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Role of Youth in Agriculture: A SWOT Analysis

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INTRODUCTION

> ***"Unless farming becomes both intellectually stimulating and economically rewarding, it will be difficult to attract or retain rural youth in farming"***
>
> ***-Dr. M.S. Swaminathan***

India is a young country and is emerging as future young nation in the globe with more than 50% of its population below the age of 25 and more than 65% below the age of 35. According to National Youth Policy (2014), youth are defined as those aged between 15 to 29 years. The Indian population under this age group comprises 27.5 of the total population, giving India a favourable demographic profile. With this immense potential of youth, the country is adding 2 million young people to the ranks of unemployed every year which would entail tremendous cost, including social unrest and dislocation. Agriculture largely being the primary occupation in India contributes to 15.35% of national GDP and covers 68% of total population. At present, the challenge before the country is to produce more food grains to feed the exorbitant growing population with limited manpower in agriculture, which is likely to reach 1.5 billion by 2030 (Swaminathan,2009). However, the average age of the farmer was estimated to be 50.10 (Agriculture Census, 2016), which means we need to attract youths in large number to increase the pace of productivity and efficiency in agriculture. But hardly 5 per cent of the rural youth is getting engaged in agriculture and allied activities. Increasing literacy, awareness and training programmes in rural areas is ray of hope for bringing youth masses back to agriculture. Therefore in future, rural youth will play a key and significant role in meeting the food and nutritional security in our country.

Importance of Youth in Agriculture

Youth being innovators and potential early adopters are capable of adopting new concepts, ideas and technology and implement as per their needs and situation. Their thinking is more dynamic, sensitive and receptive which can be

better utilized in the rapid transfer or dissemination of innovations among other farmers in their own and adjoining villages. Today's youth resort to modern and scientific agricultural practices and use techno friendly, climate smart agriculture technologies to combat the weather distress, market risk, post-harvest loss, drudgery and distress sale of the farm products. The agricultural extension also plays vital role in providing advisory services (weather alert, market information etc.) through cyber extension as maximum rural youth are using cell or smart phones. Youths need to explore new avenues in agribusiness start-ups, farm-market linkages, producer-consumer network for direct marketing, value chain management in post-harvest agriculture etc. for their sustenance. There is a huge scope for self employment and income generation for youth in allied non-conventional agriculture like livestock farming, mushroom cultivation, apiary, sericulture, dairying etc.

Realities on ground: Migration of Rural youth is the biggest problem nowadays. The present youth are attracted to lucrative jobs, urban facilities, assured employment, early return to investment in other enterprises, professionalism in job for status maintenance etc. which create harsh competition among the youth in urban area. This creates under employment and disguise employment among youths. Education and Mass Media exposure is inducing high aspirations among rural youth resulting in migration of youth from agriculture to non-agriculture sectors. Education system does not involve agriculture in initial years due to which interest is not created in the young minds. Even the majority of the farmers are not in favour of their children taking up agriculture and settling in villages. Agriculture is ridden with uncertainties in monsoon and markets making it one of the risky professions. Hence, for agriculture, there are few takers among rural youth by choice.

Table 1 Activity wise distribution of workers by different age groups (2015-16) in percentage.

Industry	15-17 years	18-29 years	30+ years
Agriculture and Allied	53.4	38.1	47.2
Mining and Quarrying	1.9	0.9	1.1
Manufacturing	14.5	13.2	9.6
Electricity ,Gas and Water Supply	0.2	0.6	0.6
Construction	14.8	15.1	10.0
Trade ,Hotels and Restaurants	12.2	19.4	17.5
Transport Storage and Communication	1.1	3.7	3.9
Financial, Insurance, Real Estate and Business Services	1.4	8.3	9.2
Community, Social and Personal Services	0.6	0.7	0.8
Total	100	100	100

Source: Report on Youth Employment and Unemployment Scenario, VolI, 2015-16

SWOT ANALYSIS OF RURAL YOUTH

Strength

- They posses good energy and have risk taking abilities.
- They have capacity and efficiency to produce more.
- Due to their exposure to media, they are capable of accepting new ideas and technology in farming.

Weakness

- Elderly farmers in the family take the decisions in farming. Hence, youth's role in decision making is limited.
- They lack training in improved methods and skills.
- Non-remunerative prices to agricultural produce.
- Agriculture is not perceived as lucrative vocation.

Opportunity

- Increased market for agricultural produce and secondary agricultural commodities, which ensures good income to young farmers.
- Farmer's friendly policies, incentives and schemes of the government in the field of agriculture.
- Training opportunities through KVK's and other training institutions.
- Continuous hike in food prices so that farm produce attracts highest prices.

Threat

- Better opportunities for youth outside agriculture.
- Increased migration to urban areas.
- Less respect for agriculture profession.
- Poverty and unemployment in rural areas.
- Lack of education
- Addiction to drugs, alcohol etc

Strategies to engage youth in agriculture

1. Link social media and ICT tools to agriculture.
2. Improve agriculture image amongst young people by creating awareness and interest for greater market engagement, innovation and farming as a business.
3. Empower young people to speak up and actively participate in policy making and discussions at national levels.
4. Facilitate access to land and credit.
5. Include agriculture or modules of farming in school curricula and provide gateway to agriculture as potential career opportunity.
6. Attract greater public investment in agriculture.
7. Make agriculture more attractive through value addition of the products.

CONCLUSION

Youth in India can play an instrumental role in addressing the challenges of food security through proper capacity building and sensitizing them towards

agriculture. Increased focus on skill training programs, providing financial support, incubation and entrepreneurship facilities will provide extra push and ample opportunities to the rural youth in various sectors like commercial agriculture, processing, marketing and export. Ensuring youth access to the right information is crucial; integrated training approaches to respond to the needs of a more modern agricultural sector; modern ICTs will bring youth together to improve their capacities for collective action. Therefore, concerted efforts should be made by government, policy makers and other stakeholders in response to increase youth's involvement in the agricultural sector as a rising food demand with increased population and decreasing agricultural productivity.

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Cryopreservation of Fish Gametes

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ABSTRACT

Cryopreservation is considered as one of the most important methods of fish gamete conservation. With the help of this method, fish spermatozoa can be stored for a long time. This is a very useful technology as it helps in in easy transport, avoiding maintenance of male fish, rapid genetic improvement etc. The process of cryopreservation includes collection of spermatozoa, dilution, mixing of cryoprotectant, storage at (-196°C) and thawing before reuse. Cryopreservation of fish spermatozoa has gained huge success, but success in case of egg and embryonic cells preservation in fish still remains a challenge.

Keywords: Cryopreservation, cryoprotectant, fish, gamete

INTRODUCTION

Cryopreservation is a very low-temperature preservation process in which cells, tissues, organelles, organs, extracellular matrix are protected and stored for future use. The temperature maintained during cryopreservation usually is in the range of (-80°C) using solid carbon-di-oxide or (-196°C) using liquid nitrogen. At extremely low temperatures, damage-causing enzymatic or chemical activities are stopped effectively which are responsible for the degradation of biological materials. Recently this technique has been successfully used for fish gamete preservation. Gametes especially sperm preservation through this technique is a well-developed procedure in animal husbandry. So, cryopreserved sperms are incorporated in the insemination of cattle, horse, pig, sheep and poultry breeding with great success.

Now it is very much surprising that renovation, modernization and up-gradation in this technology made scientists successful to transfer this process for the preservation of ova, sperms and embryos of fish.

PRACTICAL APPLICATION OF CRYOPRESERVATION IN FISHERIES AND AQUACULTURE

- Distribution of fish gametes from one location to another location makes easier.
- The headache of maintenance of male brood fish is reduced.
- Make easier of year-round seed availability.
- The selective breeding program becomes easier.
- Androgenic fish production becomes fruitful.
- Preservation of genetic resources.

USEFULNESS OF CRYOPRESERVATION TECHNIQUE FOR FISH BREEDING

- ❖ By this technique of cryopreservation, sperms/ova can be conserved/protected from spoilage with no time limit. So, by the use of this technique, we can easily overcome the problem of non-sequential maturation of male and female fish.
- ❖ The technique of selective breeding can improve the indigenous stock by producing special strains of the superior stalk. This cryopreservation technique enables the third-world countries to adopt selective breeding technique efficiently.
- ❖ Production of mono-sex culture can be enhanced by this technique.
- ❖ As cryopreservation helps to preserve fish gametes successfully, fish supply throughout the year as per requirement can be possible through the adoption of cryopreservation technique in the fishing industry.
- ❖ Establishment of genebanks served the purpose of preservation of the genetic identity of a strain which is possible through the adoption of cryopreservation technique for fish-gametes.
- ❖ Cryopreservation technique can be applied for sperms, eggs and embryos. In case of preservation of egg and embryo, application of this technique is not successful due to unavailability of proper cryoprotectants which can sufficiently be absorbed in these cells because of their larger size in comparison to spermatozoa.
- ❖ The species for which cryopreservation of the fish egg is successfully done are *Oncorhynchus, Salmo, Salvelinus fortinalis, Hucho hucho, Thymallus thymallus, Esox lucius and Cyprinus carpio, Serothodon mossambicus, Labeo rohita, Catla Catla and Cirhinus mrigala*.

CRYOPRESERVATION OF FISH SPERMATOZOA

Cryopreservation of spermatozoa of several finfish and shellfish species have been successful because-

- ✓ They are smaller in size (4-6 μm).

- ✓ Larger in number per unit volume (several millionsperm/ml milt).
- ✓ Consists of a simple membrane which is easy to dehydrate or cryoprotect.
- ✓ Because of their smaller size, spermatozoa are very easy to collect and handle.

SPERMATOZOA HANDLING BEFORE FREEZING

- ✓ Spermatozoa collection from mature male should be done in such a way that it should not be contaminated with urine, mucus, water and feces of fish.
- ✓ Male can be injected with inducing spawning agents to ensure a higher quality of milt.
- ✓ Spermatozoa with motility more than 70% should be used for cryopreservation.

APPLICATION OF EXTENDER

- ✓ The extender is a mixture of inorganic and organic chemicals like those of blood/seminal fluid.
- ✓ An extender is slightly hypertonic in nature and prevents dehydration/exhaustion of spermatozoa.
- ✓ Chemical composition of extenders widely varies depending upon the physiological and chemical characteristics of the spermatozoa.

APPLICATION OF CRYOPROTECTANTS

- ✓ Cryoprotectants are added to the extender-milt mixture for preventing damage to cells during freezing.
- ✓ Common cryoprotectants used are Dimethyl sulfoxide (DMSO), methanol, glycerol etc.
- ✓ Optimum concentration: 5-15% of the total volume.
- ✓ Mainly two types of cryoprotectants are there, penetrating or intracellular and non-penetrating or extracellular.
- ✓ The time required for the cryoprotectants to be penetrated into the sperm cell is known as equilibrium time, which varies from a few minutes to several minutes.

STORAGE CONTAINER

- ✓ Polypropylene vials (1-2 ml).
- ✓ Pellets (40-200 μl)
- ✓ Plastics (0.25-0.50 ml)

DILUTION RATIO

Dilution is done to increase the volume and use in more cases. The sperm and dilutant ratio varies between 1:1 and 1:10 depending upon species.

FREEZING/COOLING STAGE

- ✓ This is the most critical stage of cryopreservation.
- ✓ The optimum rate of freezing is 10-45 ℃ /minutes.
- ✓ Most commonly used cryogens for freezing spermatozoa is the liquid Nitrogen (-196 ℃).

WARMING/THAWING STAGE

- ✓ Thawing stage is also one of the most vital ones for cryopreservation.
- ✓ As slow thawing may cause recrystallization, so very rapid thawing rate is recommended for successful cryopreservation.
- ✓ The ideal thawing rate is 50-70 ℃ is recommended.
- ✓ The thawing of spermatozoa is done by agitating them in the hot-water bath at 37℃ for 10-15 seconds.

VIABILITY OF CRYOPRESERVED SPERMATOZOA

Spermatozoa stored under liquid Nitrogen remain fertile with no time limit.

CRYOPRESERVATION OF EGGS/EMBRYOS

This is not a successful process because of

- ✓ Presence of membrane of different water permeability.
- ✓ The relatively larger size of fish eggs (1-6 mm), insufficient dehydration during freezing/cooling.
- ✓ In the case of invertebrate eggs and embryos method of cryopreservation has become partially successful.

CRYOPRESERVATION OF EMBRYONIC CELL

- ✓ Cryopreservation of embryonic cells are partially successful as if the cells are removed from the blastula then can be successfully cryopreserved.
- ✓ The removal of cells is very laborious work, which needs lots of work, which make it unsuitable for practical use.

CONCLUSION

Cryopreservation of fish gametes is the most important conservation methods for fish germplasm which has a wide range of application in aquaculture and fisheries management. This technology has been recognized as very much useful tool for making fish breeding programs successful. This is considered as the means of artificial fertilization and responsible for increasing quality seeds of fish. Cryopreservation of fish spermatozoa have gained huge success, but success in case of egg and embryonic cells preservation in fish still remains a challenge.

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Management of Heat Stress in Dairy Cattle

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Abstract

Heat stress during the summer season has a negative impact on the growth, productive performances and reproductive ability of the dairy cattle. It results in decreased body and depression of milk yield. To combat this situation proper managemental practices should be followed. These include breeding management, selection of heat-tolerant animals, feeding management, housing management and provision of the cooling system in the farm. This will relieve the animals from heat stress and strengthen the economy of the farmers.

Keywords: Cattle, climate, heat stress

1. INTRODUCTION

India is the largest producer of milk in the World. Crossbreeding of local breeds or non-descriptive breeds has a great contribution to this achievement. More than 20% of the dairy cows of India are crossbred. But these crossbred animals are highly susceptible to heat stress which can reduce the milk production and fertility remarkably. In summer season the temperature goes very much above the comfort zone of the cows. An abrupt increase in temperature and humidity greatly affect the milk-producing animals. Especially the crossbreed or exotic animals are more susceptible to heat stress compared to indigenous cattle. Continuous emission of greenhouse gases has worsened the situation. Several anthropogenic activities have contributed a lot in environmental pollution resulting in global warming. This has a serious negative impact on all the living organisms including the domestic

animals. Deterioration of productive and reproductive performances of dairy cattle is a burning example of that. Besides disturbing the well being of the animals the economical condition of the farmer and producer is also affected. So, necessary steps should be taken to maintain productivity as well as the well being of the animals. In this article, we have briefly described the managemental practices that can alleviate the heat stress in dairy cattle.

2. EFFECTS OF HEAT STRESS ON DAIRY CATTLE

Heat stress can impair health, productive performance and reproductive ability of the animals. With the increase of environmental temperature, the temperature of the animal also increases. So it tries to reduce its temperature through evaporation or panting. Respiration rate and water intake are increased and the endocrinological balance of the animal is disturbed. In order to lower digestive and metabolic heat production the animal reduce feed intake. Consequently, it results in decreased body weight and milk production. The immune system is also compromised and the animal becomes susceptible to several diseases. Besides the loss in production, the reproductive performances of the cattle are also disturbed. Normal estrus cyclicity and follicular dynamics are not maintained due to an imbalance of reproductive hormones. A decrease in conception rate and fertility has also been observed in the dairy animals during the summer season. In the case of pregnant animals, heat stress can compromise embryonic development and increase embryonic mortality.

