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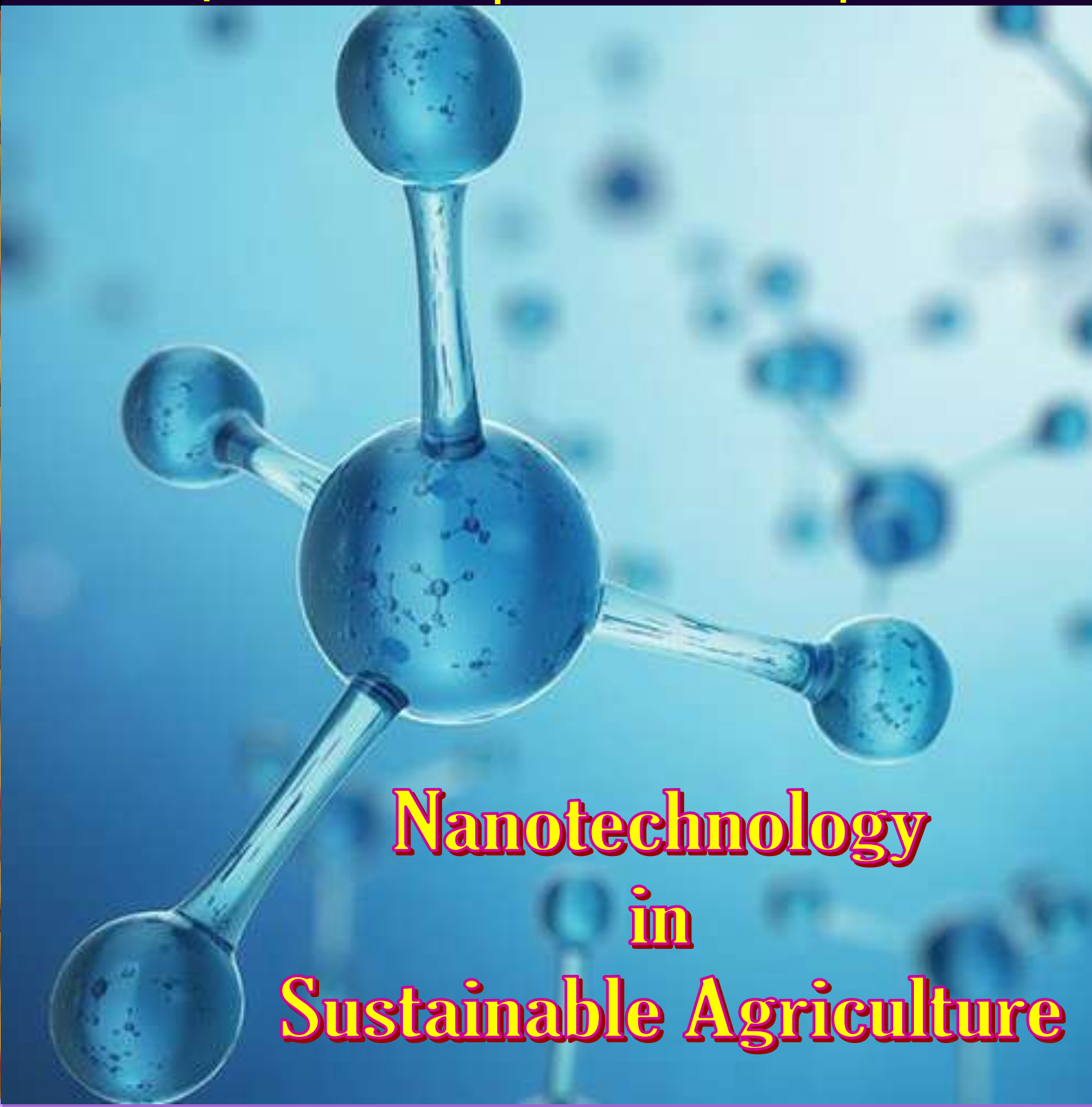

Nanotechnology in Sustainable Agriculture

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NanoFertilizers for Field Applications

Suresh Dagade, Vishwanath Sharma, Brajraj Singh and Alok Adholeya

The Energy and Resources Institute, TERI gram, Gwal Pahari, Gurugram 122 102, Haryana

**Corresponding Author: suresh.dagade@teri.res.in*

Abstract:
The increasing food demand due to the rising population has encouraged the higher use of fertilizers. On account of resource constraints and low use productivity of fertilizers, the cost to the farmer is increasing dramatically. The main reason for low fertilizer use efficiency is an inefficient splitting of fertilizer doses coupled with imbalanced fertilizer applications. Nanotechnology offers a great potential to adapt fertilizer production with the desired chemical composition and improve the nutrient use efficiency. The nano fertilizers are more effective and efficient than conventional fertilizers. The utilization of nano fertilizers isgradually expanding, due to their impact on crop nutritional yield, quality and stress resistance in plants. Hence, if the farmers apply nano fertilizers, it will reduce the input cost as well as increase the yield.

Keywords: nano fertilizers, nanotechnology, nano scale

INTRODUCTION

Plant needs 16 essential nutrients to complete its life cycle. Among these the air and water provides Carbon, Hydrogen and Oxygen to the plants and rest 13 elements are need to be supplied externally to the crops. Fertilizerscontribute up to 35 to 40% of the crop productivity. With growing population and demand for more food, fertilizer consumption is increasing proportionately with agricultural production.

The indigenous supply of fertilizer is insufficient, so the India is importing huge amount of fertilizers. In the year 2018-19 all India NPK fertilizer consumption was 273.75 million tons, including fertilizer imports of 104.94 milliontons. Such large scale application of fertilizer in crop production system has met the food demand. The indiscriminate use of fertilizers over the years has resulted in less response to applied fertilizers, increased pollution,spurt of pest and disease complex,irreparable soil health hazards, imbalanced ecosystemetc irreparable effects. Considering these facts, the large scale application of chemical fertilizers to increase the crop productivity is not an

acceptable option for sustainability. In order to achieve sustainable agriculture production, alternative nutrient sources like nano fertilizer would be a best solution.

In Greek language 'nano' means 'dwarf' say 'smaller'. The particle size of nano fertilizer ranges between 1 and100 nano meter (1 nm = 10^{-9} m). With different techniques innovative synthetic nano fertilizers are prepared in a readily available formto the plants. Because of their relatively larger surface area to mass ratio, they can become more chemically reactive and change their strength or other properties. Below 50 nm size, the laws of classical physics give way to quantum effects, provoking different optical, electrical and magnetic behaviors. Likewise, nano particles have more, sorption capacity and controlled release delivery at targeted sites as per crop demand. Therefore,nano fertilizers are preferred largely due to their efficiency and environment friendly nature compared to conventional chemical fertilizers. Following are the differences between conventional and nano fertilizers

Table: Differences between conventional and nano fertilizers(Cui *et al.,* 2010)

Particulars	**Conventional fertilizers**	**Nano fertilizers**
Method of application	Soil, drip and foliar	Seed coating, soil, drip and foliar
Purity	Lower proportion of essential nutrient. Ex Single Super Phosphate – contains 16% P_2O_5 and rest 84% is impure material	Its highly pure and concentrated material without unwanted and ecologically harmful additives.
Nutrient use efficiency (%)	Bulk composite is not easily available for roots resource and hence havelow use efficiency. Of the applied fertilizer approximately 30 to 60 % Nitrogen, 10 to 20 % Phosphorus, 40 to 50 % of Potassium and 5 to 6 % of micronutrients are utilized by plants.	Nano structured formulation increase fertilizer use efficiency due to ultrahigh absorptionand uptake ratio of the soil nutrients and saves fertilizer.
Nutrient loss from soil	High loss by way of leaching, runoff, volatilization, fixation, drift, evaporation, hydrolysis by soil moisture, photolytic and microbial degradationetc	Nanostructured formulation can reduce loss rate of nutrients into soil by leaching and/or leaking
Nutrient delivery	Uncontrolled delivery, nutrients are available within 4 to 10 days of application. Excess release of fertilizers may produce toxicity and	Nano nutrient is precisely controlled through encapsulation in envelope forms of semipermeable membranes coated by resin-polymer, waxes

	destroy ecological balance of soil.	etc that enables slow and controlled delivery to the plants upto 40 to 50 days after application.
Salt development in the soil	Used by the plants at the time of delivery, the rest is converted into insoluble salts like Sodium, Chlorine, Sulphates, Bicarbonates etcin the soil	Little or no salt development due high specificity, reactivity and bioavailability. Prevents eutrophication and pollution of water resources
Nutrient bioavailability	Less bioavailability to plants due to large particle size and less solubility.	Improve solubility and dispersion of insoluble nutrients in soil, reduce soil absorption and fixation hence increase the bioavailability
Cost of transportation and field application	Bulky in nature so needs more cost for transportation and application in the field	Highly concentrated, need little cost on transportation and application in the field.

TYPES OF NANO FERTILIZERS

Nano fertilizers are of following three types
1) Nanoscale fertilizers are made of nanoparticles that contain nutrients.
2) Nanoscale additive fertilizers are traditional fertilizers with nanoscale additives. 3) Nanoscale coating fertilizers are traditional fertilizers coated or loaded with nanoparticles.

METHODS OF NANO FERTILIZERS APPLICATIONS

1 Seed coatingseeds and fertilizers are two important inputs in crop production, but are used separately. Conventionally, fertilizers are applied by either spraying or broadcasting. However, one of the major factors that decide the mode of application is the final concentration of the fertilizers reaching to the plant. The distance between the fertilizer and the seed, has an impact on the plants capacity to utilize nutrients. So combining both materials into a unit of fertilizer coated seed may improve farming efficiency. Whenfertilizers are placed far away from the seed, the nutrients takes more time to react with the salts or ions of the soil and forms soluble compounds before the plant roots are reached the location of the fertilizer molecule. Hence, closer the fertilizer to the seed, the smaller the amount will be needed to develop fully grown plant. Thus, the effect of seeds coated with fertilizers, will be more.

2 Soil applicationnanofertilizers are synthesized so as to regulate the release of nutrients depending on the requirements of the crops. Due to nanostructured formulation of fertilizers release of nutrients into the soil happens gradually and in a controlled way which is beneficial to increase soil microbial population and enzyme

activity. Nanosized active ingredients in fertilizer help to improve nutrient use efficiency and this could be due to their high specific surface area, which facilitates good absorption of the nutrients. Qing et al. (2018) reported that the amount of soil bacteria, actinomycetes and fungi treated with nano-fertilizers were 1.07 times, 1.13 times and 1.09 times more than that of chemical fertilizer treatment, respectively. Thus application of slow release nano fertilizer would improve the ecological environment of farmland soil and has good application value.

3 Drip applicationdrip irrigation proved to be efficient in providing irrigation water and nutrients to the roots of plants, while maintaining high yield production. Along with drip irrigation, essential elements are directly made available to the active root zone, thus reducing quantity of nutrient fertilizers and increasing their efficiency from 80 to 90%, which ultimately helps to improve the yield and quality. Thus, it is possible to manage optimal nutrient management in arid and semi-arid areas by following combination of slow release nano fertilizers and drip irrigation. Hayyawi et al. (2019) revealed that, higher potato productivity of 250.7 Kg was achieved through combined application of one kilo nano N, P and K fertilizers through drip irrigation. The distribution of nano NPK element was found to be uniform and their use efficiency was 97.43 %, 98.11% and 97.03 %, respectively.

4 Foliar applicationfoliar nutrition is the technique of feeding plants by spraying fertilizers directly to the leave so as to reduce losses and getting maximum yield. Foliar applications of nutrients enable plant for rapid nutrient utilization and permit the correction of observed deficiencies in less time than can be accomplished by soil applications. Foliar feedingenhances plant height, leaf area, number of leaves, dry matter production, chlorophyll production, rate of the photosynthesis resulting in more production and translocation of photosynthates to different parts of the plant. Nano particles can penetrate the stomatal pores with the size less than 50 nm, hence significantly augment nutrient absorption and aid in production as compared with traditional fertilizers.Foliar spray of one kilo of nano chelated super fertilizer containing 12 nutrients was optimum for growth, yield, nutrient uptake and agronomic efficiency of one hectare wheat crop compared to conventional fertilizer and biostimulators (Al-juthery et al. 2019).

Case study of nano fertilizers in various crops

Paddyfoliar application of nano chelated iron fertilizer (2.5 g L^{-1}) at nursery and booting stages had the maximum effect on rice quality and quantity parameters. It increased plant height, panicle length, grain weight and paddy yield and in addition enriched white rice in nitrogen, phosphorus and potassium concentrations significantly as compared to control (Saideh et al. 2020).

The application of 100% nano nitrogen fertilizer had given the highest growth performance with respect to plant height (57.9 cm), tillers per plant (6), plant dry weight at ripening stage (9.9 g) and yield (2.8 t ha^{-1}) as compared to control. The results indicated that nanonitrogen could be used as an alternative to conventional urea fertilizer in the cultivation of rice (Rathnayaka et al. 2018).

Kumara et al. (2019) observed that, foliar application of 100 ppm nano calcite at 20, 40 and 60 days after transplanting with recommended level of fertilizer had positive effects on growth, seed quality, insect resistivity and increased the final yield by one ton ha^{-1}.

The field experiment conducted on paddy variety CORH 3 revealed that, foliar application of TERI MSN containing nano P + Zn/Fe on one month old transplanted crop had profound effect to improve the plant growth parameters and grain yield to the extent of 19.6 % as compared to control. Further, it was noted that at recommended (2 ml L^{-1}) dose of nano fertilizerspaddy yield was increased by1.25 ha^{-1}

Wheat effect of foliar application of iron oxide magnetic iron nanoparticles (IMNPs) coated NPK at different rates (0.1, 0.3, 0.6 and 0.9 gm L^{-1}) on wheat crop was reported by Yasser et al. (2018). Nutrient content, quality and yield of wheat grains treated with Fe nano fertilizer was found to be significantly increasing up to concentration of 0.9 g L^{-1}.

Maize: treatment of seeds with 500 mg of nanoporous zeolite urea 'NANO ZEOUREA' recorded 100 % germination within 5 days after sowing and found to be beneficial to soil microorganisms like bacteria (*Enterobacter cloacae*), fungi (*Trichoderma harzianum*) and earthworms (*Eiseniafoetidae*) (Manikandan et al. 2019). In a field trial 16.33 % increase in yield was observed due to maize seed coatingTERI Mycorrhiza, nano Phosphorus and Phosphorus solubilizing bacteria.

Cottontwo foliar applications of 200 ppm nano Zinc, three and five weeks after sowing helped cotton plants to mitigate the adverse effect of salinity and observed that diluted seawater could be used in the irrigation of cotton plant (Hussein and Abou-Baker, 2018).

Application of nano 50 % recommended NPK fertiliser dose was at par with traditional 100% fertilizer dose, suggesting that the use of nano fertilizers can be enhanced and improve cotton growth and yield up to optimum applied times, methods and rates. The application rates of NPK nano fertilizers significantly influenced studied fiber properties (Sohair et al. 2018). TERI Nano MSN (containing P+Zn/Fe) application increased cotton yield by 5.79%.

Groundnut foliar application of nano Fe, Mn-Zn fertilizers at 30 ppm gave the greatest of plant height, number of branches/plant, number of pods /plant, pods weight /plant, number of seed /plant, seed weight /plant, fresh weight of straw /plant , dry weight of straw /plant and 100-green seed weight of peanut as compared with untreated plants. This treatment also had highest value of N, P, Fe, Mn and Zn contents in both seeds and straw as well as chemical constituent of chlorophyll, carotenoids, total carbohydrate, total soluble sugars, total proteins and oil percentages content in seeds (El-Metwallyet al. 2018) indicating in improvements in quality alongwith yield.

Filed application of nano zinc and iron (TERI nano Zn/Fe) at 0.3 % concentration increased groundnut plant biomass and seed yield by 18 and 30%, respectively.

Finger millet Saraswathi et al. (2017) observed that, two foliar spray of nano ZnO @ 500 ppm ha^{-1} at 30 and 60 days after transplanting recorded highest grain yield (9.60 gm $plant^{-1}$) and least in control without application of fertilizers (7.00 gm $plant^{-1}$)

Soybean foliar application of TERI nano Phosphorus at concentration of three ml L^{-1} increased both dry matter content and seed yield by 23 % as compared to control.
Okrasoil incorporation of 12 t ha^{-1} FYM with soil application of nano NPK (12.5 kg ha^{-1}) and foliar application of nano NPK (0.4%) was found to be beneficial in recording higher nutrient status of the post-harvest soil in okra crop (Nibin and Ushakumari, 2019). In field experimental study 9.69 % increased okra fruit yield over control was observed with foliar spray of TERI MSN containing nano zinc, iron and phosphorusfertilizer.
Cucumber Merghany et al. (2019) observed that the treatment of 6 ml nano NPK to cucumber plant led to increase in plant height, number of leaves, chlorophyll content, yield and NPK % in leaves and fruits. Nano NPK treated plants recorded the lowest weight loss and decay % and the highest general appearance after 21 of storage at 5^{o}C of storage and increased cucumber fruit yield by 4.84% and 53.42% in the first and second seasons, respectively. Hence Nano fertilizers can be used as an alternative to mineral fertilizers.
Foliar spray of Silicon dioxide (SiO_2) nano fertilizer at 60 ppm concentration resulted in increased plant height, number of leaves, fresh and dry weights of leaves, number of fruits, mean weight of fruit, fruit length and total yield (Abdelazim et al.2017).
Beans foliar application of TERI Zn/Fe at 0.2 % concentration increased dry matter and pod yield by 28 percent as compared to control.
Tomato foliar application of TERI nano MSN (P+Zn/Fe) 45 days after transplanting at 0.2 % concentration increased plant height, leaves and fruit yield by 38.13% followed by TERI nano P and TERI nano Zn/Fe.
Saffron positive effects of Fe, P and K nanofertilizers in the improvement of saffron flowering traits was reported by Reza et al. (2014) in terms of increase in mother corm weight from 6 to 12 grams, flower number by 4.4 times and dry saffron yield by 5.17 times.

CONCLUSION

Application of nanofertilizersin crop production system in India is at nascent stage. However, its applications will have huge potential to revolutionize agricultural production scenario by allowing better scientific management practices, mitigating issues of chemical fertilizer pollution, conservation of natural mineral reserves and saving on fertilizer imports. Use of powerful and less expensive nano fertilizersmay prove one of the best alternativesto replace traditional fertilizers to a greater extent in the future.

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Pulses: Superfood for future

Raju Ram Choudhary

PhD Scholar
Department of Genetics and Plant Breeding
CCS Haryana Agricultural University, Hisar– 125004
Corresponding Author: rajuramchoudhary33@gmail.com

Abstract

Food and nutritional security becomes the more important in 21st century with the ever increasing human population and certainty of climate change. These twin challenges can be addressed by diversification of breeding materials and by promoting grain legume crops in India. Pulses are major source of plant protein and considered as the poor man's only source of protein. Pulses have symbiotic association with bacteria (especially *Rhizobium species*) and fixes the unavailable form of atmospheric nitrogen into plant available form. Pulses are adopted to wide range of environment especially suited for arid and rainfed areas because of less water requirement and short duration. The productivity and production gain is possible by growing pulses in new niches, use of quality inputs and development of elite cultivars through combination of conventional breeding and different molecular breeding tools.

Keywords: Grain legumes, N_2-fixation, Catch crop, Molecular breeding, Allele mining

INTRODUCTION:

Pulses are next to cereals in terms of agricultural importance and are the best options for diversification and intensification of contemporary agriculture on sustainable basis. India is the largest producer (World's 29%) and consumer of pulses (World's 30%).The annual growth rate of production is only 1.1% (1990-2014) i.e. much below from North America (7.7%) and Africa (3.4%), (FAO, 2018). The major reasons behinds the slow annual growth is the continuous shrinkage in cultivable legume area and conversion of legume area into cereal crop area.In India, major pulses are chick pea, pigeon pea, black gram, field pea, lentil, green gram and moth bean. Pulses were cultivated over > 29 million ha of area and production of 25.23 million tonnes at a productivity level of 841 kg/ha during 2017-18 (Anonymous, 2018).The productivity of India is low as compared to world's average productivity (1023 Kg/ha). We today face a challenge to ensuring food security while providing a balanced diet for everyone around the world. Nutritional security along with food security is an area to be taken care of as most of our

vegan population is devoid of balanced diet leading to various forms of disorders and associated deficiency diseases. Grain legumes fill the gap in supplementing the nutritional shortfall with the proteins which they possess in high quantity and qualities. Key roles of legumes in sustaining the soil fertility by fixation of atmospheric nitrogen, feed as human diet and animal fodder values inter-alia add the degree of their importance in sustainable agriculture.

BENEFITS OF PULSES

These leguminousplants are not only healthy, they're good for the environment as well. Pulses require less water than other crops to grow, which means they are especially suited to dry, arid lands where the majority of these poor rural farmers reside. Some pulses, like pigeon peas having deep root system, so they do not compete with other crops for water and nutrients. Pulses are grown also as cover crops and play their role in reducing soil erosion. Pulses do not require nitrogen fertilizer as it fixes atmospheric nitrogen and carrying it into the soil. This self-sufficiency in nitrogen saves the environment from emission of greenhouse gases, a by-product of the manufacture and use of nitrogen fertilizers.Besides that, crop residues from legumes can be used as animal fodder to fulfill the nitrogen requirement of livestock diet, thereby improving animal health and growth. Legumes plant residues left after crops are harvested have a different biochemical composition as compare to other graminaceous plants that contributing to soil microbial biodiversity. Pulses are the important crop in agro-ecosystems help to maintain and increase vital microbial biomass and activity in the soil. These microbial diversity responsible for nutrient availability and promoting soil structure. For all these reasons, pulses are ideally suited to rural and poor farmers but can be a model for organic farming.The protein content of legumes is substantially higher (20-36.0%; Gowda *et al*. 2014) compared to major cereals (6.0-15.0%; Champagne *et al.* 2004). Pulses are a rich source of protein and essential amino acids (except methionine and cystine) that act as the perfect complement to cereals (rich in methionine and cystine). Their low fat content and the interaction of their sterols have been proven to be effective at maintaining low LDL cholesterol levels andreducing blood pressure.

Why pulses aresuperfood?

There are following reasons that makes pulses as super food:

- Require less water
- Suitable for wide range of environments
- Withstanding severe weather conditions
- Atmospheric N_2-fixation (~300kg N_2/ha/year)
- High protein content (~twice of cereals) – 20-25%
- Excellent source of fiber and folate (Vitamin-B)
- Cholesterol and Gluten free
- Good Source of iron,potassium, magnesium and Zinc
- Low Fat and low sodium

- Zero Waste (Pod- human food, Shoot- animal feed and Roots- Nourishment for soil)
- Clean crops – do not emit green house gases (except lentil – 0.9%)
- Catch crops – Reduces the soil erosion

Breeding Strategies for pulses improvement

Pulses are the self-pollinated crops because of *papilionaceous* type flower (one standard + two wing + two keel).The improvement of pulses through conventional and advanced breeding methods is possible. Till now, most of released cultivars of pulses developed through conventional breeding methods (Selection, pedigree, bulk etc.) but we immediate need to use advanced breeding methods to break the yield plateau. There are following breeding strategies for pulses improvement-

- Pre-breeding – to break yield plateau and broaden the genetic base (Singh *et al*., 2013).
- Mapping populations - toimprovement of targeted traits.
- MAS and Gene Pyramiding –to develop resistant varieties against major diseases (Kumar *et al*., 2011)
- QTLs mapping - for improving grain yield and quality traits.
- Off-season nurseries - for rapid generation advancement.
- Maintenance breeding - to ensure availability of quality seeds (Singh *et al*., 2013).
- Heterosis breeding - for yield improvement in pigeonpea.
- Allele mining of genes of agricultural importance.

Released high yielding varieties of pulses in India:

There are following released varieties of pulses to meet our future per capita requirement-

Chickpea - GNG 1581, JG 11, JG 63, JG 130, JG 14, JAKI 9218 and Vijay

Pigeonpea - Bahar, Maruti, Narendra Arhar-1, Asha, BDN 711, TJT 501 and BSMR 736

Mungbean - SML 668, MH 421, IMP 2-3, GM-4, HUM 16, IPL 2-14, PDM 139 and Pant Mung 5

Urdbean - IPU 02-43, PU 30, PU 31, KU 96- 3, TAU-1, LBG-752, Uttara and KU-300

Field Pea -Vikas, Aman, Adarsh, Pant L-8, Pant L-7, Pant L-6, JL-3, HUL 57, WBL 77 and K 75 and HUDP 15, Prakash, KPMR-400 and KPMR 522,

Mothbean - RMO-40, RMO-225, RMO-425, RCG1033 and CZM1

CONCLUSION

Amongst the praises of pulses are their high nutritional value, broad geographical range and low water requirements, their distinctive ability to N_2-fixation, (adding atmospheric nitrogen to soil and improving crops), along with maintaining their health benefits over a long time. All these reasons make pulses an uncompromising enemy of hunger and malnutrition worldwide. Pulses should be an integral part of any agro-ecosystem due to the massive positive effects they have on the ecosystem. . There is a huge potential for significantly enhancing production of pulses in India, primarily by increasing

productivity and to some extent by increasing area. The use of molecular breeding and novel breeding tools may helpful for high yielding varieties development in future.

