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Sr. No.	Full length Articles	Page
1	Urban Agriculture: The Saviour of Rapid Urbanization Chaitra Bhat and Amit Paschapur	01–09
2	An overview for increasing shelf life of fruits, Vegetables and flowers Kripa Shankar, Tasso Annu , Songthat William Haokip and KH. Anush Sheikh	10–15
3	Nano Fertilizers: A Smart Nutrient Delivery System with higher Efficiency Dewali Roy, Rakesh S and Abhas Kumar Sinha	16–21
4	Biofilm Formation Vaishali and Davinder Singh	22–24
5	Fluoride Contamination and Its Mitigation Measures Dr. Karthika V, Dr. R. Sureshkumar and Dr. M. Rajasekar	25–29
6	Crop Residue Burning: Environmental Threats and Alternatives Gandu Ranjith Kumar, Manchala Santhosh Kumar and Ravula Manasa	30–33
7	Biofuel from Salicornia plants Vaishali and Davinder Singh	34–36
8	Bird of Paradise (Strelitzia reginae): A Low Maintenance, High Potential Ornamental Plant Anamika Gurung and Rajiv Kumar	37–43
9	Substrate Culture in Soilless Cropping Systems K. Sivasabari, P. Rajeshkumar and R. Ajaykumar	44–48
10	Importance of Physiotherapy in Veterinary Practice S.K. Yadav, Raju Sharda, Rukmani Dewangan, M.O. Kalim and Anupam Soni	49–54
11	Effect of Bypass Fat in Reproductive Performance of Dairy Animals Subhrajit Das, Sharad Mishra, M.D. Bobade, Ashutosh Dubey, AayushYadav,Anupam Soni, Upasana Verma, Ankit Kashyap, Suryakant Sori and Anjula Gahirwar	55–60
12	Polioencephalomalacia in Ruminants Dr. Vishnurahav R.B.	61–62
13	Animal Genetic Resources of Maharashtra Bahurupi P.R., Yadav Tejwanti and Jeet Vikram	63–74
14	Importance of Pulses as Nutrient Source, Soil Health Enhancer and Climate Change Mitigant C. Subha Lakshmi and Ch. Chandra Sekhar	75–79
15	Biodegradation of Xenobiotics– A boon to environment Nunna Sai Aparna Devi and Banka Kanda Kishore Reddy	80–82
16	The Prospects of Organic Farming under Indian Conditions Sanjay Kadam, Gaurav Singh Gurjar and Kavita Chaturvedi	83–87
17	Ozonation – An Effective Strategy in Reduction of Pesticide Residues for Food Safety Banka Kanda Kishore Reddy and Nunna Sai Aparna Devi	88–91
18	Disease and insect pest management in kharif maize Davinder Pal Singh Badwal, Mandeep Kumar, Navjeet Kaur and Nisha	92–96
19	Phytochemistry and Therapautic Properties of Aloe Vera Rukhsana Rahman, Neeraj Gupta and Fozia Hammed	97–100
20	Mastitis in goat: Clinicotherpeutic Intervention and Prevention D. Mondal, S. C. Das and T. K. Biswas	101–106
21	Problems and Constraints in Adoption of Organic Farming in India G. Vinay and K. K. K Reddy, K. Venkatkiran Reddy and E. Ajay Kumar	107–111

Urban Agriculture: The Saviour of Rapid Urbanization

Chaitra Bhat[1] and Amit Paschapur[2]*

[1] Division of Nematology, ICAR-Indian Agricultural Research Institute, New Delhi.
[2] ICAR-Vivekananda Parvatiya Krishi Anusandhana Sansthan, Almora*
**Corresponding author: amitp3929@gmail.com*

ABSTRACT

Urban agriculture is a key solution to rapid population growth, urbanization, food crisis and climate change. According to reports of FAO, by 2050, more than 6 billion populations will be dwelling in urban areas, which is almost double the current population of 3.5 billion. In case of India, the reports by UN state of the world population 2007, by 2030, 40.76% of country's population will reside in urban areas. Considering the above statistics, we can estimate the burden on rural production system to meet increasing demands of fruits and vegetables in urban markets. So, urban agriculture could be the saviour to avoid food crisis and inflation of market. The idea of urban agriculture is age old and started in the mid 19th century and has gained popularity in urban areas throughout the world. There are various types of urban agriculture, like, kitchen gardening, rooftop gardening, vertical farming, container gardening, urban beekeeping, aquaculture etc. Multiple auras of crops can be cultivated in the minimal available space, right from herbs, vegetables and fruits to aromatic and medicinal plants. There are large number of advantages of urban farming, like, providing employment and daily wages to poor farmers, educating children, strengthening the community, improving social and emotional wellbeing and environmental justice to tackle climate change. Many cities across the world are practicing urban farming and have achieved success in production, marketing and educating people. In India, urban farming is still in infant stage and has to be given much more importance by both Government and private agencies to popularize and harness the profitability of urban agriculture.

Key words: Urban agriculture, Population growth, Food crisis, Inflation, Environmental justice, Employment generation

I. INTRODUCTION

Urban agriculture, urban gardening or urban farming is the practice of cultivating, processing and marketing of food and food products in and around urban localities. Urban agriculture also involves animal husbandry, aquaculture, beekeeping and horticulture. There is also a cultivation practice in peri-urban areas (city outskirts

or perimeter of the urban area) called peri-urban agriculture, which has entirely different characteristics. According to the reports of FAO, by 2030, 60 per cent of the people in developing countries will likely live in cities. This rapid growth of city population in the developing world is placing enormous demands on urban food supply systems leading to food shortages during the time of crisis. Urban agriculture is the only solution left to overcome this crisis. The minimal land available in heavily populated town or so called concrete jungles are utilized for cultivation of crops. The high value vegetables and perishable green leafy vegetables are mostly cultivated to meet the daily needs of a family or a small community and excess is sold out to local markets. The main idea behind practicing urban agriculture is to have easy access to locally grown food, understand the way of cultivation and gain basic knowledge of crop husbandry. The knowledge of how food grows, what grows regionally and seasonally, how it is treated after harvest and how it moves from one place to other in a food route before final consumption are all important lessons of urban agriculture. Urban agriculture also provides fresh food, generates employment, recycles urban wastes, creates greenbelts and strengthens cities resilience to climate change.

Recently, urban farming is gaining importance as a hobby, whereas, few urban farms are built for education purpose, training the school children and young professionals or re-entry programmes. Many are built to improve access to healthy food in a specific community or to continue cultivation of traditional culinary. Some are built for earning economic benefits for those communities that are economically disadvantaged. The urban farming also has role in environmental justice along with improving health benefits of people. In this article we focus on history of urban agriculture, types of urban farming, major crops cultivated, and advantages of urban agriculture, success stories and future scope of urban agriculture in India.

II. HISTORY OF URBAN AGRICULTURE IN WORLD:

The idea of supplemental food production through urban agriculture is not new. It has been used during war and depression times when food shortages arose, as well as during times of relative abundance. The history of urban agriculture is mentioned in chronological order in the following paragraph.

a. **Mid 19th century**: the concept of "allotment gardens" came up in Germany to fight poverty and food insecurity in economically backward populations dwelling in urban areas. The people were allotted government owned lands to cultivate crops and earn their livelihood.
b. **1893-"Pingrees Potato Patches"**: Mayor Hazen S. Pingree, came up with the idea of vegetable cultivation in Detroit. The citizens of depression struck Detroit city were allotted lands to cultivate potato in vacant government plots. The intent was to gain income, increase food supply and even boost independence during times of hardship.
c. **1914-1918 (WWI) and 1939-1945 (WWII)- "Victory gardens"**: during World war-I, president of US, Woodrow Wilson called upon citizens of America to utilize the open spaces for food cultivation, seeing the damaging situations of

war and possible food shortages in near future. By the year 1919, over 5 million plots were growing food and over 500 million pounds of produce was harvested.

- During world war-II, National victory garden programme was set up to systematically establish functioning of urban agriculture within cities. The new plan in action lead to production of 9 million pounds of fruit and vegetables in a year, accounting to 44% of US grown produce throughout that time.

d. **Great depression of 1920's:** Urban agriculture played a major role of providing jobs, food and income to people living in and around cities in US and thus saving them from clutches of Great depression. Over 208 million dollars worth of food was produced through urban farming.

e. **1960's:** Community gardens were established in United Kingdom influenced by the movement in US.

f. **1970's Seattle's P-Patch or Community gardening**: The idea of community gardening was put forth by Darlyn Rundberg in 1973. Where, she utilized a 2.5 acre of land in her neighbourhood to cultivate crops and she insisted people to take part in the process of gardening. The programme gained huge popularity over the years and as of December 2017, Seattle had some 90 P-Patches tended by more than 3,125 gardeners.

g. **2010- The Severn project in Bristol:** The project started with the intention to provide support to prisoners, drug addicts and people with mental health problems. The community interest company produced salad leaves and herbs. The company produces 34 tons of produce per year and employs people from disadvantaged backgrounds.

III. TYPES OF URBAN AGRICULTURE:

Urban agriculture can be classified into large number of types based on area, type of commodity produced, multiple methods and medium used for cultivation. The following are common types of urban agriculture

a. **Kitchen gardening**: Cultivation of vegetables and herbs in and around the domestic area for daily kitchen use. It is a very small scale cultivation, wherein, the products are used for household purpose and there is no excess production for sale. This is to meet daily needs of a small family and to become less dependent on the market availability.

b. **Rooftop gardening**: cultivation of vegetables and herbs on the roof of a house or an apartment by single or group of families to meet the daily needs of a family or a community. The focus here is to utilize empty space available on the rooftop and reduce dependence on the markets.

c. **Vertical farming:** Cultivation of crops in vertically stacked layers. The main advantage of vertical farming technologies is the increased crop yield per unit area utilized. The vertical farming can be followed in tall apartments, abandoned old buildings and also on walls. The focus here is to multiply the minimum area available to produce vegetables.

d. **Street landscaping:** The vacant area alongside of the streets can be utilized for cultivation of vegetables. Like, garden streets in the neighbourhood, the vacant area alongside the public roads etc., and these areas are cultivated mainly for recreation and educational purpose. The vegetables cultivated here can be sold in the community or in the nearby markets.
e. **Green house gardening**: the large empty areas in and around the locality can be covered with the greenhouse for production of high value crops. These can be managed by an individual or community or commercial owners. The green houses are known for the production of high value crops under controlled environmental conditions and yield higher quantity of produce than open field cultivation. The products also fetch better price in the markets and the produce if healthy is accepted in the super markets for sale.
f. **Wasteland utilization**: The vacant and abandoned government lands are allotted to interested farmers for fruit and vegetable cultivation. The product is sold in local markets and farmers gain higher profits by cutting costs on transportation and commissions.
g. **Container gardening**: Utilization of waste materials available in the urban areas for cultivation of crops. The main focus here is to reduce, recycle and reuse the waste materials leading to pollution in the cities. Waste material may include plastic bottles, torn shoes, broken containers like drums, buckets, mugs and other urban wastes.
h. **Peri-urban farming**: Cultivation of crops in the city outskirts or perimeter of the urban areas is peri-urban farming. The farmers can follow large scale production systems by setting up polyhouses, animal husbandry, horticulture, beekeeping, mushroom cultivation, agro-forestry etc. This production system is mainly followed in India, where, 65% of the produce in urban markets in India comes from peri-urban production. The cost of transportation, commissions for middlemen are greatly reduced or almost zero in this system. Highly perishable leafy herbs and seasonally and regionally available vegetables and fruits are cultivated and sold.
i. **Urban beekeeping**: Maintaining bee colonies in and around urban gardens or peri-urban areas for pollination and for their honey is called urban beekeeping. This is mainly practiced as a hobby by countable number of people in densely populated urban areas. The bee colonies can be maintained in peri-urban areas and rooftop gardens to gain higher yields by bee pollination and also use other products like honey; wax etc, from the bee colony.
j. **Aquaculture (Fish culture):** Raising aquatic animals such as fish, prawn, lobsters, crab etc., in a city. This is typically accomplished by capturing storm water to sustaining system. Usually the fresh water fishes are cultured and sold in the local markets.
k. **Small scale animal husbandry**: Raising animals for food. For example, cities that allow residents to raise a limited number of chickens for meat and egg purpose, cow and buffaloes for milk purpose. These products help farmers to

earn their daily wages by sale of animal origin food and food products. Animal milk is also utilized for manufacturing other by-products like curd, paneer, kova, shrikhand etc.,

l. **Mushroom cultivation**: Mushrooms are scavenging fungi that can grow on organic waste and yield valuable products fit for human consumption. Mushroom is gaining acceptance in recent years as it is an excellent source of proteins, vitamins, minerals, folic acid and iron. The mushrooms can be cultured under controlled environmental conditions in urban areas and have very high market demand.

IV. MAJOR CROPS CULTIVATED IN URBAN AGRICULTURE:

Vegetables have a short production cycle; some can be harvested within 60 days of planting, so are well suited for urban farming. Urban and peri-urban agriculture aims at production of high valued, perishable and high demand fruits and vegetables.

- **Green leafy vegetables or herbs**: Spinach, Coriander, Curry leaves, kale, Water cress etc.,
- **Root crops**: Potato, Sweet potato, Cassava, Raddish, Beetroot, Turmeric, Ginger, Carrot etc.,
- **Vegetables**: Tomato, Eggplant , Chillies, Capsicum, Peas, Frenchbean, Guards, Crucifers etc.,
- **Fruits**: Avacados, Guava, Sapota, Mangoes, Banana, Citrus, Cherry, Coconut etc.,
- **Mushrooms**: Button mushroom, Paddy straw mushroom, Oyster Mushroom etc.,
- **Animals**: Poultry, Rabbits, Goats, Sheep, Cattle, Pigs, Guinea Pigs etc.,
- **Non-food products**: Medicinal and aromatic plants, Ornamental plants, Tree products etc.,
- **Bee products**: Honey, Wax etc.,

V. ADVANTAGES OF URBAN AGRICULTURE:

a. **Nutritional and quality food**: Fruits and vegetables are a rich source of Vitamins and minerals. The time lapse in their transport, storage, packing and processing is almost nil in urban farming, thus providing fresh and quality produce at door steps. As the produce is less processed (cleaning, blanching, freezing and cold storage) the chance of loss of vitamins and minerals is least and the produce is rich in its nutritional values.

b. **Health benefits:** As fruits and vegetables are cultivated in and around the human surroundings, there is increased chance of consumption of fresh, healthy produce and increased chance of staying away from chronic diseases like diabetes, heart disease and cancer. The crops cultivated in urban gardens are least exposed to pesticides, heavy metals and sewage waste, so, the food contamination is least and in turn has positive effects on human health.

c. **Environmental justice:** Practicing of urban farming has several environmental benefits like, reduction in plastic pollution due to recycling and reuse of waste

plastic containers, reduction in air pollution and reduction in water pollution etc., thus, urban agriculture is making a great justice to environment in the era of climate change where urban areas are highly resilient.

d. **Efficient utilization of time (Agriculture as a hobby):** In the era of information and technology, people can make agriculture as a hobby and spend valuable time to learn about crop and animal husbandry, beekeeping, mushroom cultivation and aquaculture. Children can also be educated and encouraged to take up farming as a hobby and continue our age old tradition of farming.
e. **Efficient utilization of land and resources**: the vacant and abandoned lands in urban areas can be utilized for agriculture through allotting lands to poor and interested farmers and in turn help them earn their livelihood. The urban green waste can be used as manure, waste water from kitchen and lavatories can used for irrigation, biodegradable waste can be used for composting etc.,
f. **Social and emotional well being**: urban farming on community bases leads to social interaction among people of the locality, children can learn agriculture, people can share their produce with neighbours and social interactions will improve over time. Agriculture as a hobby is a best mental and physical exercise to improve your emotional wellbeing. The kids these days have high IQ (Intelligence quotient) and low EQ (emotional quotient), the urban farming may help in striking balance between the two and also introducing agriculture techniques and methods in academic curriculum for children can also be considered.
g. **Economic benefits:** Urban agriculture provides employment and incomes for poor women and other disadvantaged groups. Urban women can spend their time in farming and earn some money to support their families economically. The poor and disadvantaged can be allotted waste government lands to practice farming and earn their daily wages. As urban farming does not involve middlemen for long distance transport, storage and processing the profit for production directly reaches the producer.
h. **Educational benefits to younger generations:** The younger generation have least knowledge and interest in farming. Establishing urban farms can teach them how food is grown, harvested, transported and processed to give it a final consumable form. This process can illuminate them to reduce food wastage. The idea of weekend agriculture can be inculcated in urban population where they can spend 2-4 hours on their weekends for farming and learn the divine art and science behind crop cultivation.

VI. DISADVANTAGES OF URBAN AGRICULTURE:

a. Urban farming is unrecognized in agricultural policies and urban planning thus ignoring its importance in agriculture production system.
b. Growers often operate without permits. Since it is officially "invisible", the sector receives no public assistance or oversight in many cities.

c. Urban agriculture carries health and environmental risks – potential use of contaminated land and water and inappropriate use of pesticides, fertilizers and of raw organic manure that can leak into water sources. These issues require proper attention.
d. Drastic reduction in rainwater infiltration into the soil (In Harare, Zimbabwe, it was noticed that there was 28.5% reduction in rainwater infiltration leading to depletion of groundwater)
e. The main challenges faced by urban farms are higher production costs, difficulty in managing pests and weeds and changing climatic scenario.

VII. SUCCESS STORIES OF URBAN AGRICULTURE IN INDIA AND WORLD:

To facilitate food production and supplement that from rural production to meet the rising market demands, some private organizations, government agencies and NGO's are establishing community based farming projects in urban areas. The major types among them are community gardening and allotment garden models. The most successful and popular among them are explained in brief in the following paragraphs

a. **Cairo, Egypt:** Development of rooftop gardens and cultivation of organic vegetables
b. **Queensland, Australia:** Aquaponics and urban gardens are established
c. **Havana, Cuba:** Urban gardens are established by Government agencies in collaboration with local residents to produce 90% of city's fresh vegetables
d. **Bangkok, Thailand:** Urban gardens were established by NGO and Government agencies to teach members of the community the benefits of urban green space, poverty reduction through urban gardens and community capacity building.
e. **Beijing, China:** The two tier city farms are established by Chinese Government around 10 km away from city centre. Wherein, first tier is located very near to city and produces perishable items and the second tier is located little farther, that produce hardier vegetables like, potatoes, carrots and onions. This system allows producers to sell the produce in the city markets just few hours after harvest.
f. **United States:** The urban farms in US are either non-profit or solely owned. The farms mainly practice raised bed cultivation, greenhouse, beekeeping, container gardens and animal husbandry (hens and sheep). Due to heavy contamination of city coil because of vehicle exhausts and remnants of old construction, the two alternative means of growing are practiced; rooftop gardens and hydroponics.
g. **Yorkshire, United Kingdom:** Yorkshire has established a successful urban agriculture model. 17,000 inhabitants of the city voluntarily participate in farming and passers-by and visitors are allowed to pick and use the produce. There are a total of forty gardens throughout the city and are named "propaganda gardens" as they promote growing local vegetables, to eat seasonal food, to consider provenance of food, and to enjoy fresh and healthy food. These

gardens are located along side the streets, car parking area, rail stations, police stations, in the cemetery and town schools.

h. **Rosario, Argentina:** The Government of Argentina under its Land use plan 2007-2017 has specific provision for the agricultural use of public land. The Government has developed "Green circuits", the area around the city is transformed for family and community gardens, large scale commercial vegetable gardens and orchards. In 2014 more than 30 ha of land were used to grow vegetables, fruits, medicinal and aromatic plants. This land is also used for cultural, sports and educational activities along with agriculture.
i. **Mumbai, India:** Dr. Doshi's method of city gardening is famous in Mumbai, which emphasises on pure organic production and waste recycling. Locally available agriculture and household wastes like sugarcane waste, polyethylene bags, tires containers, cylinders and soil are used for crop cultivation. This revolutionary method can be applied in reduced spaces as terraces, balconies and civil construction walls.
j. **Mumbai, India:** The Mumbai Port Trust (MBPT) practices organic farming on the rooftop of their central kitchen (280m^2) and distributes food to approximately 3,000 employees per day.
k. **Mumbai, India:** "Fresh and Local" a private organization in Mumbai takes underutilized spaces and transforms them into places of community empowered food production. The main objective is to improve the health and wellbeing of people.
l. **Hyderabad, India:** Urban agriculture is a new form of agriculture that is gaining popularity in the city outskirts of Hyderabad wherein, more than 4,000 families are self reliant for the vegetable needs of family. The government is taking keen interest in promoting urban farming through providing subsidy kit worth 360 Rs to interested farmers dwelling in and around the city.
m. **Delhi, India:** The concept of urban agriculture is not new to Delhi, because the farmers living on the banks of Yamuna River are producing vegetables from many generations and selling in the markets. But, their future is vulnerable due to lack of Government support and development of metro stations along the Yamuna banks.

VIII. CONCLUSION:

The rapid increase in the population, excessive immigration into urban areas and increased demand for fruits and vegetables has caused frequent food shortages, inflations in food prices and sometimes food crisis in Indian markets. The saying "agriculture is a gamble with climate" suits the fluctuations in production and productivity in rural areas. Understanding these lacunas would suggest "urban farming" as a major solution.

- The transformation of cities from only consumers of food to generators of agricultural products contributes to sustainability, improved health, and poverty alleviation.
- Introducing agriculture as a course curriculum in schools and colleges would educate children and enlighten them about importance of food.
- The idea of "Weekend farming" can be inculcated in the young generations to transform agriculture.
- Agriculture as a hobby is a best medicine for social, emotional, mental and Physical wellbeing.
- Efficient utilization and recycling of urban wastes into valuable produce
- Allotment of waste and abandoned Government lands to farmers for cultivation would improve the agriculture production.
- Reduction in chronic diseases like diabetes, heart diseases and cancer due to consumption of fresh, healthy and untreated fruits and vegetables.
- Urban horticulture can generate one job every 100 sq m garden in production, input supply, marketing and value-addition from producer to consumer.
- The Government should also take responsibilities to promote urban agriculture in major cities of India in order to become self sufficient and reduce burden on rural production.

REFERENCE

Awasthi, P. (2013). Urban agriculture in India and its challenges. *International Journal of Environmental Science: Development and Monitoring (IJESDM)*, *4*(2), 48-51.

Bailkey, M., and J. Nasr. 2000. "From Brownfields to Greenfields: Producing Food in North American Cities," Community Food Security News. Fall 1999/Winter 2000:6

Hampwaye, G.; Nel, E. & Ingombe, L. "The role of urban agriculture in addressing household poverty and food security: the case of Zambia" (https://www.fanrpan.org/archive/documents/d0 0780/). Gdnet.org. Retrieved 1 April 2013.

Hazen S. Pingree. Monument (http://historicdetroit.org/building/hazen-s-pingree-monument/). http://historicdetroit.org/. DAN AUSTIN. External link in |website= (help)

An overview for increasing shelf life of fruits, Vegetables and flowers

***Kripa Shankar[1], Tasso Annu[2] , Songthat William Haokip[3] and KH. Anush Sheikh[4]**

Department of Fruit Science[1,3,4]
Department of Vegetable Science[2]
College of Horticulture and Forestry, Central Agricultural University
Pasighat, Arunachal Pradesh, 791102
** Corresponding author: rawkripa.s99@gmail.com*

ABSTRACT

The postharvest losses of fruits and vegetables in the developing countries account for almost 50% of the produce. India being world's second largest producer of fruits and vegetables loses up to 40% of produce because of excessive ripening during transport and storage. Biotechnological approaches especially genetic engineering has potential and proven technology for increasing self-life. In this module, we have discussed about different methodologies and approaches adopted for incensement of the fruits and flowers shelf life through transgenic crops approaches genetic modification using the genetic engineering.

Key Words: Shelf-life, transgenic, antisense, Ornamental crops, RNAi, ACC synthase

INTRODUCTION

With the increasing world populations, the demand of food is increases. Although, from last five decades global food production is growing as with increasing population but still 1 billion persons of the world are scrawny because of food insecurity. The conventional breeding methods no more remain feasible to defeat this situation. Therefore, there is an urgent requirement to develop new approaches in order to enhance the quality and quantity of yield, to fulfill the food demand of agriculture and farming revolutionize with the biotechnology and molecular biology methods. A number of approaches have been used for the crop improvement like plant tissue culture, plant mutagenesis, plant transformation, proteome profiling, allele mining, genetic engineering (GE) or recombinant DNA technology (RDT), molecular breeding, marker assisted selection, genome wide selection (GWS), next generation sequencing

(NGS), nanotechnology, RNA interference (RNAi) and CRISPR/cas9. Among these next generation sequencing, nanotechnology, RNA interference and CRISPR/cas9 came up as new techniques for the crop improvement according to future need. Increasing shelf life of fruits The main limiting factor for shelf-life and storage is excessive softening. To increase the shelf-life, plants modified for the expression and by varying the action of cell wall enzymes, which implicated in tissue softening and deterioration. Ethylene is known as fruit ripening hormone. Biosynthesis of ethylene has been disrupted for the delaying fruit ripening by inhibition of genes which are involved in ethylene biosynthetic pathway; the shelf life increase can be achieved by maintaining resistance to ethylene. In 1994, Calgene (Monsanto) United Kingdom (UK) developed and commercialized a transgenic fresh tomatoes named 'Flavr Savr' by antisense strategy using a gene encoding polygalacturonase enzymes that involved in cell wall softening during ripening; transgenic fruits showed extended shelf-life and reduction in the ripening process of genetically modified tomato. Hamilton and Baulcombe (1999), decrease autocatalytic ethylene synthesis pathway by the down-regulation of genes, which involved for ethylene production pathway such as ACC oxidase (ACO) or 1 aminocyclopropane-1- carboxylicacid synthase (ACS) has been found efficient to enhance fruit shelf life. The 'flavr savr' *Solanum lycopersicum* (tomatoes) have enhanced flavor and total soluble solids (TSS), in adding together to the improved shelf-life. Nevertheless, three years later 'flavr savr' range was solitary from the market for the reason that of its lack of productivity and disease vulnerability. Stewart et al. (2001) generated engineered plants and these transgenic plants are under evaluation conditions, in which the polyphenol oxidase (PPO) gene has been suppressed. The polyphenol oxidase (PPO) gene from *Ananas comosus* L. (pineapple) fruits under certain condition that produces blackheart.

Blackheart is a fruit disorder caused due to higher temperature exposure of pineapples which stimulates PPO activity. Afterward, tomato varieties developed with improved shelf-life through antisense technique by using two ethylene precursors ACC synthase (ACS) or ACC oxidase (ACO). By manipulation of cytokinin biosynthesis in petunia and tobacco has been achieved delayed leaf senescence. Furthermore, Tomato transgenic plants, which transformed with CAX (H+/cation exchanger) gene of *Arabidopsis thaliana* and these transgenic plants showing more calcium (Ca2+) and enhanced shelf-life when compared to the control plants. Raffeiner et al. (2009) successfully reported in Odontoglossum and Oncidium by mutating ethylene receptor gene. A *Solanum lycopersicum* transformed tomato fruits showed enhanced shelf-life, decrease shriveling and reduced decay symptoms growth with compared to the wild-type (WT) fruits and the transgenic plants manipulated with ySpdSyn(yeast spermidine synthase) gene under control of CaMV35S constitutive promoter and E8 fruit-ripening specific promoter, and the transgenic tomato also showed delayed senescence. Dahmani-Mardas et al. (2010) developed melon fruits (*Cucumis melo* L. subsp. melo var cantalupensis) with increased shelf-life by using TILLING approach by using 11 genes that control ethylene synthesis and screened for induced mutation that promotes fruits with improved shelf-life and they concentrate in knocked out of a precise gene *CmACO1*

and pointed out a very significant amino acid (Glycine) at the position of 194, which responsible for the fruit maturation. Genetic engineering has multifaceted technique in enhancement of the nutritional quality of fruits. So many researchers have demonstrated experiments involving ACC synthase (ACS) or ACC oxidase (ACO) genes in antisense technique for enhancing the shelf life of ornamental plant products. silencing the expression of a mitochondrial Ascorbate peroxidase (APX) gene in Solanum *lycopersicum* (tomato) fruit by using RNAi technology, Ascorbate peroxidase (APX) oxidizes involved in the ascorbate metabolic pathway and decreased L-ascorbic acid and also reduces the content of vitamin C. The over-expression of expansin gene (LeEXP1 fruit specific expansion gene) under the control of LeACS4 (fruit specific promoters) in transgenic*Solanum lycopersicum* (tomato cv. Pusa Uphar) and the transgenic tomato showed enhanced fruit softening and increased red colouration. Targeted ripening specific N-glycoprotein modifying enzymes, α-mannosidase (α-Man) and β-D-N-acetyl hexosaminidase (β-Hex) and the Over-expression of α-Man or β- Hex resulted in enhanced fruit softening, and their inhibition showed improved fruit shelf life. N-glycans are reported to play a significant role during fruit ripening, though the role of any particular enzyme is until now unknown. Whereas, use of RNAi approach down-regulate the expression of ACC oxidase (ACO1) gene in *Solanum lycopersicum* (tomato) to reduce ethylene production, which require in regulation of fruit ripening and flower senescence.

The tomato transgenic lines showed lesser ethylene production and enhanced fruit shelf-life with compared to the control (wild-type) fruits, and also decreased the level of firmness loss as a result of decrease in the activities of pectin methylesterase and polygalacturonase. Reduced ripening of transgenic tomatoes by the silencing of three homologs of ACC synthase (1- aminocyclopropane-1-carboxylate synthase) using RNAi technology. These ACS homologs are effectively reduced the ethylene production and showed increased shelf-life with improved juice quality, and the inhibition of ethylene brought about compositional alter in transgenic fruits by enhanced polyamines levels. In the recent study, the over-expression of AtSHN1 (SHINE1) in transgenic mulberry plants displayed dark green shiny emergence with enhanced leaf surface wax content and significant enhancement in leaf moisture retention ability. In addition, the promoters of α-Man and β-Hex genes are also fruit ripening specific and could be helpful tools in regulating gene expression associated studies during fruit ripening. Earlier reports suggest that the transformation of N-glycan processing enzymes can be of strategic significance to reduce post-harvest losses in both climacteric as well as non-climacteric fruits. Additionally, enhanced shelf life and post-harvest stability of vegetables and fruits were also reported by silencing of the genes involved in the biosynthesis of ethylene like ACC (1- aminocyclopropane-1- carboxylic acid) synthase and ACC oxidase, and abscisic acid (9-cisepoxycarotenoid dioxygenase) that initiates and accelerates fruit ripening, and genes (polygalacturonase, expasin) that involved in fruit softening by degrading cell wall components. The CRISPR/Cas-9 technique is a novel approach used to Site-directed mutagenesis in a specific genome region. Aapplication of the genome editing (CRISPR/Cas9) system to an efficient mutagenesis of

the *Solanum lycopersicum* (tomato) genome and targeted the tomato ripening inhibitor (RIN) gene, which encodes a transcription factor (MADS-box) regulating fruit ripening. The disruption of RIN gene produced incomplete-ripening fruits (delayed ripening and permanently inhibited ripening), in which red colouration was extensively lower than that of wild type, and the results authenticate the important function of ripening inhibitor (RIN) in ripening.