3. MANAGEMENT OF HEAT STRESS

It is very much important to reduce heat stress in dairy cattle to maintain health and productivity. There are several methods which can help the animals to minimize stress. It includes breeding management, proper selection of animals, feeding management, housing management and installation of the cooling system in the farm. These practices are described below.

3.1 BREEDING MANAGEMENT

Many farmers prefer natural breeding over artificial insemination due to several reasons. But this may aggravate the situation. As already discussed above, in the summer season, the estrus cycle is disturbed and estrus detection is also poor. So there will be a need for repeated mating of the animal. Still, there will always be a chance of lower conception rate as the bull is also a victim of heat stress and shows poor fertility. Almost all the semen parameters of the breeding bull are deteriorated in higher environmental temperature. Alternatively, artificial insemination can be a good option. As the semen straws are cryopreserved, there will be no effect of heat stress on these. It can easily bypass the effect of heat stress on bull fertility. The estrus cyclicity and follicular dynamics of the cow can also be manipulated. Pregnancy rate can be increased through insemination at a fixed time following estrus synchronization process through the injection of GnRH and $PGF_2\alpha$. This TAI (Timed Artificial Insemination) protocol can help in eliminating the problem of

estrus detection. In this way, the animals will return to normal estrus cyclicity and will be pregnant subsequently.

3.2 SELECTION OF HEAT TOLERANT ANIMAL

It is very important to select those animals which are more heat tolerant. In this case, the indigenous cattle breeds or *Bos indicus* shows more competency then the exotic breeds or *Bos taurus. Bos taurus* cattle breeds have evolved in temperate environments and they fail to adapt the hot climatic conditions of India. On the other hand, *Bos indicus* can easily adapt to these conditions. They possess several characteristics features that help them to tolerate the heat load. They have a higher sweating ability, light-colored coat and a large body surface area. So, they can easily dissipate the heat produced in their body. So, they are less affected by heat stress. In higher environmental temperature they show minimum production loss compared to exotic cattle breeds. But, unfortunately, these breeds are not high yielder and a large number of Indian cattle populations are nondescriptive till date. So, the genetic improvement program should be essentially taken to upgrade the indigenous cattle population. Proper selection of indigenous cattle and cross-breeding them with exotic breeds can be a good solution. Crossbred animals with 50% exotic inheritance are preferable. 50% of indigenous germplasm will help to maintain adaptability, heat tolerance and disease resistance trait of the local breeds in crossbreds. Among the indigenous milch breeds Sahiwal cows show a higher heat tolerance in summer days. Vechur, a well known dwarf cattle breed of Kerala has also gained some attention due to its heat tolerance ability. It appears to carry a "thermometer gene" that help it to tolerate the higher temperature. Among the exotic breeds, Jersey cows show more tolerance to heat compared to Holstein cows. In moderate heat stress condition, the production of Jersey cows is not affected. So it is advisable to use the semen of Jersey bulls during artificial insemination of indigenous cattle. Through these above-mentioned ways, a farmer will be able to select a good heat tolerant animal.

3.3 FEEDING MANAGEMENT

A reduction in feed intake has been observed in heat-stressed animals. Actually, the animal tries to reduce the production of heat from digestion and metabolism. Consequently, the decreased feed intake results in decreased body weight and depression of milk yield (Fig 1). So, the ration of the animals should be carefully designed to maintain good production. The animals should be fed more concentrate and fewer roughages, as the roughages produce more heat during digestion. But the overfeeding of concentrate should also be avoided as it can result in acidosis. The frequency of feeding should be increased and the feed should be provided during the cooler time of the day. It is recommended to provide 40% of the daily ration in the morning and 60% in the afternoon or evening. Adequate clean and cold water should be provided to the animals all the times. The feed provided to the animal should be fresh and contain high-quality forage. Fat

supplementation can be provided to increase energy intake but excess feeding should be avoided. In heat stressed condition the demand for some minerals also increase. So, the mineral mixture should be provided with ration. The quality of the feed should be good and the use of total mixed ration is recommended.

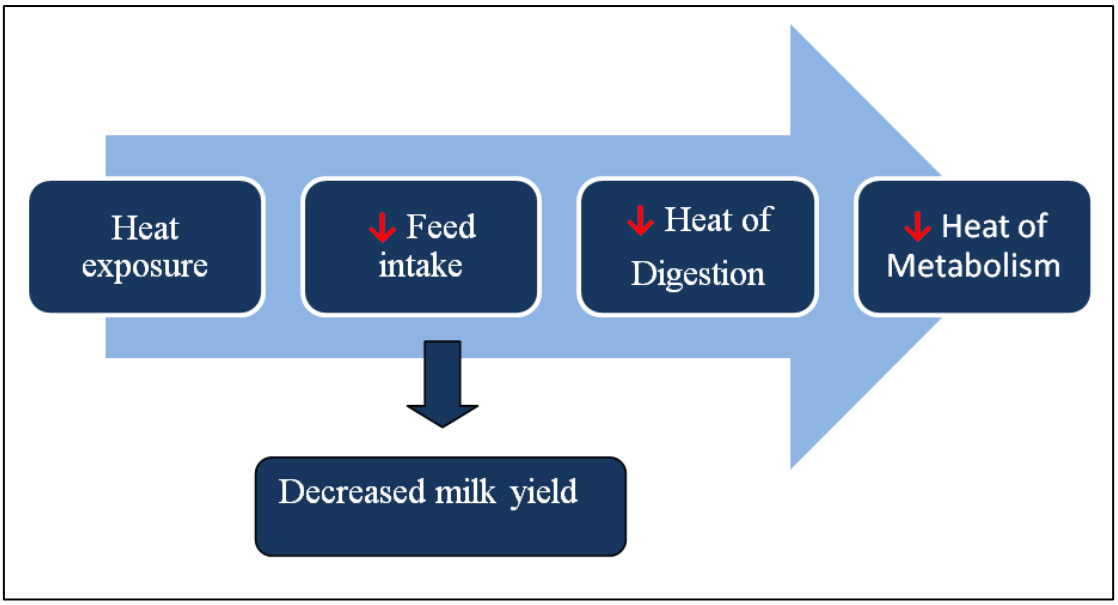

Fig 1: Heat stress causing decreased feed intake and depression in milk production

3.4 HOUSING MANAGEMENT

In Indian condition, the cowshed should be designed to protect the animals from heat stress rather than cold stress. The following points should be considered during building a shelter for animals.

- ✓ The long axis of the shed should be in East-West direction as it provides a cooler environment compared to North-South orientation.
- ✓ Use of an open type of shed is recommended compared to close type shed. The minimum and average temperature of the closed type sheds are always higher than the open type sheds.
- ✓ Slightly more shaded area than the minimum recommended floor space should be provided during the hot dry climate.
- ✓ To reduce heat load the roof height should be 10 feet.
- ✓ "A" shaped roof is recommended than the flat-shaped roof.
- ✓ The roofing material maybe hay, straw, galvanized steel, plastics etc. Hay or straw can be used as they are easily available and act as good insulator of heat (Fig 2).
- ✓ Two or three walls should be open at ridge level to maintain proper ventilation.
- ✓ The walls should be white outside and colored inside.

Considering the above-mentioned points will help in the preparation of comfortable shelter area for the dairy cattle in the summer season.

Fig 2: Cattle shed with a roof made of paddy straw (ERS, ICAR-National Dairy Research Institute, Kalyani)

3.5 COOLING MANAGEMENT

With the increase in environmental temperature, the animals start sweating. Evaporation of the sweat provides a cooling effect on the skin. Besides, these animals also increase their respiration rate and evaporate moisture from the mouth or lung.

Water can be sprayed on the body of the animal or the shelter to cool the environment. Fan and blowers can also be used to facilitate the evaporation process. It will help to reduce the temperature of the skin to the extent of 8-15°C. A study in National Dairy Research Institute, Karnal has shown that the mist and fan cooling is very effective in ameliorating the impact of heat stress in dairy cattle. It also helps to maintain the milk production and feed consumption of lactating cows during hot dry and hot-humid seasons.

CONCLUSION

It is very much clear that the increased temperature in summer seasons with consequences of global warming have a negative impact on the productivity of dairy cattle. So, it is utmost important to take proper care and follow necessary managemental practices to reduce the effect of heat stress on the animals. Proper

attention should be paid during breeding of the animals. Use of timed artificial insemination is recommended in this case. Animals should be selected based on their ability to tolerate the heat load. Proper feeding and housing should also be provided at the time of higher environmental temperature. Appropriate care and management will not only maintain good productivity but also enhance the economic condition of the farmers.

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Techniques for Estimating Composition of Weed Seed Bank in Soil

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Abstract

Evaluation of the viable seeds in a soil, otherwise known as the seed pool or seed bank, is a crucial component of many weed dynamic and plant ecology studies. Seed bank estimation is used to predict the possibility of future weed infestations in rangelands as well as the nascent native plant diversity within them. There are two main methods for estimating seed density and species composition of soil seed banks: manual seed extraction and seedling emergence. This method was more effective in detecting seeds of large-seeded species. Discrepancies in seed detection between both methods may be related to seed dormancy, specific germination requirements, seed size and mass. These two methods are necessary to describe seed density and seed bank composition. The comparative analysis of seed bank extraction methods revealed higher weed seeds density, weed frequency with more diversity of weed species under separation method in comparison to seedling emergence method. Therefore, separation method was considered superior over seedling emergence method. The feasibility analysis of seed bank extraction methods indicated that separation method (sieving) was cost-effective, less time consuming, more user friendly with higher accuracy over seedling emergence method.

Keywords: Weed seed bank, separation method, Seedling emergence.

INTRODUCTION

Weeds are unwanted plant species growing in ordinary environment. In nature there are a total of 8000 weed species out of which 250 are important for agriculture world. The weed seed bank is the reserve of viable weed seeds present on the soil surface and scattered throughout the soil profile. Seed bank in soil is a natural source for weed infestation. Weed seeds may enter in the seed bank through many sources. Among the different sources, the largest source of weed seeds in the seed bank is plants producing seed within the field. Decline in weed seed bank may occur by various factors such as germination, seed predation, seed decay and death and deep seed burial to layers from where emergence onto the soil surface is impossible. These seed banks range from near 0 to as much as 1 million

seeds m^{-2}. Determination of soil weed seed bank has primary importance to get complete picture of weed seed reservoir in the soil profile and can help the farmer prevent severe weed problems before they develop. Soil weed seed bank determination techniques were separation method and seedling emergence method.

1. Separation Method

Seeds are collected from the soil sample and counted. It includes elutriation and floating. A common aim of these methods is to separate seeds from soil using physical principles. The seeds can be extracted from soil samples by hand (wheeling sieves under running water) or using various elutriation devices.

The separated seeds are identified and counted. Seed viability has to be determined either vegetation or non-vegetation methods in order to detect a number of living seeds. Only such seeds are able to infest the soil. The detected seeds were classified into the categories entire and healthy. The category of entire seeds includes the seeds that appeared visually intact and/or injured but viable. In non-vegetation method healthy seeds were considered those that were firm, resistant to preparation needle pressure.

Elutriation

It is based on flushing the soil sample placed on sieves with running water when a proportion of non-elutriated particles remain on sieves: mineral (sand, girts, etc.) and organics (seeds, post-harvest residues, roots etc.). In this way volume of the sample is reduced, which makes collecting, identifying and counting seeds in the remained proportion easier.

Floatation

In this, seeds are separated directly from the soil sample using the so-called floatation solutions. The seeds are added to a liquid with a density greater than that of seeds so that they skimmed off. Based on difference in specific weight, lighter seeds are separated from heavier mineral proportion

2. Weed seedling emergence

Soil sample is placed in the greenhouse or controlled environment, watered on regular basis in order to emerge the weed seedlings and these emerged seedlings are then identified and counted. Soil core samples weighing 100 gram were spread onto petri dishes in separate sections according to their depth and replication. These petri dishes were placed in the germination chamber. The temperature in the germination chamber is maintained from 20 ˚C during day time (12 hours) to 8 ˚C during night time (12 hours). Petri dishes were watered on daily basis avoiding samples to dry. Emergence of weed seedlings was observed on weekly basis. Emerged weed seedlings were identified, counted and removed at regular intervals. Unidentified seedlings were transferred to another pot and allowed to grow until seedling becomes identified. The trial ends when seedling emergence will be stopped.

CONCLUSION

Soil acts as storage house for different macro and microorganisms including insects, micro-organism, fungi, algae, spores, nematodes and seeds of different weeds. Both soil weed seed bank techniques were suitable for determination of seed bank but a physical separation of seed from the soil by sieving method was effective for more weed seed counts either dormant or non-dormant and better individual species detection as more weed species can be detected in the seed bank using this method. Two techniques provided different estimates of the relative importance value of individual weed species in the seed bank. Final results for weed seeds counts can be obtained in less time using sieving method as compared to seedling emergence method which may take long time for weed seed germination.

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Emerging Diseases: Viral Zoonoses

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Abstract
Zoonotic diseases spread from animals to man. The etiology responsible includes viruses, bacteria, fungi and protozoa. Emerging diseases occur sporadically in certain parts of the world. These diseases are unfamiliar outside endemic regions. Many a times, these pathogens remerge to cause large epidemics, possibly due to limited awareness and control of the agent. This article provides a brief review on viral aspect of emerging zoonosis expected in India.

Key words: Emerging diseases, viral zoonosis, arbovirus

INTRODUCTION

Emerging infectious diseases (EIDs) are diseases of infectious origin whose occurrence has increased within the recent past or threatens to increase in the future. New diseases and those re-emerging after a while are also called emerging infectious diseases [1].

Viral diseases have plagued man, from centuries. Small pox, the first viral pandemic known to man, is claimed to be identified as early as the 3rd century. Deaths in large numbers were seen in India and African countries. The survivors were identified with de-pigmented scars, where the pustules had formed. The small pox hurdle was tackled with successful vaccination, and is thought to be the only disease that has been completely eradicated. Poliomyelitis, a fatal disease of children, resulting in lameness or paralysis, has also claimed its share of lives in the early 20th century. With efforts from the WHO, the global polio eradication program drove poliomyelitis away with the oral polio vaccine. Today only 3 countries, Afghanistan, Pakistan and Nigeria are endemic to polio and it is soon expected to be a polio free world. Measles is another highly contagious viral disease especially in children. Vaccination practices and diagnostic techniques are being used to control outbreaks, yet the disease seems here to stay.

Epidemics are sudden disease outbreaks that occur above an expected level in a particular area. Pandemics, involve epidemics of vast surface area, such as countries and continents. The agents responsible are transmitted by arthropod vectors or wild animals. The majority (60.3%) of Emerging infectious diseases (EID) are caused by zoonotic pathogens, out of which vector-borne diseases were reported to be responsible for 22.8% of EID events [2] .Although, efforts have been made with regard to certain prevalent zoonotic diseases in India, such as a database[3] but the following diseases have not been discussed at length. Even the incidence of certain EIDs, have not been accurately identified.

