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Vertical Farming: A New Prospect of Landless Farming

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ABSTRACT

With the leap of time it's become impossible to feed the increasing population with limited resources. Since the people are very much concentrate to quality foods, farming system has to be improvised and shifted to new dimension. This healthy food must be produced in a sustainable way. Keeping these in view, vertical farming has come to the surface as a potent option. Though the components of vertical farming involve high instalment cost initially, but it produces more food with very limited resources. Different types of vertical farming viz. hydroponics, aeroponics and aquaponics compel the idea to be location specific urban agricultural system. But it is one of the very few options to combat the climate change issues.

INTRODUCTION

With the passing of time, it is quite impossible to feed the ever increasing population with limited land resources. Besides, high cost involved in cultivation of crops, there is a tendency among farmers to shift to another occupation to sustain their lives. Natural calamities vis-à-vis other biotic stresses make the situation more relevant. Moreover, the obsessions of better quality foods free from chemical contamination paved the way of alternate farming. Therefore, it has led to more interest in providing healthy food and that must be produced sustainably. In this context, vertical farming appears to be as a solution. Vertical farming is growing of plants in controlled indoor environments within skyscrapers or on vertically inclined surfaces that seeks to maximize production and efficiency per square foot. The logic of vertical farming is to reduce the overall amount of resources (Despommier, 2010). In 1915, Gilbert Ellis Bailey coined the term 'Vertical Farming'. Although the concept of vertical farming has been started many decades ago but it is now gaining popularity to combat the environmental as well as overwhelming population issues. It is the most sophisticated and technologically sound way to grow crops. Indoor vertical farming allows one to precisely control both environmental and cultural factors to produce crops consistently at any time of the year. The modern concept of vertical farming incorporating techniques similar to glasshouses, wherein natural sunlight is augmented with artificial light. The idea of vertical farming is expanding rapidly in Asia especially in China and Japan.

WHY VERTICAL FARMING?

The followings are the major backdrops for the evolution of vertical farming

- Food security to the rising population
- To combat climate abnormality
- Increasing urban density
- Concern about health (residue free food)
- To maintain ecosystem balance and
- economics

Material

Plant requires specific environmental conditions for optimal growth. The components or technologies used in vertical farming methods are furnished below

- Greenhouse or other vertically growing architectures like controlled-environment buildings, repurposed warehouses, growth chambers and shipping containers.
- Lighting: there are two options available i) LED (Light Emitting Diode) ii) HPS (High Pressure Sodium). The range of light intensity needed for efficient growth of the crops can be manipulated by using LED light. Natural sunlight can also be utilized especially for rooftop gardening. The normal range of light intensity utilized in closed growing system is 50-200 mol m-2 s-1 (Kalantari *et al.,* 2017).
- Water
- Renewable energy
- Crop selection

TYPES OF VERTICAL FARMING

Hydroponics

Encyclopaedia Britannica defines hydroponics as "the cultivation of plants in nutrient-enriched water, with or without the mechanical support of an inert medium such as sand or gravel" (Harris, 1992). The term is derived from the Greek words 'hydro' and 'ponos', which translates to "water doing labor" or "water works". In this method the plant root is submerged in nutrient rich solution which is frequently monitored and circulated to ensure correct chemical composition is maintained.

Advantages

- Rapid plant growth
- Reduce soil related cultivation problems (both biotic and abiotic)
- Decrease the use of fertilizers and pesticides.
- Labour intensive
- Reduces the use of water and nutrients by about 50%

Aeroponics

In 1990s, the National Aeronautical and Space Administration (NASA) has coined the term 'Aeroponics' to grow plants in space. Aeroponics is basically a technological innovative, a variant and a step forward to hydroponics. It is defined as the growing of plants in an air or mist environment without soil and very little amount of water

(Cooper, 2013). The major difference with hydroponics is that aeroponics does not require any growing medium.

Advantages

- Requires 95% less water than traditional farming methods
- Plant needs minimal space to grow
- Free from pesticides

AQUAPONICS

Aquaponics is a modification of hydroponics integrating recirculated aquaculture (fish farming) with hydroponics. Fish is grown in indoor ponds producing nutrient rich water solution through excreta which is the nutrient source of plant in vertical farming. The plants in turn filter and purify waste water which is recycled to pond. It has bountiful benefits such as

- Water saving since water is re-used through biological filtration and recirculation
- Eliminates the needs of synthetic fertilizers
- Efficient and cost effective since waste product of one biological system serves as nutrients for other system
- Provides organic liquid fertilizers that ensure healthy growth of the plants
- Cleaning water for the fish habitat

Although aquaponics serves multiple benefits in vertical farming system, it is still in experimental stages. The prominent reason behind it is vertical farming concentrates only in producing a few fast growing vegetables crops and it hardly incorporates an aquaponics components.

Vertical farming further can be classified based on the types of structures that house the system.

I. **Building based vertical farms:** this type of vertical farming often practiced in abandoned buildings, warehouses, etc. e.g. Chicago's 'The Plant' vertical farm.

II. **Shipping container vertical farm:** being the most popular option of vertical farm, these use mobile shipping containers carrying goods around the world. Several companies refurbished dejected shipping containers and furnished with LED lights, drip irrigation systems and vertically stacked shelves for growing a variety of crops. These containers have computer controlled growth management systems that allow users to monitor all systems remotely from a smart phone or computer. E.g Freight Farms, Crop Box, Growtainers etc.

III. **Rooftop farming:** the concept of rooftop farming is rooted back to the ziggurats of ancient Mesopotamia and the Hanging Gardens of Babylon. It is simply the growing of fruits and vegetables on rooftop. Rooftop garden is a rising trends aims to scale up urban agriculture. The common vegetables can be grown on rooftop gardens are carrot, radish, bean, beet, cherry tomato and various herbs. Rooftop garden makes a distinction between vertical garden and vertical farm. Though both grow plants vertically but the former not always produces fruits

and vegetables while the latter does that exclusively. Vertical farm occupies larger area than that by vertical garden.

Advantages of vertical farming

- Year round crop production
- Reduces food miles
- Reducing water consumption for food production and recycling
- Recycling of organic waste
- Reduces fertilizers requirement and pesticide residues in food
- Improve productivity
- Protection from weather related variations in crop production
- Using renewable energy and reduction of fossil fuels
- Promoting the high-tech and green industry-'Green Technology'
- Bringing nature closer to the city
- Creating local jobs

CHALLENGES

- Land and building cost (Fletcher, 2012)
- High operation cost due to use of energy
- Social resistance since the masses of people do not accept the alteration of traditional farming (Abel, 2010)
- Location specific
- Controversy over USDA organic certification
- Limited number of crop species

CONCLUSION

Vertical farming is a strong competitor of traditional farming regarding the unsustainability of agriculture. But its confinement to certain barriers restricts it from globalization. The success of vertical farming not only depends on technology innovation but also on local condition including demand of certain food products by the people, knowledge dissemination and farming condition etc.

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Therapeutic uses of bovine colostrum

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Bovine colostrum is the first milk after parturition that contains high level of growth factors and immunomodulatory effect. It contains proteins, carbohydrates, fats, vitamins, minerals, and proteins (antibodies). In cows the antibodies provide passive immunity to the new born calf, whereas the growth factors especially stimulate the growth of the gut. Colostrum is characterised by its very high concentration of immunoglobulin G (IgG), which provides passive immunity to neonates. It is very essential that, the neonate must get the colostrum within 24 hours of birth, because the pore size of intestine decreases rapidly after birth. Antibody levels in colostrums can be 100 times higher than levels in regular cow's milk.

Table 1: Nutritional composition of human colostrum and bovine colostrum

Nutritional factor	Human colostrum	Bovine colostrum
Energy (Kcal)	58	~130
Protein (g)	3.7	~14.9
Lactose (g)	5.3	~2.6
Fat (g)	2.9	~6.7

Sources: Guthrie AH. (1989) and Kehoe et al. (2007)

THERAPEUTIC USES OF COLOSTRUM

Colostrum helps the human body by two ways. First, its immune factors and natural antibiotics pave the way for immunity. Second, its growth factors boost to the organism to encourage optimum health and healing. The immunoglobulin, growth factors, antibodies as a whole helps in preventing infection that is in passive immunity. The nutrients help for tissue development, growth and energy. Bovine colostrum is universal donor of colostrum to human. The colostrum collected from bovines within 24

hours of parturition contains maximum immunoglobins. Colostrum collected later will be more but contain less immunoglobins.

Table 2: Immune Factors in Human Colostrum and Bovine Colostrum

Immune factors	Human Colostrum (mg/ml)	Bovine Colostrum (mg/ml)
Lactoferrin	700	100
IgA	17.35	3.9
IgG	0.43	47.6
IgG2	-	2.9
IgM	1.59	4.2

Source: Stelwagen et al. 2009

BODY BUILDING AND EXERCISE PERFORMANCE

Colostrum contains insulin-like growth factors (IGF-I & IGF-II) and growth hormone (GH).

IGF-I, is the only natural hormone capable of promoting muscle growth by itself. The IGFs in humans and cows are identical, but bovine colostrum contains a higher concentration of IGF-I than human colostrum. As a result of which, bovine colostrum helps to the bodybuilders. Bovine colostrum is not on the banned drug list of the International Olympic Committee.The IGF-1 in colostrum improves the level of blood glucose and facilitates its movement to the muscles, which keeps energy levels up. Along with growth hormones, IGF-1 slows the process of catabolism that occurs after a vigorous workout. It speeds up protein synthesis, which results in lean muscle mass without an increase in the amount of stored fat. Colostrum improves the assimilation of nutrients, which leads to improved energy levels and performance.

REDUCES NSAID INDUCED GI INFLAMATION AND PERMEABILITY

Administration of NSAID leads to peptic ulceration and injury to small and large intestine. It causes increased permeability with protein and blood loss. Growth factors like α IGF 1, β IGF 1, transforming growth factor (TGF) and epidermal growth factors (EGF) are present in
bovine colostrum and these are capable of stimulating gut growth and repair process of GI
tract.

Prevention of cancer

Lactoferrin helps to prevent or reduce cancer cells. Lactoferrin obstructs colon, bladder, tongue, esophagus, lung cancer. Colostrum contains milk fats which have anti carcinogenic properties. Conjugated linolenicacid (CLA) in colostrum has anti carcinogenic properties.

Acts as a barrier to Helicobacter pylori infection

H. pylori require lipids to bind with gastric mucosa. Colostrum prevents the adhesion of this
organism to the lipid binding sites of the GI tract. colostrum prevents the adhesion of this microorganism therefore it can ever prevent peptic ulcers occurrence

Prevents GI disorder

Colostrum contains trypsin inhibitors and unchanged colostrum goes down the GI tract maintain the healthy epithelium linings and immune system.

Colitis

Bovine colostrum is used in the rectum to treat inflammation of the colon (colitis).

The flu (influenza)

Taking a specific type of bovine colostrum (Ad Colostrum, Corcon srl) by mouth for 8 weeks helps prevent the flu, including in people that have already been vaccinated against the flu and in people with heart disease who have a higher risk of getting the flu.

Rotaviral diarrhea.

Taking bovine colostrum seems to reduce diarrhea in children with diarrhea due to rotavirus.

Diabetes

Early research shows taking bovine colostrum might help to reduce levels of blood sugar following a meal, as well as cholesterol levels in people with type 2 diabetes.

Human papilloma virus (HPV)

Early research shows that applying bovine colostrum to the vagina for 6 months helps cure cervical lesions in people with HPV.

Reduced health in young children (failure to thrive)

In young children that are not growing well, early research suggests taking bovine colostrum by mouth improves weight but not height.

Diarrhea related to an immune disease called hypogammaglobulinemia

Bovine colostrum helps treat infectious diarrhea in a child with hypogammaglobulinemia.

Multiple sclerosis (MS)

Taking hyperimmune bovine colostrum might help treat symptoms of MS, but conflicting results exist

Hyperimune bovine colostrum

Researchers have created a special type of bovine colostrum called “hyperimune bovine colostrum.” This special colostrum is produced by cows that have received vaccinations against specific disease-causing organisms. The vaccinations cause the cows to develop antibodies to fight those specific organisms. The antibodies pass into

the colostrum. Hyperimmune bovine colostrum has been used in clinical trials for treating AIDS-related diarrhoea, diarrhea associated with graft versus host disease following bone marrow transplant, and rotavirus diarrhea in children. The U.S. Food and Drug Administration (FDA) has granted hyperimmune bovine colostrum "orphan drug status." Under the Orphan Drug Law, drug makers who invest in the development of treatments for rare conditions enjoy special market advantages; for example, permission to sell the drug without competition for 7 years. If these special incentives were not in place, pharmaceutical companies might not develop drugs for rare conditions because the potential market is so small. Along with these advantages, Bovine colostrum is also used for boosting the immune system, healing injuries, repairing nervous system damage, improving mood and sense of well being, slowing and reversing aging, and as an agent for killing bacteria and fungus.

Technological Innovations for Boosting Crop Productivity under dryland Conditions

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ABSTRACT

Water is the scarcest resource in dryland agriculture. Inefficient use of this scarce resource leads to inefficiency of all other inputs. In water resource management, the focus is not merely on development of new water resources but also on efficient utilization of already developed ones particularly based on indigenous systems. The precipitation reaching the earth surface may be intercepted by vegetation, may infiltrate into the ground, may flow over land surface as run-off or may evaporate. Evaporation may occur over the land surface or free water or from the leaves of the plant through transpiration. Soil acts as a reservoir for the water that enters the soil. Water in the soil is always in transitory storage. Dryland areas can be made productive and profitable by adopting improved technologies for rainwater conservation and harvesting and commensurate agricultural production technologies.

INTRODUCTION

Dry land agriculture means Agriculture in regions where annual potential evapo-transpiration exceeds precipitation. The scenario of water availability for agriculture will be critical in India, as India supports 18% of human and 30% of the livestock population on just 4.2% of the water resources. Presently 60% of cultivated land is rainfed and vulnerable to frequent moisture stress, droughts, floods and soil erosion (Rathore *et al.,* 2014).

Agriculture sector in India has been and is likely to remain the major user of water. It is estimated that the share of water allocated for irrigation is likely to decrease by 10-15% in near future. Rainfall is the ultimate source of water, affecting crop production and other biomass by directly influencing soil-moisture status as well as supporting surface and ground water irrigation. However, possibilities of occurrence of drought in India vary from once in two years in Western part of Rajasthan to once in 15 years in north-east Indian states. The strong dependence of Indian agriculture and the country's economy on monsoon is well established. It is well known that the Indian agriculture contributes around 17% of the national Gross Domestic Product (Economic

Survey, 2018). India's current production (mainly from irrigated agriculture) and reserves make the country food secure. The Ministry of Agriculture, Government of India, projects that the domestic demand of food grain by 2020 will be around 285 million tonnes. This will require a paradigm shift based on harnessing all the available natural resources for sustainable development of agriculture in drought-prone rainfed areas too, which was bypassed during the Green Revolution era (Saxena, 2012).

Nearly 70% of the annual rainfall in India is received during the S-W monsoon (Saxena, 2012). During the rainy season, generally extreme variations occur in rainfall. Floods and drought can strike the country simultaneously at different places (Singh, 2002). Nearly 60% of the net cultivated land is rainfed and the rest is irrigated. According to National Commission on Agriculture, the country has an ultimate irrigation potential of about 140 million ha. At present, irrigated area in India is around 63 million ha. All rainfed areas are not alike. There are great regional variations because of rainwater availability. About 28% of agricultural land is drought prone and as such suffers from critical water shortages (Samra, 2004). The drought prone areas are low in agricultural productivity and also low in overall economic growth. Poor people in these regions are highly vulnerable to a number of risks due to their low and fluctuating income, high indebtedness and poor human development. Helping the poor to come out of vulnerability and poverty and integrating the dryland areas into the mainstream of development is a serious challenge faced by policy makers at present.

THE FUNDAMENTAL PROBLEMS OF DRYLAND FARMING

- Storage in the soil of a small annual rainfall;
- Retention of the moisture in the soil until it is needed by the plants;
- Prevention of direct evaporation of soil moisture during the growing season;
- Regulation of the amount of water drawn from the soil by plants;
- Choice of crops capable of growth under moisture stress conditions and
- Crop management for proper utilization of stored soil moisture.

