (PSB) are among the most important bacterial physiological traits in soil biogeochemical cycles (Jeffries et al 2003), as well as in plant growth promotion by PGPR (Richardson, 2001, Rodríguez et al., 2006). Bacterial genera like *Azotobacter, Bacillus, Beijerinckia, Burkholderia, Enterobacter, Erwinia, Flavobacterium*, Micro bacterium, Pseudomonas, Rhizobium and *Serratia* are reported as the most significant PSB (Bhattacharyya & Jha, 2012). Besides, examples of some widely reported P-solubilizing microbial species intimately associated with a large number of agricultural crops like potato, tomato, wheat, radish, pulses, etc. are *Azotobacter chroococcum*, *Bacillus circulans*, *Cladosporium herbarum*, *Bradyrhizobium japonicum*, *Enterobacter agglomerans*, *Pseudomonas chlororaphis, Pseudomonas putida* and *Rhizobium leguminosarum* (Antoun et al., 1998, Cattelan et al., 1999, Chabot et al., 1998).

CONCLUSION

According to the United Nations, it is highly likely we will see 9.6 billion Earthlings by 2050 and up to 11 billion or more by 2100. When we consider that we will need 70% more food by 2050 assuming that we do not make any serious progress in reducing waste, minimizing pollution, slowing population growth or halting the increase in consumption of animal products (FAO, 2011), it is hard to feel hopeful about the future. Thus feeding an ever increasing population is the greatest challenges facing the mankind when the resources are limited, decreasing irrigational water supplies and other environmental concerns further exacerbate this problem.

Keeping in mind the beneficial services rendered by the PGPR (in terms of bio fertilization, biocontrol and bioremediation) which exhibit positive influence on crop productivity and ecosystem functioning, we should encourage their successful implementation in the main agriculture system. With better research and development, these microbial populations use will become a reality and instrumental to fundamental processes that drive stability and productivity of agro-ecosystems, thus leading us towards an ideal agricultural system which is sustainable, maintains and improves human health, benefits environment and produces enough food for the increasing world population.

Worldwide, considerable progress has been achieved in the area of PGPR bio fertilizer technology. It has been also demonstrated and proved that PGPR can be very

effective and are potential microbes for enriching the soil fertility and enhancing the agricultural yield. PGPR are excellent model systems which can provide the biotechnologist with novel genetic constituents and bioactive chemicals having diverse uses in agriculture and environmental sustainability. Current and future progress in our understanding of PGPR diversity, colonization ability, mechanisms of action, formulation, and application could facilitate their development as reliable components in the management of sustainable agricultural systems.

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Genomic Tools and Trait Mapping In Fruit Crops

Anjali Soni*, Neeraj Kumar and Maneet Rana

Division of Fruit Science and Technology, ICAR-IARI, New Delhi
ICAR-Indian Grassland and Fodder Research Institute, Jhansi UP
**Corresponding Author*: anjali00soni@gmail.com*

ABSTRACT

Fruit science is one of the important sectors of horticulture which consists of cultivation, production and improvement of different types of fruit plants. A logical extension of whole genome selection and other genomic tools will assist breeders to enhance the genetic gains in fruit crops. Thus, in the post-genomics era, high throughput approaches combined with automation, increasing amounts of sequence data in the public domain and enhanced bioinformatics techniques will contribute to genomics research for fruit crop improvement.

INTRODUCTION

The importance of fruit crops is widely acknowledged in many aspects of innovation, production, quality maintenance, for uplifting economic condition of farmers, entrepreneurs and in providing nutritional security to the people. In recent years significant technological advancement has been observed (concepts, approaches and applications) in fruit improvement which has been revolutionized the fruit production (Janick 2012). In the last two decades, the availability of many genomic resources like genome sequences, high-throughput analysis of gene expression, sufficient numbers of molecular markers, express sequence tags (ESTs) and high-density genetic maps has paved the way to the genetic engineering and molecular breeding of fruit plants for crop improvement. Availability of next generation sequencing (NGS) technologies like FLX-454, Illumina, SOLiD and Helicose have brought hopes to generate genomic resources for many more horticultural crops in few years' time. Therefore, the horticulture breeders should equip themselves to make use of this extensive genome information in their varietal development programmes.

