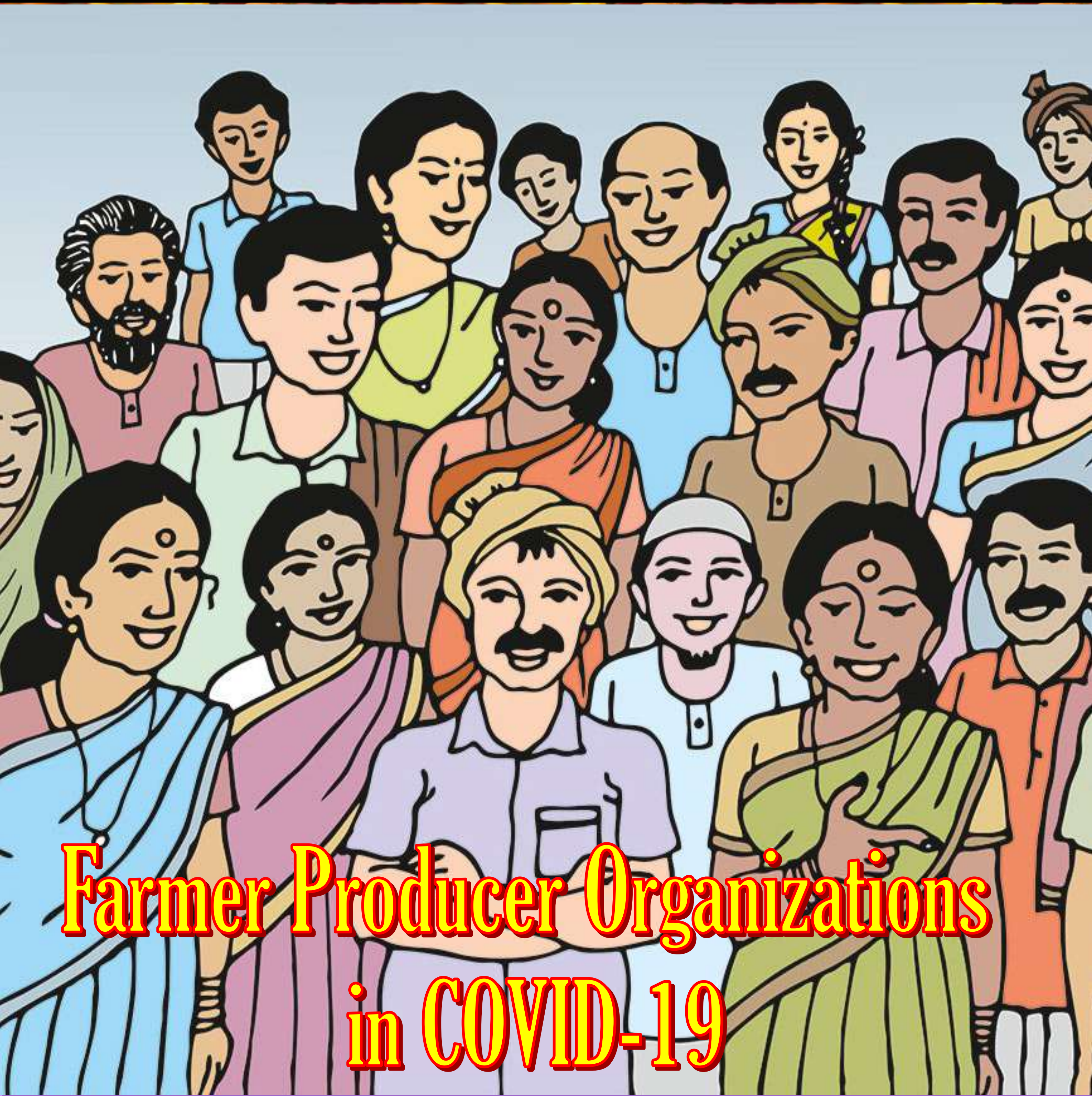
Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume– 7 | Issue - 08 | August - 2020 | Pages - 90



Farmer Producer Organizations in COVID-19

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 7, Issue – 08 August-2020

Impact of Covid-19 crisis on milk production, sales, overall welfare of producer and social constraints faced during sales by farmers

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Government of India ordered a nationwide lockdown for 21 days on 24th March 2020, thus limiting movement of the entire nation of 1.3 billion population of India as a preventive measure to control the spread of COVID-19 pandemic in India. This lockdown affected everybody and dairy industry was one of the worst sufferers. According to business today report Indian dairy industry has suffered a 25-30 per cent dip in demand ever since the country shut down for the COVID-19 lockdown happened.