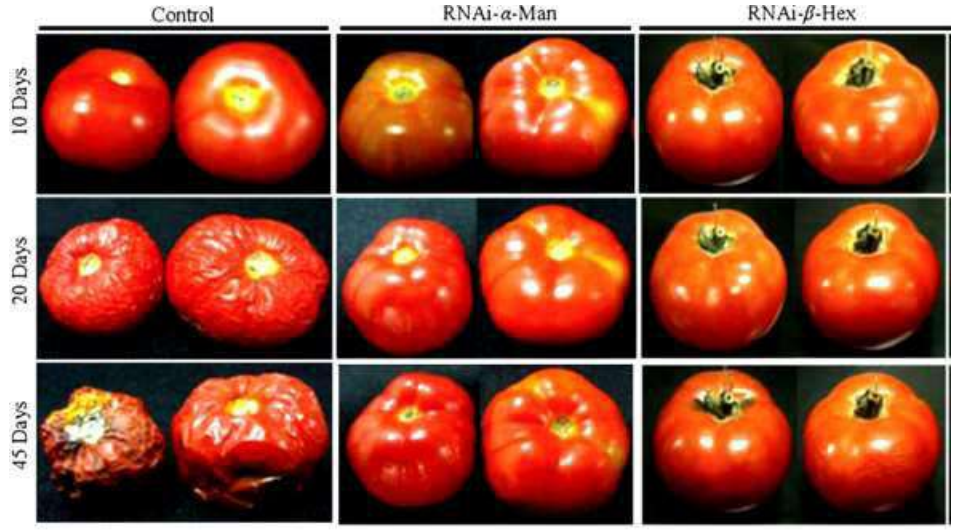


Fig. Suppression of α-Man or β-Hex increased transgenic *Solanum lycopersicum* shelf life. Harvested transgenic fruits and wild type (control) fruits were at pink developmental phase and stored at RT. The deterioration of fruit was recorded by time-lapse taking photographs. Days specified for fruits after harvest. (Adopted from: Meli et al., 2010)

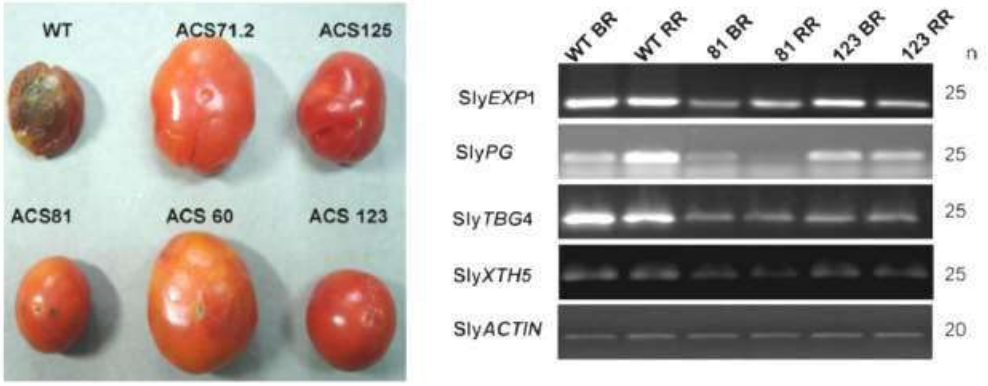


Fig. Storage quality of *Solanum lycopersicum* (tomato) fruits from control plants (wild-type) and RNAi-ACS transgenic lines. (A) Display of wide-ranging shelf-life of RNAi-ACS transgenic *Solanum lycopersicum* at RT after 70 days of post harvest at BR stage; (B) semiquantitative RT-PCR expression analysis of cell wall hydrolyzing genes. 'n'- no. of cycles in semi-quantitative RT-PCR analysis (Source: Gupta et al., 2013).

INCREASING SHELF LIFE OF FLOWERS

Genetic engineering procedure had so far narrow impact in decorative horticulture field. Though, ornamental horticulture and predominantly floriculture are very well suited to the move toward of genetic engineering system. Genetic modification

technology has been used to develop many varieties of crop plants, but in ornamental plants are very few varieties. But ornamental plants play a very important part in the human interaction with and modify the environment. Food and medicinal value of plants not bring together and domesticated for 1000 (thousands) of years, simply because of the ornamental worth of their morphology or flowers. In horticulture industry ornamental plants are well documented like financial, ecological and good benefits. Ornamental plants gathered by European to explorers to the worldwide and breeder exploited the variant that could be built up from plant breeding and the diversity of cultivated ornamentals plants increased extremely. Till date, 1000 (thousands) of varieties of cut-flowers, hanging plants, pot plants, bedding plants, shrubs, lawn and turf, ornamental tree and aquatic plants are accessible to the civic. The modification of flower color has been a paying attention work of area for all the researchers in floriculture. Many ornamentals plants have been genetically modified for flower color like rose, carnation and gerbera. The target of genetic engineering for flower color alteration, plants having pigment in flowers is a broad range of flavonoids, carotenoids and betains. By altering the flavonoids biosynthetic pathways through the transformation of novel genes, over-expression of particular key regulatory genes or by down regulation or silenced the expression of the potential gene by co-suppression technology, AS (antisense) gene technology, RNA interference approach (RNAi) or CRISPR/cas9 technique. Basically researchers has been focused on the modification of either blue or red colors (anthocyanins) or, orange or yellow colors (carotenoids) to generate a wide range of flower colors, as well as to produce natural dyes for industrial purposes (Lu et al., 2003).

Meyer et al. 1987 first developed modified flower color by the application of genetic engineering achieved by using the dfr (dihydroflavonol- 4 reductase) gene of *Zea mays* (maize) in a petunia line, in which the modified petunia plants flower colors lead to the formation of an orange pelargonidinproducing Petunia and the plants turn out flowers with pale brick color. While, van der Krol et al. (1988) reported Chs (Chalcone synthase) gene which had been used for creation of pink, white and variegated flowers in petunias, roses, chrysanthemum and gerbera through sense and antisense gene. With the manipulation of F3050H gene from Petunia hybrid have been successfully generate transgenic violet carnations, which encodes a flavonoid necessary for the biosynthesis of delphinidin. Savin et al. (1995) developed genetic engineered carnation plants by using ACO gene from *Dianthus caryophyllus* L. cv. Scania through antisense technique and these transgenic plants showed low ethylene production and delayed petal senescence. Genetic engineered carnation plants containing the Etr1-1 gene under the control of CaMV35S constitutive promoter or floral binging protein promoter (FBP1) and these transformed showing delayed senescence at least by 6 days and maximum up to 16 days, three fold enhancement in shelf-life. Another reports showed similar results when Etr1-1 promoted by a CMB2 (carnation MADS box gene) promoter (Baudinette et al., 2000, Florigene Ltd., unpublished results). Aida et al. (1998) generated transgenic torenia show flower longevity was average 2.7 – 7.1 days with compared to the wild type plants was 2 days. Cobb et al., (2002) reported

transgenic petunia having the Etr1-1 gene driven by a FBP1 promoter had fully open flowers for 14 days while non transformed plants had for 3 days. While, Century et al., 2008, identified the transcription factors regulating the anthocyanin pathway and since extra is erudite of the spatial regulation of flavonoid biosynthesis, and for genetic alteration through transcription factor for up-regulation and down-regulation of pigment biosynthesis. Additionally, during the flower induction and initiation, the endogenous production and allocation of plant growth regulators like indole-3- acetic acid (IAA), abscisic acid (ABA) and indole-3-pyruvate (IPA) may make possible by us to improved plan for utmost flower regularity and the excellence of ornamentals plants during harvest (Teixeira da Silva et al., 2013) Monsanto (US company), an agriculture biotech firm, has patented a product that will stop flowers wilting by altering their DNA by using reverse genetic engineering to prevent the natural damage of cells that take place once a plant is cut and enlarge their shelf life. The company filed a patent in 2016 for the product, which muffles the plant's DNA and stops the production of ethylene gas, which ripens fruits and rots petals. It then gets into the plant's DNA and strangles the EIN2 gene, which would otherwise trigger the production of ethylene.

(http://www.dailymail.co.uk)

Fig. Transgenic rose showing, flower that won't wilt with petals that stay fresh for days.

CONCLUSION

Genetic engineering has the potential to be used as an efficient tool to deal with the various problems in agriculture and society. The appearance of transgenic platform concerning the beginning of defined DNA sequences into plants by humans has quickly altered the surface of our planet by additional increasing the gene pool used by plant breeders for crop improvement. Genetic modification is being used to decrease yield losses due to biotic stresses, abiotic stresses, and biofortification of food crops by enrichment with excellence proteins, vitamins, micronutrients, carotenoids, anthocyanins etc. Moreover, post-harvest stability of fruits and vegetables has also been increased significantly to decrease the postharvest losses. Therefore, genetic engineering serves as a proficient tool to commence desirable uniqueness in plants in a rapid and precise way. In spite of allied bio-safety issues, if planned and developed thoughtfully, it can assist to resolve the most important world problems of undernourishment and food insecurity in combination with conventional breeding programs.

Nano Fertilizers: A Smart Nutrient Delivery System with higher Efficiency

Dewali Roy[1], Rakesh S[2] and Abhas Kumar Sinha[1]

[1]Uttar BangaKrishiViswavidyalaya, Pundibari, Cooch Behar-736165, West Bengal, India
[2]ICAR-National Academy of Agriculture Research Management, Hyderabad-500030, Telangana
** Corresponding author: rakisavan.940@gmail.com*

ABSTRACT

With the global upsurge in population and rapid urbanization, farmers across the globe are left with the daunting task of feeding more mouths every year from agricultural fields which are dwindling correspondingly. With limited availability of land and water resources, growth in agriculture can be achieved only by increasing productivity through an effective use of modern technology. Numerous studies suggest that nanotechnology will have major, long-term effects on agriculture and food production. Nano fertilizer technology are the important tools in agriculture to improve crop growth, yield and quality parameters with increase nutrient use efficiency, reduce wastage of fertilizers and cost of cultivation. Equally they are found to be very effective for precise nutrient management in precision agriculture with matching the crop growth. Both Nano macro and micro nutrients based fertilizer are manufactured in developing countries. Through mechanisms such as targeted delivery or slow/controlled release mechanisms and conditional release, it can release their active ingredients in responding to environmental triggers and biological demands more precisely thus increase in nutrients use efficiency, reduces soil toxicity, minimizes the potential negative effects associated with over dosage and reduces the frequency of the application. Therefore, Nano scale science and nanotechnologies are envisioned to have the potential to revolutionize agriculture and food systems.

OVERVIEW:

The First Green Revolution during 1970s targeted to the four basic elements of production system viz. semi-dwarf high yielding varieties of rice and wheat, extensive use of irrigation, fertilizers and agro-chemicals and consequently resulted in terrific increase in the agricultural production. However, the agricultural production is experiencing a plateau nowadays, which has adversely affected the livelihood base of the farming community at large. In fact, the country is in need of a Second Green Revolution. In present agriculture fertilizer contributes to the tune of 50% of the

agricultural production but increasing use higher doses of fertilizers does not guarantee to improved crop yield but it leads several problems like degradation of soil and pollution of surface and underground water resources. *Solution:*1. Increase the fertilizer nutrient use efficiency and reduce doses. 2. Decrease the application rate of fertilizers. 3. Value-addition to traditional fertilizers and reduce doses per unit area. 4. Combine application of macro and micronutrient sources.

Coating and binding of nano and sub-nano composites are able to regulate the release of nutrients from the fertilizer capsule. In this regard, the application of a nano-composite consists of N, P, K, micronutrients, mannose and amino acids enhance the uptake and use of nutrients by grain crops. Moreover, nanotechnology could supply tools and mechanisms to synchronize the nitrogen release from fertilizers with crop requirements. This will be accomplished only when they can be directly internalized by the plants. The final goal is production of Nano fertilizers that will release their shipment in a controlled manner (slowly or quickly) in reaction to different signals such heat, moisture and etc. Hence,Nano technology has a high potential for achieving sustainable agriculture, especially in developing countries.

CRITICAL NEED OF NANO FERTILIZERS

Indian agriculture feels the pain of fatigue of green revolution. In the past 50 years, the fertilizer consumption exponentially increased from 0.5 (1960's) to 24 million tonnes (2013) that commensurate with four-fold increase in food grain output (254 million tonnes). Despite the resounding success in grain growth, it has been observed that yields of many crops have begun to stagnate as a consequence of imbalanced fertilization and decline in organic matter content of soils. The optimal NPK fertilizer ratio of 4:2:1 is ideal for crop productivity while the current ratio is being maintained at 10: 2.7: 1 in India. The fertilizer response ratio in the irrigated areas of the country has decreased from 13.4 kg grain / kg nutrient applied in 1970's to just 3.7 kg in 2005. In order to achieve a target of 300 million tonnes of food rains and to feed the burgeoning population of 1.4 billion in 2025, the country will require 45 million tonnes of nutrients as against a current consumption level of 23 million tonnes. The extent of multi-nutrient deficiencies is alarmingly increasing year by year which is closely associated with a crop loss of nearly 25–30%. The extent of nutrient deficiencies in the country is in the order of 89, 80, 50, 41, 49 and 33% for N, P, K, S, Zn and B, respectively. In fact, the country is in great need of a Second Green Revolution. Nano fertilizers are envisioned to have the potential to revolutionize agriculture.

NANO FERTILIZER AS A SMART NUTRIENT DELIVERY SYSTEM

"Nano fertilizers" are synthesized or modified form of traditional fertilizers, fertilizers bulk materials or extracted from different vegetative or reproductive parts of the plant by different chemical, physical, mechanical or biological methods with the help of nanotechnology used to improve soil fertility, productivity and quality of agricultural produces. Nano particles can have made from fully bulk materials.Nano fertilizer technology is very innovative and scanty reported literatures are available in the scientific journals.

Nutrient use efficiencies of conventional fertilizers hardly exceed 30-35 %, 18-20 % and 35-40 % for N, P and K respectively. A smart delivery system for agriculture should consider the factors or combination of factors such as time controlled, specifically targeted, highly controlled, remotely regulated/ pre-programmed and multifunction characteristics to avoid biological barriers for successful targeted release of required nutrients. The Nano science has greatly impacted the conventional delivery systems by eliminating the limitations such as leaching, degradation by photolysis, hydrolysis and bio-instability in atmosphere. This results in repeated use of pesticides and insecticides causing higher cost of cultivation and environmental pollution. Several important benefits of nano-fertilizers are illustrated in figure 1.

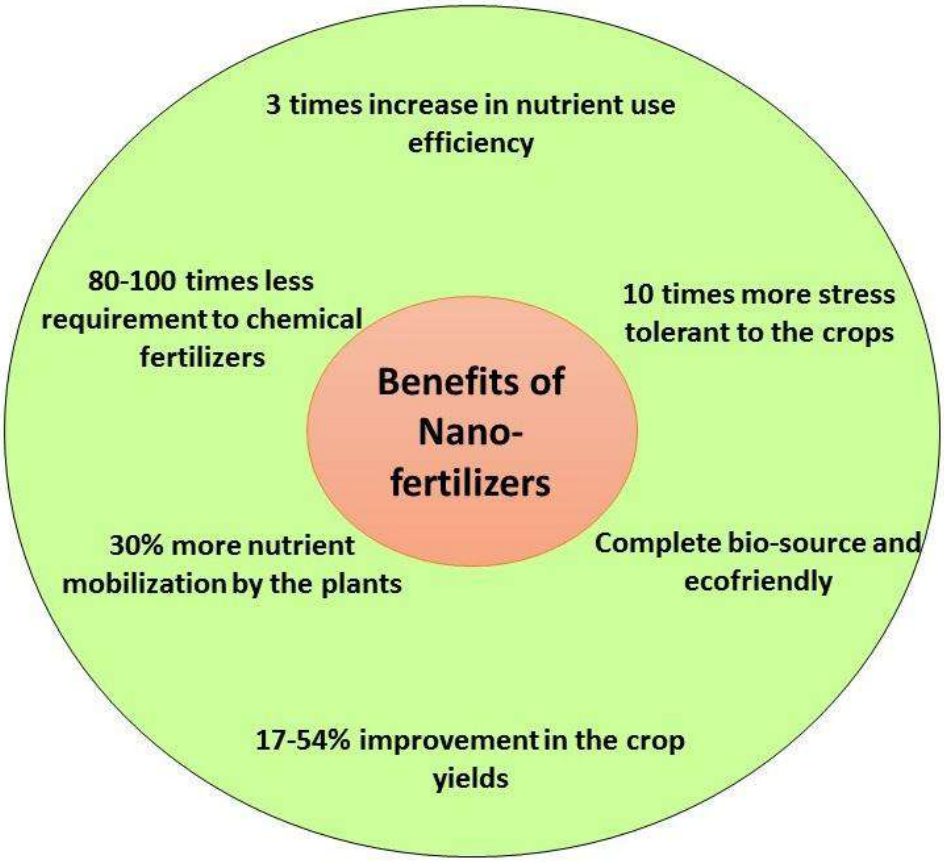


Fig. 1: Benefits of Nano-fertilizers

Essential Macronutrients based Nano Fertilizer

Nitrogen (N) Nano-fertilizer

To overcome the problems associated with the nitrogen (N) leaching during fertilization, different approaches such as polyolefin resin-coated urea, neem coated urea, sulphur coated urea were taken to control the N release. However, slow-releasing fertilizers are often expensive and the release of N is slow at the time of high N. Nitrogen loss can also be reduced using cation exchanger as additives in fertilizer to control ammonium(NH_4^+) release. The retention and timely release of needed nutrients by zeolite improves overall crop yield. Clinoptilolite zeolite (CZ), a porous mineral with high cation exchange capacity (CEC, up to 300 c mol (p+) kg^{-1}) and with great affinity for NH_4^+ (Ming and Mumpton, 1989), has been used to reduce NH_3 emission from farm manure (Amon *et al.,*1997), and to

eliminate NH_3 toxicity to plants (Gupta *et al.,* 1997). Amendment of clinoptilolite zeolite (CZ) to sandy soil has been reported to lower NO_3^- and NH_4^+ concentrations in the leachate and to increase moisture retention in the soil due to increased soil surface area and CEC (Huang and Petrovic, 1994).Urea nitrogen has been the most used N-source due to lower cost per unit of N. But N use efficiency of urea may be reduced because of losses from agricultural system by volatilization of ammonia to atmosphere. This is one of the main factors responsible for the low efficiency of urea, and may reach extreme values, close to 80% of N applied. Perrin *et al.,* (1998) stated that clinoptilolite not only improves nitrogen fertilization efficiencies, it also reduces nitrate leaching by inhibiting the nitrification of ammonium to nitrate. Lefcourt and Meisinger (2001) reported that zeolite has the potential for reducing ammonia volatilization by sequestering ammonium-N on exchange cites. An addition of 6.25% zeolite resulted in a 50 % reduction in ammonia volatilization.

Phosphorus (P) Nano-fertilizer

Allen *et al.,* (1996) conducted studies to examine the solubility and cation-exchange in mixtures of rock phosphate and NH_4^+ and K^-saturated clinoptilolite revealed that mixtures of zeolite and phosphate rock had the potential to provide slow-release fertilization of plants in synthetic soils by dissolution and ion-exchange reactions. Malhi*et al.,* (2002) reported that the zeolites (clinoptilolite), when saturated with mono-valent nutrient cations, such as NH_4^+ and K^+ have been reported to increase the solubility of phosphate rock (PR). The efficiency of fertilizer P use by crops ranged from 18 to 20 % in the year that it is applied. The remaining 78 to 80% becomes part of the soil P pool which is released to the crop over the following months and years. Bansiwal*et al.,* (2006) demonstrated that the release of P from fertilizer-loaded unmodified zeolite, surface modified zeolite (SMZ) and from solid KH_2PO_4 were performed using the constant flow percolation reactor. The results showed that the P supply from fertilizer-loaded SMZ was available even after 1080 h of continuous percolation, whereas P from KH_2PO_4 was exhausted within 264 h. The results indicated that SMZ is a good sorbent for PO_4^{3-}, and a slow release of P is achievable.

$$(\text{P-rock}) + (NH_4 - \text{zeolite}) = (\text{Ca zeolite}) + (NH_4^+) + (H_2PO_4^-)$$

The zeolite takes Ca^{2+} from the phosphate rock, thereby releasing both phosphate and ammonium ions. Unlike the leaching of very soluble phosphate established equilibrium, the fertilizers (for example, super phosphate), the controlled-release phosphate is released of a specific chemical reaction in soil. As phosphate is taken up by plants or by soil fixation, the chemical reaction releases more phosphate and ammonium in the attempt to reestablish equilibrium. Andrews and Shaw (2010) reported that zeoponic is a plant demand driven nutrient delivery system and from this phosphate (PO_4^{3-}) and other nutrients released by controlled dissolution of synthetic apatite. N, P and K were delivered when plant needs them from zeoponics. SharmilaRahale (2011) studied the PO_4^{3-}release pattern of surface modified using various nano clays and zeolite in a percolation reactor. Nano-formulations have been shown to release phosphate for an extended period of 40- 50 days and the conventional fertilizer let out nutrients only up to 10- 12 days. The review of literature suggests that surface modified zeolite could be potential strategy to promote P use efficiency which hardly exceed 18- 20 % in conventional system.

Potassium (K) Nano-fertilizer

Some natural zeolites contain considerable amounts of exchangeable K^+ that can enhance plant growth in potting media. For example, Hershey *et al.,* (1980) provided data on the slow release effect of K from K-zeolite. Mazur *et al.,* (1986) stated that the application of chemical fertilizer at the rate 625 kg ha-1mixed with zeolite 125 kg ha^{-1}indicated the largest amount of potassium in the soil because zeolite had potential to adsorb potassium from chemical fertilizer and reduce it from leakage. Natural zeolites are highly selective for K^+ rather than for sodium or divalent cations, such as calcium and magnesium, because of the location and density of the negative charge in the structure and dimensions of the interior channels (Ming and Mumpton, 1989). Treacy and Higgins (2001) suggested that among all, potassium is the only element with the highest ion-exchange capacity of 216 c mol (p^+) Kg^{-1} (Dakovic*et al.,* (2007) and consequently, it is very easily released from the crystal zeolite structure into the soil solution, eventually increasing its total content in the soil. Zhou and Huang (2007) reported that slow and steady release of K from nano-zeolite and gave the reason that it may be due to the ion exchangeability of the zeolites with selected nutrient cations, zeolites can become an excellent plant growth medium for supplying plant roots with additional vital nutrient cations and anions. Guo*et al.,* (2008) suggested that the zeolite can be "recharged" by the addition of more dissolved nutrients. Their selectivity of ion exchange on zeolite was determined in an order of $K^+ > NH^{4+} > Na^+ > Ca^{2+} > Mg^{2+}$.

Secondary nutrients Nano-fertilizer

Supapron*et al.,* (2007) reported that zeolite showed slow release fertilizer for calcium and magnesium. They suggested that, zeolite improved calcium and magnesium in soil. Fansuri*et al.,* (2008) reported that zeolite is able to freely exchange nutrient ions such as calcium and magnesium..Li and Zhang (2010) studied the feasibility of using surfactant-modified zeolite (SMZ) as fertilizer additives to control sulfate release, was tested in batch and column leaching experiments which indicated that SMZ could be a good carrier for sulfate.

Micronutrients Nano-fertilizer

Sheta*et al.,* (2003) undertaken research to characterize the ability of five natural zeolites and bentonite minerals to adsorb and release zinc and iron. The potential for sorption of these ions were evaluated by applying the Langmuir and Freundlich equations. The results suggest that natural zeolites, particularly chabazite and bentonite minerals, have a high potential for Zn and Fe sorption with a high capacity for slow release fertilizers. Broos*et al.,* (2007) reported that slow release of Zn is attributed to the sparingly solubility of minerals and sequestration effect of exchange, thereby releasing trace nutrients to zeolite exchange sites where they are more readily available for uptake by plants. The concentration of Cu and Mn in Sudangrass (in mg/kg) was significantly related to the zeolite/P-rock in experimental systems that used two different NH^{4+} saturated zeolites, two different soils and two different forms of P-rock. The concentration of Cu and Mn in Sudan grass (in mg/kg) was significantly related to the zeolite/P-rock in experimental systems that used two different NH_4 saturated zeolites, two different soils and two different forms of P-rock. Rana and Viswanathan (1998) studied Mo incorporation in MCM-41 type zeolite and IR, FT-Raman and UV-VIS DR spectroscopic analyses gave the evidences for the incorporation of Mo in the framework of MCM-41.

CONCLUSION

Small sized, nano particles (NP) act as an excellent catalyst in chemical reactions.These NPs depends on environmental factors like temperature, pH, solubility, etc. hence it is crucial to alter, it may alter the function of NPs. Introduction of any new technology always has an ethical responsibility along with the tremendous positive potential. Public awareness about the advantages and challenges of nanotechnology will lead to better acceptance of this emerging technology. Nanotechnology applications in agriculture and food systems is still at the nascent stage and a lot more applications can be expected in the years to come.

Biofilm Formation

Vaishali[1*] and Davinder Singh[2]

[1]PhD Scholar, Department of Veterinary Public Health and Epidemiology, LUVAS, Hisar, Haryana
[2]Extension Specialist, Directorate of Extension Education, LUVAS, Hisar, Haryna- 125001
**Corresponding author: seh.vaish@gmail.com*

ABSTRACT:

A biofilm is a group of bacteria either homogenous or heterogenous population which remain in a matrix formed by the constituent population of the matrix. A Biofilm is formed in multiple stages when the cells of different group of micro-organism stick to each other irreversibly on the surfaces and form an extracellular matrix comprising of exopolysaccharides, DNA, RNA and protein. It can form a single layer or multiple layers depending on the interaction between the constituent cells and the surface. The extracellular polymeric secretions protect the cells by surrounding them. Biofilms have increasingly become significant issue for public health and are hard to eliminate because for their ubiquitous nature. Various non-cellular components that have developed biofilms such as blood components, mineral crystals, clay or slit particles are also associated to be found in biofilm matrix.

INTODUCTION:

The biofilm matrix is made up of water (97%), microbial cells (2-5%), proteins (1-2%), polysaccharide (1-2%) and DNA and RNA (<1-2%). Biofilm formation can take place on a variety of surfaces i.e, biotic and abiotic.

The formation of biofilm is a complex multistep process and micro-organism transform to sessile mode from the planktonic mode. Various steps involved for the formation of biofilms are: a) Surface attachment, b) micro colony formation, c) formation of 3D matrix, d) maturation of biofilms and e) dispersal of cells of biofilm.

In first stage, the microbial cells of the planktonic bacteria attach to the surface by flagella or pilli, fimbriae, lipopolysaccharide or exopolysaccharide and makes a reversible connection through van der waals interaction. The adhesions of bacteria is greatly modulated by temperature, pressure and surface functionality. A solid liquid interface provides an ideal medium for the formation of biofilms like air-water interaction. After attachment to a biological tissue or physical surface, the binding becomes stable. Chemical signals initiate the multiplication of bacteria and as the intensity of specific threshold of signal is crossed, the bacteria cell division happens within the matrix of exopolysaccharide and it results in micro colony formation. The microbial colonization seems to increase as the roughness of surface increases because

the surface area is more and the shear forces are reduced. The autoinducer signals are produced and the microbial cells start communicating amongst each other. After the formation of micro colony, some genes related to the biofilms express themselves. The biofilm formation is by the EPS which is the basic structure and it needs the gene products. The extracellular matrix formation is triggered itself by the bacterial attachment. The micro colony increases in its size and thickness upto 100 µm. For the further transport of nutrients, water channels are formed and they act like circulatory system which distributes nutrients and remove the waste material from various communities formed in the micro colonies of the biofilm. The planktonic bacterial cells detach from the biofilms on a regular basis as a programed detachment having a natural pattern. among those bacteria few detach due to mechanical stress and few detach because the production of EPS stops. And among those new formed cells few detach from the growing cells or the biofilm aggregates disperse due to quorum sensing. Extra cytoplasmic function, quorum sensing and the two component signalling are the sensing systems used in biofilm formation. Biofilm formation can also be triggered by some secondary messengers like c-di-GMP (cyclic guanosine monophosphate).

QUORUM SENSING:

It is the mechanism of controlling the gene expression allowing various species of Gram positive and Gram negative bacteria to communicate with each other. It is a multicellular response working in a density dependent way to produce and detect extracellular signalling molecules which are known as Autoinducers. As the bacterial density increases, autoinducers intensify in the environment and bacteria then trace this information to identify the changes in their cell density and all together gene expression. Various physiological activities are regulated by the bacteria like virulence, conjugation, motility, symbiosis, sporulation, antibioticproduction which is mediated by quorum sensing. Autoinducers used by Gram positive bacteria are oligo-peptides and acylatedhomoserine lactones are used by Gram negative bacteria to communicate. When the microbial population reaches a certain threshold level, and the autoinducers have accumulated on the outside of cell, these molecules regulate the expression of genes relating to virulence and the formation of biofilm.

EXTRA CYTOPLAMIC FUNCTION:

It is another important signalling sensing system constituting of an alternative sigma factor and an antisigma factor which is present in the cell membrane. Few outer membrane proteins and periplasmic proteins are also involved in the process. The periplasmic proteins receive the extracellular signals and degrades antisigma factor which releases the sigma factor that further results in transcription of few target genes that help in biofilm formation.