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Cultural believes and religions in India: An invisible yet strong way of conservation of agricultural and forest biodiversity

Poornima S[1], Archana Sharma[2*] and Namita Das Saha[2]

[1]Assistant Director of Agriculture (ADA), PhD, Division of Agronomy, IARI, Pusa, New Delhi, India.
[2] Young Professional (YP-II), MSc, CESCRA, IARI, Pusa, New Delhi, India.*
[3]Scientist, PhD, CESCRA, IARI, Pusa, New Delhi, India.

**Corresponding author's email-ID: arc19dp@gmail.com*

Abstract

India is very rich in terms of forest plant diversity and agrobiodiversity. Also India is known as a famous land of celebrations, crowded ceremonies, fairs and festivals and other social activities. These religious ethics and festivals have great role in biodiversity conservation directly or indirectly. Ingredients that make part of a festival or celebration are naturally protected because they serve a purpose and have ritual significance. Our ancestors had left various religious beliefs for us towards nature and it was a very constructive device for conservation of agro biodiversity not only during their time but at present also. Social taboos and cultural festivals represent good examples of informal institutions in biodiversity conservation. Hence this is the need of the hour to promote such traditional festivals along with other conservative incentives through local committment, supportive policies and official legislation for long-term sustainable conservation of traditional plant biodiversity.

Key words: Biodiversity; Conservation; Cultural believes

INTRODUCTION

India is a rich bio-diverse country which comprises of multitude of religions, casts and creeds. India is a habitat of 130 million people belonging to more than two thousand ethnic groups and under Schedule-V of the constitution, the Indian Constitution has acknowledged its tribal communities and at present India has approximately 645 separate tribes. Different religions, cultures, tribal creeds altogether help to conserve many biodiversity including agrobiodiversity and forest plant species. Apart from these all, India is a god gifted country because it is very rich in biodiversity and on present date there are four biodiversity hotspots present in India (Himalayan, North East, Western Ghats and Sunderland). Nature has blessed India to become very rich in terms of Agro-biodiversity as well and it comprises 160 crop

species with hundreds of varieties, 325 wild relatives of crop species and around 1500 wild but edible plant species and diverse domesticated diversity of animals and birds.

Among these all diversity, Plant diversity has a great role in supporting life of all living creatures including human being. They also have great economic importance. Forest dwelling communities depend largely on forest resources and also nurtures many agro-biodiversity as their life style is being uplifted since many years. The typical forest dwellers have strong traditional understanding, utilizing and conserving the plant diversity. These tribal people lives in close vicinity of forests and maintain harmony with nature. Unknowingly they are the best manager and conservationist for that biodiversity since prehistoric and historic period of time. They are very rich with their own cultural believes, customs, folk tales, indigenous knowledge for multifarious uses of different plants and crops which are being conserved by them since prehistoric time. These vast repository of knowledge related to plants has been cared, nourished and conserved by the tribal communities as a common property since thousands of years by experience, trial and errors, and it is also being freely transmitted from generation to generation by means of oral communication (Saini et al., 2011).

India is famous in the world in terms of diverse celebrations, fairs and festivals, rich cultural ceremonies, tribal dancing and other social leisure activities. The variety of ethnic groups and communities with their beliefs, languages and culture living in India has made India very unique and this cultural heritage, rituals have been saving many biodiversity. Such an example is the conservation of sacred groves which is very old concept wherein a group of plant or individual plants are protected by the local communities by giving them sacred status on the basis of religious faith. Thus many plant species are being saved from centuries by primitive people for their use in variety of rituals, ceremonies, cultural believes.

Apart from the forest plant species, when considering for agro-biodiversity, it is one of the most agro-biodiversity rich countries of the world. Agro-biodiversity is the collective result of natural selection processes and the careful as well inventive selection by farmers and researchers over a longer period of time. Agro-biodiversity is a vital sub-set of biodiversity. India is agriculture dependant country and here many peoples' food and livelihood security totally depends on the sustained management of various agro-biodiversity. Thus, agro-biodiversity encompasses the total variety and variability of animals, plants and microorganisms that are must for sustaining the key functions of any agro-ecosystem, including its structure and functions. Religious belief(s), local knowledge, ethics and cultures can therefore be considered as integral part of agro-biodiversity conservation.

Thus conserving plant species through cultural and religious believes is an important aspect. We have discussed some of such examples which have been followed in India since prehistoric time and although these are invisible drivers for conservation of those diversities yet are very significant.

Conserving forest plants and herbs through social and religious ceremonies, cults and believes:

a. ***Plants/crops offered to God or used as symbolic to various Gods and Goddesses:***

Many plant species including herbs are being used as symbolic to Gods and many believes such as *Saraca asoca, Ficus religiosa, Aegle marmelos, Musa paradissiaca, Mangifera indica, Cannabis sativa, Terminalia arjuna, Coccos nucifera, Sesbania grandiflora, Nelumbo nucifera, Azadirachta indca, Ficus benghalensis, Santalum album, Ocimum tenuilfolia, Desmostachya bipinnata, Cynodon dactylon*, etc. They are being conserved since ancient time because of all these believes.

b. ***Plant conserved for using as Psychoactive purposes:***

Psychoactive drug use is a practice that dates to prehistoric times. The properties of psycho-active compounds vary with plant to plant. Psychoactive plants contain Psychotropic chemical substance that crosses the blood-brain barrier and acts primarily upon the central nervous system where it affects brain function, resulting in changes in perception, mood, consciousness, cognition, and behavior. Based on effectiveness of chemical compound in different plants, they are divided into three groups: (Anonymous, 2005)

i. Hallucinogens: Hallucinogens have been uses since prehistory and for centuries has been associated with religion as well as with magic and medicine. Many indigenous peoples attributed the fantastic effects on the body and mind to a divinity or spirit residing in the plant. And so hallucinogenic plants came to be regarded as sacred, as objects of worship. As for example: *Datura stramonium, Atropa belladonna.*

ii. Stimulants: These plants contain chemical compounds that wake one up, stimulate the mind and may even cause euphoria, but do not affect perception such as coffee, tea, cacao, ephedra etc.

iii. Depressants: In this category, plants have sedatives, hypnotics, and narcotics property, anxiety-reducing properties.

c. ***Plants conserved for magical herbalism/healing (Witchcraft):***

Since thousands of years, magical and mystical powers have been tagged with many plants. As for example:

i. *Smilax spp*. -Mix with cinnamon and sandalwood powder and sprinkle around the premises to bring money.

ii. *Syzygium aromaticum*- Flowers are added to the bath water to aid in financial dealings of all manners. Also used as sprinkle to remove negative spirits.

iii. *Juniperus sp*- Fruits are hanging over the door for protection from theft. The fruits powder is used as incense.

iv. *Altheaea officinalis* (Flowers)-Place in a glass bowl for a magical natural pot. Used in protection rites and also to stimulate psychic powers. *Althea* can also be used as incense.

v. *Cnicus arvensis* (Blessed Thistle)-Used for protection and blessing. Also used in purificationary baths and in spells to break hexes.

d. ***Conserving plants because of some believes in Vastu Shastra:***

Vastu sastra is an ancient science and according to Vastu believes many plants play significant role in activating positive energy to our day to day life. Some examples of Vastu plants are discussed below:

i. *Ocimum tenuifolium* (Tulsi): Should be planted in North, East or North-east and in the front of house.

ii. *Ficus religiosa* (Pippal): Should be planted near the temple or any other sacred places.

iii. *Ficus benghalensis* (Vat): Should be planted near the temple or any other sacred places.

iv. *Epipremnum aureum* (Money plant): May be planted inside the room as it gives good luck to house.

Fig.1. From left to right: *Saraca asoca*, *Sesbania grandiflora, Datura sp, Juniperous sp*

e. ***Conservation of agro-biodiversity because of some medicinal applications:***

Many crops and plants and their wild cultivars, land races are being conserved from ancient time from one generation to another because of different medicinal values of them. Such examplesof Rice land races and their uses are: Bhabri (used against stomach ache and shivering), Ghyasu (against loose motion), Jolya (agaist constipation), Khagola (for ease of delivery), Thapachini (against piles), Lal sati (against pox), Khullukala (against pimples) etc.

f. ***Conservation of agro-biodiversity by cultural believes and festivals:***

i. Mobile festival in Andhra Pradesh:

The festival targets at cheering up farmers of that region to exchange seeds among themselves and cultivate by using ecological farming practices to protect their lands from degradation. The festival spreads awareness among farmers regarding the need to reverse back to traditional crops to protect and conserve the biodiversity of their lands and also to acquire food sovereignty.

ii. Mulaipari festival in Tamilnadu:

This festival is celebrated to request to goddess for good rain in the monsoon month ahead for better cultivation practices and good yield. The nine different grains used for festivals are traditional one. This is how the traditional varieties are conserved. The grains which are used signify all planets. Such as: Suriyan (Sun)-Wheat, Chandiran (Moon) - Paddy , Chevvai (Mars) - Thuvarai (Toor), Bhudhan (Mercury) -Greengram (Moong), Guru (Jupitor) - Chana (Kadalai), Sukiran (Venus) - White Rajma or Avarikai,

Sani(Saturn) - Black Sesame (Til), Rahu – Black gram (Ulundu or Urad) , Kethu – Horse gram (Kollu).

iii. Bathukamma festival in Telangana:

Bathukamma festival is a festival of flowers. This flower festival is celebrated in Telangana and it helps for conserving the indigenous flowers of that region. 19 flowers are used viz. *Mirabilis jalaba, Jasminum, Cassia auriculata, Crysanthemum, Cucurbita pepo, Crossandra, Rosa, Portulaca grandiflora* etc.

iv. Chhath puja in Bihar:

Chhath Puja is celebrated by Hindu. It's a festival to worship Sun. Rituals during the festival are believed to help cure skin ailments such as leprosy, and bring health benefits to family members. This festival involves application of many fruits, crops.

v. Harela festival in agro-biodiversity conservation:

Harela festival is celebrated in the Himalayan region two times in a year. In this festival, the seeds of five to seven traditional crops/landraces is sown in a small basket 10 days before viz. Maize (*Zea maize*), Sarson (*Brassica spp.*), Gahat (*Macrotyloma uniflorum*) (legume), Jau (*Hordeum vulgare*), Wheat (*Triticum aestivum*), traditional land race(s) of Paddy (*Oryza sativa*), Mass (*Vigna sp.*) and Bhatt (*Glycine sp*) needed for Harela festival, should have stored by every household. This is one such socio-cultural activity of the Central Himalayan people through they make efforts to keep conserving the traditional crops/landraces/genetic resources which seems to be in jeopardy due to variety of factors.

Fig.2. From left to right: Mobile festival, Chatth Puja, Mullaipari festival and Harela

CONCLUSION

It is evident from the above discussion that, the cultural believes, social festivals, rituals, religions, different application values etc altogether have been playing a great role since ancient past in conserving many plant species and agro biodiversity in India.Involvement of indigenous people like tribes, villagers is an important part of conserving all theses biodiversity. The agro-biodiversity feeds us and is the nature's treasure which should be conserved for future generation. Hence this is the need of the hour to promote such traditional festivals along with other conservative incentives through local committment, supportive policies and official legislation for long-term sustainable conservation of traditional agrobiodiversity.

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Oyster Mushroom's – "Production And Marketing In Manipur"

Jai Raj Sougaijam, Suliyaa Mantaw, Sharad Sachan*, Sanjeev P S, Bhanu Pratap and Namgyal Wangchuk

School of Agriculture, Lovely Professional University, Jalandhar (144411), Punjab (INDIA)

**Corresponding author: sharad.19461@lpu.co.in*

ABSTRACT

Mushroom cultivation is a brand new phenomenon which has solely definitely taken off in the final three to six years. Most farmers are the expert male formative years of Manipur while merchants are in precise middle-aged female trained up to important college level. The farmers also use present infrastructure and reachable tools to enhance mushroom at an especially decrease cost than a dedicated mushroom facility. Though this saves fee handing over margins ranging from 59% for Oyster and 68% for Paddy Straw farmers, it limits productiveness and year-round production capability with most manufacturing coming in after the height demand had subsided. A farm economic model used to be created primarily based on a modern farm and it demonstrated that an average farmer needs an upfront funding of Rs2.3 lakhs to set up a new mushroom farm successful of producing 1,000kg of oyster mushroom a 12 months with an IRR of 17% and BCR of 1.01. For Paddy Straw mushroom production, the upfront investment is Rs.3.4 lakhs on the other hand the returns are lots greater though.

Keywords- Oyster Mushroom, Production, Marketing, Economic Importance and Production Technology

INTRODUCTION

Oyster mushroom (Pleurotus sp.) belongsto theFamily Agaricaceae and Class Basidiomycetes, which is famously recounted as 'Dhingri' in India. In the temperate and tropical forests it thrives on decomposed timber logs and vain or once in a while on demised coniferous & deciduous wood trunks. It also grows on decomposed herbal matters. The mushroom's fruitbodies are particularly spatula or shell fashioned alongside precise hues relying on the species themselves.This mushroom is reckoned to be the highestsuitable fungal organisms for fabricating protein prosperous meals from profusewoodland wastes or agro-wastes without composting.

Genesis:

Rearing of*Pleurotusostreatus* sp. of oyster mushrrom Fig. i, soon initiated on the lines ofan experiment in Germany by capacity of "Flack in the path of the 12 months,1917 on tree stumps and wooden logs". Growingtechnology was made immaculate in USA via Block, Tsao and Hau.Growing of unique sorts of this mushroom used to take place in India during earlysixties followed by mercenary culturing which commenced in mid-seventies.

BIOLOGICAL ELUCIDATION:

There are 3 distinctive parts of the oyster mushrooms namely, a central stalk or lengthy lateral or brief referred to as stipe with prolonged ridges andfurrows& a fleshy shell or spatula structured cap(pileus). Lamellae or gills are found underneath the pileus, in which from the cap's location the gills are stretched, downto the stalk and spores are spawned(Spores are sheeny and columnar and grow with ease on any mycological structure media within 45-93hrs).

Fabrication:

The manufacturing of mushroom takes location in multiple steps and requires advisable prerequisites each handy naturally like in caves or in controlled increase chambers. The device begins with the manufacturing of spawn which is genuinely the 'seed' for larger-scale mushroom cultivation. Spawn is produced through the use of creating mycelia in a sterile environment on cereal grains. The mycelia-covered grains then emerge as the seeds for mushroom cultivation in trays or luggage in a temperature and humidity-controlled environment. Depending on the variety of mushroom, growth can take place internal a few days to weeks. In the following sections, the steps for producing two of the most usually cultivated mushroom kinds have been described.

Importance

The monetary vitality of the mushrooms resides incredibly for their usage as food for humanconsumption. It is massively affluent in Vitamin B and Vitamin C with aprotein contentof1.8 to 2.6 percent. It consistsalmost all of the mineral salts requiredby the human body. The percentage of niacin is ten times larger than those of other vegetables.Presence of folic acid in such mushrooms remedies Anemia. Also is appropriate for individuals who suffer from diabetes, hyper-tension, obesity, constipation and hyperacidityThe utilized straw can be re-processed for creating this mushroom followed by post supplement of rice bran or wheat @ 12-15 p.cmoreover for setting compost of white button mushroomsafter appropriate addition with nitrogen affluent chicken or horse manure. The used straw can be employed as cattle feed alongside using slurryas manure.

DIFFERENT SPECIES OF OYSTER MUSHROOM

- *Pleurotussapidus*
- *Pleurotusostreatus* (Pearl oyster)
- *Pleurotusflorida*
- *Pleurotusostreatus* var. columbinus (Blue oyster)

- *Pleurotusmembranaceous*
- *Pleurotusflabellatus*
- *Pleurotussajor-caju*

PRODUCTION TECHNOLOGY

Agro-climatic requirement:

These Mushrooms can grow at an average temperature of 20ºC - 300ºC and humidity 55% -70% for a time period of six-eight months in a year. They are preferably cultivated during summertimeby way of dispensing the greater humidity which is desired for the maturation and development. In regions at above 900mof sea level, the pleasant growing season is for the periodical duration of March/April to October and in the limit regions from Sept/Oct to March/April.The Indian states bearing this mushroom are Orissa, Maharashtra, WestBengal, Karnataka, Madhya Pradesh and most of the North Eastern states.

THE DISTINCT STEPS CONCERNED IN THE CULTIVATION OF OYSTERS MUSHROOM ARE:

Composition of layer:

Oyster mushroom is raised on a variety ofagro-industrial by-products which have excessive contents of cellulose, lignin and hemi-cellulose. The substrate need to be fresh, dry free from the mildew infestations and accurate stored. It is encouraged that substrate which is harvested immature, having green chlorophyll patches have to now not be used. A range of substrates such as "wheat straw, paddy straw, ragistraw, maize leaves and stalk, jawar, cotton,bajra, sugarcane bagasse, wastes of cotton and jute, peanut shells, dried grasses, used tea leaf waste etc." can be used for Oyster cultivation.

Spawning

Spawning ought to be completed in a room which used to be till now fumigated with 2% formaldehyde for forty eight hours. If spawning is performed outside, then the floor of tarpaulin sheet as nicely as fingers need to be sterilized with spirit or alcohol. Then mix the spawn certainly or in layers whilst inserting the straw into polypropylene baggage (60 x 45 cm, 125- one hundred fifty gauze thickness). 300 grams of spawn grain is enough for 10-12kg of moist substrate. Around 10-15 small holes have to be made on all the aspects of polypropylene baggage with the assist of a pin.

Incubation and fruiting:

By placing the bags in incubation room for mycelial run retaining in wondering the baggage can be stored on raised systems or cabinets or hanged from the roof. Optimum temperature for growth is 22-26°C. Once the mycelial run is over i.e. the baggage have turned white due to the increase of mushroom mycelium, make some holes at countless places in the bag so that the fruiting bodies can develop out. During fruiting maintain the relative humidity of 75- 85% with the aid of spraying water on the gunny bags or sand unfold on the floor. One or two spraying of water day by day is sufficient. There be 8-12 hours of moderate in the direction of fruiting.

Plant Protection

- It is Susceptible to assaults from flies i.e. (cecid, sciarid) mites and spring tails. So precise spraying of pesticides in accordance to the insects is required.
- It is susceptible to fungal diseases, sundry combatantmoulds e.g. Cladosporium sp., Aspergillus sp.,exhibit in the underlying substance utilized for culturing. Bavistin applicationis an encouraged control measure.
- It is additionally problem to ailments like brown spot, bacterial rot and yellow blotch, manipulative measures such are wished to include: Judicious administration of humidity and temperature at some point of developing period. Regular software of chlorinated water containing hundred – hundred fifty ppm of straightforwardly handy chlorine at an interlude of three – five days must be given. Application of oxytetracycline and streptocycline is effective as well.

Yield and Harvesting

Required shape for choosing can be judged with the useful resource of the form and size of the mushrooms. The fruit can be harvested earlier than spore release, with the aid of using twisting to ensure there are no stubs' leftovers on the beds (straw). Picking out of all the mushrooms at once is encouraged from a dice and the showing up subsequent flush at one time. More thanfive hundred kilos of fresh mushrooms per ton of dry wheat or straw are acquired for crops produced within fortyfive -sixty days.

MUSHROOM CULTIVATION FOR SUSTAINABILITY IN MANIPUR

Mushroom cultivation has won recent traction in the kingdom of Manipur owing to its low enter cost.The youthful entrepreneurs of the kingdom have developed the innovatively grown and packed mushroom sacks as their supply of income. The beneficial climatic stipulations have furnished sufficient probabilities for the formative years to take farming as a commercial employer for higher sustainability.

Mushroom cultivation as a business is a new trend in Manipur – this is backed via the use of the fact that 41% of the corporations are much less than three years old. This additionally explains why 59% of the companies are now not but registered and this is an area that ought to be considered in future sector-specific programs. It used to also observe that an exact sized majority of the farmers grow Oyster mushroom. Besides patron preference, inexperience would maybe also supply an explanation for the core of interest on one kind of mushroom as farmers research from each and every distinctive in the early years of growing mushroom.

Jamini Mushroom Processing Industry in Imphal holds sheer grant of 3,000 packets of mushroom in regional farms with 20 kg of mushroom being offered out on a day by using day foundation at the wholesale fee of Rs hundredthirty per kg. On an aggregate basis, 1.5 to three tonnes of mushrooms are produced below the farm.The local farmers in the country are engaged in the cultivation of bottle-mushroom in iciness and the local merchandise are promoting in the markets of special parts of the region.Jamini Mushroom Processing Industry has a lengthy way employed-form of three normal teams of workers which is appearing as a platform for them to earn their livelihood for greater sustainability. The exceptional advisable season to strengthen this mushroom in Manipur is from September to February. The grown packed mushroom farming of the

country is step by step rising as a thriving business enterprise for many trained unemployed early life of the state. Through such revolutionary industrial agency idea, one can without difficulty earn Rs 27,000 to 30,000 each month.

As Mushroom cultivation in Manipur is a predominant supply of employment and income. Entrepreneurs in the US have developed revolutionary mechanism to make mushroom farming a sustainable source of business. Jamini Mushroom Processing Industry concocted a neighborhood mushroom bagging laptop to simplify the technique and making it efficient. The laptop is capable of finishing the work robotically which include cultivation bag making, compost loading, compost filling, compost urgent and cultivation bag sealing.

USHM (ultrasonic humidifier machine) anda Humidifier desktop. The humidifiers work the usage of the rotating disc that vaporizes water droplets which are then pumped out of the unit and later into the room. Benefit of piping in the humidity is it brings in the glowing air, which is vital in lowering Carbon dioxide tiers and creating applicable looking out fruits.

Pictures showing the developing of oyster mushroom in Manipur via KVK, Imphal west, ICAR Manipur Centre are exhibited in Fig.ii, Fig.iii, Fig.iv& Fig.v.

MARKET SURVEY AND POLICY

Stipulation and distribution patterns:

The oyster mushroom isnot well-known in the home market as much as white button mushroom. A few gadgets are utilized for re-rearing such that it can be commercially used for exportation. “Cultivation of this mushroom on industrial foundation would be extra worthwhile as in contrast to white button mushroom as capital fees are low.”The culturingrange of such mushrooms isvery easy and less costly in pastoral sites where uncooked substances and amenities are required with barring problems available.Merchandising of clean oyster mushroom does not create any hassle in this modern era as a result of very low production. With manufacturing, extension in linkage of developers with local markets and export-oriented processing inputs relatively get developed to make positive lucrative fees to the concoctors.

Import / Overseas sells’trends:

Total value of export is 18.80 USD million. There are around 102 countries that import mushrooms from India. The volume of oyster mushroom exported is a suitable deal decreased in comparison to button mushrooms that account for the supreme share of sales abroad.

Inspection of forthcoming approaches:

Pleurotus species are the most economical and effortless to rear amongst every cultured mushroom sp., which are fit for human consumption. Cultivation process does not need intricate substrate guidance method for button mushroom procurement. It is grown on non-decomposed matter almost on easy plant remains. Substrate training does no longer in need of well-administered environmental stipulations for button mushroom.

Mushrooms have miscellaneous kinds ranging in structure & size, color, aroma and texture which are obtained over the course of a year in assorted agro-climatic conditions. Speedy development cost and premature cropping are observed. 5 to 6 produces are taken ina time period of 12 months with the total cropping length being 60 days merely.

CONCLUSION

Cultivation of mushrooms commercially is now no longer for everyone. As it needs those individualswho areacquainted with fungal existence cycles, and are committed to investing time, designing systems, cash in to researches, and setting up a business. The producers ought to execute operations on time, be attentive to details and show vigilance about pest invasions. Typically marketing requires wonderful public members, nevertheless the possibility is prominentfor an innovator who uses a contemporary facility, acquiring with a less rate substrate and producing a dependable grant of exceptional end-products. Thus, within an area of a whole-farm system, mushrooms can expand productiveness at the highest level.

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Fig 1: Species of Oyster Mushroom (Source- KVK, Imphal West, ICAR Manipur Centre, Lamphelpat, District: Imphal West**)**

Fig 2: Mushrooms kept in controlled room(Source- KVK, Imphal West, ICAR Manipur Centre, Lamphelpat, District: Imphal West**)**

Fig 3: Rice Straw(Source- KVK, Imphal West, ICAR Manipur Centre, Lamphelpat, District: Imphal West**)**

Fig 4: Oyster Mushrooms (Source- KVK, Imphal West, ICAR Manipur Centre, Lamphelpat, District: Imphal West**)**

Fig 5: Oyster Mushroom at the early stage(Source- KVK, Imphal West, ICAR Manipur Centre, Lamphelpat, District: Imphal West**)**

COVID-19 and its Effect on major sectors of Agriculture

Bulusu Swati Rani, Oviya M., Arshi Khan and Uzma Manzoor

School of Agricultural Sciences, Sharda University

**Corresponding author: uzmamanzoor52@gmail.com*

With COVID-19 spreading in India, massive consequences to health and livelihood are feared. The impact of COVID-19 on the economy is no doubt devastating. No sector has escaped its impact. The outbreak of novel corona virus in India shut down offices of the gloating services sector and closed factories. Only one sector that did not stop to work is agriculture.