STRATEGIES FOR ENHANCING CROP PRODUCTIVITY IN DRYLAND AREAS

Various water economization practices, land configuration, selection of crop, varieties, intercropping, moisture conservation practices, use vegetative barriers, use of transpiration suppressants according to the availability of water. With good management and adoption of appropriate practices improved agricultural water conservation and subsequent use of that water for more efficient crop production are possible under dry land area (Wang *et al*., 2004).

1. Agronomical practices

Many agro-management practices can be used for improve the crop productivity in dryland area choice of crop cultivar, optimum sowing time, minimum tillage, intercropping practices, use of mulch and hydrogel are helpful to increasing the water use efficiency and yield of dryland crops (Sharma *et al.,* 2004).

Selection of crops and varieties

The farmers used to grow crops and varieties of long duration and slow growing nature till recently and therefore the scope for increasing the crop productivity in these lands was less. Introduction of high yielding, drought resistant/tolerant varieties under dry land condition now hold the promise for getting higher yields. It is imperative to select the crops and varieties, which possess wider adaptability, short duration and evade or tolerate insufficient moisture periods by virtue of their ability to maintain high internal water content with deep root system and less transpiration.

The crops and varieties suitable for dry land condition should have following characteristics:-

- Short duration and early vigour;
- Deep root system with ramified roots;
- Dwarf plants with erect leaves and stem;
- Moderate tillering in case of tillering crops and varieties;
- Resistance/tolerance to biotic stresses;
- Lesser period between flowering and maturity so that the grain filling is least affected by adverse weather;
- Resistance/tolerance to abiotic stresses;
- Low rate of transpiration;
- Less sensitive to photo-period and wider adaptability.

Sorghum and pearl millet are grown in the arid and semi-arid tropical regions, Moth bean (*Vigna aconitifolius*), mung bean (*Vigna radiate*), cluster bean (*Cyamopsis tetragonoloba*), horse gram (*Macrotyloma uniflorum*) and cowpea (*Vigna unguiculata*) are the major leguminous crops grown in the hot arid climate of western Rajasthan (Manga *et al.,* 2015). Suitable varieties for dryland area, pearlmillet varieties (HHB-67, PB-106, GHB-536) complete their life cycle within 65-95 days, similarly moth bean varieties (RMO-40, RMO-225,CAZARI MOTH-3) complete their life cycle within 60-65 days and Cowpea variety RC-101 complete its life cycle within 60-62 days (Manga *et al*., 2015).

Sowing time

In dryland condition moisture is the crucial input for crop production. Moreover biotic and abiotic stresses such as prolonged and recurring dry spells during crop growth period further add to woes of the rainfed farmer. Sowing date is an important determinant of crop yield. Sowing date depends on the onset of monsoon, amount and distribution of rainfall to the region. Timely sowing of kharif crops and early sowing of rabi crops resulted in higher moisture utilization (Reddy *et al*., 1984).

Tillage practices

Conservation tillage practice normally stores more plant available moisture than the conventional inversion tillage practices when other factors are same. The high soil moisture content under conservation tillage is due to both improved soil structure and decrease in the evaporation loss due to crop residue mulch cover. Increase in the

available water content under conservation tillage, particularly in the surface horizon, increases the consumptive use of water by crops and hence improves the water use efficiency. Of season deep tillage to a depth of 30 - 45 cm at 60-120 cm intervals helps in breaking subsoil hard pans in Alfisols facilitating growth and extension of roots and improving grain yield of crops as well as increase in the residual soil moisture in dryland area (Singh *et al.,* 2010). Singh *et al.* (2002) reported that early sowing (15th October) of horsegram resulted in significantly higher grain yield and water use efficiency than late sowing. An advancement of 15 days and minimum tillage (just one ploughing) increased the utilization of residual soil moisture of kharif season.

Intercropping

Intercropping is a practice to have an opportunity to diversify cropping system by making the multiple land use possible utilizes water and other resources more effectively and also provides a cover against the failure of one crop particularly under the rainfed situations. Any factor that increases yield will increase water use efficiency. Likewise any factor reducing evapo-transpiration that has no seriously deleterious effect on yield will increase water use efficiency (Eastin and Sullivan, 1984). Higher water use efficiency has been reported for maize + soybean and maize + mungbean (De and Singh, 1981), maize + cowpea (Hulugalle and Lal 1986), pearlmillet + greengram and pearlmillet + cowpea (Goswami *et al.* 2002) intercrops in relation to their respective monocrops in dryland area.

Mulching

About 60-75 per cent of the rainfall is lost through evaporation. Evaporation lose can be reduced by applying mulches. Mulch is any material applied on the soil surface to check evaporation losses, to conserve soil and water and to regulate soil temperature in favour of crop production. Beside this, application of mulches result in additional benefits like reduction in soil salinity, weed control and improvement in soil structure. By way of these benefits, mulches play an important role in improving crop productivity under dryland and rainfed farming.Crops residues, leaves, tree waste, manure, paper, plastic films and certain petroleum products are few materials used for mulching (Rana, 2007). Patel *et al.,* (2011) reported that application of white plastic mulch in pearlmillet field resulted in significantly higher grain (5213 kg ha^{-1}) and straw (8398 kg/ha) yields over control.White plastic mulch treatment is at par with application of Pearlmillet Bhusa @ 5 t ha^{-1} in term of grain and straw yields. Higher water use efficiency was recorded with application of white plastic mulch. This is due to that mulches played an important role in changing the hydrothermal regime of soil and conserving soil moisture for the better growth of plant.

Hydrogel

Hydrogel are water absorbing polymers, these polymers are cross linked structures and form a three dimensional network. Depending on synthetic conditions, type and density of covalent bonds that forms cross-link, these polymers can absorb upto 500-600 times their weight in pure water and form gels. Most of hydrogel

marketed for agriculture comes from cross-linked polyacrylamides and cross-linked acrylamide-acrylate copolymers, as they remain active for a much longer time (Bhaskar *et al*., 2013).

Importance of hydrogel

- Increase water holding capacity of soil
- The use of hydrogels leads to increased water use efficiency since water that would have otherwise leached beyond the root zone is captured.
- Enhance soil permeability and infiltration rates
- Reduce irrigation frequency
- Reduce fertilizer leaching
- Reduce compaction tendency of soil
- Reduce soil erosion and water run-off
- Hydrogel help to reduce water stress of plants resulting in increased growth and plant performance.

Singh, (2012) reported that seed coating in pearl millet with hydrogel @ 20g hydrogel/kg seed resulted in significantly higher grain yield over control. Seed coating with hydrogel is also resulted in higher water use efficiency than control. It was due to hydrogel application increased the availability of water in root zone at early stage of crop. Hydrogel when hydrayed transformed into water gels and these gel chunks acted as local water reservoirs which help in initial establishment of crop and better crop growth.

MICRO-IRRIGATION TECHNOLOGIES

The status of adoption of drip and sprinkler irrigation systems under various programmes, *viz.,* macro management plan; technology mission on horticulture; cotton development programme and oil palm development programme. The total area covered by MI systems is 7.7 million hectares of this, nearly 43.6 % is under drip systems, and the remaining 56.4 % is under different types of sprinklers. The total potential of micro irrigation in India is estimated at around 69 m ha, however currently the coverage of micro irrigation is only 7.7 M ha (2015). With the current target of achieving 0.5 mh hectare/ annum coverage, it would take a very long time to realise the potential estimates of micro irrigation in India (FAO, 2015).

The major crops for which drip systems are currently adopted are cotton, sugarcane; banana, orange, grapes, pomegranate, lemon, citrus, mangoes, flowers, coconut, and a wide variety of vegetables such as cauliflower, cabbage, chilly, ladies finger and brinjal. Sprinkler systems in the country are mainly used for field crops such as wheat, sorghum, pearl millet, groundnut and mustard. But the use of sprinklers is often limited to certain part of the crop season when farmers face severe shortage of water in their wells. Normally, this happens before the onset of monsoon when the farmers have to do sowing of these crops, or when there is a long dry spell during the monsoon season. Sprinkler for groundnut is common in Saurashtra in Gujarat; for

mustard in Khargaon district of Madhya Pradesh and IGNP command areas in Rajasthan. In the high ranges of Kerala and Tamil Nadu, sprinklers are used for irrigating tea and coffee plantations. However, recently, farmers use micro sprinklers and mini micro sprinklers for potato, groundnut and alfalfa (Kumar, 2016).

Benefits of micro irrigation

- Increase in water efficiency 50 to 90%
- Energy consumption savings 30.5%
- Fertiliser consumption savings 28.5%
- Productivity increase, Fruit/Crops 42.4% , Vegetables 52.7%
- Irrigation cost savings 31.9%
- New crop introduction 30.4% farmers
- Increase in Farmers' income 42%

2. Mechanical measures

Contour bunding

Bunding is the most effective and widely practiced field measure for controlling run-off and reducing soil erosion. Contour bunding is defined as series of mechanical barriers across the land slope. Each contour bund acts as a barrier to the flow of water. Thus, the water flow is restricted and there is possibility of impounding water which infiltrate overtime in the soil profile. This type of bunding is recommended for rolling lands with the slope of less than 6 % and flat land with scanty or erratic rainfall. In soil of very shallow depth (< 7.5 cm) contour bunding is not suitable. The design of contour bund involves spacing of bunds, its cross section and surplusing arrangement, which vary with slope, rainfall, soil texture and depth of soil profile. Surplusing arrangements for contour bunds are necessary in high rainfall areas to drain-off excess run-off water safely out of land without causing erosion (Rana, 2007).

Bench terracing

A terrace is a ridge or embankment of earth constructed across the slope to control run-off and minimize soil erosion. This is one of the most widely adopted mechanical measures of soil moisture conservation suitable for hilly areas with a slope of 6-33%. Bench terracing consist of step like fields or benches constructed along contours by cut and fill method to reduce length as well as degree of slope for either impounding rain water for cultivation or channeling it for safe disposal. In addition, it helps in promoting uniform distribution of soil moisture, irrigation water and controlling soil erosion and thereby increasing productivity of land. Depending upon the soil, climate, topography and crop requirements, bench terraces may be of table top or level type, outwardly sloping or inwardly sloping with mild longitudinal grades for run-off disposal. Cultivation is carried out on the leveled field (Rana, 2007).

Vegetative barriers

The vegetative hedges and buffers are placed on existing field bunds to conserve soil and water. Dense vegetation raised across the slope, makes a live bund. The live bunds help to reduce the length of field slope, check the run-off velocity, improve the soil moisture, control the soil erosion and trap the silt up to some extent. It is a cheaper and permanent measure. There is need for making a suitable choice of plants for the live bunds. *Sachharum munja*, *Vetiver, jatropha*, *agave, prosopis* etc. can be used for vegetative barrier (Rana, 2007).

Crop establishment method

Ridge and furrow planting, broad bed and furrow, raised bed & sunken bed are act as continuous barrier to free movement of rain water, check soil erosion and harvest more rainwater. Singh *et al*. (2015) reported that ridge and furrow planting of pearl millet resulted in significantly higher grain yield and rain water use efficiency over flat bed with broadcast sowing. Seed is sown at bottom of furrow resulted in greater in-situ moisture conservation and weed population is also less than flat planting.

Laser land leveling

In controlled experiments on agricultural plots, researchers at Punjab Agriculture University found that laser leveling increases crop yields by around 11 percent and results in water saving of around 25 percent, holding constant other inputs like fertilizers and seed quality. These experiments have also demonstrated that leveling reduces weeds by up to 40 percent and labor time spent weeding by up to 75 percent (Rajput *et al*., 2010). Kanannavar *et al.* (2016) reported that Laser land leveling with 0.4 per cent slope resulted in 40.5 per cent saving of irrigation water compared to control and 28.03 per cent irrigation water saving in groundnut crop compared to traditional land leveling method. Laser land leveling method has resulted in more uniform distribution of water in the field and there is more uniform germination and growth of plants.

Watershed management

The Government of India in its Seventh Five Year Plan had launched a national development programme of rainfed agriculture on watershed basis. The work initiated in 47 model watersheds under the technical guidance of Indian Council of Agricultural Research. Watershed is a geo-hydrological unit draining at a common point by a system of streams. The watershed represents a hydrological unit of area, but can also be described as bio-physical, socio-economic and sometimes a political unit for planning and management of natural resources. A good watershed management therefore must consider the social, economic and environmental sustainability and institutional factors operating in and outside the watershed area. The basic concept of watershed is to conserve all the basic natural resources and plan for their optimal utilization (Rana, 2007).

3. Physiological approach

Use of Anti-transpirants

Plants transpire water vapours continuously from all the above ground parts particularly through leaves. This process of evaporation of water from the aerial parts of plants is termed "Transpiration". Approximately 99 % of the water taken by the plant roots is transpired to the atmosphere. Transpiration occurs through different types of apertures such as culticles, lenticules and stomata. Among these apertures, stomata accounts for 90-97 % of transpiration. Transpiration is considered an unavoidable evil. Reduction in transpiration may help in maintaining of favorable water balance in dry farming. Any material that is applied to plant surfaces with the aim of reducing or inhibiting water loss from plant surface is called "anti-transpirant".

Scope of using anti-transpirants

- Under dry land area to reduce water losses through transpiration.
- In costly irrigation for extending the irrigation interval.
- In areas having poor quality of soil water or irrigation water to reduce the uptake of salts.
- For reducing transplanting shock of nursery plants

Singh *et al.* (2008) reported that application of ABA @ 5 ppm in wheat crop at 50 and 80 days after sowing resulted in significantly higher grain yield over control. Both PMA and ABA are stomata closing type but after application of water ABA activity is reduced but PMA activity is remain as such for longer time even after application of irrigation water and stomata is closed for longer time resulted in yield reduction.

Seed hardening

Seed hardening is physiological preconditioning of seed by hydration to with stand drought. Soaking of into water or chemical solution (Kcl, $Cacl_2$, HNO_3) for a definite duration and shade drying to bring back the seed to original moisture (Manjunath *et al.,* 2010).

Importance of seed hardening:

- Increase the speed of germination
- Increase the seedling vigour
- Uniform germination
- Increase the root growth

Manjunath *et al.* (2010) reported that seed hardening in chickpea with $Cacl_2$ (2%) resulted in significantly higher 100 seed weight and grain yield over control. Seed hardening with $Cacl_2$ (2%) resulted in improving the morpho-physiological parameters it was due to redistribution of resources leading to cell enlargement and cell division.$Cacl_2$ increase the activity of β-amylase which resulted in hydrolysis of complex food like starch into simple compound during germination

CONCLUSION

Ridge and furrow planting and laser land levelling increase the in-situ moisture harvesting. Seed coating with hydrogel, seed hardening, use of mulches, anti-transpirants are helpful to increase water use efficiency in dryland area. Adoption of

micro irrigation system is beneficial in increasing water use efficiency. Watershed, farm pond and check dam are helpful in water harvesting.

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Immunopathology of Bovine Theileriosis

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Theileriosis is a tick borne disease caused by obligate intracellular protozoan parasite *T. annulata* and *T. parva*. Parasite is present inside the lymphocytes, erythrocytes and histiocytes of the infected host animal. *Theileria annulata,* the causes of Bovine Tropical *Theileriosis* is transmitted by the bite of *Hyalomma anatolicum* ticks whereas *T. parva* which causes East Coast Fever which is transmitted by *Rhipicephalus appendiculatus* tick vectors. Disease is more common in exotic, crossbred and young calves. Incidence increases after rains because of increased tick population and stress among animals due to hot and humid climate.

Main clinical signs are fever (39ºC) with enlargement of superficial lymph nodes, anemia, jaundice, drop in milk production, difficult breathing with rapid and shallow breaths. Most of the pathology of *Theileria* is mainly induced by the ability of parasite to transform host cells. Main pathogenic effect is due to massive division of parasites inside lymph nodes and widespread dissemination through lymphatics. Parasite proteins interact with host cell proteins therefore altering signal transduction pathway hence causing uncontrolled division leading to lymphomas.