TWO COMPONENT SIGNALLING SYSTEM:

It consists of Histidine kinase (HK), a sensor protein that sense environmental conditions and Response regulator (RR) protein, a transcriptional regulator that allows

cell to respond by regulating the expression of gene. The main function of the two component signalling system is adaptation, survival and virulence of the bacteria by sensing the changes in environmental conditions and regulating the gene expression to variety of stimulus. After stimulation the sensor protein undergoes autophosphorylation at histidine residue. The cognate response regulator receives the phosphoryl group and this is turn regresses or activates the transcription of target gene. This can broadly regulate the bacterial cell cycle, numerous metabolic processes, cell to cell communication and virulence factors in different bacterial species.

REFERENCES:

Brown, J.R., Jurcisek, J., Lakhani, V., Snedden, A., Ray, W.C., Mokrzan, E.M., Bakaletz, L.O. and Das, J., 2019. In Silico Modeling of Biofilm Formation by NontypeableHaemophilusinfluenzaeIn Vivo. mSphere, 4(4), pp.e00254-19.

Algburi, A., Comito, N., Kashtanov, D., Dicks, L.M. and Chikindas, M.L., 2017. Control of biofilm formation: antibiotics and beyond. Appl. Environ. Microbiol., 83(3), pp.e02508-16.

Kragh, K.N., Hutchison, J.B., Melaugh, G., Rodesney, C., Roberts, A.E., Irie, Y., Jensen, P.Ø., Diggle, S.P., Allen, R.J., Gordon, V. and Bjarnsholt, T., 2016. Role of multicellular aggregates in biofilm formation. MBio, 7(2), pp.e00237-16.

Arciola, C.R., Campoccia, D. and Montanaro, L., 2018. Implant infections: adhesion, biofilm formation and immune evasion. Nature Reviews Microbiology, 16(7), p.397.

Fluoride Contamination and Its Mitigation Measures

***Dr. Karthika V, **Dr. R. Sureshkumar and **Dr. M. Rajasekar**

*Assistant Professor (ENS) and **Assistant Professor (AGR)*
Department of Crop Management, Kumaraguru Institute of Agriculture, Erode – 638315
**Corresponding Author: karthiwtc@gmail.com*

ABSTRACT

Water is most abundant and is an essential component of our life supporting system. But today most of the countries are facing drinking water problems. In India, drinking water is contaminated at many places by various pollutants such as fluorides, nitrates, iron etc. In India, endemic fluorosis affect more than one million populations and is a major problem in 17 of the 29 states. Similar health problems due to high fluoride content in ground water have also been reported worldwide and it is estimated that around 260 million people are adversely affected in 30 countries of the world (Neelo Razbe *et al*.,2013).Fluoride is considered as a "two edged sword" because deficiency of fluoride intake leads to dental caries while excess consumption leads to dental and skeletal fluorosis (Gopalakrishnan *et al*.,1999).Fluoride ion is attracted by positively charged calcium ion in teeth and bones due to its strong electro negatively which results in dental, skeletal and non skeletal forms of fluorosis (Vaishali Tomar *et al*.,2013). Because of high toxicity of fluoride to mankind, there is an urgent need to treat fluoride contaminated drinking water to make if safe for human use.

INTRODUCTION

Fluorine is the lightest member of halogen group of elements and most electronegative of all elements. In solution it forms fluoride (F-). Fluoride forms strong solute complexes with many cations. Concentration of fluoride in the continental crust is 611 mg/kg. Various rock types contain fluoride at different levels: basalt, 360 µg/g; granites, 810 µg/g; limestone, 220 µg/g; sandstone, 180 µg/gm; shale 800 µg/gm; oceanic sediments, 730 µg/gm and soils, 285 µg/gm. Fluoride is an essential constituent in minerals such as fluorite, apatite, cryolite and topaz. Minerals like biotite, muscovite and hornblende may contain considerable per cent of fluoride. Of the 85 million tons of fluoride deposits in the earth crust world-wide, 12 millions are found in India (Teotia and Teotia 1994). Beside rocks, it is commonly present in plants, soil, phosphatic fertilizers and rock minerals.

Occurrence and Hydro geochemistry

Fluorite (CaF2) is a common fluoride mineral but has low solubility and occurs in sedimentary and igneous rocks. Apatite Ca5 (Cl, F,OH) (PO4)3 commonly contains fluoride. Amphibioles such as hornblende and some mica may contain fluoride which has replaced part of hydroxide. At low pH the form "HF" could occur. Strong fluoride complexes could be formed with aluminium, beryllium and ferric ions and a series of mixed fluoride-hydroxide complexes is possible with Boron. In acid solution, fluoride could be associated with silica however their stability is seldom reached in natural water. Ion exchange effects show amount of adsorption to be large for gibbsite, kaolinite and halloysite, especially for a fresh Al(OH)3 precipitate. F-adsorption is dependent on pH.

The occurrence of the fluoride in groundwater is predominantly geogenic. Fluoride enrichment in groundwater takes place mainly through leaching and weathering of the Fluoride bearing minerals present in the rocks and sediments. The important fluoride-bearing minerals are; fluorite (fluorspar), fluorapatite, cryolite, biotite, muscovite, lepidolite, tourmaline, hornblende series minerals, glucophane-riebeckite etc .Besides these, there are anthropogenic source of fluoride also, like phosphatic fertilizer, cow dung and urban waste etc.

Health Hazard

Low level fluoride is required by human system, while consumption of high concentrations of fluoride can lead to serious health issues. The long exposures and use of ground water having high fluoride in excess of 1.5 mg/l results in *Fluorosis,* The types of fluorosis are dental, skeletal as well as non-skeletal type. The dental fluorosis is the discoloration starts from white, yellow, brown to black. It affects both the inner and outer surfaces of the teeth. Skeletal fluorosis is due to excessive quantity of fluoride deposited in the skeleton, which is more in cancellous bones compared to cortical

Figure 1Symptoms of Fluorosis Mottled Teeth and Knocking Knees

bones. Fluoride poisoning leads to severe pain associated with rigidity and restricted movements of cervical and lumber spine, knee and pelvic joints as well as shoulder joints. Crippling deformity is associated with rigidity of joints and includes Kyphosis, Scoliosis, flexion deformity of knee joints, Paraplegia and Quadriplegia. Skeletal fluorosis affects both young children as well as adults. Non-skeletal type of Fluorosis includes ill effects on skeletal muscle, Erythrocytes, Gastro-Intestinal system, ligaments or combination of all. Fluorosis is irreversible and no treatment exists for it.

REMEDIAL MEASURES

The fluoride remedial measures broadly classified into three major categories (Shrivastava and Vani 2009, Piddenanavar and Krishnappa, 2013).

(a) Adsorption and ion exchange

This technique functions on the adsorption of fluoride ions onto the surface of an active agent such as activated alumina, red mud, bone char, brick pieces column, mud pot and natural adsorbents where fluoride is removed by ion exchange or surface chemical reaction with the solid bed matrix. Activated alumina is a highly porous aluminium oxide exhibiting high surface area. The maximum absorption capacity of activated alumina for fluoride is found to be 3.6 mg F/g of alumina. Red mud is the insoluble product after bauxite digestion with sodium hydroxide at elevated temperature and pressure. In Brick pieces column, the soil used for brick manufacturing contains Aluminium oxide during burning operation it gets activated and adsorbs excess fluoride when raw water is passed through it. Mud pots are the raw pot subjected to heat treatment in the case of brick production and thus act as an adsorbent media. Many natural adsorbents from various trees tried as defluoridation agents. Seeds of the Drumstick tree, roots of Vetiver grass and Tamarind seeds were few among them.

Ion-Exchange resins

Synthetic chemicals, namely, anion and cation exchange resins have been used for fluoride removal. Some of these are Polyanion (NCL), Tulsion A - 27, Deacedite FF (IP), Amberllte IRA 400, LewatitMIH - 59, and AmberliteXE - 75. The fluoride exchange capacity of these resins depends upon the ratio of fluoride to total anions in water.

(b) Coagulation-precipitation

Precipitation methods are based on the addition of chemicals (coagulants and coagulant aids) and the subsequent precipitation of a sparingly soluble fluoride salt as insoluble. Fluoride removal is accomplished with separation of solids from liquid. Aluminium salts (eg. Alum), lime, Poly Aluminium Chloride, Poly Aluminium Hydroxy sulphate and Brushite are some of the frequently used materials in defluoridation. The best example for this technique is Nalgonda technique.

Nalgonda Technique

Nalgonda technique (Nawlakhe *et al*., 1975) involves addition of Aluminium salts, lime and bleaching powder followed by rapid mixing, flocculation, sedimentation, filtration and disinfection. It is used in various scales from household level to community scale water supply.

The Nalgonda technique can be used for raw water having fluoride concentration. between 1.5 and 20 mg/l and the total dissolved solids should be <1500 mg/l, and total hardness < 600 mg/l. The minimum residual alkalinity of 1 - 2 meq/l in the treated water to achieve a pH of 6.5 - 8.5 in treated water. Several researchers have attempted to improve the technique by increasing the removal efficiency of fluoride using Poly Aluminium Chloride (PAC) and Poly Aluminium Hydroxy Sulphate (PAHS).

Methodology developed by IISc, Bangalore (Rao and Mamatha, 2004)

This technique uses Magnesium oxide, lime and Sodium bisulphate. Magnesium oxide removes dissolved fluoride ions from water samples by precipitating fluoride as insoluble Magnesium fluoride. To overcome this bicarbonate interference, 0.3 mg of lime and 0.8 mg of MgO are added per liter water.

(c) Membrane techniques

Reverse osmosis, nanofiltration, dialysis and electro dialysis are physical methods that have been tested for defluoridation of water. A study was conducted in fluoride affected Nalgonda District of Andhra Pradesh, to introduce groundwater recharge, a check dam was constructed on upstream of capture well of 3 m dia with 5 m depth. The groundwater from capture well has been envisaged to be transferred through pipe by passing the delineated hydraulic barrier using gravity-siphon system for augmenting the main drinking water supply well source during lean period.

Capture well rejuvenated by recharged water

CONCLUSION

There are several options available for providing fluoride-free water to the people. People can harvest rain water from their own rooftop for meeting the drinking and cooking requirements. Building of large number of groundwater recharge structures for diluting the fluoride levels in aquifers at appropriate locations are another option to minimize the problem. A government based common treatment plant will have to be installed to supply fluoride free water for public. Conducting awareness programmes and educating people on fluorosis and promotion of calcium and phosphorus rich diet are recommended which are directly associated with a reduced risk of dental fluorosis.

Vitamin C ingestion also safeguard against the risk of fluorosis. Apart from this, free medical camps can be arranged to provide right treatment to the victims.

REFERENCES

Gopalakrishnan P., R. S. Vasan, P. S. Sarma, K. S. Ravindrannair, K and R. Thankappan (1999) Prevalence of dental fluorosis and associated risk factors in Alappuzha district, Kerala. *The National Medical Journal of India*, Vol.12, No.3.

Nawlakhe W.G, D.N.Kulkarni , B.N.Pathak and K.R Bulushu (1975) De-fluoridation of water by Nalgonda technique*. Indian Journal of Environmental Health*, 17: 26-65.

Piddennavar, R and P.Krishnappa (2013) Review on defluoridation techniques of water*. International Journal of Engineering and Sciences*, Vol 2(3) : 86-94.

Rao, M.S and P.Mamatha (2004) Water quality in sustainable water management. *Current Science*, 87(7): 942-947.

Razabe, Neelo, Kumar, Rajesh, Pratima and Kumar, Rajat (2013) Removal of fluoride ion from aqueous solution. Internat. J. Computat. Engg. Res., 3(4): 128-133.

Shrott, H.E., G.R.Merobert, T.W.Barnald, A.S.M. Nayar (1937) Endemic fluorosis in the Madras presidency. *Indian Journal of Medical Research*, 25: 553-561.

Shrivastava, B.K. and A.Vani (2009) Comparative study of defluoridation technologies in India.*Asian J. Exp. Sci,* 23(1): 269-274.

Teotia, S.P.S and M.Teotai (1994) Dental Caries: A disorder of high fluoride and low dietary calcium interactions (30 years of personal research) *Fluoride*, 27: 59-66.

Vaishali Tomar and Dinesh Kumar (2013) A Critical Study on Efficiency of Different Materials for Fluoride Removal from Aqueous Media. Chemistry Central Journal,Vol.7(1):115.

Crop Residue Burning: Environmental Threats and Alternatives

Gandu Ranjith Kumar[1*], Manchala Santhosh Kumar[2] and Ravula Manasa[1]

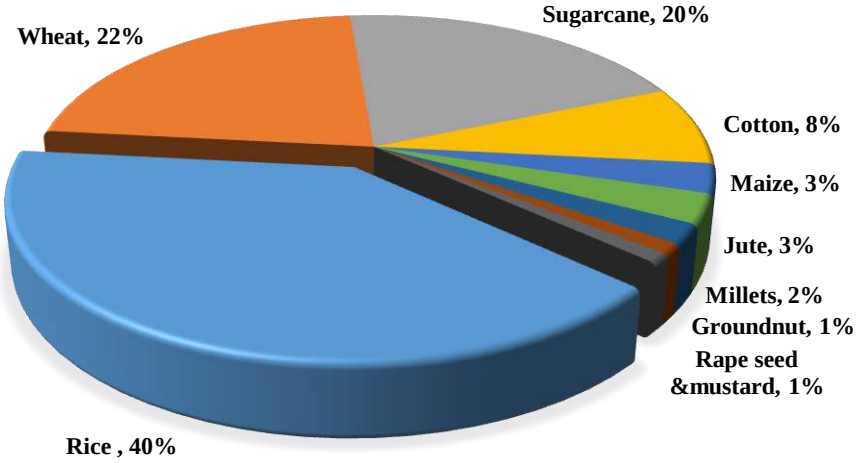
ICAR – National Academy of Agricultural Research Management[1]
CCS Haryana Agricultural university[2]
**Corresponding author: ranjithsiddu28@gmail.com*

ABSTRACT

The growing demand for food in developing countries have led to tremendous increase in food production around the world as well as in India also. Hence, agro-based activities represent profitable businesses, both in developing as well as developed countries. The multitude of agricultural activities increases the amount of agro-products produced and this has led to an overall increase in residue generation. Improper maintains of these crop residues causes environmental pollution. Mostly north Indian states (Delhi, Haryana, Punjab etc...) are affected because of these burning of crop residues.

Key words: Crop residue, Burning, Environment, Pollution, Smog

In India, about 2.5 million farmers in the Indo-Gangetic plains grow two crops a year rice and wheat. Rice is planted such that its water requirements are met from the monsoon rain, and within a short period of 10 to 20 days, the fields are cleared for wheat. A convenient way to get rid of the whopping 23 million metric ton of grass and hay left behind by rice cultivation is to burn them. Out of several crops grown, rice, wheat crops are prone to crop maximum residue burning. Compared to other crops farmers mostly choose these crops due to conductive growth and ensures maximum yield. In a study conducted by the Ministry of New and Renewable Energy, it is estimated that about 500 million tons of crop residues are generated annually. Another study by scientists working in the US and India has found that impact of crop residue burning in the Northwest region can spread as far as to central and southern states like Maharashtra, Madhya Pradesh, Telangana, Chattisgarh and even parts of Odisha.Another important aspect that cannot be ignored is the fact that many of these regions of crop residue burning are closer to some of the large metros including the National Capital Region, where there is already a pressure on the environment due to emissions from thousands of vehicles, air conditioners etc.However, this practice contributes to air pollution in cities like Delhi, where the air quality is already the worst in the world.

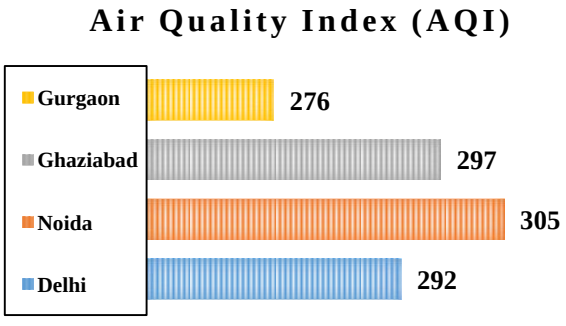


CONTRIBUTION OF DIFFERENT CROPS IN RESIDUE BURNING

In Punjab during October – November farmers burn the stubble of harvested rice. The open burning emit greenhouse gases like CO_2, CO, CH_4, N_2O, NO_xetc which are the reason for climate change and adverse health problems (Wang and Christopher, 2003).

Threats to Air Quality:

Day by day air quality index rises in Delhi,due to crop residue burning in paddy fields in Punjab and Haryana. The more air quality index rises, the more people likely to suffer from adverse health effects. Delhi's AQI reached to an alarming level of nearly nearly 201-207. Punjab and Haryana states are reason for the almost 48% of the emissions. Annually India emits 144719 mg of total particulate matter due burning of stubble. Poor air quality is the main reason for the Aggravate asthma, chronic respiratory problems.



Seasonal smog imposes enormous costs, such as major transportation disruptions and the closure of 4000 schools in Delhi in November 2017. Burning of rice crop residues during October and November in Delhi and nearby areas cause much more impact than seasonal smog.

Threats to soil quality:

Burning of crop residue drastically changes in soil physical, chemical and biological properties, which includes pH, Soil Organic Carbon, nutrient availability, infiltration rate and microbial activities. Crop residue burning in humid regions less harmful than dry environments. Stubble burning in arid and dry environments reduce soil fertility quite quickly.

Impacts of Crop residue burning

ALTERNATIVES FOR CROP RESIDUE BURNING IN INDIA

According to the study of Dr. shyamsunda *et al* stated"Happyseeder" method is more profitable among other alternative methods. Happy seeder machine is tractor mounted that cuts and lifts rice stubbles, sows seed, and then deposits the stubbles over the sown area as mulch. This is more profitable for farmers and can also help the environment through reducing the emissions. Happy Seeder method reduces the agricultural greenhouse emissions per hectare by 78%,the land preparation cost is often less than other practices that uses a combination of machinery, and the removed biomass improves soil moisture and could be good for the long-term health of the soil. Compared to other alternative methods farmers can be achieved 10 – 20% more profits by happy seeder method.Bailing (cutting and compressing of stubbles) is another alternative method which is which is less profitable than happy seeder method.

Farmers can use crop residue as mulching to conserve soil moisture. They can convert residue as Biochar which improves soil physical condition and use as carbon source for soil.

Alternative methods for crop residue burning

CONCLUSION

The sustainable management of crop residue has become a great challenge, especially for developing countries such as India with an increasing population and production. Crop residues are one branch of agricultural wastes that have posed challenges due to their vast volume and lack of capacities to manage them. Taking into account the fact that rice and wheat are usually produces the majority of crop residue being the major staples of India. The large-scale cultivation of these crops for feeding, increasing population definitely main reason for production of large quantities of crop residues.Educating the farming community is crucially important to bring them out of generational thinking that they are used-to that the waste management is not their responsibility. It is even more important to empower them with technical assistance. With proper management practices, government and farmers collaboration, adaption of alternative methods crop residue burning issue no more threat to our society.

REFERENCES

Wang, J and Christopher, S. A. 2003. Intercomparison between satellitederived aerosol optical thickness and PM2.5 mass: Implications for air quality studies, Geophys. Res. Lett., 30(21), 2095.

Jain, N., Bhatia, A., Pathak, H. 2014.Aerosol Air Qual. Res. 14, 422.

Sharma, M., Dikshit, O. 2016. Comprehensive Study on Air Pollution and Green House Gases (GHGs) in Delhi Indian Institute ofTechnology, Kanpur.

Shyamsundar, P., Springer, N. P.,Tallis, H.,Polasky, S.,Jat, M. L., Sidhu, H. S.,Krishnapriya, P. P., Skiba, N., Ginn, W., Ahuja, V., Cummins, J., Datta, I., Dixon, H. H. J., Gerard, B., Gupta, R., Hellmann, J., Jadhav, A., Jat, H. S., Keil, A., Ladha, J. K., Lopez-Ridaura, S., Nandrajog, S. P., Paul, S., Ritter, A., Sharma, P. C., Singh, R., Singh, D., Somanathan, R. 2019. Fields on fire: Alternatives to crop residue burning in India. Vol. 365, Issue 6453, pp. 536-538.

Biofuel from Salicornia plants

Vaishali[1*] and Davinder Singh[2]

[1]PhD Scholar, Department of Veterinary Public Health and Epidemiology, LUVAS, Hisar, Haryana
[2]Extension Specialist, Directorate of Extension Education, LUVAS, Hisar, Haryna
**Corresponding author: seh.vaish@gmail.com*

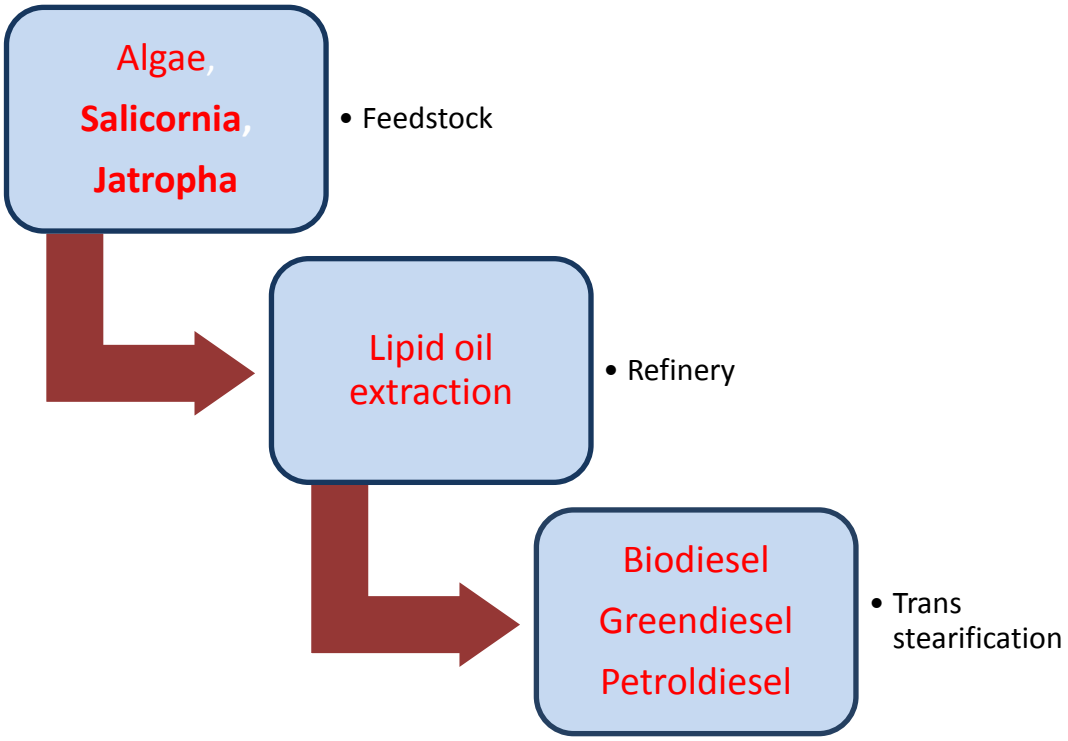
ABSTRACT

Biofuel is considered 'carbon neutral' as the plant biomass takes in carbon as it grows and releases it again during the combustion process. It has been found essential to find alternatives to fresh water to produce biofuels in the UAE where the consumption per capita ofwater is almost double that of global consumption. Salicornia is a halophytre which has been used for biofuel production. The oil-rich *Salicornia* is now being grown as part of the pilot project in Masdar city and is supported by Etihad Airways, Takreer, Safran, Boeing and General Electric to be used to produce aviation biofuel as part of a mixed fish/shrimp aquaculture project based around the use of brackish water or seawater.

K**eywords:** Salicornia, biofuel, halophytes, aquaculture and silviculture

Salicornia also known as glasswort or pickle grass is a genus of succulent, halophyte (salt tolerant) flowering plants in the family Amaranthaceae that grow in salt marshes, and among mangroves. This plants species is native to North America, Europe, South Africa and South Asia. These plants develop mainly in sandy or muddy saltmarshes that are flooded by the tide, in mudflats, sandflats, and sometimes in open saline areas. The Salicornia seed is small, ellipsoid and is characterized by heteromorphism: i.e., seeds from the same plant have a difference in colour, shape and size. The population is substantially growing and due to global climatic changes and salinization of ground water by rising sea levels, fresh water is limited and members of Salicronioidae family are proved to be promising candidates for the saline agriculture due to increasing tolerance to salinity being halophiles. Since its seed contains proteins (40%) and high-quality unsaturated oil (30%), it can be used to make biodiesel and used as animal feed. High doses of chemical fertilizers, particularly nitrogenous, and excess irrigation water for optimal yields of 'improved varieties' such as those of wheat and rice of in 1960s in the era of 'green revolution', has caused pollution of underground water leading to salinization of prime agricultural land. Also, aviation is one of the leading causes of the green house emissions and as a result, Salicronia plants has also been recently used as a biofuel in the commercial flight Etihad.Biofuel is considered 'carbon neutral' as the plant biomass takes in carbon as it grows and releases it again during the combustion process and it functions as one of the key parts of Masdar project to

determine economic sequestering of carbon. The first commercial flight using a sustainable biofuel originating from a fish farm was confirmed by Sustainable Bioenergy Research Consortium (SBRC),a non-profit entity established by Masdar Institute, part of the Khalifa University of Science and Technology.This special fuel was produced through SRBC in UAE. Liquid biofuels are an important renewable fuel in this transition because they are the preferred renewable energy source in the transportation sector, and the only renewable energy susbtitute for the aviation industry. The SBRC partners have been working together to prove the concept of a comprehensive value chain by establishing the biofuel that is centered around the Seawater Energy and Agriculture System (SEAS)Masdar City. The oil-rich *Salicornia* is now being grown as part of the pilot project in Masdar city and is supported by Etihad Airways, Takreer, Safran, Boeing and General Electric to be used to produce aviation biofuel as part of a mixed fish/shrimp aquaculture project based around the use of brackish water or seawater.



Salicornia as a biofuel feedstock are helpful in preventing the detrimental effects of industrial sources of saline water on terrestrial and aquatic ecosystems and produce a feedstock that resolves some of the issues with first-generation biofuels.The UAE is a place where water scarcity is prevalent, and food security is of utmost importance. Arid land is abundant in the UAE, and developing biofuel technologies will serve the entire world not only UAE which is in need of bioenergy,with fertile land and fresh water resources.Also because of more arid land, "water is more important to people of UAE than oil". SEAS is a flagship project of Sustainable Bioenergy Research Consortium (SBRC).The SEAS is feasible from a financial perspective, and generates important environmental and social benefits relaed to transition from petroleum-based fuel to renewable sustainable alternatives for the aviation industry. This project combines an

integrated system of aquaculture, halo-agriculture, and mangrove silviculture to produce sustainable biofuels for aviation and other by-products such as seafood.The SEAS pilot project facility main goal is to produce an alternative biomass resource that can further be converted to aviation biofuels, and to practically demonstrate that the integrated process is sustainable and environmentally responsible with respect to carbon emissions, land and water use, and discharge of other byproducts, such as aquaculture and silviculture waste products. The entire project worked on a format where sea water is pumped from the oceans to the ponds where fishes / shrimps would be grown.

Aquaculture for fish and shrimp has been designed on a large scale. The waste water which is obtained after the aquaculture operation is used to irrigate the salt tolerant biomass halophiles exclusively Salicronia that is capable of growing in arid land and capable of growing in water that is highly rich in nutrients. The biomass from the halophiles is further used to produce bioenergy including biofuel. Along with the aquaculture, there are mangrove wetlands and the waste water that is drained from the field of halophiles is transferred to the mangrove wetlands. The biomass from the mangrove wetlands is also used to produce bioenergy and also provides a barrier, so that none of the polluted water from the fish farm returns to the ocean. This is the world's first bioenergy pilot project that is utilizing desert land and saltwater contributing to sustainable production of both bioenergy and food. At a global level, SEAS is focused on promoting integrated food energy system that uses the resources available to them in a smart and sustainable way.After the acceptance of United Arab Emirates, successful acceptance of a new Boeing 777-300EER,flight to Abu Dhabi from Seatle was flown using biofuel (first such flight in the Persian Gulf). The biofuel was sourced from Recycled vegetable cooking oil and supplied by Holland's SkyNRG.Biodiesel has depicted its advantages in being renewable in origin,good energy balance, high flash point and miscibility with petroleum fuels.In India, Gujarat State Fertilizers & Chemicals Ltd. (GSFC), a plant in Baroda is also promoting cultivation of *Salicornia spp.*

REFERENCES

Kumar, A., Abraham, E. and Gupta, A. 2018. Alternative biomass from saline and semiarid and arid conditions as a source of biofuels: Greenhouse and gas mitigation and global warming, 229-240.

Al-Rashed, S.A., Ibrahim, M.M., Hatata, M.M.A. and El-gaaly, G.A. 2016. Biodiesel production and antioxidant capability from seeds of *Salicornia begelvoii*collected from Al Jubail, eastern province, Saudi Arabia. Pak. J. Bot., 48(6): 2527-2533.

Javid, U., Almardeai, S., Bastidas-Oyanedel, J.R. and Schmidt, J.E. 2016. Biomethane potential of Salicornia Sinus-Persica at seawater conditions. Int. J. of Sustainable Water & Environmental Systems. 8(1).

Bird of Paradise (*Strelitzia reginae*): A Low Maintenance, High Potential Ornamental Plant

Anamika Gurung[1*] and Rajiv Kumar[2*]

[1]Ph.D. Scholar, [2]Principle Scientist
[*]Division of Floriculture and Medicinal Crops, ICAR-Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru – 560089
**Corresponding author: anamikagurung10@gmail.com*

ABSTRACT

Bird of paradise is one of the most beautiful flowers that can be grown in both full sun or in partial shade in the regions having moderate climate. Apart from being an important choice for landscaping, it is also grown as cut flowers as well as an indoor plant suitable for keeping in a room having good natural lighting. It is quite hardy and less prone to diseases and pests. Clumps are divided when the plant is mature, only dried leaves and spent stems are to be removed which makes it a low maintenance, high potential ornamental plant.

INTRODUCTION

Bird of paradise (*Strelitzia reginae*) is also known as 'crane flower'. The genus *Strelitzia* includes 5 species, belongs to the family Sterlitziaceae and it is native to South Africa.

It has a unique flower that resembles coloured bird in flight which makes is exceptionally attractive landscape plant. It is an evergreen perennial herbaceous ornamental plant grown in the moderate sub-tropical climate. Plants are rhizomatous, usually reaches a height of 1 to 1.5 meters, foliage resembles small banana leaves which is evergreen, thick with long petioles, stiff, leathery, concave, and oblong, making it a attractive ornamental plant.