Needs of Genomic studies

1. To know sequence of whole genome
2. To locate genes on chromosomes & transcribed regions
3. To locate promoters and function of motif
4. Genome manipulation & MAS
5. Evolutionary studies

6. To discover and use of genetic variation

GENOMIC TOOLS IN FRUIT CROPS

Since the publication of the first plant genome sequence of Arabidopsis thaliana (Arabidopsis Genome Initiative, 2000), technology based on plant genomics has advanced substantially and revolutionized our understanding of plant biology by unraveling basic mechanisms in plant development, tolerance to biotic and abiotic stresses and adaptation (Feuillet et al., 2011). Among fruit plants, grapevine was the first crop genome to be sequenced and the first draft with 8 times high-quality sequence was released by the International Grape Genome Project (Jaillon *et al*., 2007) after that Velasco *et al*. (2010) reported a high-quality draft genome sequence of the domesticated apple (*Malus domestica*) simple-sequence repeat (SSR), markers were developed using CA and CT enriched genomic libraries of *Mangifera indica* L. The new SSR markers and the present map will be useful for mango genetic studies and breeding applications in the future (Chataporn et al 2015). Regular bearing and low seed content of the crop are important properties of scion citrus cultivars. The genetic control of these traits was studied in a progeny derived from the cross *Citrus volkameriana* × *Poncirus trifoliata* using molecular marker analysis. Since the traits were not normally distributed, the Kruskal-Wallis non-parametric test was used for quantitative trait loci (QTLs) detection. Most of the QTLs detected correspond to the trait "number of fruits per tree", in agreement with its known physiological complexity. Related traits (fruit number, fruit size and seed number) are controlled by QTLs some of which are located in the same genomic regions, suggesting that undesired associations could be broken to some degree by recombination.

Molecular Mapping studies in fruit crops:

Most agronomically important traits are complex, are controlled by multiple genes, and are quantitative in nature. The principle of mapping a quantitative trait locus (QTL) was first described in the early 20th century by Sax (1923). Molecular markers offer great opportunities for dissecting complex traits using QTL mapping. Since then, QTL mapping has been widely used in plants for genetic dissection of biomass, yield, and disease resistance traits. Although there are many published reports on QTLs, only a few QTLs have been used in breeding programmes (Bernardo, 2008). Association mapping (AM), also known as linkage disequilibrium (LD) mapping, has been proposed as an alternative approach to overcome limitations of pedigree based QTL mapping. In AM, genotype and phenotype correlations are investigated in unrelated individuals. Unlike QTL mapping, AM takes advantage of LD as well as historical recombinations present within the gene pool of an organism, thus utilizing a broader reference population is one of the first economically important fruit crops whose genome was sequenced. Having access to the genome sequence has facilitated the identification and development of genetic markers and has also enabled LD studies in grapes. The cultivated grapevine is primarily a self-pollinated perennial fruit crop. Integrating both QTL and AM strategies has proven highly effective in various studies. Also combined

QTL and AM to study the genetic patterns of anthocyanin content, a determinant of berry colour, in grapes. A strong QTL, accounting for 62% of the variation in anthocyanin content. Sweet- and floral-flavoured Muscat cultivars are highly regarded as table grapes and for wine making. Using QTL analysis, Muscat flavour determination has been investigated and a major QTL on chromosome 5 linked to the Muscat flavour has been found to co-localize with a VvDXS gene encoding 1-deoxy-D-xylulose 5-phosphate synthase (Emanuelli et al., 2010). For apples, Cevik et al. (2010) have used a pedigree-based QTL mapping approach and have identified markers (MdMADS2.1, MdMADS2.2, and MdMADS14) from two candidate orthologous FRUITFULL-like genes linked to fruit flesh firmness. 8000 SNP Infinium assay for apple, peach, and cherry (Chagne et al., 2012), will provide more opportunities for candidate gene-based association mapping. Although the Infinium has 8000 SNPs, this is not sufficient for genomewide AM due to rapid LD decay in apple and in other rosaceous fruit crops. single species, thus rendering synteny across species as a minor factor. However, it should also be noted that, unlike forest trees, where population structure is minimal, domesticated fruit trees can have substantial population structure that may confound AM inferences. Therefore, a large set of accessions/ genotypes are required for reliable identification of associations by minimizing spurious associations due to population structure.