SPOROZOITE AND THE PROCESS OF INVASION

Mature sporozoites are small (0.75 - 1.5 µm diameter), spherical and are covered with distinct 20-25 nm thick trypsin-sensitive surface coat. No clearly defined apical complex is present. Each sporozoite is surrounded by plasma membrane and no elaborate sub-pellicular complex or microtubules are observed. The process of cell invasion involves defined series of steps which include:

1) Initial recognition and binding of the sporozoite to host cell surface.
2) The formation of a close, continual junction between sporozoite and host cell which is separated by a thin (approximately 6-nm thick) layer.
3) The progressive circumferential “zippering” of the two closely apposed sporozoite and host cell membranes, concomitant with loss of sporozoite surface coat and movement of parasite into host cell, resulting in parasite becoming fully internalized.
4) The separation of tightly apposed membranes with discharge from rhoptries.
5) Dissolution of host cell membrane with escape of the parasite into cell cytoplasm.

6) Formation of array of host cell-derived microtubules surrounding sporozoite.

FACTOR INVOLVED IN IMMUNE-PATHOGENESIS OF THE PARASITE

1. Immunopathogenesis

It depends on certain factors like nature of cells affected, cytokines produced and capacity to induce nonspecific activation of T-cells. *Theileria parva* preferentially infects T-cells; whereas *T. annulata* mainly transforms MHC class II-positive cells. There is massive and uncontrolled cell proliferation observed during infection with *Theileria* schizonts. It has been shown that growth factors such as IL-2 enhance proliferation of parasitized cells. Pathogenesis of *Theileriosis* is primarily due to infection of host's leukocytes by macroschizonts. The macroschizonts of *T. parva* and *T. annulata* live within the cytoplasm of the host cells, in which the parasites proliferate synchronously with their host's cells. Although the macroschizonts are the most pathogenic stage of these species, merozoites also seem to be involved in the pathogenesis of the disease via tissue injury and anemia.

2. Cytokines and their role

Cytokines are released systemically and play major role in pathology and clinical signs of Bovine Tropical *Theileriosis*. They act as growth factors for infected cells.

- IL-1- Paracrine effect that is cell to cell signaling, cell produce signal to nearby cell thus altering their behavior.
- IL-10 - Inhibit cytotoxic response hence suppress immunity.
- IFN - Involved in development of anemia, muscle wasting and necrosis.

They also play role in pathogenesis of *Theileria* infections by promoting the proliferation of macroschizont-infected cells and the associated lymphoid hyperplasia. *Theileria annulata* infected macrophages show reduced ability to express inducible nitric oxide (NO) synthase mRNA. Nitric oxide has also been implicated in vasodilation and, if produced in excess, may induce cell and tissue damage.

3. Theileria schizonts induce fundamental alterations in their host cells

After being inoculated by ticks, sporozoites invade bovine leukocytes, where they differentiate to schizonts. The infected cells acquire the characteristics of transformed cells, have a short generation time in vitro and show phenotypic changes. The macroschizonts undergo a nuclear division ahead of the host cells due to a shortened G-2 phase.

Theileria transforms lymphocytes, which proliferate continuously without need for exogenously added growth factors. The infected cells show increased activity of casein kinase II and Jun NH2-terminal kinase (JNK). In addition, several transcriptional pathway such as Nuclear factor kappa- B (NF-kB) and Activator Protein-1 (AP-1) are activated. It has been postulated that parasite proteins interfere with signal-transduction pathway of the host cells.

4. Oncogenecity

Theileria infected cells show many characteristics of tumor cells. In vitro, they proliferate in uncontrolled manner and cease to require addition of exogenous growth factors. In vivo, they show increased ability to migrate, infiltrate, and proliferate in non-lymphoid as well as lymphoid tissues, generating lesions that resemble multi-centric lymphosarcomas. Infiltration is most apparent in lungs and gastrointestinal tract.

5. Warburg Effect

This is commonly seen in cancerous cells and has been demonstrated in *Theileria* infected cells. It is a metabolic switch leading to shift in ATP production from oxidative phosphorylation to glycolysis leading to deregulation of ROS (reactive oxygen species). This causes generations of HIF-1α (Hypoxia Inducible Factor 1α) which cause cell survival without depending on nutrients.

6. Matrix Metallo Proteinases (MMP)

The dissemination of *Theileria* infected cells is correlated with a marked expression of MMPs. MMP produced by the infected cells leads to lesion formation by digestion of the extracellular matrix. This has important implications for a number of pathological features of *Theileriosis*. Cell lines with a low level of MMP activity exhibit reduced metastasis. Accordingly, researchers have postulated that MMPs are virulence factors contributing to some pathological features of Bovine Tropical *Theileriosis*.

7. Parasite interference with host cell signal transduction pathways

In *Theileria* transformed cells, cells escape the down-regulatory mechanisms and cell death. Different biochemical pathways regulate these events. Src-family protein tyrosine kinases are activated following engagement of different classes of cellular receptors and participate in signaling pathways that control a diverse spectrum of receptor-induced biological activities. They mediate early signaling events of important T-cell, B-cell, and macrophage/monocyte membrane receptors. They interact with cellular cytosolic, nuclear and membrane protein therefore modifying these proteins by phosphorylation of tyrosine residues leading to deregulation hence interfere with cellular transportation and oncogenic activity. The presence of the parasite could, directly or indirectly, alter the state of activation of kinases with important functions in T-cell activation and proliferation.

Pesticide Contamination in Food Commodities and Their Adverse Health Implications on Food Consumers

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ABSTRACT

All over the world pesticides are widely used in agricultural field mainly to increase crop production to full-fill a gap between demand and supply of food among the consumers simultaneously protecting agricultural crops from pests. However, uncontrolled use of pesticides leads to contamination of food commodities through various means; water, air, fodder and soil. Contamination of food commodities may tends to cause broad variety of hazardous effect on human health that includes acute short-term effects to chronic long term toxic effects. The impact of pesticide contamination can be reduced by taking certain preventive measures such as the rational use of pesticides, promoting organic farming, exploiting natural and bio pesticides, proper implementation & amendment of pesticide-related laws and most importantly regular monitoring of MRL of pesticides used for agricultural food commodities that have been set by regulatory bodies. The present article has been focused on types of pesticides used in agriculture, source of contamination of pesticides in food commodities, toxicity of pesticide and preventive measures to overcome hazardous health implication problems of pesticides.

INTRODUCTION

Any substance or mixture of substances which is intended for preventing, destroying or controlling any pest is referred as pesticide. Pesticide residues in food commodities become major food safety issue due to uncontrolled use of pesticides by farmer on agriculture commodities to increase yield. However, contaminated food with pesticide residues takes place through various sources such as water, air, soil and fodder. Various pesticides have been used around the world ensuring that food is not damaged or destroyed by pests which includes organochlorines, organonophosphates, carbametes and chlorophenols. Contamination of food with pesticide residues may cause wide range of acute and chronic toxicity effects on health. Acute toxicities includes upper and lower respiratory tract irritation, allergic responses, gastrointestinal symptoms, neurological symptoms, cholinergic crisis, caustic lesions and pulmonary fibrosis. However, chronic toxicity tends to cause abnormal growth, impaired neurobehavioral

development, cancer, infertility and congenital malformations. The different regulatory agencies such as Codex Alimentarius Commission (CAC), Food Safety and Standards Authority of India (FSSAI) and European Food Safety Authority (EFSA) have set Maximum Residue Level (MRL) of many of these pesticides for different food products. However, many of the food commodities have exceeding MRL posing serious safety issue towards the consumer health.

WHAT ARE PESTICIDES?

Different definitions have been given by different pesticides related working agencies but most commonly used definition for pesticides has been given by Food and Agricultural Organization (FAO); *"Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies"*

SOURCE OF CONTAMINATION OF PESTICIDES IN FOOD

The uncontrolled use of pesticides may lead to contaminate air, soil, water and plants which further contaminate food commodities. Lack of proper knowledge among agricultural farmers and uncontrolled use of pesticides on agricultural food commodities may tends to cause major reason of pesticide residues transmission in fruits and vegetables. Moreover, not only agricultural farmers but also the people of urban areas are using pesticides in their homes and home gardeners, in and around the schools, business areas, and hospitals that means ultimately contaminating food which leads to cause several harmful effects on the health. Furthermore, milk contamination with pesticides is best example especially with organophosphorus pesticides due to their wide use on fodder. Inappropriate and uncontrolled use of these pesticides may leave residue in animal feed which when supplied to milking animals get metabolized and are found in milk.

CLASSIFICATION OF PESTICIDES

There are different classes of pesticides available presently and these classification as per the requirements of user. However, now a days, most popular way of pesticides classification includes; based on targeted pest (insecticides, herbicides, fungicides, rodenticides), based on chemical properties (organochlorines, organophosphorus, carbamates, chlorophenols) and based on mode of action (contact, systematic).

Toxicity of pesticide

Pesticides have been gaining attention in agricultural filed to increase the productivity and yield of agricultural crops. However, on the other hand harmful effect on human

health has become an emerging food safety issue since past couple of years. It has been reported by World Health Organization that each year, near 3,000,000 cases of pesticide poisoning and 220,000 deaths are reported in developing countries. In developing countries near about 2.2 million people are at increased risk of exposure to pesticides. Pesticides enter in to human body through various routs such as ingestion and inhalation. Nevertheless, most of the people get contaminated with pesticides through the intake of pesticide contaminated food. The effects of pesticides on human health are highly variable which may be acute in nature or chronic in nature. Acute effect of pesticides on human health seems to be of short periods including headache, stinging of the eyes and skin, irritation of the nose and throat, skin itching, appearance of the rash and blisters on the skin, dizziness, diarrhoea, abdominal pain, nausea and vomiting, blurred vision, blindness and very rarely death. Whereas, chronic effects of pesticides possessing for long period of time that includes neurological problems, different kind of cancer, lymphoma, leukaemia, stillbirth, birth defects, spontaneous abortion and infertility.

CONCLUSION AND FUTURE PROSPECTS

Pesticides became blessing for the farmers all over the world for increasing agricultural productivity and yield. Nevertheless, toxic effects on human health raise burning concern of pesticides with respect to food safety. Although, it is not practically possible to completely eliminate contamination but preventive measures and precaution to reduce contamination of pesticides in food commodities can be undertaken by several means such as alternative cropping methods, using bio-pesticides & increasing organic farming, use of appropriate quantity of pesticides for agricultural purposes only when needed, focus on farmer agricultural education, implementation of regular monitoring programs of regulatory agencies by regularly monitoring MRLs of pesticides for agricultural food commodities that have been set by regulatory authorities.

Brown manuring: New tactics for Production of Crops

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ABSTRACT

Brown manure is a technique alternate to green manuring. In green manure it takes times for decompose it does not supply immediately nutrients to standing crop. To overcome menace brown manure it decompose un wanted weeds in field for use of non selective herbicides its influence like parameters physico-chemical properties of soil, soil moisture, nutrient efficiency and yield.

INTRODUCTION

Brown manuring is technique to grow in standing rice crop and kill them with help of herbicide for manuring.After killing the colour of the sesbainia residue become brown so it called brown manuring . it is not adds organic matter content but also improves the physio chemical and biological properties of soil.The rising cost of cultivation and less availability of inputs is the present scenario of agriculture. In India, now re-defining the farming practices and increased attention is paid towards the development of resource conservation practices. There are many options available, among them 'brown manuring' is becoming a recent trend developed for paddy eco-system and is also becoming a popular technique in agriculture. Traditionally, farmers grow green manure crops before rice culture and incorporate it by puddling before transplanting rice seedlings and this requires more number of tillage operations for green manuring leads to loss of soil moisture and also it needs additional irrigation water and fuel costs for incorporation. Since there is water scarcity during peak summer, farmers have not been able to take full advantage of green manuring in rice growing season. So, Brown manuring is the alternative practice to the green manuring. It can be defined as a technique of growing green manuring crops viz., dhaincha, sesbania, sun hemp etc., as an inter or mixed crop and killing them by the application of post emergence herbicides for manuring. After spraying, the colour of green crops becomes brown due to loss of chlorophyll, hence the process is called as brown manuring (Tanwar TS et al., 2010.

HOW TO ADOPT BROWN MANURE IN FIELD LEVEL PRACTICE

Brown manuring practice was introduced where Sesbania crop @ 20/25 kg ha-1 was broadcasted three days after rice sowing and allowed to grow for 30 days. Co-cultured Sesbania crop was dried by spraying 2,4-D ethyle ester (Singh J2007 and Sharma A 2017). The dried leaves of Sesbania fell on the soil and decomposed very fast to supply nitrogen, dry matter, soil organic carbon and other recycled nutrients to the soil. The practice led to reduction of weed population by nearly half without any adverse effect on rice yield. Pest attack was also reduced (Mondal S et al., 2012). Brown manuring can be practiced in maize, rice, sugarcane etc. It is an advanced weed management strategy as well as no till version of green manuring using a non-selective herbicide.

Integrated weed management practices comprising butachlor 1.5 kg/ha as pre-plant surface application + brown manuring + 2,4-D 0.50 kg/ha at 40 DAS could become effective in controlling weeds as well as getting higher yield during kharif season in dry direct seeded rice ecosystem under terai agro-climatic region of West Bengal. There has been considerable improvement in nutrient use efficiency due to adoption of weed control practices coupled with nitrogen management (Swapan Kumar Maity and P. K. Mukherjee 2011). Brown manuring (BM) is now emerging as an advanced weed management strategy which seems promising method of controlling weeds in direct seeded rice. In another words brown manuring is a no-till version of green manuring, in which selective herbicide 2, 4-D @ 400-500 g ha-1 is applied to knockdown and desiccate the Sesbania or any other green manure crop at blooming (30-40 days) stage. As a result, this practice results into falling of Sesbania leaves to fall on the ground and forms a layer in the form of mulch which helps in smothering of weeds, conserving moisture and adding about 15 kg N ha-1 without adding much on cost of production (Gill and Walia 2014). Moreover, Yadav et al. (2014) observed brown manuring with Sesbania and cowpea had positive responses in lowering weed population and increasing yield in direct seeded rice. The brown leaves of Sesbania spp after the herbicide application would serve the purpose of mulch and hence smother the weed flora associated in rice (Mahajan et al., 2009).

Sharma et al. (2017) noted significantly higher actinomycetes count with brown manuring in Basmati rice cultivated under the method of system of rice intensification. Increasing soil organic matter through brown manure or addition of plant or animal organic matter from external sources is also important in decreasing bulk density of the soil and acting as a buffer preventing or lessening the transmission of compaction to subsoil from external loads acting on the topsoil (Hamza and Anderson, 2005).

EFFECTS OF BROWN MANURING ON PHYSICO-CHEMICAL PROPERTIES OF SOIL

Brown manuring has its positive impact on soil physico-chemical properties viz., soil structure, organic carbon, bulk density and pH of the soil. Zero tillage with Sesbania as brown manuring in rice significantly increases Organic carbon (0.55 %), hydraulic conductivity and decreases the bulk density. This was due to rice, wheat residue and brown manuring effect of sesbania on soil properties. Sesbenia seed sown @ 25 kg ha-1

and after 35 days sowing, foliar application of 2,4-D (sodium salt) @ 625 g in 500 liter of water sprayed on the crop (Singh S 2011). The results revealed that, productivity of sugarcane increased from 67.9 to 76.2 t ha-1 , increased soil organic matter (organic carbon) from 0.30 to 0.75 per cent and decreased the pH from 8.0 to 7.2 (Satyarakash S 2011). The soil organic carbon was increased by 0.03-0.05 per cent due to brown manuring. More response was found in sodic soil (Khan AR 2013). Organic carbon builds up was higher in inclusion of brown manure (0.52 ± 0.04%) and 13.04 per cent more carbon build up was recorded when compared to farmers practice (0.46 ± 0.04%). The increased organic carbon content might be attributed to the addition of organic materials from brown manuring and better root growth of the crops grown (Sarangi DR 2016). The highest concentrations of total N, soil organic carbon, porosity, soil organic matter, soil microbial biomass carbon, and soil microbial biomass nitrogen were recorded with direct seeded aerobic rice + sesbania brown manuringno tilled wheat and also lowest soil bulk density and total soil porosity at 0-5 cm depth were recorded with the same treatment (Nawaz A 2016). Indeed, sesbania is a fast-growing and high biomass producing legume crop, which can fix a large amount of atmospheric nitrogen into plant usable form (Kwesiga FR1999, Orwa C2009).