Agriculture sector accounts for 15 percent of India's gross domestic product and it is a source of livelihood for more than half of the country's 1.3 billion population. The lockdown happened in peak of the harvesting season of Rabi and crops like wheat, gram, lentil, mustard, etc. were at harvestable stage or almost reaching maturity. This is also the time when the harvest reaches the mandis for sale. However, the government allowed the daily necessities like milk, vegetables, fruits , cereals and pulses to be sold in limited timing but most challenging was making available the food and other essential items to consumer, both in rural and urban areas where transportation stopped. The pandemic showed its effect on different sectors related to agriculture.

Poultry and Livestock: Meat industry was the foremost industry to shut down because most people believed that meat could be one of the vectors for the diseases and viruses. When the processing plants and meat industry starts to open back up, then the selection and price issues will be reduced.

Fisheries: More than nine million active fishers directly depend on fisheries for their livelihood of which 80% are small scale fishers. It employs over 14 million people and contributes to 1.1 per cent of the Indian GDP.Aquaculture is the fastest growing food-producing sector in the world, contributing one-third of global food fish production.Fish, particularly produced through aquaculture, is commonly cheaper than other animal meat. It also contains much higher protein levels, as well as other important minerals and vitamins. As a means of providing greater nutrition for many poorer households, increased availability of fish can mean better health and a more diverse diet. This sector also faced the brunt of the covid as the collection, transportation and sale was affected drastically.

Floriculture: It is a 20 thousand Crore Rupees business per annum. Pandemic and lockdown happened during that time of the year when everywhere you go, you see

farms bursting with bloom. Despite April-May being the peak season for flowers, the growers could not find takers for their produce. With the curfew enforced in the wake of corona virus outbreak the demand for flowers in the market was almost nil.

The coming days will bring us new challenges and crises and we need to get ready. Good things also happened that farmers realised the benefits of PM schemes, e-commerce, etc. Relaxations of the norms by Agricultural Produce Market Committees (APMC) allowing farmers to sell their produce beyond the designated mandis also eased the burdens of the farmers.

Fishery industry needs to be stable and has a major role in food security. So inland fishing can be started as maximum in all costal areas with proper maintained and hyigene program. E- commerce can also be established with a proper or reasonable pricing that helps farmers to handle their families during this pandemic. Many useful compounds can be extracted from flowers for medicines, perfumes, flavours, and dyes etc. There should be more investment in technologies that has the capacity to withstand in tough times.

Avian Influenza – A Challenge to Poultry Industry and a Threat to Human Health

Monika Thakur*[1] and Ramandeep[2]

Veterinary Pathologist, Veterinary Polyclinic Lalhri, Distt Una (Himachal Pradesh) - India
Veterinary Officer, Civil Veterinary Hospital Dher (Punjab) – India
Corresponding author: monikkathakur27@gmail.com

The highly pathogenic avian influenza (HPAI) H5N1 virus, which is panzootic in poultry, continues to spread and pose a major threat to animal and human health. Since pandemic influenza virus has its origin in avian influenza viruses, HPAI H5N1 virus has to be considered a potentially serious pandemic threat. World Organization for animal Health (OIE) has listed the disease as a notifiable AI (NAI) and it has now a significant impact on animal and human health. H5N1 viruses are taking a huge toll on the poultry industry in many developing countries, and this directly or indirectly impacts both economic and social well being. The potential impact of HPAI H5N1 virus (and human reaction to its spread) on wildlife and ecology has received less attention but is also worthy of consideration. While the H5N1 virus transmits from infected poultry to humans, often with fatal consequences, such transmission remains inefficient. Although the virus replicates efficiently in diseased humans, it has not yet adapted to efficient human-to-human transmission. H5N1 therefore continues to challenge our understanding of interspecies transmission of influenza viruses. In addition, since 1997, the consequential human health implications of AI infections of poultry have been identified, especially as a result of the spread of Asian H5N1 virus. This has dramatically drawn the attention of the scientific communities of both veterinary and medical sciences.

GENOME ORGANIZATION

Influenza viruses have eight-segmented, single-stranded (ss), negative-sense RNA genome belonging to the family Orthomyxoviridae. At present, Orthomyxoviridae family consists of five genera out of which only viruses of the Influenza virus A genus are known to infect birds. Influenza virus type A causes recurrent epidemics almost every year, leading to significant human morbidity and mortality. However, only influenza A virus is associated with influenza virus pandemics, where an antigenically novel influenza virus emerges to spread rapidly worldwide in an immunologically naive population. In past pandemics, 20 to 30% of the global population was infected within the first year, and in this regard, influenza A viruses are unique human pathogens. The

last century witnessed three such pandemics, in 1918 ("Spanish flu"), 1957 ("Asian flu") and 1968 ("Hong Kong flu"). The pandemic of 1918 is believed to have claimed over 40 million lives, while those of 1957 and 1968 are each believed to have led to over 4 and 1 million deaths, respectively.

Molecular basis of virulence and replication

The eight gene segments of influenza A virus encode 10 proteins: hemagglutinin (HA), neuraminidase (NA), matrix proteins M2 and M1, nonstructural (NS) proteins NS1 and NS2, the nucleocapsid, and the three polymerases, the PB1 (polymerase basic 1), PB2, and PA (polymerase acidic) proteins. For some influenza viruses, the PB1 gene has recently been discovered to encode an additional protein, the PB1-F2 protein. Influenza type A viruses are subtyped based upon the HA and NA antigens, which are surface proteins found on the viral envelope.

Antigenic drift (endemic influenza) and antigenic shift (pandemic influenza)

Replication of influenza genome requires RNA polymerase activity. This enzyme lacks proof-reading ability and has limited potential to correct mistakes during RNA transcription, resulting in a high frequency of mutations in any newly replicated virus population. These new strains accumulate random point mutations that may result in amino acid substitutions in surface glycoproteins that allow new variants to evade immunity. Viruses that have undergone antigenic changes or "antigenic drift" to evade immunity and are capable of re-infection and inter-pandemic outbreaks.

Mutation in these genes is selected for by herd-immune selection pressure in the host, leading to a directional antigenic change over time ("antigenic drift"), thereby explaining the repeated epidemics observed with influenza A or B virus. The segmented genome of influenza viruses also allows for genetic reassortment to occur when two influenza viruses infect the same cell. This provides influenza viruses a powerful option for the generation of genetic diversity for interspecies transmission and to evade host immune responses through a major antigenic change ("antigenic shift"). Pandemics arise at infrequent intervals when an influenza virus with a completely novel HA (and sometimes NA) acquires the ability for efficient and sustained human-to-human transmission in a population that is immunologically naive to the virus surface proteins (HA and NA). The H2N2 influenza virus responsible for the pandemic of 1957 arose through genetic reassortment, where the prevailing human influenza A virus (H1N1) acquired the HA (H2), NA (N2), and PB1 genes from an avian virus. Similarly, the pandemic of 1968 arose through the acquisition of a novel HA (H3) and the PB1 gene from an avian source. In contrast, the pandemic of 1918 is believed to have arisen through the direct adaptation of a purely avian virus to efficient transmission in humans, although the lack of genetic information on relevant avian precursors and on the pre-1918 human viruses precludes a definitive conclusion on this matter. Thus, pandemic influenza virus is a zoonosis, and avian viruses play a critical role in its genesis. Since the pandemics of 1957 and 1968 arose in southern China, this region has been identified as a hypothetical pandemic epicenter.

Sixteen subtypes of HA (H1 to H16) and nine subtypes of NA (N1 to N9) are recognized in aquatic birds. While many of these subtypes can be consistently detected in wild aquatic waterfowl, only few subtypes have established themselves in mammalian species such as humans (HA [H1, H2, and H3] and NA [N1 and N2]), pigs (HA [H1 and H3] and NA [N1 and N2]), horses (H3N8 and H7N7), and dogs (H3N8). Indeed, only some of the diverse influenza virus subtypes found in aquatic birds have established themselves as low pathogenicity avian influenza (LPAI) virus in terrestrial poultry such as chicken, turkey, and quail (e.g., subtypes H9 and H6). Both human and avian influenza viruses have established stable virus lineages in pigs, possibly a reflection of the fact that receptors for both avian and human influenza viruses are present on the porcine epithelium. For these reasons, pigs have been regarded as being a possible intermediate host ("mixing vessel") for the generation of pandemic influenza virus through reassortment. Human influenza viruses that have become established in pigs include classical swine H1N1 and H3N2 viruses and reassortants thereof (H1N2 and H3N1). The 1918 H1N1 virus appears to have entered human and pig populations, although the epidemiological evidence favors the initial host as being humans. Avian-like H1N1 viruses have established themselves in pigs in Europe. In addition, other viruses have been transiently detected in pig populations. These include avian virus subtypes H1N1 (Asia), H4N6 (Canada), H9N2 (China), and H5N1 (Asia). More recently, equine H3N8 viruses have been transmitted to racing dog populations in the United States, possibly facilitated by the practice of feeding horsemeat to racing dogs, another example of a human intervention that promoted interspecies transmission of viruses. Overall, there are strong barriers to interspecies transmission that prevent the adaptation of influenza viruses to new hosts. It is likely that these prevent the more frequent emergence of pandemics from the wide diversity of HA subtypes prevalent in waterfowl.

Highly Pathogenic Avian Influenza Virus (HPAI)

Two subtypes of influenza A virus (H5 and H7) are known to give rise to HPAI virus in terrestrial poultry (chicken and turkeys). The HPAI virus phenotypes of these viruses are largely, though not exclusively, to mutations giving rise to multiple basic amino acids in the connecting peptide between the HA1 and HA2 domains of the HA0 precursor protein. In the viral life cycle, post-translational cleavage of the precursor HA molecule (HA0) into two subunits (HA1 and HA2) by host proteases is essential for productive virus replication, since this generates a fusogenic domain mediating the fusion between the viral envelope and the endosomal membrane. This may occur extracellularly by trypsin-like proteases that are restricted in tissue distribution to the respiratory and gastrointestinal tracts. However, when multiple basic amino acids are introduced into the HA cleavage site, the HA0 precursor becomes cleavable by a wide range of proteases (e.g., furins [PC6-like]) with ubiquitous tissue distribution. This permits productive virus replication in organs outside the respiratory and gastrointestinal tracts, including the brain, resulting in fulminant disseminated disease with high mortality, leading to HPAI virus. The acquisition of a carbohydrate side chain

near the cleavage site can modulate the pathogenicity of a virus by masking the accessibility of the proteases to the cleavage site. In the 31 years from 1959 to 1990, there were nine HPAI virus outbreaks recorded in Europe, North America, and Australia, and these outbreaks were contained by the "stamping out" of infected flocks. In the 11 years since 1990, there have been 10 further HPAI virus outbreaks, including in Asia. The current HPAI H5N1 virus outbreak (from 2003 onwards) is, however, unprecedented in scale and geographic distribution. These viruses are now panzootic across three continents, leading to huge economic losses, and have transmitted to humans with lethal consequences. The expansion of intensive poultry husbandry, which is the fastest growing livestock industry globally, with an estimated 16 billion chickens and 1 billion ducks worldwide, is likely facilitating the increasing frequency and scale of HPAI virus outbreaks. Furthermore, the commercialized large-scale poultry industry is now associated with the movement of live poultry and poultry products over long distances, thereby facilitating the transmission of infection. On the basis of the genetic sequence of HA and the biological properties of the virus, it appears that the avian influenza viruses that contributed to the origin of the pandemics of 1957 and 1968 were LPAI viruses of chicken and other terrestrial poultry. Therefore, for pandemic preparedness, surveillance of poultry and other avian species must be directed at healthy as well as diseased birds. On the other hand, reconstruction of the H1N1 virus causing the "Spanish flu" pandemic of 1918 suggests that this virus may have had high pathogenicity for terrestrial poultry even though it did not have the multibasic cleavage site in the HA that characterizes HPAI virus. However, direct proof of high pathogenicity of the 1918 virus for chickens is still awaited.

INFLUENZA H5N1 VIRUS IN HUMANS

Transmission and Epidemiology

The first human disease caused by H5N1 was reported in Hong Kong in 1997, with 18 cases and six deaths. The source of human infection appeared to be live-poultry markets where chickens, ducks, geese, and other species of minor poultry (e.g., quail, pheasant, chukka, pigeon, etc.) were sold for human consumption. In February 2003, as the world was girding itself to confront severe acute respiratory syndrome, H5N1 disease was diagnosed in Hong Kong in a father and son who had just returned from a holiday in Fujian Province, China. In retrospect, another case of H5N1 occurred in Beijing, China, in November 2003. Subsequently, with the increasing spread of H5N1 disease in poultry, further human cases from Vietnam, Thailand, Cambodia, Indonesia, and elsewhere were reported. In a number of instances, the detection of a human case in a region was the first indication of the presence of poultry infection in that locality. Since HPAI H5N1 virus in poultry is associated with the presence of infectious virus in many organs, as well as the excretion of large amounts of virus in the feces and other secretions, sick poultry are a major source of human infection. Most human cases of H5N1 infection were associated with the direct handling of infected poultry, slaughtering or preparing sick poultry for consumption, consumption of uncooked poultry products such as raw blood, or close contact with live poultry. Since H5N1

infection may not always be overtly symptomatic, especially so in ducks, even asymptomatic poultry may pose an infection risk, e.g., at wet markets, in areas of endemicity. Contact with a contaminated environment, such as water and poultry feces used as fertilizer or fish feed, has been suspected to be a source of infection in human H5N1 cases that had no direct exposure to poultry. In bird-to-human transmission, the likely portal of virus entry is via the respiratory tract, the gastrointestinal tract, or the conjunctiva. Cats experimentally infected with H5N1 virus after feeding on infected chickens showed evidence of viral replication in gastrointestinal plexi. However, this is not seen in those infected via the respiratory route. In humans, the possibility of intestinal infection is supported by reports of H5N1-infected patients who presented with diarrhea as the only initial symptom as well as by patients who reported consumption of raw duck blood as the sole exposure to poultry. In addition, the presence of infectious virus in fecal material may indicate virus replication in the human gastrointestinal tract. There are a number of enigmas with regard to human H5N1 infection and disease. In spite of large-scale outbreaks of H5N1 viruses among poultry in densely populated areas and presumably massive exposure of humans to the virus, the number of reported H5N1 patients has so far been relatively small.

In Hong Kong in 1997, where there was excellent surveillance for symptomatic influenza virus, there were still only small numbers of cases in spite of the exceedingly heavy virus load in retail poultry markets, where 20% of poultry were infected. Sero-epidemiological studies following the 1997 H5N1 outbreak in Hong Kong have shown that mildly symptomatic or asymptomatic infections had occurred in a few individuals exposed to infected patients or poultry. Similar studies of persons at risk for H5N1 exposure during the recent H5N1 outbreaks have shown little or no evidence of human-to-human transmission in unprotected health care workers exposed to H5N1 patients. Similarly, villagers, poultry workers, and poultry cullers in Vietnam, Thailand, Indonesia, and Cambodia who are heavily exposed to infected poultry rarely have clinical or asymptomatic (serological) evidence of infection. In contrast, around 10% of poultry stall holders in Hong Kong in 1997 had serological evidence of H5N1 infection without presenting as overt H5N1 disease, although it is unclear whether the sero-positivity represented recent infection with HPAI H5N1 virus or prior infection by LPAI H5-subtype viruses known to be present in ducks.

Pathogenesis of Human Influenza H5N1 Virus

Human H5N1 disease is clinically and pathologically distinct from seasonal human influenza virus caused by H3N2 or H1N1 viruses. An understanding of the pathogenesis of human H5N1 disease may derive from three sources: the clinical findings, virology, and pathology of human H5N1 disease; relevant animal models; and studies of cell-virus interactions in vitro or ex vivo. While viral dissemination may contribute to the unusual disease presentation, the primary pathology that contributes to death in most patients is the rapidly progressing fulminant primary viral pneumonia that often progresses to ARDS. The target cells for H5N1 replication in the respiratory tract are not fully defined, but alveolar pneumocytes and macrophages have been

identified by immunohistochemistry in autopsies, virus binding studies, and ex vivo infection of lung fragment cultures. Since both H5N1 and human H1N1 influenza viruses can replicate in the alveolar epithelium as well as the nasopharyngeal epithelium, a differential tropism of H5N1 virus within the respiratory tract is unlikely to be a key explanation for the unusual pathogenicity of H5N1 viruses. Human H5N1 disease differs from that of human influenza virus in terms of the viral load kinetics, virus dissemination beyond the respiratory tract, and induction of hypercytokinemia.

The clinical manifestations of influenza H5N1 virus including diarrhea, liver, and renal dysfunction, severe lymphopenia, and reactive hemophagocytosis suggest pathology in multiple organs. This may suggest a wider tissue tropism of the virus or may be the manifestations of multiple-organ dysfunction that is related to the systemic effects of a severe "sepsis like" syndrome. For example, it has been reported that Kupffer cell-dependent hepatitis is not uncommon in "conventional" human influenza virus in the absence of virus infection in the liver. Compared to human influenza virus, patients with H5N1 disease have detectable viral RNA in the respiratory tract for a longer period, presumably because of the lack of prior cross reactive immunity. Higher levels of viral RNA in the nasopharynx and detection of viral RNA in the serum were adverse prognostic factors. Virus has been isolated from the plasma, indicating the potential for systemic dissemination. The demonstration of H5N1 RNA in feces from patients and in limited autopsy studies, together with the prominent diarrheal presentation of some patients with H5N1 disease, suggests that the virus very likely affects the gastrointestinal tract either as part of the initial infection or through subsequent dissemination. While the limited postmortem examinations reported so far revealed no evidence of viral replication or viral pathology in organs other than lungs and intestines, more studies, especially during the acute stage of infection, are essential to confirm or exclude the possibility of infection at sites other than the respiratory and gastrointestinal tracts. While the mechanisms of pathogenesis of HPAI viruses such as H5N1 virus infection in chicken are well defined and are determined largely by the multibasic amino acids in the HA connecting peptide and the consequent broad tissue tropism of the virus, these findings cannot be directly extrapolated to mammals or to human disease. H5N1 viruses infect BALB/c mice without prior adaptation. Virulence of H5N1 viruses in mice, ferrets, felids, and viverrids is associated with virus dissemination beyond the respiratory tract to involve multiple organs including the brain. However, primates experimentally infected with H5N1 virus do not manifest virus dissemination, and pathology is restricted to the respiratory tract. Animal models differ among each other and from humans with regard to the attachment of H5N1 virus to respiratory tissues. Fluorescently labeled H5N1 viruses bound more efficiently to the alveolar epithelium than tracheal epithelium in humans, ferrets, cats, and macaques, but the reverse was true in mice. Furthermore, while H5N1 virus attached to type 2 pneumocytes in human, cat, and ferret lungs, the virus bound predominantly to type 1 pneumocytes in macaques. Therefore, while mice are a convenient animal model for some purposes (e.g., vaccine-induced protection from

virus challenge), the pathogenesis of H5N1 disease in mice probably differs from that in humans in important ways.

Laboratory Diagnosis

This section addresses issues pertaining to laboratory diagnosis of human H5N1 disease and does not cover veterinary diagnosis. In view of the non-specific nature of the illness, laboratory confirmation of H5N1 influenza virus is essential. Laboratory confirmation of a diagnosis of H5N1 disease is, however, challenging. It requires a high index of suspicion and the most sensitive detection methods available (e.g., reverse transcriptase PCR [RT-PCR]) and may require the testing of multiple specimens. The options for diagnosing influenza virus in clinical specimens include virus culture, antigen detection, detection of viral nucleic acids by RT-PCR, and detection of rising titers of antibodies. In the absence of epidemiological links to areas with H5N1 influenza virus activity, further sub-typing is not essential for routine diagnostics. However, in countries where avian influenza H5N1 virus is known to be active, patients with severe pneumonia of unexplained etiology should be investigated virologically for influenza virus and, if positive, further investigated using H5-subtype-specific assays so that appropriate therapy, infection control measures, and timely epidemiological investigations can be initiated. Therefore, there is a need for rapid diagnostic assays which distinguish influenza virus subtypes.

Clinical specimens for virus detection

Virus has been isolated and viral RNA has been detected in respiratory specimens obtained from H5N1-infected patients for up to 16 days after the onset of illness, indicating that virus is shed and can be detected for prolonged periods. Nasopharyngeal aspirates (NPA) and nasopharyngeal, throat, and nose swabs have all been used for the detection of H5N1 virus, but it remains unclear which is the diagnostic specimen of choice, because parallel studies comparing different diagnostic specimens are limited. Nasal and pharyngeal swabs have been tested in parallel during recent outbreaks in South East Asia, and this comparison suggests higher virus loads and consequent higher diagnostic yields in throat swabs than in nose swabs. NPA were successfully used for H5N1 diagnosis in Hong Kong during the H5N1 outbreak in 1997, but data directly comparing diagnostic yields from NPA and pharyngeal swabs with other respiratory specimens are lacking. An advantage of NPA is that it provides the ideal specimen for the rapid diagnosis of many other respiratory virus infections (e.g., human influenza A or B virus, adenovirus, and parainfluenza virus), which may help to exclude a diagnosis of H5N1 influenza virus, although dual infections with other respiratory viruses remain a possibility. Limited data suggest that viral load is higher in the lower respiratory tract (e.g., endotracheal aspirates) than in throat or nose swabs. Thus, endotracheal aspirates or bronchoalveolar lavages are likely to represent the optimal diagnostic specimens for the diagnosis of H5N1 disease. H5N1 virus has also been isolated and viral RNA has been detected in feces and sera in

some but not all H5N1 patients tested and in the cerebrospinal fluid of one patient. However, for screening purposes, respiratory specimens remain the first choice. In H7N7 infected patients, conjunctival swabs appeared to be the specimen of choice for virus detection. However, there appears to be a significant difference in the tropisms of H7 and H5-subtype viruses for the human conjunctiva, with conjunctivitis being a common manifestation in H7N7 infections but not in H5N1 infection. There is no systematic data on the utility (or lack thereof) of conjunctival swab specimens for the diagnosis of human H5N1 disease. Autopsy specimens are critical for confirming or excluding avian H5N1 influenza virus disease. If a full autopsy is not possible, paramortem biopsies are alternative options. Specimens should be transported on ice and tested fresh upon receipt in the laboratory. For long-term storage of specimens for virus detection or isolation, they should be frozen at 70°C, ideally in multiple aliquots. Respiratory specimens should be placed into virus transport medium. WHO guidelines for specimen collection and laboratory testing for H5N1 diagnosis are available

Virus isolation

H5N1 viruses can be isolated by inoculation of embryonated eggs or of Mardin-Darby Canine Kidney (MDCK) or other permissive cell lines. While culture of seasonal human influenza A viruses requires the addition of exogenous trypsin for growth in MDCK cells, H5N1 virus and other HPAI viruses are not dependent on exogenous trypsin supplements for growth. Virus culture still represents the "gold standard" for diagnosis, and virus isolates are essential for further genetic and antigenic characterization of avian influenza viruses. However, because of the length of time required for virus culture and the need for biosafety level 3 (BSL-3) laboratory facilities for culturing HPAI viruses, RT-PCR rather than virus isolation is usually the first diagnostic test applied to suspected clinical specimens.

Antigen detection

Detection of viral antigens in clinical specimens by direct immunofluorescence (IFA) and enzyme immunoassay (EIA) is widely used for the diagnosis of human influenza virus because of their rapidity. Presently, such testing is directed at conserved viral antigens (e.g., nucleoprotein and matrix protein) and does not differentiate human from avian influenza virus subtypes. The EIA-based methods are simple and convenient to use and could theoretically be applicable as point-of-care tests. Commercially available antigen detection EIA test kits have comparable analytical sensitivities for human and avian influenza viruses, but their overall sensitivity was 1,000-fold lower than that for virus isolation. Thus, currently, viral antigen detection tests, while having acceptable clinical sensitivity for the diagnosis of human influenza viruses, appear to have low clinical sensitivity for the diagnosis of avian influenza H5N1 virus. Aside from this apparently poor clinical sensitivity, a positive antigen test only confirms a diagnosis of influenza A virus. Thus, it would require additional subtype-specific diagnostic methods (e.g., RTPCR or culture) to differentiate avian from human influenza virus. Although H5-

subtype-specific antigen detection tests are now becoming available on an experimental basis and are undergoing evaluation for the diagnosis of diseased poultry, the current commercially available antigen detection tests seem to have limited clinical utility for the diagnosis of H5N1 disease in humans.