CONCLUSION

Ultimately, the goal of the breeder is to enhance the genetic gain and select desirable genotypes from populations. However, the costs applying to genomics strategies and tools are often more than the available in commercial or public fruit breeding programmes which leads to slow growth of these technologies but in mean time they are getting pace. These breeding tools are now days assisting fruit breeders to breed superior fruit varieties for the target environment.

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Backyard Japanese Quail Farming: A new venture for rural farmers

Vinod Bhateshwar

Ph.D. Scholar, Department of Animal Husbandry & Dairying, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi - 221005 (U.P.) India
Corresponding author: vinodbhu0883@gmail.com

The Japanese quail (*Coturnix coturnis japonica*), in Hindi called 'Bater' is raised for egg and meat production. It is one of the best source of non-vegetarian diet and a good converter of agri-byproducts or cereals to animal protein. The quality of 'Bater' meat is very high due to low calorific values, nutrient contents is more, very tender, juicy and delicious meat. The dry matter content in quail meat is high. To boost up the family income particularly for poor farmers who do not have any other source for high investment for diversified farming can easily opt for low cost quail farming. Initial investment is very less in comparison to other livestock farming and suitable for landless and marginal farmers. It is ideal for backyard farming also. Quail is a small bird and weigh about 200 to 250 gm at mature age. Generally males are lighter than female. Identification of male and female can be done at 3 to weeks of age. Males are cinnamon colour at upper portion of breast and lower portion is having light brown in shade. Female colour varies from brown with black markings in throat, face and upper portion of breast but, tan colour in lower portion. In male there is hypertrophied gland in cloeca. The newly hatched chicks are brown in colour with yellow stripes. At the age of 6 weeks female start laying and at 50 days age starts full production. On an average a quail lays 280 eggs/ year. The egg weight is 10 to 12 gm and colour of egg shall is white to brown with dark coloured mottling and often covered with a light blue chalky material. Generally quail lay eggs at evening hours between 3 to 6 pm and in some cases at night. Throughout the year quail lay eggs. The egg of quail is handled very carefully because of very thin egg shell. Eggs are collected 2 to 3 times a day to avoid egg loss. The weight of hatched chick is 0.8 gm and unsuitable for transportation. Hence, they are reared at production site up to 2 weeks and thereafter shifted to farmers' door. At the age of 5 weeks they weigh about 180 to 200 gm.

Fig.1 Backyard Japanese quail farming (Source: *www.backyardquail.com*)

WHY TO START JAPANESE QUAIL FARMING?

1. Japanese quail is very prolific and have short generation interval.
2. Have twin capacity for egg and meat production.
3. Japanese quail meat with low calorific value and high protein content it is recommended for children, old family member and pregnant women.
4. It is one of the cheapest sources of animal protein and can be adopted as backyard farming for egg and meat production.
5. Due to hardiness and adoptable capacity the quail can thrive in adverse conditions also when other livestock easily collapse.
6. For rural poultry and backyard farming quail farming can be started with minimum investment.
7. Space requirement and demand for feed supply is very less in comparison to other livestock like poultry.
8. Laying capacity is more and meat quality is better.
9. Resistant to most of the poultry diseases and require no vaccination.
10. High economic return and can be utilized for egg and meat purposes as and when required.

HOUSING OF JAPANESE QUAIL

The optimum room temperature and relative humidity at quail house is 15 to 20^0 C and 40 to 70 %, respectively. The birds can be reared in litter system or in cage. If litter system is practiced, locally available bedding material can be used. The room should be well ventilated, insulated and free from dust. Dry litter approximately 10 cm thick may be provided in deep litter system. The bird should also be protected from predators like dog, cat, rodents, hunting birds etc.

For a quail up to 4 weeks of age 145 to 150 sq cm is sufficient, but up to 5 weeks and above 250 sq cm is required. In general in deep litter system 70 birds can be housed in one sq mt area and in cage system 80 birds per sq mt area. Sometimes the quail hide their eggs inside the litter. Hence, the cage housing is preferred in quail farming to

reduce the egg loss. The size of the cage may be 13 x 20 cm for two birds. To get the optimum production hygiene and sanitation is must for quail farming. The quails are territorial in nature and they defend their home from other new entrants. If two groups of birds are introduced in same cage or in room, may be placed both of them in new cage to avoid infighting.