It produces flowers in a horizontal inflorescence emerging from a stout spathe. The inflorescence is born at the top of a long scapes or pedicels and are remarkably shaped and coloured, like the crested head of a bird.The flower consists of three brilliantorange upright sepals and three purplish-blue highly modifiedpetalswhich emerge one at a time from the spathe.Two of the petals are joined together in a structure resembling an arrowhead with the third petal forming a nectary at the base of the flower. The long extended blue tongue from the stamens is a female part.

Bird of paradise is a low-maintenance plant which is easy to grow and is suitable for landscaping. It does well in full sun to semi-shade and flower several times in a year.

It is suitable to grow along the side of water bodies like pond, lilypool, water tank, swimming pool, etc. as leaves do not fall in the pool water.It gives a highly delightful effect when grown along the side of a herbaceousborder and in front of a shrubbery. It is also grown as specimen plant because of its unusual shape of the flower.

It is gaining popularity as cut flower because of its brilliant colour, unusual appearance and long vase life. It is commercially grown for cut flower purpose in California, Florida, Hawaii, Israel and South Africa for both domestic and international markets. It is also grown in pots as an indoor plant which can be kept in the room having good natural lighting.

In India, Bird of Paradise is grown in sub-temperate and sub-tropical regions such as Himachal Pradesh, Sikkim, Kalimpong and Darjeeling in West Bengal, Nilgiri hills and the Western Ghats, Bangalore and adjoining areas in Karnataka *etc*.

SPECIES AND THEIR DESCRIPTION

Some of the important species of *Strelitzia* are described below:

i. ***Strelitzia augusta*** **(syn.** ***Strelitzia alba*****)**

It is also called as White Bird of Paradise. The inflorescence is composed of 2 spathes, from the middle of which emerge white flowers. It reaches up to 5 meter tall with long (60-90 cm) and oblong leaves.

ii. ***Strelitzia caudate***

It is commonly known as the Swaziland *Strelitzia* or African Desert Banana.It is unbranched and multi-stemmed that reach up to 6 meter tall height. It can be planted as a focal point in mid-size to large garden.

iii. ***Strelitzia juncea***

It is also called as leafless Bird of Paradise as it lacks leaf blades, leaves and stems look like reeds. This characteristic makes it easily distinguishable from common Bird of Paradise. Considerably slower growing than others and produces orange and blue flowers in winter and early spring.

iv. ***Strelitzia nicholai***

This is known as the Giant Bird of Paradise because it can grow into a tree with multiple stems; also called as white Bird of Paradise as it bears large flower predominantly white with dark blue-purple accents. It reaches upto the height of 1.5 cm long, rounded or heart shaped at the base with long (2 cm) leaf stalks.

v. ***Strelitzia reginae***

It is a clump forming perennial of about 1meter wide, stems grow up to 90 cm high, leaf stalk about 45 cm long and leaf blade about the same length. It produces its stunning flowers most of the year, but blooms most heavily from winter to spring, bearing flowers of red, yellow, orange and purple. Among the

varieties, var. 'Glauca' has the attractive, glaucous foliage and stems, var.'Humilis', is a dwarf with dense clumps and ovate-oblong leaves while, var. 'Rutilans' has purple midrib. Mandela's Gold is a yellow-flowered cultivar.

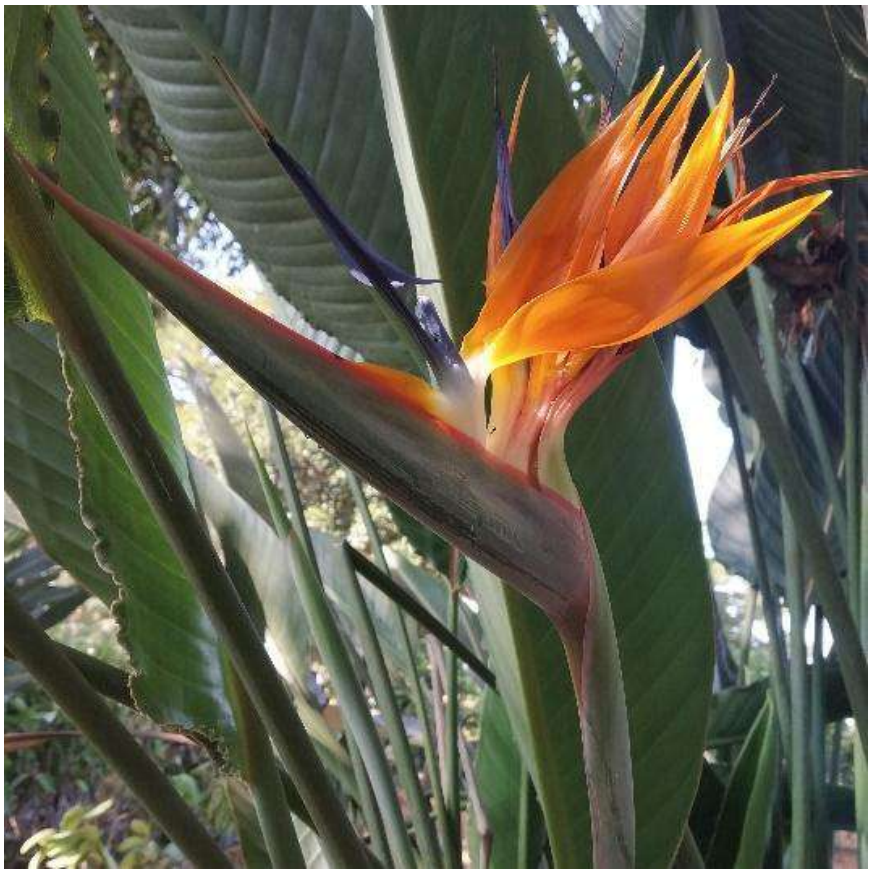


Fig.1 *Strelitzia reginae*

vi. *Strelitzia kewensis*

This species is a garden hybrid developed from a cross between *Strelitzia augusta* and *Strelitzia reginae.*

Pollination

Bird of Paradise is mostly pollinated by birds and insects. Fruits are leathery capsule which contains numerous minute seeds; oily, orange aril. The one of the reasons for its suitability to grow in the garden is that it produces no airborne pollen, thus saving people from the pollen allergy.

Propagation

It is commonly propagated by seeds; separation of offsets and division of clumps. Usually, plant raised through seeds takes longer period to establish than the vegetatively propagated plants.

i. Seed

Seeds must be sown while they are fresh. Soaking of seeds in water and keeping at room temperature for 3-4 days prior to planting helps in easy germination.While sowing, potting mixture should be moist and warm and can germinate in a 25-30 days depending upon soil temperature and seed freshness.Plants grown from seeds may take five to seven years to give economic yield.

ii. Separation of offsets

Bird of paradise suckers freely, if plants are crowded in the garden or pot, it produces less number of flowers per plant or it will stop flowering. So, offsets can be separated to make new plants.

iii. Division of clumps

The clump of mature plants that have been previously flowered for at least three years can be divided in spring prior to new growth. Lift the plant from the ground or pot and separate the underground rhizomes with a sharp knife making sure that each section contains a fan with the roots. The divided plants can be replanted in similar locations, at the same depth as previous plant. Newly planted plant should be watered thoroughly. Similarly, planting can be done in individual pot containing fertile and well drained soil.

Fig.2 Division of clumps

Fig.3 Divided clumps ready for planting

CULTIVATION

Soil

It performs well in loamy soil rich in organic matters, well drained and slightly acidic.

Light

Bird of paradise can be grown in full sun or semi-shaded light condition. Low light intensity may cause flower abortion, whereas too much exposure to too much sunlight, especially summer may scorch the leaves.

Temperature

The optimum temperature required for the growth and development of Bird of Paradise at day time is 20-25^{o}C and night temperature should not be less than 10^{o}C. They are sensitive to cold and need to be sheltered from frost as it can damage flowers and leaves although for a short period, it can tolerate lower and higher temperature without affecting the flower quality. A temperature higher than above 27°C tends to promote leaf production and inhibit flowering.

Planting

For commercial cultivation, planting may be done 60 x 60 cm apart with a planting density of 4 plants/m^2.Pits of 90 x 90 x 90 cm are prepared andfilled with soil, sand and farmyard manure at the ratio of 1: 1: 1. Planting should be done either during late spring or early summer.

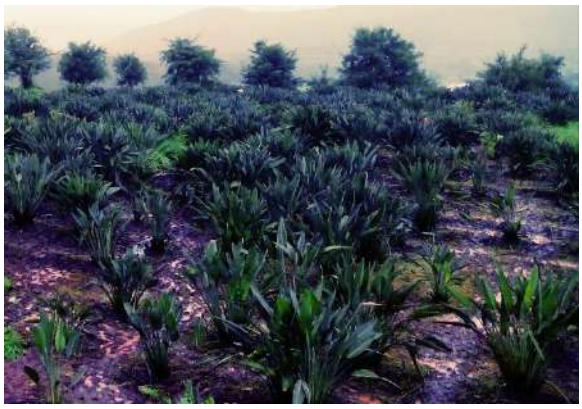


Fig.4 Bird of paradise plant in the field

Fig.5 Bird of paradise planted in plastic bag

Manure and Fertilizers

Liquid nutrient feeding improves the growth and flowering. To get maximum production, spraying the plants with solutions containing 6 g superphosphate and 3 g potassium nitrate/L of water at an interval of 10 days is effective.

Irrigation

A regular watering schedule during the first growing season should be followed to establish a deep, extensive root system. Watering is reduced after the plant has established itself; however, it requires moist conditions throughout its growing season. Soil should be well drained to avoid root decay as the roots are rhizomatous and fleshy in nature.

Harvesting and Postharvest Handlings

Flowers are cut when the first floret opens. The storage life of flower can be extended up to one month by harvesting it in the tight bud stage and keeping in pulsing solutions containing 10% sucrose, 250 ppm citric acid and 150 ppm hydroxyquinoline citrate (HQC) for two days at 22^0C.

Packaging and storage

After harvesting, each flower of Bird of Paradise is wrapped with polythene sheet or butter paper. The stems are packed in cardboard box of size 120 x 30 cm and stored at an 8°C temperature.

Fig.6 Flower of Bird of Paradise wrapped with polythene sheet

Diseases and Pests

Bird of paradise is less prone to diseases and pest as it is a quite hardy crop. Flower and bud damage are attributed mainly to *Fusarium culmorum*, *Fusarium*

avenaceum and *Boyrytis cinera*, plants should be sprayed with bavistin to control. Root rot caused by *Fusarium monoliforme*, hot water (45-50^{o}C) treatment of seeds for 30 minutes followed by sterilization of soil by fumigation is effective to control this soil-borne disease.

Maintenance

Dried leaves and stems should be removed by cutting with sharp secateurs, close to the ground when flowering is over. Galvanized wires or nylon strings supported by iron poles/bamboo poles are used to avoid lodging of flower stalk. The leaves can be removed from the strategic position if it obstructs the view of a flower.

Substrate Culture in Soilless Cropping Systems

[1]K. Sivasabari, [2]P. Rajeshkumar and [3]R. Ajaykumar

[1]Asst.Professor (Soil science), J.K.K.Munirajah college of Agricultural Science, T.N.Palayam, Gobi, Erode
[2]Ph.D., Scholar (Plant pathology), Tamil Nadu Agricultural University, Coimbatore.
[3]Asst. Professor (Agronomy),Vanavarayar Institute of Agriculture, Pollachi
**Corresponding author: sabarisiva3@gmail.com*

The term "soilless culture" generally refers to any method of growing plants without the use of soil as a rooting medium (hydroponics). The simplest and oldest method for soilless culture is a vessel of water in which inorganic chemicals are dissolved to supply all of the nutrients that plants require. Often called solution culture or water culture, the method was originally termed hydroponics (i.e., "water working") by W. F. Gericke in the 1930s. Currently, the soilless culture systems (SCS) are considered a major technological component of modern greenhouses due to their advantages.

Why soilless culture?

Due to problematic soils, water shortage and difficult to control the soil borne pest and diseases economically we go for soilless culture. The major advantages of soilless culture method is Weed and soil diseases are not a problem in Soilless culture, high quality yield, cultivating crops in any region even in regions where poor soil conditions prevail, controlling the root environments and increasing water use efficiency.

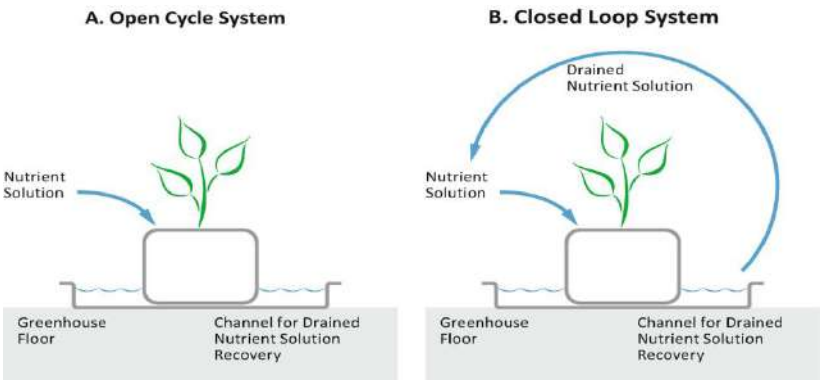
TYPES OF SOILLESS CULTURE

There are two types of culture followed in soilless culture
1. Substrate culture and 2. Water culture (Liquid system)

Substrate culture

Substrate culture is the cultivation of crops in a solid, inert or non-inert medium instead of soil. Substrate culture can be divided depending on (a) types of drainage system and (b) types of substrate

Types of drainage systems



Open system Excess nutrient solution is allowed to turn to waste.

Closed system Excess nutrient solution is collected, disinfected and re-circulated.

TYPES OF SUBSTRATES

There are four functions that substrate must serve in order to support good plant growth. They are 1. It must serve as a reservoir for plant nutrients. 2. It must hold water in a way that makes it available to the plant. 3. It must provide plants with gases and water at the same time. 4. It must support the plant. Some individual materials (substrates) can provide all four functions, but not at the required level of each. For example, sand provides excellent support and gas exchange but has insufficient water- and nutrient supplying capacity. The coarse particles of sand have small surface area per unit of volume compared to the finer parties of soil Or peat moss. Since water is held on the surfaces of particles, sand has a small water reserve. Since most nutrients in the sand medium are held in the water films, there is likewise little nutrient reserve. Soilless substrates can be divided into organic substrates and inorganic substrates.

Organic substrate

Peat moss is formed by the accumulation of plant materials in poorly drained areas. The type of plant material and degrees of decomposition largely determine its value for use in a growing medium. Although the compositions of different peat deposits very widely, four distinct categories may be identified:

1. Hypanaceous moss. 2. Reed and Sedge. 3. Humus or Muck. 4. Sphagnum moss.

Peat: Sphagnum moss is perhaps the most desirable form of organic matter for the preparation of growing media and the Sphagnum moss is light in weight and has the ability to absorb 10 to 20 times its weight in water. This is attributed to the large groups of water holding cells, characteristic of the genus. Peat substrate may be used in various ways for raising crops the most popular are bags, modules and troughs, but also in basins, rings, mattresses and bolsters.

Wood residues: Wood residues constitute a significant source of soilless growing media. These materials are generally bi-products of the lumber industry and are readily available in large quantities. Nitrogen depletion by soil microorganisms, during the decomposition process, is one of the primary problems associated with these materials. However, supplemental applications of N to the growing media can make most wood residues valuable amendments.

Sawdust: Several sawdust, such as walnut and non-composted redwood, are known to have direct phytotoxic effects. However, the C:N ratio of sawdust is such that it is not readily decomposed. The high cellulose and lignin content along with insufficient N supplies creates depletion problems which can severely restrict plant growth. However supplemental application of nitrogen can reduce this problem.

Barks: It is primarily bi-products of the pulp, paper and plywood industries. Suitable particle size is obtained by hammer milling and screening. This produces a material, which is suitable for use in container media. Physical properties obtained from tree barks are similar to those of Sphagnum moss.

Rice hulls: Rice hulls are a bi-product of the rice milling industry. Although they are extremely light in weight, rice hulls are very effective at improving drainage. The particle size and resistance to decomposition of rice hulls and sawdust are similar. However N depletion is not as serious of a problem in media amended with rice hulls.

Coconut peat: Coconut peat is used for a wide range of soilless crop production throughout the world including: tomato, cucumber, egg plant, capsicum, zucchini, strawberry, melons, carnation, rose, gerbera, gypsophila, lisianthus, chrysanthemum etc. with no harmful environmental impact. The high water holding capacity of this substrate provides a buffer in high temperatures and high crop load demand without compromising air supply. The presence of organic compounds in Coconut peat can stimulate root growth and offer some natural resistance to plant disease.

INORGANIC SUBSTRATES

Perlite: Perlite is a unique volcanic mineral, which expands from four to twenty times its original volume when it is quickly heated to a temperature of approximately 1600-1700º F. This expansion is due to the presence of two to six percent combined water in the crude perlite rock, which causes the perlite to pop in a manner similar to that of popcorn. When expanded, each granular, snow-white particle of perlite is sterile with a neutral pH and contains many tiny, closed cells or bubbles. The surface of each particle is covered with tiny cavities, which provide an extremely large surface area. These surfaces hold moisture and nutrients and make them available to plant roots. In

addition, because of the physical shape of each particle, air passages are formed which provide optimum aeration and drainage. Because perlite is sterile, it is free of disease, seeds, and insects.

Table 1. Main advantages and disadvantages of inorganic and organic materials used as growing media

Material	Origin	Advantages	Disadvantages
Sand	Natural with particles of 0.05–2.0 mm	Relatively inexpensive, good drainage ability.	Low nutrient- and water holding capacity, high volume-weight (1400–1600 kg m^{-3}), low TPS (40–50% V/V).
Rockwool	Melted silicates at 1500–2000°C	Light volume weight (80–90 kg m^{-3}), high total pore space (95–97% V/V), ease of handling, totally inert, nutrition can be carefully controlled.	Disposal problems, energy consumed during manufacture.
Vermiculite	Mg+, Al + and Fe + silicate sieved and heated to 1000°C	Light volume weight (80–120 kg m^{-3}), high nutrient holding ability, good water holding ability, good pH buffering capacity, good aeration: TPS (70–80% V/V).	Compacts when too wet, energy consuming product, expensive.
Perlite	Siliceous volcanic mineral sieved and heated to 1000°C	Light volume weight (90–130 kg m^{-3}), sterile, neutral in pH (6.5–7.5), no decay, TPS (50–75% V/V).	Low nutrient capacity, energy consuming product, expensive.
Pumice	Light silicate mineral of volcanic material	Light volume weight (450–670 kg m^{-3}), good TPS (55–80% V/V), cheap and long-lasting, environmentally friendly.	High transport costs, pH may be high.
Peat	Natural anaerobically processed plant residues	Physical stability, good air and water holding capacity: TPS (85–97% V/V), low microbial activity, light volume weight (60–200 kg m^{-3}), low and easily to adjusted pH, low nutrient content.	Finite resource, environmental concerns and contribution to CO_2 release, increasing cost due to energy crisis, may be strongly acidic, shrinking may lead to substrate hydro-repellence.
Coconut coir	By-product of fiber coconut processing	Physical stability, light weight (65–110 kg m^{-3}), good air content TPS (94–96% V/V) and water holding capacity, subacid-neutral pH (5–6.8).	May contain high salt levels, energy consumption during transport.
Bark (well-aged)	By-product or waste of wood manufacture	Good air content and water holding capacity, good TPS (75–90% V/V), sub-acid-neutral pH (5–7), average volume weight (320–750 kg m^{-3}), long lasting.	High variability, need time to reduce C:N ratio and terpenes concentrations, increasing cost since used as an alternative to fuel and in landscaping.
Green compost	Composted plant residues	Good source of potassium and micronutrients, suppression of diseases, good moisture holding capacity, urban waste reduction.	Variable in composition, high volume weight (600–950 kg m^{-3}), may contain excess salt, need time to be composted, becomes easily waterlogged.
Biochar and hydrochar	Solid material derived from biomass pyrolysis or biomass hydrolysis	Production is energy-neutral, helps with carbon sequestration, biologically very stable, wet material can be used for hydrochar; hydrochar has low EC.	Properties vary dependent on feedstock (biochar), high production costs, biochar often has high pH, can be dusty.

TPS = total pore space.

Sand: Sand is a basic component of soil, ranges in particle size from 0.05mm to 2.0mm in diameter. Fine sands (0.05mm to 0.25mm) do little to improve the physical properties of a growing media and may result in reduced drainage and aeration. Medium and coarse sand particles are those, which provide optimum adjustments in media texture. Although sand is generally the least expensive of all inorganic amendments it is also the heaviest. This may result in prohibitive transportation costs. Sand is a valuable amendment for both potting and propagation media. But washed sand should be purchased since it is nearly free of clay and organic matter.

Vermiculite: Vermiculite is a micaceous mineral produced by heating to approximately 745ºC.the expanded; plate-like particles, which are formed, have a very high water holding capacity and aid in aeration and drainage. Vermiculite has excellent exchange and buffering capacities as well as the ability to supply potassium and magnesium.

Although vermiculite is less durable than sand and perlite, its chemical and physical properties are very desirable for container media.

Calcined clays: Heating montmorillonitic clay minerals to approximately 690ºC forms calcined clays. The pottery-like particles formed are six times as heavy as perlite. Calcined clays have a relatively high cation exchange as well as water holding capacity. This material is a vary durable and useful amendment.

Pumice: Pumice is direct product of acidic volcanism. Pumice is a highly vesicular volcanic glass, silicic in composition and occurs as massive blocks or unconsolidated, fragmented material. The vesicles are glass–walled bubble casts, which give pumice a low density compared to natural glass. Pumicite, the commercial term for fine grained, fragmented pumice with shards under 2mm in diameter, may be deposited some distance from the source. Pumice is formed from silicic lavas rich in dissolved volatiles, particularly water vapour. On eruption, sudden release of pressure leads to expansion of volatiles, which, in turn, generates a frothy mass of expelled lava. This mass may solidify on contact with the atmosphere as a vent filling or flow, or may be shattered by a violent eruption. Pumice has many advantages such as high strength-to-weight ratio, insulation and high surface area, which result from the vesicular nature of this rock.

CONCLUSION

Soilless substrates either having organic or inorganic ingredients have been used as for finding suitable growing media for crop production. The types of raw material used vary according to their domestic availability in the world. Raw materials variations in different substrate influence the plant growth and development directly and/or indirectly. Thus selection of ideal substrate from various materials is imperative for productivity of each crop. Lots of substrates evolved for crops production with their cultural guidelines. From them only suitable or adapted cultural guidelines will benefits the grower in successful cultivation for his produce.

REFERENCES

Johnson, H., Jr. 1980. "Hydroponics: A guide to soilless culture." Leaflet 2947. Berkeley: Division of Agriculture and Natural Resources, Univ. of California.

Maynard, D. N., and A. V. Barker. 1970. Nutriculture: A Guide to the Soilless Culture of plants. Publication 4 1. Amherst, MA: Massachusetts Cooperative Extension Service, University of Massachusetts.

Olympios CM. Soilless media under protected cultivation rockwool, peat, perlite and other substrates. Acta Horticulturae 1995: 443-451.

Importance of Physiotherapy in Veterinary Practice

S.K. Yadav[1], Raju Sharda[2], Rukmani Dewangan[3], M.O. Kalim[3] and Anupam Soni[4*]

[1]M.V.Sc Scholar, [2]Professor and Head, [3]Assistant Professor,
Department of Veterinary Surgery and Radiology,
College of Veterinary Science and A.H., Anjora, Durg (C.G.).
[4]M.V.Sc Scholar, Department of Livestock Production and Management,
College of Veterinary Science and A.H., Anjora, Durg (C.G.).
**Corresponding Author Email: vetanupam456@gmail.com*

Physiotherapy is techniques in which to increase the mobility with enhances the functional activity of joint & muscles in animals. Its main aim to reduce pain, fast recovery from any surgery, reduce the age-related diseases. Physiotherapy also reduces stress and improve better life of animals. Among this, physiotherapy mostly used pet animals such as dog and cat; it can also be applied horse, rabbit and other animals. Physiotherapy most commonly used in human being.

Objectives of Physiotherapy

The main objectives of physiotherapy are relief pain, enhance the healing process, increase muscle strength and joint flexibility, promote and restore normal movement patterns, reduce the cardiac disorders.

Techniques: - different techniques of physiotherapy used in animal especially in canine. Each technique having own benefits and disadvantages. All techniques of physiotherapy are not useful for each condition. For example; for orthopaedic condition thermotherapy (heat), cryotherapy (ice), hydrotherapy (water), muscle exercises, electrical stimulation and coordination exercises are used. Whereas, coordination exercises, muscle exercises electrical stimulation and hydrotherapy for the useful in neurological conditions. While, in case of surgical repairs and traumatic injuries treated with heat therapy, cryotherapy, massage, electrical stimulation, and hydrotherapy.

Indications:- Acute injuries, chronic injuries, relieving pain, improve joint movement, provide complete recovery of injured & inflammed neurologic and musculoskeletal tissues, control of shortening of muscles due to disuse, improve function of weak & paralyzed limbs, preventing soft tissue contracture & fibrosis, treat laminitis, reduce oedema, speedy healing of open & closed wounds.

TYPES OF PHYSIOTHERAPY

- Massage

- Thermotherapy
- Exercise
    - Therapeutic exercise
    - Balance exercise
    - Passive Range of Motion(PROM) & Stretching
- Hydrotherapy
- Electrotherapy
- Diathermy
- Therapeutic ultrasound
- Laser therapy
- Infrared therapy
- Acupuncture

Massage: It is used to relieve from tension in muscles and promotes the muscle development. Massage helps to increase the blood flow to the injured area, thus, enhances the recovery from injuries and surgery and also useful relieving from muscle spasms. Massage is used widely in canine physical therapy and can be helpful in improving the comfort of animals affected by nearly all medical conditions.

Indications:-Race warm-up/recovery, maintain articular mobility, reduce muscle stiffness/contractures.

Types of massage:-

Relaxation Massage- promotes general relaxation, increase circulations and relieves muscular tensions

Remedial Massage – it help in return in normal function of injured soft tissues

Sports Massage- to enhance sports performance.

Aromatherapy Massage- Therapeutic properties of essential oils are used.

Digitpressure Massage- it is massage of tissue and organ with help using thumb and finger pressure.

Oriental Massage-acupressure

Shiatsu Massage- combination of pressure and assisted stretching techniques.

Thermotherapy

1. Heat Therapy: Indications: Best applied in acute inflammation, reducing muscle spasm & pain due to musculoskeletal injuries, to enhance joint & tendon mobility, enhancing the healing response related to soft tissue injuries. Heat had been used in traditional period; it is useful in acute and chronic conditions. In canine practice, superficial forms of heating (including hot packs and bathing) are the simplest and most practical to use. They penetrate to a depth of 1 to 2 cm, and are particularly useful in subacute and chronic conditions to relieve pain, and as a prequel to passive movements, stretching or exercise. Deeper forms of heating using electrotherapy modalities such as ultrasound should only used by experienced person.

2. Cold Therapy: Indication: it is advised in acute and hyperacute injuries, particularly effective during the first 24-48hrs. after injury.

Technique: it is done by using ice packs, applications of volatile liquids and running cold water.

Mechanism: by using cold therapy it cause the constriction of blood vessel lead to diminishing blood circulation to affected area to help reduce the odema and control haemorrhages and relief from pain. Reduced tissue metabolism may inhibit effect of inflammatory mediators, pain, and muscle spasm and enzyme system. Therapeutic effects of cold occur at tissue temperature between 15-19^0 C. Each application should last 15 to 20 minutes and there should be at least 1-2 hrs. interval between the applications. Cold application is generally combined with compression bandage.

EXERCISE

a. Therapeutic exercise: Indications: Joint stiffness, Abnormal posture, Spastic paralysis, Orthopaedic problems

Methods: Passive exercise: affected part is grasped between thumb and forefinger and flexion and extension for 10-15 times is done.

Active exercise: its comprises the grazing and slow running.

Effects: Mechanical movement of joint & muscles improves venous & lymphatic return. Sensory stimulation by keeping cortical pathways open. Mobility and range of movement of joints can be increased, Balance& coordination with cardiovascular & respiratory capabilities can be improved.

a**. Balance exercise**: Balance exercises make use of equipment designed to strengthen weak muscles and build up limbs affected by atrophy. This exercise includes wobble boards and balance boards. Balance exercises could be used in animals recovering from surgery and neurological situation. The animal is forced to place weight on the surgical repair, building muscle in the affected area. For example, an animal recovering from a stroke has decreased coordination and balance which can be improved through a physical therapy regime that includes balance exercises.

b. Passive Range of Motion (PROM) & Stretching: Passive range of motion (PROM) is accomplished through flexion and extension of the joint to its limits. It is important for the physical therapist not to stretch the joint past its normal limits. PROM is used to encourage animals to use the full range of motion of the joints. This therapy technique can significantly increase an animal's range of motion and decrease joint pain, improving its quality of life. Place hands above & below the joint & gently flex & extend the joint while supporting the limb. Manipulate joint through pain-free ROM. Slowly flex & extend the joint beyond pain-free ROM to stretch the tissue. Do not force motion beyond comfort level. Hold the stretch for 15-30 sec. Return the joint to normal. Repeat stretch up to 20 times/session. Manipulate all joints of affected limb for maximum benefit. Monitor for pain, active ROM, quality of movement.

Hydrotherapy: it is techniques in which by the use water to improvement of muscle and joint function in small animals. This technique includes swimming and underwater

treadmill. In swimming to allow the animal to swim and work several muscles simultaneously. It helps to build up the muscle strength and endurance, also is a technique that minimizes stress on the joints. Underwater treadmill technique more commonly used in animals. It provides the benefits of land exercises while decreasing the weight placed on the animal's limbs. Underwater treadmill and swimming used successfully in canine for recovery from any surgery like anterior cruciate ligament and cranial cruciate ligament repairs and break repairs.

Electrotherapy: Electrical stimulation techniques uses of electric currents to either stimulate muscles or to relief pain. Neuromuscular electrical stimulation (NMES) is used to help improve muscle strength, and motor recruitment.