EFFECTS OF BROWN MANURING ON SOIL MOISTURE

The brown manuring practice improves the soil physical properties results in higher moisture holding capacity, hydraulic conductivity and decreases the moisture evaporation from the soil. Pre-emergence application of Alachlor @ 1 kg ha-1 + Brown manuring (dhaincha) recorded highest available soil moisture followed by preemergence application of Alachlor @ 1.0 kg ha-1 + diancha as intercrop with in-situ incorporation on 35 DAS. This was due to ability of dhaincha to impove the moisture holding capacity of the soil. The maximum water saving can be done in the direct seeded rice with Sesnania co-culture as brown manuring (39.4 %) followed by direct seeded rice compared to transplanted rice. However, the gross water productivity was maximum (0.31 kg m-3) where, rice cultivation was done through direct seed sowing with Sesbania (Brown manuring) . The residue retained plot under zero till rice and wheat followed by Sesbania brown manuring resulted in more soil moisture content during both the years of study at 0-15 cm and 15- 30 cm soil depth and lower was recorded under direct seeded rice followed by conventional wheat with incorporation of Sesbania. It might be due to reduced water evaporation . Water use efficiency (WUE) of maize significantly increased with mulching over no mulching. Water use efficiency was significantly high with wheat straw mulching treatment (20.13 kg ha-1 mm) and was at par with sunhemp brown manuring (two rows) (19.67 kg ha-1 mm) .

EFFECTS OF BROWN MANURING ON WEED DENSITY

No doubt herbicides are important tools to control weeds. But because of concerns about the evolution of herbicide resistance in weeds, shift in weed population, and less availability of new and broad-spectrum herbicides, there is a need to integrate herbicide

use with other measures like brown manuring to control weeds. In recent years, more attention has been given to the possibilities of exploiting brown manuring to aid in weed management. It aimed at suppressing the weeds without affecting the soil physicochemical properties and its associated microbes. It can be achieved through raising green manure crops such as Sesbania (Daincha), sunhemp etc. as inter crop and killing the same by application of post-emergence herbicides. The killed manure is allowed to remain in the field along with main crop without incorporation / in-situ ploughing until its residue decomposes itself in the soil aiming to add organic manure beside weed suppression by its shade effect. A lower broad-leaved weed density and dry weight were observed with Sesbania and other brown manuring species than the surface mulch. Brown manuring helps in smothering weeds and conserving moisture without adding much on cost of production (Sneha 2016). To use brown manuring for weed control, pulse crops must be desiccated at or before the milky dough stage of the target weeds. This is usually at or before the flat pod stage of the pulse, well before the crop's peak dry matter production. At this stage, the crop is growing at its maximum rate about 80 to 100 kg of dry matter per hectare per day.

EFFECTS OF BROWN MANURING ON NUTRIENT USE EFFICIENCY

As there is a rising trend in the chemical fertilizer cost, brown manuring would form an alternative approach for higher production and net benefit. By the practice brown manuring can replace 25 per cent of nitrogenous fertilizer with the overall soil health (Sarangi DR 2014). Sesbania crops were knocked down by herbicide after 30 days when it is tender and succulent so as to get maximum response and makes N available immediately after application. Nutrient use efficiency (NUE) was positively influenced by weed management practices. Among the integrated weed management practices, nutrient use efficiency of N (50.00 and 64.67 kg grain yield kg-1 nutrient applied), P (229.36 and 296.64 kg grain yield kg-1 nutrient applied) and K (90.36 and 116.87 kg grain yield kg-1 nutrient applied) was highest under butachlor 1.5 kg ha-1 + brown manuring + 2,4-D 0.5 kg ha-1 treated plots during both the years of investigation [Maity SK, Mukherjee2009]. Growing of direct seeded rice + brown manuring increased the available nitrogen (102 kg ha-1), available phosphorus (22.1 kg ha-1), available potassium (265.9 kg ha-1) in soil compared to transplanted rice (Singh S 2009).

EFFECTS OF BROWN MANURING ON GROWTH AND YIELD OF CROPS

Sesbania intercropping resulted increased grain yield and net income of direct seeded rice (DSR) by 15 per cent compared with the plots where no intercropping was done [Singh J 2007]. Paddy yield in bed transplanting (4.43 t ha-1) and direct seeding + brown manuring (4.23 t ha-1) were at par and significantly higher than direct seeding without brown manuring (3.36 t ha-1) that produced the lower yield [Aslam et al M 2008]. Rice yield in direct seeding + brown manuring (3.50 t ha-1) were at par compared to conventional transplanting (3.56 t ha-1) but significantly higher than direct seeding without brown manuring (3.22 t ha-1). Pre-emergence application of

butachlor @ 1.5 kg ha-1 as pre-plant surface application + brown manuring with Sesbania rostrata + 2,4-D @ 0.50 kg ha-1 recorded the highest grain yield (3.88 t ha-1), which was at par with that obtained from season-long weed-free situation (3.98 t ha-1) (Kumar MS, Mukherjee PK.2011).The treatment combination of rice + BM (4 WAS) with pendimethalin 750 g ha-1 fb bispyribac 25 g ha-1 recorded the highest grain yield (59.68 q ha1) which was significantly higher than all other combinations of brown manuring with herbicide treatments (Gaire R et al 2013). Pendimethalin @ 1.0 kg ha-1 has been quite effective and economical in DSR for reducing weed count and their biomass and increasing grain yield whether applied as a sole treatment or followed in sequence with a postemergence herbicide (Jayadeva HM, Bhairappanavar ST 2002). The higher grain yield was obtained from brown manuring + inorganic fertilizer treatment and it was identical to soil test based inorganic fertilizer for high yielding genotype (HYG). The highest gross margin was also obtained from brown manuring + inorganic fertilizer treatment (Ferdous MZ 2011). Pre-emergence application of pendimethalin fb brown manuring and pendimethalin fb bispyribac fb brown manuring resulted in significantly higher grain yield than other weed management practices. This result could be attributed to higher weed control efficiency and increased crop growth under these treatments (Joseph M etal 2008). Pre-emergence application of pendimethalin @ 1.0 kg ha-1 + Brown manuring at 30 DAS + Hand weeding at 60 DAS recorded the highest dry matter production and grain yield (4.12 t ha-1) which were statistically at par to all other weed management practices except weedy check. Brown manuring of dhaincha suppressed the weeds and increased the availability of nutrient (Seema, Krishna M, Devi, MTT 2014). Sesbania sown at 4 days of rice seeding recorded maximum yield (5.54 t ha-1) and it was at par with Sesbania sown at 5 days of rice seeding (5.41 t ha-1) and significantly higher than sole crop of rice (4.70 t ha-1). The brown manuring practice recorded 16.15 per cent higher grain yield (30.2 q ha-1), higher harvest index (47.34 %), production efficiency (28.8 kg ha-1 day-1) and extension gap (4.2 q ha-1) than farmer's practice .

CONCLUSION

Brown manure is it can be withstand for longer time of period and also enhances carbon source and other nutrients it can be used as dry land cultivation to save water for rice cultivation,

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Common cause of Livestock death in the Indian context

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DEATH

Cessation of all vital functions of the body including heart beat, brain activity and breathing.

There are two types of death which are as follows:

1. **Systemic / Somatic Death**

- Also known as tripod of life (B, H & L)
- After few minutes
- It is complete and irreversible

2. **Molecular Death**

- Death of tissues and cells takes place here
- After somatic death there is cooling of the body
- It may take few minutes to hours

Modes of Death

✓ **Coma**

- There is insensibility in the central portion of brain stem.
- Nervous failure usually takes place due to disturbance of respiration or/and circulation

✓ **Syncope**

- Due to stoppage of Heart's action
- There is cessation of circulation or circulatory failure

✓ **Asphyxia**

- Cessation of respiration or respiratory failure
- Stoppage of respiratory function before heart ceases to act

COMA

➢ Brain compression- injuries or diseases, skull fracture, abscess, new growth, embolism, thrombosis
➢ Poisons- Opium, Barbiturate, Alcohol, Carbolic acid
➢ Endogenous poison- Acetonemia, Uraemia

❖ **Symptoms of coma**

- Stupor leads to unconsciousness which is followed by loss of reflex and finally patient is comatose.
- Pulse is full and bounding but slow.
- Breathing is slow and irregular.
- Death is rattle type.

POST-MORTEM FINDING

Post-mortem findings include the following changes:

- Injuries to skull
- Congestion of brain
- Clotted blood
- Right side of heart full with left side empty
- Tumor, cyst or abscess in cranial cavity

SYNCOPE

Syncope can take place due to:

- Anaemia- haemorrahge
- Shock due to sudden fright, blow, cold water
- Asthenia- Fatty degneration, poison
  - Exhausting diseases

❖ **Symptoms**

- Pallor mucuos membranes, dimness in vision, dilated pupil, gasping respiration
- Pulse is slow, weak in anaemia and rapid in asthenia
- Animal retains consciousness

POSTMORTEM FINDINGS

- Signs of trauma
- General visceral congestion
- Oedema of lungs
- Dark red color blood
- Petechial hemorrhages in membranes and on organs

ASPHYXIA

Asphyxia refers to an interference with the oxygen interchange in the lungs. Asphyxia can occur due to:

- Mechanical obstruction
- High altitude, inert gas, carbon monoxide
- Chest muscle stoppage due to debility, cold, paralysis, respiratory center, tonic spasm in tetanus and strychnine poisoning.
- Penetrating wound leading to collapse of lung
- Embolism in pulmonary artery

❖ **Symptoms of asphyxia**

- Dyspnoea

- Convulsion
- Exhaustion

Aetiology

- Drowning
- Strangulation
- Suffocation

DROWNING

Drowning means death from prevention of atmosphere air from entering the lungs caused by the submersion of the body in any fluid medium. Face submersion alone can lead to drowning.

Phases of Drowning

Submersion of body in water leads to struggle. After exhaustion of animal in some time drowning begins.

Carbon dioxide accumulation leads to stimulation of respiratory centre which leads to inhalation of water.

Gulping of water leads to coughing and vomiting and finally loss of consciousness. Profound unconsciousness and convulsions are associated with involuntary respiratory movements and the aspiration of water. Respiratory failure precedes heart failure. Death occurs within 2 to 3 minutes.

PATHOPHYSIOLOGY OF DEATH DUE TO DROWNING

Drowning may be:

- In fresh water
- In sea water

On aspiration of fresh water, it goes to the alveoli in lungs and water absorption leads to hypervolemia which further leads to haemodilution and hemolysis in circulation, which leads to anoxia and ventricular fibrillations.

On aspiration of hypertonic salt water, when water reaches alveoli it withdraws water from pulmonary circulation which leads to pulmonary oedema and haemoconcentration.

Signs indicating death due to drowning

-While leathery froth is present at mouth, nostrils and also at larynx, trachea and bronchial tubes.

-Lungs look distended like balloons and are oedematous and spongy in consistency. Presence of water in lungs.

-Stomach containing objects present in water at the time of immersion e.g. algae.

-Skin looks corrugated in appearance.

-Rigor mortis will setup early in such cases.

-If animal was alive at the time of drowning, the injuries will have an inflammatory reaction.

Mode of death

- ❖ Asphyxia is the most common mode of death.
- ❖ Shock due to fright or terror, laryngeal shock leads to vagal inhibition and finally cardiac arrest
- ❖ Fatal injuries like-
- Concussion
- Apoplexy due to excitement, violent struggle to keep up with life
- Exhaustion due to continued efforts

DROWNING TESTS

1. **Specific gravity of blood**

Lower plasma specific gravity in blood from the left side of the heart leads to haemodilution.

2. **Plasma Chloride**

Haemodilution in fresh water drowning will lead to lower chloride level in left heart blood. Haemoconcentration and chloride ion absorption in salt water drowning will lead to high chloride level in left heart blood.

3. **Serum Ca & Mg**

Both calcium and magnesium are elevated in salt water.
Calcium level high in fresh water.

4. **Diatoms**

Diatoms could enter the systemic circulation via the lungs implying that the decedent was alive in the water.

Strangulation

Strangulation is the closure of air passage due to external pressure on the neck which prevent the inhalation and exhalation of air during the respiration.

Accidental causes

Crossing of halter of two animals tied close together, insertion of leg of a standing animal into the neck chain of lying animal.

Suffocation

Death results from exclusion of air from lungs by means other than compression of the neck.

Causes

1. Closure of mouth and nostrils:

-Calves are often accidently smothered by being overlaid by their dams.
-Closing of mouth and nostrils by cloth or mud.
2. Choking or obstruction of air passages from within.
-Presence of foreign bodies like carrot, potato, leaves etc.
3. Inhalation of irrespirable gases like CO2, CO, anaesthetics used by mistake, hydrogen sulphide or smoke from burning home.

Mode of death

- Asphyxia
- Shock when heart stops reflex action through the vagal nerve.

- Fatal period is 10-15 minutes after complete withdrawal of air from the lungs.

Symptoms of asphyxia

Four stages:

- Dyspnoea
- Convulsions
- Apnoea
- Final stage is of respiratory paralysis

Post mortem changes

- External changes include forcible application of hand on mouth and nostrils
  - Bruises and abrasion on lips
  - Inner surface of lips lacerated due to pressure of teeth
  - Nose septum may be fracture due to pressure
  - Frature of cervical vertebrae, if neck wrenched
- But no signs are seen if soft cloth used to block mouth and neck.
- Eyes are open with eyeballs are prominent, tongue is protruded, frothy blood stained fluid from nostrils and conjunctival mucous membrane is congested. Lungs are engorged and oedematous. On section a copious, frothy, dark-coloured, blood-stained exudate is seen. Marginal portion shows emphysematous changes (Tardieu's spots).
- Trachea contains slightly frothy mucus and the bright red mucous membrane, marked venous congestion of the abdominal viscera.
- Heart with petechial haemmorhages on pericardium, myocardium, endocardium, right side of the heart is engorged with dark-coloured, imperfectly clotted blood while left side of heart is empty.
- Brain and abdominal organs are congested.

LIGHTNING STROKE & ELECTROCUTION

Current of low tension and intensity will lead to ventricular fibrillation and of high tension and intensity leads to bulbar respiratory centre paralysis.

- Lightning- DC 10,000- 2,00,0000 Ampere 2,00,00,000 Volts
- Lightning Time- 1/1000th of a sec.
- Destruction zone- 30 meters
- Current of 110- 220 V is sufficient to kill adult cattle.

Cause of Death

- Severe nervous shock
- Paralysis of respiratory and other vital centers
- Ventricular fibrillation

Symptoms

- Varying degree of shock
- Animal falls dead without struggling
- In less severe cases there is unconsciousness in few minutes and leads to recovery.

- Residual nervous symptoms of depression, paraplegia, cutaneous hyperaesthesia which will persist or disappear gradually
- Singeing and burning marks in 90% cases
- Half chewed food in mouth of the animal.

Post-mortem changes

- Rigor mortis develops and passes quickly in such cases
- Early putrefaction of the carcass
- Blood discharge from all natural orifices
- Blood is dark and clots slowly
- Distended rumen and swollen carcass
- Generalized petechial haemorrhages
- Congested upper respiratory tract mucosae
- Extravasations of blood in muscles and superficial lymph nodes
- Longitudinal fracture of long bones
- Singeing or burning marks on body

Soil factors associated with disease staus and crop production

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Soil is a complex mix of organic and inorganic matter that includes thousands of different species, the vast majority of which are still un described. Some of the organisms are pests which cause significant crop losses while others perform 'environmental services' such as biological control of pests, aeration, drainage, and nutrient and water cycling. As a dynamic living resource, soil is the basis of sustainable agriculture, as well as the physical support for most other human activities. In many areas of the world, soil fertility is declining and erosion is getting worse.

Soil microorganisms (Flora & Fauna), just like higher plants depends entirely on soil for their nutrition, growth and activity. The major soil factors which influence the microbial population, distribution and their activity in the soil are:

1. Soil temperature, 2. Soil moisture, 3. Soil Organic Matter, 4. Soil pH (H-ion Concentration), 5. Soil type / Nature of soil, 6. Soil fertility Status : Mineral nutrients and 7. Soil Biota / Microbial associations.