More than 70 per cent of milk is being produced by small farmers; milk provides immediate cash for their livelihood. These small farmers are worst hit due to lower demand and consequently no/partial procurement. The major share of milk is handled by the unorganised sector comprising milkmen, milk contractors, halwai shops/ creameries/city-based private dairy shops etc., while only 30 per cent is handled by the organised sector — dairy cooperatives and private milk plants. Milk is a perishable product and it can't be stored without proper processing. Lockdown severely impacted the small milk producers who work outside the metropolitan areas, and used to supply milk to local tea shops, sweet shops, ice-cream manufacturers, etc. – most of whom had to pull their shutters.

A middle-aged man in committed suicide and his family alleged that he was allegedly cane charged by the police while going out to buy milk for the family. Many workers who used to earn money in day and buy their necessities from that money were also haltered and many people committed sucides because of unable to buy basic necessities like milk, sugar.

A large portion of the dip in demand was due to out-of-home consumption, which contributes 15 per cent of the milk consumption, coming to a grinding halt. "Restaurants, road-side eateries, all of them have shut down. Even marriages are not happening. All the bulk buyers have vanished.

Indian dairy industry which faced a shortage of milk before covid-19 saw bulk production during lockdown as there was no one to buy milk, milk processing was stopped and also export was hampered.Prior to the outbreak of COVID-19, the Indian dairy industry was going through a shortage of milk and lot of private dairy companies were planning to import skim milk products (SMP) from countries such as New Zealand to make up for the shortfall. The global SMP prices, which had sky-rocketed to Rs 340 per kg prior to the COVID-19 outbreak, in the last few weeks have crashed to Rs 230 per kg, with demand in the global markets also dipping.

Usually, when there is greater availability of liquid milk, extra milk is converted by dairy plants into skimmed milk powder (SMP) to meet the peak demand in the summer season. However, mainly due to the liquidity crisis and limitation of working capital, dairy plants cannot afford to manage delivery of surplus milk. We also saw some photages how farmers were throwing their milk on the roads as there was no one to buy their milk and neither they were able to do home sales, which have completely come to a halt, because they were adherent to government notification.

COVID-19 has affected the lives and livelihoods of millions across the world. The virus has taxed dairy farmers in a number of ways, the first being management of dairy animals and second the marketing and sale of milk and other by-products.

COVID-19 presents challenges for all agricultural sectors and the working group is responding to issues as they emerge by developing industry specific advice to support dairy businesses. Some examples include:

- How to milk cows while maintaining social distancing;
- How to manage staff coming on and off farm;
- How to address supply issues that may disrupt operations for farms and factories;
- Protocols for managing milk collection; and
- Questions consumers may have regarding the safety of dairy operations.

During these difficult times of the dairy farmers, our cows and buffaloes must be taken care of, as any compromise on their feeding and health care would impact reproductive efficiency and productivity. Both governments and dairy cooperatives should provide these inputs and services to the farmers on subsidised rates or deferred payments basis. The country cannot afford to go through another phase of supply disruption resulting in pressures on availability and prices of milk.Covid-19 crisis has witnessed reverse migration of labour force from urban to rural areas leading to social disruptions. On the positive side, we can look at this as an opportunity; these workers can be encouraged and incentivised to join their family agriculture/dairy farms.

To enhance the marketing of milk and milk products, many dairy organisations, initiated home delivery of milk and milk products through mobile carts, vans, e-commerce, etc. All these measures helped stabilise milk sales, opening up opportunities to use e-commerce. Many smart and progressive dairy farmers converted their surplus milk into khoa, paneer, ghee, etc, and sold it to the neighbourhood markets through informal channels. All these measures helped sustain dairy industry.

Difficulties are also arising in fixing milk prices. There is a fall in milk prices and farmers may be disposing the milk at a price lower than the cost of production. SameerCharania, Director, CRISIL Ratings said , "Steady demand for milk and higher

VAP prices (hiked 10% in the second half of last fiscal) will help partially offset lower VAP volume, and arrest any decline in the dairy sector's revenue. Further softer input prices will provide some respite and limit the fall in operating profitability to 50-75 basis points."