RT-PCR

RT-PCR assays need to be targeted at genes (e.g., matrix gene) that are relatively conserved in order to detect all influenza A viruses and, separately, at the HA or NA genes to identify specific influenza A virus subtypes. Usually, a panel of such RT-PCR assays, which includes generic influenza A virus detection plus specific detection of H5, H3, and H1 subtypes, is used to investigate suspected human H5N1 disease. This strategy helps overcome potentially false-negative PCR results due to the mutation of the HA gene because a specimen with a positive matrix gene that is negative for H5, H3, and H1 would flag that specimen for more detailed investigation. Including the time needed for viral RNA extraction and analysis of the amplification products, the turnaround time for conventional RT-PCR assays is 6 to 8 h (or typically overnight). The use of real-time PCR shortens the turnaround time to around 4 to 6 h, increases sensitivity and specificity by the use of probes, and enables the quantification of the viral target gene. Even more importantly, because these are closed systems, the risk of PCR cross-contamination is minimized. The existence of several distinct sub lineages and the high mutability of H5N1 viruses pose a challenge for molecular diagnostics and necessitate continued evaluation, and possibly the modification of primers or probes, over time. Alternative molecular detection methods such as loop-mediated isothermal amplification tests have also been used, although they are not in routine use.

Antibody detection

The detection of H5N1-specific antibodies is essential for epidemiological investigations. Because of the delayed sero-conversion and the need for paired sera, serology can provide retrospective confirmation of H5N1 infection. While HI is the preferred method for the detection of subtype-specific antibodies to human seasonal influenza viruses in human sera, conventional HI tests (using avian or human erythrocytes) have limited value for detecting antibodies against avian viruses in humans and other mammals because of low sensitivity. Comparison of HI antibody tests with detection of neutralizing antibodies in H5N1-infected persons from the 1997 Hong Kong outbreak showed the latter to be more sensitive. Based on these observations, neutralization assays have become the methods of choice for the detection of H5-specific antibodies in humans. Using these assays, antibodies against H5N1 virus were generally detected 14 or more days after the onset of symptoms in patients infected during the 1997 Hong Kong outbreak. This is comparable to kinetics of the antibody response during primary infection with human influenza viruses. While neutralization assays seem to be the most reliable methods for the detection of human antibodies to avian viruses, the requirement of BSL-3 laboratory facilities and the labor-intensiveness are important disadvantages. HI assays using horse erythrocytes have shown promising results for detecting antibodies against H5N1 viruses in humans and may provide a convenient alternative to neutralization tests and serve as a confirmatory test of a

positive neutralization test result. Lentivirus pseudotyped with H5 HA may provide an alternative option for the sero-diagnosis of H5N1 infection in mammals.

CONCLUSION

The rationale for particular concern about an H5N1 pandemic is not its inevitability but possible severe impact on human health. Such a pandemic, especially if it arises by direct adaptation rather than genetic reassortment with a preexisting human virus, could well be unusually virulent in humans. Thus, an H5N1 pandemic is an event of low probability but one of high human health impact. What is certain, however, is that the H5N1 panzootic already impacts human health via its economic and consequent nutritional impacts on rural societies and by occasional zoonotic transmission, leading to severe human disease with its attendant social impact. It is just as bad to die of protein malnutrition (because of the depletion of a major protein source for many people) as it is to die of zoonotic "bird flu." Given the increasing geographical spread and the endemicity of H5N1 viruses in poultry across the world, and its possible (yet-to-be-proven) foothold within wild bird populations, H5N1 is likely to remain a serious threat to human health for quite some time to come. Clearly, there is every reason to attempt to control the current panzootic in poultry. If not, the attendant pandemic threat from H5N1 will continue to pose a predicament for public health.

Role of Artificial Intelligence in veterinary medicine

Himalaya Bhardwaj[1]*, Tajeshwer Preet Kaur[2], Raunak Bhardwaj[3] and Vineet Ahlawat[4]

[1]Department of Veterinary physiology and Biochemistry, GADVASU, Ludhiana, Punjab.
[2]College of Animal Biotechnology, GADVASU, Ludhiana, Punjab.
[3] Remount and Veterinary Corps, India.
[4]LUVAS, Hisar, Haryana.
*Corresponding Author: himalaya530@gmail.com

ABSTRACT

In 21st century, world is experiencing the fourth industrial revolution which is the result of the growth in highly complex and intelligent technologies like Artificial Intelligence, Machine Learning, Deep Learning, and Robotics. India has actively demonstrated its willingness to emerge as a leader in the fourth industrial revolution. For this purpose, every sector of economy needs to be aligned with the technology of the day. In our veterinary field, it has immense importance which helps physicians in recording their case histories and reference cases. Medical kiosks have helped in frequent consultation. Moreover, improvement in accuracy and speed in lab diagnosis have contributed to early diagnosis and treatment of the patients. As the major population of the country is dependent on the agriculture which is the domain of rural areas, AI has contributed in telemedicine where farmer can have access to the doctor while being in remote areas. It is the demand of the day that we as the contributors to the veterinary field, learn and use the technology for the welfare of people and the growth of the nation.

INTRODUCTION

Artificial Intelligence (AI) refers to the development of machine technology where it can simulate the intelligence of humans. They are programmed to an extent where they can think like humans and imitate their actions. We might think that it is a newly emerging technology in the 21st century. Yes, it is, but, it has been in development since the year 1956 when an eminent scientist John McCarthy coined the term in his first academic conference of the subject.

The term rightly depicts the technology as machines are becoming intelligent day by day. Further, it has made its presence felt in various fields of technology like the computer sciences, education, marketing, medicine, manufacturing, and more. We can not deny the fact that in the upcoming decades, AI would penetrate into every sector. And, veterinary medicine is no exception. Interestingly, it has transformed the field of

human medicine by accurately diagnosing the diseases and helping doctors to act early. It has also helped scientists and researchers to develop medicines in a shorter period of time by reducing the time for trials. Let us look at the various dimension where this technology can help the veterinary doctors and researchers to perform efficiently.

AI can help veterinarians code their notes

When the patient visits the veterinary physician, they make their notes on the paper sheets. There is no widespread infrastructure to appropriately put down the electronic records of visits. Moreover, the hand made notes are only helpful for the specific visit but have their limitations in sharing and for further references in the future.

This has been adopted in human medicine and has led to easiness in referring to specific cases by the doctor and can also be shared with researchers for studying the various aspects of the disease. With the lack of infrastructure at the clinics, millions of precious health records are wasted over time. Simply put, organized electronic records with the help of AI can also have desirable effects on human public health as we have seen in the times of COVID-19. Therefore, proper records of veterinary cases can positively affect the "One Health" of the world.

Medical imaging processing and assessment

It refers to the rapid, yet sensitive and accurate interpretation of radiographs, MRI, CT scans, and ultrasound images right the way through to cytology assessment. As computer processing power, affordability, and speed go on increasing exponentially, we won't have to wait longer when the standard clinical experimentation carried out in practice in laboratories, would be delegated to the AI. For instance, examining a urine sample for the presence of potential crystals and urinary infection with the increase in machine vision reference directories. It would supply an accurate and rapid date after examination of the sample ensuring consistency, which might be lacking now due to variability in the experience and skill levels of the veterinarians.

First line primary consultation

Smart Kiosks have been developed in human medicine that not only cut down the long lines, which is a source of frustration of patients and stress for the physicians. These kiosks collect the patient's history and symptoms by guiding the patients through AI-assisted video themselves to fill the information. Afterwards, the information and symptoms are forwarded to the physician, who through a video call counsels the patient and changes the treatment according to the symptoms. The AI-assisted system helps keep the accurate record of patient's history for further consultations and doctor's references. This model should be adopted in the veterinary field also for keeping proper records of zoonotic and other diseases.

Telemedicine and hidden Diseases

AI can be of much help in the development of telemedicine where a physician can consult an expert present somewhere else and give proper treatment to the patient.

This field is essential to make the veterinary accessible, affordable, and available to all even in the remotest of areas.

Some diseases like Addison's disease or leptospirosis are a cause of concern for doctors as their symptoms coincide with others and cannot be diagnosed properly. AI-driven software, which has been fed with the history and symptoms of thousands of patients, can help in formulating an algorithm to detect these diseases at early stages and make their prognosis favourable.

CONCLUSION

To conclude, some people fear that AI automation would lead to the loss of jobs for doctors and the other veterinary staff. But, the truth is that the empowerment of the veterinary medicine field with the help of AI will lead to accurate and proper diagnosis and enhance the abilities of the doctors. On the contrary, the only issues are that the doctors will need to upgrade them and learn new technologies. AI is of very much help in keeping farm management records related to milking, estrous, and breeding of the animals. This will help in the reduction of costs and efforts would enhance the incomes of the farms. AI is the ultimate need of the time and physicians and staff should be trained to use the technology efficiently.

Application of Nanotechnology in sustainable agriculture and its current status

M. K. Prajapati[*1] and K. Shankar[2]

*[*1]Department of Plant Pathology, GBPUAT College of Agriculture, Pantnagar, Udham Singh Nagar Uttarakhand--263145, INDIA, Email: buat2552013@gmail.com*
[2]Department of Fruit Science, College of Horticulture and Forestry, Central Agricultural University, Pasighat -791102, Arunachal Pradesh, Email: rawkripa.s99@gmail.com
**Corresponding author: buat2552013@gmail.com.*

ABSTRACT

In the era of climate change, global agricultural systems are facing numerous, unprecedented challenges. In order to achieve food security, advanced nanotechnology is a versatile and multipurpose tool for boosting crop production and assuring sustainability. Nanotechnology helps to improve agricultural production by increasing the efficiency of inputs and minimizing relevant losses. Nanomaterials offer a wider specific surface area to fertilizers and pesticides. In addition, nanomaterials as unique carriers of agrochemicals which facilitate the site-targeted and site-specific controlled delivery of nutrients, fertilizers, pesticides, herbicides and insecticides at exact site and location with increased crop protection. Nano-tools and devices such as nanobiosensors, nanosensor which support the development of high-tech agricultural farms. Nano-DNA crystals based process provides delivery of macromolecules, recycling of agricultural waste, biosensor, silkworm industry and honey bee culture etc. The integration of biotechnology and nanotechnology into nanosensors has greatly increased and improved their potential to sense and identify the environmental conditions or impairments and detection of plant diseases. Thus recent attempts at innovative approach of nanotechnologies in agriculture that may help to meet the rising demand for food and environmental sustainability.

Keywords: Nanotechnology, sustainability, agrochemicals, nanosensor and biotechnology

INTRODUCTION

Nature is unique phenomenon where human population is the most important part among different biological communities. To fulfill the basic needs of human including food, shelter, clothing and medicines etc. agriculture is the main resource in

the nature which allows us to obtain food. At present scenario, the huge exploitation of natural resourses by the human beings in agriculture field and widespread adoption of genetically improved new varieties, chemical fertilizers, pesticides, intensive irrigation, optimum agronomic conditions and modern machinery all these processes obviously eliminate original genotype from the nature and erosion of biodiversity. Currently, agricultural production faces the many challenges for enhancing crop productivity and providing nutritionally adequate diets for the increasing population, under uncertain climatic extremes, water scarcity, in limited (and degraded at many places) land area, and mostly with poor quality water and air, associated with rapid changes in natural biodiversity.

Nanotechnology is a growing, exciting, emerging and promising field of interdisciplinary research, applied in various fields of science and technology. It is the design, characterization, production and application of structures, devices and systems by controlling shape and size at nanometer scale level. This technique opens up new avenue of opportunities in different sectors including medicine, pharmaceuticals, electronics and agriculture. Some of the potential
applications of nanotechnology in sustainable development of agriculture especially with respect to food safety, processing, product development and productivity improvement mainly focused on nanoparticles potential in insect pest management associated in agricultural sector and also their role in improvement of silk and honey production. The formulations of nanomaterials-based pesticides and insecticides, using bio-conjugated nanoparticles (encapsulation) especially for slow and controlled release of nutrients, water, stabilization of bio-pesticides, slow release of nanomaterial assisted fertilizers, bio-fertilizers and micronutrients for efficient use in addition to field applications of agrochemicals. Recent advancements in tissue engineering and engineered nanomaterials-based targeted delivery of CRISPR (clustered regularly interspaced short palindromic repeats)/Cas (CRISPR-associated protein) mRNA, and sgRNA for the genetic modification (GM) of crops is a noteworthy scientific achievement. Nanoparticle-mediated gene or DNA transfer in plants for the development of insect pest-resistant varieties and for preparation of varieties of biosensors for precision farming and enhancing the agricultural productivity. The overall goal of this imaging Nanotechnology is to reduce the number of unnecessary problems in agriculture arising during crop production.

Meaning of nanotechnology?

The father of Nanotechnology, a physicist, Richard Feynman. In fact, the word “Nano” is developed from the Greek word meaning “dwarf”. The term ‘nanotechnology’ was first coined by Norio Taniguichi, a professor at Tokyo University of Science, in 1974. In more technical terms, the word “nano” means 10^{-9}, or one billionth of meter (for example, a virus is roughly 100 nm in size). Naturally, the word nanotechnology evolved due to use of nanometer size particles (size of 1 to 100 nm). This scale helps to denote that a strand of DNA size is 2.5 nm wide, a red blood cell is 7000 nm, while human hair is about 80,000 nm wide (K, Lyons. 2010).

Potential application of nanotechnology in agriculture:

Nanotechnology can be applied either theoretically or practically in different sectors of agricultural sciences. The effective use of nanotechnology in agriculture sector could be multi-directional. Using this technology, it can be used in:

(1): Soil improvement: There are different types of nanomaterials regarding the soil health improvement i.e. zeolites and nanoclays. The nanoporous zeolites have the capacity of water retention and slow-release of water and fertilizers in soil for plants to maintain the efficient dosage, and also helps to supply proper nutrients to the agricultural plants It is also reported that especially porous hollow silica based, clay-polyester, plastic starch coated or cemented are also essential for soil conservation.

(2): Crop production: It includes nano-based formulation of fertilizers, biofertilizers for enhancing nutrient absorption by plants, balanced nutrient supply, to stimulate crop growth, quality improvement, and reduction of cost of production results in enhanced crop yield. Different forms of nanomaterials such as nanocapsules, nanoparticles and nanoemulsion are also used for in enhancing the crop productivity.

(3): Crop protection: Specifically, application of Nanoparticles/nanomaterials technology in plant pathology which targets specific agricultural problems in plant–pathogen interactions and provide new ways for crop protection. It includes the use of nanofungicides, nanoherbicides, nanoinsecticides and nanobiopesticides as a nanocides used for management of plant diseases and insects pests. **Eg.** Silver nanoparticles are broad spectrum antifungal and antibacterial agents have role in agricultural crop protection where these particles also regulate proper nutrition to plants. Besides these some other advantages such as higher efficiency, easy handling development of plant-based resistance, regulation of migration of chemicals to the environments biodegradability and precision farming.

(3): Precision farming: Using the nanosensors/biosensor to detect the plant pathogens and pesticides detection and for monitoring the soil conditions.

(4): Crop improvement: Nanomaterials assisted plant genetic modifications through nanobiotechnology. It can be improved by target genetic engineering, biomedical delivery, nucleic acid (DNA, RNA) delivery, monitoring physiological responses and environmental sensing results in sustainable agriculture. Besides these, nanomaterials regulate plant growth by means of synthesis of phytoharmones, heavy metal uptake, adaptation to progressive climate change (salt, drought stress), stress gene expression and ROS accumulation that results in sustainable environment.

Use of Nano-DNA Crystals:

Bio-security is one of the important factors for preservation of agricultural food and, a major concern is that of the safety of the food products. As food contains huge bacteria and viruses, which frequently ends in illness and sometimes fatality of the humankind (Li and Xia, 2004 and Lang, 2013). Metal nanoparticles, posses unique properties viz., optical, electrical, thermal and catalytic (Xu et al. 2009) hence have the

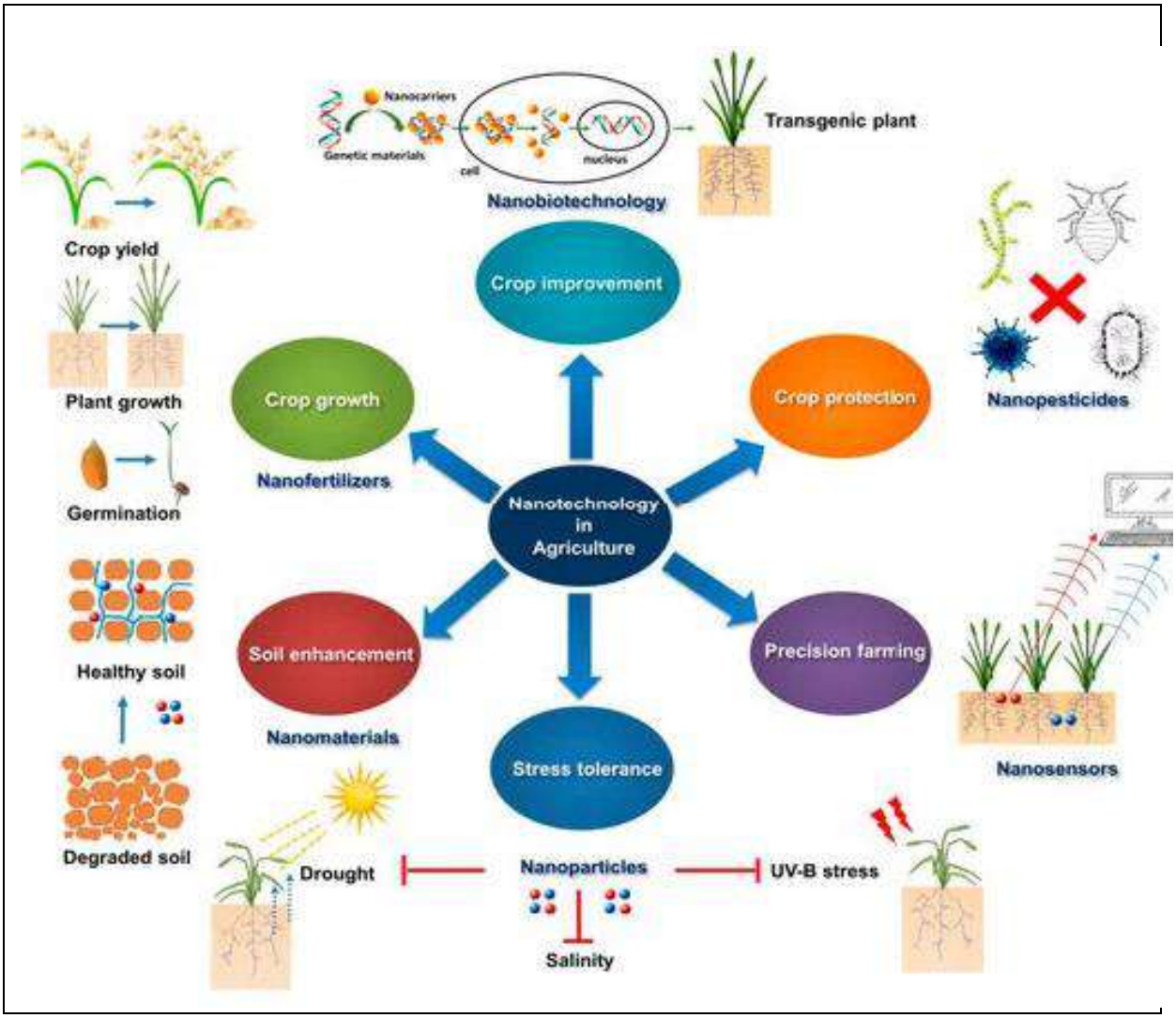
ability to interact with chemical and biological processes. This could be exploited to develop selective biomarkers or biosensor. A biosensor is composed of a biological component, such as a cell, enzyme or antibody, linked to a tiny transducer. The biosensor reacts with biological component and the reaction mediated electrical changes were proportional to the quantity the agriculture food substance which was transferred to a transducer to produce a signal. Therefore, biosensors detect changes in cells or at molecules level those are then used to measure and identify the test substance, even it is in a very low concentration. In fact, several nanoparticle based DNA biosensors were developed which could be effectively used in agricultural host disease control.

In development of DNA biosensor using gold as metal counter-part, thiol–Au (SH–Au) linkages play significant role to bind Au nanoparticles covalently with DNA due to the strong affinity of covalent bonding between sulfur atoms and gold atoms. Xu et al. reported that gold based biosensor can bind with single stranded DNA (ssDNA) greatly, and the surface coverage value of DNA molecules decreased as the size of the gold nanoparticles increased (Xu, et al. 2009). In order to reduce the cost of the biosensor and improve application spectra by reducing the production cost, silicon (Si) and sapphire (Al_2O_3) were evaluated to prepare a DNA
biosensor. The use of zirconia (ZrO_2) in development of biosensor could be advantageous as this is a heat stable, chemically inert, non- toxic and inorganic oxides possess affinity with oxygen. These properties of zirconia make it as an ideal material for immobilization of biomolecules containing oxygen or phosphate groups. Moreover, the carbon nanotubes can bind with the DNA due to its high catalytic activity and this attachment is possible as the DNA-end can share the covalent linkage with the carbon nanotubes (CNTs) surface.

In the recent period, the most interesting development in agriculture sector is the synthesis of nano-DNA crystals. The synthetic DNA sequences that can self-assemble into a series of three-dimensional triangle-like patterns have“sticky-ends” or small cohesive sequences that can attach to another molecule in an organized fashion. When multiple helices are attached through single-stranded sticky ends, there would be a lattice-like structure that extends in six different directions, forming a three-dimensional crystal. This technique could be applied in improving product yields in important crops like, tobacco and corn plants harvest in agricultural
Fields.

Nanoparticles can serve as ‘magic bullets’, containing herbicides, chemicals, or genes, which target particular plant parts to release their content. Nano - capsules can enable effective penetration of herbicides through cuticles and tissues, allowing slow and constant release of the embedded substances. Chemists at the Iowa State University have utilized a 3-nm mesoporous silica nanoparticle (MSN) in delivering DNA and chemicals into isolated plant cells. Mesoporous silica nanoparticles are chemically coated and used as containers for the genes delivery into the plants. The coating triggers the plant to take the particles through the cell walls, where the genes are

inserted and activated in a precise and controlled manner, without any toxic side or after effects. This technique has been applied to introduce DNA successfully to tobacco and corn plants.



(**Source:** https://www.mdpi.com/1420-3049/24/14/2558/htm**).**

DIFFERENT METHODS OF NANOPARTICLES BASED GENE DELIVERY SYSTEM:

1. Nanoparticles mediated nonviral gene delivery:

Gene delivery systems are an important area in the field of genetic nanomedicine. Gene delivery involves the transport of genes, which requires a transport vehicle referred to as a vector. Possible vectors include viral "shells" or lipid spheres (Liposomes), which have properties that allow them to be incorporated into host cells.

2. Polymer based gene transfer:

Non-viral gene medicines have emerged as a potentially safe and effective gene therapy method for the treatment of a wide variety of acquired and genetic diseases. An important advantage of polymer-based gene delivery systems over viral transfection systems is that transient gene expression without the safety concerns can be achieved. In addition to the polymeric systems to deliver DNA, therapeutic ultrasound is potentially useful because ultrasound energy can be transmitted through the body

without damaging tissues and could be applied on a restricted area where the desired DNA is to be expressed.

3. Liposome gene transfer:

The liposome-based gene transfer strategy is one of the most powerful nonviral gene delivery strategies. Liposomes may offer several advantages as vectors for gene delivery into plant cells i.e. enhanced delivery of encapsulated DNA by membrane fusion, protection of nucleic acids from nuclease activity, targeting to specific cells, delivery into a variety of cell types besides protoplasts by entry through plasmodesmata. Liposome based gene therapy have no effect of toxic potential in humans and plants.

4. Biobeads gene transfer:

Micrometer-sized calcium alginate beads referred to as "bio-beads" that encapsulate plasmid DNA molecules carrying a reporter gene and provide efficient transformation process in plant cells due to high sensitivity and fast response time. Drug delivery systems with Liposomes and Nanoparticles have become very popular in nanotechnology. Sometimes these particles may also cause to microbial degradation

Nanotechnology used in recycling of agricultural waste

Another application of nanotechnology for recycling of agricultural waste. Generally cotton residues material is best for preparation of nanofibres. It is the richest source of cellulose (90%) and biodegradable in nature. Nanofibers can be produced using electro spinning technique to spin cellulose using high voltage electrical current to draw very fine (typically on the micro or nano scale) fibers from a liquid. The body of the liquid becomes charged, and electrostatic repulsion counteracts on the surface tension. At this moment, the droplets are stretched at a critical point where a stream of liquid erupts through the surface as cone and forms a charged liquid jet. The elongation and thinning of the fiber resulting from this bending instability leads to the formation of uniform fibers with nanometer-scale diameters. Moreover, the ultra-fine fibers produced by electro spinning are expected to have two main properties, a very high surface to volume ratio, and a relatively defect free structure at the molecular level and make them suitable for activities requiring a high degree of physical contact, such as providing sites for chemical reactions, or the capture of small sized particulate material by physical entanglement – filtration. Thus electro spinning helps in scrapping the cotton seeds to produce cotton balls, yarn, and cotton batting. The nanofiber embedded chemicals would be then release the fertilizers or pesticides at a specific time and considered as targeted application (Lang, 2003 and Lance, 2005). An effective utilization of this nanofiber based controlled release of fertilizers or pesticides could be at biomass to bio-fuel.