EXPECTED EPIDEMIC SCARES

The Centre for disease control, labels certain zoonotic pathogens as emerging and remerging. Such viruses belong to *Bunyaviridae*, *Flaviviridae*, *Filoviridae* and *Togaviridae* family, collectively called 'Arboviruses' as they specifically have arthropods as their vector. Viruses of the family *Paramyxoviridae*, *Orthomyxoviridae*, *Picornaviridae*, *Coronaviridae* and *Poxviridae* have also been the leading cause of certain pandemics. The viruses discussed are zoonotic in nature with non-human host, such as monkeys, rats and ruminants playing the role of carriers. Secretions from these animals, meat, as well as vectors have been identified as routes of transmission. Human to human transmission occurs via aerosol in filo and corona viruses, whereas, it is deemed unclear in arboviral infections.

The Centre for disease control (CDC) and the World health organization (WHO) provide regular updates on disease outbreaks across the globe along with guidelines to be followed. Most of the diseases mentioned are identified to be endemic to certain continents. The global nature of today's citizen has introduced these endemic diseases into new neighborhoods. Based on the outbreak status reported by these esteemed organizations, a brief disease list has been compiled;

Crimean Congo hemorrhagic fever virus (CCHFV)

It is a viral tick borne fatal hemorrhagic disease that spans Europe, Middle East, Asia and Africa. Belonging to the bunya viridae family, it is characterized by petechial hemorrhages, bleeding as well as muscular pain. Health care and abattoir workers exposed to infected blood and mucosal tissue are at high risk. It has case fatality rate of 10- 40%[4].India has reported outbreaks in 2011 and 2016 [5]. Cases were described from Gujarat, Rajasthan and Uttar Pradesh [6]. Sheep's and goats are the other host of the virus having only mild symptoms. It is suspected to be also transmitted through unpasteurized milk [7].Vaccine based control measures are limited to an inactivated vaccine used in Russia and Bulgaria [8].

Nipah virus

It is a vector borne viral infection, of paramyxoviridae family, responsible for encephalitis, respiratory and systemic conditions. Case fatality rate up to 40% has been reported. Fruit bat vectors have been identified as natural hosts. The recent

epidemic of 2018 in India has identified date palm tree sap as a source of infected bat saliva. Epidemics, in Malaysia in 1999 [9] and India in 2018 has given us an insight into the lethality of this disease. Animals, especially pigs are affected with a fatal respiratory condition known as 'barking syndrome'. Health care workers and care givers can also easily contract this virus. Hygienic practices are relied on as a control measure as no vaccine is available in the market.

Zika virus

It is a mosquito born flavivirus, which causes flu like symptoms. It is predominant in the African subcontinent, Caribbean Islands and Asian countries. The virus causes a lethal disease responsible for brain defects at birth, putting pregnant women at risk. Human to human transmission has also been spotted [10]. Strict measures and guidelines have been taken up by the WHO and CDC on disease surveillance and prevention. Disease outbreaks have been reported in Rajasthan, Gujarat and Tamil Nadu in 2017 and 2018 [11]. A few vaccines trials yet in the phase 1, are awaited to be prophylactic [12].

Hanta virus

A bunya viral disease transmitted through rat urine and droppings. It causes cardiopulmonary and renal syndromes in humans and is relatively asymptomatic in rodents. It is majorly reported in North and South America. India has reported few cases as of 2017 [13]. Infection due to person to person transmission is unclear. No vaccines are available. Disinfection practices can aid in the control of disease, especially to individuals who have come in contact with stray rodents, or keep them as pets.

Hendra virus

It is a bat born virus, of the paramyxoviridae family which produces respiratory illnesses and encephalitis. It is one of the viruses of the *henipa* virus group (hendra and nipah). It is predominant in Australia. Horses contract a fatal infection, leading to pulmonary signs and meningitis. Transmission to humans through infected horses can also occur. The disease has not been reported in India. Although vaccines are present for horses, none are known for the human host.

Ebola virus

It is a fatal filovirus that startled the world in the recent years. It is reported to have a case fatality rate of up to 90% [14]. It is responsible for hemorrhagic fever, multi organ failure, shock and death. Bats and rodents are suspected to play vectors, whereas the main route of transmission is through contact with body fluids of infected primates (humans, monkeys). Health care workers and care givers are the highest risk group. A number of cases have been reported in various parts of Africa. No confirmed case of Ebola has been reported in India. An experimental vaccine has been released in 2016. Strict quarantine and hygienic practices can curb the spread of this deadly pathogen. A recombinant vesicular

stomatitis virus (rVSV)-vectored *Zaire ebola virus* (rVSV-ZEBOV) vaccine has proved to be efficient [15].

Marburg virus

Another filo virus, similar to the ebola virus, also causes hemorrhagic infection. Initially it was identified in Germany, Yugoslavia and Central African countries. Fruit bats are a transmission vector. No reports of Marburg have been reported in India. A combined vaccine against both ebola and marburg is yet under trial [16].

Rift valley fever (RVF)

A mosquito born viral pathogen of livestock, RVF is caused by bunyaviridae. It is a significant disease of livestock characterized by abortion and neonatal mortality. Herdsmen, veterinarians and those in close contact with ruminants are at high risk. Transmission through mosquito vectors has been identified. Disease in man is seen in ocular form, meningioencephalitic form and hemorrhagic forms. It has been reported in small ruminants of India [17], but not in man. Outbreaks have been reported in Africa, Madagascar and Saudi Arabia. Vaccines are used in veterinary field (Smithburn vaccine), but registered human vaccines are not known.

Lassa fever

An endemic disease of West Africa transmitted by rats, that causes hemorrhagic fever in only a small percent of the population. Although, it has not been reported in India, a large outbreak occurred in Nigeria in 2018. Hospital workers and caretakers are at risk. Vaccines for the disease have not been released.

Monkey Pox

A rare viral disease transmitted through infected monkeys. Transmission through contact with secretions or consumption of infected flesh has been detected. It is endemic to central and western Africa. Forest dwellers and animal handlers are at risk. Symptoms similar to small pox are observed [18]. Vaccines in nonhuman primates have been tested whereas human vaccines have not been well established [19].

SARS and MERS

Severe acute respiratory syndrome (SARS) was defined by some as the first pandemic of the 21st century, with outbreaks reported in China in 2002 and 2003. It is suspected to be an animal virus that had crossed over causing 8,450 positive cases and 810 deaths. It has been reported in 33 countries across 5 continents [20]. Guidelines were recommended, in 2003 with respect to sample handling, diagnosis and management of infected people. [21] An inactivated vaccine is under clinical trial [22].

Middle Eastern respiratory syndrome is a corona viral disease identified in Saudi Arabia and Africa. The virus is transmitted from dromedary camels, although route remains unclear. Symptoms can range from simple shortness of

breath to pneumonia, typically seen in older, chronically ill patients [23] .Although 26 countries have identified it, no outbreaks have been found in India, but it has every potential to cause epidemics similar to SARS [24].

Yellow fever

A hemorrhagic viral disease endemic to the African subcontinent, transmitted through mosquitoes. Infected individuals show signs of jaundice, headache and fever. Accurate diagnosis of yellow fever remains tricky, as it poses similar symptoms to other flavi viral diseases. Strict vaccination is practiced in endemic areas, with 17D vaccine. It has not been reported in India.

PERSISTENT SCARES IN INDIA

Influenza

Influenza is a highly infectious virus that can causes epidemics as well as pandemics. Acute respiratory disease, head ache, malaise, fever are the common symptoms observed. Influenza belongs to the Orthomyxoviridae family, which can affect humans, birds as well as animals. Species crossover of strains, have been identified as a cause of outbreaks. Combinations of H and N proteins of the virus, occurs in infected hosts. Viral variations, population susceptibility, species cross over are the few reasons identified for the uncontrolled outbreaks.

Influenza species infecting human host belong to the A group. Influenza epidemic can be traced back the Spanish flu of 1918[25], that is reported to have killed 50 million people [26]. The outbreaks that occurred in the following years were of different strain, due to the genetic re assortment nature of the virus. H1N1, H2N2, H3N2, H5N1 have been reported in outbreaks[27]. Inactivated and attenuated vaccines approved by WHO are available [28].

Wild birds are natural hosts to Influenza A virus; outbreaks seem to occur only among domestic birds. It is a virus of zoonotic importance reported to have had 50% mortality [29]. Low pathogenic (LPAI) and high pathogenic strains of Avian Influenza (HPAI) exist. H5N1, H7N9 and H9N2 predominantly affect humans.

Swine, referred to as the “mixing vessel of influenza” are affected by the same strains as the human host. 30,000 confirmed cases across 74 countries had reported H1N1 infection in 2009 [30]. Human to human transmission is observed in Swine influenza, whereas it remains unclear in avian influenza. Oral antivirals are available for influenza. Guidelines regarding quarantine, disposal of animal carcasses, along with hygienic practices are available at the CDC and OIE. VaxifluS is one of the vaccines available in India [31].

Chikengunya

It is a mosquito born disease in India, Africa and Brazil. Cases of low mortality and high morbidity are observed. Caused by togaviridae, it is characterized by long term polyarthritis, in older age group. Nonhuman primates have also been identified to be susceptible to the virus. Although much work

regarding serotype identification is done in Africa, it is limited in India. Vaccines are not known.

Dengue

After its first report in 1946, several outbreaks have been reported up to recent years. It is one of the most prevalent mosquito-borne disease in India, characterized by severe musculoskeletal pain, nausea, headache and fatal hemorrhagic fever. Although, diagnostic methods have improved over the last decade, control of the disease remains a hurdle. WHO has recommended the use of a live recombinant tetravalent vaccine in endemic areas[32] which is yet to be implemented in India.

Kyassanur forest disease (KFD)

A tick born viral infection, it commonly affects monkeys and humans. Although first identified in 1957, its relatively recent outbreaks in Karnataka, Tamilnadu and Kerala, has arouse concern nationwide. It is characterized by sudden fever, headache and myalgia. An inactivated vaccine is being used as prophylaxis in India.[33]

Rabies

A fatal zoonotic disease, that causes thousands of death every year in India. It is still reported in most continents, as the virus is maintained in wild animals. Bats, rodents and feral animals are carriers, although transmission through infected dog bite is most common. Death within a week is expected in a positive case. Effective vaccines have been discovered from the 19th century, and even today extremely safe vaccines are used. Pre exposure prophylaxis on 0, 7, 21, 28 days are recommended for those working with animals, or rabies virus. In animals, modified live, inactivated, oral and recombinant vaccines are available. Inactivated vaccines are safer and commonly used.[34] In humans, nervous tissue, cell culture and embryo egg based vaccines are available. Human diploid cell vaccine are considered extremely safe. [35]

ADDITIONAL ZOONOTIC PATHOGENS

Many viruses of flavi viridae and togaviridae family seem to have a zoonotic trait. Flavi viruses such as West Nile virus (WNV), Japanese Encephalitis (J.E), Kunjin, Powassan and Murray valley fever are responsible for few disease conditions. Toga viruses such as Venezuelan Equine Encephalitis (VEE), Western Equine Encephalitis (WEE), Eastern Equine Encephalitis (EEE), Ross river virus, Semliki forest disease, Mayaro virus, Getah virus, Onyoug-onyoug virus, and Barmah forest virus have also been identified. Viruses of the Hepeviridae family have also played a role in zoonotic diseases.

Minor zoonotic conditions from Foot and mouth disease virus such as fever, papules and conjunctivitis from Newcastle disease virus has also been described. Chandipura virus, a rhabdovirus has also caused lethal outbreaks in India and Africa, with arthropods as vectors.

COMBAT

One health concept

One health concept implies that man, animal and environment, are equally significant in spread of diseases, hence the three entities must be collaborated for the eradication of pathogens. Although such a theme concerns a wide range of issues, zoonotic agents have undoubtedly found utmost importance. Efforts by the WHO, CDC and OIE have focused on zoonotic diseases, wildlife diseases and food producing animal diseases following which 'one health' has been arrived at as an effective concept in disease control. Use of highly sensitive surveillance methods and retrospective studies, are some of the factors that can aid in understanding disease epidemiology. CDC has implemented global health security agenda in 2014 and India epidemic intelligence service in 2012 by establishing global disease detection program, which has detected up to 91 outbreaks, overall in India .Whereas, sanitation is concerned, engagement of communities with influential people can be used as a good instigator. Hence active participation of members of a community is an absolute necessity.

Eradication of vectors

Vectors such as mosquito, bats, ticks and rats are responsible for most of the viral zoonotic pathogens. Trapping and disposing of the vectors is the need of the hour. Physical methods such as nets and trap containers are commonly employed whereas chemical or biological methods are recommended in endemic areas. Identification of species of vectors responsible will help in implementing control measures in their habitat and lifecycle. Thus an integrative understanding of ecology is essential. Integrated vector management has been suggested by WHO. Use of insecticide coated outerwear for travellers has also been discussed.

Plant based mosquitocides[35], predatory fish, amphibians[36] and bacterial toxins[37] are few of the options available for vector control. The sterile insect technique (SIT) allows reproductively defective insects to be released into the environment. The sterility is triggered at the embryonic level by radiation causing sterilization of certain genes or enabling expression of dominant lethal genes. Interfering RNA larvicides have been used as well [38]. Mosquitocidal plant based nanoparticles have also been studied [39].

Virus factors

Most of the viruses to be feared have a segmented genome, hence are prone to variants. RNA viruses particularly give rise to mutant strains. Another point to be considered is the stability of the virus, so as to employ appropriate disinfectant measures by altering temperature, pH and lipid solubility. Transmission routes such as aerosol emphasize the infection span of certain viruses. Obtaining an understanding of structural and nonstructural proteins also provides insight into their pathogenic determinants. For example, flavivirus possess 3 structural and 7 nonstructural (NS1, NS2A, NS2B, NS3, NS4A, NS4B, and NS5) proteins. The

former allows viral assembly, while the latter determines viral replication and immune evasion. Diversity in nonstructural proteins leads to lack of cross protection between the strains[40].

Host factors

Studies on Influenza virus have concluded that Human Leukocyte Antigen (HLA) is responsible for viral processing in host. Hence, in depth studies on polymorphisms of HLA correlating to host infection are required. Mutations in *Mx, TLR3 and RANBP2* gene have been reported to cause differences in viral infection. Factors such as blood group and ethnicity are also suspected to play a role in influenza virus infection.[41] Single nucleotide polymorphisms in receptors of Chikengunya [42] and dengue virus [43] have been reported to determine host susceptibility. Exploratory studies in other viruses can broaden the host pathogen interactions.

As hemorrhages and bleeding are the lethal effects seen in most of the above mentioned viruses, studies on reticulo-epithelial affinity of the viruses might shed light into control mechanisms for these diseases.

Environmental factors

Environmental factors such as temperature, humidity and climatic conditions act as a catalyst in causing epidemics, either by affecting the virus, vectors or host. A study reported satellite based temperature and vegetation index as potential factors, for identifying RVF outbreaks [45]. Marshy areas in Africa have been suspected as to host RVF carrier mosquitoes [46]. Temperature has also been identified as a determinant in dengue viral replication in the mosquito vector [51]. Sylvatic maintenance – forest creatures such as monkeys, wild birds, ticks, boars, and other carnivores act as reservoir hosts. The disease is maintained in nature due to these agents. Thus prophylactic measures that target wildlife also has to be applied, failing which, pathogens will continue to persist. Collaborations between the endemic countries have also been recommended so as to identify environmental factors that trigger outbreaks.