"After an initial hitch, the supply chains (in the dairy sector) were restored. From March 15 to April 30(2020), the procurement of milk from farmers across the country was only 3.50 per cent less while sale of milk during this period fell by 13.70 per cent. But in the last two week of April a growth of 1.30 per cent in sale of milk across the country was noted. In other words, the market in terms of procurement and sale of milk is seeing a steady growth," said DilipRath, who is also the Mission Director of World Bank assisted National Dairy Plan.

"In a country of 1.35 billion, we ensured uninterrupted supply of milk to every household...and we also protected the interest of millions of dairy farmers during the lockdown,"DilipRath, Chairman of National Dairy Development Board (NDDB).

In contrast to sectors like construction, manufacturing, hotel, travel & tourism, etc, which were severely hit by the lockdown restrictions, dairy industry seems to have done remarkably well. Globally, Covid-19 impact has pushed many large commercial dairy farms even in the most dairy developed nations to the brink of closure, prompting governments to announce bailouts. Similarly government of India also announced a Rs15,000 crore fund approved by the Cabinet that will be open to all and will help in increasing milk production, boost exports and create 35 lakh jobs in the country.

R S Sodhi, Chairman and MD, Amul, says that the situation is averaging out gradually.Like most other FMCG companies, the dairy companies are also finding newer ways of reaching out to consumers. Both Creamline Dairy and Lactalis India have started direct distribution of milk and value-added products, says Kanwar of Creamline.

Also this crisis could be the start of a new WHITE Revolution.Covid-19 pandemic has thrown up the real possibility for our dairy industry to benefit as large sections of consumers may shift from meat-based to dairy-based protein. Covid-19 has made people more aware of the need to adopt a healthy diet and government is also thinking of reducing ghee and butter GST from 12% to 5%.

Some important tips to maintain steady state uninterrupted supply of manpower for dairy industry, milk supply to every house-hold as well as to protect the interests of dairy farmers-

- Emergency Plan: All dairy farms must have in place a well-designed plan that can be implemented during any emergency. The plan must be tested once in two years for its practical utility. Few workers at the farm must be permanently employed and live on the farm. Entry of relatives/friends of workers and other people should be banned.
- Bio-security & Hygiene: Essential to check disease, bio-security and hygiene are paramount for the well-being of animals. Main gate of the farm should remain closed at all times. One worker may be entrusted with the job of a watchman to check trespassing and entry of stray animals. Farm cleanliness and personnel hygiene should get due attention.

- Health Status: A farmer must be trained for first aid management or AI of animals. Semen doses in good number with proper storage, vaccination, de-worming, sample testing etc. should be followed in a planned manner.
- Insurance: All animals including young and old should be insured.
- Records: Properly maintained and relevant records will help in the quick evaluation of profit or loss situation and aid future strategies. Contacts and telephone numbers of personnel/organizations which could extend help during an emergency should be displayed at a frequently visited spot on the farm.
- Value addition: Farm gate milk processing — paneer or curd can be done for sale. When selling or disposal of milk becomes a serious problem, it can be processed into products like ghee or milk powder, which have a longer shelf life.

Brown Manuring: A Tool for Integrated Nutrient Management

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ABSTRACT

Indian agriculture is getting redrawing by the practices and increased attention paid to improving nutritive resource management. Efficient nutrient management is essential to achieve good sustain ability in the crop yield. Integration of all possible sources of nutrients can only fulfill the requirement of crops since the yield sustainability of the crops is said to be ascertained. With the inclusion of chemical fertilizers as a source of nutrients organic manures can also play an important role in this direction. But these manures are bulky in nature and low in nutrient content, hence the substitution is highly required. Many options are available for this but the viable option can be the brown manuring as a tool for integrated nutrient management.

Keywords: Chemical fertilizers, Brown manuring, Integrated nutrient management, sustainability

INTRODUCTION

The present agricultural scenario is concerned with the rising cost of cultivation and increase in the agricultural inputs. Among the inputs for agriculture, fertilisers are one of the major inputs that are essential in crop production. The Fertilizers have made a major contribution to the remarkable increase in crop yield. However, the application of inorganic fertilizers in large quantities alone over a long period leads to an imbalance in other nutrient supplies. The combined use of organic manures and inorganic fertilizers helps to preserve yield stability by reducing marginal secondary and micronutrient shortages, improving the productivity of applied nutrients and maintaining favorable physical conditions in the soil. India has sufficient bio-waste potential that can be converted into composts and organic manures and used in crop fields. But the enormous amount of organic waste is not being properly and scientifically transformed into composts and lost by various means. Besides, it is also costly to carry the low-value bulky organic manures.