Devices and different forms of Nanoparticles and its application:

Nanoparticles exist many forms like, ultrafine, aggregates, and agglomerates, surface related nano, carbon nanotubes, nanosilver, nanogold, nanosilicon, nanocopper,

nanozinc oxide and nanotitium oxide etc. The mentioned nanoparticles are being used in different sub-sectors of agriculture.

Nanosensors:

To improve and protect the agricultural production, it is necessary to detect the pathogens in the early stage of the host plant in agriculture system as indicated previously. This type of detection is possible through a micro biosensor process. The biosensor is an analytical device with their characteristics features is that small, portable, rapid in response and real-time processing, specific, quantitative, reliable, accurate, reproducible, robust and stable that uses a biological recognition system to detect the pathogens in the host, if any. It poses a physiochemical transducer that helps to isolate the infected parts of the plants. The developed biosensor system is an ideal tool/ device for online monitoring of organophosphate pesticides and nerve agents. Bioanalytical Nanosensors are utilized to detect and quantify minute amounts of contaminants like viruses bacteria, toxins bio-hazardous substances etc. in agriculture and food systems. These biosensors basically generate signals depending on the concentration level of pathogen presence i.e. large amount of bacteria infected in a particular food, the nano-biosensor will produce a strong signal indicating that the food is unsafe to eat. However, biosensor methods are currently being developed as screening tools for use in field analysis in case of detection of diseases.

Role of silicon (Si-NPs) in agriculture:

The unique physiochemical properties of nanoscale silicon particles allow them to cope with agricultural damage that may occur through climate change and/or abiotic stress and may also lead to global food security by helping in the development of improved varieties with high productivity. Si-NPs were observed to be applied as a weapon against heavy metal toxicity, UVB stress, salinity stress and dehydration etc. Moreover, additional novel applications of Si-NPs include their use as fertilizers, pesticides, fungicides, and herbicides. In the present scenario,
where the focus is to increase crop productivity or to eradicate weeds, Si-NPs may act as an agent for target-specific delivery of herbicides and fertilizers Silicon nanocarriers have been observed to carry herbicides (chloroacetanilide, anilide, and benzimidazole) embedded in a diatom fistule and deliver the herbicide to the field in its active form and in the case of fertilizer delivery, the application of nano-silicon dioxide with organic fertilizer was used to improve plant productivity and mesoporous silica nanoparticles (MSNs) with a specific pore size (2–10 nm) served as an efficient delivery vector for urea-, boron-, and nitrogenous-based fertilizers. (Janmohammadi et al. 2016). Therefore, Si-NPs have the potential to improve crops for sustainable agriculture. Mesoporous Silica Nanoparticles (MSN) can serve as 'magic bullets', containing herbicides, chemicals, or genes, which target particular plant parts to release their content. The main features of mesoporous materials is the high surface area, pore volume and the highly ordered pore network which is very homogeneous in size. Mesoporous silica Nanoparticles (MSN) helps in delivering DNA and chemicals into

isolated plant cells. MSNs are chemically coated and serve as containers for the genes delivered into the plants. The coating triggers the plant to take the particles through the cell walls.

Si-NPs embraces the promise of controlled and regulated release of agrochemicals and site-targeted delivery of various macromolecules, such as proteins, nucleotides, and chemicals, for improved plant resistance and nutrient efficiency, as well as increased crop yields (Nair et al. 2010). Si-NPs act as a one of the most crucial component of nanozeolite for the purpose of increasing water holding capacity of soils, improved soil quality controlling nutrient and water reserves and improve soil quality is vital for increasing crop productivity (Lal, 2015). Soil is the most essential factor that regulates plant growth by controlling nutrient and slow release of water reserves (Ghaemi et al. 2014). Natural zeolites are an important alternative to overcome the effects of drought in arid regions (Ghanbari and Ariafar, 2013). Thus, the observed results clearly showed the ability of Si-NPs to enhance the water holding capacity and, therefore, improve soil quality.

Honey bee culturing

To improve the semiconductor nanoparticles on honey bee, as it is the most important field to produce different drugs through honey. The biogenic magnetic properties of the honeybee- *Apis dorsata Fabricius* were investigated to understand the bee's physiological response to magnetic fields at the time of pollination. The study clearly denoted that the Indian rock bee *Apis dorsata Fabricius* possess calcium – silicate nanoparticles (5-50 nm size) on their surface which has been incorrigible with the help of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Atomic Force Microscopy (AFM) (Bhattacharya et al, 2012). Data on these semiconductor nanoparticles suggested that these may be responsible for visiting specific plant species by stimulating their physiological system. The role of these natural nano particles of the honey bees may open up some important clues for conserving the unique pollinators

Use of nanoparticles in silkworm industry

The imperative role of mesoporous nanoparticles in silkworm (*Bombyx mori* L.) physiology exposed that mesoporous (2.5 nm) particles positively regulate the silk production resulting in the production of good quality of green cocoon, increased shell weight and silk ratio percentage (SR%). The best results with regard to cocoon weight, shell weight and silk ratio when treated with silica mesoporous nanoparticles loaded with curcumin allelochemicals and silica mesoporous nano alone than that of control (Meinwald and Eisner, 2008).

Role of Silver (Ag) Nanoparticles in agriculture:

Nanosilver is used in agriculture to a wide extent because of its specific properties. A number of studies are conducted on the reaction of plants after their contact with nanosilver obtained by chemical reduction (Oukarroum et al, 2013). Nanomolecular silver solution reduced the incidence of root diseases and demonstrates

that the use of a colloidal nanosilver solution may considerably improve the growth and health of various plants.

Application of green nanotechnology and its sources and synthesis of green Nanoparticles.

The rapid advancement and application of nanomaterials in nanotechonology to enhance the productivity of crops in a various aspects have also been emerging a risk with respect to environmental, health, occupational and socio economic aspects. It is very important that the size of nanomaterials like other tiny particles might be able to enter the human body and those of other species imperceptibly through various pathways such as inhalation, ingestion, dermal contact, etc. Early reports also indicated that nanoparticles could reach various parts of the body where they may exert adverse effects. Nanoparticles, as it is believed might be able to disrupt cellular, enzymatic and other organ related functions posing health hazards. On the other hand
nanoparticles also non-biodegradable and disposal in the nature cause environmental problems and risks. To overcome it, in present scenario, one can recommend in providing good quality of food based agricultural product through the application of green nanotechnology rather than introduction of chemically synthesize nano materials has open new avenue in modern agriculture.

CONCLUSION AND FUTURE PERSPECTIVES

Nanotechnology is a promising area of interdisciplinary research that opens avenues in several fields, such as medicine, pharmaceuticals, electronics, and agriculture. The potentiality of Si-NPs in agriculture including nanoparticles as pesticides, fertilizers, herbicides, genetic and drug transfer agents, soil improving agents, and sensors for soil analysis. Studies show that Si-NPs have the potential to revolutionize the existing technology used in various sectors, such as agriculture and plant biotechnology. Silicon nanoparticle-mediated targeting of biomolecules would be useful for developing new cultivars that are resistant to various biotic and abiotic factors. These nanoparticles can provide green and eco-friendly alternatives to various chemical fertilizers without harming nature. Further developments in nanotechnology in this sector can
be expected to become the main economic driving forces in the long run and benefit consumers, producers, farmers, ecosystems, and the general society at large. The positive side of it is that the proposed technology will be boom and gloom to maintain the eco- factors of the agricultural field and the society in future however needs a design of effective regulatory mechanisms and strong governance system from authorities with involvement of all stakeholders.

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Impact of COVID-19 on Agriculture: Problems, Challenges and Strategies

[1]Soma Biswas[*], [2]Souradeep Chatterjee and [3]Dulal Chandra Roy

[1,]Assistant Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia,W.B. [2]Research Scholar, Department of Agricultural Extension, B.C.K.V., Mohanpur, Nadia, Pin-741252*
[3]Assistant Professor, West Bengal University of Animal Science & Fisheries, Nadia, Pin-741252

**Corresponding author; biswas.soma@bckv.edu.in*

ABSTRACT

The impact of COVID-19 on Indian Economy is devastating. There are increasing uncertainties of agricultural and food security programs. Now its impact can be seen throughout the agriculture sector as the lockdown imposed across nationwide to combat and contain spread of the virus. Labour unavailability and market access are two major problems. The Covid-19 pandemic has great negative impact on global agriculture as well as Indian agriculture in different issues and aspects. Government has undertaken some steps at the time of commencement of lockdown and announced packages to compensate the loss in different sector related agriculture and allied. Despite of all these measures taken during last few months the agriculture sector of the country will continue to face some formidable challenges. Policymakers need to take different mitigate strategies to face the challenges and overcome the problems. The need of the hour is to maximise possibilities of agriculture, which has a great potential to face the challenges of Covid-19 pandemic in future.

Key words : Agriculture, Challenges, COVID-19, Packages, strategies

Corona virus is serious threats to the worldwide all developmental activities of human being . The virus has potential negative impacts to the human health and ultimately adverse effect on food security, livelihood security, economic activities, and physical infrastructures. The impact of COVID-19 on Indian Economy is devastating. There are increasing uncertainties of agricultural and food security programs. Now its impact can be seen throughout the agriculture sector as the lockdown imposed across nationwide to combat and contain spread of the virus. But the impact on agriculture is quite less as compared to other sectors. “The country's farm sector is functioning smoothly despite COVID-19 lockdown and there will not be much impact on its growth in the current fiscal unlike other sectors”, Agriculture Minister Narendra Singh Tomar said on 29th

April, 2020. Agriculture GDP was at 3.7 per cent last year. Farm sector growth is estimated to be 3 per cent in the 2020-21 fiscal despite prevailing adverse circumstances. The problems in agriculture at the moment are primarily related to (a) labour availability and, (b) inability to access markets for produce due to issues in transportation as well operation of markets. . Its impact on agriculture is complex and varied across diverse segments that form the agricultural value chain. Even among the different segments, its impact varies widely among different regions and among producers and agricultural wage labourers. This impact will reverberate across the larger economy and will linger longer than a few months. The most important issue that farmers have to surmount is the problem of repaying their crop loans and gold loans at least for those who have borrowed from the formal banking sector. Crop loans are repaid between April and May and a fresh loan is granted at the onset of a new season. Recent price collapse means that farmers are staring at huge losses and most of them are already highly indebted and hence unlikely to have the means to repay their loans. They will have to be forced to borrow money from the informal sector at high rates of interest for the new season .The immediate problems in agriculture at the moment are primarily categorized under two heads:

A. Impact on Global Agriculture

Seeds availability and Crop cultivation **:** For crop production, the largest part of the seeding process has been almost unaffected during the onset of pandemic. So there would be no impact as such on seeds availability initially. But if the same scenario continues till year end, then surely seed availability can be an issue.

Fertilizers shortage: Due to global trade disturbance, farmers are facing the shortage of agricultural inputs like fertilizer and pesticides**.** In a shorter span, there is little shortage to be expected. In the longer term, the delivery of fertilizer via international markets may become a problem.

On food production and distribution: Most of the countries have taken measures such as home confinement, travel bans and business closure to control the rate of infection. Agriculture produce is mostly perishable in nature, so farmers are compelled to hold their unsold produce for a longer period of time. This has led to a reduction in food quality as well as an increase in the cost of production.

On livestock: Different agricultural and allied sectors such as livestock and fishery have been hit hard by the pandemic. In India, COVID-19 has caused a higher impact on livestock farming due to limited access to animal feed and a shortage of labour. For example, the travel ban has affected the delivery of breeding stock of poultry.

*On workers***:** Agricultural workers in low and middle-income countries lack proper health services and social protection and due to little saving or no saving. Many informal workers in agriculture are obligate to work for their sustenance despite the self-isolation protocol during COVID-19 pandemic.

*Impact on food demand and food security***:** The demand for food has affected due to reduction in income and purchasing capacity. Panicked Consumers are stock piling the foods which in turn has affected the food availability and price. Due to the decline in

international trade, disturbance in food supply chain and food production, food insecurity may arise.

B. Impact on India : Agriculture contributes about 17 per cent to Indian GDP. Agriculture, with its allied sectors, is the largest source of livelihoods in India. 70 percent of rural households still depend primarily on agriculture for their livelihood.

*Peak harvest with no procurement***:** When the pandemic started This is the peak of Rabi season in India and crops like wheat, gram, lentil, mustard, etc. (including paddy in irrigated tracts) were at a harvestable stage or almost reaching maturity. This is also the time when the farm harvests reach the mandis for assured procurement operations by designated government agencies.

*Labour unavailability due to reverse migration***:** The non-availability of labour has hurt operations in many parts. Consequently, the shortage of migrant labour has resulted in a sharp increase in daily wages for harvesting crops. Some parts of agriculture that have the luxury of deploying technology for harvestings, like Paddy and Wheat, are relatively more insulated since they often do not have to depend on large numbers of manual labour.

*Fall in prices***:** Agricultural prices have collapsed due to lack of market access including the stoppage of transportation and closure of borders. The rise in labour costs and lack of access means that farmers are staring at huge losses and hence allowing crops to rot in the fields, a better 'stop-loss' mechanism.

*Scarcity of public goods***:** Making the food grains, fruits and vegetables and other essential items available to consumers, both in rural and urban areas, is the most critical challenge. Transportation of public distribution system (PDS) items to last-mile delivery agents, by both rail and road, has been severely impacted in the beginning.

*Restrictions on Sale***:** There were self-imposed restrictions on the inter- and intra-state movements of farmers/labourers, as well as harvesting and related farm machines.

*Disruptions in supply-chain***:** The absence of transport facilities clubbed with vigilant blocking roads has a limiting effect on the movement of migratory harvest labour and agri-machinery. Also, trucks and tractors are not inclusive of 'farm machinery' by definition..

*Lockdown induced debt and Cash Flow Constraints***:** The most important issue that farmers have to surmount is the problem of repaying their crop loans, gold loans and other informal debts. Crop loans are repaid between April and May and a fresh loan is granted at the onset of a new season. Any failure to do so will mean that they will be forced to borrow money from the informal sector at high rates of interest for the new season.

Government Initiative: Following are some steps undertaken at the time of commencement of lockdown:

1. To ease the lockdown selectively for rural areas to allow harvesting of Rabi crops.
2. Indian Council of Agricultural Research (ICAR) has also issued an agro-advisory to maintain hygiene and social distancing among farmers working on their fields.

3. The Government of India has announced that the first instalment of the PM-Kisan Yojana payment to farmers, i.e., Rs. 2,000 will be paid up front to farmers, benefitting over 8.7 crore Indian farmers. It has also announced that the wages under MGNREGS will be raised from Rs. 182 to Rs. 202 per day.
4. The Reserve Bank of India (RBI) has announced a moratorium on agricultural term loans (including crop loans) for a period of three months.
5. The Indian Railways has been roped in to ease transport logistics of agricultural produce.
6. Allowing critical agricultural activity, filling in gaps in agricultural supply chains and ensuring farmer's ease is imperative for the smooth functioning of the backbone of our economy.

Union Finance minister Nirmala Sitharaman on 15th May,2020 announced a Rs 1.63 lakh crore package for agriculture and allied sectors aimed at strengthening infrastructure, logistics and capacity building at farm gate. Here is the list of all key measures announced by the finance ministry as part of Aatma Nirbhar Bharat Special Package with regard to agriculture.

1. Government to amend Essential Commodities Act to enable better price realisation for farmers which will result in the deregulation of prices for foodstuffs including cereals, edible oils, oilseeds, pulses, onions and potato. The minister said the amendment would help in attracting investments and making agriculture sector competitive. Stock limits- a feature of the old act-- to be imposed under very exceptional circumstances like during national calamities like famine that see a surge in prices.
2. A Central law will be formulated to provide adequate choices to farmer to sell produce at an attractive price and for barrier-free interstate trade. It will also set up the framework for e-trading of agriculture produce. The move is aim to end fragmentation of markets available to farmers who are currently forced to sell only to licensed APMC marketers.
3. Rs 1 lakh crore Agri Infrastructure Fund for farm-gate infrastructure for farmers for projects at farm-gate & aggregation points-- primary agricultural cooperative societies, farmers producer organisations, agriculture entrepreneurs, startups, etc.
4. Rs 20,000 crore for fishermen through Pradhan Mantri Matsya Sampada Yojana (PMMSY) for integrated, sustainable, inclusive development of marine and inland fisheries and to fill critical gaps in the fisheries value chain. Out of this, Rs 11,000 crore will be allocated for activities in marine, inland fisheries and aquaculture and Rs. 9000 Cr for infrastructure including fishing harbours, cold chain, markets etc. It is expected to lead to additional fish production of 70 lakh tonnes over 5 years and employment to over 55 lakh persons apart from double exports to Rs 1,00,000 crore.
5. Rs. 13,343 crores for National Animal Disease Control Programme for foot and mouth disease (FMD) and brucellosis launched. It will help in 100% vaccination of cattle, buffalo, sheep, goat and pig population (total 53 crore animals).

6. Animal Husbandry Infrastructure Development Fund worth Rs 15,000 crore will be set up with the aim to support private investment in dairy processing, value addition and cattle feed infrastructure. Incentives to be given for establishing plants for export of niche dairy products.
7. Promotion of herbal cultivation with a fund of Rs 4,000 crore to cover 10,00,000-hectareland under herbal cultivation in the next two years. It is expected to lead to Rs. 5,000 crore income generation for farmers. The programme hopes to create a network of regional market places for medicinal plants. National Medicinal Plants Board (NMPB) will bring 800-hectare area by developing a corridor of medicinal plants along the banks of Ganga.
8. Rs 500 crore for beekeeping initiatives –- Infrastructure development related to integrated beekeeping development centres, collection, marketing and storage centres, post-harvest & value addition facilities etc. This will lead to a likely increase in income for 2 lakh beekeepers and quality honey to consumers.
9. Rs 500 crore for Operation Green to prevent distress sale leading to a reduction in the price of perishable fruits and vegetables at the farm level. All fruits and vegetables will be covered under this initiative for the next 6 months. It includes 50 % subsidy on transportation from surplus to deficient markets and 50 % subsidy on storage, including cold storages. This is likely to result in better price realisation to farmers, reduced wastages and affordability of products for consumers.

A list of challenges amid Covid-19 crisis: Despite of all these measures taken during last few months the agriculture sector of the country will continue to face some formidable challenges.

1. *Acute shortage of agricultural laboures* : Agriculture has also been hit hard by labour shortages. With labourers fleeing to their villages to contain the pandemic, farmers look at disruptions in the agricultural processes. The ongoing lockdown had already hit the harvesting season of wheat and pulses in northern India, boro rice in eastern India, and now it is affecting the sowing of kharif rice. Experts predict that cost of labour is going to double due to the shortage. Labour shortage amid COVID 19 lockdown leads to an increase in farming expenses.
2. *Unavailability of machinery*: Amid acute shortage of labourers due to prolonged lockdown in the wake of rapid spread of coronavirus, a major problem faced by farmers is a scarcity of combined harvesters, a versatile machine designed to efficiently harvest a variety of grain crops at low cost. With boro rice ready for harvest, prediction of India Meteorological Department of severe thunder strom in West Bengal and Odisha coast has unnerved the farmers. There was also massive harm to standing crops as there was delay in harvesting due to unavailability of agriculture machineries.
3. *Perishable food* : The producers of perishable products – such as milk, fruit and vegetables – are suffering because of the distortions in supply chains. Their products fetch higher prices in cities, but at the same time, the demand from

hotels and restaurants has plummeted. In Punjab, for instance, dairy farmers are reportedly spilling milk on roads because their usual clients, sweet shops, hotels and restaurants, are shuttered.

4. *Procurement of crops* :The government is in a dilemma on how to maintain social distancing during the procurement of rabi crops in mandis. India has 2,477 principal regulated markets and 4,843 sub-market yards regulated by APMCs. In these mandis, post-harvest operations – transportation, cleaning, grading, packaging and loading – are conducted manually by workers. The embargo on movement means there will be fewer workers available this year.Even if mandis operate normally, how will the government ensure social distancing among large numbers of labourers, farmers, traders, government officials, transporters?
5. *Problems associated with cold store* : Farmers are unable to use cold storages for crops like potato because of closure of cold storages and short supply of ammonia which is urgently required in many cold storages as the temperature is rising and any delay would cause damage to the perishable stocks.
6. *Flower market*: Brightly coloured roses, chrysanthemums, lilies, marigold and other flowers that might normally have been destined for marriage decoration and temples, are now being destroyed by growers in unprecedented manner as the rapidly spreading coronavirus brings demand to a standstill.The situation in horticulture and floriculture sectors is worse, as fruit, vegetable and flower growers are unable to find markets due to restrictions in movement and fall in demand. This has resulted not only in mounting stocks of perishables such as grapes, strawberries, watermelons, bananas, broccoli, lettuce, red radish and Chinese cabbage but also in steep fall in prices. Already growers of exotic vegetables in northwest India have started to dump their produce for use as animal feed and manure. Many, who had taken loans to invest in poly houses and greenhouses, fear they will slip into indebtedness. Exportable commodities as spices also face a fall in demand and prices.
7. *Poultry farming*: The Indian poultry sector is headed for a crisis as rumours and fears associated with novel coronavirus (Covid-19) hit consumption of chicken meat and eggs, resulting in a price crash. The coronavirus outbreak and the consequent lockdown have pushed the poultry sector in the country into a crisis with losses projected at Rs 22,500 crore.

MITIGATION STRATEGIES:

1. Policymakers need to take steps to mitigate the acute labour shortage. Government may allow inter-state and inter-district movement of labours with mutual consent of both administrations at the time of harvesting and sowing of crops. Farm employers will need to provide adequate safety equipment and implement social distancing measures to keep workers safe. Government may suggest farmers to cultivate crops other than rice where labour shortage is acute as rice needs more labour than other crops.

2. Expanding PM-Kisan scheme to cover rural landless/migrant workers is very important .
   The PM-Kisan scheme is a major cash transfer programme launched in 2019, under which every farmer receives Rs 6,000 annually in three instalments. Landless agricultural workers, who are among the poorest of the poor, are not covered under this or any other such scheme. They constitute 55% of the total workforce (Census 2011) and should have the first right on government assistance, more so now that they are the hardest hit.
3. Government should encourage farmers to use custom hiring centres of farm machineries amid acute labour shortage problem.
4. Lack of credit in the agrarian economy may lead to distressed sale of produce to private traders and money lenders that may create distortion in food supply management in the near future.Therefore, credit provisioning to the agrarian economy is crucial in maintaining food reserves in the country.
5. The system of procurement should continue to feed 1.35 billion Indians even as the entire country is locked down to fight against the spread of COVID-19. The government of India, through FCI and the state governments or their agencies, should procure rabi crops immediately before farmers are compelled to sell their produce to middlemen in villages.The distress sale to ease the ready cash required for kharif preparation can be averted if procurement happens at the village level. It will not only help farmers get the actual price of their produce, but also ensure that food grains stocks are maintained for the months to come.
6. The government should compensate farmers for their crop loss during covid 19 crisis especially for perishable products.

Now the unlock phase has already started. The problems will not be end with the end of the lockdown. Moreover the framers are facings more problems at the starting of the new agricultural sowing season. Government support is necessary to fulfill the need for different agricultural inputs. Sufficient relief is necessary to overcome the agricultural crisis . The need of the hour is to maximise possibilities of agriculture, which has a great potential to face the challenges of Covid-19 pandemic in future.

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Lasoora: A Lesser Known Fruit

Monika Sood[1]* Julie D. Bandral[1] and Upma Dutta[2]

[1]Division of Food Science and Technology
Faculty of Agriculture
[2]Divion of Microbiology, Faculty of Basic Sciences
SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu

**Corresponding Author; monikasoodpht@gmail.com*

The botanical name of Lasora, is *Cordia dichotoma / Cordia myxa*. It belongs to plant family Boraginaceae. Lasura grows in moist and dry forests of the country, spreading throughout the northern states of Himachal Pradesh, Rajasthan, Punjab, Maharashtra, parts of the sub-Himayalan tract and the Western Ghats. It is a perennial, medium sized tree with crooked stem. Lasoora bears small sized fruits in bunches. The fruit is a globular-ovoid drupe. It is smooth, and is the size of a cherry. It is yellow on ripening, and the pulp is almost transparent, tough, and viscid. Nut is cordate, and seed is solitary. The dried fruit is conical with acute apex, up to 2 cm in length, and 1.5 cm in diameter, occasionally with attached calyx, and pedicel, greyish brown to dark brown, surface shrunken, hard to break. The smell of the nut on cutting is heavy, and disagreeable. The sticky white substance from the fruits can be extracted, and as used as glue.

IMPORTANCE OF LASOORA

The fruits are good sources of minerals, fiber and vitamins. The most important nutrients present in plants are: carbohydrates, such as the starch and free sugars, oils, proteins, ascorbic acid, and the antioxidant phenols, such as chlorogenic acid and its polymers. The fruit contains sugar, gum, β-sitosterol, palmitic, stearic, and oleic acids and have about 70% pulp. Fruits are considered as rich sources of natural antioxidants i.e. carotenoides, ascorbic acid, phenols, very high sucrose (29.09 %) has been found in ripe fruits. Comparing the fruits mineral contents with recommended dietary allowances, *Cordia myxa* fruits could be a good supplement for some nutrients such as protein, carbohydrates, K, and Na. The seed kernel of *Cordia dichotoma* contains a high proportion of fatty oils and proteins (46 and 31 %, respectively) which have potential as cattle feed. Being a multipurpose plant it has long been associated with health, nutrition and other diversified uses in curing certain human ailments.