Travellers concern

The global citizen trend has led to migration of endemic diseases world over along with the traveler. Especially in case of pandemics like Ebola and Zika, control measures are implied by endemic countries to travellers entering the country as well as leaving. Developed nations have made it mandatory to practice vaccinations while their citizens travel to such endemic places.

WHO international travel health guide enlists vaccine preventable diseases of which viral diseases are Hepatitis A, E, Japanese encephalitis, polio, yellow fever, rabies and tick borne encephalitis, depending on the destination.[47]

Prioritization of vaccines is important. Although, strains used for vaccinations may vary with particular regions they are expected to be immunogenic and safe. Yellow fever vaccine for example: YFV 17 D contains multiple passages of Asibi strain of

the virus. Japanese encephalitis vaccine: JEV-SA14-14-2 contains a virulent live attenuated strain. Dengue virus vaccine strategy is particularly strenuous as a tetravalent vaccine against the 4 strains of the virus must be administered. [48]
Routine assessment of post-vaccinal responses is a an important way to assess the efficacy of such vaccines, and is very much required

Animal associated workers

Veterinarians, Veterinary assistants, pet/livestock owners, forest dwellers, wild life workers, abattoir workers, doctors, medical staff and health care workers who come in contact with infected patients on a regular basis, have to take special precautionary measures. Use of personal protective equipment (gloves, sterile gowns, disinfectants), practicing laboratory biosafety measures, sterile disposal of carcasses, reporting positive cases are few of the elementary steps that one can take.

Potential Bioweapons

With the world facing constant crisis, the threat of bioterrorism is not new. Although the known factors have been bacterial, viral agents have every potential to be hazardous. Some of the agents include ebola, lassa fever virus as well as monkey pox. These agents are divided into Category A, B and C. Category A are the most dangerous as they are easily transmitted in a population, also causing high mortality. Examples include small pox virus, filo viruses (ebola, marburg) and arena virus (lassa fever). Category B include eastern equine encephalitis, western equine encephalitis, venezuelan equine encephalitis viruses. Category C includes nipah and hanta viruses (CDC). With limited control facilities available, such pathogens have every potential to be hazardous.

Antivirals

Therapeutic control for influenza viruses includes use of baloxavir, marboxil or oseltamivir. Ribivarin, has also been used in some viral zoonosis.

ABBREVIATIONS

CDC: Centre for disease control EID: Emerging infectious diseases FAO: Food and agriculture organization OIE: Office international des epizooties WHO: World health organization

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Smart Livestock Extension: Reaching the unreached farmers

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Abstract

Livestock sector is getting more attention as described as important component in doubling the farmers' income by 2022 as targeted by government of India. With the help of ICT mediated knowledge management system, all the related information can reach to the farmers timely and effectively. Following the smart livestock farming different actions and plans need to be implemented in collaboration with ICT based programme and systems. There is need to upgrade the knowledge of veterinarian and extension functionaries for reaching the all sectors of farmers. Regular upgradation and training of farmers need to taken care for increasing the effectiveness of these ICT platforms for livestock management.

INTRODUCTION

The global food system is experiencing profound changes as a result of anthropogenic pressures. The ever-increasing human population (more than 9 billion by 2050), together with changes in consumption patterns (i.e., increasing demand for livestock products) caused by urbanization, increasing incomes, and nutritional and environmental concerns, is shaping what we eat, who eats, and how much, more than ever (Herrero *et al*., 2013). Livestock rearing is one of the most important economic activities in the rural areas of the country contributing significantly to the national economy. It provides supplementary income to most of the family dependent on agriculture and for many landless families, the income generated through the livestock rearing activities has been the mainstay. It has been found that the families with holding size less than 4 hectare own around 88% of the livestock. Within this, about 37% of the livestock is owned by the families with land holding size less than a hectare (Livestock census, 2017). Present world

is observing the vast of information availability in public as well as private domain. With the advent of information technology, the world is getting much competitive. Information and communication technologies have been establishing themselves for so long as the futuristic tools for technology dissemination (Kumar *et al.,* 2017). The desire to promote better information access to improve the socio-economic condition of the farmers has always been the top priority of agricultural extensionists and rural advisory service providers (Syiem *et al.,* 2015). ICT is an emerging tool for achieving meaningful societal transformation and it is an emerging tool for achieving meaningful societal transformation (Meera *et al.,* 2004). Various ICT tools have been deployed for agriculture knowledge management which includes organizational web portals created for specific commodities, sectors, and enterprise and for e-commerce activities (Sulaiman *et al.,* 2012). Therefore Knowledge Management in agriculture has an immense scope and challenge for managing agricultural knowledge in public, private and non-government organizations in India (Venkatasubramanian *et al.,* 2012). ICT can make Indian AKM more substantive by providing affordable, relevant, searchable and up-to-date agriculture information service to farm communities (Patil *et al.,* 2011).

Present Status of livestock information delivery

The sector is still considered as subsidiary to crop sector and the extension format and methodology developed for crop production are considered to take care of the livestock extension needs (Chander *et al.,* 2010). The National Sample Survey Organization (Anonymous, 2005) in its survey of 51,770 farmer households across the country revealed that only 5.1 % of the households were able to access information on animal husbandry as against 40.4 % households accessing information on modern technology for crop farming. In that perspective there is sense of need for having proper staff and para vets which can reach up to large section of farmers. The extension worker to farmer ratio is very wide in India, i.e. 1: 5000 (estimated 60 thousand extension workers) which is far wider than Ethiopia (1: 476) and China (1: 625) whereas agricultural population to agent ratio is 1: 9788 in Congo. In India, different research institute have built knowledge and information module for famers as well as extension personnel (Davis *et al*., 2010).

Digital knowledge and information modules

1. **Livestock and poultry disease information system (LPDIS) and PasudhanavumKukkut rog suchnaPranali (PAKRSP):** It has been developed by Indian Veterinary Research Institute (IVRI) Izatnagar in 2011. LPDIS developed in English and PAKRSP in hindi language. It covers major diseases of livestock (Cattle, Buffalo, Sheep, Goat, Pig, and Horse) and poultry and different common package of practices for production. It has audio backup which help in understanding of the disease among end users. This provides information on every disease in 4 sub heads: Epidemiology, symptoms, treatments, prevention

and control. The LPDIS contains original high quality photos of majority of diseases.

2. **Animal Health Information System (AHIS):** It is useful for para veterinarians and stockman. It is available in English and in Marathi entitled 'health information system for dairy animals' developed by IVRI (Tiwari et al., 2010).
3. **Pashuchikitsa and Pashupalan Prashnottri:** In this a compact disc entitled as 'Pashuchikitsa and PashupalanPrashnottri' at IVRI,Bareily, to provide solution to farmers on their frequently asked questions through e-module, which is easy to search and operate.
4. **Bhains Prajanansoochna Pranali:**It is an information system which gives information about reproductive disorders of buffaloes in north gangetic plains of UP. It is in hindi language, provide help with text, visuals, and audio backup. The topics are categories into three groups as reproductive disorders, parturition and major disease affecting reproduction (Sethi, 2012).
5. **Goat health management information system (GHMIS):** developed by IVRI and educating goat growers on different issues. It is multilingual software in three languages, English, Hindi and Bangla. It provides various information such as, diseases, symptoms of healthy and sick animals, vaccination schedule and deworming schedule (Roy, 2014).
6. **Information system for organic livestock farming:** Developed by IVRI, and provide information about organic livestock farming practices, standards, certification procedure and help in setting of organic livestock farm.
7. **Kashvet.org:** It has been developed by society for advancement of veterinary education. It provides information to farmers as well as professionals. It has information like, online disease diagnosis help, project proposal, pet care and statistics.

Expert system modules for disease diagnosis and farm management

In order to remain competitive, the modern farmer often relies on agricultural specialists and advisors to provide information for decision making. Unfortunately, agricultural specialist assistance is not always available when the farmer needs it. In order to alleviate this problem, expert systems were identified as a powerful tool with extensive potential in agriculture (Prasad *et al.,* 2006). Various Expert systems have been developed and used by farmers and other functionaries. Some of the expert systems are as follows:

1. **Buffalo reproductive information system (BRIS):** It is a knowledge base information retrieval system for buffalo reproduction, developed at IVRI, Izatnagar.It covers differnt aspects of buffalo reproduction, information on male and female reproductive system. This system can assist the field veterinarians in understanding the buffalo reproduction system (Singh and Singh, 2013).
2. **Poultry Expert System (PES):** It has been developed by Venkateshwara University, Hyderabad. It can diagnose ten diseases of poultry.

3. **"Make feed" Dairy and "Make feed" Poultry:** It is an window based software developed by Central Avian Research Institute for formulation of balanced feed for wide variety of poultry birds like layer, broiler chickens, quails, guinea fowls and various categories of dairy animals for maximum production performance.
4. **Expert system for cattle and buffalo:** It has been developed by TANUVAS, provides information about breeds, housing management, fodder production, feeding management, breeding management, disease control, calf management and production technology, milking management, general care, common management practices, farm machineries and FAQs.
5. **Expert System for dairy cattle management:** It has been developed by Central Tobacco Research Institute, Rajmundry, Andhra Pradesh, for farmer as well as extension personnel can use this expert system very easily and identify the problem by photographs. It is a tool for management of small dairy unit including, shed structure, fodder and maintenance for high milk yield. This expert system is also useful for farmers, Goplamitras, and state department , para vets, dairy entrepreneurs in accessing recent information with images (Ravishankar *et al.*, 2014).
6. **National Animal Disease Referral Expert System:** It is a web based dynamic and interactive livestock disease rational database supported by geographic information system (GIS) which serves as an epidemiology software. This addresses the needs of data collection, transmission, retrieval analysis of critical reporting of diseases, which is useful for farmer and other extension workers.

STRATEGIC OPTIONS:

Smarter production, nutrition, and waste management, as well as increased animal welfare and better education, have the potential to decrease the impact of livestock farming on our natural resources are major strategies for smart extension for livestock. Adoption of Best practices or techniques have shown consistent results superior to those achieved by other means. Digitalization can make it easy, faster, and less expensive by leveraging transparent supply chains, cloud computing, improved networks, and global knowledge platforms. Precision feeding can be a highly effective tool in reduction of feed intake per animal while also maximizing individual growth rates. Smart waste material management can bring a numerable earning. Animal health and welfare monitoring Health issues and diseases can decrease production efficiency of livestock. The trend towards more and more intensification of livestock farming systems increases productivity, but can also have adverse effects on animal health and welfare, and increases the risk of rapid and far-reaching disease outbreaks within stocks.

Advantage:

Smart Farming could (1) improve or at least objectively document animal welfare on farms; (2) reduce greenhouse gas (GHG) emission and improve environmental performance of farms; (3) facilitate product segmentation and better marketing of

livestock products; (4) reduce illegal trading of livestock products; and (5) improve the economic stability of rural areas (Banhazi *et al.,* 2012).

CONCLUSION

The success of any KM model depends on knowledge generation, technology up gradation and technology dissemination (Kumar *et al*., 2017). These ICT mediated platforms need regular updation and implementation in a proper channel in dissemination system. Livestock being large sector needs huge amount of such initiative to reach the last mile of farmers. Smart livestock extension and advisory services can bring and reach in effective manner with in timely and accurately. There is need to upgrade the knowledge of para veterinarian/extension workers at regular basis. Government should focus on deploying more such initiative with establishing networks for proper utilisation and providing and considering the feedback of farming communities.

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Specialty Fertilizers and Their Importance in Yield Maximization of Agricultural Crops

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Abstract

Technological interventions in the form of high yielding varieties and fertilizers have played a crucial role in yield enhancement during green revolution era and thereafter. The indiscriminate use of bulk fertilizers, especially the highly subsidized nitrogenous fertilizers, without considering the nutrient requirements of crop and soil nutrient status in the intensive systems lead to multi nutrient deficiencies. Further, nutrient use efficiency is also abysmally low in India. Hence the global fertilizer sector has also undergone a revolution in search of its use efficiencies and a new category of fertilizers generally known as specialty fertilizers have emerged. Specialty fertilizers are those fertilizer products which are applied at special conditions of soil or plant. All water soluble fertilizers (WSF), fortified fertilizers with micronutrients, customized fertilizers, slow and control release fertilizers comes under its ambit. The importance of specialty fertilizers in the context of Indian agriculture arises from the distorted nutrient ratio in the soils across different agro-climatic regions. In this context, WSF increases the use efficiencies, fortified fertilizers are helpful to correct the emerging micronutrient deficiencies, customized fertilizers ensure crop and region specific nutrient management and both slow and control release fertilizers reduce the nutrient losses extending the nutrient availability for the crops. Use of these fertilizers in combination with organics for crop production leads to higher productivity and sustainability. Ideally, the NPK ratio for cereals should be 4:2:1 but as per the available records, it is around 7.2:2.9:1. The utmost challenge is to keep pace of production with decreasing per capita arable land without losing land productivity.

Keywords: water soluble fertilizer, fortified, customized and slow and controlled released fertilizer.

INTRODUCTION

To feed the ever growing population of India and world, land productivity has to be enhanced by increasing input use efficiencies while focusing on energy savings

and low emission technologies. Fertilizer plays a crucial role in the food production through feeding the soils and plants. No country in the world has been able to increase agricultural productivity without expanding the use of mineral fertilizers. In India, contribution of fertilizers towards increase in food grain production is estimated to be 50 per cent. There is a rapid growth in fertilizer consumption to increase the yields. India is the 3rd largest producer and 2nd largest consumer of fertilizers. Urea, DAP, NP or NPK complexes and MOP dominate the consumption scene among the other fertilizers. Presently these major fertilizers are facing criticisms due to its negative effects on soil health.

With a view to maximize yields from unit area, exploitation of soils has started by intensive cultivation, indiscriminate use of fertilizers and unscientific crop management. This led to decreasing responses to fertilizers, deteriorating balance in NPK use ratio and depletion of essential secondary and micronutrients in soils thus eventually leading to stagnation in crop production. But the utmost challenge is to keep the pace of production with decreasing per capita arable land without losing land productivity.

Specialty fertilizers

The specialty fertilizers are high analysis innovative products mostly with combination of N, P, K and fewer micronutrients at varying proportions. These fertilizer products are developed after proper experimentation to suit matrix of soil fertility status, type of crop, availability of water and climatic conditions. The application schedule for these fertilizers is computed taking in to account the crop growth stage and also physical, chemical and biological properties of the soil.

Classification of specialty fertilizers

Broadly, the specialty fertilizers can be grouped into:

1. Water soluble fertilizers
2. Fortified fertilizers
3. Customized fertilizers
4. Slow and controlled release fertilizers

1. Water soluble fertilizers (WSF)

These are generally 100 per cent water soluble materials having very low salt index to minimize the chances of burning of plant tissue. Water soluble fertilizers are characterized by high purity, driven by R&D, applied in lower doses and give high benefit-cost ratio.