Diathermy: Application of high-frequency electrical energy, short wave diathermy, used to generate stimulating effect in body tissues, used to bring massaging effects in deeper tissues, renewed interest due to research documenting efficacy heat produced in the tissues

Therapeutic ultrasound: Ultrasound produces sound waves beyond the capacity of human hearing. For therapy, the frequencies typically used are between 1·0 and 3·0 MHz. Ultrasound can impart both thermal and non-thermal effects to body tissues to depths of 4 cm or more, although the effectiveness of penetration depends on the frequency used and also types of tissue involved. This techniques are more successful during inflammatory, proliferative and repair stages of tissue healing stimulates or improves the normal ways of events, thereby increasing the efficiency of the repair process. It influences the formation of scar tissue by enhancing the orientation of newly establish collagen fibres. It also converted into dominant type I collagen fibre from collagen type III for the increasing tensile strength and enhancing scar mobility. Low-intensity pulsed ultrasound accelerates fracture healing and also benefit of disease related to bones, such as healing fractures process, stress fractures and non-union fractures

Laser therapy: A laser is a form of light amplifier that used for therapeutic purposes. Excessive laser light absorb in superficial tissues and produce adverse effects. It also evidences the clinical use of lasers in humans to promote wound healing and relief from pain.

Infrared therapy: Indications: Sub acute and chronic traumatic and inflammatory conditions, Traumatic synovitis, tenosynovitis and sprain, Neuralgia, arthritis & rheumatic conditions, acute, sub-acute & chronic catarrhal conditions of mucous membranes and sinusitis, Infection of the skin, folliculate and furunclous.

Technique/Source: it includes the sunlight, low temperature, high temperature and infrared rays are electromagnetic waves.

Mechanism: The infrared stimulates local circulation. Radiant heating causes constriction of capillaries, it leads to release of vasodilator substances which are absorbed. Capillaries are become more active causes to increase the blood circulation at affected area. Infrared ray exposed for short time it leads relief of pain. While, strong heat act as counter irritant to stimulate the nerve endings.

Acupuncture: Acupuncture is used to treatment of different nerve and musculoskeletal disorders in animals. It is used to relief from pain and also promotes healing in the affected parts. Various acupuncture points are used in animal and human body for relief from pain.

REFERENCES

Busse, J. W., Bhandari, M., Kulkarni, A. V. and Trunks, E. 2002. The effect of low-intensity pulsed ultrasound therapy on time to fracture healing: a meta-analysis. *Canadian Medical Association Journal,* 166, 437-441

Canine Rehabilitation Therapies I and II. Proceedings of the 79th Annual Western Veterinary Conference; 2007 Feb 18-22; Las Vegas. 11p

Draper, D. O., Castel, J. C. and Castel, D. 1995. Rate of temperature increase in human muscle during 1 MHz and 3 MHz continuous ultrasound*. Journal of Orthopaedic and Sports Physical Therapy*, 22, 142-150

Dycus, D., Levine, D., Marcellin-Little, D.L. 2017. Physical Rehabilitation for the Management of Canine Hip Dysplasia. Veterinary Clinics of North America: *Small Animal Practice*, 47(4):823-850.

Heckman, J. D., Ryaby, J. P., Mccabe, J., Frey, J. J. and Kilcoyne, R. F.1994. Acceleration of tibial fracture-healing by non-invasive, low-intensity pulsed ultrasound. *Journal of Bone and Joint Surgery (American),* 76, 26-34

Hellyer, P., Rodan, I., Brunt, J., Downing, R., Hagedorn, J. and Robertson, S. 2007. AAHA/AAFP Pain Management guidelines for dogs and cats. *J Am Anim. Hosp Assoc*, 43:235-248.

Kristiansen, T. K., Ryaby, J. P., Mccabe, J., Frey, J. J. & Roe, L. R. 1997. Accelerated healing of distal radial fractures with the use of specific, low-intensity ultrasound. A multicenter, prospective, randomized, double-blind, placebo-controlled study. *Journal of Bone and Joint Surgery (American)*, 79, 961-973

Marsolais, G. S., Dvorak, G. and Conzemius, M. G. 2002. Effects of postoperative rehabilitation on limb function aftercranial cruciate ligament repair in dogs. *Journal of the American Veterinary Medical Association*, 220, 1325-1330

Marcellin-Little, D.J., Levine, D., Canapp, S.O. 2007. The Canine Shoulder: Selected Disorders and Their Management with Physical Therapy. *Clinical Techniques in Small Animal Practice*, 22:171-182.

Marcellin-Little, D.J., Drum, M.G., Levine, D., McDonald, S.S. 2015. Orthoses and Exoprostheses for Companion Animals. Veterinary Clinics of North America: *Small Animal Practice*, 45(1):167-183.

Mlacnik, E., Bockstahler, B., Muller, M., Tetrick, M., Nap, R., Zentek, J. 2006. Effects of caloric restriction and a moderate or intense physiotherapy program for treatment of lameness in overweight dogs with osteoarthritis. *J Am Vet Med Assoc*, 229(11):1756-1760.

Millis, D. L., Levine, D., Brumlow, M. and Weigel, J. P. 1997. A preliminary study of early physical therapy following surgery for cranial cruciate ligament rupture in dogs. *Veterinary Surgery,* 26, 434

Monk, M. L., Preston, C. A. and Mc Gowan, C. M. 2006. Effects of early intensive postoperative physiotherapy on limb function after tibial plateau leveling osteotomy in dogs with deficiency of the cranial cruciate ligament. *American Journal of Veterinary Research*, 67, 529-536

Rivera P.L. 2007. Canine Rehabilitation Therapies I and II. Proceedings of the 79th Annual Western Veterinary Conference; 2007 Feb 18-22; Las Vegas. 11p.

Steiss, J. E. and Adams, C. C. 1999. Effect of coat on rate of temperature increase in muscle during ultrasound treatment of dogs. *American Journal of Veterinary Research*, 60, 76-80

Ter Haar, G. (1999) Therapeutic ultrasound. European Journal of Ultrasound 9, 3-9.

Warden, S. J., Bennell, K. L., Mcmeeken, J. M. and Wark, J. D.1999. Can conventional therapeutic ultrasound units be used to accelerate fracture repair? *Physical Therapy Reviews,* 4, 117-126

Watson, T. 2000. Masterclass. The role of electrotherapy in contemporary physiotherapy practice. *Manual Therapy,* 5, 132-141.

Effect of Bypass Fat in Reproductive Performance of Dairy Animals

Subhrajit Das[1], Sharad Mishra[2], M.D. Bobade[3], Ashutosh Dubey[3], AayushYadav[3],Anupam Soni[1*], Upasana Verma[1], Ankit Kashyap[1], Suryakant Sori[1] and Anjula Gahirwar[1]

[1]M.V.Sc. Scholar, [2] Professor and Head, [3]Ph.D. Scholar
Department of Livestock Production and Management,
College of VeterinaryScience & A.H, CGKV, Anjora, Durg
**Corresponding author: vetanupam456@gmail.com*

Dairy animals mainly buffalo gives a large amount of high-fat milk and at the same time in early lactation, the energy required for maintenance number of times exceeds the amount of energy available in diet, leads to negative energy balance, hence enforce utilization of body fat reserves to fascinate energy requirement, thus causes increase in the level of non-esterified fatty acids (NEFA) increases in plasma and leads to hepatic lipidosis. Sometimes the negative energy balance period starts before calving due to declined feed intake at the end of gestation. The negative energy balance affecting peak milk yield and overall lactation yield also cause delayed post-partum ovarian activity. In the early stage of lactation, body fat reserve helps to meet the energy requirement of high yieldingmilch animals. To solve this problem animal should be provided with either high level of cereal grains or bypass fat, although we know to overfeed of grains may lead to rumen acidosis that may effect on feed intake of animal and there might be declined milk production. , that's the reason behind the concept of Bypass fat. In acidic ph, Bypass fat gets digested in the abomasum, without interfering with the fermentative digestion in the rumen. This form of fat supplementation termed as bypass fat, which can help in enhancing milk production and persistency of lactation.

WHAT IS BYPASS FAT?

Bypass fat is the calcium salt of fatty acid, essentially dry fat that is generally mixed with animal feed mainly in dairy animal to improves, production of milk, metabolism, meat quality, reduces digestive problems, body condition by decreasing weight loss.

Types of bypass fat*?*

Bypass fat is mainly divided into 2 types one is Naturalbypass fat and other is chemically prepared bypass fat.

Natural bypass fat

Whole oilseeds known for its natural bypass fat properties whenever fed without processing except drying because inside the rumen outer seed coat protect internal

fatty acids from lipolysis.Other important examples of natural bypass fatare cotton, roasted soybeans, sunflower and canola are important whole oil seeds.

Chemically prepared bypass fat

This kind of bypass fat mainly includes formaldehyde-treated protein encapsulated fatty acids, fatty acyl amides and calcium salts of long-chain fatty acids (Ca-LCFA)crystalline or prilled fatty acids.

How to manufacture rumen protected fats?

By pass fat can be manufactured based upon 2 types of mechanism-

1.Based upon the melting point of fatty acid-Rumen protected fats with saturated fats are manufactured with saturated fatty acids.This fatty acid remains solid in environmental temperature but melt at the temperature of 50-55^0 C.So this fat remain solid in rumen temperature (38-39^0 C) and insoluble in rumen liquid but digested in small intestine.

Limitation- Relatively less digestible due to high proportion of saturated fatty acids.

2.Fatty acids of calcium salts-Based on acidity or ph level of rumen and small intestine.The main target of this method is to increase the digestibility of bypass fat in ruminant's small intestine. This bypass fat ismanufactured based on saponification of fatty acid.These are also known as calcium soaps.This compound is formed of saturated and unsaturated fatty acids joined to calcium ion to form salts.The calcium salts remain intact in neutral acidity of rumen (pH 6.2-6.8) &remaininsoluble in rumen liquid but dissociate in acidic pH(pH 2-3) of abomasum. Fatty acids are soluble and absorbed in intestine more efficiently(95%).

What is the reason behind the feeding of fat?

In the early phase of lactation, dairy animals start loosening body weight, due to the imbalance between energy intake and energy needed to satisfy the nutrient demand for milk production. Thus, cow starting depleting its body fat for milk production. Sobypass fat supplementationis the best choice that can provide better health and productivity to animal.

What are the synonyms of bypass fat?

Most popular synonyms are Calcium salts of long-chain fatty acids, Rumen protected fat.

Characteristics of Bypass Fat?

- Low solubility in the rumen.
- Less susceptible to biohydrogenation.
- Increase milk and fat yield in the early stage of lactation.
- Highly digestible energy supplement.
- Not degraded in the digestive tract (rumen) of animal, but gets digested in the lower alimentary tract.

Why bypass fat is supplemented in dairy cattle?

Pregnant animal after parturition is going through a stage where animal loses a huge amount of energy through milk. Bypass fat helps to overcome this situation and helps to shift towards positive energy balance, this also helps in high reproductive performance, high milk production, and overall healthand fulfil the nutrient requirement of high-yielding animals, helps in to decrease the chances of metabolic disease like milk fever,

ketosis and acidosis. bypass fat can be a better choice of energy supplement to the dairy animal.

Advantages of feeding bypass fat?

- Satisfy the dairy cow nutrient requirement.
- Helps to gain peak milk production.
- Helps to maintain persistency of lactation.
- Enhance the productivity & productive life of a dairy animal.
- Helps to decrease the chances of metabolic disorder, such as milk fever, ketosis and acidosis.
- Best choice for lactating as well as dry animal.
- It helps to maintain high rumen heat production.
- Helps the animal to return in positive energy balance, thus improves the reproductive performance.
- Helps in appetite improvement.
- Helps dairy animals to overcome negative energy balance during early lactation.
- Improves BCS.
- Improves digestive performance.
- Prevent dustiness of feed.

How much bypass fat to be supplemented?

15-20 g/ kg milk production/ animal/ day.It can be supplemented to dairy cattle 15 days before to 150 days after parturition.

How bypass fat is supplemented?

Bypass fat used to mix with a concentrated mixture, can be given in two ways either single or as divided dose.

How does bypass fat works?

Bypass fat contains an unsaturated fat related to calcium particles, rather than a glycerol backbone. The association between fatty acid & calcium salt means the fat supplement with low solubility, less susceptible to bio-hydrogenation and remains 100% inert in the rumen. Although in the acidic pH of the abomasum, it dissolves and the fatty acid and calcium are set free for absorption.

Why is it essential to supplement choline with bypass fat?

Normally, an adequate amount of choline can be synthesized, but the problem occurs in lactating dairy animals where the supply of choline may be insufficient. Supplementation of Dietary choline must be in the protected from otherwise it might be easily degraded in the rumen. Choline acts as a methyl donor, const0ituent of phospholipid. As it helps in fat export from the liver by playing a vital role in the synthesis of very-low-density lipoprotein and importantly the metabolism of fat for milk production and energy. It is reported that feeding of rumen-protected fat results in a significant decrease in serum NEFA.

What is the effect of bypass fat on reproduction?

Supplementation of bypass fat in the diet of dairy animal has a positive effect on Reproductive performance. This improves pregnancy rate as well as helps to reduce the

open days. It also helps in earlier return to post-partum ovarian cycling, improves fertility.Supplementation of bypass fat in KF cows in pre-partum period significantly ($p<0.01$) increased calf birth weight and decreased the cases of metritis & retention of fetal membrane. (Yadav 2014). The prilled fat feeding in KF resulted in earlier resumption of oestrouscyclicity, and improved conception rate. (Rajesh, 2013).

What is the effect of bypass fat on milk production?

Rumen protected feed fed animal produce more milk as well as more milk lactose. Total SNF and milk fat percentage increased. Negative effect on milk protein percentage because of the dilution of milk protein as higher milk synthesize is not synchronized with the uptake of amino acid by mammary glands. Advance pregnant Murrah buffaloes were either received a dietary supplement of prilled fat at 100 g/day for 35 days pre-partum and at 150 g/day for 95 days post-partum (supplemented group) or did not receive fat supplement (control group)

Parameters	Control group	Supplemented group
Milk yield (kg/day)	10.87a±0.21	12.85b±0.32
FCMY (kg/day)	12.96a±0.27	15.99b±0.44
Fat (%)	7.48a±0.09	7.93b±0.10
Protein (%)	3.56±0.05	3.54±0.04
SNF (%)	9.57±0.12	9.56±0.11
Lactose (%)	5.61±0.05	5.62±0.04

Different superscripts (a, b) differ ($p<0.01$) in a row. ECM=Extracellular matrix, FCMY=Fat corrected milk yield, SNF=Solid not fat

Effect of bypass fat on economics?

Indigenous method of production of bypass fat is inexpensive, the total cost of production depends on the cost and availability of raw ingredients.Feeding of bypass fat to dairy animals generate additional profit of Rs. 34.50/- (Naik et al., 2009), Rs. 11.60/- (Gowda et al., 2013) and Rs 94.46 per cow per day (Yadav et al., 2015). Similarly,during early lactation bypass fat feeding of buffaloes yielding 8-9 kg of milk daily resulted in Rs. 26.61 more income per day (Parnerkar et al., 2010). In field conditions cost benefit ratio of 1.5 has been reported (Khan, 2015).

Effect of bypass fat on Mean body weight, BCS and DMI?

Feeding bypass fat helps to improve the BCS of dairy animals. bypass fat helps to stop the reduction of body weight loss after parturition and helps to gain bodyweight after 90 days of feeding.

Why oil cannot be supplemented instead of bypass fat?

Oil results in digestive problems in cattle. Oil degraded in the upper part of the digestive tract (rumen), provides less energy than bypass fat.

Parameters	Pre-partum		Day of parturition		Post-partum	
	Control group		Control group	Supplemented group	Control group	Supplemented group
Body weight (kg)	652.80±20.19	655.55±38.99	598.57±19.31	611.85±38.84	584.16a±19.15	625.35b±37.70
BCS	2.84a±0.18	3.21a±0.19	2.21b±0.15	2.51b±0.19	2.35b±0.13	3.40a±0.16
DMI(Kg/day)	15.16a±0.17	15.61a±0.07	14.73a±0.06	15.18b±0.08	16.68b±0.14	16.73bc±0.13

CONCLUSION

Bypass fat in the diet helps to solve the problems of negative energy balance without effecting the dry matter intake and rumen fermentation. Not just only in negative energy balance it also helps the dairy animal in every possible way by increasing milk production, improving BCS and also by improving the reproductive efficiency of a dairy animal. Now further research is necessary to find out the various type of basal ration at a different lactating stage of a dairy cow.

REFERENCES

Gowda, N.K.S., Manegar, A., Raghavendra, A., Verma, S. and Maya. G., 2013. Effect of protected fat supplementation to high yielding dairy cows in field condition. Anim. *Nutr. Feed Technol,* 13: 125-130.

Naik, P.K., Saijpaul, S., Sirohi, A.S. and Raquib, M., 2009. Lactation response of cross bred dairy cows fed on indigenously prepared rumen protected fat-a field trial. *Indian J. Anim. Sci,* 79: 1045-1049.

Parnerkar, S., Kumar, D., Shankhpal, S.S. and Thube, H., 2010. Effect of feeding bypass fat to lactating buffaloes during early lactation. Proceedings of the 7th Biennial Animal Nutrition Association Conference, December 17-19, 2010, Bhubaneswar, India, pp: 126-131.

Rajesh, G., 2013. Studies on postpartum physiological adaptation in hormones, metabolites and milk production in crossbred cows fed with prill fat. M.V.Sc Thesis, NDRI Deemed University, Karnal, Haryana, India.

Singh, M., Roy, A.K. and Sharma, S., 2015. Augmentation of Milk Production by Supplementing Bypass Fat in Dairy Animals. *Asian Journal of Animal and Veterinary Advances*, 10 (9): 476-488.

Sharma, S., Singh, M., Roy, A. K. and Thakur, S., 2016. Effect of pre-partum prilled fat supplementation on feed intake, energy balance and milk production in Murrah buffaloes.*Veterinary World,* 9(3):256-259.

Yadav, G., 2014. Effect of prill fat supplementation on milk production and reproductive performance in crossbred cows.M.V.Sc. Thesis, National Dairy Research Institute, Deemed University, Karnal Haryana

Yadav, G., Roy, A.K. and Singh, M., 2015. Effect of prilled fat supplementation on milk production performance of crossbred cows. *Indian J. Anim. Nutr,* 32: 133-138.

Kumar,2017. By pass fat in animal feeding-A review. *Journal of Entomology and Zoology Studies*, 5(6): 2251-2255

Polioencephalomalacia in Ruminants

Dr. Vishnurahav R.B. (M.V.Sc., Ph.D.)

Teaching Assistant
University Veterinary Hospital and Teaching Veterinary and Clinical Complex
College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala 680 651
Corresponding author:vishnurahav@outlook.com

Polioencephalomalcia is a disease mainly caused by the deficiency of thiamine and /or sulphur toxicity and it affects cerebral part of brain predominantly grey matter that therefore called as cerebrocortical necrosis. The disease is most common inwell-nourished thrifty cattle 6 to 18 monthsof age. Goats from two months to three years of age group were mainly affected.

Dietary related predisposing factors

- ✓ Animals fed with high concentrate and receiving inadequate roughage leads to acute carbohydrate engorgement (acute ruminal acidosis).The ingestion of large quantities of highly fermentable carbohydrate by ruminants are followed within 2-6 hours the marked change in the microbial population of the rumen. Lactic acid destroys rumen favourable bacteria and protozoa, which affects the production of thiamine in rumen.
- ✓ Thiamine - Impaired absorption and/or phosphorylation and presence of a thiamine inhibitor in the tissues of the host
- ✓ Lack of sufficient or appropriate coenzyme-apoenzyme binding for thiamine-dependent systems
- ✓ Increased metabolic demands for thiamine or increased rate of excretion in the body
- ✓ Thiamine can be destroyed by thiaminases of which significant amounts can be found in the rumen contents and faeces of cattle and sheep affected with naturally occurring Polioencephalomalcia.

The ingestion of excessive quantities ofsulfur from the diet and water supply cancause the disease in cattle and sheep withoutany change in the thiamine status of thetissues.

Clinical signs

Sudden blindness, ataxia, staggering, head-pressing, tremors of head and neck, ear twitching, champing fits, clonic-tonic convulsions, recumbency, opisthotonus, rumen contractions normal initially, pupilsusually normal and responsive, nystagmus, death

may occur in 24–48 hours in calves, whereas older cattle up to 18months of age may survive for several days.

Differential diagnosis

- ✓ Enterotoxaemia
- ✓ Pregnancy toxaemia
- ✓ Lead poisoning
- ✓ Meningoencephalitis

Treatment

- ➢ Thiamine hydrochloride @ 10mg/kg bw slow IV or IM every three hours for at least five treatments
- ➢ Mannitol (@ 0.25-1g/kg bw) or sodium chloride 7.2 -7.5 %(4-5ml/kg) in acute severe cerebral edema conditions. Dexamethasone (1mg/kg IV SID) can also be given
- ➢ Thiamine hydrochloride, at a rate of 1 g for lambs and kids and 5 g for calves in a drench, is recommended.

  When treatment is givenwithin a few hours of the onset of signs, a beneficial response observed commonly within 1 to 6 hours, and complete clinical recovery can occur in 24 hours. Sheep and goats will commonly respond within 1 to 2 hours.

Prevention

- ➢ Feed fresh or conserved green forage with at least 60% of the dry matter in it
- ➢ Thiamine inadequacy form was treated by altering intraluminal environment by increasing roughage or changing source of roughage. Supplement ration with thiamine at 3 mg/kg dry matter of feed and remove amprolium from diet
- ➢ Avoid feeds and water with a high sulphur content or introduce these slowly. Restrict access to pastures with brassicaceaefamily plants that have high sulfur content.
- ➢ Be aware of risks associated with animals starting grazing after a long period without or on a reduced diet (particularly following long and severe periods of rainfall)
- ➢ Do not use ammonium sulphate as an acidity regulator in vitamin/mineral premixes, if these are used on the farm. Administer thiamine HCl (10-15 mg/kg BW iv) or multi-B vitamin preparations i.v. to the affected animal every three to four hours until recovered.
- ➢ If there is no response to treatment, arrange for on-farm casualty slaughter

REFERENCE

Constable, P. D., Hinchcliff, K. W., Done, S.H. and Grenburg, W. 2017. VeterinaryMedicine. A Textbook of the diseases of Cattle, Horses, Sheep, pigs and Goats (11thEd.)

Animal Genetic Resources of Maharashtra

Bahurupi P.R.*, Yadav Tejwanti and Jeet Vikram

Department of Animal Genetics and Breeding,
College of Veterinary Sciences,
Lala Lajpat Rai University of Veterinary and Animal Sciences,
Hisar, 125004, India
Corresponding author: pooja26993@gmail.com

India is hub to domestic animal diversity, it harbors more than 160 well documented indigenous breeds of various species viz., Cattle-43, Buffalo-16, Sheep-43, Goat-34, Poultry-19. These valuable genetic resources are outcome of adaptive evolution in specific ecosystem over thousands of year as a result of interaction of environment and human selection has lead to present domestic animal diversity. Indigenous breeds are bestowed with unique, sustainable germplasm, well adapted to harsh and extreme climatic condition with ability to survive in stress and resistance to prevalent tropical diseases and better feed utilization.

The total livestock population consisting of Cattle, Buffalo, Sheep, Goat, Pig, Horses & Ponies, Mules, Donkeys, Camels, Mithun and Yak in the country is 535.78 million numbers in 2019.

Maharashtra is one of the most important states having diversity of 15 indigenous animal breeds having well differentiated characters that has role in enrichment of biodiversity. Maharashtra has valuable genetic resources of cattle (Gaolao, Khillar, Red kandhari, Deoni, Dangi and Konkan Kapila), Buffalo (Pandharpuri, Marathwadi, Nagpuri), Sheep (Deccani), Goat (Osmanabadi, Berari, Sangamneri, Konkan kanyal), Poultry (Busra)

GAOLAO (**Synonyms**: Arvi, Gaulgani)

Breeding tract: The breeding tract of the breed includes Balaghat, Chhindwara, Seoni districts of Madhya Pradesh; Durg and Rajnandgaon districts of Chattisgarh and Wardha and Nagpur districts of Maharashtra.

Morphological characters: Gaolao is a breed of western and middle part of India and known for its agility. The breed is suitable for transportation in hilly areas. The breed resembles Ongole breed, except that it is lighter. The coat colour is blackish white in males and white in females. Males are generally grey over the neck. Horns are short, stumpy and curved slightly backward. Head is markedly long and taper towards muzzle. Forehead recedes at the top giving a slightly convex appearance. Bullocks are trained for moving fast.

Economically important characteristics:
The milk yield is low with an average of 604 kg per lactation with 4.32% fat (ranges between 470 to 725 kg per lactation)

Red Kandhari (Synonym: Lakhalbunda)

Breeding tract: Originated from Kandhar tehsil in Nanded district of Maharashtra. It is a draught breed of cattle. Its breeding tract comprises Ahmadnagar, Parbhani, Beed, Nanded and Latur districts of Maharashtra.
Morphological characters: The colour is uniform deep dark red, but variations from a dull red to almost brown are also found. Bulls are a shade darker than cows. Horns are evenly curved and medium sized.

Economically important characteristics: The bullocks are used for heavy agricultural work like ploughing and carting as well as for transportation. The cows produce fair quantity of milk with an average of 598 Kg per lactation with average fat percentage of 4.57%.

DANGI (Synonyms: Kandadi)

Breeding tract: Dang district of Gujarat and Thane, Nasik, Ahmednagar districts of Maharashtra.

Morphological character: The animals are adapted to heavy rainfall conditions. The skin exudes an oily secretion, which protects them from heavy rain. Dangi cattle have distinct white coat colour with red or black spots distributed unevenly over the body. Horns are short and thick with lateral pointing tips. Animals with inward pointing horns or downward pointing horn tips are also available in sizable numbers. The head is usually small with a slightly protruding forehead.

Economically important characteristics: Average milk yield per lactation is 430 kilo grams with an average milk fat of 4.3%. The lactation milk yield ranges from 175 to 800 kg.Dangi cattle are extensively used for ploughing, harrowing and other field operations, and for carting timber from forest area. The breed is well known for its excellent working qualities in heavy rainfall areas, rice fields and hilly tracts.

DEONI (Synonyms: Surti, Dongarpati, Dongri, Wannera, Waghyd, Balankya and Shevera)

Breeding tract: Deoni is a draught type animal developed its name from the place of origin i.e. Deoni taluk of Latur district in Maharashtra. The breeding tract of the breed includes Bidar district of Karnataka and Parbhani, Nanded, Osmanabad and Latur districts of Maharashtra.

Morphological character: Body colour is usually spotted black and white. This breed has three strains viz. Balankya (complete white), Wannera (complete white with partial black face) and Waghyd or Shevera (black and white spotted). Small sized horns emerge from the side of the poll behind and above the eyes in outward and upward direction. The tips of the horn are blunt. Drooping ears, prominent & slightly bulging forehead.

Economically important characteristics: Deoni bullocks are preferred for heavy works and bullocks can effectively be used even up to 12 years of age. The breed produces scanty milk with average yield of 868 kg per lactation (ranging between 638 to 1229 kg per lactation). The fat percentage in the milk is 4.3 % on an average.

Khillar (Synonyms: Mandeshi, Shikari and Thillar)

Breeding tract: The breeding tract of this breed is Belgaum, Bijapur, Dharwad, Gulbarga, Bangalkote district of Karnataka and Pune, Satara, Sangli, Solapur, Kolhapur, Osmanabad district of Maharashtra. This breed is believed to have originated from Hallikar or Amritmahal breed of cattle. Four types of Khillar cattle are prevalent in different parts of the country. "Atpadi Mahal" in Southern Maharashtra, "Mhaswad" in Solapur and Satara area, and "Thillari" in Satpura range of hills, and "Nakali" in adjoining area of this region.

Morphological character: The typical Khillar animal is compact and tight skinned, with clean cut features. The whole appearance is like a compact cylinder with stout, strongly set limbs. There is a slight rise in the level of the back towards the pelvis. Horns are long and pointed and follow the backward curve of the forehead which are placed close together at the root with thick base, grow backward for half of the length and then turn upwards in a smooth bow shape peculiar to this breed ending in pointing tips. The ribs are well sprung and give the trunk a barrel shape. The gait of Khillar is quick and spirited. Khillar cattle of Deccan plateau - the "Mhaswad" and the "Atpadi Mahal" type are greyish-white. Males are dark over the fore & hindquarters with peculiar grey and white mottled marking on face. The "Tapti Khillar" are white with carroty nose and carroty hooves.

Economically important characteristics: Bullocks are highly valued as fast powerful draught animals. They can travel miles without showing any signs of fatigue. Average milk yield per lactation of Khillar cattle is 451 kg with an average milk fat of 4.2 %. The lactation yield ranges from 240 to 515 kilo grams.

Konkan Kapila (Synonyms: Konkan gidda, Konkan)

Breeding tract: Thane, Raigadh, Ratnagiri, Sindhudurg, Palghar districts of Maharashtra.

Morphological character: Animals are Small to medium in size with compact body, horizontal ears and straight forehead. Eyelids, muzzle, hoof and tail switch are generally black. predominant coat colour is reddish brown followed by black. Animals with white/grey, mixed, brown or fawn coat colour animals are also available. Horns are straight emerging from side of the poll behind and above eyes in outward direction and going upwards and backwards ending with pointed tips.

Economically important characteristics: Konkan Kapila cattle are low milk producer (around 450 kg/lactation with 4.5 % fat) and possess good draft ability best suited to hilly region and hot and humid climate of its native tract and are significantly contributing to the livelihood of small and marginal farmers.

BUFFALO BREEDS

Nagpuri (Synonyms: Berari, Gaorani, Puranthadi, Varhadi, Gaolavi, Arvi, Gaolaogan, Gangauri, Shahi, Chanda.)

Breeding tract: Akola, Amravati, Yavatmal, Wardha and Nagpur districts of Maharashtra. The breed is maintained for milk and draught purposes.

Morphological character: The breed is black with white patches on face, legs and tail tips. However, "Puranthadi" strain is slightly brown in color. The horns are long, flat and curved, bending backward on each side of the neck nearly up to the shoulders with tips pointed mostly in upward direction.