Nutritional value of Lasoora (per 100g)

Protein	8.32%
Fibre	25.7%
Crude fat	2.2%
Carbohydrates	57.08%

Calcium	55mg
Phosphorus	275mg
Iron	0.51mg
Potassium	7.83mg
Sodium	1.62mg

(Source: Aberoumand, 2011)

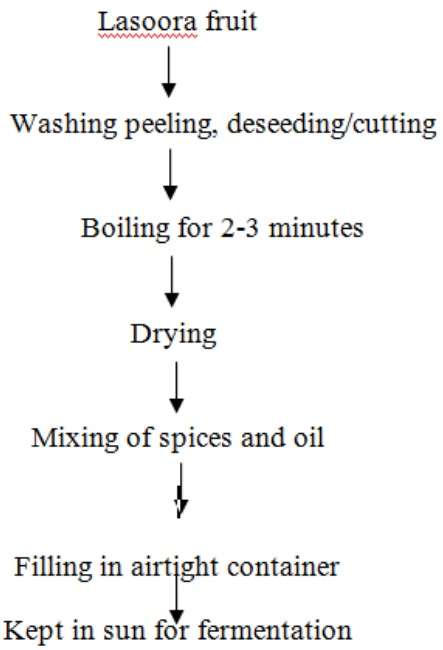
Medicinal properties

Lasoora is a one of the important constituent of traditional medicine systems. The fruits are rich in medicinal properties. The understanding of these medicinal properties will help us to better utilize this fruit. The presence of polyphenols in the fruit has been shown to have analgesic, anti-inflammatory, anti-ulcer, diuretic and laxative properties. It is useful in dry cough, asthma, catarrh, coryza, chronic bronchitis, Syphilis, and influenza.

Utilization/Uses

Green, unripe lasoora has a sour taste that can easily be confused for raw mango in its pickled form. Its tart, tangy flavour makes it an ideal candidate for additional preparation, such as sautéing and marinating. Pickle is prepared from its raw fruits and the fruits are also used as vegetable. The fruit is pickled with or without seeds by adding salt, sugar, spices, oil and citric acid. The pickle has a characteristic spicy taste and can be kept for consumption for about 1-2 years. The other uses of lasoora are mentioned below:

- The fruit mucilage is used as a gum for pasting cardboard and paper sheets.
- The juice of the fresh fruit is used to treat burning sensation and dryness of the body, remove excess phlegm from lungs and treat asthma and cough.
- The fruit is consumed to improve the digestive power and indigestion.
- The decoction of the bark is consumed regularly to improve body strength and remove fatigue, treat diarrhoea, irritable bowel syndrome and intestinal worms.
- The gum of the fruit is used as glue.



Flowsheet for preparation of Lasoora pickle

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Scope of Agricultural Robotics in India

B. Padmaja

SRF, ICAR-NAARM, Hyderabad
**Corresponding author: padmaja7054@gmail.com*

Sowing the seeds, Plantation, watering the plants, cutting the weeds spraying fertilizers and chemicals, examining the soil and harvesting the yield, cutting the weeds, killing the pest and insects that harm the crops. Whether the above mentioned works can be done by the robots are not? Question is answered by "yes". Farm robots have taken a test drive in the Oklahoma state in the United States. "Green Seeker" By John Solie- Oklahoma State University introduced the "green seeker sensor" that was developed at Oklahoma state university. This smart machine reads a plant's needs and then applies precisely the amount of fertilizer of herbicides needed. Green Seeker is a machine which uses the sensors to let the plant tell us that what it needs. The green seeker shines light at red and near infrared wavelength on the plants. That light is absorbed by the plant and some of the light is reflected back up into the sensors. The sensor measure the amount of light reflected of the plant, and determines the amount of fertilizer that the plant is needed. By using this we can know how much amount of fertilizer is needed by plant and applicator is the device which takes signals from amount of fertilizer to the plant. The report from the Oklahoma farmer "Tom Denker" has used green seeker in his wheat field he used to spread 80 pounds of nitrogen fertilizer per acre but with the use of Green seeker Tom Denker has used only 20 pounds and hence 75% decrease in the use of fertilizers. "It is great technology and a great savings" by Tom Denker a farmer.

ROBOT DRONE TRACTORS

A new generation of robot drones is revolutionizing the way we farm, with manufacturing of different robots, i.e announcing the first ever robot drone tractor becomes part of the agricultural mainstream. Robot will decide where to plant, when to harvest and how to choose the best route for crisscrossing the farmland. These are used in America now. "We can design Robots to reduce the usage of pesticides, herbicides, fertilizers and water" a robotic scientist says.

Flying Robots to Spread Fertilizer

A flying robot monitors the growing condition of the crops over farmlands in Ili, a Kazak autonomous prefecture in Northwest China's Xinjiang Uygur autonomous region, July 25, 2011. With camera equipment and an automatic fertilizing system in the front, the robot can fly autonomously and apply fertilizer independently. It is made by the national key laboratory of robotics of Shenyang Institute of Automation of Chinese Academy of Sciences.

Fruit Picking Robots

The research is still in full progress, especially as the robots need to be carefully designed so that they do not bruise the fruit while picking. One solution is the use of suction grippers, used on automated fruit picking machines manufactured, for example, by ACRO. Citrus fruit robot pickers have thus far been the focus of research and development, but cherry pickers are also being researched. Vision Robotics, in particular, has made several robots that are already capable of taking over the work. Researchers in the U.K. are working at turning newly developed imaging technology into an intelligent harvesting machine.

Robot Cattle Grazing and Automatic Milking

Is the milking of dairy animals, especially of dairy cattle, without human labor. Automatic milking systems (AMS) also called voluntary milking systems (VMS) were developed in the late 20th century. They are commercially available since the early 1990s. The core of such systems, that allows complete automation of the milking process, is a type of agricultural robot. Automated milking is also called robotic milking therefore.

SCOPE OF FARM ROBOTS IN INDIA

Our farm equipment companies and researchers have developed a lot of small and heavy farm equipment for traditional farming needs but some kind of robotic and pneumatic mechanism are required in precision farming. As robots have entered in the mentioned above fields it is important to think that till, why the robots are not entered in the farming field? If the robots are being used for weed control, that will help to reduce the herbicides usage and the produces will turn into an organic, the same way robots can be used for transplanting the seedlings to avoid intensive labour. We used to read in newspapers on few impressive innovative technologies by rural inventors i.e. electric motors can be operated remotely by cell phones, it's very helpful to farmers in summer time since the power supply is irregular. If we think advanced intelligent machines in farming, Sensors or readers and hand held PDAs are going to be great

helpful in computation and accuracy in farming. There are lot of hurdles taken in the agriculture sector in all countries but specially in India.

Farmers decreasing in India a daily report from the newspaper. According to Shineveramya a famous writer gave a report mentioning that the "Farmers are eyes of our country. They are great men who provide food for us but now a day's farmers are reducing more in number. Many are leaving the farming profession by telling some repeated common sentences that it is no longer profitable and none want to get losses and it is becoming risky day by day. So many disadvantages. Also the youngsters are not interested in that. So they are ready to work in construction companies and not in farmland.

Advantages of robots in farm

Seeing to the above mention crisis that Robots will make a remarkable perfect entry into the agriculture, following are the advantages of robotics farming.

- Elimination of labour - The farmer is freed from the milking process and associated rigid schedule, and labour is devoted to supervision of animals, feeding, etc.
- It brings us an opportunity of self-employment for those who are unemployed and thinks the farming profession as a nightmare.
- It is one-time investment then the expenditure of the farming will drastically.
- The use of fertilizer, pesticides, insecticides, herbicides and water consumption can be reduced in very large percentage.
- It brings revolution in the farming, agriculture and cattle grazing.
- Productivity will be increased to a lot extent.
- No more farming will be a difficult occupation it becomes the engineers' choice and lot of youngsters will be engaged in the farming.
- Soil testing gives the information of the soil and that information when is taken as the intelligence this report is signalled and given to the artificial intelligence along the Robotics gives us perfect results that perhaps increases the quality.

Disadvantages

- It is costlier to implement.
- Complexity is increased.
- Time management and skill full labour is required.
- Roberts run with power but in India power cut in the farming region is more than 65%.

Significances of Fasciolosis in Small Ruminants

[1]Poobitha S and [2]Ramajayan P

[1]Veterinary pathologist, Department of Pathology, Bioscience Research Foundation, Kandamangalam, 602 002,
[2] Scientist, CSIR-IIIM, Jammu.

**Corresponding Author: drboovi@gmail.com*

ABSTRACT

Fasciolosis is an economically important disease of domestic livestock, in particularly cattle, sheep, goats and occasionally man. The two species most commonly implicated as the causative agents of fasciolosis are *Fasciola hepatica* or temperate liver fluke and *Fasciola gigantica* or tropical liver fluke. Most of the reports on prevalence of Fasciolosis were based on data gathered passively from slaughter house records, which shows that fasciolosis is common in sheep and goat, cause great economic losses and might induce a mortality of 30-40 % in affected animals. The severity of the disease depends upon the age and species of host involved, the phase of parasitic development in the host, its nutritional state and the number of metacercariae ingested. The main forms of Fasciolosis are acute, subacute and chronic. However, rotational grazing combined with strategic treatment with anthelmintics is one of the most widely recommended methods in the developing countries.

Key Words: Fasciolosis, Small ruminants, Pathogenesis, Significance

INTRODUCTION

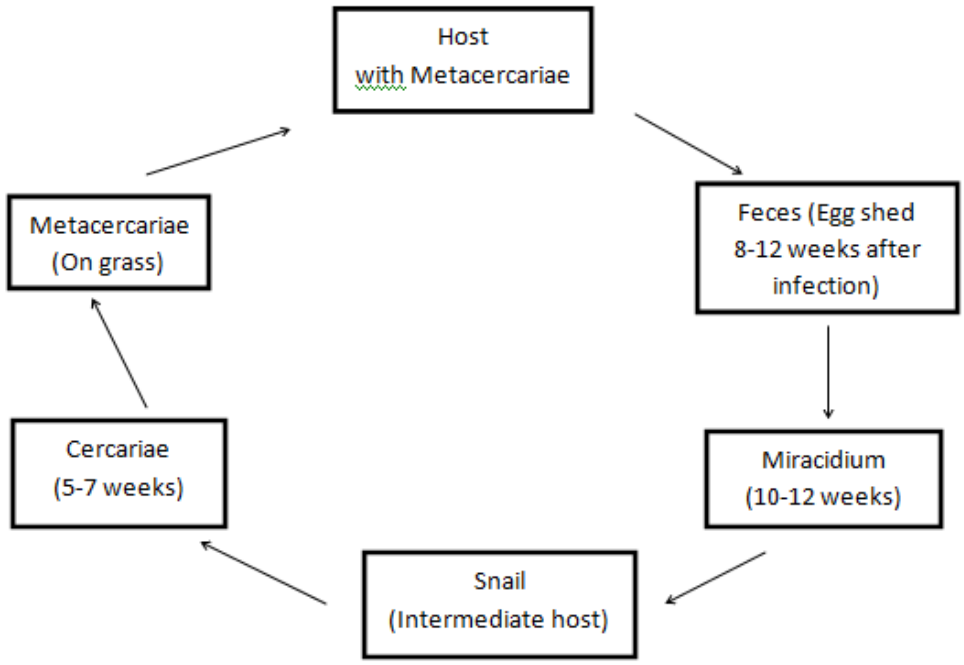
Parasitism is one of the major limitations in livestock productions in most of the tropical and sub-tropical countries of the world. Goats become more susceptible to various parasitic infections under arid conditions especially when reared under unhygienic managemental system. The parasitic diseases could cause great economic losses and might induce a mortality of 30-40 % in affected animals. Among several Helminth parasitic diseases of economic importance in ruminants, Fasciolosis is the most important disease. This is distributed worldwide and causes enormous economic losses in terms of reduction in milk and meat production, condemnation of liver, loss of draught power, reproductive failure and mortality.

CAUSES

- *Fasciola hepatica*
- *Fasciola gigantica*

Different biological and environmental factors play major roles in their life cycles. The only snail hosts for Fasciola species belongs to the genus Lymnaea. The epidemiology of the disease is associated with the life cycle of the intermediate host. The ecology and habitat of the snails play a vital role in the normal development of the liver fluke. There are three important factors influencing the production of sufficient infective factors to cause the disease, availability of suitable snail habitats, temperature and moisture.

LIFECYCLE



PATHOGENESIS

The severity of the disease depends upon the age and species of host involved, the phase of parasitic development in the host, its nutritional state and the number of metacercariae ingested. The main forms of Fasciolosis are acute, subacute and chronic. Acute disease is usually rapidly fatal and mainly important in sheep. The chronic disease is important in both sheep and cattle.

Acute form:

In acute form, death may occur 4-6 weeks after ingestion of a large number of metacercariae. Acute disease occurs usually towards the end of summer in temperate regions or after the long rainy season in tropical areas. The acute form of disease is a traumatic hepatitis caused by the action of large numbers of migrating immature flukes resulting in considerable liver parenchymal damage.

Subacute form:

In subacute form, fewer infected animals die and it is not as rapidly fatal as acute form. In this form, death results from the traumatic damage to the liver and very large number of flukes entering the bile ducts.

Chronic form:

Chronic form may continue for many years because the flukes can survive in sheep and goats for as long as animal alive. It should also be noted that sheep may be infected year after year because of a lack of required resistance so that damage can be cumulative. The fluke cause physical damage to the bileduct epithelium by the action of their suckers and spines leading to inflammation of bileduct and liver. They eventually cause partial obstruction of the ducts resulting in progressive biliary retention.

CLINICAL SIGNS

- Anorexia
- Rapid loss of condition
- Pale mucous membranes
- Palpable enlarged liver
- Distension of abdomen
- Abdominal pain
- Sub – mandibular edema (Fig. 1.)

GROSS PATHOLOGY

- Enlarged liver
- Haemorrhagic tracks of flukes on the surface of liver
- Fibrinous clots on the liver surface and peritoneum
- Blood stained exudates in peritoneal cavity
- Small flukes can be squeezed from the cut surface of the liver and bile duct (Fig.2)
- Atrophic liver lobe (Fig. 3)
- Fibrosis in liver (Fig. 4)

HISTOPATHOLOGY

- The liver capsule is thickened and edematous.
- Migratory pathways of flukes surrounded by fibrous tissue which are tortuous tunnels appear on cross-section as haemorrhagic foci (Fig. 5)
- Cross section of migratory fluke in the liver parenchyma surrounded by fibrous tissue (Fig. 6)
- Infiltration of liver by leucocytes with fibrosis.
- Hyperplastic cholangitis arising from severe erosion and necrosis of epithelium by flukes.
- Desquamation and ulcerative lesions in bile ducts and thickening of bile duct.
- Thrombosis of hepatic vessels associated with flukes damaging the small vessels leads to obstruction of blood flow which further causes necrosis, inflammatory reactions in surrounding liver lobules.

- Calcification of bile ducts.

DIAGNOSIS

- Clinical signs
- Faecal egg counts
- Biochemical and hematological tests
- Serum bile acids level
- Gross and histopathology
- Serological antibody tests

TREATMENT

- A great number of drugs have been used against the disease but very few have been found to be effective against all stages of the infection. Many have toxic effects and the efficacy of others is only against either the adult fluke or flukes at the migration stage.
- Tremendous advances have been made recently in both the efficacy and safety of anthelmintics. Some of the recent drugs are rafoxanide, nitroxynil, oxyclozanide, diamphenethide and triclabendazole. These drugs are highly effective against immature flukes.
- Triclabendazole have been proved effective against adults and migrating flukes at 2-3 weeks of infection @ 10mg / kg body weight of animals.
- Rafoxanide and Nitroxynil are highly effective against flukes of 4-5 weeks of age @ 10 mg /kg and 13.5 mg/kg body weight respectively.

ECONOMIC SIGNIFICANCE

In many parts of the world, Fasciolosis is one of the most important helminth infections affecting production in animals. Though very little is known about the significance of the disease for the productivity of goats, in many countries goats are becoming economically more and more important. In the tropics where the economic situation is very poor, regular control measures are often not practicable. Therefore, the scale of the economic losses can be much greater and relatively higher in tropical areas than in temperate regions.

CONTROL

- Effective control of the disease may involve use of anthelmintic, control of the intermediate host and reduction of exposure to infection by appropriate farm management.
- The ideal approach to controlling the disease is
    - Prophylactic use of anthelmintics to reduce pasture contamination
    - Use of molluscicides to limit the snail population
    - Improved drainage to eliminate intermediate snail hosts
    - Fencing of habitats

CONCLUSION

As for control in tropical countries, anthelmintic treatment seems to be the most reliable way to reduce fluke infections for the present. In most areas, since patterns of infection have not been adequately analysed, there will be little on which to base a dosing programme. In such places, treatment is commonly recommended at quarterly intervals relying upon the prepatent period of the parasite. However, rotational grazing combined with strategic treatment with anthelmintics is one of the most widely recommended methods in the developing countries.

Fig. 1.Sub mandibular edema

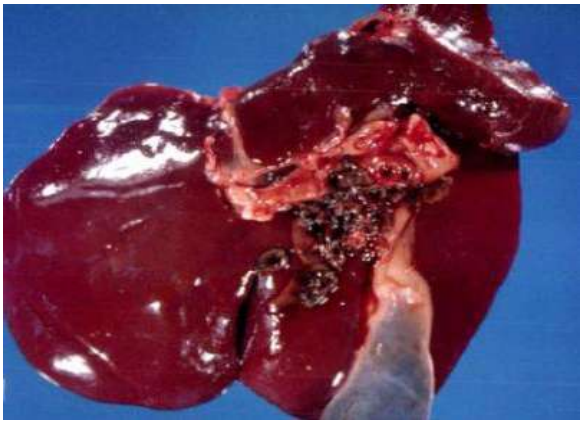


Fig. 2. Flukes in the lumen of bile duct

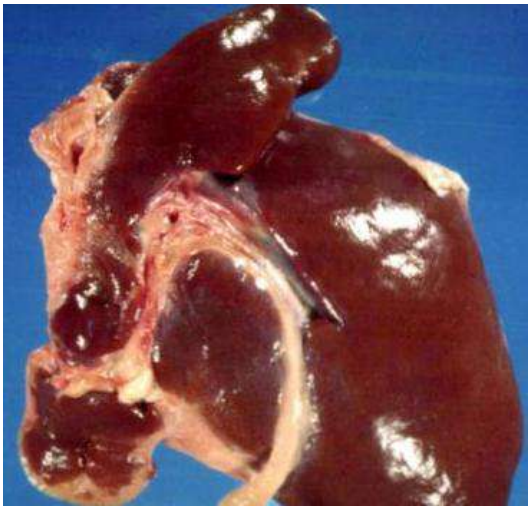


Fig. 3. Atrophy of left lobe of liver

Fig. 4. Mild fibrosis noticed in liver

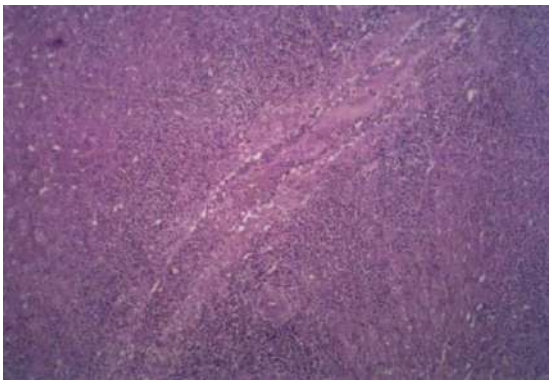


Fig. 5.Migratory track of the fluke in the the liver parenchyma

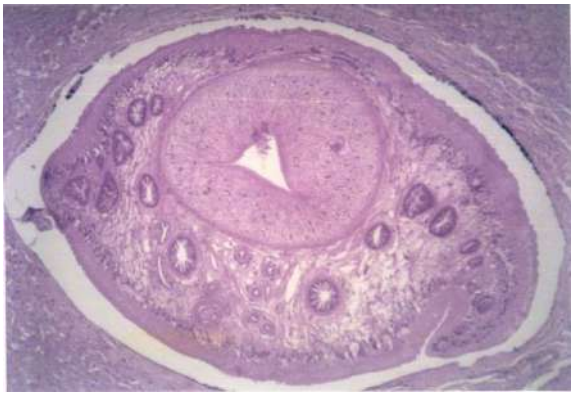


Fig. 6. Cross section of migratory fluke in parenchyma surrounded by fibrous tissue

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Protected Cultivation: A Non-Conventional Way To Double Farmers Income

Subhradip Bhattacharjee[1*], Punam Bhattacharjee[2], Sahanob Nath[3] and Jagathjhuti Datta[4]

[1]PhD Research Scholar, ICAR-National Dairy Research Institute, Karnal, Haryana-132001
[2,4] Independent researcher, Growing Seed Organization, Dharmanagar, Tripura-799250
[3]PhD Research Scholar, Uttar Banga Krishi Viswavidyalaya, Coochbehar, West Bengal-736165

**Corresponding Authors: subhradip25@gmail.com*ndia

India has been a predominantly agriculture-based country; credit goes to its unique geographical, and climatic conditions along with fertile plains contributed by its mighty rivers. Large chunks of Indians depended upon farming as a source for their bread and butter. Considering the statistics; the agricultural GDP is increasing since Independence although the share of agriculture in overall GDP is decreasing year after year which is quite natural for a developing country which is moving toward industrialization and population boom. Till now, it is safe to say that the entire Indian population is directly or indirectly depending upon the agriculture. As stress upon Indian agriculture is increasing day after day; there is a severe need to reform the condition of the farming community. In the past, the development strategies and government policies for agriculture were primarily targeted on raising agricultural production and providing food security to its population. Due to the Green revolution and subsequent development in the agriculture sector, India became successful to feed its entire population by its means and also a net exporter in agriculture. However; this whole process overshadowed one of the most critical issue, i.e., the overall income of the farming community involving poorest of the poor of our nation. As the traditional ways of farming are getting bottlenecked due to issues like shrinking cultivable lands, increasing cost of cultivation, irresponsive lands and climate change; modern approaches like protected

cultivation of high-value crops can tremendously improve the financial condition of farmers in coming days. Protected cultivation which is also known as controlled environment agriculture (CEA) or partially greenhouse cultivation is a modern-day practice of production of qualitatively and quantitatively superior high-value crops under a certain controlled environment to obtain a higher level of yield without sacrificing the soil and water conservation aspect. The micro-level management of all needed resources such as temperature, humidity, light intensity, soil, water, fertilizers and manures for optimum plant growth ensures higher return as compared to other types of cultivation as well as sustained production during the off period too.

Concept and History:

The technology of protected cultivation is based on the greenhouse effect or absorption of infrared energy and retention of long outgoing wave radiation to increase the temperature within greenhouse up to a certain limit. The frame of greenhouse is made up of galvanized iron, aluminum or steel pipes while the whole structure is covered with plastic sheets or nets.

Romans first practice the idea of growing of fruit and vegetable crops in protected condition. The Roman gardeners used artificial methods of growing cucumber to have it available year-round. Cucumbers were planted in wheeled carts which were put in the sun daily and then taken inside to keep them warm at night. The cucumbers were stored under frames or in cucumber houses glazed with either oiled cloth known as “specular” or
with sheets of selenite according to the description by Pliny the Elder. The first account of the building of a heated greenhouse is from Korea during the 1450s. They used this method to raise vegetables during winter. The Annals of the Joseon Dynasty confirm that greenhouse-like structures were constructed to provide heat for mandarin orange trees during the winter of 1438. The concept of relatively better-structured greenhouse appeared in Netherland and England during the 17th century. Even today Netherland houses many of the world’s largest greenhouses. The first modern greenhouse is made by French botanist Charles Lucien Bonaparte at Leiden, Holland, during the 1800s to grow the tropical medicinal plant. The popularity of greenhouse increased during the 1960s when polythene sheets became widely available.

Global and National Scenario of Protected agriculture:

The area under protected culture is increasing quite rapidly. The total area under greenhouse was little higher than three million ha, scattered among 115 countries during 2011. While China is leading the race with the highest area (2760000 ha); South Korea, Spain, Japan and Turkey is not far behind. Many of these countries, especially in Europe more emphasis is given on low-cost poly houses to bring more area under protected cultivation. India being a land of a marginal and small landholder, found it challengingto adopt the modern protected cultivation practices. Rapid urbanization followed by a rapid increase of population and the urge to meet their both ends meet with the help of cereal crops hinders the expansion of protected cultivation. Currently

around 50000 ha in India is under protected cultivation. Maharashtra, Karnataka, Gujrat and Himachal Pradesh are the leading states in protected cultivation. Maharashtra being the leading state has 5730.2 ha area under greenhouse and shed net. Major crops which are grown in India are tomato, capsicum, cucumber melons, rose, gerbera and carnation etc. Greenhouse and shed net oriented nursery raising is becoming very popular in India, especially in Northeastern states. This is primarily because hilly terrain constitutes nearly two-third of the regions geographical area, and large-sized holding are not feasible. The average size of landholding for the NE States (1.60 ha) is marginally higher than all India (1.57 ha). Among the NE States, the average size of landholding is highest in Nagaland (6.92 ha) and lowest in Tripura (0.97ha). The average plot size is very small for mechanization of agriculture and the adoption of modern farming practices. Hence, high-value crops such as different types of flowers will provide high remuneration from limited resources.