BROWN MANURING

Brown farming was first introduced in North-South Wales, Australia's Lock hart district in 1996. Goodens was the first person to adopt the practice of brown manuring. In Australia for winter crops they employed this strategy against the herbicide-resistant ryegrass population. They planted a cover crop with the intent to incorporate it in to soil before weed seed setting. This practice has helped to rotate the chemical classes, preserve ground cover, prevent weed seed setting and add useful nitrogen from pulse nitrogen fixation, as well as provide the farm's cropping system with agronomic advantages of improved soil quality and water holding capacity.

Brown farming can be defined as a technique of growing green manuring crops viz., dhaincha, sesbania, sunhemp, etc., as an inter or mixed crop and killing them by applying herbicides for manuring during post-emergence.Brown manuring is simply a 'no-till' version of green manuring that uses as herbicide to desiccate the crop before flowering rather than cultivating. Cutting brown manure involves growing a grain legume crop with minimal fertilizer and herbicide inputs to achieve maximum production of the dry matter before the major weed species have established viable seed.

According to brown manuring technique, Sesbania or other green manure crops are cultivate in standing crops and killed using the post-emergence herbicide for manuring where the plant residues are left standing in the field along with the main crop without incorporating / in-situ ploughing until its residue decomposes into the soil with the aim of adding organic manure besides weed suppression by its shade effect. The post-emergence herbicide spray on greenmanure leaves resulting in loss of chlorophyll in leaves and showing the brown colour is referred as brown manuring (Tanwar*et al.,* 2010).

BENEFITS OF BROWN MANURING OVER GREEN MANURING

Farmers typically cultivate green manure crops before the crop cultivation and introduce them by incorporating into soil.This process of green manuring involves a larger number of green manure tillage operations leading to a lack of soil moisture and increased labour cost, irrigation water and fuel costs for cultivation. Since there is no cultural operation during the brown manuring for manure crop incorporation it saves the cost of manuring. Farmers can grow the manure crop in the standing main crops hence, brown manuringis the alternative to green manuring.

GREEN MANURINGV/S BROWN MANURING

Green manuring	Brown manuring
It is the incorporation of a manure crop by tillage before seed set usually around flowering	It is a no-till version of green manuring, where herbicides are used to kill the manure crop and weeds
Risk of soil surface erosion	The plants are left standing so it protecting lighter soil from risk from soil erosion

Moisture is necessary for incorporation and decomposition.	Moisture is conserved during the practice
The microbial population is necessary for decomposition	Chemical desiccation will take place

CROPS USED FOR BROWN MANURING

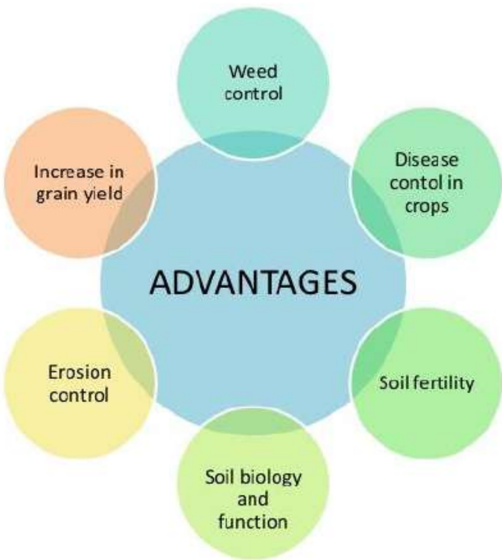
Non-leguminous crops: The non-leguminous crops used as a green manuring crop that provides only organic matter to the soil. The non-legumes are used for green manuring to a limited extent.
Example: Niger, Wild indigo,*etc*.
Leguminous crops: Crops provide nitrogen as well as organic matter to the soils. Legumescan acquire nitrogen from the air with the help of its nodule bacteria. The legumesare also preferably used in green manuring crops
Example: Sunnhemp, Dhaincha, Mung, Cowpea,Lentil,*etc*