Economically important characteristics: The animals of this breed are very well-adapted to the harsh climate of Vidarbha region. These buffaloes are used for heavy draught purpose and Farmers prefer this breed due to its low maintenance cost, efficiency of feed conversion, moderate production and better adapation to local climatic conditions. Average milk yield per lactation is 1039 kg ranging from 760-1500 kg with average milk fat of 8.25% ranging from 7.0-8.8%.

Pandharpuri

Breeding tract: They are named after the name of the geographical area i.e. Pandharpur block in Solapur district of Maharashtra. The breeding tract includes Solapur, Sangli and Kolhapur districts of Maharashtra. These buffaloes are concentrated in Pandharpur, North Solapur, South Solapur, Barshi, Akkalkot, Sangola and Mangalvedha tehsils of Solapur district; Miraj, Walwa, Jathand Tasgaon tehsils of Sangli district; and Karveer, Shirol, Panhala, Radhanagri, Hatkanangale and Gadhinglaj tehsils of Kolhapur district.

Morphological character: Pandharpuri buffaloes are usually black in colour but colour varies from light to deep black. White markings are found on forehead; legs and tail in few animals. Horns are very long and extend beyond shoulder blade, sometimes up to pin bones. The Nasal bone is very prominent, long and straight.


Adult male


Adult female

Economically important characteristics: The animals have multiple milk let down capability. Farmer takes animals to customer's door and milks as per requirement. Then the animals are taken to the next customer and are milked again. The buffaloes produce on an average 1790 Kgs of milk per lactation with fat % of 8.

Marathwadi (Synonyms: Ellichpuri, Dudhana Thadi)

Breeding tract: Parbhani, Nanded, Beed, Jalna and Latur districts of Maharashtra.
Morphological character: The animals are greyish black to jet black in colour and white markings are sometimes present on forehead and lower parts of the limbs. Horns are medium in length and parallel to the neck, reaching up to shoulder but never beyond shoulder blade. Distinguishing feature from Pandharpuri breed is the length of the horns, which reach only up to shoulder, unlike in Pandharpuri breed wherein they may even reach up to pin bones sometimes.


Adult male


Adult female

Economically important characteristics: Average lactation milk yield is 1118 kg and average milk fat is 8.8% ranging from 6.25-10.50%.

GOAT BREED

Konkan Kanyal

Breeding tract: These goats are native to the Konkan region of Maharashtra, and are reared mostly by the Dhangar and Maratha communities for meat.
Morphological character: Goats are mainly black with a white marking in a specific pattern–the ventral surface of the body is white and the legs have white 'stockings'. Konkan Kanyal goats have bilateral white strips from nostrils to ears; a flat and broad forehead; flat, long drooping ears; backward, straight, pointed, cylindrical horns; white muzzle and long legs, laterally black, medially white from knee to the fetlock joint.

Economically important characteristics: The body weight of adult bucks and does averages 35 and 30 kg respectively. Konkan Kanyal goats are regular breeders and breed round the year, with a twinning percentage of about 66%.

Sangamneri

Breeding tract: The semi arid region of Maharashtra comprising of Nasik, Ahmednagar and Pune districts forms the native habitat of the Sangamneri goat breed.The breed derives its name from the Sangamner Tehsil of Ahmednagar District.
Morphological character: They are medium-sized animals. The coat is completely white with mixtures of black and brown. Ears are long and drooping. Both sexes have horns directed backward and upward. The litter size is mainly single however 15 – 20% goats show twinning whereas triplets are rare.

Economically important characteristics: The average daily milk yield varies between 0.5 to 1.0 kg with an average lactation length of about 160 days. Although this breed is reared mainly for meat, some animals show a good milch potential. Dressing percentage is about 41% at 6 months, 45% at 9 months and 46% at 12 months of age.

Osmanabadi

Breeding tract: Latur, Tuljapur and Udgir taluks of Osmanabad district of Maharashtra, from where they derive their name. They are also fairly widespread in Karnataka, and the Nizamabad district of Andhra Pradesh.

Morphological character: The goats are large in size. The colour of the coat varies, but is mostly black (73%), with the rest being white, brown or spotted. Ninety per cent males are horned; females may be horned or polled.

Economically important characteristics: The breed is considered useful both for meat and milk. Average daily milk yield varies from 0.5 to 1.5 kg for a lactation length of about 4 months. In favourable conditions they breed regularly twice a year and twinning is common.

Berari (Synonyms: Lakhi and Gaorani)

Breeding tract: They are found in the Vidarbha region of Maharashtra and in the Nimari region of Madhya Pradesh. Berari goats derive their name from the erstwhile Berar region.

Morphological characters: The coat colour is light to dark tan. Thigh hair, eye brows and nostrils are tan to black in colour. The horns and ears are flat, leafy and drooping. The head is convex shaped with a slightly roman nose and with light or dark stripes on the lateral sides extending from the base of the horn to the nostril. Berari goats have a black hair line along the vertebral column extending up to the tail.

Economically important characteristics: These goats show good prolificacy, with the litter size ranging from single kids to four kids. Twinning is common. Milk yield for farm reared goats is about 43 kg in a lactation period of 123 days.

Deccani (Synonyms: Lonand, Sangamneri, Solapuri (Sangola) and Kolhapuri)

Breeding tract: The Deccani breed of sheep is widely distributed in the Deccan plateau across the three states of Maharashtra, Andhra Pradesh and Karnataka

Morphological characters: The breed has a thin neck, narrow chest, prominent spinal processes. It has Roman nose and dropping ears. The colour is dominantly black, with some grey and roan. Different strains (or within breed types) are observed in the breed tract. Four types have been noticed

Economically important characteristics: Means of body weights at birth, three, six, nine and twelve months of age were 3.13, 14.30, 18.20, 20.10 and 22.57 Kg, respectively for Deccani sheep maintained under NWPSI. Sheep were sheared two times a year and the overall means for lambs first six monthly clip and second six monthly clip and adult annual clips were 467, 499 and 488 g

POULTRY BREED

Busra

Breeding Tract: Busra birds are found in the Navapur Taluk of Nandurbar and the Sakri Taluk of Dhule districts of Maharashtra, and the Songadh and Uchchal Taluks of Surat district of Gujarat.

Morphological characters: Plumage is mostly white mixed with black feathers on the neck, back, tail, and reddish brown feathers on shoulders and wings. Comb is red, single, small to medium in size, stands erect. Beak is yellow and wattles are red, with a yellow shank. The shell colour is primarily light brown.

Average Flock Size: 9 birds.

Cultural / Economic Significance: The birds are reared in a free range system for home consumption as well as for sale of live birds and eggs. The bird is preferred as a meat bird, since the egg laying capacity is poor.

REFERANCES

National Bereau of Animal Genetic Resources
www.nbagr.res.in
Department of Animal Husbandry and Dairying www.dahd.nic.in

Importance of Pulses as Nutrient Source, Soil Health Enhancer and Climate Change Mitigant

C. Subha Lakshmi[1*] and Ch. Chandra Sekhar[2]

[1]ICAR- National Academy of Agricultural Research Management, Rajendranagar, Hyderabad
[2]ICAR- Central Research Institute for Dryland Agriculture, Santhoshnagar, Hyderabad
**Corresponding Author: cslagro2410@gmail.com*

Pulses belonging to family *Fabaceae* are next to cereals in terms of their economic and nutritionalstatus as human diet. These crops are cultivated globally and hold prominence as important constituents of cereal based vegetarian diets. They assume significance in contributing to nutritional security, sustainable crop production and soil health enhancement. Malnutrition remains a scourge in many developing countries. The effective management of severe acute malnutrition is a huge challenge in low resource health care settings (Kramer and Allen, 2015). Pulses are rich source of nutrients and could be regarded as efficient tools to alleviate the problem of malnutrition. The proximate composition of pulse grain (per 100g) is presented in Table 1.

Table 1. Proximate composition of pulse grain (per 100g)

Pulses	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Total dietary fiber (%)
Chickpea	368	21.0	5.70	61.0	22.7
Pigeonpea	342	21.7	1.49	62.0	15.5
Urdbean	347	24.0	1.60	63.4	16.2
Mungbean	345	25.0	1.10	62.6	16.3
Lentil	346	27.2	1.00	60.0	11.5
Field pea	345	23.0	1.30	63.4	18.2
Cowpea	346	28.0	1.30	63.4	18.2
Horsegram	321	23.6	2.30	59.1	15.0

Source: Pulses for Human Health and Nutrition, Indian Institute of Pulse Research

In order to meet the food grain demands of escalating population,there was a paradigm shift in crop production system biased towards cereal based cropping system. Cereal-cereal cropping system requires high input of fertilizers and are also highly nutrient exhaustive.Over exploitation of nutrients resulted in soil health deterioration, water table decline and environmental problems. Inclusion of pulses in cropping system would play major role in improving,sustaining soil productivity and also might

contribute to curtailing GHG emissions. The major advantages provided by legumes towards soil health enhancement is presented inFigure 1.

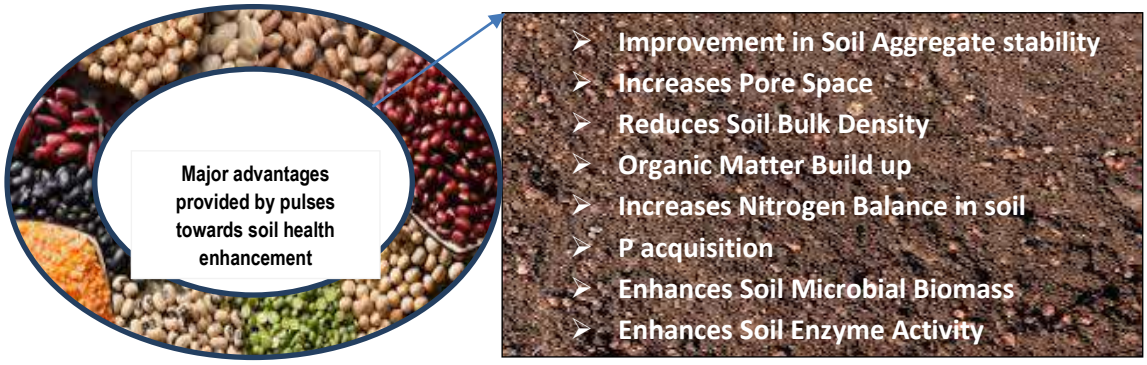


Figure 1. Major advantages provided by pulses towards soil health enhancement

Aggregate stability could be regarded as a soil parameter of significance which could serve as an index to compare the shifts in soil quality. Inclusion of pulse crops in crop rotations aided in enhancing aggregate stability and formation of favourable soil structure. The improvements in soil aggregates might be attributed to the presence of the protein, glomalin released by rootsof pulses and other plants. This proteinis insoluble and sticky, serves as "glue" that binds soil together intostable aggregates. Aggregate stability increases pore space and tilth,reducing both soil erodibility and crusting. Aggregates contain many microbial communities which are effective in decomposing organic matter and mineralize nutrients in a protected environment near plant roots. Soil aggregates act like slow release fertilizer pellets and provide nutrition to the growing crop.Pulse crops return sizable portion of leaf litter which contribute to augment organic matter content in soils and also reduce bulk density (Ganeshamurthy et al. 2006).

Pulse crops possess deep root systems (1 to 2cm diameter) which can penetrate upto 2 metres into the soil profile. These roots are rich in nitrogen and encourage earthworm activity and they in-turn create burrows. The root channels and the earthworm burrows increase soil porosity promoting air movement and water percolation deep into the soil.Legumes have the potential to fix nitrogen from the atmosphere and store it in nodules in their roots which could be utilized by the subsequent crop, eventually curtailing fertilizer use and reducing N_2O emanation.Deep rooting also facilitates recycling of nutrients from deeper layers. It also contributes towards increased available P pool which could be attributed to P acquisition from insoluble phosphates through root exudates.

Pulses also provide congenial environment for microbial activity and multiplication. The increased microbial activity depending upon the environment influence mineralization and immobilization of nutrients *viz*. N, P and S. Incorporation of legume residues into soil increased enzyme activity levels *viz*. β -glucosidase, arylsulphatase, cellulase and amylase (Dinesh et al. 2000).Organic acidsreleased by

pulse crop's root into soil also aid in mobilizing un-available soil nutrients (NarendraKumar and Arti Yadav, 2018). Organic acids released by different pulse crops is presented in Table 2.Pulse residues serve as rich source of nutrients to plants. Quantity of leaf fall in different pulses and their nutrient contribution is presented in Table 3.

Table 2. Organic acid released by different pulse crops

Crop	Organic acid	P fraction used
Chickpea	Citric acid	Ca-P
Lupin	Citric acid	Fe-P
Pigeonpea	Piscidic acid	Fe-P
Soybean	Citric, malonic acid	Ca-P

Source – Ae et al. 1990; 1993

Table 3. Quantity of leaf fall in different pulses and their nutrient contribution

Crop	Leaf litter (t/ha)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Chickpea	1.1-1.7	7-14	3.5-5	8-20
Lentil	1.3-1.6	8-10	3.5-4.5	12.5-19
Pigeonpea	1.3-2.8	8-16	2.5-5.0	13.5-24

Source: Narendra Kumar and Arti Yadav, 2018

CLIMATE CHANGE MITIGATION

Food production, food security and climate change are intrinsically connected. Climate change impacts every level of food production as well as ultimately, the price instability of foodand the livelihood security of affected farming communities. Introducing pulses into farming systems can be key to increasing resilience to climate change. Climate change mitigation through pulses could be attained in three ways (Figure 2).

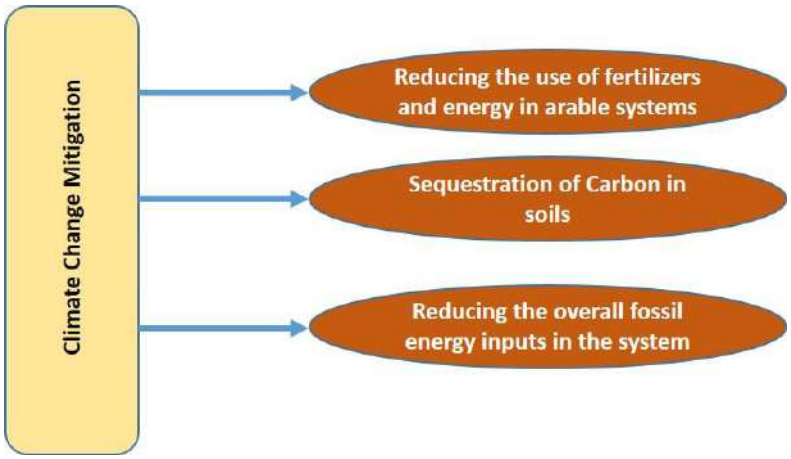


Figure 2. Climate Change Mitigation through Pulses

Livestock contribute to global climate change by emitting GHG either directly (from enteric fermentation and manure management) or indirectly (from feed production and the processing and converting of forest into pasture).CH_4 and N_2O are the most importantGHGs from the animal production system and have veryhigh global warming potentials (GWP) of 25 and 298 CO_2equivalent (eq), respectively (Solomon et al. 2007). Among the nutritional strategies of CH_4 mitigation, dietary manipulation is a simplistic and pragmatic approach that can ensure better animal productivity as well as a lower CH_4 emission. The utilization of pulses crops as forage would help in curtailing methane emissions which could be attributed to the presence of condensed tannins, a low fibre content, a high dry matter intake and a fast passage rate (Beauchemin et al. 2008).

CONCLUSION

Pulse crops are nutrient rich crops which hold potentialto deliver multiple advantages viz. malnutrition alleviation, soil health enhancement (enhancing availability of soil nutrients, supplementing nitrogen, increasing soil microbial activity) and climate change mitigation. In order to overcome the critical challenges of food security, soil health deterioration and climate change, pulse crops could prove beneficial. Introduction of these crops into cropping systems and fallows would help in enhancing resource use efficiency and livelihood security.Hence, capacity building and policy initiatives to overcome constraints in pulse production and bringing more area under pulse cultivation should be given emphasis.

REFERENCE

Ae, N., Arihara J., Okada, K., Yoshihara, T., Otani, T. and Johansen, C. The role of piscidic acid secreted by pigeonpea roots grown in an Alfisol with low-P fertility, Genetic Aspects of Plant Mineral Nutrition (eds.) P.J. Randall, E. Delhaize, R.A. Richards and R. Munns. Kluwer Academic Publishers, Dordrecht. pp. 270-288 (1993).

Ae, N., Arihara, K., Okada, K., Yoshihara, T. and Johansen, C. Phosphorus uptake by pigeonpea and its role in cropping systems of Indian subcontinent. Science248, 477-480 (1990).

Beauchemin, K.A., Kreuzer, M., O'Mara, F. and McAllister, T.A. Nutritional management for enteric methane abatement: a review. Australian Journal of Experimental Agriculture 48, 21-27 (2008).

Dinesh, R., Dubey, R.P., Ganeshamurthy, A.N and Shyam Prasad, G. Organic manuring in rice-based cropping system: Effects on soil microbial biomass and selected enzyme activities. Current Science 79 (12), 1716-1720 (2000).

Ganeshamurthy, A.N., Masood Ali and Srinivasa Rao, Ch. Role of Pulses in Sustaining Soil Health and Crop Production. Indian Journal of Fertilizers 12(1), 29-40 (2006).

Kramer, V.C and Allen S. Malnutrition in developing countries. Pediatrics and Child health 25(9), 422-427 (2015).

Narendra Kumar and Arti Yadav. Role of Pulses in improving soil quality and enhancing resource use efficiency. Conservation Agriculture for Advancing Food Security in Changing climate 2, 547-561 (2018).

Solomon, S., Qin, D., and Manning, M. Technical summary. In: Solomon, S., Qin, D., Manning, M., Marquis, M., Averyt, K., Tignor, M.M.B., Miller, H.L., Chen, Z.L., editors. Climate change 2007. The physical science basis. Contribution of working group to the fourth assessment report of the Intergovernmental Panel on Climate Change. United Kingdom and New York,USA: Cambridge University Press, Cambridge. p. 19–91 (2007).

Biodegradation of Xenobiotics- A boon to environment

Nunna Sai Aparna Devi[1*] and Banka Kanda Kishore Reddy[2]

Dept. of Agril. Microbiology, Tamil Nadu Agricultural University, Coimbatore.
[*]Corresponding author: aparnanunna24@gmail.com

ABSTRACT

Xenobiotics are artificially man-made chemicals harmful threat and are not easily degradable. These are the compounds made of chemicals, synthesized for industrial or agricultural purposes e.g. halogenated Hydrocarbons, aromatics, pesticides,PAH, lignin, humic substances. These materials are generally recalcitrant to biodegradation due to their xenobiotic nature. But microbes are recently known to degrade these tough compounds by efficient release of enzymes in whichorganic compounds are converted to metabolic products but does not serve as a source of energy or nutrients to microorganisms *Ex*. insecticides, aliphatic & aromatic H.C.Mostly fungi belonging to the genera of Basidomycetes have been shown to mineralize azo dyes. Reductive cleavage of azo bond, leading to the formation of aromatic amines, is the initial reaction during the bacterial metabolism of azo dyes. Anaerobic/anoxic/aerobic azo dye decolorization is done by several mixed and pure bacterial cultures. Pure bacterial strains of *Aeromonas hydophila, Bacillus subtilis, Proteus mirabli, Sphingomonasxenophaga*BN6. Biodegradation of harmful materials helps to maintain toxic chemical free and reduces greenhouse gases and protects the environment.

Key words: Xenobiotics, PAH-polycyclic aromatic hydrocarbons

SOURCEOFXENOBIOTIC COMPOUNDS

- Petrochemicalindustry: oil/gasindustry,refineries andtheproductionofbasicchemicalse.g. vinylchlorideandbenzene
- Plasticindustry: closelyrelatedtothepetrochemicalindustry; usesanumberofcomplexorganiccompounds suchasanti-oxidants,plasticizers,cross-linkingagents
- Pesticideindustry: mostcommonlyfoundcentralstructuresarebenzeneandbenzenederivatives,oftenchlorinatedandoftenheterocyclic
- Paintindustry majoringredientaresolvents, xylene ,toluene,methylethylketone,methylisobutylketoneandpreservatives

- Others :Electronicindustry,Textileindustry,Pulpand Paperindustry,CosmeticsandPharmaceuticalindustry,Woodpreservation.

Biodegradation of different xenobiotic compounds

- Aliphatic hydrocarbone.g. alkane, alcohol, aldehyde; Aromatic hydrocarbon e.g. benzene, phenol, toluene, catechol; Azo dyes; Aromatic Cyclic hydrocarbons
- Both anaerobic and aerobic metabolism modes transform PCBs. Different microorganisms show preferential attack on PCBs resulting in different patterns of degradation.

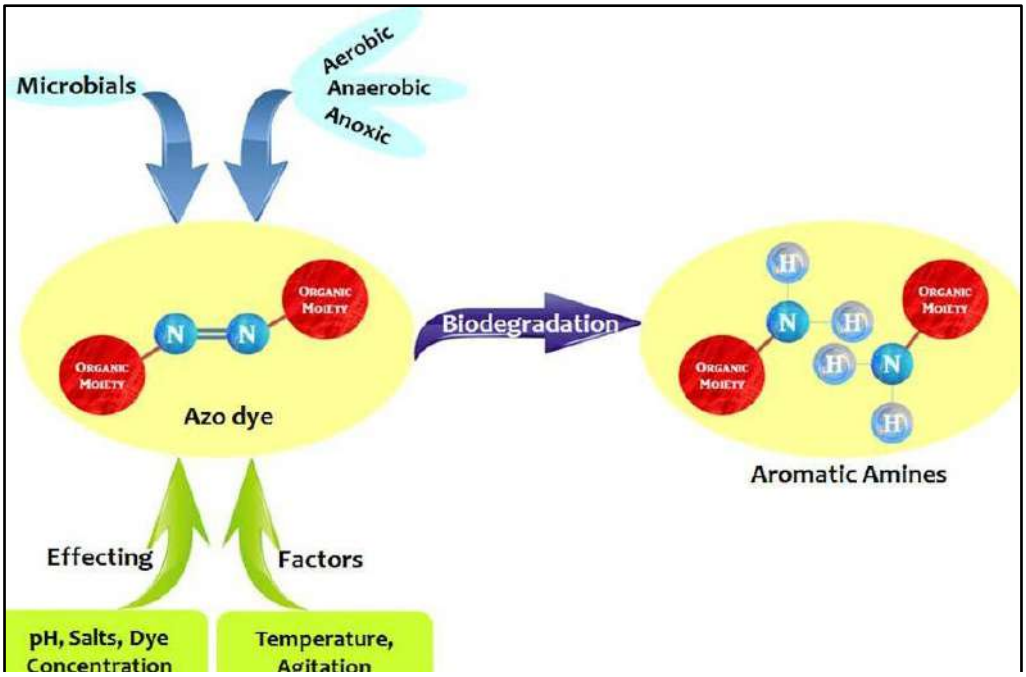


Fig.1. Mechanism involved in Microbial degradation of Azodyes

Microorganisms involved in biodegradation

Organic pollutant	Organisms
Phenolic compound	*Achromobacter,Alcaligenes, Acinetobacter,Arthrobacter,Azotobacter,Flavobacterium, Pseudomonasputida, Candidatropicalis*
Benzoate&related compounds	*Arthrobacter,Bacillus*spp., *Micrococcus,P. putida*
Pesticides	*P. aeruginosa* DDT
	B. sphaericus Linurin
	Arthrobacter,P. cepacia 2,4-D
	P. cepacia 2,4,5-T
	E. coli, P. Aeruginosa Parathion
Azodyes	*Bacillus subtilis, Proteus mirablis*

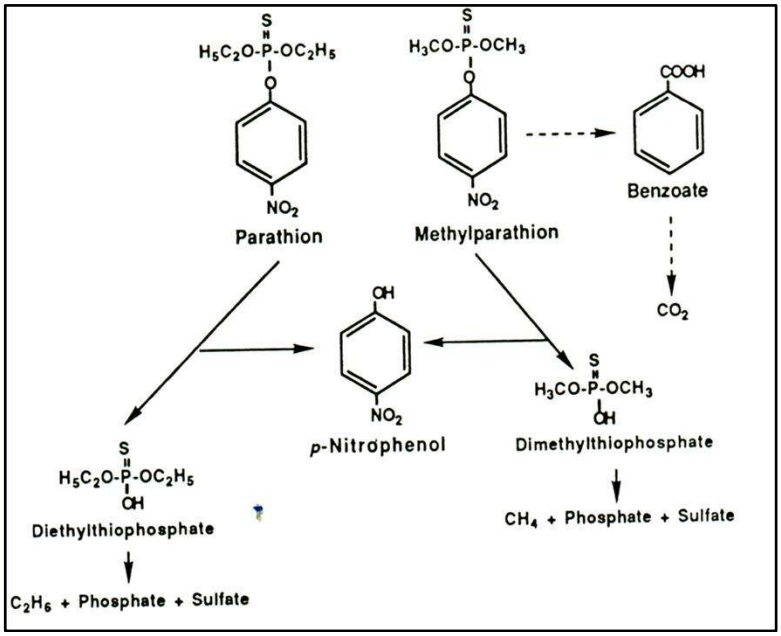


Fig.2. Pathwayinvolvedinbiodegradation of parathion

Benefits of biodegradation

- To control the mutagenic activity of the ground and surface waters polluted by industrial effluents.
- To control aesthetic problems.
- To save the aquatic life and to maintain optimum COD and BOD.
- As these Xenobiotic compounds are carcinogenic in nature.
- Even though microbial degradation gives good result its efficiency and effectivity are questionable. So, studies on improving their efficiency as an effective method can be indulged for future aspects.

REFERENCES

Pandey, A., Singh, P., & Iyengar, L. (2007). Bacterial decolorization and degradation of azo dyes. *International biodeterioration & biodegradation*, *59*(2), 73-84.

Kumar, S., Kaushik, G., Dar, M. A., Nimesh, S., Lopez-Chuken, U. J., & Villarreal-Chiu, J. F. (2018). Microbial degradation of organophosphate pesticides: a review. *Pedosphere*, *28*(2), 190-208.

Pailan, S., Gupta, D., Apte, S., Krishnamurthi, S., &Saha, P. (2015). Degradation of organophosphate insecticide by a novel Bacillus aryabhattai strain SanPS1, isolated from soil of agricultural field in Burdwan, West Bengal, India. *International Biodeterioration & Biodegradation*, *103*, 191-195.

The Prospects of Organic Farming under Indian Conditions

Sanjay Kadam [1*], Gaurav Singh Gurjar [2] and Kavita Chaturvedi [3]

[1] Fodder Development Officer, Mumbai Veterinary College, Goregaon, Mumbai-65 (MS)
[2 &3] M.Sc. scholars, Department of Agronomy, Rajasthan College of Agriculture, Udaipur
**Corresponding Author: sskbvc@gmail.com*

The green revolution begun during 1965 changed the scenario of Indian agriculture at the greater extent. The country's food grain production increased largely and attained the self sufficiency. The green revolution emphasized on introduction of the high yielding varieties of crops, use of chemical fertilizers and synthetic pesticides. It had positive impact from "food deficit" towards "food surplus", import towards export and enhanced the income of the farmers as result of increment in crop yield. These modern technologies adopted during green revolution era although increased the crop production created negative effects such as decline in soil fertility and productivity, destruction of soil structure, development of pests and diseases resistance, salinity problem, pesticide residues that created health hazard and illness problem environmental pollution and reduction of quality of agricultural produce etc. due to excess use of chemicals. To overcome these problems that we have been facing since last many decades the organic farming is one of the solutions. Organic farming is an alternative agricultural system which originated early in the 20th century in reaction to rapidly changing farming practices.

During ancient period farmers were using organic manures for improvement of soil fertility and pest control by using natural methods before the advent of synthetic fertilizers, pesticides, mechanization etc. In traditional India only organic farming was practiced. No chemical fertilizers and pesticides were used. It relies on fertilizers of organic origin such as compost manure, green manure and bone meal and emphasizing on techniques such as crop rotation, companion planting, biological pest control, mixed cropping and the fostering of insect predators are encouraged. In general, organic standards are designed to allow the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances. For instance, naturally occurring pesticides such as pyrethrin and rotenone are permitted. The organic products produced in this way are of good quality and free from any chemical residues are therefore demanded more by the farming community. The certain high quality agricultural products are also in more demand for the export purpose. Recently India has exported agriculture produce with having value of 298 million USD. Hence, there is better scope for organic farming in our country in future also.

NEED OF ORGANIC FARMING

Due to excessive tilling, watering and continuous use of chemicals in farming through chemical fertilizers, insecticides, fungicides, fumigants and growth hormones create the soil structure and texture get destroyed, majority of the soils are degraded and becoming unproductive, fertile layer of soils are getting eroded, agriculture produce carry chemical residues causing serious health hazards among the human and animals, ground water is polluted, salinity problem reduces the crop productivity and overall the ecologic balance is disturbed. Due to excess use of chemicals certain pests, disease causing pathogens and weeds are becoming resistant and require more and more quantities to control pest, disease and weeds add to the cost of cultivation. Therefore, organic farming will overcome these problems and will produce the agricultural production of better quality free from any chemical residues as well as maintain the soil fertility and productivity. The organic farming will check environmental pollution, reduce the degradation of soil, reduce the cost of agriculture production and will ensure sustainability of agricultural production

CONCEPT OF ORGANIC FARMING

Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, genetically modified organisms and livestock food additives. To the maximum extent possible organic farming system rely upon crop rotations, use of crop residues, animal manures, legumes, green manures, off farm organic wastes, bio fertilizers, mechanical cultivation, mineral bearing rocks and aspects of biological control to maintain soil productivity and tilth to supply plant nutrients and to control insect, weeds and other pests.