Japanese quail can be raised in multitier system. The length of the tier is 120 cm, height 25 cm and width 60 cm. Twenty to 40 birds can be housed in one tier. The space requirement for feed and water is 2.0 cm and 1.0 cm up to 3 weeks of age and 3.0 cm and 1.5 cm, respectively up to 3 to 6 weeks and above. To avoid feed loss the feed trough should be filled up to three forth and there should be provision for clean drinking water throughout the day. Quail house should have facility for 14 to 18 light hours for optimum feed intake and egg production. In winter months or in rainy days extra light may be provided in the quail house. If quails are raised commercially for meat purposes 24 hours light may be provided for early growth and higher market value.

Fig.2 Housing for Japanese quail farming (Source: *www.backyardquail.com*)

BREEDING OF JAPANESE QUAIL

The ideal age of breeder is 10 to 30 weeks. During 2 to 8 months of age group fertility remains maximum in Japanese quails and after that gradually declines. The male female ratio should be 1:3. Before incubation eggs may be stored at 13^0C with 70 to 75% humidity after fumigation. Eggs may be stored up to 7 days. Beyond 7 days hatchability will be reduced. Eggs are stored in a plastic bag to reduce dehydration.

SELECTION OF HATCHING EGGS

Clean, defect less and sound eggs may be selected for incubation. A medium size egg selected for hatching should have 10 to 11 gm weight. The eggs are disinfected before incubation by fumigation with formaldehyde gas for 15 to 20 minutes which contains

Potassium permanganate and 40% formalin. After fumigation eggs are arranged in setting tray by keeping broad end up for incubation.

INCUBATION OF EGGS

Eggs are incubated for 17 to 18 days. Up to 14 days from day one the temperature of incubator should be 37.5 ± 0.3^0C with 60% humidity. After 14^{th} day till 17^{th} day relative humidity should be maintained up to 70% in hatcher. During incubation period eggs are turned uniformly 8 times/day or every 2 to 4 hours to prevent sticking of embryos to egg shell. On 17^{th} or 18^{th} day chicks hatch out from egg.

CARE FOR NEWBORN CHICKS

Care for chicks in 1^{st} week is very important because the chicks are very delicate and weigh only 7 to 8 gm. Chick mortality may occur if proper care and management is not provided to newborn chick. There should be provision for 24hrs light in brooder house. If there is light failure chick may huddle together and collapse. Sometimes chicks drown in waterer. To avoid chick drowning pebbles may be given inside the waterer and also corrugated paper may be spread over the litter or wire mesh to avoid sprawling of legs during 1^{st} week after hatching. It is advisable to put about 150 or less chicks in a single brooder for prevention of stampeding.

Different types of brooder can be used for quail brooding, namely floor brooding, battery brooding, gas brooding etc. Heater or electric bulb may be used for provision of heat generation in brooder house. Battery brooding is advantageous than floor brooding. The brooder house temperature should be initially 37^0C and gradually temperature may be decline at the rate of 3^0C for every 4 days. Generally brooding is done for 3 weeks but provision for extra light may be continued for 5 weeks for early maturity and growth.

FEEDING MANAGEMENT OF JAPANESE QUAIL

Feed alone consider 70% feed cost of quail farming. Hence, the feeding should be balanced, economical and with preferably with locally available material may be used for feed formulation. In backyard quail farming agri-byproducts and household leftover food grains may be utilized for maximum profit. In backyard farming it is always advisable with minimum input maximum gain. However, for commercial or medium to large scale quail farming balanced ration with 2700 to 2800 ME Kcal/kg of feed, 22 to 27% protein and adequate calcium (3%) particularly during laying period and phosphorus (0.8%) along with vitamins and minerals may be provided in quail ration. During early stage i.e. in starter and grower period the demand for essential amino acid and protein is more and for optimum growth molasses at the rate of 6 to 8% may also be provide at least for 3 to 4 days. An ideal quail ration may be prepared with following ingredients.