QUALITIES OF AN IDEAL BROWN MANURE CROPS

Crop species that are most suited to brown manuring enable growers to maximize weed control and nitrogen fixation while minimizing cost and risk.
The main criteria to be consider in selection of brown manuring crops includes:

- Seeds of the plants should be easily availability and cost effective
- It should be easy to cultivate and have vigor growth
- High dry matter production in less span of the crop
- It should have competitiveness with target weeds
- The crops should have high ground cover to reduce wind erosion and conserve moisture
- It does not compete with the main crop

ADVANTAGES OF BROWN MANURING



ADVANTAGES OF BROWN MANURING

- Brown manuring increases the soil organic carbon content, thereby supplying required nitrogen through biological nitrogen fixation (BNF) to component crop plants. Thus, a part of nitrogenous fertilizer (upto 25%) can be replaced by brown manuring
- It increases the yield of the crops thereby improving the economic benefit of the farmers
- It improves the soil health parameters like organic carbon content and earthworm population of the soil
- Brown manuring reduces the weed population in the early stage due to its high growth rate and competition with the weeds.
- Brown manuring has a positive impact on soil Physico-chemical properties viz., soil structure, organic carbon, bulk density and pH of the soil.
- Integration of herbicide/herbicides with brown manuring markedly improved protein content in grain and protein yield than other management practices

CONCLUSION

Considering the increasing cost of chemical fertilizers, brown manuring can be seen as an alternate path to higher production and productivity of the crops and therefore enhancing the income of farmers. Brown manure is the perfect cost-effective way in nutrient management strategy for crops to improve production and to restore soil quality which in need of today's agriculture. By the significant advantages in environmental sustainability and enhances overall soil quality with least usage of herbicide application, the brown manuring method should actively promote by the extension agencies to reap its advantages by the farming community.

REFERENCES

Kumar, M.S and Mukherjee, P.K., 2011. Effect of brownmanuring on grain yield and nutrient use efficiencyin dry direct seeded kharif rice. *Indian Jornalof Weed Science*,**43**(1&2): 61-66.

Mondal S., Salam M. A., Islam M. S., Chaki A. K.,Shahidul M and Hossain M. F. Effect of brown manure and level of nitrogen on T. Amanrice and subsequent effect on wheat. *Journal of BangladeshAgrl. Univ*. 2012;**2**(1):41-45.

Ramachandran A and Veeraman A. Effect ofbrown manuring on weed dynamics,available soilmoisture and growthattributes in irrigated maize. *Madras Agric.Journal*. 2012; **100**(7):656-659.

Satyarakash S and Poolchand P. Brownmanuring in sugarcane for higherproduction. *Prog. Agric.* 2011;**11**(1):194-197.

Tanwar T. S., Singh T and Lal B. Weedmanagement in paddy. *Popular Kheti.*2010;**1**(2):130- 135.

Yadav, S.K., Singh, D.K. and Manisha Rani. 2014. Studieson nutrient uptake as influenced by different weedmanagement practices and brown manuring at varyingnitrogen levels in direct seeded aerobic rice. *Int. J. Basicand Appl. Res.*, **12**(2): 178-183.

Efficacy of pheromone dispenser trap with low cost bottle trap in attracting the mango fruit fly

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SUMMARY

The studies was undertaken to understand the efficacy of Agri pheromone dispenser trap with low cost bottle trap in attracting the fruit fly.Population of fruit flies wereassessed during fruiting season from April to August 2018.Significantly highest number of fruit flies were trapped in Bottle trap followed by Agri pheromone dispenser trap with the mean trap catches of 738.13 and 542.41 fruit flies / trap / week respectively.