Inorganic V/s Organic farming

Inorganic farming	**Organic farming**
Against nature	Harmony with nature
Soil structure destroyed	Soil structure improves
More chemical residues present in crops	No chemical residues
Low quality produce	Premium quality
Highly fluctuation in yield	Satisfactory and reliable yield

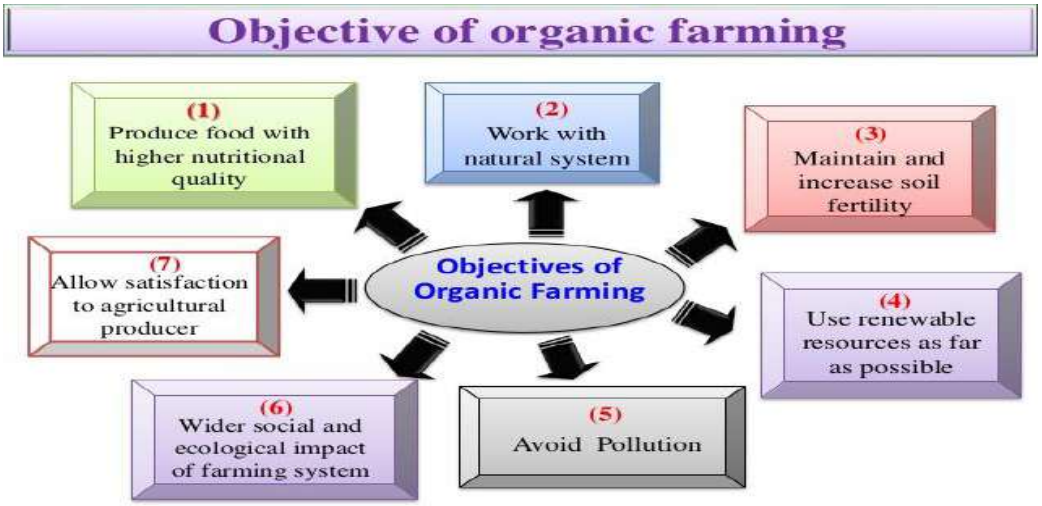
MAIN PRINCIPLES OF ORGANIC FARMING

The main principles of organic farming are as follows (Chandrashekar, 2010):

1. To work within a closed system and draw upon local resources as much as possible
2. To maintain long-term fertility of soils •
3. To avoid all forms of pollution that may result from agricultural techniques •
4. To produce foodstuffs in sufficient quantity and having high nutritional quality •
5. To minimize the use of fossil energy in agricultural practices •
6. To give livestock conditions of life that confirm to their physiological needs •
7. To make it possible for agricultural producers to earn a living through their work and develop their potentialities as human being

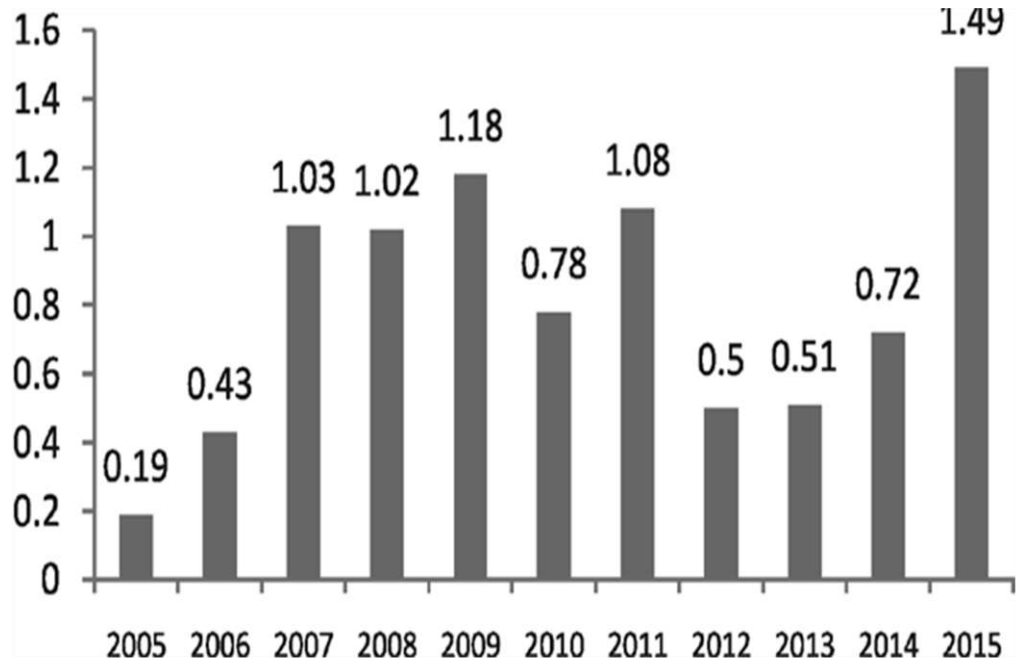
AIM OF ORGANIC FARMING

- The aim of organic farming is to maintain optimum soil health and thus making the soil capable of supplying all essential plant nutrients to crop for its proper growth, development and production.
- Organic farming gives organic food of better quality and also helps to restore soil fertility on long term basis.
- Organic farming aim to sustaining and increasing the productivity by improving soil health and overall improvement of agro-ecosystem.



STATUS OF ORGANIC FARMING IN INDIA

- Total area under organic farming 5.71 million ha
- Cultivated area under organic farming 1.49 million ha
- Wild forest area under organic farming 4.22 million ha
- Number of organic producers (2013) 6,50,000 (Highest in the world)
- Organic production 1.35 million ton
- Organic exports 2, 63,683 ton (298 million USD)
- Topmost exported organic item Oilseed
- Largest contributed organic product in global market Cotton **(APEDA, 2017)**



Area (M ha) under organic cultivation in India

(Aulakh and Ravisankar ,2015)

Area under organic farming is comparatively less in India. The Australia ranks the first in area under organic farming (22.89 m ha) followed by Argentina, USA, Spain and China. Inspire having the larger land resources in India only 1.49 m ha area is under organic farming. Therefore, there is large scope in future to increase the area under organic farming in our country.

Export potential of organic products in India

- India exports about 31 organic products.
- India is the best exporter of organic tea.
- Certified organic production is about: 1.35 m t
- Organic exports: 0.264 m t
- Leading state: Madhya Pradesh >HP >Rajasthan
- Japan is the largest organic food market in Asia

Type of products	Products
Commodity	Tea, Coffee, Rice, Wheat
Spices	Cardamom, Black pepper, White pepper, Ginger, Turmeric, Clove,
Pulses	Red gram, Black gram
Fruit	Mango, Banana, Pine apple, Orange, Walnut
Vegetables	Okra, Brinjal, Garlic, Onion, Tomato, Potato,
Oil seeds	Mustard, sesame, Castor, Sunflower
Others	Cotton

CONCLUSION

For better perspective of organic farming and for sustainable high quality agricultural production it is necessary to adopt environment friendly modern agricultural technologies and avoid misuse of certain detrimental chemicals that is becoming threat to all. There is better prospects to organic farming in future also as organic produce from India is more demanded by the other countries which will add to the foreign exchange. Good quality organic products would minimize also health hazards among the human beings.

REFERENCES

APEDA 2017. www.apeda.gov.in

Aulakh C.S. and Ravisankar N (2017). Organic farming in Indian context: a perspective. *Agric Res J* 54 (2) : 149-164,

Chandrashekar, H.M., 2010. Changing scenario of organic farming in India: an overview. *Int. NGO J.*, 5: 34-39

Ozonation – An Effective Strategy in Reduction of Pesticide Residues for Food Safety

Banka Kanda Kishore Reddy[1] and Nunna Sai Aparna Devi[2]

[1]Ph.D. Scholar, Dept. of Agril. Entomology, [2]Ph.D. Scholar, Dept. of Agril. Microbiology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore.
[1]Corresponding author: bankakishorereddy@gmail.com

ABSTRACT

In agriculture, pesticide residues have always posed a major safety hazard to human health. With the development of agricultural production and improvements in science and technology, additional methods for degradation of pesticide residues have emerged. Amongst them, ozone treatment recently became a popular method owing to its outstanding technical advantages. This information is an in-depth analysis of the mechanisms by which ozone treatment degrades pesticide residues. The main mechanism involves direct oxidation by oxygen atoms, and indirect oxidation driven by hydroxyl radicals. The effects of ozone treatment on pesticide residues in food with respect to the ozone concentration, duration of ozone treatment, type of food, variety of pesticides, level of pesticide residues have been discussed. In addition, this article discusses several restrictions surrounding the current application of ozone treatment for the degradation of pesticide residues.

SCENARIO OF PESTICIDES ON HEALTH CONCERN

Food safety is a major issue related to the economy of a nation and livelihood of people. In recent years, the frequency of pesticide poisoning incidents has increased. During agricultural production, spraying of chemical pesticides to control and prevent the negative effects of pests and insects is a necessary measure to increase crop yields, which equates to preventing approximately 30% of economic losses. Many pesticide residues show bioaccumulation and biomagnification at levels that are deleterious to the human body, because they are amplified through the food chain and can be detected in meat, poultry, fish, vegetable oils, nuts and various fruits and vegetables. Trace amounts of pesticide residues in the human body can result in chronic hazards. Long-term consumption of food containing pesticide residues can lead to the development of numerous diseases such as asthma, diabetes, leukaemia, Parkinson's disease and cancer.

These effects can even extend to the next generation by causing birth defects, low fertility rates, high infant mortality rates and certain hereditary diseases. In fact, because of their behavioural and physiological state, a child is more susceptible to the effects of pesticides than an adult. Therefore, it is urgently necessary to develop 'green' and effective strategies to reduce the amount of pesticide residues in food.

Ozone treatment in the degradation of pesticide residues

Ozone treatment provides numerous advantages in the degradation of pesticide residues, such as exhibiting a broad spectrum of action against pesticides and bacteria, high efficiency, ease of use, a relatively low cost, guaranteed quality of raw materials and user safety. Hence, ozone is widely used to treat drinking water and to preserve food. It is now beginning to be applied to the process of cleaning fruits and vegetables and degrading pesticide residues to ensure food safety.

Mechanism underlying the degradation of pesticide residues by ozone

Ozone, or trioxygen, is an inorganic molecule with the chemical formula O_3. It is a pale blue gas with a distinctive, pungent smell. Ozone is an allotrope of oxygen that is much less stable than the diatomic allotrope O_2. It breaks down to O_2 or dioxygen. Compared to oxygen, ozone has greater oxidative potential. It can decompose organic chlorides, dioxins and other pollutants into carbon dioxide and other innocuous substances. It can also oxidise toxic and hazardous substances, such as phenol and cyanide, into harmless substances. Water-soluble manganese (Mn2+), iron (Fe2+), and other inorganic substances can be oxidised by ozone into high-valence deposits that are insoluble in water and can be removed physically. Ozone treatment can break the double bond of members of the coloured group, playing a role in decolourisation. The chemical bonds of functional groups, such as =S, =NH, -SH, -NH, -OH, and -CHO, in the molecular structure of a malodour can be broken by ozone to reduce unpleasant smells. Large molecular weight organics that are rarely biodegradable can be oxidised by ozone into medium and small molecular organics that are more easily decomposed (Qiao *et al.,* 2012a).

Ozone degradation of pesticide residues is essentially based on two forms, the first is to wash or immerse food in a solution containing ozone, and the second is to add ozone gas continuously or intermittently into the atmosphere of stored food. There are differences in using ozone to degrade pesticides in aqueous and gaseous phases, because they have different properties and are affected by environmental conditions in different ways. The former has better degradation effects because aqueous ozone has the dual action of ozone and hydroxyl radicals (O_3 in water generally reacts with OH and H_2O to generate $OH^{\cdot}$). In contrast, the latter usually requires multiple gaseous ozone concentrations and ozone treatment times to achieve the desired effects.

Effects of ozone treatment on reduction of pesticide residues in food

Dipping apples in ozonated water of 0.25 ppm resulted in reducing the levels of azinophos-methyl on the surface of apples to 75 per cent (Ong *et al.,* 1995). Ikeura and his co-workers (2011) studied the effect of ozone water (2.0 mg L^{-1}) for 10 min on the

level of fenitrothion residues in strawberries and removal rated were concluded as 25 per cent. Removal of chlorpyrifos in lychee fruits with aqueous ozone water concentrations of 2.2, 2.4, 3.2 and 3.4 mg L^{-1} for 10, 20, 30 and 60 min resulted in 0, 25.8, 29.7 and 67.4 per cent respectively. Similarly, fumigation of O_3 at 80, 160, 200, 240 mg L^{-1} for 10, 20, 30 and 60 min resulted in 10, 18, 30, 45 per cent respectively (Whangchai *et al.,* 2011). Treating the citrus fruits with ozonated water (10mg L^{-1}) for 5 min reduced the chlorpyrifos by 94.2 per cent (Kusvuran *et al.,* 2012). Washing of strawberries in ozonated water (1mg L^{-1}) for 5 min resulted in removal of chlorpyrifos by 71.5 per cent (Lozowicka *et al.,* 2016). Heleno and his co-workers studied the effect of ozone (O_3) treatment effect on residues of difenoconazole in strawberries with three different concentrations (0.3, 0.6 and 0.8 mg L^{-1}). All the concentrations of ozone reduced the residues to 95% and below 0.5 mg kg^{-1}.

Current restrictions in application of ozone treatment for pesticide residues

Although ozone treatment has many technical advantages in the degradation of pesticide residues and its efficacy is remarkable, there are still several limitations to its practical application. For instance, ozone treatment may generate ozonation by products and cause secondary pollution. Further studies are necessary to characterise and understand this unpredictable possibility. Ozone is also likely to cause some damage to human health and production equipment. Therefore, it is necessary to investigate such a phenomenon further, so that ozone treatment can be integrated into agricultural production on a larger scale.

FUTURE THRUST AREAS

(i) Improving the efficiency of ozone treatment and degradation of pesticide residues effectively, while maintaining the quality of product,

(ii) Identifying the by-products of pesticide residue degradation and evaluating their toxicity.

(iii) Studying the mechanism of the degradative action of ozone on the different types of pesticide residues should help achieve accurate regulation of product safety.

REFERENCES

Heleno, F. F., M. E. L. R. Queiroz, A. A. Neves, R. S. Freitas, L. R. A. Faroni and A. F. D. Oliveira. 2014. Effects of ozone fumigation treatment on the removal of residual difenoconazole from strawberries and on their quality. *J. Environ. Sci. Health. Part. B.,* 49: 94-101.

Ikeura, H., F. Kobayashi and M. Tamaki .2011. Removal of residual pesticides in vegetables using ozone microbubbles. *Journal of Hazardous Materials.,* 186: 956-959.

Kusvuran, E., D. Yildirim, F. Mavruk and M. Ceyhan. 2012. Removal of chlorpyriphos ethyl, tetradifon and chlorothalonil pesticide residues from citrus by using ozone. *Journal of Hazardous Materials.,* 242: 287-300.

Lozowicka, B., M. Jankowska, I. Hrynko and P. Kaczynski. 2016. Removal of 16 pesticide residues from strawberries by washing with tap and ozone water, ultrasonic cleaning and boiling. *Environmental Monitoring and Assessment.,* 188: 51-55.

Ong, K. C., J. N. Cash, M. J. Zabik, M. Siddiq and A. L. Jones. 1995. Chlorine and ozone washes for pesticide removal from apple and processed apple sauce. *Food. Chemi.,* 55(2): 153-160.

Whangchai, K., J. Uthaibutra, S. Phiyanalinmat, S. Pengphol and N. Nomura. 2011. Effect of ozone treatment on the reduction of chlorpyrifos residues in fresh lychee fruits. *Ozone Science Engineering.,* 33: 232-235.

Qiao, C., J. Li, W. Hui, M. Li, and Q. Ma. 2012. Research progress of application of ozone technology in the disinfection and preservation. *Science and Technology of Food Industry.,* 33: 432-435.

Disease and insect pest management in kharif maize

Davinder Pal Singh Badwal[1], Mandeep Kumar[2], Navjeet Kaur[3] and Nisha[4]

[1, 3 & 4] M.Sc, Department of Agriculture Sciences, Sant Baba Bhag Singh University, Khiala, Jalandhar
[2]M.Sc, Department of Genetics and Plant Breeding, Lovely Professional University, Phagwara
[2]Correspondence author: mandeep25193@outlook.com

Maize is one of the most important cereal crops after wheat and rice in India as well as in Punjab also. It is grown in almost all states of India. It covers an area of about 116 thousand hectares in production and its productivity is nearly about 38.5q/ha during 2016-17 in Punjab. Maize is mainly a short duration crop. In India, maize is traditionally grown during *kharif* season, but now days the farmers are growing Maize throughout the year especially in North Indian states Punjab, Haryana. Out of total Maize production 50-60% is used in poultry and dairy, 15-20 in processing industry, 8% in human consumption and rest in seed purposes etc. Being as an important cereal crop it is also an important fodder crop in different regions of India, as it conveniently fits into various crop rotations. Maize crop is profitable crop for farmers, but 30-78% loss of Maize yield is due to effect on insects, pest and diseases in various agro climatic regions of India. Major diseases attacking Maize crop are leaf blight and bacterial stalk rot. In Punjab, majority of crop is affected by stalk rot on different hybrids of Maize in Hoshiarpur, Nawanshahar, Jalandhar districts. Among insect pests, most serious pest is maize stem borer which effects yield of crop .Other insects are Shoot fly, maize leaf roller, *kharif* grass hopper, shoot fly, cutworm, white grub. So, to prevent losses from these insect-pests and diseases, integrated disease management and integrated pest management should be followed.

DISEASES

1. **Seed Rot and Seedling Blight:** General symptoms of these diseases are poor emergence or patchy growth, rotting of seed in the collar region of mescotyle, presence of red brown lesion on radicles or mesocotyle and wilting of seeding. To control them treat the 3g of Bavistin or Thiram per kg of seed.
2. **Maydis Leaf Blight:** This disease starts appearing from the first week of July, through the state. Symptoms appear as spindle shaped water soaked chlorotic lesions on the leaves, which later coalesce to give blighted appearance to the leaf. In extreme cases, the symptoms also appear on leaf sheaths, cob husk and ears. Though the hybrids recommended cultivation in the state as it possesses resistance to may disease leaf blight, yet it has due significance in inbred lines,

breeder seed plots and hybrid seed production plots. The diseases caused by fungus *Drechslera maydis*, the secondary inoculums is transmitted by air. It is mainly found in waterlogged conditions as well as in late sown conditions. It can be controlled by two to four Mancozeb 75 WP (2.5 kg in 1000 litres of water per hectare)

3. **Bacterial Stalk Rot:** This bacterial disease occurs at pre-flowering stage of the crop and becomes severe in heavy soils under high temperature and humidity conditions. It is caused by bacterium *Erwinia carotovora* var Zea. Frequent rains and waterlogged conditions in the month of August and September aggravate this problem. The basal internodes develop soft rots and emit characteristic fermenting odour. The rind loses its natural green colour and becomes pale straw coloured as if boiled in water. Basal internodes become soft, discoloured and give a bad fermenting smell. Ear shoots and cobs occasionally get infected directly, but these droop down and hang limply on the infected plant. Ultimately, the stalk breaks and the plant collapse.

   To minimize the yield losses, farmers are advised to keep their fields well drained and must not allow water to stagnate. Dense planting should be avoided. Ridge sowing should be preferred than flat sowing in disease prone areas of Punjab. Use of improved varieties along with destruction of diseased debris in affected fields helps to reduce the incidence of this disease.

   Control Measures: 1) Select well drained field or arrange proper drainage to avoid water logging. **2)** Bleaching powder should be applied along the rows at the rate of 20-25 kg per hectare.

4. **Black Bundle Disease:** Blackening of vascular bundles appears as black dots on the cut ends of the stalk. In severe cases, leaves dry and plants wilt. Ears may rot or may not form at all. To control this disease treat the seed with systematic fungicides like Bavistin or Benlate at the rate of 3g per kg seed.
5. **Sugarcane Downy Mildew:** Long, rather broad , yellowish or whitish stripes appear on or up to the upper leaves of plant . Whitish coarse fungus growth is more apparent on affected leaves and may spread up to tassels. And leaves look pale yellow in colour.

   Control Measures: Spray Mancozeb 75WP 1.5 kg + 0.25 kg Zinc sulphate in 500 litres of water per ha.
6. **Post-flowering Stalk Rot:** Post flowering stalk rot is a complex caused by number of fungi, out of which, charcoal rot caused by *Macrophomina phaseolina* and Fusarium stalk rot caused by *Fusarium moniliforme* cause economic damage to maize crop under Punjab conditions. The symptoms of the disease become more conspicuous, when plants show premature drying. The pathogen commonly attacks the roots, collar region and lower internodes. The affected internodes become pale, pith become soft and spongy, resulting in deterioration of the vascular system. The disease includes rapid wilting and premature drying at or after flowering. The infected stalk show reddish browning of parenchymatous tissues.

The most economical and efficient method of disease control is the cultivation of resistant hybrid-PMH 1. Its 'stay green' character imparts resistance to stalk rot pathogens. Water stress at flowering predisposes the plant to infection. Crop sanitation, adequate balanced fertilizers and recommended plant density are required to reduce the incidence of disease. Healthy and vigorous plants are more tolerant to post flowering stalk rot disease and thus, able to produce comparatively higher yields.

7. **Banded Leaf and sheath blight:** Apart from the above mentioned diseases, yield losses due to banded leaf and sheath blight have increased in the past with cultivation of susceptible cultivation of susceptible cultivars of maize. This disease starts appearing after 35-40 days old plant. The infected leaves show blotched or blighted appearance with alternating light and dark bands. The pathogen is generally identified by characteristics of mycelium and sclerotia as it lacks spore formation. Maximum damage is caused when ears are infected. Severe infection produces blotching on sheaths and cob husks, and later sclerotia develop on sheaths, husk leaves, silks and kernel rows. Crop rotation and removal of lower leaves touching the soil is very effective in reducing the disease spread.

INSECT PESTS

1. **Maize Stem Borer:** Maize stem borer is active from March to September in Punjab. It is more serious at the end of May to mid-June sown crop, afterwards the incidence reduces with the onset of rains. The moths lay egg clusters (25-50 eggs) on the under surface of leaves of 10 to 15 days old maize plants. Thus, that control measures should be started at early crop growth stages. Moreover, the young larvae scraping on leaf surface are easily exposed to the spray chemicals, while, the grown up larvae enter deep into the stem and are difficult to control. A single female lays upto 300 oval, light yellow eggs.

   The newly hatched larvae of maize stem borer feed by scrapping and cause pinhole injury and grown up larvae tunnel down into the stem. In younger plants, due to boring by larvae, the central shoot dries up to from 'dead heart'. The larvae per plant may vary from 1 to 15 or even more under severe infestation and migrate to neighbouring plants by wind with the help of silken thread. So, damage in field is sometimes observed in patches. In advanced stages of plant growth (>45 days), the infestation of borer rarely causes complete loss of plant i.e. dead formation.

   Management: 1) The management of any pest should be based on environment friendly pest management approaches. In maize, two releases of *Trichogramma chilonis* parasitized Corcyra cephalonica eggs @ 40,000 per acre recommended at 10 and 17 days old crop. The trichocards with these eggs are available at PAU, Ludhiana. Cut them into 40 strips, each having approximately 1,000 parasitized eggs. These strips should be stapled on the underside of the central whorl leaves (as the eggs are laid on underside) during evening hours.

2) Also follow the cultural practices like: **a)** Since borer hibernates in plant remnants like stubbles, stalks, left over cobs, to reduce them, plough up the fields after harvesting, collect and destroy the stubbles. **b)** Use maize stalks, cobs and cores kept for fuel purpose by the end of February. Chop the remaining stalks, if any, for subsequent use. These practices will reduce the carryover of the hibernating borer larvae. **c)** To reduce further spread of borer in the standing crop, minimize larval dispersal by removal and destroying of the plants showing severe borer injury.

3) Alternatively, spray on the crop should be done 2-3 weeks after sowing on the appearance of first leaf injury using 60 litres of water with Decis 2.8 EC (deltamethrin) @ 80 ml or Coragen 18.5 SC (chlorantraniliprole) @ 30 ml per acre.

2. **Maize Leaf Roller:** Damage is caused by the caterpillar which is glossy green in colour and becomes pink when fully grown up. The larvae after emergence wander on the tender leaves. They fold the leaves by silking threads and hide themselves inside the rolled leaves. The surface becomes white and paperu in appearance.

   Control Measures: Spray Endosulphan (0.1%) or 0.2% Carbaryl (4g of Savin 50 WP in one litre of water) at the rate of 500-700 litres per hectare.
3. ***Kharif* Grass Hopper:** *Kharif* Grass Hopper generally does not cause much damage to maize crop. However, in a favourable season, it may prove very harmful and leaves nothing on the plant except stem and midribs of leaves. Both adult and nymph stages of this pest are responsible for the damage. Adults are green or dry grass coloured.

   Control Measures: Grass hopper can be controlled by dusting 2% Methyl parathion dust at the rate of 20 kg per hectare. For well grown nymphs and adult, spraying with 0.04% Carbaryl (Sevin) at the rate of 500-800 litres of water per ha is effective.
4. **Armyworm:** Its attack is relatively more on the border rows. It feeds on the leaves of the central whorl but it does not make pinholes/shotholes like maize borer. It feeds from the outer margins of the leaves towards midrib. The damage of this pest can be detected from its faecal pellets on the leaves or in the whorl. The insecticides used against the maize borer are effective in controlling this pest also.
5. **Silk Cutter:** A number of lepidopteran insect pests like hairy caterpillars, armyworm and semiloopers feed on the silk of green cobs but american bollworm is more damaging as it occurs in large number sporadically. The young larvae feed silks and may tunnel in ears damaging the grains in the milky stage. However, only a few grains are damaged in the mature cobs but the presence of masses of excreta on the attacked ears lowers its market value of green cobs. The insecticides used against the maize borer are effective in controlling this pest also.

6. **Hairy Caterpillars:** Hairy caterpillars, appearing in an epidemic form, cause serious damage by feeding on the leaves and the tender stems. When young, they feed gregariously on the green tissue of the leaves leaving the network of veins. The grown up caterpillars feed voraciously on leaf margin and may migrate from one field to another.

   Management: 1) The light traps could be employed for collection and destruction of the months. They young gregarious larvae can be destroyed by plucking the infested leaves or by pulling out the infested plants and burying deeply. The grown up caterpillars can be destroyed by crushing them under feet or by picking and putting them into kerosenized water. 2) If the population is high, spray 500 ml Ekalux 25 EC (quinalphos) per acre in 100 liters of water with a manually operated sprayer.
7. **White Grub:** This pest is very serious in sandy soils. The larvae are white C-shaped and feed on the roots of plants. In areas where it is problem, damage may result in complete failure of crop. For controlling white grub , Phorate (Thimet) 10 % granules at the rate of 15kg per hectare or Carbofuran (Furadan) 3%granules at the rate of 30 kg per hectare should be mixed in soil before sowing.

REFERENCES

Modern Techniques of Raising Field Crops by Chhida Singh, Prem Singh, Rajbir Singh
Diseases and Pest of Cereal Crops by PAU
Principles of Agronomy by Reddy and Reddy
Handbook of Agriculture by ICAR

Phytochemistry and Therapautic Properties of Aloe Vera

Rukhsana Rahman*, Neeraj Gupta and Fozia Hammed

Division of Food Science and Technology, SKUAST-J, 180009.
**Correspondence author: rukhsanarahman786@gmail.com*

Traditional health care system relies on herbal medicines, and World Health Organization has already recognized its contribution in tribal communities. Medicinal herbs can be procured easily from nature, and these natural products are assumed to have fewer side effects (Sharma et al., 2018). According to the World Health Organization (WHO), up to 80% of the people of the world are dependent on herbs as traditional remedy to cure various ailments since the beginning of civilization. Among the reported medicinal plants, *Aloe barbadensis* Miller, commonly referred to as Aloe vera, is one of more than 400 species of Aloe belonging to family Liliaceae which is used as a popular folk medicine throughout the world, and is an important component in the traditional medicine of many contemporary cultures, such as China, India, the West Indies, and Japan (Arunkumar and Muthuselvam, 2009). Recently, only a few species of Aloe have been considered for commercial importance, of which Aloe vera is considered the most potent and, thereby, the most popular plant in the research field. It was known as 'Universal Panacea' by the Greek scientist 2000 years ago.

Aloe vera is a perennial, drought-resisting and succulent plant. It is found primarily in the arid regions of Americas, Africa, Europe, and Asia. In India, Andhra Pradesh, Rajasthan, Maharashtra, Gujarat, and Tamil Nadu are the main Aloe vera cultivating states (Surjushe *et al*., 2008). The etymology of Aloe comes from "alloeh (k)" (Arabic) or "allal" (Hebrew) or "alsos" (Greek); which means 'bitter' (Shrestha et al., 2015); "vera" means, true veritable. It is comprised of inner fleshy, colourless gel and outer dark green parenchyma. Many Aloe species have earned recognition as therapeutic botanicals in western societies and as a result, numerous industries have exploited the medicinal values of Aloe vera.

PHYTOCHEMISTRY OF ALOE VERA

The moisture content of raw aloe vera leaf is recorded to be around 98.5% - 99.5%. Of the residual dry matter consists of polysaccharides (55%), sugars (17%), minerals (16%), proteins (7%), lipids (4%) and phenolic compounds (1%) (Fig.1.). The aloe gel

contains many important antioxidant and vitamins viz. Vitamin A (retinol), Vitamin B1 (thiamine), Vitamin B2 (riboflavin), Vitamin B3 (niacin), Vitamin B9 (folic acid), C (ascorbic acid) and Vitamin E (tocopherol). Polysaccharides present in the inner leaf parenchymatous tissue of leaf extracts have been credited with curative potential. Aloe vera gel contains polymannans which consist of linear chains having higher amount of mannose with lower amount of glucose molecules (Radha and Luxmipriya, 2015). Among polymannans, acemannan is the major polysaccharide which is made up of one or more polymers of different chain lengths of glucose and mannose in a 1:3 ratio. Aloe vera is also known to contain a variety of useful secondary metabolites, including anthraquinones with tricyclic aromatic quinine structure. Aloe-emodin and chrysophanol are key naturally-occurring anthraquinone compounds. Two types of exudates are secreted by aloe leaves. One is a bitter reddish-yellow juice due to the presence of aloin, aloe-emodin and related compounds. The other exudate is transparent and resembles colorless gelatin.