Table1. Recommended rations (per quintal of feed) for Japanese quail

Ingredients	Starter ration	Grower ration	Layer ration
Rice polish	14	9	10
Maize	43	35	40
Groundnut cake	16	30	25
Sunflower Cake	14	12	10
Fish meal	10	12	10
Bone Meal	1.4	0.7	0.2
Lime Stone	1.0	0.5	0.5
Salt	0.3	0.5	0.5
Vitamins and Minerals	0.3	0.3	0.3

According to age group feed consumption varies. During 1st week it is 5 gm, 2nd week 10 gm, 3rd week 15 gm, 4th week 19 gm, 5th week 22 gm and 6th week and above 25 gm. An adult quail daily consume 20 to 25 gm feed.

HEALTH CARE MANAGEMENT FOR JAPANESE QUAIL

Unlike other poultry species no special care or attention is required for Japanese quail except environmental stress. During first two weeks the chicks remain very fragile and environmental changes particularly in summer and winter months required special care like protection from summer or winter stress, hot or cold wind, heat stroke etc.

Quail are resistant to some of the poultry diseases like Ranikhet disease, Fowl pox etc. Quail do not require vaccination, deworming however, regular cleaning and hygiene is must in quail farm. To prevent cannibalism debeaking is recommended in commercial quail farming. Debeaking can be done with simple nail cutter. But, over cutting of beak may lead to lower fertility in quail due to mating problem in males.

Source: Handbook on Animal Husbandry, ICAR and Text books on poultry production

Immediate management practices for pets during Heat stroke

Ajay Satbige* and N.A. Patil

Department of Veterinary Medicine,
Veterinary College, KVAFSU, Bidar
**Corresponding author: dr.ajaysatbige@gmail.com*

Summer gives lots of fun frolic for you and your pets, as it involves lots of outdoor activities like trails, hunting, beach walk and background games. During the hot summer, heat stroke will be one of the biggest challenging issues of the pet owners, particularly if the pet parents are having brachycephalic breeds like pugs, boxer, Pekingese (difficulty in breathing during heat and stress conditions due to the presence of elongated soft palate, stenotic nares, hypoplastic trachea and everted laryngeal saccules in brachycephalic breeds), obese dogs, muzzling dogs and dogs with heavy hair coats or with dark fur. Pets playing in the sun are highly dangerous and life threatening. This article provides an awareness of heat stroke, signs, how to manage (first aid) and prevent it.

WHAT IS HEAT STROKE?

Unlike human beings, dogs do not have sweat glands. Dogs cool themselves by dissipating heat through the skin, by evaporation through rapid panting, through paws (little regulation of heat) and simply by drinking water. However, in extreme heat condition, these cooling efforts may be insufficient and finally leads to dehydration and heat stroke. If the body temperature reduces 106°F (>41°C), the earth is in danger of brain damage followed by vital organs failure and death. Organ damage and lifelong health issues are recorded in recovering dogs.

SIGNS OF HEAT STROKE

- Heat stroke affects the gastrointestinal tract, cardiovascular system, renal, hepatic, endothelial and

musculoskeletal systems.

- High temperature (41°C) , rapid, anxious panting, widening of eyes, thick saliva, vomiting, epistaxis (bleeding from the nose), dry, red or congested mucous membrane (gums and eyes), staggering gait , seizers, rapid irregular heart beats, muscle tremors and advanced cases coma and collapse.

Do and don't in heat stroke cases

- Shelter your pets in a cool and shady place on summer days.
- Provide plenty of fresh and cool water at all times
- Clip the hair in heavy coated dogs to a one inch length.
- Never leave your pet inside a parked car not even for a few minutes even if the doors are opened
- Don't allow for heavy exercise on hot sunny days
- Don't allow them to drink water, after laborious exercise

EMERGENCY APPROACHES IN HEAT STROKE

- Heat stroke is an emergency! First inform to your vet or bring your pet to the pet hospital
- First move your pet by placing wet clothes or wet towels or use cold compresses around the head, neck, tummy, in between legs, t he foot pads and belly areas.
- The pet can be brought to the comfort zone by sprinkling water or immerse the dog in cool water (not cold) and use fans or air conditioner highly helpful
- Rubs the body with isopropyl alcohol, which provides some cooling effects and dilate the vessels
- Don't use ice or ice cold water. Extreme cold can constrict the blood vessels and cause further complications
- Allow your dog to drink cool water, but do not force water into your pet's mouth.
- If the pet doesn't drink water, allow th em to lick the ice cubes.
- Monitor the dog's rectal temperature regularly and stop these cooling procedures once its temperature decreases to 103°F