INTRODUCTION

Fruit flies are major pests of several fruit and vegetable crops throughout the tropical and subtropical world. Nearly 35 per cent of the known fruit fly species attack soft fruits of which mango, guava, citrus, ber, peach and several cucurbitaceous vegetables are important. India is the second largest producer of fruits in the world with an annual production of 43 million tons from an area of four million hectares and contributes to more than nine per cent of world's fruit production. Mango is important fruit crops which are severely damaged by fruit flies. Most common species attacking these two fruits are *Bactrocera dorsalis*Hendel, *B. correcta*(Bezzi) and *B.zonata*(Saunders) (Verghese and Sudhadevi, 1998). Fruit flies deposit their eggs on host fruits when they are physiologically ripe. On hatching, maggots bore their way to the interior and feed on the pulp. Area fed by the maggot is discoloured due to rotting of the fruit and the fruit drops prematurely. Being polyphagous pests with high reproductive potential, wide host range, adaptability to climate and overlapping of generations, their management is rather difficult. Present management strategies mostly focus on chemical insecticides. Due to cryptic nature of the larvae of fruit flies they mostly remain unaffected by such insecticides, vis-à-vis the chance of insecticide residues in the fruits also increase. Sanitation combined with the use of lures and traps as well as baits proved to be the best alternatives for management of fruit flies. These traps have high specificity, low cost and are environmentally quite safe. In India, Verghese*et al.* (2002) have reviewed management strategies on mango. Among the various alternate strategies available for the management of fruit flies, the use of methyl eugenol traps stands as the most outstanding alternative. Methyl eugenol has both olfactory as well as phagostimulatory action and is known to attract fruit flies from a distance of 800 m (Roomi*et al*., 1993). Methyl eugenol, when used together with an insecticide impregnated into a suitable substrate, forms the basis of male annihilation technique. This technique has been successfully used for the eradication and control of several *Bactrocera*species. Continuous research in the development of efficient trapping system afford several new opportunities in the efforts to control the fruit flies. Since adult fruit flies use visual and olfactory stimuli to locate hosts, traps that combine visual and olfactory cues proved to be most efficient for capturing fruit flies.

MATERIALS AND METHODS

The studies was undertaken to understand the efficacy of Agri pheromone dispenser trap with low cost bottle trap in attracting the fruit fly.Population of fruit flies wereassessed during fruiting season from April to August 2018.TheAgri pheromone dispenser traps (Plate 1) were supplied by shagri agency, Mangalore. Ten traps were set up in one hactare of mango orchard. Trapped fruit flieswere collectedat weekly interval of standard meterolgical week. Care was taken to maintain a distance of 50 m between the traps to avoid trap interference effect. The low cost bottle trap (Plate 2) was designed by using plastic bottles of one litter capacity. Two cuts of 1cm × 1cm were made in the opposite ends of the bottle in order to facilitate entry for the male fruit flies and also it acts as a support to place the plastic thread to hang the traps to the trees. The methyl eugenol + malathion in 0.4 ml and 1.0 ml ratio dipped with cotton were suspended exactly in the center.Ten traps were set up in one hactare of mango orchards.Trapped fruit flieswere collectedat weekly interval of standard meterolgical week. Care were taken to maintain a distance of 50 m between the traps to avoid trap interference effect and at every forthnight interval the traps were charged methyl eugenol + malathion in 0.4 ml and 1.0 ml ratio.

RESULTS AND DISCUSSION

Mean population ofmales fruit fly of *Bactrocera*spp. captured/trap/week in mango orchard using different fruit fly traps depicted significantly that bottle traphad more population of fruit flies captured as compared toAgri pheromone dispenser trap.Pooled mean of all the weekly observations revealed that the number of fruit fly males captured/trap/week was significantly high inbottle trap(738.10) as compared to Agri pheromone dispenser trap (542.40), which was significantly difference between the traps(Table 1). The study initiated in 17th SMW had population *i.e*. 664.20 males in bottle trap and 484.20 inAgri pheromone dispenser traps. The data recorded at weekly interval till 34th SMW showed that the mean population of males captured showed progressive increase inbottle trap till 35thSMW and then the population started declining after 30thSMW. In Agri pheromone dispenser trap, the population of male captured had a progressive increase till 29thSMW and then the population started declining after 29thSMW. The highest mean population was recorded inbottle trap (888.00 males) in 30th SMW compared to Agri pheromone dispenser traps (692.20 males). The study showed that bottle trap**s** had significantly high trap catches. Pooled mean of all the weekly observations revealed that the number ofmale fruit fly captured/trap/week was significantly high inbottle trap with 738.10 as compared to Agri pheromone dispenser trap (542.40)**.** More number of fruit flies were collected in bottle trap might be due to the bottle trap was charging with the pure methyl eugenol at regular interval. The volatailes may be play important role as compared with the methyl eugenol mixtures which may be less volatailes. This study is inline withVargas *et al*., (2000) were compared the methyl eugenol mixtures dispensers (bucket traps, canec disks trap and Min-U-Gel trap) with pure methyl eugenol. *Bactoceradorsalis* captures differed significantly with treatment and season. *Bactocera dorsalis* captures with 100% methyl-eugenol were significantly greater than all other treatments (25% Min-U-Gel trap, 50% canecdisks trap and 75% bucket traps). Chandaragi*et al*., (2012) observed that bottle trap was found to have significantly higher trap catch in mango as compared to cylinder, sphere, PCI and open trap. Whereas *Rizket al.,*(2014) opined that Abdel-Kawi trap charged with 0.5 ml methyl eugenol was the most effective trap than bottle trap, glass McPhail trap and plastic McPhail trap. Similarly, Bekker*etal.*, (2017) conducted a study to check the efficacy of two commercially available traps *i.e*. yellow Delta traps and yellow Bucket traps, used for monitoring of *B. oleae* (Rossi) (olive fruit fly).