100 per cent water soluble complex fertilizers

1	Potassium nitrate (13-0-45)
2	Mono potassium phosphate (0-52-34)
3	Calcium nitrate (15.5 % N, 18.8 % Ca)

4	NPK (13-40-13)
5	NPK (18-18-18)
6	NPK (13-5-26)
7	NPK (6-12-36)
8	NPK (20-20-20)
9	NPK (19-19-19)
10	Potassium magnesium sulphate (22 % K_2O, 20 % S, 18 % MgO)
11	Mono ammonium phosphate (12-61-0)
12	Urea phosphate (17:44:0)

Comparison between 100 per cent WSF and conventional fertilizers

Property	100 per cent water soluble fertilizers	NPK conventional fertilizers-complex mixture
Solubility	Readily soluble in water	Nutrient may be in soluble form but carrier material may not be fully soluble. Leave undissolved particles/ precipitation may take place during preparation of solution
Uniformity of nutrient ions	Ionic distribution is uniform depending upon concentration and composition of base	Ionic distribution is not uniform as phosphatic ions fixation with other elements in carrier occurs frequently
Solubility time for preparation of solution	1 to 4 minutes in water	12 to 24 hours at 25 °C water
Filtration of solution before application	Not required	Filtration is required (2-3 times)
pH of 1 per cent solution	Acidic varied (pH 2.5 - 6.5)	Neutral/ slightly alkaline (pH 7.5 - 8.0)
Salt index	8 to 40	Varies depending upon K_2O source if derived from MOP varies up to 50 to 125

Nutrient use efficiency	Very high	Higher if split doses are applied
Microbial population	More due to less concentration of nutrient solution present near root zone	Less due to more application of nutrients at one time. They release more concentration which affects the microbial population.
Application costs Labour	Very less	High
Human error	Eliminated	High
Energy required	Less	More
Time of application	For every irrigation, application is possible, quick absorption by plants and immediate availability to overcome deficiency resulting higher qualitative yield	Maximum two or three split doses. Not practical to apply at the time of its maximum demand

2. Fortified fertilizers

To address the problem of increasing deficiency of micronutrients in Indian soils, some companies have started the development and marketing of fortified fertilizers. These fertilizers are commonly used bulk (straight) fertilizers fortified with micronutrients like zinc and boron. This also includes coated fertilizers which act as slow release fertilizers and improve the fertilizer use efficiency.

Fortified fertilizers

Boronated single super phosphate
Zincated urea
Zincated phosphate (suspension)
Zincated NPK (10:26:26:0.5)
Zincated NPK (12:32:16:0.5)
Boronated DAP (18:46:0:0.3)
Boronated NPK (10:26:26:03)
Boronated NPK (12:32:16:0.3)
Calcium nitrate with boron
15:15:15:0.2B
DAP:0.5Zn
SSP:0.5Zn

3. Customized fertilizers

The fertilizers, which are catering to regional soil, crop-stage specific fertilizer requirements, can be classified under this category. They facilitate the application of the complete range of plant nutrients in the right proportion and to suit the specific requirements of a crop in different stages of growth and are more relevant under site specific nutrient management practices. Multi-nutrient carriers designed to contain macro and/or micro nutrients forms, both from inorganic and/or organic sources, manufactured through systematic process of granulation, satisfying the crop's nutritional needs, specific to its site, soil and stage validated by a scientific crop model, capability developed by an accredited fertilizer manufacturing/ marketing company. Depending on the soil test report, climate, water requirement, crop and seed chosen, a particular type of grade of fertilizer is prescribed along with the recommended doses and time and method of application to get the best yield and maintain soil health. The multi-micronutrients mixture customized fertilizers have been worked out based on prevailing deficiencies of Zn, Fe and other micronutrients in soils.

Customized fertilizer grades are approved for sales in India by different companies

Company	Crop	Formulations
TCL (Tata chemicals limited)	Sugarcane	N:P:K:S:Z:B(7:20:18:6:0.5:0)
	Wheat	N:P:K:S:Z:B(10:18:25:3:0.5:0)
	Rice	N:P:K:S:Z:B(8:15:15:0:0.5:0.15)
	Potato	N:P:K:S:Z:B(8:16:24:6:0.5:0.15)
NFCL (Nagarjuna fertilizers and chemicals limited)	Rice	N:P:K:Zn (15:32:8:0.5)
		N:P:K:Zn (18:33:7:0.5)
		N:P:K:Zn (18:27:14:0.5)
		N:P:K:Zn (18:24:11:0.5)
		N:P:K (23:0:12)
		N:P:K (27:0:10)
	Rice	N:P:K:S:Zn (11:24:6:3:0.5)
	Maize	N:P:K:S:Zn (14:27:10:4:0.5)
	Rice	N:P:K (22:0:12)
	Maize	N:P:K (18:0:14)
Deepak fertilizers	Grape ,sugarcane	N:P:K:S:Mg:Zn:B:Fe (10:20:10:5:2:0.5:0.3)
	Grape, pomegranate, rice	
	Sugarcane, tomato, Leafy and guards, vegetable	N:P:K:S:Mg:Zn:B:Fe (20:10:10:5:2:0.5:0.3:0.2)
	Grape, onion, cotton, Banana, tomato, leafy	N:P:K:S:Mg:Zn:B:Fe (15:15:15:5:2:0.5:0:0.2)

	guards, vegetables Sugarcane, Citrus	N:P:K:S:Mg:Zn:B:Fe (10:20:20:3:2:0.5:0.3:0.2)
CIL (Coromandel international limited)	Groundnut Maize Rice Maize Groundnut	N:P:K:S:Zn:B (15:15:15:9:0.5:0.2) N:P:K:S:Zn:B (20:0:15:0:0:0.2) N:P:K:S:Zn:B (16:22:14:4:1:0) N:P:K:S:Zn:B (14:20:15:4:0.6:0) N:P:K:S:Zn:B (17:17:17:4:0.5:0.2)

4. Slow and controlled release of fertilizers

During the crop season, nutrients can be lost to the ground water, to the air and into the soil's organic matter. Several efforts have been made to develop slow-release nitrogen fertilizers and modification of urea has been experimented extensively for increasing its use efficiency by various crops. Neem cake and elemental sulphur has been used extensively as coating materials for modifying urea fertilizer.

CONCLUSION

The traditional fertilizers that we are using are facing criticisms due to its negative effect on soil health. These specialty fertilizers have been emerged as one of the option or solution for various problems in fertilizer usage**.** Hence using these fertilizers as an option along with organics can reduce the losses and increase the productivity with sustainability.

Trade facilitation in Indian context

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The global economy has witnessed wide variety of trade reforms after the establishment of World Trade Organization. Now, the attention has focused increasingly on domestic, institutional and regulatory regimes on international trade in the name of trade facilitation. According to WTO, trade facilitation is defined as the simplification and harmonization of international trade procedures. It relates to a wide range of activities at the border like import and export procedures, transport formalities, payments, insurance and other financial requirements. The trade facilitation has the potential to reduce trade cost by a significant amount and thereby to increase both global trade and output (WTO,2015).

BASIC PRINCIPLE OF TRADE FACILITATION

Four basic principles of trade facilitation are Harmonization, Simplification, Standardization and Transparency. Harmonization is the alignment of national procedures, operations and documents with international conventions, standards and practices either as part of a regional integration process or as a result of business decisions. Simplification means reducing the burden in administrative and commercial formalities, procedures and documents. Standardization is the process of developing formats for practices and procedures, documents and information internationally agreed by various parties. Transparency entails disclosure of information (Eg: laws, regulations and administrative decisions of general application, budgets, procurement decisions and meetings) so that the public can readily access and use it.

India's trade facilitation performance

Organization for Economic Corporation and Development (OECD) has developed a set of trade facilitation indicators for 163 countries in order to help governments to simplify their trade related procedures so as to gain from international trade. These indicators help nations to identify areas for

improvement and enable the assessment of potential impact of reforms in border procedures. The OECD Trade Facilitation indicators comprises of 11 components with index value ranges from 0 to 2, where 0 indicates least and 2 denotes best performance.

According to latest OECD trade facilitation indicators, India performs better in the areas of information availability, advance rulings, appeal procedures, fees and charges, involvement of trade community, governance and impartiality (Table 1). India's performance for internal and external border agency corporation is poor as compared to the best practice.

Table 1. OECD trade facilitation indicators: India, 2017

Indicators	India	Best practice
Information availability	1.55	1.57
Involvement of the trade community	1.43	1.62
Advance rulings	1.50	1.64
Appeal procedures	1.56	1.62
Fees and charges	1.54	1.71
Documents	1.00	1.67
Automation	1.15	1.62
Procedures	1.26	1.51
Internal border agency co-operation	0.90	1.18
External border agency co-operation	0.40	1.18
Governance and impartiality	1.50	1.89

Source: OECD available at http://www.oecd.org/regreform/facilitation/indicators.htm

The World Bank have also developed logistic performance index (LPI) to assess the challenges and opportunities faced by the traders in logistics. The LPI allows rating of six key components of logistic on 1-5-point rating (Very low to very high). According toLPI data for the year2018, India ranks 44th among 160 countries. India performs well compared to its Asian counterparts like Pakistan, Sri Lanka, Bangladesh, Afghanistan etc., but countries like Japan (5th Rank) and China (25th rank) are far ahead of India in LPI. Similarly, World Bank ease of doing business ranking of 190 countries in 2018, India ranked 77 while China ranked 44. India's score for the trading across border component in ease of doing business is 77.46 with a rank of 80 while china scores 82.59 holds a rank of 65. This clearly indicates that India has to improve to a great extent in trade facilitation.

India's initiatives in trade Facilitation

Over the years, Government of India has taken many initiatives in the field of trade facilitation. The Indian Customs EDI System (ICES) is one of the major attempts that is developed to manage customs clearance related information electronically using Electronic Data Interchange (EDI). A large number of documents that trade, transport and regulatory agencies are required to submit/

receive in the process of live customs clearance, are now being processed online. ICES is now operational at 215 major customs locations handling around 98% of import and export consignments.

ICES have major three components: ICEGATE is the interface of ICES with the external world for sharing customs clearance related messages, sharing of trade and custom clearance data with licensing and regulatory agencies such as DGFT, DGCI&S, Ministry of Steel, RBI etc. The second component is Single Window Interface for Trade (SWIFT) that facilitates required permissions or clearance from other regulatory agencies through online without any direct approach to these agencies by the trader.. The SWIFT has reduced interface with Governmental agencies, dwell time and the cost of doing business. The third component is E-Sanchit which enables paperless processing of trade documents.

Maritime trade constitutes 90 percent volume and 70 percent value of foreign trade in the country. India is having 12 major ports, 200 non major ports; spread over 7517 km. For facilitating maritime trade, India has developed a Port Communication System (PCS) for integrating all ports for efficient transportation and to facilitate electronic flow of trade related information to various stakeholders.

In agriculture trade, Agricultural and Processed Food Products Export Development Authority (APEDA) has developed traceability system for fresh grape export (GrapeNet) from India to European Union. The internet-based traceability software allows monitoring of pesticide residue, facilitate tracing back from retail shelves to the farm of the Indian grower, through the various stages of sampling, testing, certification and packing, and, issues electronic phyto-sanitary certificate.

Trade facilitation has become widely recognized as an important part of regional and multilateral efforts at promoting trade integration. India's performance in trade facilitation and ease of doing business is improving over the years. The initiatives like GrapeNet, ICES, and PCS are major steps taken by the government in this line to reduce the barriers in trade and it will also improve the welfare of the economy.

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Transplanting of Pigeon pea

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Pigeon pea is an important pulse crop grown in majority of states such as Uttar Pradesh, Bihar, Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh etc. It is also known as Red gram, Arhar, Tur and it is originated from Africa. Botanical name of pigeon pea is *Cajanus cajan* L. and belongs to *leguminaceae* family. It is an important pulse crop since it is rich in iron, iodine, essential amino acids like lycine, threonine, cystine and arginine etc. India ranked first in area and production in the world with 79.65% and 67.28% of world's acreage and production respectively. The productivity of India was 587 kg/ha (FAO Stat., 2014).

Nutritive Value			
Protein		22.3 %	
Fat	1.7 %	Calorific value	335 Kcal/ 100g
Carbohydrate	57.6 %	Phosphorus	304 mg /100g
Minerals	3.5 %	Iron	5.8 mg /100g
Moisture	13.4 %	Calcium	73 mg/ 100g

It is a tropical crop grown in India, during *Kharif* crop grown as sole crop or intercrop between cereals. It can be grown in wide range of climatic conditions. The importance of this crop is it can fix a large amount of nitrogen into the soil through its nitrogen fixing capacity and improves organic matter in soil profile. It is most suitable crop for the dryland and rainfed areas since it has deep root system that observes water and nutrients even from the deep soil profile.

The average productivity of pigeon pea in the world is about 714 kg/ha and India is 685 kg/ha. However, the potentiality of pigeon pea is about 2700 kg/ha and there if yield gap of 2015 kg/ha. The main reasons for the lower yield of pigeon pea in India are:

- Since it is a pulse crop grown in dry land, Indian farmers won't prefer for proper pest management practices.
- Use of low yielding varieties.
- High plant population that leads to low yield of pigeon pea due to low photosynthetic rate.

- Lack of agronomic practices in case of pigeon pea.
- Farmers prefer growing pigeon pea in low soil fertile soil
- No proper integrated nutrient management practices
- Due to low rainfall, dry spell and farmers don't prefer to grow pigeon pea in irrigated areas.
- Imbalance use of fertilizers
- Improper time of sowing
- Infestation of pest and diseases
- In recent years *kharif* rains (monsoon) are generally becoming irregular due to which sowing in first week of June is delayed and many times happens in July, because of this optimum yield is not obtained and due to the late sowing the crop encompass many disease and pest problems.

IMPORTANCE OF TRANSPLANTING IN PIGEON PEA

Transplanting in pigeon pea catch proper timing of sowing, avoid pest attack at greater rate that ultimately helps in progressive yield. Growth of transplanted pigeon pea crop will be higher when compared over direct seeding as sowing can be conducted at the precise time in the nursery by adjusting soil temperature and humidity. Transplanting is not a new practice; vegetable crops are usually sown using transplanting method especially in small seeded crops such as in chilli, brinjal, capsicum *etc.* In the same way, pigeon pea crop can also be transplanted for higher germination and the major advantage here in transplanting pigeon pea is, the weak, diseased, damaged seedlings can be avoided while transplanting in the field to ensure 100% germination.

During establishing seedlings of pigeon pea in nursery, one should take care of three things majorly, they are:

1. Rising of pigeon pea seedlings in proper way in plastic bags using healthy soil and weed seed free farm yard manure to avoid disease and weed infestation in pigeon pea seedlings.

2. Care should be taken in the nursery such as irrigation, application of 2% of urea as spray for good growth of pigeon pea seedlings.

3. Care should be taken during transplanting of seedlings in the field to avoid damage of seedling especially the roots.

4. Management practices should be taken properly after transplanting of seedlings for better growth of the crop.

METHODOLOGY OF TRANSPLANTING PIGEON PEA

Preparation of pigeon pea seedlings in nursery:

- Preparation of seedlings one month before sowing especially first week of May to sow it in June when *Kharif* begins.
- Use polythene bags 4 x 6 inch.
- Take healthy fine soil and farm yard manure or compost.
- Mix well the soil and farm yard manure in equal proportion.

- Fill the mixture of soil and farm yard manure in plastic bags for transplanting.
- Sow the pigeon pea seeds in the plastic bags.
- Provide water to the bags preferably sprinkler method of irrigation. Irrigation can be given alternate days or once in three days.
- After germination of pigeon pea seeds, thinning should be done to maintain the single seedling in each plastic bag and discard poorly grown seedlings.
- Spray 2% urea to the seedlings for good growth in the beginning.
- After 25-30 days after sowing in the plastic bags, the seedlings are ready for transplanting in the field.