MANAGEMENT OF HEAT STROKE

There are no specific medications to manage the complications associated with heat stroke. Coolant temperature, intravenous fluids and electrolyte therapy may be used depending upon the clinical conditions of dogs. Patients should be closely monitored around the clock during the first two days. Heat stroke is deadly and it needs an emergency car e in the first few hours. You have to cool the dog in whatever way you can and take the dog immediately to the veterinarian. The earlier you bring the dog to the hospital faster will be the recovery. The prognosis for the heat stroke affected dogs is highly variable depending upon how quickly the condition is treated.

Breeding for traits related to nutrient acquisition to develop organic responsive crop varieties

A. P. Salini

PhD scholar, Tamil Nadu Agricultural University
**Corresponding author: apstnau@gmail.com*

As the world population increases and the availability of resources, the need for efficient food production has become paramount. The high input agricultural system consumes more of the non-renewable resources as any other heavy industry. The production, transportation, and application of pesticides and fertilizers are all energy expensive, consuming 15% of the energy resources used by agriculture (Helsel, 2002).

Besides the energy issues, the excessive use of chemical fertilizers and pesticides have created severe effects on the human health and environment. In a survey, it has been found that 58% of drinking water samples drawn from hand pumps and wells around Bhopal are contaminated with Organ Chlorine pesticides above the EPA standards. Another study revealed that 50% of the vegetable samples taken from farm gate were found contaminated with various pesticides (0.01-2.23 ppm) of which 16% were above MRL (Maximum Residual Level) (Kole et al., 2002). Also, there are many reports of acute and chronic fatalities due to agricultural chemicals across the world. They include from instant death to wide range of serious health problems like respiratory effects, neurological, cancer and reproductive problems. The better solution to address all these problems is going for organic agriculture.

ORGANIC AGRICULTURE

Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects (IFOAM).

BREEDING FOR ORGANIC RESPONSIVE CROP VARIETIES

Breeding of crops for organic agriculture requires to be carried out in the low-input or no-input conditions unlike the usual breeding which is usually carried out under high-input conditions. This would enable the breeders to identify the inherent traits by which plants are able to grow and yield under natural conditions without the supplement of external inputs.

BREEDING FOR NUTRIENT ACQUISITION

Of the various traits associated with organic responsiveness, nutrient acquisition is considered as an efficient trait to be targeted. Efficient acquisition of nutrients by roots is crucial issue for plants as most of the crop growing environments are poor in nutrient status and supply to the plants. The mechanism of nutrient acquisition differs with the nutrient. Hence the breeding is focussed on individual nutrient acquisition and some common factors like root structure, root numbers, root exudates and plant-microbe interaction in rhizosphere.

TRAITS FOR NUTRIENT ACQUISITION

The capacity of any genotype to acquire essential nutrients from the soil depends on the following factors, (1) nutrient interception, which is dependent on root size and architecture, Several root structure related traits like density or length of root hairs (Gahoonia and Nielsen 2004), maintaining new root development with minimal expenditure of additional resources through more rapid root turnover (Lambers et al. 2006), root angle, number of crown roots (2) nutrient acquisition involving efficient uptake of available nutrients and solubilization of less plant-available nutrients (Hinsinger et al. 2005; Ismail et al. 2007; Wissuwa et al., 2009). (3) Interaction of plants with microbes and other components of rhizosphere.

BREEDING STRATEGIES

Breeding for crop varieties with the ability of nutrient acquisition from the soil can be based on i) Screening the available cultivars under low input condition ii) employing direct selection for the targeted traits.iii) identification of donors with inherent nutrient acquisition, from the vast germplasm reserves of the crops. Ismail et al., (2007) suggested broadening the genetic base of modern varieties through reintroduction of genes from suitable donors such as traditional varieties or wild relatives could be a key strategy iv) introgression of the identified trait for nutrient acquisition into segregating breeding population and subsequently carrying out selection unfavourable soil conditions, in the presence of biotic and abiotic soil stresses. v) participatory plant breeding in farmer's field, with no inputs. Bänziger and Diallo (2001), from maize evaluation trials in low N/low rainfall environments concluded that participatory evaluation approach was very successful not only in developing adapted cultivars but importantly also in bringing them into farmer's fields vi) Using molecular methods. The complexity of the traits involved in nutrient acquisition make it difficult to screen and evaluate in the field conditions. This could be addressed by employing molecular tools for the characterisation of nutrient acquisition traits and confirm their introgression in the breeding lines (Wissuwa *et al.,* 2009) Though numerous studies have been conducted to map QTLs associated with nutrient acquisition traits like root hair number, root angle, root exudation the use of these QTLs in practical plant breeding is much restricted. This could be due to the lack of proper association between trait of