Design and characteristics of structures used in protected cultivation:

Protected cultivation structures can be moderately complex to highly sophisticated depending upon the area where it is intended to be used and the farmers who will use it. All things have to be done without compromising. The growth factors, i.e. light, temperature, humidity and air composition at optimal levels. While technologically sound countries like Israel uses highly sophisticated greenhouse technologies like automated total climate control system and super frogger sprinkler to convert their nearly desert land into fertile one; the adaptation rate of these technologies in India is quite sluggish due to financial constraints.

These protected structures not only provide plants favourable condition but also saves them from high-velocity winds, heavy rains, hails and insect attack. Protected cultivation structure comes into various shapes and size depending upon the specific requirements. Mostly used structures are protected mulches, row cover, cloches, low tunnel, more massive greenhouse with active, semi-active and passive climate control options. Greenhouse being the larger most customizable one became the synonym of protected cultivation.

Greenhouse:

The greenhouse is a semi-permanent to a permanent structure made up of wood, bamboo, steel or aluminium frame and covered with transparent materials such as glass, acrylic, corrugated polycarbonate sheet, polythene films, thermal and shedding nets. Among these materials, glass has the highest transmittance (90%) although being heavier, brittle, and higher maintenance cost associated with it results in lesser acceptance. Acrylic with 80% transmittance is moderately impact resistance, but due to its scratch-prone nature, the transmittance reduces over time. Polycarbonate sheets come with various thickness and have transmittance about 78%. Fibreglass with 80% transmittance has quite a long service life. Polythene sheets are widely used as covering material due to its low cost and higher transmittance (88%). Polythene sheets having 200-micron thickness has a service life of approximately three years. Thermal and

shading nets are future proof in this context. The premium quality HDPE sheets are UV ray stabilized and come with 25% to 90% UV ray protection level.

The design of greenhouse varies widely depending upon the location, profitability, expertise of the farmer etc. The cheapest form of a greenhouse is Plastic low tunnel/row cover. These structures are self-explanatory; covers the rows of the plant with approximately 50 cm high tunnel made up with 30-40-micron thick polythene sheets in case if it is to be used during winter however materials such as windbreak nets, cheesecloth etc. can be used during summer. Gable; another type of greenhouse; shaped like a traditional hut is perhaps the oldest greenhouse type. The inclination of the roof is made in such a way to reduce the outer reflection as much as possible. Another structure type known as Gambrel is the slight modification of the Gable structure. It is generally preferred in an area where wind velocity is relatively high around the year as it can withstand higher wind speed due to its improved structure. When there is a fixed building on one side; the Skillionstructure is generally preferred. The roof of these type of greenhouse is generally slanted toward the southward direction while the fixed wall remains on the north side. One of the most commonly made greenhouses is Curved-roof-raised high arch greenhouse where semicircular structures are m ade. Due to its more straightforward design, the acceptance rate is relatively high. The only disadvantage of this type of greenhouse is poor ventilation. To improve the aeration in these type of structure, raised arch structures are constructed. Another common type of greenhouse structure is Saw-tooth structure where an alternative series of vertical and horizontal sloped are being made. So far as ventilations concern; this is the best type of greenhouse structure. The naturally ventilated greenhouse is a very popular zero energy model of greenhouse used by Indian farmers due to its cost-effectiveness.

Microclimate inside greenhouse:

Crop yield has been reported to depend on the response of the plant to environmental responses, for example,the temperature has considerable influence on crop timing, and yield and light is a primary determinant of growth. Greenhouse temperature, humidity and leaf temperature are in turn affected by the light transmission of the cover material. The highest survivable temperature for plant depends on relative humidity. Photosynthetic rates are reduced at low PAR integrals, and it is generally assumed that the loss of the light will lead to a proportional loss in yield. Gaseous components are also important. Contents of CO_2, oxygen, nitrogen, water vapour and other trace gases influence the plant metabolism immensely. Plant root development depends on the physical, chemical and microbial composition of the soil. To overcome the complexities of these things, artificial growing media are becoming popular. The main advantage of these mediums is vigorous root growth and low mortality.

Alternatives to soil-based cultivation:

The Soils inside the greenhouse is subjected to frequent change due to degradation of fertility, soil-borne pathogen etc. As a result, soilless cultivation is becoming popular day by day. Media for soilless cultivation can be either solid (made up of tree bark, Rockwool, peat, pearlite, vermiculite wood chips etc.) or close circuit liquid media otherwise known as "hydroponics". Hydroponic and aeroponics are the latest addition to this. In hydroponics and inert material saturated with nutrients is used of simply nutrient dissolved in water is used. Although being a high tech method; this is generally preferred in relatively developed countries. With proper fertigation, right media and hormonal treatment; plants can be grown without the support of the soil. The plug-tray nursery raising method is gaining popularity for raising off-season plants. Generally, coco-peat, perlite and vermiculite in the ration 3:1:1 is used as alternative media. Other materials such as hydrogel and organic matter can be used as supplemental material to hold up water and nutrient. In soilless culture, liquid fertilizers are generally preferred over normal fertilizer. This type of nursery promotes vigorous root development which ensures less mortality rate during transplanting.

Management practices:

Proper management practice is the key component of protected cultivation. When it comes to water management, generally micro-sprinkler, drip etc. are commonly used in association with fertigation facility. The efficiency of fertigation is higher than normal fertilizer application. Sometimes foliar application of nutrients is also preferred thus nutrient use efficiency of plant increases. It has been found that foliar fertilization increases yield, pest and disease resistance. Following 'Good Agricultural Practices (GAP)' is a must for protected cultivation. As protected cultivation is a simulation of natural plant growing process within an artificial environment; the negligence to management practice leads to severe loss as there is always costly inputs are at stake. The stress increases, even more, when people expect organic or low chemical but high-quality foods on their plate. The consequence of pesticide accumulation on media surface or plant leaves overtime should also be taken care of.

Pollination within protected cultivation structure is another issue which should be addressed with modern technologies. As natural pollinators like honey bees are not present within greenhouse; manual or mechanical pollinator like electric vibrator or blowing of air should be practised. The incidence of pest and disease is quite less in protected cultivation, but sill few pests like aphids, leaf-miner, thrips, mites can be problematic. Sometimes fungal disease attack can also occur. Incidence of root-knot nematode can also be found where the soil is used as growing media. While controlling these, maximum emphasis should be given to cultural management practices and organic pesticides (like neam extract) rather than the chemical to reduce chemical burden.

Advantage and scope of protected cultivation in India:

- The major advantages of protected cultivation are that it enables the production of flowers and vegetables round the year.

- In protected cultivation, the quality of produced material is generally higher due to optimum use of water and nutrient, far less incidence of weed competition and pest and disease attack. The less use of insecticide and pesticides helps in two ways; the first one is it reduces the cost associated with pesticide and second one is that the acceptance of less pesticide-laden crops are more among common people.
- Year-round production ensures sustained income for the farmer.
- Several exotic herbs and spices like Oregano, Basil, thyme etc. can be only cultivated under protected cultivation due to different climatic requirement.
- Seed production is also better suited inside the greenhouse where maintain its purity is easier for a farmer.
- Protected cultivation is also an element of the new era "Urban Agriculture" where the small urban landholder can also practice farming.

Limitation of Protected Cultivation:

- The major drawback of protected cultivation, especially in India is the most obvious one; i.e., lack of financial flexibility. While a marginal and small farmer finds it difficult to even practice the common agricultural practices; protected cultivation is a distant dream for them.
- Lack of technical knowhow is another serious issue.
- The cladding material is too costly for the maximum of Indian small scale farmers.
- Most importantly, as there is very less scope to raise major field crops within these protected structures, which are the prime thrust area in Indian agriculture.

Conclusion:

The popularity of protected cultivation is increasing day by day. Modification of protected structures as per the local condition can ensure sustained high-value crop production even in extreme climatic condition. In coming days, the effect of climate change, ever-shrinking farmland and population explosion will drive a large number of farmers to take protected cultivation.

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Soil fertility management- Keep Your Soil Healthy

Saroj Choudhary [1*] and Arjun Singh[2]

[1]Ph.D.Research scholar at Department of Soil Science and Agricultural Chemistry, Banaras Hindu University, Varanasi (U.P.) - 221005, India; [2]Scientist, ICAR-NRC for Banana, Tiruchirappalli (TN)

**Corresponding Author: sarojchoudhary0007@gmail.com*

Abstract

Production of good quality food is the ultimate goal of farming. About 95 percent of today's food is being produced in the soil. The soil is a non-renewable asset that has to be taken care with utmost priority. Soil organic matter (SOM) content is the soul of soil. SOM determines the soil health and it's capacity to function and support life on it. With advent of green-revolution during 1960s, intense use of fertilizers and pesticides became part of cultivation which ill effects are now being visible. A healthy soil can be maintained with the various agronomic approaches viz. use of FYM, rural and urban compost, vermicompost, cover cropping with legume, diversified crop rotation, integrated nutrient management etc.

INTRODUCTION

Soil is increasingly recognized as an important non-renewable asset that has to be managed properly to ensure sustainable development. Soil health refers to the capacity to function as a critical mechanism that sustains crop production within an ecosystem's limits. A fertile soil will contain all the major nutrients which are needed for basic plant nutrition (e.g., nitrogen, phosphorus, and potassium), as well as other nutrients which are needed in smaller quantities (e.g., calcium, magnesium, sulphur, iron, zinc, copper, boron, molybdenum, nickel).The presence of organic matter in the soil is essential for maintaining soil fertility. Organic matter of the soil consists of fresh organic matter (the remains of dead plants and animals) and humus. Fresh organic matter is converted into humus by soil organisms. Humus gives the soil a dark color and can store a lot of water and nutrients.

Soil quality is essential indicator of the degree of sustainability of agricultural activities, and is a subjective decision rendered for agriculture according to soil fitness requirements. Farming practices that increase organic carbon in soil are therefore necessary for improving soil quality and sustainable development (Wang *et al.* 2018).

India is not self-sufficient in producing primary plant nutrients. A large pat of nitrogenous and phosphatic fertilizers and entire quantity of potassic fertilizers are

imported. Efficient management of soil fertility is, therefore, of prime concern to the scientist in view of increasing gap between production and consumption of fertilizers with fertilizers as well as of increasing threat to the environment. Efficient management of soil fertility requires knowledge about the nutrients needs of the plants, recycling of nutrients in soils, soil fertility constraints and efficient nutrients management.

Thus, the first step to maintain soil fertility is to preserve the organic matter in the soil. This can be done with the right methods of growing plants, using organic manures. If the soil is very deteriorated, chemical fertilizers may be required. Nutrients become available to the plant as soon as the fertilizer dissolves in the soil.

It takes much longer time before organic matter is transformed into humus and has released its nutrients. But for healthy soil we should use the fertilizers efficiently and/or combined use of organic and chemical fertilizers. Healthy soil provides nutrient-rich growth medium for healthy plant growth, which leads to the formation of plant tissues, which contain essential nutrients and these are required for human life.

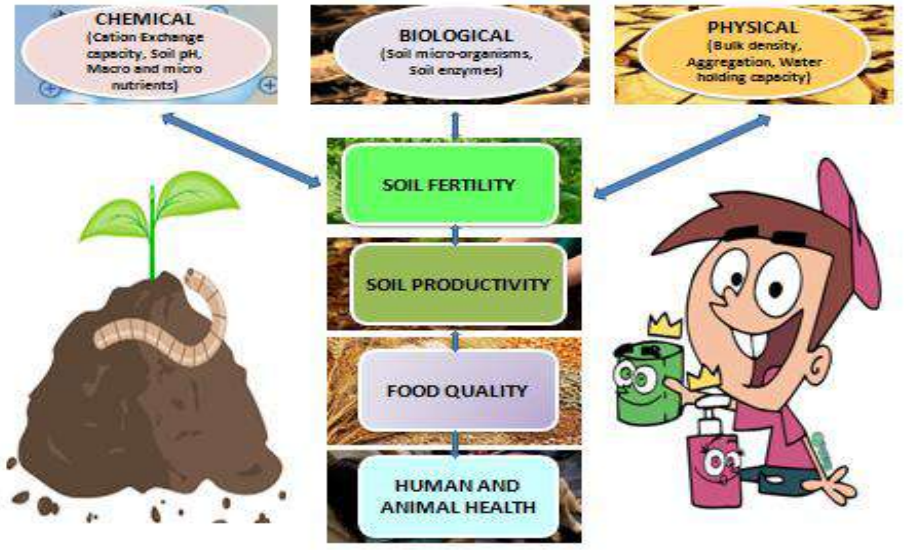


Fig. 1: Different components and factors affecting soil fertility

Healthy soils are evaluated with the ability to manage pests and diseases by means of certain critical interactions of their physical, chemical and biological qualities which preserve fertility and productivity. Healthy soils improve the productivity of drainage and water usage, avoid compaction and degradation, conserve nutrients and support natural biological processes.

Mineral composition – Knowing the mineral composition of the soil, we can predict the plant's ability to store nutrients. It is determined by rock origin, climate, biological and chemical processes.

Regarding minerals in soil, there is a large gap between the total amount of minerals in soil and the availability of plants. In fact, the minerals that make up the soil are only a small part of the plant's nutrient availability. An adequate application of fertilizer is one

of the most successful soil productivity factor, for increasing yield and maintaining the soil fertility.

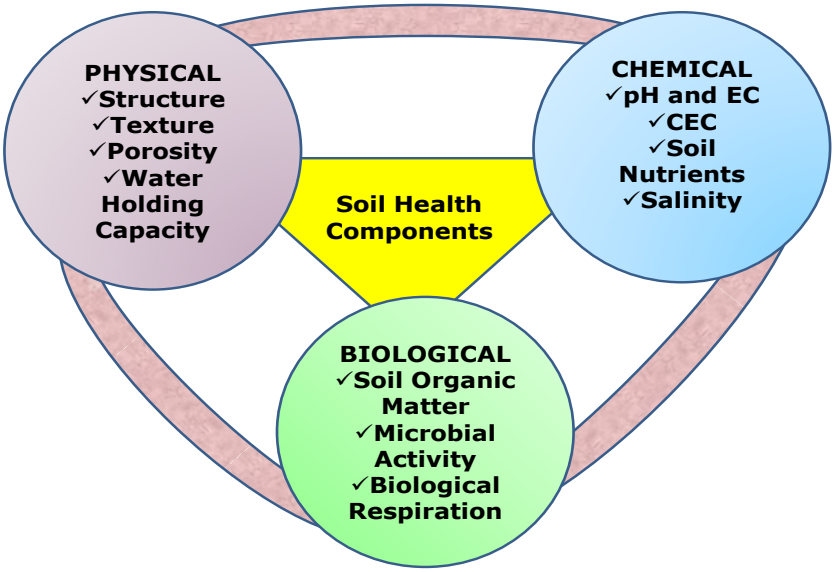


Fig. 2: Soil health components

Organic Matter – The organic matter is considered to be a source of nitrogen and phosphorus. It can mineralize nitrogen and phosphorus and become available for plant uptake. Organic matter often improves soil productivity, enhancing the soil structure thus increasing the CEC. Organic matter is good source of nitrogen and phosphorus. Nitrogen and phosphorus are mineralized and become available to plant. Organic matter also enhances the fertility of the soil, structure and improving CEC.

Soil pH – Soil pH is important factor in maintaining good soil fertility. It affects the nutrient availability in the soil. A pH range of 5.5-7 is considered to be adequate for most plants for nutrient availability.

Cation Exchange Capacity – The CEC (cation exchange capacity) can be used as an indicator of soil fertility. When the soil have high CEC, it means that soil have higher the nutrient retention capacity. Clay has a higher CEC than sandy soil and is generally more fertile.

Soil Texture – Different particles size of minerals give the structure to soil are - sand, silt and clay. In comparison to sandy soils, clay soils are able to retain more nutrients and so act as a bigger nutrient pool.

HOW TO MAINTAIN A FERTILE SOIL

Cover cropping- This approach includes planting crops that provide shield or protection against degradation for soil resources. Their presence reduces evaporation of water present in soil. They help to prevent soil erosion which may wash away nutrients. Cover crops help feed the decomposing leaves from the crops thus increasing their productivity. For cover crops, legumes are more recommended that provide nitrogen to the soil and grass can also used that improve the structure of soil.

Mulching- A mulch is typically organic in nature, but not exclusively. It can be permanent (for example plastic sheeting) or temporary (for example, bark chips). It can be applied to bare soil or existing plants around it. Mulches of manure or compost are normally introduced into the soil by the actions of worms and other organisms. The procedure is used in both industrial crop processing and planting, and can greatly increase soil fertility if implemented correctly.

Fig. 3: Use of plastic mulch

Mulching is planned to:

- maximizing infiltration,
- protect the soil from dehydration, water and wind erosion,
- prevent high ground temperatures,
- increase the amount of moisture in the soil; and, raise or maintain the level of organic matter in the soil while mulching with organic material ,
- better utilise the nutrients,
- stimulate soil micro-organisms.

Green manuring- It involves using leguminous crops that are ploughed into the soil to supply the soil with nutrients. A growing crop is called a green manure crop which is plowed under and mixed with soil to enrich the organic material. Green manures are mostly leguminous crops with a high content of nitrogen. The following crops are generally suitable for green manure: cow peas, Alfalfa and Sun hemp etc.

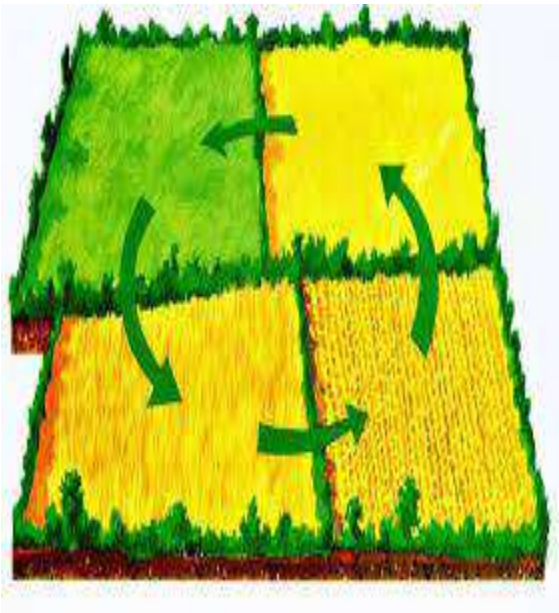
Fig.4: Green manure of *Sesbania spp*.

- when leguminous plants are us the air, which becomes availab ploughed into the soil

The target of green manuring are to:

- make nutrients available for the main crop,
- improve the soil structure,
- raise or maintain organic matter amount in the soil,
- improve the soil's capacity to maintain moisture
- Protect the soil from rain and wind erosion, dehydration and extreme temperature fluctuations at a time when there are no other crops

Crop rotation- It involves sequencing various crops into the same piece of land. This prevents over consumption by a single crop of soil nutrients. It's about filling the field with various crops that develop over time to maintain soil fertility.



Advantage of crop rotation:

- keeps the ground covered,
- Encourages ecological stability, decreasing the cycles of pests and diseases.
- Enables the production field to be better utilized over time
- Add stubble after harvest .
- minimum production cost.

Fig.5: Diversified crop rotation

Agroforestry- Agroforestry includes all forms of land use where woody crops (trees and bushes) are cultivated along with certain plants or animals. This is where after a certain period of time a piece of land is allowed to rest without planting any crop on it so that the soil field remains fertile. The downside of a green fallow process is that soil fertility will be recovered faster. Fallow periods can be shorter, which is especially advantageous in places where there is an extreme land burden. The falling of tree leaves increases organic content in the soil.

The targets which are most relevant are:

- Avoid depletion of nutrients
- Protect against wind and water erosion
- To supply organic mulch material
- Produce essential products
- Make the environment more suitable for livestock.

Compost- Compost, like manure, is an ideal fertilizer. Organic material (e.g. crop residues, straw, manure, garbage in the kitchen etc.) is collected and stored together to create a heap of compost. The substance is decomposed by microorganisms in the heap.

Proper Nutrient Management- Inadequate use of fertilizers has adverse effects on the fertility of soils. Overuse of fertilizers is not only costly, it also creates soil health problems. Mineral salts which are not utilized by the crop collect and influence subsequent crops cultivated on the surface.

Objective: After spreading over a farm, the compost offers nutrients and increases the amount of organic matter in the soil.

Fig. 6: Urban compost

In contrast, fertile soils would originally slowly deplete nutrients without the use of adequate quantities of fertilizers. The crop would not meet its full yield under this way, and the grower 's income would decrease. So we should use the fertilizers in adequate quantity.

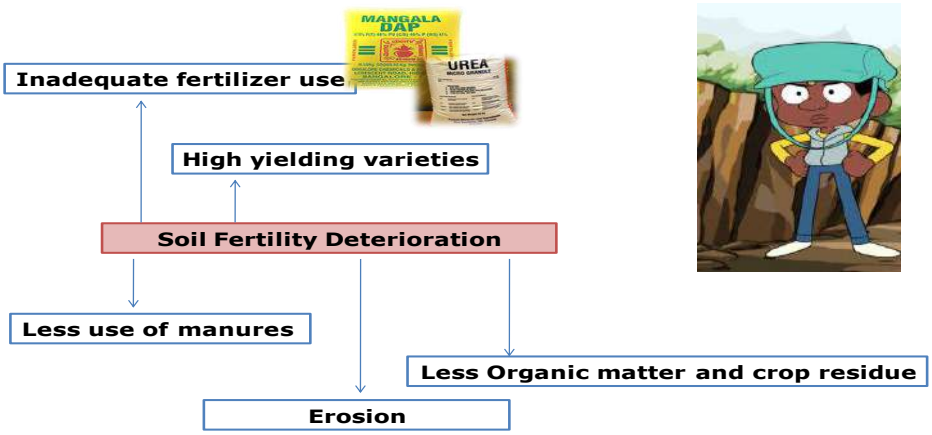


Fig. 7: Fate of soil fertility

Soil testing- Soil testing will help us to figure out what nutrients your soil requires. Bearing in mind that our soil type can play a vital role in keeping soil healthy. It will help you know what kind of crops to grow and what kind of chemicals to use when controlling pests and diseases. We need to improve our soil health to achieve improved efficiency and production. Better soil provides the best conditions in the soil for living organisms to provide the nutrients that plants require.

Challenge of Organic Soil Fertility Management

Timing and quantities of mineralization sometimes do not sufficient for crop needs. This lack of synchrony between organically mineralized nitrogen and crop uptake of nitrogen is a major challenge for the management of fertility in organic systems. Organic manure is recommended, but through its application plant can suffer because of slow

releasing, less amount of nutrient and care must be taken to prevent the spread of plant diseases.

CONCLUSION:

It can be concluded that soil organic matter has indispensible place for functioning of soil. A health must be the focus point of current agricultural practices. A healthy soil can produce the good quality food. Therefore, best agricultural practices like use of FYM, Compost, organic mulching, diversified crop rotation and integrated nutrient management has to be popularize among farmers.

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Application Techniques of Insecticide with reference to Seed treatment

Sushil Kumar*, Farahnaz Rasool*, M.A.Sofi[1], Purshotam Singh*,S.S.Pathania[1], S.C. Kashyap[2], and Yash Paul Attri[3]

**Directorate of Extension, SKUAST-Kashmir,[1]Div. of Entomology, [2]Div. of PBG, SKUAST-Jammu, [3]Stat. Asstt. Deptt of Planning and Development, UT of JK*

Correspondence Author: sushilent@gmail.com

For insect pest management, use of insecticides is one of the most important component of Integrated pest management. The insecticides have a rapid curative action in preventing economic damage and they have a wide range of properties from fumigant gases to long term residual persistence. These insecticides are applied as sprays, dusts, fumigants, aerosols, smokes, granules to soil, baits, impregnated into cloths, timber and papers; administered as systemics to plants and animals and also as seed treatments, for the management of different insect pests. Combination of several insecticides can be used together to achieve desired range of properties.

Now, it is very important to determine how insecticides can be used most effectively and harmoniously in pest management programme. Two major principles will promote this objective:

- Treat when necessary insecticide application in contrast to presently employed routine treatment insecticide schedule should be followed.
- Recognize that 100 per cent control of insect pests is not required to prevent economic damage.

Insecticides for pest management can be used in the following different ways.

Seed Treatment: Chemical control is still the only effective method of controlling most insect pests when their population has reached at the economic threshold levels. Pesticides are a valuable resource and must be used more wisely if we are to reduce the amount of chemical applied and the number of application made. This can be achieved through seed treatments, which is simple, ecological sound and economically viable and compatible with other tools of Integrated pest management (IPM). Seed treatment offers the most efficient and concentrated means of protecting the germinating seed and seedlings. Seed treatment results in reduced pest damage, less expenditure and minimum environmental pollution.This method of control has proved very effective,

cheaper and ecologically sound for the management of soil inhibiting insects-pests particularly termites.