All these factors play a great role in determining not only the number and type of organism but also their activities. Variations in any one or more of these factors may lead to the changes in the activity of the organisms which ultimately affect the soil fertility level. Brief account of all these factors influencing soil micro flora / organisms.

IMPACT OF SOIL FACTORS ON DISEASE DEVELOPMENT AND CROP PRODUCTION

Soil Temperature

Temperature is the most important environmental factor influencing the biological physical & chemical processes and of microbes, microbial activity and population in soil. Though microorganisms can tolerate extreme temperature (such as -60° or + 60 u) conditions, but the optimum temperature range at which soil microorganisms can grow and function actively is rather narrow. Depending upon the temperature range at which microorganisms can grow and function, are divided into three groups i.e. psychrophiles (growing at low temperature below 10°C) Mesophiles (growing well in the temp range of 20°C to 45°C) and thermopiles (can tolerate temperature above 45°C and optimum 45-60°C). Most of the soil microorganisms are mesophilic (25 to 40°C) and optimum temperature for most mesophiles is 37° C. True psychrophiles are almost absent in soil, and thermopiles though present in soil behaves

like mesophiles. True thermopiles are more abundant in decaying manure and compost heaps where high temperature prevails. Seasonal changes in soil temperature affect microbial population and their activity especially in temperate regions. In winter, when temperature is low (below 50° C), the number and activity of microorganisms falls down, and as the soils warms up in spring, they increases in number as well as activity. In general, population and activities of soil microorganisms are the highest in spring and lowest in winter season. The effect of temperature on the occurrence of charcoal rot disease on many crops such as sorghum, cotton, soya bean etc. (Dhingra and Sinclair, 1974 & 1975) have been investigated and have been found to be the quite important for the disease incidence and crop productivity.

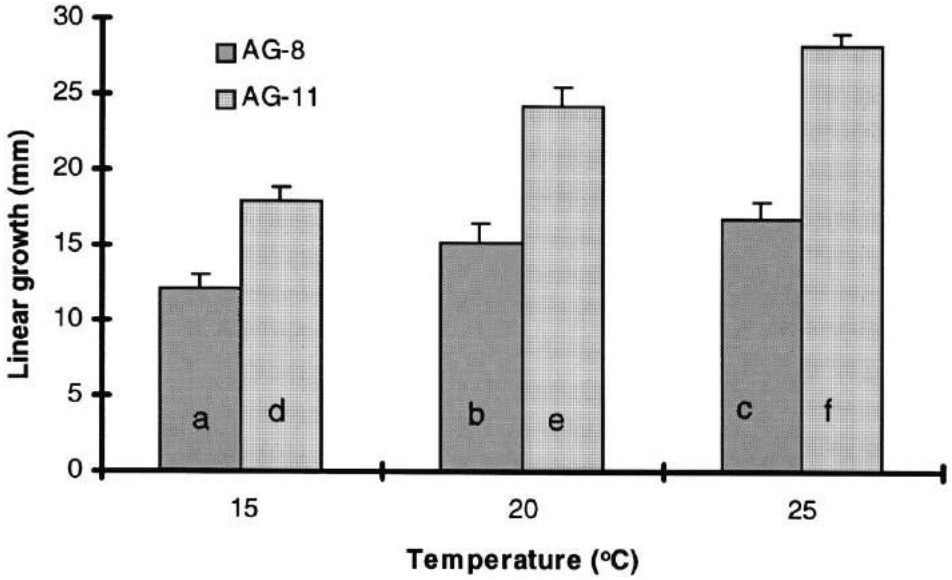

Fig. 1. Effect of soil temperature on linear growth (mm) of *Rhizoctonia solani* AG-8 and 11

Rhizoctonia solani anastomosis group (AG) 11 causes serious damping-off and hypocotyl rot of lupins (*Lupinus angustifolius* L.) and is wide-spread in the northern grain-belt of Western Australia. Kumar *et al.* (1999) found that AG-11 grew significantly faster than AG-8 on potato dextrose agar (PDA) at several temperatures (10, 15, 20, 25, or 30°C). There was no difference in the linear growth in soil of both AGs at 10°C, but AG-11 grew at a significantly faster rate at 20°C. Reduction in growth of AG-11 on osmotically adjusted PDA at temperatures between 10 and 30°C was more pronounced than that of AG-8. AG-11 caused very little lupin pre-emergence damping-off and hypocotyl rot at 10°C, and most severe hypocotyl rot was recorded at 20 and 25°C. The 3-way interaction of pH × temperature × AG was not significant. Both the AGs responded positively to increasing temperatures.

Soil Moisture

RH, Dew, rainwater, and irrigation water are some form of moisture that affects initiation spread and development of plant diseases *viz*. late blight of potato, apple scab, downey mildews and bacterial blights are more serious in areas having high rainfall/

high humidity. However diseases caused by *Fusarium, Streptomyces* etc. are more serious under low moisture condition. It is one of the important factors influencing the microbial population & their activity in soil. Water (soil moisture) is useful to the microorganisms in two ways i.e. it serve as source of nutrients and supplies hydrogen / oxygen to the organisms and it serve as solvent and carrier of other food nutrients to the microorganisms. Microbial activity & population proliferate best in the moisture range of 20% to 60%. Under excess moisture conditions / water logged conditions due to lack of soil aeration (Oxygen) anaerobic microflora become active and the aerobes get suppressed. While in the absence of adequate moisture in soil, some of microbes die out due to tissue dehydration and some of them change their forms into resting stages spores or cysts and tide over adverse conditions. Therefore optimum soil moisture (range 20 to 60 %) must be there for better population and activity of microbes in soil.

Table 1. The effect of soil moisture on the average disease rating of plant height (Arora and Pareek, 2013)

Sl. No	Moisture (%)	Age of plant after inoculation 60 days onward	Average Disease rating of Plant height
1.	40	1-30	3.46
2.	60	1-30	2.96
3.	100	1-30	1.72
4.	80 (Check)	1-30	2.82

Average disease rating of 4 replication
Total Number of plants / replication - 5
Total Number of plants / treatment – 20

At different moisture levels height of the plants was affected. As soon as the moisture level increased from 40 to 100%, average disease rating decreased. So at 40% moisture level plant height was very much affected with a disease rating 3.46 and ant 100% average diseased rating was reduced to 1.72. Thus it concluded that soil moisture level was inversely proportionate to average disease rating. A study on the effect of soil moisture of all the parameters showed that maximum disease occurred at low soil moisture level (40%) and disease incidence decreased as the moisture level increased (100%). In other words dry soils are more favourable for the disease.

Soil Organic Matter

The organic matter content of soil has an important influence on some soilborne pathogens. Bare patch disease of cereals caused by *Rhizoctonta solani* is more common in poorer, sandy soils than in more fertile soils. OM influences soil productivity, by serving as a storehouse for plant nutrients that are released slowly, in supporting a diverse soil organism population, thereby helping suppress plant diseases and pests. The organic matter in soil being the chief source of energy and food for most of the soil organisms, it has great influence on the microbial population. Organic matter influence directly or indirectly on the population and activity of soil microorganisms. It influences

the structure and texture of soil and thereby activity of the microorganisms. Application of organic amendments has been proposed as a strategy for the management of diseases caused by soilborne pathogens. However, inconsistent results seriously hinder their practical use. In this work Bonanomi *et al.* (2009) use an extensive data set of 2423 studies derived from 252 papers to explore this strategy. First, we assess the capability of a specific organic amendment to control different diseases; second, they investigate the influence of organic matter (OM) decomposition on disease suppressiveness; and third, they search for physical, chemical and biological parameters able to identify suppressive OM. OM was found to be consistently suppressive to different pathogens in only a few studies where a limited number of pathogens were tested. In the majority of studies a material suppressive to a pathogen was ineffective or even conducive to other pathogens, suggesting that OM suppressiveness is often pathogen-specific. OM decomposition in many studies (73%, n ¼ 426) emerged as a crucial process affecting suppressiveness. During decomposition, disease suppression either increased/ decreased, was unchanged or showed more complex responses, such as 'hump-shaped' dynamics. Peat suppressiveness generally decreased during decomposition, while responses of composts and crop residues were more complex. However, due to the many interactions of contributing factors (OM quality, microbial community composition, pathosystem tested and decomposition time), it was difficult to identify specific predictors of disease suppression. Among the 81 parameters analysed, only some of the 643 correlations showed a consistent relationship with disease suppression. The response of pathogen populations to OM amendments was a reliable feature only for some organic matter types (e.g. crop residues and organic wastes with C-to-N ratio lower thanw15) and for pathogens with a limited saprophytic ability (e.g., *Thielaviopsis basicola* and *Verticillium dahliae*). Instead, population responses of the pathogenic fungi *Phytophthora* spp., *Rhizoctonia solani* and *Pythium* spp. appeared unrelated to disease suppression. Overall, enzymatic and microbiological parameters, rather than chemical ones, were much more informative for predicting suppressiveness. The most useful features were FDA activity, substrate respiration, microbial biomass, total culturable bacteria, fluorescent pseudomonads and *Trichoderma* populations. Author concludes that the integration of different parameters (e.g. FDA hydrolysis and chemical composition by 13C NMR) may be a promising approach for identification of suppressive amendments.

The effects of the degree of decomposition of the OM on disease incidence and severity was classified into six categories ,and took into account the suppressiveness trends observed during decomposition: 1. increased suppression; 2. constant suppression (with no significant changes, as reported in the original articles); 3. constant conducivity or null (with no significant changes); 4. decreased suppression; 5. decreased suppression followed by an increase (hereafter indicated as U-shaped); and 6. increased suppression followed by a decrease (indicated as X-shaped). Datawere subjected to three types of analysis: i. the general behaviour of each organic matter type (compost, cropresidues, waste and peat); ii. the response of each different pathogen to all amendments pooled, and, iii. All possible combinations between OM types and

pathogen species. OM decomposition significantly affected the degree of disease suppression in 73% of studies, either at short (days or weeks; Phillips *et al.,* 1971) or long time scales (months or years; Widmer *et al.,* 1998; Stone *et al*., 2001).

Soil pH

Soil reaction has a definite influence / effect on quantitative and qualitative composite on of soil microbes. Most of the soil bacteria, blue-green algae, diatoms and protozoa prefer a neutral or slightly alkaline reaction between pH 4.5 and 8.0 and fungi grow in acidic reaction between pH 4.5 and 6.5 while actinomycetes prefer slightly alkaline soil reactions. Soil reactions also influence the type of the bacteria present in soil. For example nitrifying bacteria (*Nitrosomonas* & *Nitrobacter*) and diazotrophs like *Azotobacter* are absent totally or inactive in acid soils, while diazotrophs like *Beijerinckia, Derxia,* and sulphur oxidizing bacteria like *Thiobacillus thiooxidans* are active in acidic soils. Soil pH, a measure of acidity or alkalinity influences few diseases such as common scab of potato and club root of crucifers (*Plasmodiophora brassicae*).

Potatoes are commonly grown in soils with a pH of 5.0 to 5.2 for control of common scab caused by, *S. scabies*. Potato scab is more severe in soils with pH levels above 5.2. Below 5.2 the disease is generally suppressed. Soil pH 8–10 could inhibit the growth of *B. pseudomallei* significantly ($P < 0.05$). The numbers of bacteria gradually reduced to below the level of detection within 2 and 3 days for pH 10 and 9, respectively. However, at pH 8, the bacteria could persist until the end of experiment done by Wang-ngarm *et al.* (2014).

Soil type / Nature of Soil

The physical, chemical and physico-chemical nature of soil and its nutrient status influence the microbial population both quantitatively and qualitatively. The chemical nature of soil has considerable effect on microbial population in soil. The soils in good physical condition have better aeration and moisture content which is essential for optimum microbial activity. Similarly nutrients (macro and micro) and organic constituents of humus are responsible for absence or presence of certain type of microorganisms and their activity. For example activity and presence of nitrogen fixing bacteria is greatly influenced by the availability of molybdenum and absence of available phosphate restricts the growth of *Azotobacter.* Certain pathogens are favoured by loam soils and others by clay soils. *Phymatotrichum* fungus is serious only in black alkaline soils—pH 7.3 or above—that are low in organic matter.

Table 2. Incidence of potato tuber infection at three soil depths when sporangia of *Phytophthora infestans* were applied to the soil surface of five soil types in greenhouse pots (n = 10, experiment A)y

Soil type	Incidence of infection (%)z							
	Trial 1				Trial 2			
	Surface	2 cm	4 cm	Total (%)	Surface	2 cm	4 cm	Total (%)
Potting soil	100 a	80 a	60 a	80 A	100 a	100 a	60 a	87 A

Quincy medium sand	100 a	20 bc	20 c	47 B	60 a	20 ab	0 b	27 B
Quincy fine sand	90 a	50 a	0.0 b	47 B	50 a	30 ab	0 b	27 B
Quincy loamy fine sand	100 a	40 b	10 b	50 B	40 a	0 a	0 a	13 B
Shano silt loam	80 a	0.0 b	0.0 b	27 C	10 a	0 a	0 a	3.0 C

y Approximately 1 × 106 sporangia that had been chilled for 2 h at 4°C were applied to the soil surface in each pot in 100 ml of water. The soil in each pot received 800 ml of water, which was equivalent to 0.83 cm of rain or irrigation water. Pots were 35 cm in diameter by 25 cm deep. Potato tubers of cv.Ranger Russet were used.

z Lowercase letters within a row represent significant differences between soil depths for a given soil type. Uppercase letters within a column represent significant differences between the soil types in percent total incidence. Significant differences for both upper- and lowercase letters were determined using a series of pair wise differences by tests of two proportions with an adjusted Bonferroni procedure (P < 0.05).

Porter (2005) found that in both trials where tubers were buried to assess spore movement, the total percentage of incidence of tuber infection in the potting soil was significantly greater than in the other soil types (P < 0.05, Experiment A, Table 2). There were no significant differences in incidence of tuber infection among Quincy medium sand, Quincy loamy fine sand, and Quincy fine sand soils (P > 0.05, Table 2). Incidence of infected tubers was significantly less in the Shano silt loam compared to the other soil types. Incidence of infected tubers decreased with increasing soil depth for all soil types (Table 2).

Chickpea (*Cicer arietinum* L.) is the most important pulse crop and India accounts for approximately 75% of world's chickpea production. Despite the high total production, yields of chickpea are low due to many biotic and abiotic constraints. Among the biotic constraints more than 50 diseases have so far been reported on chickpea. Among them soil borne diseases such as fusarium wilt (*Fusarium ox ysporum* f.sp. *ciceris*), dry root rot (*Rhizocotonia bataticola*), collar rot (*Sclerotium rolfsii*) and black root rot (*Fusarium solani*) are the major limiting factor in chickpea production. Only data on few specific diseases in chickpea are available from different states in India. However no current information on occurrences and distribution of chickpea diseases in India is available. Chickpea diseases may cause yield losses of up to 100% depending on time of infection.

Soil fertility Status: Mineral nutrients

Fertility level of the soil has a great influence on the microbial population and their activity in soil. The availability of N, P and K required for plants as well as microbes in soil determines the fertility level of soil. On the other hand soil micro flora has greater influence on the soil fertility level. Mineral nutrients are essential for the growth and development of plants and microorganisms, and are important factors in plant-disease interactions. Greenhouse and field experiments have shown that raising or lowering the levels of certain nutrient elements required by plants frequently influences the development of some infectious diseases. Several factors influence the effectiveness of K fertilizer in reducing crop stress and disease incidence. These factors include K status of the soil, K rate and source, nutrient balance, variety/hybrid susceptibility, and disease organism virulence and population. The incidence of leaf spot disease caused by *Cercospora*, *Stemphylium* and *Alternaria* in cotton has been related to K fertility. This disease organism can cause significant yield reduction where premature plant defoliation is extensive. Potassium was broadcast and incorporated at the rate of 0, 30, 60, and 120 lb K2O/A.

Chloride interactions with crop diseases are well documented. However, the mechanisms involved are not well defined. Proposed mechanisms involve suppression of the pathogen or increased host tolerance. Researchers in Texas found that Cl fertilization increases heat yields in years with high leaf rust and *Septoria* pressure.