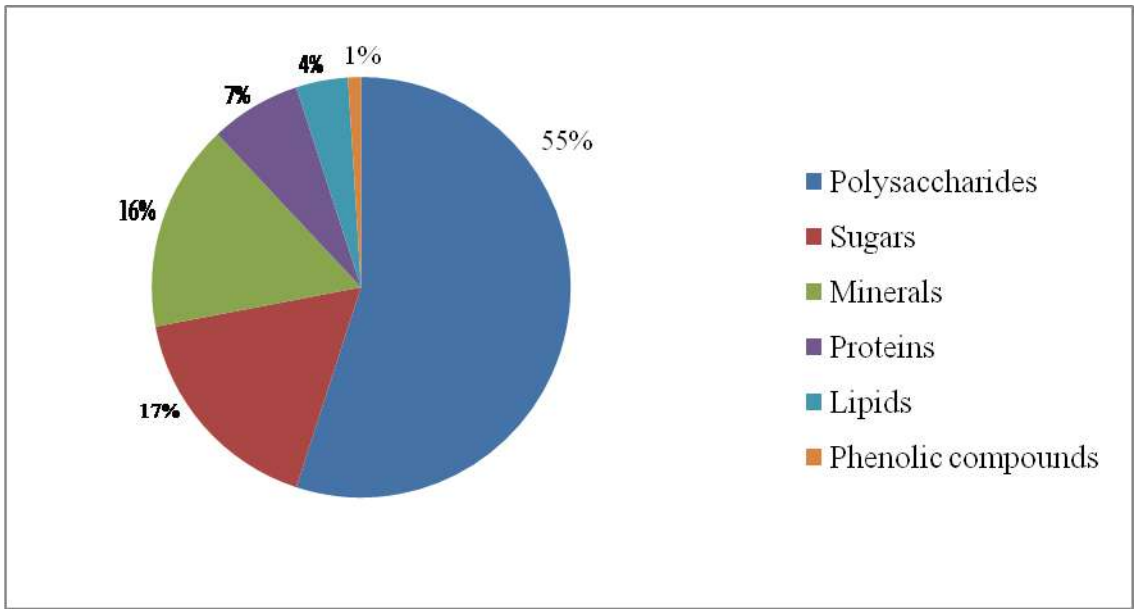


Figure1.

THERAPEUTIC PROPERTIES

The therapeutic claims for Aloe vera cover a broad range of conditions.

1. Healing properties: Glucomannan, a mannose-rich polysaccharide, and gibberellin, a growth hormone, interacts with growth factor receptors on the fibroblast, thereby stimulating its activity and proliferation, which in turn significantly increases collagen synthesis after topical and oral Aloe vera. Aloe gel not only increased collagen content of the wound but also changed collagen composition and increased the degree of collagen cross linking (chithra *et al*., 1998). Due to this, it accelerated wound contraction and increased the breaking strength of resulting scar tissue. An increased synthesis of

hyaluronic acid and dermatan sulfate in the granulation tissue of a healing wound following oral or topical treatment has been reported.

2. Effects on skin exposure to UV and gamma radiation: Aloe vera gel has been reported to have a protective effect against radiation damage to the skin. Exact role is not known, but following the administration of aloe vera gel, an antioxidant protein, metallothionein, is generated in the skin, which scavenges hydroxyl radicals and prevents suppression of superoxide dismutase and glutathione peroxidase in the skin (Robert *et al*., 1995).

3. Anti-inflammatory action: Aloe vera inhibits the cyclooxygenase pathway and reduces prostaglandin E2 production from arachidonic acid. Recently, the novel anti-inflammatory compound called C-glucosyl chromone was isolated from gel extracts.

4. Effects on the immune system: Alprogen inhibit calcium influx into mast cells, thereby Inhibiting the antigen-antibody-mediated release of histamine and leukotriene from mast cells. In a study on mice that had previously been implanted with murine sarcoma cells, acemannan stimulates the synthesis and release of interleukin-1 (IL-1) and tumor necrosis factor from macrophages in mice, which in turn initiated an immune attack that resulted in necrosis and regression of the cancerous cells. Several low-molecular-weight compounds are also capable of inhibiting the release of reactive oxygen free radicals from activated human neutrophils.

5. Laxative effects: Anthraquinones present in latex are a potent laxative. It increases intestinal water content, stimulates mucus secretion and increases intestinal peristalsis.

6. Antiviral and antitumor activity: These actions may be due to indirect or direct effects. Indirect effect is due to stimulation of the immune system and direct effect is due to anthraquinones. The anthraquinone aloin inactivates various enveloped viruses such as herpes simplex, varicella zoster and influenza. In recent studies, a polysaccharide fraction has shown to inhibit the binding of benzopyrene to primary rat hepatocytes, thereby preventing the formation of potentially cancer-initiating benzopyrene-DNA adducts. An induction of glutathione Stransferase and an inhibition of the tumor-promoting effects of phorbol myristic acetate has also been reported which suggest a possible benefit of using aloe gel in cancer chemoprevention.

7. Moisturizing and anti-aging effect: Mucopolysaccharides help in binding moisture into the skin. Aloe stimulates fibroblast which produces the collagen and elastin fibers making the skin more elastic and less wrinkled. It also has cohesive effects on the superficial flaking epidermal cells by sticking them together, which softens the skin. The amino acids also soften hardened skin cells and zinc acts as an astringent to tighten pores. Its moisturizing effects has also been studied in treatment of dry skin associated with occupational exposure where aloe vera gel gloves improved the skin integrity, decreases appearance of fine wrinkle and decreases erythema. It also has anti-acne effect.

8. Antiseptic effect: Aloe vera contains 6 antiseptic agents: Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulfur. They all have inhibitory action on fungi, bacteria and viruses.

9. Teeth and gum protection

Aloe vera is widely used in the field of dentistry to treat a variety of dental complications, such as to relieve pain and accelerate healing after periodontal flap surgery (Eshun and He, 2004). Gum diseases like gingivitis and periodontitis are treated by using aloe vera to reduce bleeding, control inflammation and stop the swelling of the gums (Sujatha *et al*., 2014).

REFERENCES

Arunkumar, S., and Muthuselvam, M., 2009. Analysis of phytochemical constituents and antimicrobial activities of Aloe vera L. against clinical pathogens. *World Journal of Agricultural Sciences*; 5: 572–576.

Chithra, R., Sajithlal, G,B., and Chandrakasan, G.1998. Influence of aloe vera on collagen characteristics in healing dermal wounds in rats. *Molecular Cell Biochem*istry; 181:71–6.

Radha, M.H., and Laxmipriya, N.P, 2015. Evaluation of biological properties and clinical effectiveness of Aloe vera: a systematic review. *Journal of Traditional and Complementary Med*icine; 5:21–26.

Roberts, D,B., Travis, E, L. 1995.Acemannan-containing wound dressing gel reduces radiation-induced skin reactions in C3H mice. *International Journal of Radiation Oncology Biology Phys*ics; 32:1047–52.

Sharma, U,K., Kumar, R., Ganguly, R., Gupta, A., Sharma, A.K., Pandey, A.K, 2018. Cinnamaldehyde, an active component of Cinnamon provides protection against food colour induced oxidative stress and hepatotoxicity in albino Wistar rats. *Vegetos* ; 31: 123–129.

Shrestha, A., Acharya, A. and Nagalakshmi, N. C. 2015. Aloe vera as traditional medicinal plant: a review on its active constituents, biological and therapeutic effects. *World Journal of Pharm. Research;* 4: 2146-2161.

Sujatha, G., Kumar, G.S., Muruganandan, J., Prasad, T.S., 2014. Aloe Vera in Dentistry*. Journal of Clinical and Diagnostic Research*; 8(10) :1-2.

Mastitis in goat: Clinicotherpeutic Intervention and Prevention

D. Mondal*, S. C. Das and T. K. Biswas

Eastern Regional Station
ICAR-Indian Veterinary Research Institute
37, Belgachia Road, Kolkata-700037
**Correspondence author: dayamoy21@gmail.com*

ABSTRACT

Mastitis is the inflammatory reaction of udder due to infection of microorganisms. A wide range of bacteria and gungi are responsible for mastitis.Common bacterial mastitis *due to Staphylococcus aureus, Staphylococcus hyacus, Streptococcus pyogenes, Srep. Intermedius, Bacillus coagulans, B.licheniformis, Klebsiella pneumonae, Escherichia coli, Corynebacterium psuedotuberculosis, Actinobacillus equali, Mycoplasma agalactiae, Mycoplasma mycoides var mycoides,Bocardia asteroides, Brucella melitensis*. The clinical findings of mastitis are painful swelling of udder, drustic reduction in milk secretion, watery and caseous nature, reduced appetite,depression, fever, recumbency and enlargement of supramammry lymph nodes. Diagnosis of mastitis can be made by various clinicopathological means. It can be detected by somatic cell count, California mastitis test, electrical conductivity test of milk, N-acetyl-β-D-Glucosaminidase (NAGase), β – glucoronidase in milk and lactoferintest. Treapeutic intervention can be done by using suitable antibiotics, antiinflammatory and fibrinolytic drugs. Cleanliness and hygienic cow shade management is to be maintained for control of it.

Key words: Mastitis, Goat, Therapeutics

INTRODUCTION

Mastitis is inflammatory reaction of udder parenchyma with wide range of causative agents. The inflammtion is characterozed by swelling of udder, heat, pain and induration of mammary glands along with physical and chemical changes of milk constituents. Although the goat is less susceptible to mastitis.Milk is the secretion of mammary gland after perturition for the nurishment of the offspring of mammalian animals. The milk constituents are so rich for the growth of microorganisms. Contamination of udder may be with inter teat infection or from the environmen contagions. Cuases of Mastititis in goat varies with wide range of microbial infection may be bactreia and several viruses like lentivirus, caprine arthritis encephalitis (Koop et al,2011) and even with some fugus like Candidia sp (Reddy, et al, 2018) and Aspergillous fumigatus (Pachauri et al, 2013).

Most cases bacterial infection for goat mastitis are *Staphylococcus aureus, Staphylococcus hyacus, Staphylococcus dysgalactia, Streptococcus pyogenes, Srep. Intermedius, Bacillus coagulans, B.licheniformis, Klebsiella pneumonae, Escherichia coli, Corynebacterium psuedotuberculosis, Pasturella haemolytica, Actinobacillus equali,Mycoplasma agalactiae, Mycoplasma mycoides var mycoides, Bocardia asteroides, Brucella melitensis.*.

But some times we confuse some cases of swollen udder with true mastitis that in certain physiological states udder may be swollen but actually there is no udder inflmammatory reaction. The pfysiological changes of udder swollen may be due udder oedima for high yielding animals, during first kidding with high hormonal influence, lack of exercise during advance pregnancy, heriditary traits, high nutritional mamanegent, high salt diet etc.

TRANSMISSION OF INFECTION

Mastitis may be of two type when the clinically udder is swollen, spoiled milk secretion along with pain is clinical mastitis. While sometime it has been occurred that such swollen udder and pain may not be perceptible but milk constituents and amount are changed and higher range of somatic cell count in the milk called subclinical mastitis. Most of the time mastitis infection transmit through milking machine,milkers hands, farm utensil and fomites.Other route of infection the oro-udder route from calf mouth and dam's udder contaminationm. Environmental mastitis from infected does to healthy goats through contamination as well as infection may take up from the soil contact with udder particularly just after milking (Falkenberg et al,2003).

Clinical finding

The formost clinical signs with a complaint of reduced milk secretion, reduced appetite, swelling of udder and even no milk secretion. If some milk is secreted the consistency be watery and caseous clots of milk. It may affect either one teat or both. Like cattle both subclinical, peracute, acute andchronic mastitis.Some time acute pain and hot udder may be observed in acute and subacute cases of mastitis. Most acute mastitis charecterized by warm,swollen, hyperemic and painfull udder. There may be depression, fever, recumbency and enlargement of supramammry lymph nodes(Anderson et al 2002)

Peracute mastitis where inflammatory reaction may not be much but milk composition and consistency changes, animal show severe depression, fever, frequenct changing recumbent posture and supramammary lymph nodes are enalrged with painful touch (Faruq et al 2019)

Purulent-catarrhal mastitis does show depression and fever are usual along with swollen hard painful udder and teats reddish blue haemorrahgic spot may be visible on the skin, lymph nodes swollen and painful with thick yellow greenish secretion (Aliyev and Mastit,2017).

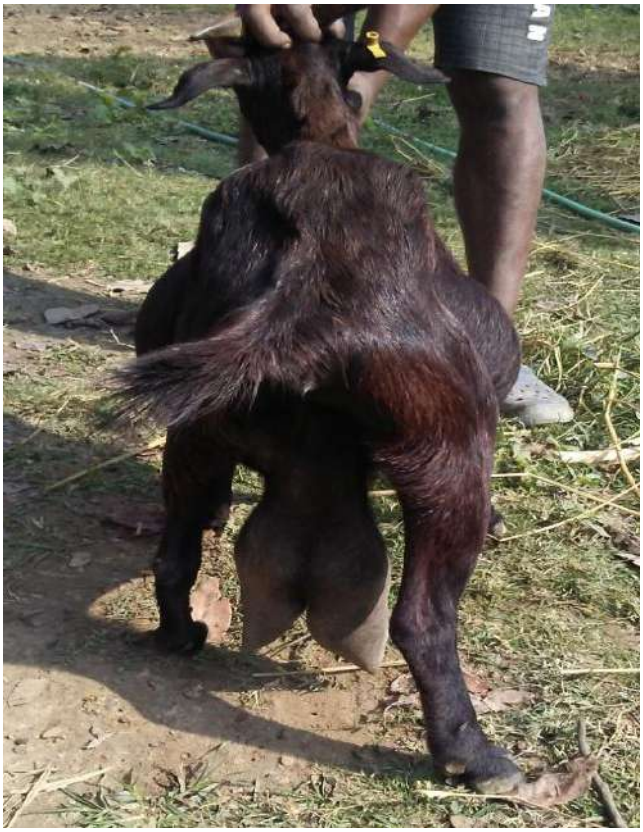


Fig-1: Chronic Mastitis in a doe

Diagnosis of mastitis

Once the clinical mastitis is manifested the total healing could not be harder to attain due to soft tisue reaction of udder. Subclinical mastitis prevails in some cases prior to clinical findings.Clinically, the cases of mastitis can be diagnosed based on clinical signs and udder consistency. Therefore if subclinical mastitis be identified then the outbreak may be controlled well in advance. Therefore, subclinical mastitis be identified with some tests, they are as follows(Dimiter et al, 2018).

1.Somatic cell count (SSC): Although SSC is one of the standrad for declaring subclinical mastitis but in goat medicine it is not a standrad refreence for declaring sunclinuical mastitis as the SSC may be incresed in many conditions like stage of lactation, oestrus, breed, milking procedures. The number of SSC varies indifferent countries and region as normal for pool milk. The values may be as high as one million per ml of milk. Somatic cells in the milk including desquamted teat and udder tissue cells (2%) and majority are leucocytes of immune in nature (98%).

2. Rapid mastitis test / California mastitis test (CMT): California mastitis test is based on the disruption of cell membrane by the anionic surfactant (detergent) and then reaction with DNA of disruptive cells forming gel like viscous substance if higher amount of somatic cells are present in the milk. It is a simple and useful technique for detecting subclinical mastitis on-farm, providing an immediate result and precaution may be taken against clinical mastitis. A four-well plastic paddle is used as tools, one well is used for separate quarter check. The foremilk is discarded, then an amount about 2-5 milk drawn into each well from separate quarter. An equal volume of test reagent is

added in each well and the paddle is well agitaed for mixing. In positive cases a jelly like liquid is form. Depending on the nature of viscused mass the reaction is categorized numerically by 0, 1,2,3.

3. **Electrical conductivity test of milk:** Pathogenicity of blood vessels and tissue of udder increases permiability of cell membrane. Increase in sodium (Na^+) and chloride (Cl^-) ions in milk which increases and decreased the concentration of K+ and lactose in milk.The increase in sodium and chloride ions in milk increases the electical conductivity through milk. This study in cow and buffalo are conducted for indetification of subclinical mastitis but in goat milk the test can be applied. The mean Electrical conductivity value for subclinical mastitis is 5.97mS/cm where for clinical mastitis it is 6.7mS/cm. In goat milk the average EC values of 6.6 ± 0.5
mS/cm3 for subclinical mastitis(Boulaaba ,2009*)*

4.**N-acetyl-β-D-Glucosaminidase (NAGase**) Inflammatory reaction in the udder increases the polymorphonuclear cells as immune effect. Due to the presence polymorphonuclear cells, the lysosomal N-acetyl-β-d-glucosaminidase (NAGase) in milk samples can be the indicator mastitis. subclinical and clinical mastitis with a high level of accuracy of the NADase are 0·85 and 0·99 respectively. Although the values in goat milk is much less than that of cow milk however, it can be an accurate indicator for declaring subclinical and clinical mastitis(Hovinen et al 2016)

5. **β – glucoronidase in milk**: In the inflammatory process of maastitis the somatic cells secrets several types of enzymes like β -galactosidase, N-acetyl-b-glucosaminidase, alpha manosidase, and b-glucuronidase and β –Glucuronidase. Estimation of this enzyme be a indicator declaring level of mastitis. It is declared that above 15U/ml of milk can be declared as mastitic in goat (OliszewskI, et al 2002).

6.**Lactoferin Test:** Lactoferrin is an iron-binding glycoprotein, acts as non specific disease protective immune factor in mammary gland.The lactoferin also protective to some types of neoplastic growth. In normal condition the level of lactoferin is 167 µg /ml, average quality milk the value be 218 µg/ml, while mastitic milk be more than 204 mg.ml of milk. The somatic cell count and lactoferin is proportional. In colostrum highest quantity of lactoferin found 387µg/ml(Hiss et.al, 2008)

THERAPEUTIC INTERVENTION OF MASTITIS:

Treatment of subclinical mastitis with antimicrobials is not economical due high expensive drugs and poor efficacy of the condition. Moreover, production is not hamper during subclinical condition. Management factors to be practiced to keep the udder healthy.There are several ways to keep subclinical mastitis under control are keep hygienic house and environment so that the shed be remain dry, clean and fresh. To avoid soil contact provide bedding in the shelter to avoid fecal contamination. Pre and post milking disinfction wash of the teats with mild antiseptic and dry up teats. Avoid laying down just after milking, keep the doe standed for some time so that teat orifice dry up and closed. Use of milking machine to avoid contamintion from milkers' hand.

Antimicrobial drugs

Several broad spectrum antibiotics may be given by intra venous route fllowed by intramuscular route for quick action. For strepto and staphylococcus infection penicillin G and its derivaties can be used. Cephalosporin can be used as broad spectrum antibiotics. In coliform bacterial mastitis ceftiofur, cefquinome and fluoroquinolone can be a good antibiotic. The ß- lactum like amoxycillin,Ampicillin along with cloxacillin, gentamicin can be used with good response.

Some of intra mammary infusion preparation used for veterinary mastitis treatment are Cobactin LC(cefquinome), Tilox (Ampicillin+Cloxacillin),Zymast LC(Cefquinome),Metricef (Cephapirin), Pendistrin SH (Penicillin).Anti infflammatory drugs which can reduce pain and inflammation are flunixin meglumide, dexamethasone etc. Anti-fibrotic or fibrinolytic drugs like hyaluronidase can be used for mild fibrosis of udder. Marketed fibrinolytic drugs are Hyalase,Lyporase etc.

Mastitis is an infectious disease of udder which reduce productivity drustically can be kept under control by elemination of source of infetion, Optimise hygiene, cleanliness of housing. Clinical cases can be treated effectively with suitable antibiotic and non steroid antiinflammatory drugs.

REFERENCES

Aliyev A.Y. and Mastit, O(2017) Diagnostika, Etiologiya I Terapiya):Dissertatsiya Doctor Veterinarny Nauk/SPbGAVM. Sankt-Peterburg. 2017:287.

Anderson D.E, Hull B.L, Pugh D.G.(2002) Diseases of the mammary gland. In: Pugh D.G, editor. Sheep and Goat Medicine. Philadelphia, PA: W.B. Saunders; . pp. 341–358

Boulaaba A.(2009), Contributions to understand caprine udder health and flow cytometric differentiation of caprine milk cells. Thesis, Gießen, p. 285,

Dimiter Dimitrov, Georgi Stoimenov and Oliver Morrison (2018) Diagnosis of subclinical mastiris in dairy goats.

Falkenberg U, Tenhagen BA, Heuwieser W, Kalbe P, Klünder G, Baumgärtner B.(2003) The clinical effectiveness of a post milking teat disinfection method with a foaming iodophor teat dip. Dtsch Tierarztl Wochenschr.110(2):59-64.

Faruq A, Danmallam and Nikolai V P.(2019) Study on prevalence, clinical presentation, and associated bacterial pathogens of goat mastitis in Bauchi, Plateau, and Edo states, Nigeria
Vet World. 12(5): 638–645.

Hiss, S, Meyer, T and Sauerwein, H (2008) Lactoferrin concentrations in goat milk throughout lactation,Small Ruminant Research, 80(1-3): 87-90.

Hovinen. M, Simojoki H., Pösö R., Suolaniemi, J, Kalmus, P., Suojala L, Pyörälä S.(2016) N-acetyl -β-D-glucosaminidase activity in cow milk as an indicator of mastitis. J Dairy Res. :83(2):219-27. doi: 10.1017/S0022029916000224.

Koop, G., van Werven, T., Toft, N., & Nielen, M. (2011). Estimating test characteristics of somatic cell count to detect Staphylococcus aureus-infected dairy goats using latent class analysis. *Journal of Dairy Science*, *94*(6), 2902–2911. https://doi.org/10.3168/jds.2010-3929.

Oliszewski, R ., Nu, M. S.´ Ez De Kairu, N., Gonza, S. N. ´ Lez De Elias, and Oliver, G.(2002) Assessment of b-Glucuronidase Levels in Goat's Milk as an Indicator of Mastitis: Comparison with Other Mastitis Detection Methods.

Pachauri, S, Puneet Varshney, Sandeep Kumar Dash and Manoj Kumar Gupta (2013) Involvement of fungal species in bovine mastitis in and around Mathura, India.

Reddy,S, Sivajothi S, and Deepika Kumari (2018) Successful Management of Fungal Mastitis in Goats - A Report of Three Cases.In: Approaches in Poultry, dairy and Veterinary Sciences . Crymson Publishers,288—289.

Problems and Constraints in Adoption of Organic Farming in India

G. Vinay[1] and K. K. K Reddy[2], K. Venkatkiran Reddy and E. Ajay Kumar

Ph.D Scholar, Department of Agronomy, PJTSAU
Corresponding author: vinaygadipe6859@gmail.com

The most important constraint felt in the progress of organic farming is the inability of the government policy making level to take a firm decision to promote organic agriculture. Unless such a clear and unambiguous direction is available in terms of both financial and technical supports, from the Centre to the Panchayath levels, mere regulation making will amount to nothing. The following are found to be the major problem areas for the growth of organic farming in the country:

LACK OF AWARENESS:

It is a fact that many farmers in the country have only vague ideas about organic farming and its advantages as against the conventional farming methods. Use of bio-fertilizers and bio pesticides requires awareness and willingness on the part of the farming community. Knowledge about the availability and usefulness of supplementary nutrients to enrich the soil is also vital to increase productivity. Farmers lack knowledge of compost making using the modern techniques and also its application. The maximum they do is making a pit and fill it with small quantities of wastes. Often the pit is flooded with rainwater and result is the top of the compost remains under composted the bottom becomes like a hard cake. Proper training to the farmers will be necessary to make vermicompost on the modern lines. Attention on the application of composts/organic manure is also lacking. The organic matter is spread during the months when the right moisture level is absent on the soil. The whole manure turns into wastes in the process. The required operation is of course labour intensive and costly, but it is necessary to obtain the desired results.

Output Marketing Problems:

It is found that before the beginning of the cultivation of organic crops, their marketability and that too at a premium over the conventional produce has to be assured. Inability to obtain a premium price, at least during the period required to achieve the productivity levels of the conventional crop will be a setback. It was found that the farmers of organic wheat in Rajasthan got lower prices than those of the conventional wheat. The cost of marketing of both types of products was also same and the buyers of wheat were not prepared to pay higher prices to the organic variety.

Shortage of Bio-mass:

Many experts and well informed farmers are not sure whether all the nutrients with the required quantities can be made available by the organic materials. Even if this problem can be surmounted, they are of the view that the available organic matter is not simply enough to meet the requirements. The crop residues useful to prepare vermi-compost are removed after harvest from the farms.and they are used as fodder and fuel. Even if some are left out on the farms termites, etc destroy them. Experiments have shown that the crop residues ploughed back into soil will increase productivity and a better alternative is conversion into compost. The small and marginal cultivators have difficulties in getting the organic manures compared to the chemical fertilizers, which can be bought easily, of course if they have the financial ability. But they have to either produce the organic manures by utilizing the bio-mass they have or they have to be collected from the locality with a minimum effort and cost. Increasing pressure of population and the disappearance of the common lands including the wastes and government lands make the task difficult.

Inadequate Supporting Infrastructure:

The certification agencies are inadequate, the recognized green markets are non-existent, the trade channels are yet to be formed and the infrastructure facilities for verification leading to certification of the farms are inadequate.

High Input Costs:

The small and marginal farmers in India have been practicing a sort of organic farming in the form of the traditional farming system. They use local or own farm renewable resources and carry on the agricultural practices in an ecologically friendly environment. However, now the costs of the organic inputs are higher than those of industrially produced chemical fertilizers and pesticides including other inputs used in the conventional farming system. The groundnut cake, neem seed and cake, vermi-compost, silt, cow dung, other manures, etc. applied as organic manure are increasingly becoming costly making them unaffordable to the small cultivators.

Marketing Problems of Organic Inputs:

Bio-fertilizers and bio-pesticides are yet to become popular in the country. There is a lack of marketing and distribution network for them because the retailers are not interested to deal in these products, as the demand is low. The erratic supplies and the low level of awareness of the cultivators also add to the problem. Higher margins of profit for chemical fertilizers and pesticides for retailing, heavy advertisement campaigns by the manufacturers and dealers are other major problems affecting the markets for organic inputs in India.

Absence of an Appropriate Agriculture Policy:

Promotion of organic agriculture both for export and domestic consumption, the requirements of food security for millions of the poor, national self-sufficiency in food

production, product and input supplies, etc. are vital issues which will have to be dealt with in an appropriate agriculture policy of India. These are serious issues the solution for which hard and consistent efforts along with a national consensus will be essential to go forward. Formulation of an appropriate agriculture policy taking care of these complexities is essential to promote organic agriculture in a big way.

Lack of Financial Support:

The cost of certification, a major component of which is the periodical inspections carried out by the certifying agencies, which have freedom to fix the timings, type and number of such inspections appears to be burdensome for the small and marginal farmers. Of course, the fees charged by the international agencies working in India before the NPOP were prohibitive and that was a reason for the weak response to organic agriculture even among the large farms in the country. No financial support as being provided in advanced countries like Germany is available in India. Supports for the marketing of the organic products are also not forthcoming neither from the State nor from the Union governments. Even the financial assistance extended to the conventional farming methods are absent for the promotion of organic farming.

Low Yields:

In many cases the farmers experience some loss in yields on discarding synthetic inputs on conversion of their farming method from conventional to organic. Restoration of full biological activity in terms of growth of beneficial insect populations, nitrogen fixation from legumes, pest suppression and fertility problems will take some time and the reduction in the yield rates is the result in the interregnum. It may also be possible that it will take years to make organic production possible on the farm. Small and marginal farmers cannot take the risk of low yields for the initial 2-3 years on the conversion to organic farming. There are no schemes to compensate them during the gestation period. The price premiums on the organic products will not be much of help, as they will disappear once significant quantities of organic farm products are made available.

Inability to Meet the Export Demand:

The demand for organic products is high in the advanced countries of the west like USA, European Union and Japan. It is reported that the US consumers are ready to pay a premium price of 60 to 100 per cent for the organic products. The upper classes in India are also following this trend as elsewhere. The market survey done by the International Trade Centre (ITC) during 2000 indicates that the demand for organic products is growing rapidly in many of the world markets while the supply is unable to match it. India is known in the world organic market as a tea supplier and there is a good potential to export coffee, vegetables, sugar, herbs, spices and vanilla. In spite of the several initiatives to produce and export organic produces from the country, the aggregate production for export came to only about 14000 tonnes. This also includes the production of organic spices in about 1000 ha under certification.

Vested Interests:

Hybrid seeds are designed to respond to fertilizers and chemicals. The seed, fertilizer and pesticide industry as also the importers of these inputs to the country have a stake in the conventional farming. Their opposition to organic farming stems from these interests.

LACK OF QUALITY STANDARDS FOR BIOMANURES

The need for fixing standards and quality parameters for biofertilizers and biomanures has arisen with the increasing popularity of organic farming in the country. There are a very large number of brands of organic manures, claiming the high levels of natural nutrients and essential elements. But most farmers are not aware of the pitfalls of using the commercially available biomanure products. While the concept of organic farming itself lays great stress on the manures produced on the farm and the farmers' household, many of the branded products available in the market may not be really organic. Elements of chemicals slipping into the manures through faulty production methods could make the product not certifiable as organic. The process of composting which is a major activity to be carefully done is achieved usually by one of the two methods, vermi-composting or microbe composting. While the former is ideal for segregated waste material without foreign matter, microbe composting is suitable for large scale management of solid wastes, especially in cities and metres. Even though the farmers are using manure produced by different methods, proper parameters for biomanure are yet to be finalized. Most farmers are still unaware of the difference between biomanure and bio-fertilizer, it is point out. While biomanure contains organic matter, which improves the soil quality, bio-fertilizers are nutritional additives separated from the organic material, which could be added to the soil, much like taking vitamin pills. Biofertilizers do nothing to enhance soil quality while the loss of soil quality has been the major problem faced by farmers these days.

Improper Accounting Method

An understanding of the real costs of erosion of soil and human health, the loss of welfare of both humans and other living things and the computation of these costs are necessary to evaluate the benefits of organic farming. These costs will have to be integrated to a plan for the implementation of organic agriculture. A recent study shows the inappropriateness of the cost and return accounting methods adopted to find out the economics of the organic farming. An economic evaluation of the bad effects of inorganic agriculture and their internalization through environmental taxes is proposed for a market based approach to promote organic farming in India.

Political and Social Factors

Agriculture in India is subject to political interventions with the objectives of dispensing favours for electoral benefits. Subsidies and other supports from both the Central and state governments, government controlled prices of inputs like chemical fertilizers, the public sector units' dominant role in the production of fertilizers,

government support/floor prices for many agricultural products, supply of inputs like power and water either free of cost or at a subsidized rate, etc. are the tools often used to achieve political objectives. Any movement for the promotion of organic farming in India will have to counter opposition from the sections who benefit from such policies in the conventional farming system. The political system in a democracy like India is likely to evade the formulation of policies, which affect the interests of the voting blocks unless there are more powerful counter forces demanding changes.