IMPROVEMENTS OVER THE CONVENTIONAL METHOD OF SEED TREATMENT

- Now-a-days number of seed treating machines are available for seed treatment. Equipments with more vigorous re-mixing mechanism are expected to produce a more uniform seed coating and to seed distribution.
- Another recent innovation is technique of film coating. It involves the use of natural or synthetic film coating and to seed distribution.
- Development of slow release micro-capsule suspension of tefluthrin is another recent development in this field. Micro-capsule suspension of tefluthrin is used as seed treatment, it is a pyrethroid with physical and chemical properties for use as a soil insecticide.Application at a low rate of 20 g a.i /100 kg cereals seeds have been successfully made to control wheat bulbfly, Delia coarctata (Frost et al., 1994). Tefluthrin seed treatment gave effective control of soil inhibiting pests of sugarbeet seedlings (Winder, 1990)

Root Zone placement: It is the placement of insecticide in the root zone of the crop, also known as deep placement or band placement of insecticides. This method was developed to apply reduced quantity of insecticides to the crop. The pesticide is more readily absorbed from the root zone and the covering layer of the soil, protect it from heat, sunshine volatilization and drainage with overflowing water.The insecticide can be applied to the root zone in the form of straw capsule, gelatin capsules, paper capsules, tablets or large granules.

Whorl application: Whorl application of insecticides has been found very effective for a number of stem borers. Whorl application of Chlorpyriphos 10G @ 1.0 kg /ha at 30 and 60 days is advocated for the management of shoot borer of sugarcane. This application is also fount effective against stem borer in maize and sorghum (Sekhon *et al.,* 1989)

Seedling Dip: In this, seedlings are dipped in insecticidal emulsions to check insect pest infestations. For the management of stem borer, gall midge and whorl maggots infesting rice crop, seedling dip method found very effective. This method is also selective and safe to the natural enemies.

Chemigation: It is defined as the application of agrochemicals by injection into the water flowing through an irrigation system. Chemigation is possible with all types of irrigation (Drip / flood/furrow/ sprinkler) systems. The minimum equipment required for chemigation is an irrigation system, a chemical injection pump and a chemical reservoir.

Tree Injection: Application of systemic insecticide like dimethoate by fusion and injection method has been found effective for the control of beetles , bugs, aphids, leaf miners, mealybug and mites.

Soil injection: Some volatile pesticides, including nematicides and herbicides require sub surface application. For a small area treatment a hand operated soil injector is used.

Fumigation: It is one of the most important of pest management. To be lethal, a toxic chemical is used in gaseous state in sufficient concentration for a given time. They are used to treat plants and the soil, for example in plant quarantine work but are particularly useful when insect and other animal pest have to be controlled inside the stored grain in silo, warehouses, ships, and other enclosed areas. Fumigation must always be carried out by person with proper training and equipments.

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Emerging Cell Analysis: Single Cell Proteomics

Lalhmangaihzuali[1], Himalaya Bhardwaj[1*], Tajeshwer Preet Kaur[2] and Raunak Bhardwaj[3]

[1]Department of Veterinary physiology and Biochemistry, GADVASU, Ludhiana, Punjab-141004.
[2]College of Animal Biotechnology, GADVASU, Ludhiana, Punjab-141004.
[3] Remount and Veterinary Corps, India.

Correspondence Author: himalaya530@gmail.com

Abstract

Cells from microbial cultures and mammalian cell cultures with identical genomes growing in the homogenous environment do not have same proteome. The differences in the proteomes have significant functional consequences.In Single Cell Proteomics, the proteome of each individual cell will be analysed using high throughput analytical platforms; advanced isolation and sampling methods are required to minimize protein loss and a highly sensitive techniques are required for analysis of the proteome. Single Cell Proteomics can be applied for generation of a proteome map of each kind of cell in multicellular organisms and single-cell organisms. This helps in the study of protein expression and modification under a given biological condition,characterization of protein functions in a genome, identification of protein localization and compartmentalization at a given time, and determination of protein– protein interactions related to a biological process.

INTRODUCTION

The body is made of different organs and tissues having specific function and processes making up the different systems of the body. Each system undergoes different physiological and biochemical processes. Any deviation from these processes can lead to diseases. These disease conditionscan be understood only after complete comprehension of the normal physiological and biochemical processes. Wholesome knowledge of all molecules expressed at a particular time under different conditions and their interactions within subcellular level and between different types of cells of an organism is required to comprehend and manipulate the key processes *(Altelaar et al., 2013).* For the expression of molecules, the genes for the molecule have to undergo the central dogma where the end product is the proteins and through these proteins, the different molecules are expressed. Therefore, the full knowledge of the protein expressed is highly required to understand the physiological and biochemical processes

and even the pathological process in the body. Cells can be analyzed on different levels of the central dogma – when it is done on DNA, it is called Genomics, when it is done on mRNA, it is called Transcriptomics and when it is done on Proteins, it is called Proteomics. Genomics and transcriptomics can be used for analysis of a cell but they have disadvantages as they cannot open most of the cellular windows, since proteins are the end product of central dogma and gene expression is unable to fully predict the expression of protein molecules and their modifications (Su et al., 2017).

CONCEPT OF SINGLE CELL PROTEOMICS

Single cell proteomics is an emerging technique for protein identification using various throughput analytical platforms. Some microbial cultures and mammalian cell cultures are composed of many cells with identical genomes growing in the homogenous environment. These cells are expected to produce identical proteomes but they do not have same proteome.The proteomes of cells from homogeneous culture share many similarities which can be identified by lysis of millions of cells together and analysed by LC-MS/MS to quantify the average abundance of each protein across all cells togive the population average. Population average often overlook the cellular heterogeneity; therefore, population average is not representative for all cells. The differences in the proteomes have significant functional consequences. Such differences can only be detected by quantifying protein levels in individual cells. (Specht et al., 2018)

SINGLE CELL PROTEOMICS – NEXT LEVEL CELL ANALYSIS

Multicellular organisms show heterogenicity in expression of protein molecules under a particular condition at a particular period of time. So, in Single Cell Proteomics, the proteome of each individual cell will be analysed using high throughput analytical platforms. Cell analysis may be qualitative or quantitative or both. The qualitative andquantitative analyses of a proteome can provide insight into the response of a cell population, tissue,or organ under different disease conditions; the therapeutic effect ofdrugs; the effect of disease on survivability; the functioning of organs, regenerativeprocesses, differentiation, aging, etc. (Suet al., 2017; Budnik et al., 2017).
Proteins cannot be amplified like nucleic acids, so, advanced isolation and sampling methods are required to minimize protein loss and a highly sensitive techniques are required for analysis of the proteome(Pellerin et al., 2015).The technologies in Single Cell Proteomicshave potential to identify large number of proteins expressed within a single individual target cell at a given time.

TECHNIQUES IN SCP

The general steps involved in Single Cell Proteomics includes cell isolation, sample preparation, generation of proteome map by high throughput analytical platforms and analysis using bioinformatic tools. These techniques allow high throughput screening with high sensitivity to prevent protein loss. The different techniques involved in Single Cell Proteomics are given below: (Minakshi et al., 2019)

	CELL ISOLATION	
	Method	Principle
1.	Fluorescence Activated Cell Sorter (FACS)	Encapsulation of cells into small liquid droplets, label with fluorescence coupled into antibody and separation of labelled cells using electric field.
2.	Laser Capture Microdissection (LCM)	Transparent thermoplastic film applied over target cell. With laser beam focus, target cell adheres to the film. Removing the film captures the target cell fused with the film for isolation.
3.	Manual cell-picking	Target cells picked by micropipette coupled with sharp tungsten needles.
4.	Limiting dilution	Based on serial dilution. Samples are diluted upto an extent that leads to single-cell isolation
5.	Microfluidics	Droplet in oil-based isolation, pneumatic membrane valving and hydrodynamic cell traps
	SAMPLE PREPARATION	
1.	Physical and mechanical force induced cell lysis	Optical Laser, electrical field and sonication can be applied.
2.	Chemical lysis of cells, protein precipitation and contaminant removal	By detergent lysis where detergent is incorporated into the cell membrane, solubilizing lipids & proteins in the membrane leads to formation of pores and full cell lysis
	ANALYTICAL PLATFORMS	
1.	Fluorescence flow cytometry	Based on the principle of binding of target proteins with differently labelled antibodies for data generation
2.	Mass Cytometry	Based on principle of binding of target proteins with differently labelled antibodies for data generation but a pure heavy metal ion tag is applied instead of fluorochrome.
3.	ELISpot	Principle same as Sandwich ELISA but on a nanoscale
4.	Single Molecule Array (SiMoA)	Based upon the isolation of individual immunocomplexes on paramagnetic beads using standard ELISA reagents
5.	Microfluidic antibody capture chip (MACS CHIP)	Combination of the fluorescent labeling of an antibody, a chip, software and modern microscopy
6.	Single cell western blotting	Follows principle of western blotting but done in a standard histopathological microscope slide.
7.	Capillary electrophoresis	Samples injected into capillary tube containing a liquid polymer or gel. Samples separated based on their electrophoretic mobility by applied voltage.
8.	Ultrathin layer gel electrophoresis	Depends on two-dimensional gel electrophoresis.
9.	MALDI-TOF MS	Based on measurement of the mass-to-charge ratio (m/z) of

		different analytes
10.	SCoPE-MS	Depends on liquid chromatography tandem mass spectrometry (LC-MS/MS).

APPLICATION OF SINGLE CELL PROTEOMICS

Single Cell Proteomics can be applied for generation of a proteome map of each kind of cell in multicellular organisms and single-cell organisms. This helps in the study of disease development and its effect on different kind of cells, for diagnosis, treatment, and prognosis of treatment (Mannello et al., 2012; Magness et al., 2017). It is used in the study of protein expression and modification under a given biological condition, characterization of protein functions in a genome, identification of protein localization and compartmentalization at a given time, and determination of protein– protein interactions related to a biological process.

Single Cell Proteomics can be applied for lineage tracing of cellular phenotypes, for comparing the functioning of different immune cells in normal, deficient and excess, cancer immunotherapies, phosphoprotein signalling pathways, analysis of cell motility, response of targeted inhibitors on cancer cell, response of cells to engineered molecular stimulations or different cells nearby, cell-cell separation distance, understanding of cellular functionality, high-throughput drug screening, etc. (Heath et al.2016)

Single Cell Proteomics helps in biomarker discovery and drug development. It also helps in cancer diagnosis by its ability to reveal the origins and properties of cancer cells, the progression and susceptibility to drugs and the response of immune system to cancer cells (Mannello et al., 2012).

CONCLUSION

Single-Cell Omics is a powerful tool for analysis and sampling of single cells from a heterogenous pool. It can help in the comprehension of variabilities of different cells at each level of central dogma. As the proteins are the final product of the central dogma, Single Cell Proteomics can help in analysis of different proteome of cells at individual level to comprehend the normal biological processes and pathological processes in the body. With the development of high throughput and highly sensitive techniques, SCP has the potential to help in faster and more accurate diagnosis of diseases, especially cancer; potential for development of highly specific drugs to act on the specific cells and potential to aid in getting better analysis and understanding of the developmental processes of life. So, Single Cell Proteomics will open the gateway to transform biology and medicine.

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Point of Care Testing (POCT) in Clinical Veterinary Biochemistry

Himalaya Bhardwaj[1]*, Tajeshwer Preet Kaur[2] and Raunak Bhardwaj[3]

[1]Department of Veterinary physiology and Biochemistry, GADVASU, Ludhiana, Punjab-141004.
[2]College of Animal Biotechnology, GADVASU, Ludhiana, Punjab-141004.
[3] Remount and Veterinary Corps, India.

**Correspondence Author; himalaya530@gmail.com*

Abstract

In Veterinary, clinical biochemistry labs play important role in diagnosis of different infectious diseases but sometimes these laboratory methods of diagnosis delay the treatment of animal and so increase the risk of life of animal. Therefore, alternative to lab diagnosis is point of care (POC) testing, which involves bedside testing of different laboratory parameters like pH, Blood gas analyzer, pCo2, electrolytes etc. and decrease the therapeutic turn around time. PoCT technologies can be split into many categoriesout of which the two major categories, the first is small handheld devices, providing qualitative or quantitative determination of an increasing range of analytes (glucose, electrolytes, antibody). The second category of devices are larger, often bench-top devices that are essentially laboratory instruments thathave been reduced in both size and complexity. These include critical care analyzers and, more recently, small haematology and immunology analyzers. Recent advances in emerging technologies [i.e., cellphone (CP)-based technologies, paper-based assays (PBAs), and lab-on-a-chip (LOC) platforms] are paving the way for next-generation point-of-care testing (POCT). In veterinary with the advancement of artificial intelligence, this area is likely to grow with many devices being developed and is likely to reach the commercial market in the next few years.

Keywords: POCT, Veterinary, Cell phone.

INTRODUCTION

The most important driver responsible for the increased growth in the veterinary diagnostic market is the imminent demand for the animal-derived food products and a higher rate of occurrence of zoonotic diseases. Diagnosis of diseases in companion animals like cats, dogs and horses are expected to boost the demand for veterinary diagnostics for maintaining the animal health and safety over the forecast period. Zoonosis can cause a wide range of ailments in individuals and animals resulting in mild to severe illness and can even cause death.With the development of artificial

intelligence, (AI) and technological innovations in healthcare sector provide a closer connection with the patient. With the use of smartphone apps, biosensors, lab-on-a chip, and wearable devices—all of which offer an on spot or near patient bedside diagnostics(Vashist et al. 2015). Therefore, on spot testing technologies are quickly becoming part of the healthcare landscape. The driving concept in support of point of care testing (POCT) is to bring testing closer to the patient and results conveniently and quickly to the provider to expedite diagnosis and subsequent treatment. POCT helps in decreasing turn around time (TAT), time from test request to patient treatment.Point-of-care testing (POCT) is the testing of patient samples outside the hospital laboratory, in clinical areas near to the patient, usually by staff who are not trained and registered healthcare scientists. Other terms used to describe POCT includes bedside testing, near patient testing. POCT's devices popularity has risen in recent years, As POCT devices are very handy so they are very helpful in improving likelihood of patient, physician, and care team will receive the results faster, allowing for immediate clinical management decisions. Furthermore, development, implementation, and connectivity of portable diagnostic and monitoring devices for POCT will be part of a successful shift from curative medicine to predictive, personalized, and pre-emptive medicine.

BACKGROUND

In 1500 B.C.,Egypt pharaoh's doctor noticed accumulation of ants around the urine of some people rather thanothers that gives the indication of some disease in humans. Inthe pre -1900s, chemical analysis have been carried out close to the patient, i.e., at the bedside, or more commonly, in specially designated ward side- rooms since they were first introduced for diagnostic purposes during the early 19th century at differenthospitals. So with the advancement in science push the diagnostic lab methods to point of care testing to decrease turn around time and for faster result so that treatment will start.

In 1950s, first urine test stripswere made on industrial scalecommercially. Company Boehringer Mannheim, today Roche, launched its first Combur test strips (urine) in 1964. The first glucose meter were used in 1970 under name of Dextrostix®. In 1990 MediSense, now owned by Abbott Laboratories, introduced electro-chemical readings or biosensors, which were supposed to make glucometers more accurate. This is done by turning biochemical reactions into electrical signals.

FACTORS STIMULATING POCT DEMAND

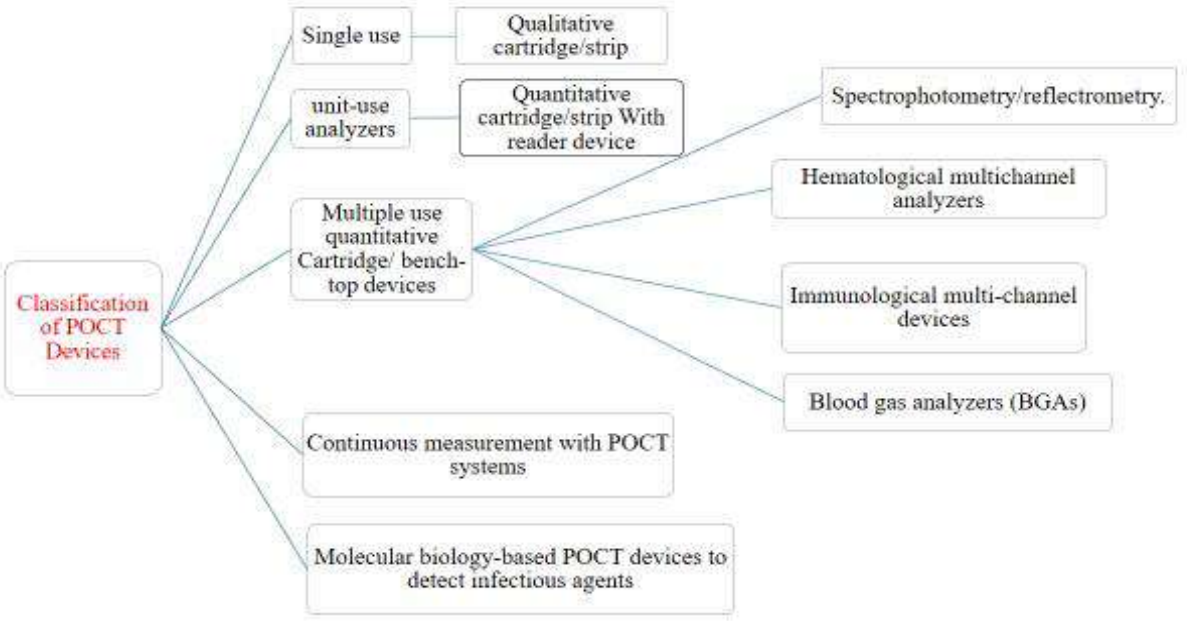
The increasing prevalence of infectious zoonotic diseases in developing countries, the rising incidences of lifestyle diseases such as cardiac diseases and diabetes, the rising usage of home based POC devices, and technological advancements with regard to development of advanced, faster, and easy to use devices are stimulating the demand for POCT (Bill 2012).

- Technological advancements (faster, easier-to-use devices)
- Laboratory staff shortages
- Increasing older population and more chronic disease

- Rising incidence of lifestyle diseases (e.g., cardiac, diabetes)
- Increase in home-based POC usage
- Long-term savings
- Rural locations with limited lab services
- Prevalence of diseases in developing countries

TYPES OF POCT TECHNOLOGY

A typical classification of PoCT technology splits devices into small handheld ones including quantitative and qualitative strips, and those which are larger bench-top devices with more complex built-in fluidics, often variants of ones used in conventional laboratories (Umesh G. 2018).



Now-a-days, biosensor as the basis of analysis in many point-of-care testing (POCT) instruments. Biosensors are used for toxicology and drug screens, measurement of blood cells, coagulation, detection of cardiac markers and glucose self-testing.Different others POCT devices works on different analytical principle like

(a) Reflectance : e.g. Urine and blood dipsticks for glucose and various other analytes,

(b) Electrochemistry in strip device, cassette and bench-top device

(c) Lateral Flow Immunoassays: The recognition agent is an antibody that binds to the analyte in a biological sensor.E.g. measurement of troponin T, myoglobin, and D-dimer.

REQUIRED FEATURES OF POCT DEVICES

Designers of PoCT devices start with the needs of their users and some extent depend on the clinical setting(Price Cet al. 2010). However some key features include are common to virtually all users in all settings: (Table 1)

1. It must be simple to use.

2. The reagents and consumables are robust in storage and usage.
3. The results should be concordant with an established laboratory method.
4. The device together with associated reagents and consumables are safe to use.

Table 1. The **ASSURED** guidelines that indicate the features that should be designed into all PoCT devices.

1	**A**ffordable	For those at risk of infection (Improve economic outcomes)
2	**S**ensitive	minimal false negatives
3	**S**pecific	minimal false positives
4	**U**ser-friendly	minimal steps to carry out test
5	**R**apid &**R**obust	short turn around time (TAT) and no need for refrigerated storage
6	**E**quipment-free	no complex equipment
7	**D**elivered	to end users

(TAT = time from test request to patient treatment)

Novel Technological Developments: With the advancements in artificial intelligence and technology new generation POCT devices includes the usages of cell Phone (CP) Based Technologies e.g. iHealth Align glucometer, paper base assay (PBA) e.g. cardiac markers estimation and lab on chip (LOC) devices which is very helpful in on spot determination of results near bed side patients. Following things to keep in mind while developing new generation devices (Vashist et al. 2015).

(a) Miniaturization: With the trend of increasing miniaturization of devices and the application of technologies developed in relation to consumer electronics, it is becoming increasingly possible to make smaller and smaller devices that incorporate all of the previous mentioned design features. Microfluidics, chip technology and DNA may be directly analyzedin a few microliters of sample. The advantages of miniaturization fluid volumes in the nL and pL range, Requires less time (Vashist et al. 2015).

(b) Parallelization: Chip technology opens up the possibility of measuring multiple channels or multiple time points in the smallest space; photolithographic techniques allow reaction reservoirs and liquid channels to be etched on a wafer to enable 100 or more measurements to be taken simultaneously(Vashist et al. 2015).

(c) Networking: Next-generation laboratory systems will generally be networked via IT, and an international communication standard (POCT1-A) already exists for this purpose

The available market for both professional and patient self-monitoring POCT tests and includes testing kits for blood gases/electrolytes, cardiac markers, cholesterol/lipids, coagulation monitoring, drugs of abuse testing (DAT), fecal occult blood, food pathogens, glucose monitoring, hematology, infectious diseases, pregnancy and fertility, tumor/cancer markers, urinalysis testing

Some examples where POCT devices can be used includes:

- Outbreaks of disease veterinary medicine;
- Critical Care Unit Emergency Department
- Respiratory Medicine Outpatient Department
- Community Respiratory Service in managing COPD
- Air Ambulance Retrieval Unit
- Remote Rural Hospitals
- Intra–operatively in cardiac bypass surgery
- General Practice
- Home Use
- Military medicine
- Mobile emergency paramedical care (blood mobiles, mobiles for public events); transport vehicles (e.g., ambulances and helicopters);
- Fitness studios.

Point Of Care Diagnostics In Veterinary Medicine

Many pet owners desire to have all the information possible to make important decisions about their pet's healthcare, while they are also very busy with life's fast pace and are actually stressed about the veterinary visit and health of their pet. Since many veterinarians send blood to a commercial lab and the results are not returned for interpretation or discussion until after the client leaves the building, the assumption is made that the client is not concerned with the wait. The veterinarian must assume that not only is the wait ok for the client, but that running the tests at the point-of-care does not provide a medical or financial advantage to the practice, client and patient. Veterinarians account for multiple factors when determining whether to run blood work in house or send to a commercial laboratory. Various common reasons for the choice of POC testing includes:

1. Cost
2. The time (or perceived time) to prepare and run the sample
3. The perception of the need for immediate results
4. The work flow of the practice
5. The tests available on the panel vs. those on the point-of-care analyzer

Benefits of POC testing (Umesh G. 2018)

- Faster test results lead to more timely triage or treatment
- Less sample volume (neonatal, pediatric, ICU benefit)
- Tests at a variety of remote locations meet a diversity of medical needs
- Decrease pre-analytical concerns related to processing of specimen. (e.g., clotting, centrifugation, etc.)
- A Lean process
- Improved patient morbidity & mortality Reduction in hospital admission
- Increase provider and patient satisfaction
- Reduce length of hospital stay

- Reduce hospital admissions
- Optimize drug treatments
- Decrease inappropriate use of drugs
- Reduce postoperative care time
- Rapid analysis times
- Optimize clinical efficiency and use of staff time
- Reduction in clinical visits

Disadvantages (Vashist et al. 2015)**:**

- Increase in administrative work associated with training and Certification of operators
- Caregivers required to perform test so chances of increased risk of errors
- Interference due to endogenous substances in the sample can affect result.
- Result is dependent on operators.
- Narrower measurement range for some analytes or variability in results.
- Higher cost of POCT compared with laboratory testing. Cost can, however, be partially offset by processing small sample volumes on-site with resulting short TTAT (therapeutic turn around times) to minimize the overall hospital cost.
- An extra step is required to integrate test results with laboratory information systems.

Quality Control (QC)Requirement:

This is very important step in POC testing, if any test performed incorrectly presents a significant patient risk and potential for increased healthcare costs. So quality control tests must run time to time like in areas of low use, QC should be conducted weekly even when patient samples are not processed to identify faults. Testing should be conducted at each analyzer site to monitor differences in storage conditions and operator performance.

CONCLUSION

- Decreasing costs, rapidly increasing processing power, inbuilt sensor and camera capabilities, connectivity, and widespread uptake even in the developing world, CPshave emerged as highly promising interfaces for POCT, thereby constituting the next generation of futuristic smart devices for affordable personalized health care, mobile veterinary care, and telemedicine.
- Recent developments in paper- and LOC-based microfluidic assays together with novel assay formats have unprecedentedly expanded the number and complexity of tests that can be conducted using low-cost and disposable POCT kits, particularly in the developing world.

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