Soil biota / Microbial associations / interactions:

Microorganisms interact with each other giving rise to antagonistic or symbiotic interactions. The association existing between one organism and another whether of symbiotic or antagonistic influences the population and activity of soil microbes to a great extent. The predatory habit of protozoa and some mycobacterium which feed on bacteria may suppress or eliminate certain bacteria. On the other hand, the activities of some of the microorganisms are beneficial to each other. For instance organic acids liberated by fungi, increase in oxygen by the activity of algae, change in soil reaction etc. favors the activity or bacteria and other organisms in soil. Soil organisms are very sensitive to changes in soil conditions and management practices. They may be beneficial or harmful.

WHAT SOIL MANAGEMENT PRACTICES CAN ADOPT FOR DISEASE REDUCTION AND ENHANCEMENT OF YIELD

Management of soil borne diseases depends on a thorough knowledge of the pathogen, the host plant, and the environmental conditions that favours the infection. In order for a disease to develop, all three factors must be present. The pathogen (a virulent, infectious agent) must have viable inoculum, such as zoospores, available to infect the host. The host (a susceptible plant) must be exposed to the pathogen's inoculum, and be physiologically susceptible to infection. Finally, the environmental conditions must be favourable for the infection of the plant and growth of the pathogen. For example, the soil must be saturated with water for a certain period of time in order for water moulds to develop and infect roots. An understanding of these pathogen-host-

environment dynamics will help you devise a disease management strategy. An effective disease management option must be economical: that is, the value of the crop saved must exceed the cost of control. For this reason, assessments of disease incidence, disease severity, and potential crop loss are key factors when considering control strategies. The careful, regular monitoring of fields and the thorough examination of symptomatic plants are essential steps. The timing of control measures is also critical. Management of a destructive disease such as *Phytophthora* root rot may requires early implementation of appropriate management measures. Besides being economically sound, a management strategy should also be simple, safe, inexpensive to apply, and sufficiently effective to reduce diseases to acceptable levels. Few management options possess all of these desirable qualities, however, so it usually is best to integrate multiple management options (e.g., planting resistant varieties, following beneficial cultural practices, and applying disease-control materials. For a better disease management strategy the following measures may be adopt:

- Management practices that restrict the growth of pathogens by producing soil conditions unfavourable to their growth will reduce the likelihood of disease outbreaks.
- The susceptibility of the plant to disease is affected by factors such as its age and nutritional status.
- Monoculture can increase the probability of a disease outbreak occurring. So adopt multiple cropping, inter cropping
- Crop rotations increase crop yields by improving soil conditions and reducing weed and insect populations.
- Application of organic amendments for disease suppression and crop productivity.

CONCLUSION

Soil temperature has been found quite important for disease incidence and crop productivity. For different crop disease infection can occur at different temperature levels. Soil moisture affects initiation, spread and development of plant diseases. Some diseases occur at low moisture condition whereas some others at high moisture condition. Soil type also influence on pathogen build up. Size of the pore in silt loam found to be favorable for zoospores to remain as cyst and become active at proper time. As disease incidence depends on soil condition, so it gives us opportunity to modify soil conditions for suppression of soil borne pathogens. Till date focus of most plant disease control programs in agriculture is on controlling the pathogen with pesticides. Yet, the ultimate impact that these pathogens have on plants will depend on a favourable soil environment for the pathogens. This dependency could provide an opportunity to modify soil conditions with different management practices for long-term control through suppression of soil borne pathogens. For sustainable crop production, soil management practices that help maintain soil carbon should be adopted, and practices that result in its decline should be discouraged. Such practices include green manure

cropping, addition of composted organic waste, application of organic fertilizers, and reduced tillage.

FUTURE PROSPECTS

- The future challenge is the identification of specific soil parameters for predicting the suppressiveness of each OM type in combination with each different pathogen species.
- Identification of soil factors that influence biological control will provide a basis for improved integration of bio control with cultural practices that manipulate soil properties, with an aim toward improved disease control.

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Coccidiosis in Rabbits

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Domestic rabbit belongs to genus *Oryctolagus cuniculus* (Chromosome No. 44) which has 38 important breeds and 77 varieties of European rabbits. The domestic rabbit is known to produce quality meat, fur and very fine quality animal fibre. Rabbit rearing has gained momentum in the recent past years among the developing countries including India, owing to their small body size, rapid growth rate, high prolificacy, early maturity, shorter generation interval and ability to utilize forage and fibrous agricultural by-products.

In India, there has been a rising awareness in recent years on the virtues of broiler rabbit production as an alternative means of alleviating food shortages. India is also one of the developing countries which is also facing meat shortage of 4.66 g/day against the recommended requirement of 87g/ day. In India, the total rabbit population has increased from 424 thousand in 2007 to 591.6 thousand in 2012 which is around 39.55% increase in last 5 years.

Rabbit, a new farm animal which is gaining popularity for meat, fur skin and wool production is due to the following reasons.

- It can be raised on roughage diet solely without affecting productive and reproductive performance.
- Rabbit has a very high reproduction capacity (one female doe give birth of 24 to 32 kits in a year). They have the potential of being in a constant state of reproduction they can be bred within 24 hours of kindling, utilizing post-partum heat (Lebas, 2009).
- Rabbit meat is very nutritious and tasty and higher in protein. All aged and all types of people can easily consume and digest rabbit meat.
- It requires less amount of capital investment to start rabbit farming so resource poor (or) landless farmers can easily start rearing rabbit to improve their livelihood.
- Women can also easily raise some rabbits along with other household animals or birds to earn some extra income or to fulfill their family nutritional demand.
- Rabbit farming in India can also be a great source of income and employment. Unemployed educated young people can create an income and employment opportunities by raising rabbits commercially.

Rabbits are most vulnerable to protozoan infestations during cold stress, more stocking density and improper management mostly during post weaning stage. Among the protozoan diseases, coccidiosis is a common and worldwide sporozoan disease of rabbits caused by the protozoan parasite *Eimeria sp*.

CAUSES OF COCCIDIOSIS IN RABBITS

There have been twelve species of coccidia described in rabbits affecting the intestinal tract. Usually to appear clinically ailing, the rabbit will have more than one species infecting it at the time. There is only one species of Eimeria which affects the liver of rabbits and this is *Eimeria steidae.*

Although many rabbits can carry the protozoa without symptoms, in some cases, the parasite may cause trauma and illness. The spore enters the intestinal wall of the rabbit following ingestion; this is often through food or water sources infected with faecal matter containing oocysts.

TYPES OF COCCIDIOSIS

1. **Intestinal Coccidiosis**

This condition can occur even in rabbits with excellent care and good sanitation. This affects younger rabbits from a few weeks old to 5 months, particularly newly weaned bunnies. Risk factors include stress and immunosuppression.

2. Hepatic Coccidiosis

This condition is known to have poor sanitation as a risk factor for transmission. This liver form of the disease is known to affect rabbits of all ages. It can lead to distension of the liver, gall bladder, and bile ducts. In some cases, secondary bacterial infections may occur.

Susceptibility

Severity of the intestinal form of the disease will depend on the species of coccidia present in the animal and the age of the rabbit - young rabbits are more susceptible to disease than older rabbits, but if a concurrent illness is present, if antibiotics have been given for a long period of time, or when exposed to a large coccidia burden then disease may also occur in adults. Hepatic disease can affect rabbits of any age.

Coccidiosis is primarily a disease of husbandry, with damp, crowded and unhygienic conditions predisposing to it. Coccidiosis is caused by the transmission of the sporulated oocysts; this is usually due to ingestion of contaminated feed or water. Although many rabbits may be carriers of this parasite, in severe cases symptoms such as weight loss and depression may be seen leading to the deterioration of the animal.

Clinical Signs

Intestinal Coccidiosis

As with most coccidial disease, watery or mucoid diarrhoea is usually present and this is sometimes blood-tinged. Depression and weight loss as well as general signs of malaise are also observed. Some cases are sub clinical and no clinical signs are observed.

Hepatic Coccidiosis

May occur only as sudden death in acute cases, but more likely appears as stunted growth, anorexia and weight loss, diarrhoea and abdominal pain. Depression and general malaise is also seen.

Diagnosis of Coccidiosis in Rabbits

Faecal sample examination under light microscopy may reveal the Eimeria oocysts (Fig. A). Both types of rabbit coccidiosis have oocytes present in the faeces during an acute infection. In hepatic disease a blood sample can be taken for biochemistry. Increased liver enzymes or bilirubin may indicate hepatic coccidiosis.

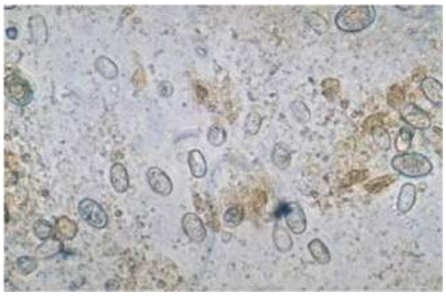

Figure A

Although this disease often causes changes in the liver and gastrointestinal system seen on gross examination, diagnosis is often difficult.

Lesions present on postmortem examination would include caecal core lesion, mucoid secretion, haemorrhage and oedema of the ileum and jejunum (Fig. B) particularly. In the hepatic form, a grossly enlarged liver containing abscesses (Fig. C) would be seen on post mortem examination.

Figure B

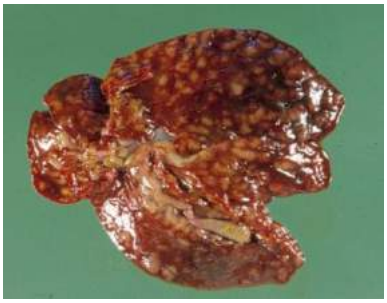

Figure C

Treatment of Coccidiosis in Rabbits

- If rabbit is suffering from severe dehydration intravenous fluid therapy may be considered.
- For hepatic coccidiosis, oral doses of antiprotozoal agents such as sulfaquinoxaline administered into either the drinking water for 30 days or in the feed for 20 days, may reduce clinical signs. This may decrease symptoms but may not prevent the lesions from forming.

- For intestinal coccidiosis, treatment is similar to that for hepatic coccidiosis. Sulfaquinoxaline is given in the drinking water for 7 days and then repeated after a 7-day interval.
- Anti-coccidial drugs such as amprolium can be given in the drinking water, or alternatively coccidiostats, which do not kill but slow the growth of coccidia, can be used. Other medications that may be considered salinomycin, diclazuril and toltrazuril.
- Antibiotic therapy may also be offered which allows the rabbit to develop immunity while the protozoon is controlled. Rabbits may require repeated treatments with regular intervals.

Recovery of Coccidiosis in Rabbits

1. The prognosis for rabbits with coccidiosis is good when diagnosed earlier. For rabbits with severe infections, the prognosis may be guarded. Depending on severity of infection and immune status and age of rabbit.
2. In order to give rabbit the best chance of a successful recovery, excellent sanitation and husbandry is essential.
3. Regularly clean the rabbit's environment
4. The hutch/cage should be kept dry, with the floor, feed hoppers and water crocks kept clear of feces; the wire bottoms should be regularly brushed
5. The cage should be routinely disinfected with a solution that is lethal to oocysts such as ammonia (10%)
6. Provide the rabbit with a nutritionally complete diet that supports its digestive system
7. Reduce stressors for the rabbit by ensuring overcrowding does not occur and by ensuring it is not exposed to predators or environmental changes

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An Overview on Tent Pegging of Horses

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Abstract

Tent pegging is a cavalry sport of ancient origin that has a mounted horseman riding at a gallop and using a lance or sword to pick up, pierce, slice or stab a small ground target or series of small ground targets. The International Tent Pegging Federation recognised it as an official equestrian discipline. Tent pegging competitions either individual or team competitions vary based on a few factors like, the size, shape and number of targets, dimensions and weight of weapons, the manner in which target has to be attacked, the minimum time in which a course must be covered and the extent to which a target must be struck, cut or carried. The riders are awarded points for each target based on the execution, with penalties enforced for violations. The rider with the most points at the end of the competition is declared as the winner. The game is played under strict rules and regulations enforced by the International Tent Pegging Federation.

Keywords: Tent pegging, lance, sword, gallop, International Tent Pegging Federation

INTRODUCTION

Tent Pegging is a popular equestrian sport of ancient origin in India, Pakistan, Iran, Iraq, Afghanistan and Australia, in which riders carrying a lance or sword must spear and pick up a peg from the ground while the horse is at full gallop. The sport developed as a cavalry training exercise designed to develop a soldier's prowess with sword and lance from the back of his horse. This discipline is truly said to belong to Asia and is officially recognised by the International Equestrian Federation. It demonstrates the energy, skill and obedience of the horse and the physical power and aiming skill of the rider (Panwar and Yadav, 2010). Tent pegging is a game for the youth as it helps the youth to stay away from societal evils like drug abuse and other anti-social activities. This is a game where staying healthy of both the rider and horse is paramount. It is valued as cultural tradition. Moreover, it is a dangerous game where riders often break their legs and arms (AJplus, 2015). Used narrowly, the term refers to a specific mounted game with ground targets. More broadly, it refers to the entire class of mounted cavalry games involving edged weapons on horseback, for which the term "equestrian skill-at-arms" is also used (Anonymous, 2019b). This article throws light on the history, exercising authority, competitions and rules and regulations of tent pegging.

History of tent pegging:

Cavalrymen have practised the game since the 4th century BC which later spread to Europe. The sport evolved from a battlefield ploy used in the middle ages by horsed cavalry against troops mounted on elephants. The soldiers attacked the elephants with sharp spears aiming behind the toenails of the forelegs. This part of the elephant was thought to be the weakest and most sensitive spot on the body. If the charge was successful, the pain caused the elephant to remain still, unseat his mahout and perhaps run amok, charge back into the ranks and trampling infantry. Another theory suggested the practice in North India of conducting dawn raids on sleeping enemy encampments by galloping through the tented lines and lancing and removing the pegs which held the tents in place, thus collapsing the tents on their occupants and causing havoc and terror in the camp.

In India, the sport was taken up with enthusiasm by the British army during the colonial period, and during the first half of the 20th century it was one of the most popular sporting activities of cavalrymen in India. The sport includes ring jousting (galloping rider attempts to pass the point of his weapon through a suspended ring), lemon sticking (galloping rider attempts to slice a lemon suspended from a rope), and quintain tilting (galloping rider attempts to spear a dummy through the heart). The sport was included in the Asian Games in Delhi in 1982. Later, General O.P. Malhotra, President of the EFI convinced the International Equestrian Federation (FEI) that India should host a tent pegging competition at Games (Anonymous, 2019a).

Exercising authority of tent pegging

The recognised international exercising body of tent pegging is International Tent Pegging Federation. The ITPF headquarter is located in Muscat, Oman. It was founded as World Tent Pegging Federation on 21st March, 2013 at the World Tent Pegging Championship held in Gurgaon, Haryana, India. ITPF is the largest equestrian body in the world that recognizes and governs tent pegging competitions (Mohandoss, 2014). The ITPF has 28 members' countries in the beginning: Afghanistan, Australia, Bahrain, Canada, Denmark, Egypt, Germany, India, Iran, Iraq, Jordan, Kazakhstan, Lebanon, Namibia, Netherlands, Norway, Oman, Pakistan, Qatar, Russia, South Africa, Sri Lanka, Sudan, Sweden, United Arab Emirates, UK, USA, and Yemen. The first and the inaugural Tent Pegging World Cup was organised by the Oman Equestrian Federation (OEF) at Al Rahba Farm, Barka, Oman from March 31st to April 4th, 2014. The participant countries were Pakistan, Oman, Qatar, Yemen, Iraq, Egypt, South Africa, Sudan, Britain and Australia. South Africa won the event by a total of 758.5 points and Oman secured second position with 693.5 points. Sudan finished in third place with 654 points (Anonymous, 2019b).

Tent pegging competition

Tent pegging involves horse and rider racing along a 120-200 meter course and collecting, cutting, or accurately stabbing a series of pegs, rings, lemons, or mannequins along the way. Tent pegging competitions vary based on a few factors like, the size and

shape of targets, number of consecutive targets, types of weapons allowed, the duration in which the course has to be completed, and the manner in which the target has to be attacked. Presently, we have two variations of this competition, i.e. individual tent pegging and the team tent pegging. In earlier, the competition is based on the individual skills of the horse and its rider. While later, deals with 4 riders that compete as a team with other teams (Maharaj, 2006). It is therefore, both the rider and his mount together, which contributes towards the successful results.