interest and QTL identified. Moreover, the ability of nutrient acquisition differs among the genotypes. Hence, going for holistic and broadened approaches like association mapping and genome wide association studies might possibly give better understanding of their genetic nature.

CONCLUSION

Breeding for organic responsiveness in crop varieties, chiefly for nutrient acquisition is becoming increasingly necessary, with declining energy and environmental resources. But there are challenges involved in breeding for these traits. To overcome them, thorough understanding of the various mechanisms and factors involved in nutrient acquisition, their interaction with rhizosphere and the soil microbes are be studied systematically by evolving appropriate phenotyping techniques and by employing molecular tools.

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Disease, transmission, infective stage and diagnosis of important zoonotic parasites

Anil Kumar[1]*, Muthu Sankar[2], Dharmesh Bhinsara[3] and B. C. Parthasarathi [4]

[1&4]Ph.D. Scholar, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh-243122

[3]M.V.Sc. Scholar, [2]Senior Scientist, Indian Veterinary Research Institute, Mukteshwar, Uttarakhand -263138

**Corresponding author: anilnehra15@gmail.com*

A parasite is an organism that lives on or in a host organism and is metabolically dependant on it. There are three main classes of parasites that can cause disease in humans: protozoa, helminths (nematodes,cestodes and trematodes), and ectoparasites.

Protozoa

Protozoa are microscopic, one-celled organisms that can be free-living or parasitic in nature. They are able to multiply in humans, which contributes to their survival and also permits serious infections to develop from just a single organism. Transmission of protozoa that live in a human's intestine to another human typically occurs through a fecal-oral route (for example, contaminated food or water or person-to-person contact). Protozoa that live in the blood or tissue of humans are transmitted to other humans by an arthropod vector (for example, through the bite of a mosquito or sand fly).

Helminths

Helminths are large, multicellular organisms that are generally visible to the naked eye in their adult stages. Like protozoa, helminths can be either free-living or parasitic in nature. In their adult form, helminths can't multiply in humans. There are three main groups of helminths that are human parasites:

Flatorms (platyhelminths) – include **trematodes (flukes)** and **cestodes (tapeworms)**.

Thorny-headed worms (acanthocephalins) – the adult forms of these worms reside in the gastrointestinal tract. The acanthocephala are thought to be intermediate between the cestodes and nematodes.

Roundworms (nematodes) – cylindrical worms, the adult forms of which can reside in the gastrointestinal tract, blood, lymphatic system or subcutaneous tissues. Alternatively, the immature (larval) states can cause disease through their infection of various body tissues (Soulsby, 1982).

A list of some common parasites with their disease, transmission, infective stage and diagnosis is mentioned below:

Protozoa			
Protozoa	**Disease**	**Transmission**	**Diagnosis**
Intestinal			
Entamoeba histolytica (Pseudopodia)	-Amebic dysentery (diarrhea) -Liver abscess	Faeco- oral (trophozoite & cysts)	Mature cyst with 4 nuclei
Giardia lamblia (Flagella)	Giardiasis (diarrhea)	Faeco- oral (trophozoite & cysts)	Trophozoite & cysts with 4 pairs of flagella
Balantidium coli (Cilia)	Diarrhea	Faeco- oral (trophozoite & cysts)	Ciliated trophozoite & cyst
Urogenital			
Trichomonas vaginalis	-Vaginal inflammation -Abnormal discharges	Sexual	Trophozoite only in : urine & swab discharge
Blood			
Plasmodium malaria (Intracellular)	Malaria	Sporozoites infect RES by female *Anopheles*	Blood film schizont & ring stages in RBCs
Toxoplasma gondii (Intracellular)	Toxoplasmosis: abortion & congenital abnormalities in fetus	Oocyst in cat faeces (Definitive host)	Blood film
Trypanosoma cruzi (American)	Chagas disease (Myocarditis)	Reduvid bugs	Blood film
Trypanosoma rhodesiense (African)	Sleeping sickness	Tse-tse fly	Blood film
Leishmania donovani	Visceral leishmaniasis (Kala azar)	Sand fly	Blood film