Transplanting the seedlings in main field

- Prepare the land to fine tilth.
- After receiving monsoon rain, open the furrows with a distance of 6 feets.
- Transplant the seedlings by digging small pits
- On time weed management should be undertaken.
- Nipping practices should be done after 30 days after transplanting.
- Balanced nutrient application and add 20 kg/ha Zinc sulphate
- Take up pest management practices on time.
- Give irrigation at the time of water sensitive stages i.e. flower initiation and pod filling stage.

Advantages of transplanted pigeon pea:

- Catch the right sowing time with proper temperature and humidity.
- Higher growing degree days over direct seeding.
- Good initial growth of pigeon pea crop.
- Gap filling can be done using the seedlings to ensure 100% plant population in the field.
- Seed rate is reduced since single seedling is used to transplant in each hill.
- Incidence of insect, pest and disease can be reduced in the crop especially pod borer damage.
- Uptake of water and nutrients is increased due to good root growth in transplanted plants.
- Higher number of branches which results in higher number of pods in crop.
- These results in higher yield of seed pigeon pea over direct seeded crop.
- Less biotic and abiotic stress to the transplanted crop.
- Yield and quality of the crop is increased.
- Increased net returns. Since yield and quality is enhanced in transplanting method of establishment.
- B: C ratio can be attained up to 6.

Disadvantages of transplanting in pigeon pea:

Transplanting of pigeon pea plants is labour intensive procedure. Transplanting shock is one the problems during the beginning of transplanting of seedlings in the crop field.

CONCLUSION

Simplified transplanting method reduced the labour cost and increases the net returns. Transplanting method of pigeon pea crop establishment will be a good technique that ensures higher yield of seed pigeon pea. The biotic and abiotic stress such as insect, pests, drought during reproductive stage is reduced using 25-30 days old transplanted pigeon pea seedlings.

Gaushalas:

An institutional approach for conservation of cattle genetic resources

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Abstract

Gaushalas in India play a vital role in protection of cows and cattle wealth of the country. They serve a large section of old, stray, infirm, unproductive and rescued cattle population with innate care and attention. But due to introduction of mechanized farming operations and indiscriminate cross breeding programmes for increasing milk production, many farmers have forced to abandon such indigenous unproductive cattle. This has led to extra burden on the farmers' to take care of feeding, breeding and healthcare needs of the cattle. As a result, majority of this category of cattle population find shelter in the Gaushalas instead of individual households. At present, India is having more than 4,500 Gaushalas registered under Animal Welfare Board of India and different State Gaushala Act that provide grant in aid for the sustenance and development of Gaushala all over the country. However, the growing consensus for protection and conservation of our cattle resources due to drastic decline in the indigenous cattle population over past few decades, institution like Gaushalas have gained significant importance over the time .But, still the potential of Gaushala is yet to be tapped by its stakeholders especially in India. Therefore, by adoption of good management practices and addressing the key constraint areas in Gaushala, we can enhance the potential of productivity of cattle by many folds. For this, government has given due impetus by initiating Rashtriya Gokul Mission (2014) for conservation of the local breeds of cattle in a scientific manner.

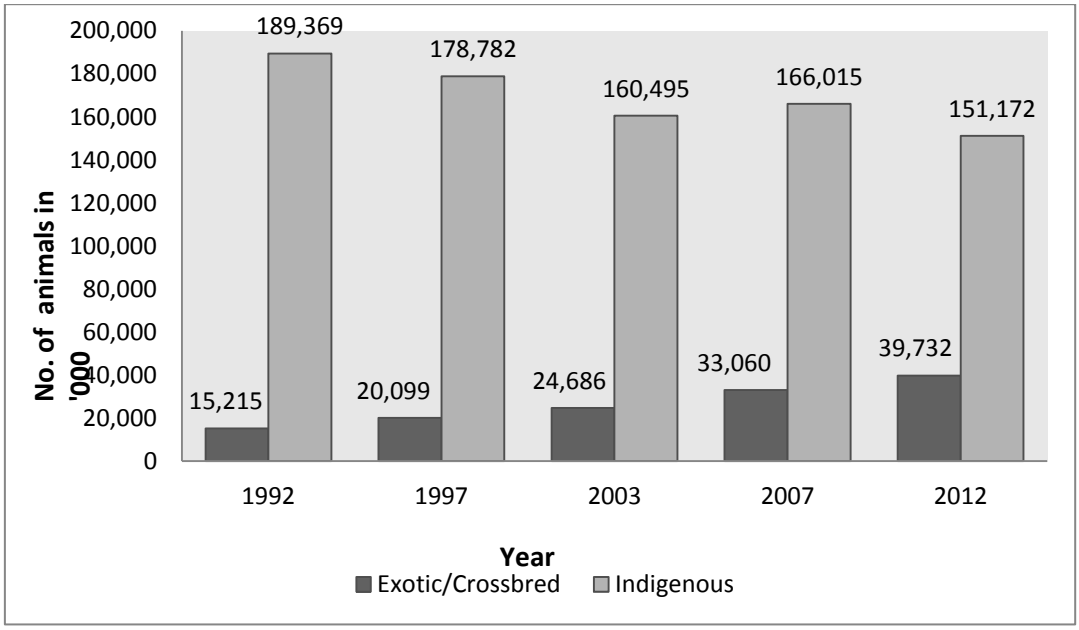
Keywords: Gaushalas, indigenous cattle, breeds

INTRODUCTION

The Gaushalas symbolize our cultural heritage for the animal welfare and is synonymous with the protection of cows and cattle wealth of the country.

"Gaushala" is derived from the Sanskrit word ("Gau" means cow and "Shala" means a shelter place: Gau + Shala = shelter for cows), means the abode or sanctuary for cows, calves and oxen. It is an institution established for the purpose of keeping, breeding, rearing and maintaining cattle or for the purpose of reception, protection and treatment of infirm, aged or diseased cattle. It is primarily focused on providing shelter to cows and caters mostly to the needs of non-lactating, weak, unproductive, and stray cattle (Yadav, D.K., 2007). As per the 19th Livestock Census (2012), India is having about 190 million cattle population, 79% of which are indigenous and the rest 21% constituted as crossbred/exotic. A last half decade (2007-12) has seen decline in the total indigenous cattle population to a tune of 8.94 percent. The major factors for decrease in indigenous cattle population are attributed to uneconomical returns due to low productivity and replacement of draft power in agriculture by mechanization. However, recently many few fore front Gaushalas are striving to maintain nucleus herd for *in-situ* conservation of indigenous purebred cows and produce quality males so as to enhance productivity of indigenous breeds. Sadana (2009) in the study at NBAGR (National Bureau of Animal Genetic Resources) reported that several Gaushalas (cow-herds) have been noted as potential centers for breed conservation and improvement. It has been recorded that purebred animals of several breeds (Sahiwal, Kankrej, Tharparkar and Hariana) are maintained in Gaushalas. Kachhawaha *et al.* (2015) noted that in some parts of Rajasthan, Tharparkar bull was used for the Gaushala cows to improve the non-descriptive breed through grading up of area specific indigenous breeds. Vij and Yadav (2010) emphasized that through proper planning and intervention, Gaushalas can become potential centre for *in-situ* conservation of indigenous breeds and for progeny testing of large number of bulls.

Fig.1. Exotic/crossbred and Indigenous population during 1992-2012



Source: 19th livestock census (2012). Ministry of agriculture, department of animal husbandry, dairying and fisheries

Need for conservation of indigenous cattle breeds

- They are resistant to various animal diseases.
- Indigenous breeds are tolerant to heat stress.
- Efficiency and working capacity.
- Milk of indigenous cattle is high in fat and SNF content.
- They have ability to withstand/tolerance to natural calamities.
- They are known for efficient conversion of low quality forages and utilization of bio-mass.
- Their suitability and contributions to organic and natural farming.
- Their adjustment to local eco-system.
- Low cost of maintenance in their management.

Advantages of establishing Gaushalas

1. It acts as a nucleus herd for *in-situ* conservation of indigenous breeds.
2. It enhances productivity of indigenous breeds and increase economic returns from animal products in a sustainable manner.
3. Propagate high genetic merit bulls of indigenous breeds.
4. Promotes green power and eco technology.
5. It provides proper shelter, health care, feeding and maintenance of indigenous cattle.
6. Increases economic returns from animal products in a sustainable manner.
7. It also promotes agro/dairy tourism and acts as a recreational centre or cafeteria for different indigenous breeds.

Different types of Gaushala[Cow-shed]: Brett Evans(2013)

TYPE OF ANIMAL HOMES	GENERAL PURPOSE
Panjrapole	Protects animals, primarily those without economic value
Vania Goshala	Protects cows, primarily those without economic value
Temple Goshala	Provides pure cow products—milk, ghee, dung, urine as well as the cow herself, for use in temple rituals and activities
Court Goshala	Historically, provided a private stock of cow products for royalty, evidenced wealth and piety
Gandhian Goshala	Provides milk for ashrams and educates public about agricultural uses of cows
Gosadan	Provides alternative to slaughter and space for unwanted cows away from where they could cause harm in the forms of crop damage or spread of disease, while concentrating them for more efficient use of dung and carcasses

a. Indigenous cows in Gaushala

b. Fodder cultivation

c. Vermicomposting unit

d. Gobar gas unit

Fig.2 Glimpses of elite Gaushala

Constraints in management of Gaushalas

- Insufficient availability of green and dry fodder for the cattle in Gaushalas.
- Unavailability of grazing land water resources.
- Irregular sources of funding and high dependency on public donations or charity.
- Inadequate space and improper infrastructure facility for the animals in cowsheds.
- Lack of knowledge in making value added products like silage, vermicompost, panchgavya etc.
- Unavailability of timely veterinary services.
- Shortage of labour supply and improper management practices.
- Lack of awareness about improved breeding practices through natural services or A.I. techniques.

- Ignorance of the management towards animal welfare practices.
- Lengthy and tedious procedure for getting a Gaushala registered.

Suggestions for efficient management of Gaushlas

- Upgrading the genetic merit of the non-descript and indigenous cattle through various breeding techniques in their natural breeding tracts, thereby maintaining genetic biodiversity.
- Developing additional fodder farms, feed preparation units and storage houses at state levels to meet the feed and fodder requirement of the cattle especially during the lean season.
- Provide timely veterinary services at the farmers' doorstep and organizing vaccination and medical treatment through free veterinary health camps.
- Giving technical know-how and capacity building in the form of training, workshops and field exposure to various Gaushala stakeholders engaged in conservation of local breeds.
- Regular and timely allocation of budget/financial assistance for development of Gaushalas.
- Giving recognition in the form of awards/prizes for encouraging Gaushala management.
- Seeking necessary technical guidance and support from institutes like National Dairy Research Institute, National Dairy Development Board, Indian Council of Agricultural Research and its Institutions, State Veterinary Universities and Colleges etc.
- Promote small scale business/entrepreneurship through sale of organic by-products from cattle like milk cowdung, urine, vermi-compost, panchgavya etc.

CONCLUSION

Gaushalas play a pivotal institutional role in sustainable conservation of our indigenous cattle wealth. It can act as a potential centre for in-situ conservation of the nucleus herd in their native tracts. Due to decline in the population and productivity of indigenous breeds over the past few decades, it has posed a major challenge to our country. The need of the hour demands productivity enhancement in indigenous cattle, which could be achieved by adoption of various modern technologies for selection and faster multiplication of genetically superior germplasm and adoption of improved animal management strategies. Also, considering the looming climate changes, the adaptive characteristics of the local breeds would become more important in future.

With active participation of all stakeholders including state govt. agencies and NGOs, efforts in developing common grazing lands, improving production environment and appropriate health care and management systems of the bovine livestock can be enhanced manifolds in Gaushalas. Therefore, an integrated approach with due consideration to proper feeding, breeding, healthcare and

improved management practices are recommended to address the future challenges in Gaushalas and exploit potential for sustainable conservation of our native breeds. Ultimately, there is also a strong need to sensitize and train the Gaushalas management about the selection, breeding policy, animal welfare and good management practices through adequate extension, policy and financial support for holistic development of Gaushalas in our country.

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Utilization of Earthworms as a Waste Manager

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Earthworms are an important contributor to soil health. It has an amazing ability to convert waste organic matter into nutrient-rich manure. Earthworms are the master of converting biodegradable organic matter into useful component (vermicompost) for organic farming. The utilization of earthworms in organic farming is significant. It is in demand for organic farming, especially for health issues. The use of chemicals for cultivation and growth of vegetables (human consumption) can lead to the long term health effect. The propagation and commercialization of vermicompost as an organic fertilizer produced through eco-friendly recycling process can be one of the ways of replacing the chemical fertilizer in farming. Vermicomposting not only converts organic debris into high-quality compost but also induce certain chemical changes to the debris making the nutrients easily available for plants. The conventional method of composting is a time-consuming process; but the use of earthworms in composting process reduces the time required for the stabilization of the waste and thus produces an efficient end product, i.e., vermicompost.

Vermicomposting in organic farming:

Vermicompost is found to be an excellent organic fertilizer which has several advantages over chemical fertilizer. Use of different chemical fertilizers have boosted the productivity of crop plants, but it tremendously decreased the nutritional quality of food as well as the fertility of the soil over the years. Excessive use of chemical fertilizers destroys the beneficial microorganism present in the soil which is essential for plant growth. Therefore the concept of organic farming is tremendously increasing for its emphasis on food quality and soil health. Now a day's vermicompost has been used to grow various crop plants as well as vegetables, which is found to be productive and economical. It also helps in restoring important microbial population present in the soil includes nitrogen fixers, phosphate solubilizers etc. Therefore organic farming is the productive way of gaining high-quality food product in an environment-friendly manner.

The excellent plant growth promoter:

1. It provides micronutrient to the plants necessary for growth.
2. It improves the water holding capacity of the soil
3. Improves the soil texture by providing structural stability of the soil, preventing soil erosion.
4. It is a good soil conditioner, provides sufficient aeration due to the burrows made by the earthworms.
5. It improves the quality of the fruit or grains by increasing the carbohydrate content.
6. Cost-effective and eco-friendly.
7. It also assumes to contain several plant growth regulators as well as hormones i.e., auxin and cytokinine.
8. It also was shown to release vitamin B and D to the soil during the composting process.
9. The increasing availability of N, C, P, K, Ca and Mg in the vermicompost.
10. Reduces plant pathogens.

Earthworms:

Earthworms belong to the Phylum Annelida and class Clitellata which are important soil organisms strongly influencing the chemical, physical and biological properties of soil, thus accelerating the decomposition of organic matter and nutrient cycle. Earthworms have burrowing nature.The different species of earthworms have different ecological strategies to survive and thus occupy different ecological niches. Based on the part of the soil profile where the earthworms inhabit into, be classified into following 3 types:

1. **Epigeics:** This type of earthworms generally live above the mineral soil surface and mostly depend upon the decaying organic matter such as vegetable and animal debris for their survival. They are usually small and have high metabolic and reproductive rates. They are adaptable to the changing environmental conditions of the soil surface, thus play a vital role in the transformation of the organic wastes into vermicasts. For example *Eisenia fetida* and *Eisenia Andrei*.
2. **Anecics:** Anecics are the species which live in the vertical galleries and can extend several meters up to the mineral soil profile. These species come to the soil surface at night to feed on dead leaves and decomposing organic matter. They drag the dead leaves to their galleries. These earthworms are usually large in size and have relatively low reproductive rates. *Lumbricus terrestris* is an example of anecic earthworm.
3. **Endogeics:** Endogeic earthworms live deeper in the soil horizon. They are survive based on soil-enriched with organic matter. These worms are able to construct highly branched horizontal burrows. Endogeic earthworms are known to have lower reproduction rates but their life cycle is pretty much

longer as compared to epigeic earthworms. For example *Aporrectodea caliginosa* and *Aporrectodea rosea*.