The pegs employed in the competition are 30 cm long, 2.5 cm thick, but the width will vary from 6 cm/ 4 cm/ 2.5 cm. These are driven into a specially prepared furrow, at an angle of 60° from the horizontal. The sloping side facing the start line with exactly 17 cm of peg showing above the surface. The face of peg is painted white or sprinkled with pure white chalk/lime. The first peg is 70 m from the start line. The pegs are made of wood of date palm or any other fibrous material of similar weight that will not break up when pierced by the lance. The pegs are bound with wire, 2 cm. from the top end and again at 13 cm from the bottom point. Later, the pegs are soaked in water before the competition, to prevent them from splitting. Cardboard pegs of 2.5 cm thickness can also be used. It should be made of 2 layers and transparent taping should be applied to prevent splitting (ITPF, 2014).

Each competitor in individual and team competition is allowed 3 runs in round 'A' i.e. first two runs on 6 cm wide pegs and third run on 4 cm wide pegs, and 3 runs in round 'B' i.e. first run will be on 6 cm wide pegs and second and third run will be on 4 cm wide pegs. The gallop should not be at a speed less than 800 m/min. and 750 m/min for individual and team competition, respectively. The overall time conceded by the rider and the horse in the competition can be recorded by use of automatic timing devices, which automatically starts and stops the clock when the beams are cut. If not, then manual time keeping can be used. The chest of the horse will activate the timing device which will be placed 70 meters before the peg and the chest of the horse will stop the clock as it breaks the beam 10 meters beyond the peg. It is advisable to keep two time keepers at the finish line in all major competitions. In case of using manual time keeping, the average of the time recorded by the two time keepers will be the official time for that run (ITPF, 2014).

Once a rider commences an event, the emphasis is on the object and not on his horse. Tent pegging requires well-schooled horses that will respond to the commands instantaneously and have no fear of noise or sudden movements. If a competitor makes certain faults, such as losing his lance, sword or exceeding the time allowed etc., he incurs penalties. On exceeding the time limit, the rider will be penalized by ½ point per every commenced second over the prescribed time. These penalty points will be deducted from the points he gains. The winner of the competition is the competitor who gains the highest number of points. A high standard of riding skill is required to gallop a horse at full speed and maintain posture as judges award points for the style and accuracy with which objects are struck or retrieved. The points awarded in the tent pegging competition are discussed in Table 1 (Anonymous, 2019a).

Table 1: Award of points in tent pegging competition	
Particulars	**Points**
For wooden pegs carried all the way or falls forward/ sideways beyond 15 meters, For cardboard pegs carried all the way or falls forward/ sideways beyond 10 meters, measured from the point at which the peg was placed, Peg struck with point of lance or sword but breaks and part of it still in the ground, even if no part of it still attached to the weapon, Rings carried on lance and lemon cut/sliced by sword, Heart is pierced by lance	06
Peg removed from the ground, but not carried full distance as stipulated above	04
If dummy is pierced but missing the heart	03
Peg struck on face, but not removed from its position in the ground	02

Rules and regulations

Strict rules and regulations have been enforced by the International Tent Pegging Federation, some of which are discussed below (Maharaj, 2006; ITPF, 2014):

1. The country or federation hosting the competition will not be held responsible for accidents, injuries or loss of any property.
2. Each member country will appoint 2 senior Judges from their country to serve on a panel of IETA Judges. The names of these Judges must be forwarded to the Secretary-General. Only Judges appointed to this panel may be used to judge an IETA competition. The Judge's decision will be final unless overruled by appeal to the Jury.
3. The Jury will consist of the officiating Judge and one member from each competing country and will resolve all objections. This body will be the highest level of appeal at an IETA competition, and its decision will be final. A simple majority of votes will rule.
4. The minimum and maximum length of the course is 120 and 200 meters, respectively. The width of the course must be between 20 to 25 meters. The barrier must be a minimum of 1.5 meters high and maximum of 20 meters wide.
5. Only riders using the right hand for carrying the lance are permitted.
6. The minimum and maximum length of lance is 2.2 m and 2.75 m, respectively. It must be free from serrated edges and should have clear point.
7. The minimum and maximum length of the sword/blade is 81 cm and 90 cm, respectively. The total length of the sword must not exceed 110 cm.
8. The ring must be made of a light metal and be white. The inside diameter of the ring must be 6 cm.
9. The lemons or oranges must be of a uniform size and not smaller than the rings.
10. The pooled horses must be suitable for tent pegging and be sufficiently big and strong to carry the rider. All pooled horses must have a number printed on their bodies. Five horses must be available per team. The Jury will be in charge of the

drawing. The host country will draw first. A veterinary surgeon must inspect all pooled horses before the draw, to determine their fitness.

11. A maximum of two sessions of one and a half-hours each will be allowed. This excludes saddling of the horses, but includes the warming up of the horses.
12. The horses used in the competition should not be less than 6 years of age.
13. A competitor who either falls or his horse falls during a run will be eliminated for that run. In team competition the points scored by the other 3 competitors will stand.
14. If a competitor drops his lance or sword between the start & finish, there will be no points awarded for that run. In a team competition, the scores scored by other competitors will hold good.
15. If the lance or sword is broken in the process of striking the target, then the points of this run will be considered.
16. If any object falls off or moves out of line and disadvantages the rider after he has gone through the start, he will receive full points for that object.
17. The speed of the horses will be timed over a distance of 50 meters, starting 40 meters before the peg and ending 10 meters beyond the peg.
18. A competitor may be disqualified and replaced by the reserve for the remainder of the competition if mistreats his horse, or he or his horse is considered dangerous.
19. A competitor may be disqualified if found using a weapon to encourage or strike a horse when approaching the start or during a run.
20. A competitor starting a run without the Judge's signal, or failing to start within 2 minutes of being called will be disqualified.
21. A rider must ride in his own lane and score on his own peg or object. A rider taking the wrong peg will be disqualified for that run.
22. A rider may not change his position in the team during the competition without the Judge's permission.
23. One false start is allowed per run.
24. During any event only the Judge and scorer may be on the demarcated track while a run is in progress. They must be at least 5m away from any object.
25. Only one entry per competitor will be accepted in teams and individual events.

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Indigenous Flowers for Livelihood Security of Farmers

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History of flower cultivation and gardening in India

Use of flowers in the social life of India has a long tradition. The origin of flower and ornamental plant growing is contemporary with agricultural crops. In the beginning their use was exclusively for esthetic and religious purposes. References regarding the use of flowers during ancient time exist in the old Hindu classics such as *Veda, Puran* and *Ramayana*. Mention of the lotus was made by Kalidasa in his play Shakuntala. The poet Asvaghosa (A.D.100) also mentions the lotus in his Buddha Charita. Many paintings and carvings on the walls of old structures provide strong evidences that flowers were an integral part of daily life and adornment. Motivation for cultivating flowers arose due to their extensive use for religious purposes, particularly for worship. A large number of festivals and rituals are celebrated, using flowers in various ways. Such usages along with the steady increase of population virtually have created huge domestic demand for these so that floriculture has become an increasingly important industry in India.

India's diversity of native flowers and ornamental crops

India is bestowed with a wide variety of agroclimatic conditions suitable for growing all kinds of flowers and ornamental plants. High rise hills to vast coastal areas together with the fertile Indo-Gangetic plains provide a unique combination of climate and soil, the envy of many countries. India has been designated as one of the twelve mega-diversity states of the world. The flora of the Indian sub-continent is very rich in diversity with many endemic species, largely due to its varied agro-climatic conditions. Ten bio-geographic zones, namely Trans-Himalayan, Himalayan, North-east India, Indian Desert, Semiarid Zone, Indo-Gangetic Plain, Western Ghats, Deccan Peninsula, Coastal Zone and Islands, depict diversity of climate and flora. Each zone has its own unique and characteristic natural vegetation. Some of the zones like the North East (Assam, Arunachal Pradesh, Meghalaya, Sikkim) harbour indigenous economically important ornamentals such as orchids, zingibers, and *Nepenthes*. Due to congenial agro-climatic conditions, an enormous opportunity exists throughout India for cultivation of various flowers and ornamental plants on a commercial scale.

Among the flower crops which are under cultivation in different parts of the world, those that are native of India include orchids, rhododendrons, musk rose (*Rosa mosch*ata), begonia (*Begonia* spp.), balsam (*Impatiens balsamina*), globe amaranth (*Gomphrena globosa*), gloriosa lily (*Gloriosa superba*), foxtail lily (*Eremerus himalicus*), primula (*Primuladenticulata rosea*), blue poppy (*Meconopsis*), lotus (*Nelumbo nucifera*), water lily (*Nymph*ae spp.), clematis (*Clematis montana*) and the wild tulip of the Himalayas (*Tulipa stellata* and *T. aitchisonii*).

Among the native shrubs and climbers, the most important ones are the jasmines (*Jasminum* spp.). Jasmines are native to tropical and warm temperate regions of Europe, Asia and Africa. The centres of diversity of jasmine are South Asia and Southeast Asia. India is one of the centers of origin of jasmine. Of the 200 species of jasmine reported, 40 inhabit the Indian sub-continent (Veluswamy *et al.,* 1975). The other indigenous species which are under commercial cultivation are *Ixora spp. (I. coccinea, I. parviflora, I. barbata, I. undulata), Crossandra infundibuliformis, Glorosia superba* and *Tabernaemontana coronaria.* The other native shrubs popularly used in gardening are *Bauhinia acuminata, Mussaenda frondosa, Hamiltonia sauveolens, Holmskioldia sanguinea, Clerodendron inerme, Plumbago rosea, Plumbago zeylancia, Trachelospermum fragrans, Osmanthus fragrans, Passiflora leschenaulti, Clitoria ternatea, Porana paniculata,* and *Clematis montana.*

Among the ornamental trees which are native to India, the important ones include *Saraca indica, Terminalia arjuna, Mesua ferrea, Ficus benghalensis, F.religiosa, F. infectora, Michelia champaka, Butea monosperma, Butea frondosa, Anthocephalus indicus, Bauh*inia *variegata, Cassia fistula, Cassia nodosa, Erythrina blakei, Lagerstroemia flos-reginae, L. thorelli, Cordia sebestena, Cochlospermum gossypium, Pongamia glabra, Thespesia populnea, Crataeva roxburghii, Sterculia colorata* and *Rhododendron* spp.

Many flowers including Primula, Orchids, Aconitum, Delphinium, Erigeron, Anemone, Aquilegia, Aster, Bergenia, Campanula, Corydalis, Gentiana, Geum, Saxifraga, Allium, Fritillaria, Lilium, Iris, Paeonia, Clematis, Prunus, Rhododendrons, Sorbus, Viburnum and several others were introduced from their wild habitats in India into England and other European countries. Some of these, like the Blue poppy (*Meconopsis*), *Clematis montana*, many species of orchids, rhododendrons, primula, balsam, begonia, foxtail lily (*Eremurus himalaicus*), gloriosa lily (*Gloriosa superba*, musk rose (*Rosa moschata*) etc, are now widely grown in gardens in several parts of the world. Several species of orchids and rhododendrons, which are native of India, have been extensively used in breeding new varieties and hybrids. Most of the plants species introduced from India into Great Britain are being maintained in the Kew and Edinburgh Botanic Gardens.

Avenues in utilizing indigenous flowers

The various avenues existing in the floriculture based on India's indigenous flower and ornamental crops for securing farmers' livelihood include cultivation of loose flowers and cut flowers, ornamental pot plant culture, value addition with fresh

and dry flowers, establishment of ornamental plant nurseries for landscaping and the rapidly expanding export potentials.

Cultivation of loose flowers

The most popular native flower crops cultivated commercially in different parts of the country as loose flowers are jasmine (*J. sambac, J. grandiflorum, J. auriculatum, J. pubescens*), crossandra (*Crossandra infundibuliformis),* star flower *(Tabernaemontana coronaria),* Ixora *(Ixora coccinea, I. parviflora, I. barbata, I. undulata)* and globe amaranth (*Gomphrena globosa).* Among the native aquatic ornamental plants, lotus (*Nelumbo nucifera*) and water lily (*Nymph*ae spp.) are the most popular both as garden plants as well as loose flowers. The lotus has the added merit of being the National Flower of India and it symbolizes divinity, fertility, wealth, knowledge and enlightenment.

In India, Tamil Nadu is the leading producer of jasmine in the country and the flowers produced in the state are being exported to the neighbouring countries *viz.,* Singapore, Malaysia, Sri Lanka, Dubai, Bahrain and Muscat and also to the United States. Musk rose (*Rosa mosch*ata) is cultivated for its loose flower and for value added products such as essential oil, attar, etc. C*rossandra infundibuliformis* is a popular plant grown for its loose flowers which have no perfume but stay fresh for several days on the bush. It is also grown as a houseplant in containers and also in beds

Cultivation of cut flowers

The northeastern states (Assam, Arunachal Pradesh, Meghalaya and Sikkim) are the natural habitat of hundreds of orchid types. Many of them are cultivated for cut flowers and potted plants. Private entrepreneurs have started large scale micropropagation mainly for export
of plantlets. *Cattleya, Cymbidium, Dendrobium, Phalaenopsis* and *Vanda* are the commercially important genera marketed in India.

Plants for gardening

Clematis, begonia (*Begonia* spp.), balsam (*Impatiens balsamina*), foxtail lily (*Eremerus himalicus*), primula (*Primula denticulata rosea*), blue poppy (*Meconopsis*), etc. are some of the native ornamentals used in gardening and for pot plants. *Tabernaemontana coronaria* is a popular evergreen ornamental plant and also has importance in temple garden. It flowers throughout the year. *Clerodendron inerme is c*ommonly planted in the gardens for making hedges. It is also well adapted to the topiary art for cutting and making various designs. The juice of the leaves has much reputation to bring down fever.

*Saraca indica*t is considered as a historically important tree since it is associated with ancient literature. It produces attractive flowers. Many of the ornamental trees possess medicinal value apart from their aesthetic values. *Terminalia arjuna* is an excellent medicine for heart disease. *Ficus benghalensis* is used in indigenous system of medicines namely Ayurveda, Siddha, Unani and Homeopathy. *Cassia fistula* which

produces attractive yellow flowers *is a popular tree for gardening.* The flowers are of ritual importance in the *Vishu* festival of Kerala.

Value addition with fresh and dry flowers

Value added products from flowers including floral ornaments, garlands, essential oils, dry flowers and export packaging of loose flowers such as jasmine, crosandra, gomphrena have proved to be potential activities for women employment. Many of India's native ornamental species have valuable medicinal importance. *Gloriosa superba* is a herbaceous ornamental climbing perennial plant. Its rhizomes, seeds and leaves possess several medicinal values. India's wide diversity of indigenous ornamental plant species are a rich source of raw materials for the dry flower industry.

Potential unutilized flowers

India is also native to a wide array of ornamental plant species which are considered 'wild' since they remain unutilized. Many of these have potential as ornamentals for use as loose flower, cut flower, pot plant as well as medicinal uses. If strategies are formulated to utilize them optimally, keeping in view the essential norms of biodiversity conservation, these potential unutilized species can yield great economic benefits to the farming community. Some of the potential unutilized ornamental plant species are listed out below with brief details.