Nematodes (Roundworms)			
Parasite	**Disease**	**Transmission & Infective stages**	**Diagnosis**
Intestine			
Ascaris lumbricoides	Abdominal pain & Pneumonitis	Faeco- oral Eating ova	Ova in stool
Trichuris trichiura (Whip worm)	Abdominal pain & vomiting	Faeco- oral Eating ova	Ova in stool
Enterobius vermicularis (Pin worm)	Autoinfection in children	Faeco- oral Eating ova	- Ova in stool - Ova on perianal skin
Trichinella spp.	Larva encysted in tissues (muscle inflammation)	Encysted larva in uncooked pork	Lay neither egg nor larva in intestine
Strongyloides stercoralis	Pneumonitis	Filariform larva penetrate the skin	Rhabditiform larva in stool
Ancylostoma duodenale (Hook worms)	-Pneumonitis -Bleeding in stool & anaemia	Filariform larva penetrate the skin	Ova in stool
Tissue			
Dracunculus medinensis	Skin ulcer	Larva in copepods	------
Loa loa	Loiasis Skin swelling	Larva in deer fly (mangrove fly)	Microfilaria in blood film
Onchocerca volvulus	-Blindness -Skin nodules	Larva in black fly	
Wuchereria bancrofti	Filariasis (elephantiasis)	Larva in female *Anopheles* & *Culex*	

Trematodes (Flukes)					
Parasite	**Habitat**	**Disease**	**Transmission**	**Infective stages**	**Diagnosis**
Blood fluke					
Schistosoma mansoni	Mesenteric venules	- Schistosomiasis -Colon damage	Human → Egg in water ↓ Miracidium ↓ Snail → Cercaria ↑ Human	Swimming cercaria penetrate skin	- Ova with lateral spine in stool - Blood in stool
Schistosoma haematobium	Bladder venules	- Schistosomiasis (Hematuria) -Bladder damage	Human → Egg in water ↓ Miracidium ↓ Snail → Cercaria ↑ Human	Swimming cercaria penetrate skin	- Ova with terminal spine in urine - Blood in urine
Liver					
Fasciola hepatica	Liver	-Abdominal pain -Jaundice	Human → Egg in water ↓ Miracidium ↓ Snail → Metacercaria ↑ Grass ↑ Human	Eating metacercaria in grass	Ova in stool
Lung					
Paragonimus westermani	Lung	-Chest pain -Cough	Human → Egg in water ↓ Miracidium ↓ Snail → Metacercaria ↑ Crab ↑ Human	Eating metacercaria in raw crab	Ova in sputum

Cestodes (Tapeworms)				
Parasite	**Disease**	**Transmission**	**Infective stages**	**Diagnosis**
Taenia saginata (Beef tapeworm)	Taeniasis	Human → Egg ↓ ↓ Cyst in muscle ← Cattle ← Human	Eating uncooked beef cyst	- Ova in stool - Proglottids in stool
Taenia solium (Pork tapeworm)	Taeniasis (cysticercosis)	Human → Egg ↑ ↑ Cyst in muscle ← Pig ↓ Cysticercosis ← Human	Eating uncooked pork cyst	- Ova in stool - Proglottids in stool
Echinococcus granulosus	Hydatidosis	Dog (definitive host) → Sheep ← Egg → (Dead host) human	Ova in dog faeces	Ova in stool
Diphyllobothrium latum (Fish tape worm)	Vitamin B_{12} deficiency (pernicious anemia)	Human ↓ Egg in water ↓ Fish → Copepods → Human	Eating uncooked fish	Ova in stool
Hymenolepis nana (Dwarf tape worm)	Hymenoleposis	Human ↓ Egg ↓ Rodents → Human	Faeco- oral Eating ova	Ova in stool

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