Vermicomposting process:

Vermicomposting is a mesophilic process in which earthworms interact with the soil microorganisms, enhancing the decomposition process. Mostly epigeic types of earthworms are preferred because they used organic matters as a substrate for vermiculture, not the soil. The vermicomposting process involves the following steps:

1. Ingestion of the organic matters by the earthworms
2. Mechanical size reduction: it is done by the gizzard present next to the mouth of the worm.
3. Digestion of the particles: digestion of the particle takes place when it passes through the gut of the earthworms under the action of several microbes and enzymatic secretions which helps in moistening the decaying organic particles and thus making it easier to tear it into shreds.
4. The exit of the substrate in the form of vermicast.

Different phases in vermicomposting:

1. Phase I: It involves the collection of organic wastes such as kitchen wastes, dead leaves, potato peels etc. The mechanical separation of glass, ceramics, metals etc.
2. Phase II: Pre-digestion of the organic waste by heaping them for several days with sprinkling cattle dung slurry.
3. Phase III: Preparation of vermi-bed.
4. Phase IV: Collection of the earthworms after harvesting of the compost.
5. Phase V: Storing of the vermicompost in order to maintain proper moisture.

Preparation of vermi-bed or vermicomposting unit:

A vermicomposting bin is a self-contained ecosystem which is well ventilated and has the provision for drainage. A vermicomposting bin is designed with several holes at the bottom that allows for the drainage of excess water. It enables to maintain the optimum moisture content in the composting bin.

1. For the preparation of the composting unit, either plastic or concrete tank can be used. The size of the tank depends upon the availability of the organic matter to be decayed.
2. Partially composted organic mixture and cow dung (1-2 week old) are put in the composting unit in the ratio of 6:1.
3. Water should be sprinkled in the composting unit in order to maintain the moisture content.
4. Once after adding all the biowastes, earthworms should be added (about 100 earthworms/kg of the compost).
5. The organic wastes are then topped with a layer of cow dung and sprinkled with water.

6. Composting unit should be covered with a wire mesh to protect the worms from predators such as snakes, birds, rats etc. Care should be taken to make the container ant proof. The unit should be covered to prevent direct sunlight.
7. The moister content of the unit should be checked regularly.
8. About 80% of the feed is converted to vermicompost in a period of 3 months.

Method of Harvesting: (There are different harvesting methods as follows).

1. **Manual harvesting method:** In this method, a small amount of vermicast is collected from the top of the partially decomposed pile just after few days of adding the earthworms. Manual harvesting method is generally practised by gardeners.
2. **Bulk harvesting by pyramidal heap:** In this method, vermicompost is harvested by exposing them into the sunlight. Since earthworms are sensitive to sunlight, they go deeper at the base of the pile, thus allowing the gardener to collect the compost from the top. This method is repeated again and again until all the compost is harvested. If any of the earthworms being picked up while collecting, they are kept back to the pile.
3. **Screening or sieving:** As the name suggests, here the harvesting of the compost is achieved by sieving using a screener. The compost is transferred to a screener (which is made up of wire mesh) positioned on a large container that allows the passage of compost but not the earthworms.
4. **Harvesting by inducing the migration of earthworms:** As soon as all the food source of the composting pile is depleted, the earthworms have a tendency to move towards a new palatable food source. It is better to construct a new composting pile adjacent to the ripe pile that induce the migration of the earthworms from the depleted food source to the new food source.

CONCLUSION

Vermicomposting offers a solution to recycle organic wastes in an economical and eco-friendly manner. Vermicomposting is an effective tool for the sustainable management of organic waste in agrarian countries. This process induces the breakdown of bio-degradable materials. It also allows utilizing the products for crop production. In recent years, a huge amount of waste is released from various sources like household, kitchen, agriculture and industries. The dumping of this waste has a serious environmental hazards. Burning of organic wastes releases a large amount of carbon dioxide gas which is a major greenhouse gas and the main contributor to global warming. The dust particles and ashes can also lead to environmental pollution. Moreover, burning of such waste cause deteriorates impact on soil quality. The burning of waste also destroys the microbial population of the soil. Therefore vermicomposting can be used as an alternative to treat organic waste in a more efficient manner.

Moreover vermicomposting also provides an additional source of income, assuring sustainable development of socio-economic status of various communities which are largely agro-based.

Oncolytic Animal Viruses: At a glance

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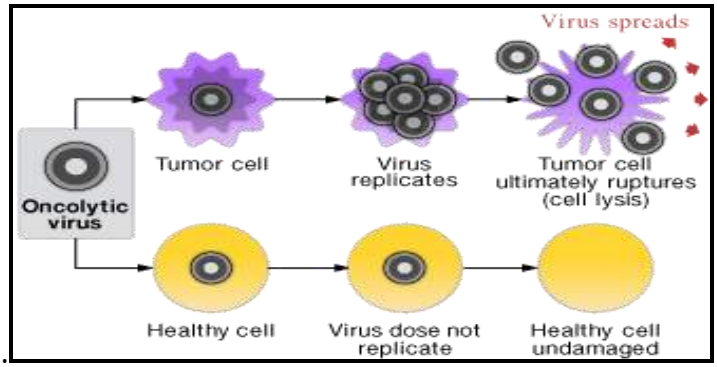
Oncolytic viruses are defined as those viruses that are capable of specifically targeting, and subsequently destroying tumor cells without causing excessive damage to surrounding normal tissues. These viruses are able to replicate in the target tumor cells, thereby producing high levels of infectious progeny virus and subsequently enabling the infection of additional malignant cells to be employed successfully and safely as an anti-cancer therapeutics. Replication competent viruses are genetically engineered or selected to be avirulent in normal cells but can exploit the aberrant molecular / genetic pathways in tumors resulting in viral replication and cancer cell lytic destruction. This leads to their efficient replication within cancer cells and the lytic destruction of the infected malignant cell.

Characteristics of oncolytic viruses

It is desired that an oncolytic virus displays a number of attributes:

- Relatively low pathogenicity
- Able to replicate specifically in malignant cells
- Easily genetically manipulated
- Relatively well characterized in terms of viral genome and protein function, possess a rapid life cycle
- Well characterized in terms of mechanism of oncolytic action and tumor cell specificity
- Able to be delivered systemically
- Display susceptibility to an antiviral drug, and not cause serious side effects following administration.



Oncolytic viruses used for cancer therapy (Bauerschmitz *et al.*, 2008).

- Adenovirus
- Vesicular stomatitis virus
- Polyoma viruses
- Poxviruses
- Parvoviruses
- Retroviruses

Mechanisms of tumor targeting by oncolytic viruses

Most oncolytic viruses have been engineered in some way to enhance their tumor specificity. Targeting mechanisms that have been exploited to date can be classified into the four broad categories of transcriptional, translational, transductional and pro-apoptotic. (Russell and Peng, 2007).

Pro-apoptotic targeting

- The virus is engineered (or adapted) to disable viral proteins that prevent apoptosis. Normal cells then die quickly upon infection before progeny viruses can be produced.
- Infected cancer cells are impaired in their ability to undergo apoptosis.
- Hence, the virus can generate progeny and spread only in the cancer cells

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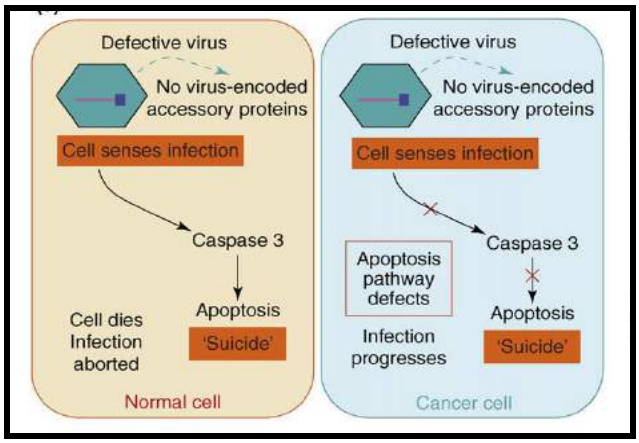
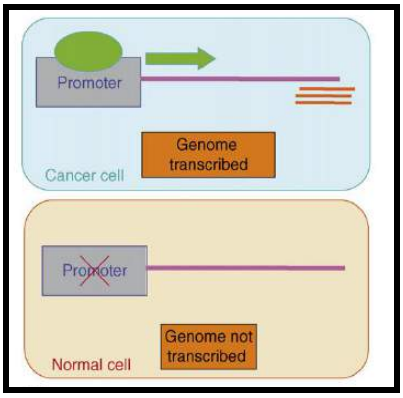


Transcriptional targeting

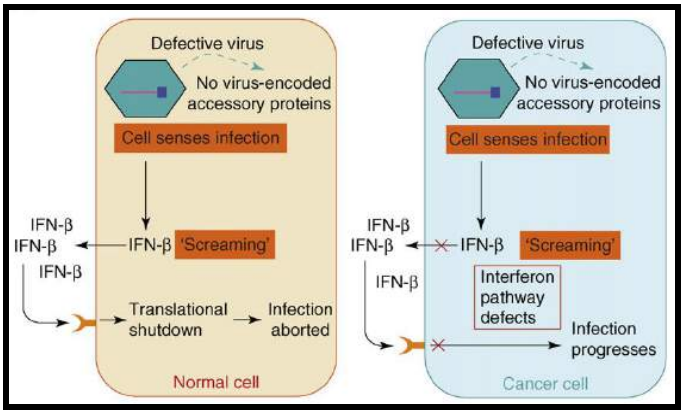
An essential viral gene is placed under the control of a tumor-specific promoter (some virus promoters are naturally tumor specific).

- Typically, the selected gene encodes an early viral protein that is essential for successful completion of the virus lifecycle.
- This is applicable only to DNA viruses (excluding poxviruses) and retroviruses



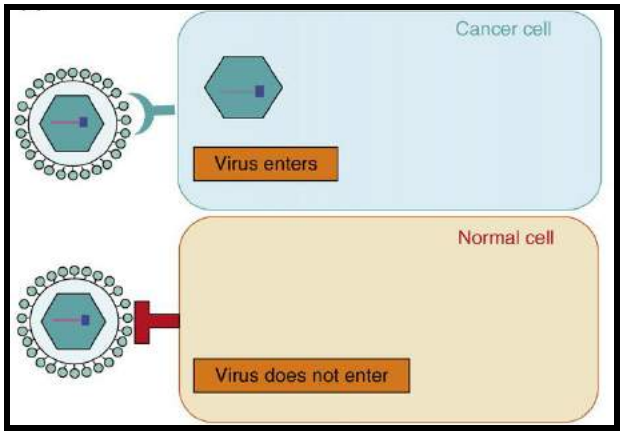
Translational targeting

- The virus is engineered (or adapted) to disable viral proteins that antagonize the cellular interferon (IFN) response.
- Normal cells then release interferon upon infection, causing neighboring cells to shut-off translation.
- Infected cancer cells are impaired in their ability to release or respond normally to interferon



Transductional targeting

- The virus gains entry to its target cells through a receptor expressed more abundantly on tumor cells than on normal cells.
- The natural receptors for several viruses fall into this category.
- Alternatively, the attachment specificity of the virus can be reprogrammed towards tumor antigens by the display of single-chain antibodies or other polypeptide-binding ligands on the viral surface



MECHANISM OF ACTION OF ONCOLYTIC VIRUSES

Direct cell lysis due to viral replication

The virus itself can destroy tumor cells by replicating. This cycle then can repeat, by infection of adjacent cells and their subsequent destruction by the same mechanism. This feature of viral replication provides continuous amplification of the input dose which continues until stopped by the immune response or a lack of susceptible cells.

Direct cytotoxicity of viral protein

In which some oncolytic viruses synthesize certain proteins during replication that are directly cytotoxic to cancer cells. For example, adenoviruses generate the death protein E3 11.6 kD and the E4ORF4 protein late in the cell cycle, both these proteins are toxic to cell (Shtrichman *et al*., 1998).

Induction of antitumoral immunity

Oncolytic viruses act is by initiating specific and nonspecific anti-tumor immune responses. Tumor cells are inherently weakly immunogenic because they express low levels of major histocompatibility complex (MHC) antigens and stimulatory signals such as cytokines which activate a local immune response. Adenoviruses express E1A protein during replication, which mediates killing of tumor cells by increasing their sensitivity to tumor necrosis factor (TNF). Induction of specific anti-tumor immunity might result in long-term defense against cancer recurrence. Viral peptides are presented on the cell surface with MHC class 1 proteins; this complex is recognized by cytotoxic T lymphocytes (CTLs), which are attracted to the virally-transduced tumor cell. These CTLs then acquire specificity for cancer-specific antigens and kill the cells by a still unknown mechanism.

Route of administration of oncolytic viruses

A variety of pathways have been opted for the administration of oncolytic viruses to the tumor site. But systemic administration of the oncolytic viruses is

considered to be more effective than the intratumoral injection (Mhaske *et al*., 2015).

STRATEGIES TO ENHANCE TREATMENT EFFICACY

Polymer coatings

There are several strategies to prevent the sequestration of viruses in the liver and spleen. Hydroxypropyl methacrylamide (HPMA), PEG (Polyethylene glycol) and PGA (Polyglutamic acid) polymers were used for stabilization of virus.

Use of carrier cells

Carrier cells or the cells that are infected *ex vivo*, if infused intravenously then vectors would be protected from the defense cells of the body.

Neovascularization

Tumors growth shows areas of neo vascularization newly formed immature blood vessels are leaky due to incompletely developed endothelial cells. This property of leakiness can be put to advantage as there can be increased delivery of macromolecules to the tumor site. The use of angiotensin II (slow infusion, I.V.) and use of drugs that release nitric oxide (NO) will increase the enhanced permeability and retention effect required for delivery of the oncolytic viruses to the tumor site. It is possible to put these viruses to the great advantage of the treatment of cancer in human (Fang *et al*., 2011).

Enhancing virus delivery

Oncolytic viruses pre-treatment with proteolytic enzymes, e.g. hyaluranidase or collagenase, could alter the extra cellular membrane and thus facilitate virus penetration. Also, increasing the oxygenation of tumors to relieve hypoxia and to lower the interstitial pressure has been proposed to resensitize the tumors to radiation and facilitate drug delivery by normalizing the vasculature.

Repeated dosing

With or without pre-treatment, the foremost strategy to enhance tumor transduction by viruses has been to use multiple administrations. Five consecutive injections of an oncolytic herpes virus provided dramatically enhanced transduction in large (490– 695 mm3) tumor xenografts compared to single injection of the same total dose, leading to complete responses in all the treated animals (Currier *et al*., 2005).