Unutilized *Jasminum* spp.	:	*Jasminum nitidum* - It is a species with year-round flowering potential. The flowers buds resemble those of *J. grandiflorum* and are attractive and mildly fragrant. This species can yield flowers during off-season (Sep to Feb) when the commercial jasmine species don not produce flowers. The plant architecture is attractive making it an ideal ornamental plant for gardening also.
Rosa brunanii (Himalayan musk rose)	:	Flowers are fragrant and ornamental. Ideal for preparation of value added products namely, attar and marmalade. A soothing cough syrup is made out of the hips which have a high vitamin C content.
Hedychium spicatum (Sweet snow)	:	A perfume prepared from its roots is used for perfuming tobacco. The roots are used medicinally as a carminative and stimulant. The leaves are woven into mats.
Echinops cornigerus (Globe thistle)	:	The flower heads are almost perfect spheres and made up of small closely packed blue flowers. They are quite outstanding in flower beds.
Delphinium denudatum (Wild Delphinium)	:	The flowers are attractive and are produced in shades of pink, white and blue.
Viola canescens	:	It produces attractive purple fragrant fowers. It has

(Dog violet)		medicinal value and a very effective cough mixture is made from it. In the Ayurvedic and Unani systems of medicine, violet flowers are used for treating several diseases. Homeopathic remedies for skin, eye and ear troubles also use the violet plant.
Vinca minor (Blue periwinkle)	:	It is an attractive garden plant producing purple-blue flowers. It is used in herbal medicines to treat diarrhea and dysentery
Commelina forkalii	:	This is an unusually pretty blue wild flower. The petals are a beautiful sky-blue and have an orchid-like appearance. It is used in herbal medicine for remedies for inflammation of the skin.
Gentiana cochemirica (Kashmir gentian)	:	It is an ornamental garden plant. It is used in herbal medicine.
Tulipa stellata (Wild Indian tulip)	:	It is an ornamental plant.

Women empowerment

Floriculture is a highly woman-friendly venture. Floriculture farming and value addition activities have proved to be a reliable source of employment and income generation to womenfolk. Value addition in flowers is a predominantly woman-friendly sector of the floriculture industry, since it involves more of creativity and artistic skills. This area offers tremendous scope for women empowerment through women entrepreneurship promotion. Owing to the potential of value added floral products in generating higher levels of income, employment opportunities, greater scope for women empowerment and export promotion, value addition in floriculture is growing rapidly as a profitable and successful industry.

FUTURE PROSPECTS

India's share in global floriculture trade may not be significant but the country has, of late, shown enough potential to eventually turn itself as a favourite destination of flower importers in near future. Surprisingly, the small land-holding pattern, considered a handicap for the country's agricultural production, comes as an advantage in floriculture due to its 'low volume high value nature. Since the sector has huge export potential, a number of small and marginal farmers have started turning towards flower production.

The country is bestowed with ideal temperature conditions for commercial floriculture throughout the year in some or other part. This has helped entrepreneurs

and growers in recognizing diversification into floriculture as of a commercial value. Even non-arable land can be put to agricultural use since protected floriculture involves specific growing media or amendment of the existing soil.

Horti-Tourism: A potential enterprise for youth

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Worldwide, tourism is emerged as one of the most vibrant sector, and it has established and diversified tremendously in recent past. Current generation of urban tourists are eyeing for adding diversity to their experience, live closely with nature, get back to their roots, learn agriculture practices and purchase fresh farm produce (Bansal *et al*., 2010). This has led to demand of alternate kind of tourism worldwide viz. farm tourism, rural tourism, eco-tourism, agro-tourism, adventure tourism, and nature tourism. Simultaneously, constraints in agriculture sector demands more activities for earning additional income, generating employment and sustainability. Agro-tourism and has great appeal to the urban tourist as it fulfils the desire to share farm life and learn from host and in this sense is an experimental learning and self-discovery experiment. Agro tourism in general and horti-tourism in particular is in stage of infancy in India, whereas in European countries like United Kingdom, Italy, and France it is well developed. Horticulture has emerged as a most promising sector in Indian agriculture to enhance profitability through diversification, optimum utilization of land and natural resources, bringing nutritional security and generating employments for rural people. Horticulture is defined as cultivation, processing and utilization of wide range of crops including fruit, vegetable, ornamental, medicinal, spices, aromatic, and plantation crops. Favourable wide variety of agro-climatic and soil condition coupled with farmers' enthusiasm for horticulture crops has led to tremendous development in horticulture sector in the country.

CONCEPT

Agro-tourism can be defined as a set of activities that occur when people link travel with products, services and experiences of agriculture (Barbuddhe *et al*., 2014). Horti-tourism is a part of agri-tourism industry and relatively new concept it can be describe as the act of visiting a working horticulture farm for the purpose of entertainment, learning, amusement or active participation in the farm activities (Kuchi *et al*., 2017). Spectacular growth in horticulture sector provides perfect opportunity to enhance horti-tourism ventures and create employment for rural youths. Horticulture is applicable to all aspect of daily life, and horticulture crops and their products carries

great appeal to the urban tourist. It is also emerging as a choice of small and marginal farmers beside contributing towards strengthening social sustainability and conserving natural resources. Linking horticulture with tourism can offer excellent opportunity to both tourist as well as farmers. Tourists can live closely with nature, experience the realities of rural leavings and participate in farming operations, on the other hand it enables farmers to diversify their activities while enhancing the value of farm produce, further it helps farmer reconcile farming interests and environmental protection through sustainable management and optimum utilization of land.

Basic principles of horti-tourism

- ❖ Something to see: theme villages (strawberry village, mango village, organic village, spices garden, medicinal and aromatic parks.) different species and varieties of horticulture crops.
- ❖ Something to do: participation in farm operation (fruit harvesting, irrigation, sowing etc.) cooking (pick your own-cook your own), learning skills of kitchen gardening, organic farming.
- ❖ Something to buy: farmers can sell homemade processed products and value added products e.g. pickles, chutney, jam, jelly, seeds of vegetables, flowers and other crops, saplings of fruits, properly picked fresh farm produce etc.

Scope of Horti-tourism

I. Employment opportunity: horti-tourism has potential to generate new form of employment locally and in turn reduces migration and strengthens rural economy. Skilled youths can engage themselves in wide range of activities like plant propagation, nursery raising, value addition, processing, hospitality, horticulture therapy, kitchen gardening, organic farming, short term certificate courses, vocational training to tourists etc.

II. Conservation and maintenance of biodiversity: horticulture farms engaged in horti-tourism should maintain diversity of different horticulture species and varieties to attract tourists. Underutilised fruits and vegetable species native of local region can be conserved and maintained at farm. Horti-tourism farms can be powerful centres for creating awareness about conservation of biodiversity among the tourists.

III. Affordable opportunity to tourist: horti-tourism provides cost effective options to urban tourist as cost of food, accommodation, travel and amusement activities is optimum.

IV. Additional income: horti-tourism enables farmer to diversify their income generating activities while enhancing value of their farm produce. Farmer can sell fresh fruits, flowers, vegetables, spices and their value added products at appropriate rate to visitors and can get insulate from fluctuation in prices.

V. Attraction towards agriculture activities: People having roots in villages would like to experience farm life, share traditional culture, and learn horticultural practices, organic farming and vegetable cultivation can get it fulfilled through horti-tourism.

VI. Health awareness: environment in farms provides true opportunity for promotion of nutritional and aesthetic security. Horti-toursim provides easy access to nature, lower job pressure, improves psychological health and enhances the quality of life.
VII. Learning opportunity: the tourist desire is to share farm life and learn from host and in this sense is an experimental learning and self-discovery experience.
VIII. Psycho-social issues: urban tourists suffering from lifestyle diseases, mental aggressiveness, attention deficit disorder, depression and anxiety can experience peace and tranquillity in farm as horti-tourism is nature friendly. Horticulture therapy (HT) is a powerful tool to treat such ailments, it can be explained as the engagement of a person in gardening and plant-based activities, facilitated by a professionally trained therapist, to attain particular remedial treatment objective.

Products of horti-tourism

Horti-tourism consists of wide range of components for tourist attraction viz. spice garden, herbal garden, theme park, bee keeping, biodiversity park, watershed farming model, high tech horticulture, floriculture farm, vermi-composting unit, horticultural nursery, fruit processing unit, kitchen garden, educational tours for school children, certificate courses and short term training programmes, fruit festivals, pick your own cook your own, organic horticulture cultivation, green house farming, miniature village, wineries, home stay in farm, farm safari, exotic fruits/vegetable garden and maintenance of underutilised horticulture species.

Mango Tourism

India has the richest wealth of mango germplasm (more than 1000 varieties) and it is the National fruit of India. It is the most popular fruit among millions of people in the orient, particularly in India. Enormous utility of mango in various forms and kinds have attracted the attention of tropical and subtropical world. India's fascination with the mango is not new; it starts in March-April with early varieties like Bambaiya, Pairi and Banganapalli. Alphonso and Dashehari hit the markets mid-season, while the late-maturing Fazli, Neelam and Chausa show up towards July-August. Taking cue from the popularity of the mango across the age groups, mango cultivators are taking consumers or tourists to mango plantations of rural India and even holding mango festivals with the help of state tourism departments. Mango tourism is getting popularity in Maharashtra, especially in Konkan region where the popular Alphonso variety (*Hapus*) is grown. In mango fruiting season March to May people flock to the Ratnagiri and Sindhudurg districts to feast on fresh mangoes and mango products. A mango tourism festival is held every year by Maharashtra Tourism Development Corporation (MTDC) in association with the Global Konkan for attracting tourists. Rural skilled youths can engage themselves in value addition and processing of mango fruits. They can establish small scale home based unit for production of different value added products viz. Mango juice, pickle, juice, *panna*, pulp, jam, dehydrated mango, *amchur* powder, leather, chutney.

Table 1: Successful mango tourism ventures in India

S.No	Venture	Location	Special features
1	Ganesh Agro Tourism	Nate, Ratnagiri, Maharashtra	Alphonso- variety, value added products, traditional food, learning opportunity, home stay.
2	Oceano Pearl	Ganshgule, Ratnagiri, Maharashtra	Coconut and mango plantation, different mango dishes, beach view, home stay, mango picking.
3	Dwarka Farm Stay	Sawantwadi, Sindhudurg, Maharashtra	Organic mango cultivation, Alphonso mango, Coconuts, cashews, bananas and pineapples.
4	Mango Meadow Agricultural Pleasure Land	Kaduthuruthi, Kottayam, Kerala	Organic cultivation, mango theme garden, fruit nursery, herbal garden.

Spice- tourism

Spices are essential part of life in Indian food, society, tradition and economy. The enormous health benefits of spices are known in India from ages, their use as a nutraceuticals and functional food is increasing at very fast pace. Worldwide, India is famously known as a "land of spices" or "spices bowl of the world". Under Indian condition more than 63 kinds of spices are grown in various parts. Wide variety of spices such as black pepper, chillies, cardamom, large cardamom, ginger, turmeric, garlic, fenugreek, coriander and tree spices such as kokum, nutmeg, tamarind, cinnamon are cultivated in some of the states of country. Major spices producing states includes Tamil Nadu, Andhra Pradesh, Kerala, Gujarat and Rajasthan. The awareness about spices is expanding very fast; the demand for organic spices is swelling at the 20% annually. Health conscious consumers have an inclination towards procuring original, high quality and organically produced spices. In spice based tourism, spice component plays a key role, it can provide the tourist perfect single window opportunity to see the spices in natural condition, breath the spice aroma in air, learn about spices cultivation, harvesting, packaging and value addition (Malhotra, 2012) Spice based tourism have huge potential to attract visitors especially foreign tourist and Non-resident Indians.

Blooming Kerala spice tourism

Historically Kerala is strongly linked with spices cultivation, utilization and trade. Kerala is famous for distinct taste and flavour of different spices. Travellers around the world journeyed Kerala in search of spices. Several kind of spices are grown in Kerala including ginger, garlic, nutmeg, cardamom, vanilla, pepper, cinnamon, coffee, tea, clove and nutmeg. Mostly spices are grown as a multi-story, mixed and intercrop, cardamom and black pepper are generally grown in multi-storey cropping with other plantation crops such as coconut, cocoa, arecanut, coffee, etc. ginger and turmeric being

partially shade tolerant mostly grown as an intercrops with other horticulture crops. Spice tourism in Kerala is enhancing at very fast pace, Kerala state government and spice board is promoting spice tourism by conducting training programme and promotions. Kerala tourism department with the support of United Nations World Tourism Organisation (UNWTO) has launched Spice Route Project aiming at sharing heritage among the 31 countries along the ancient route. The initiative is likely to bring in a sizeable number of foreign tourists to Kerala to trace the historic journey.

Table 2: Successful spice-tourism ventures in India

S.No	Name of venture	Location	Speciality
1	Sahakari spice farm	Curti Ponda,Goa	Organic cultivation of vanilla, Goan food, large farm with different spices, dense forest, learning opportunity for tourists
2	Pascoal Spice farm	Khandepar, Goa	Variety of spices, nut and plantation crops, arts and crafts, gift baskets, spices saplings and seed for sale, organic spice cultivation.
3	Tropical spice plantation	Keri Ponda, Goa	Cashew fenny, traditional food, bamboo bridge, mixed plantation (spices, nuts, herbs), bird watching, farm tour, elephant riding
4	Anakkara Spice Tourism	Idukki, Kerala	Spice walk, Home stays, Plantation visits, traditional Ayurvedic treatments, trade on Organic & Garden fresh spices, herbal garden.
5	Spice Walk	Murikkaddy, Kumily, Kerala	110 acre eco-friendly plantation, traditional Kerala food, fishing, coffee processing

Meghalaya strawberry revolution

North Eastern Indian state Meghalaya the "Land of clouds" is the third largest producer of strawberry fruits. Strawberry which is a symbol of purity and sensuality, fertility and abundance has made a great impact in the lives of rural people of Meghalaya. In year 2010, Indian Institute of Entrepreneurship (IIE) Guwahati with the help of Ribihi Strawberry Growers Association (RBSGA) launched horti-tourism project at Sohlia village in Ri-Bhoi district. As a result, Sohliya a picturesque village located around 26 km from Shillong, emerged as a nerve centre of strawberry production and eco-tourism. Currently about 300 farmers are cultivating strawberry in ½ to 3 acres of land and getting monitory benefit of Rs 25000-5000 per annum (Lyngdoh, 2014). This strawberry revolution puts Sohliya village on the tourist map of Meghalaya, resulting in hundreds of tourist visiting village to witness strawberry revolution and relish strawberry fruits.

Linking horti-tourism to organic farming

In recent past awareness of urban population towards organic food has increased owing to environmental concern, health awareness and lifestyle. Concurrently, many farmers are also moving towards organic cultivation of fruits and vegetables. Organic farming can act as a service allied to horti-tourism and this linkage between horti-tourism and organic farming has potential to benefit environment, conserve biodiversity while rewarding farmer through sell of organic farm produce, on farm consumption of organic fruit and vegetable (Privitera, 2010). Furthermore, tourists can get opportunity to learn organic vegetable cultivation, kitchen gardening, vermi-composting, organic gardening etc through educational programmes and short training courses. Organic state of India, Sikkim has great potential to attract tourists to learn the organic farming of turmeric, ginger, large cardamom, kiwi and other vegetables.

Critical Success factors

- Location and accessibility are very crucial to establish horti-tourism venture. Horticultural farms in vicinity of conventional tourist spots and farms well connected with big cities by road, train or air can help in attracting tourists easily.
- Effective marketing/promotion/publicity of venture is a key for successful horti-tourism venture. Publicity through use of social media, website, advertisement agencies, Non-Government Organizations (NGO) and government agencies is crucial to attract tourist.
- Most of the small and marginal farmers in India are resource poor and thus requires financial assistance for initial establishment of horti-tourism venture.
- Provision of quality service in terms of hygienic and peaceful environment, pure water, home cooked food, comfortable home stay. Timely and effective service delivery is essential for visitor's satisfaction.
- Community participation in horti-tourism is imperative as it provides tourists chance to participate in local festivals, cultural activities, music, folk, dance and share cultural values with rural people.
- Capacity building of rural youths is very critical since horti-tourism involves wide range of activities. Rural youths need to learn hospitality skills e.g. communication skills, interpersonal skills, safety/hygiene issues, teamwork, computer know-how. In addition, acquiring techniques of plant propagation, organic cultivation, high-tech horticulture, green house farming, and processing is useful to conduct certificate course, educational tours of tourists.

CONCLUSION

Horti-tourism sector in country is getting popularity at very fast pace, it revolves around horticulture crops, products, cultivation practices, farmers and local culture. Horti-tourism has potential to offer new generation of youths with tremendous opportunities for showcasing their potential to earn a very lucrative livelihood. Further, it can reduce poverty through employment creation, value addition, earning foreign

exchange and provision of nutritional security. The best horti-tourism venture is undoubtedly one that involves local community, preserve local environment, conserve biodiversity, aspire towards local ownership and showcase modern farm practices. In true sense horti-tourism is economically rewarding, intellectually satisfying, enriching, adventures and learning gateway.

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