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Nanotechnology: A Novel Multi-Tasking Strategy for Aquaculture

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ABSTRACT

Nanotechnology is a novel technology that covers many areas of science and technological applications. Advancements in nanosciences and nanotechnologies in recent years help many industrial and consumer sectors including aquaculture and allied sectors. Aquaculture in India faces challenges of meeting growing demands of the large population for nutritionally safe foods, with limited availability of land and water resources that are increasingly threatened by environmental and climatic pressures. To cope up with these challenges, increasing productivity and income per unit of the scarce natural resources is required. It may be happened through understanding, integrating new advancements in science and technology in aquaculture production. This new area of science has exciting implications in aquaculture. In the aquaculture division of science, several "impossible" can be possible by nanotechnology.

Keywords: Nanotechnology, Aquaculture, Nano Biosensor, DNA Nano vaccine

INTRODUCTION

Nanotechnology has been defined by the U. S. National Nanotechnology Initiative (NNI) as "understanding and control of matter at dimensions of roughly 1 to 100 nm where unique phenomena enable novel applications". More precisely, it may be defined as "the study, design, creation, synthesis, manipulation and application of functional materials, devices, and systems through control of matter at the

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nanometer scale (1-100 nanometers, one nanometer being equal to 1 x 10-9 of a meter), that is, at the atomic and molecular levels, and the exploitation of novel phenomena and properties of matter at that scale". Several applications of nanotechnology for aquaculture production are being developed. With a strong history of adopting new technologies, the highly integrated fish farming industry may be among the best to incorporate and commercialize nanotech products.

IMPLICATIONS OF NANOTECHNOLOGY IN AQUACULTURE AND FISHERIES

The fisheries and aquaculture industry can be more advanced by using nanotechnology with new tools like-

- Rapid disease detection,
- Enhancing the ability of fish to absorb drugs like hormones
- Vaccines and nutrients etc.

As per the National Science Foundation (USA), current prediction shows the emergence of value of the global nanotechnology industry at USD one trillion by 2015. This could be possible due to huge potential of nanotechnology not only in electronics and materials science but also in humans, animal food and agriculture sectors involving aquaculture and its application in biomedical and biological sciences for analysis of biomolecules, cancer therapy, development of non-viral vectors for gene therapy, as transport vehicle for DNA, protein or cells; targeting drug delivery, clinical diagnosis and therapeutics etc. The areas related to aquaculture and fisheries where nanotechnology can be applied are:

USE OF NANO-BIOSENSORS

Nanotechnology-based biosensors can be used in the aquaculture industry for microbe control.

- Carbon nanotubes-based biosensor that can detect the minute amount of microbes including bacteria, viruses and parasites and also heavy metals from water and food sources.
- Nano colloidal sliver It works on a wide range of bacteria, fungi, parasites and viruses by rendering an enzyme which is used for their metabolism. They are able to kill methicillin-resistant *Staphylococcus aureus.* Tracking nanosensors such as "Smart fish" have sensors and locators that show data about fish health and geographical location to a central computer. Such technology may be used to control cognitive cage systems or individual fish (ETC Group Report, 2003).

DNA NANO-VACCINES

- Nanoparticle carriers like chitosan and poly-lactide-co-glycolide acid (PLGA) of vaccine antigens together with mild inflammatory inducers may give a high level of protection to fishes and shellfishes not only against bacterial diseases but also from certain viral diseases.

- Nanocapsules contain short strand DNA, Capsules are broken by ultrasound which releases the DNA thus giving an immune response to fish due to the vaccination.

WHY NANOPARTICLES ARE NEEDED TO ADMINISTER ORALLY

1) Improvement of the bioavailability of drugs which have poor absorption characteristics
2) Prolongation of the residence time and digestive stabilization of drugs in the intestine.
3) High dispersion at the molecular level and consequently efficient absorption.
4) Delivery of vaccine antigens to gut-associated lymphoid tissue and
5) Control of the release of the drugs

AS A SMART DRUG DELIVERY SYSTEM

Antibiotics, probiotics and pharmaceuticals/nutraceuticals through feed or injection system act as a preventive treatment. Nanoscale devices are capable to detect and treat infection and health problems with the help of smart probiotics, hormones, chemicals and vaccines delivery system which have multifunctional characteristics such as preprogrammed, time-controlled, monitoring.

AS AN ENHANCER OF FISH GROWTH

A basal diet with Selenium (Se) sources (nano-Se and selenomethionine) improves the final weight, relative gain rate, antioxidant status as well as Glutathione Peroxidase(GSH-Px) activities. Nano-Se is more effective than organic selenomethionine in increasing muscle. Similarly, the growth and performance of the experimented fishes are much better at nano-level.

AGENT OF NUTRACEUTICALS- NANODELIVERY

Nutraceuticals are required for health management, value addition and stress mitigation in fish and shellfish which is an emerging area of aquaculture research. As their requirement is very low, so the incorporation of nutraceuticals has a higher cost. Thus, it needs to be incorporated in such a way that wastage will minimum and utilization will maximum. Development of nano delivery system for these kinds of molecules may have disadvantages in aquaculture practices at commercial level. So nanoparticles are very efficient to deliver nutraceuticals in fish feed and nutrigenomics studies. Moreover, various nanoformulations of feed helps to maintain better consistency and taste of feed.

TAGGING AND NANO-BARCODING

- Radiofrequency ID (Rfid) is a chip with a radio circuit has the power to incorporate nanoscale component with an identification code embedded in it. These tags can tell more information, scanned from a distance and also present in the product to identify any object anywhere automatically. These tags may

be used as a tracking device as well as a device to monitor the metabolism, swimming pattern and feeding behavior of fish.

- A nano-barcode is a monitoring device consisting of metallic stripes containing nanoparticles where striping variations encode information. By incorporating the nanobarcoding, processing industry and exporters can check the source as well as track the delivery status of their aqua product until it reaches the market. Further, coupled with nanosensors and synthetic DNA tagged with colour coded probes, the nano-barcode device could detect pathogens and monitor temperature change, leakage etc., thus improving the product quality.

IT HAS THE POWER OF WATER FILTRATION AND REMEDIATION

Nanotechnologies are available for removing contaminants from water.

- Nano-materials such as carbon or alumina, with additives like zeolite and iron used in aquaculture applications for holding aerobic and anaerobic biofilm as well as for removing of ammonia, nitrites and nitrate contaminants.
- Ultrafine nanoscale iron powder is an effective tool for cleaning up contaminants such as trichloroethane, carbon tetrachloride, dioxins and polychlorinated biphenyls to simpler less toxic carbon compounds thus paving the way for nano-aquaculture.

DEVICE FOR AQUATIC ENVIRONMENT MANAGEMENT

- NanoCheck uses 40 nm particles of a lanthanum-based compound which absorbs phosphates from the water and prevents the growth of algae. It is currently undergoing large-scale testing in swimming pools and Altair had launched a swimming pool cleaner in early 2005.
- Besides, nanoscale delivery of weedicides and soil-wetting agents may be very useful for aquatic weed control in large water bodies, and mitigation of stress due to climate change and aquatic pollution.

IN HARVEST AND POST-HARVEST TECHNOLOGY

To catch fish, fishing lures are painted to reflect light to attract the attention of fish. However, these conventional lures reflect light only in one direction. To overcome this problem, the surface of the lure is colored and then nano-coated with a polyimide film which enhances the chance of catching fish 2 to 3 times compared to the case where a lure without a polyimide coating is used.

Aquaculture problems	Main causes	Nanotechnology potentials
Biological contamination	Bacteria, viruses and parasites	using nanomaterials (nanoparticles in food packing) Nanobiosensors Biodegraded nanoparticles with essential oils

Chemical contamination	A wide range of chemicals are used in aquaculture – chemical fertilizers, as well as medicines, are used to control diseases	Nano drug delivery systems Nanodelivery of nutraceuticals Nanocarriers to enhanced bioavailability, stability and shelflife of sensitive ingredients
Eutrophication	The growth of biofouling organisms, such as unwanted bacteria, algae and invertebrates (bedbugs and mussels) in aquaculture environments	Use of nanoparticles to control of biofouling agents Nanoparticles for nutrient delivery Nano fertilizers to decrease in the amount of fertilizer used
Fisheries problems	Genetic diseases as well as metabolism, swimming pattern, feeding and behaviour of fish.	Tagging and nano barcoding Nanoparticles for enhancement of fish growth DNA nano-vaccines Production of more effective fish feed

CONCLUSION

Nanotechnology undoubtedly is a better way for the economy and sustainable development of aquatic resources because of their various functional aspects. Although the application of nanotechnology is still at a very early stage in aquaculture, it may have the potential to solve most of the problems in aquaculture and fisheries with better technical innovation at different levels.

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Direct Seeded Rice: Constraints in its Adoption

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Increasing water scarcity, water loving nature of rice cultivation and increasing labour wages triggers the search for such alternative crop establishment methods which can increase water productivity. Direct seeded rice (DSR) is the only viable option to reduce the unproductive water flows. DSR refers to the process of establishing a rice crop from seeds sown in the field rather than by transplanting seedlings from the nursery. It has been recognized as the principal method of rice establishment since 1950's in developing countries. Direct seeding is can be done by sowing of pregerminated seed into a puddled soil (wet seeding) or standing water (water seeding) or prepared seedbed (dry seeding). Improved short duration and high yielding varieties, nutrient and weed management techniques encouraged the farmers to shift from traditional sytem of transplanting to DSR culture. Direct seeding offers certain advantages like saving irrigation water, labour, energy, time, reduces emission of greenhouse-gases, better growth of succeeding crops, etc. Farmers are facing several problems in adoption of direct seeding rice (DSR) such as weeds, shift and changes in weed flora, development of herbicide resistance, emergence of weedy rice, , increase in soil borne pathogens such as nematodes, nutritional disorders especially N and micronutrients, panicle sterility, , lodging, stagnant yield and diseases and insects' pests. Each of them is described as follows:

Weeds

Weeds are the most important constraint to the success of DSR in general and to Dry-DSR in particular. The weeds pose to be more problematic in DSR than in puddled transplanting because (1) The emerging weeds are more competitive as compared to the simultaneously emerging DSR seedlings and (2) lack of water layer in Wet- and Dry-DSR make these crops more prone to initial weed infestation which lacks otherwise in case of transplanting. The research has shown that, in the absence of effective weed control options, yield losses are greater in DSR than in transplanted rice. The reported range of such yield losses in DSR in India is 20-85 percent.

Shift and Changes in weed flora

Composition of the weed flora changes drastically with a shift from CT-PTR (Conventional tillage-Puddled transplanted rice) to alternative tillage and rice establishment methods. As a result of shifting from flooded to direct seeding system, there is variation in water, tillage and weed management practices which results in changes in weed composition and diversity. Some new grass and broadleaf species that were not adapted to CT-PTR appears in Dry-DSR (Dry- Direct seeded rice). Higher numbers and more diverse flora in Dry-DSR results in lower efficacy of weed management strategies, including herbicides. In addition, adopting DSR results in weed flora shifts toward more difficult to control and competitive grasses and sedges.

Development of herbicide resistance

The practice of direct seeding on large scale increases herbicide use for weed control in rice, which slowly results in the appearance of resistance in weeds against certain herbicides. For example, the first case of herbicide resistance was reported in *F. miliacea* against 2,4-D in 1989 in Malaysia. But, later on, the numbers of resistant weed biotypes to different herbicides increased to 10. In Thailand, Korea, and the Philippines, the number of herbicide-resistance cases in weeds increased from zero before DSR introduction to 5, 10, and 3, respectively, after its introduction.

Emergence of weedy rice

Weedy rice/red rice (*O. Sativa, F. spontanea*), has emerged as a serious concern to rice production in areas where direct seeding especially Dry-DSR widely replaces CT-PTR. Weeds in rice are highly efficient and causes severe rice yield losses ranging from 15 to 100 %. Milling quality is also impaired if weedy rice gets mixed with rice seeds during harvesting. Weedy rice is difficult to control because of its genetic, morphological, and phenological similarities with rice. Selective control of weedy rice was never achieved at a satisfactory level with herbicides.

Increase in soil-borne pathogens such as nematodes

Root-knot nematodes pose a severe constraint when shift from PTR to DSR takes place. Root-knot nematode, *Meloidogyne graminicola* was first reported in 1963 from the Louisiana State University, Baton Rouge, USA. In a study in Philippines, RKNs were found to be most damaging pathogen for aerobic rice.

Nutrient disorders, especially N and micronutrients

Nutrient dynamics altogether varies in both DSR and PTR systems mainly because of the difference in land preparation and water management techniques. In case of DSR, soil remains aerobic beacause of dry land preparation as compared to PTR where soil is kept flooded and is puddled. Puddling has positive impact on weed control and nutrient availability. In submerged conditions, less oxygen in the rhizosphere prevents oxidation of NH_4^+ and thus reduces leaching, increases

availability of P as well as of Fe. Deficiencies of micronutrients are of major concern in DSR. A shift from PTR to DSR affect Zn availability to rice and it reduces because of reduced release of Zn from highly insoluble fractions in aerobic rice fields. Availability of Fe is often particularly high in anaerobic soils because of low redox potential. In aerobic soils, however, Fe may become limiting, especially when the soil pH is high. Moreover, nutrient uptake and supply to plants may be reduced because of lower delivery rates to roots through mass flow and diffusion as both of these processes are influenced by the reduced soil water content. Thus, unsaturated soil conditions in DSR fields can lead to iron deficiency and plants show chlorosis. Prolonged iron deficiency may result in severe yield losses in DSR, hence care should be taken to manage iron deficiency. In the dry-seeded aerobic treatments, the iron content was about half of that in the submerged PTR and WSR treatments.

Panicle sterility

The most sensitive stage in rice is flowering during drought period. Both patterns of rice planting i.e. TPR and DSR are sensitive to deficiency of water. Rice grown in DSR have less moisture so in any type of shortage of water will reduce the time to anthesis resulting a panicle sterility. Water stress reduces the starch level and viability of pollens which increase the number of sterile spikelets.

Stagnant yield

Yield decline in DSR has been reported, which may be due to various reasons viz., soil sickness, plant autotoxicity, presence of *G. graminis var. graminis* in dry-seeded rice fields and continuously growing DSR for more than two years.

Lodging

Lodging is the permanent vertical displacement of the stem of a free-standing crop plant. DSR is more prone to lodging as compared to PTR. Lodging makes the harvesting of the crop difficult and also reduces yield and impairs the quality of rice both in terms of appearance and taste. Rice cultivars having lodging resistant characteristics viz., intermediate plant heights, large stem diameters, thick stem walls and high lignin content should be preferred. Moreover, thicker band of sclerenchyma at the periphery of the stem and more vascular bundles makes the cultivars more resistant to lodging.

Diseases and insect pests

DSR is susceptible to various diseases and rice blast is one of the most common and damage due to rice blast increases under water stress conditions; since the water level affects several processes such as liberation and germination of spores and infection in rice causing blast. In DSR, the other disease and insect problems reported are sheath blight and dirty panicle, brown spot disease and plant hoppers and soil borne pathogenic fungus *Gaeumannomyces graminis var. graminis* in dry-seeded rice in Brazil without additional irrigation.

Others

- Rice seeds are exposed to birds and rats
- Sudden rain immediately after seeding can adversely affect crop establishment
- Uneven crop stand also results in failure of obtaining potential yield of DSR