CONCLUSION

The study showed that bottle trap**s** had significantly high trap catch. Pooled mean of all the weekly observations revealed that the number ofmale fruit fly captured/trap/week was significantly high inbottle trap with 738.10 as compared to Agri pheromone dispenser trap (542.40).

PLATES


(Plate 1): Agri pheromone dispenser traps (Plate 2): low cost bottle trap

Table 1. Efficacy of the agri pheromone dispenser trap and bottle trap in attracting the fruit fly

Month	SMW	Trap catches per week*	
		Bottle trap	Agri pheromone dispensure trap
April	17	664.2	484.2
May	18	686.2	467.2
	19	693.4	500.0
	20	704.0	496.2
	21	717.0	511.8
June	22	714.4	501.6
	23	736.6	531.8
	24	747.0	516.4
	25	761.6	581.6
July	26	798.4	555.4
	27	825.8	615.6
	28	837.4	572.0
	29	872.2	692.2
	30	888.0	634.4
August	31	741.6	561.6
	32	695.4	538.4
	33	616.0	502.4
	34	587.2	500.6
Pooled mean		738.13	542.41
S.D =		81.93	58.88
CV at (0.05%)=		11.09	10.85
t (cal) value		8.016*	
t (tab) value		2.036	

*Significantly difference

REFERENCES

Bekker, G., Addison, M. F.and Addison, P., 2017, Comparison of two trap types for monitoring *Bactroceraoleae* (Rossi) (Diptera: Tephritidae) in commercial olive groves of the Western Cape Province, South Africa. *African Entomol*., 25(1):98-107.

Chandaragi, M.,Sugandhi, R., Kumar V. M. M., and Uppar, V., 2012, Evaluation of different trap designs for capture of fruit flies in mango orchard. *Proc. Int.Conference of Entomol*., Punjabi University, Patiala.*pp.* 28.

Rizk, M. M. A., AbdelGalil, F. A., Temerak, S. A. H. andDarwish, D. Y. A.,2014, Factors affecting the efficacy of trapping system to the peach fruit fly (PFF) males, *Bactrocerazonata* (Saunders) (Diptera: Tephritidae). Archives of Phytopathology and Plant Protection. 47:490-98.

Roomi M. W., Abbas, T., Shah, A. H., Robina, S., Qureshi, A. A., Hussain, S. S. and Nasir, K. A., 1993, Control of fruit flies (*Dacus* spp.) by attractants of plant origin. Anzeigerfurschadlingskunde, Aflanzenschutz, Umwdtschutz, 66: 155-157.

Vargas, R. I., Stark, J. D., Kido, M. H., Ketter, H. M. and Whitehand, L. C., 2000. Effect of lure mixture and weathering. *J. Econ. Ent.,* 93 (1):83-87.

Verghese, A. and Sudhadevi, K., 2001, Relation between trap catch of *Bactrocera dorsalis*Hendel and abiotic factors. In: Proceedings of First National Symposium on *Pest* Manage. Hort. Crops, Bangalore, pp.15-18.

Verghese, A., Madhura, H. S., Jayanthi, P. D.K. and Stonehouse, J. M., 2002, Fruit flies of economic significance in India, with special reference to *Bactrocera dorsalis* (Hendel). *Proceedings of 6th International Fruit fly Symposium held between 6-10 May 2002*, Stellenbosch, South Africa, pp. 317- 324.

Insect Pest Complex of Chappan kaddu (*Cucurbita pepo*) and their management in North India

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ABSTRACT

Chappan Kaddu (*Cucurbita pepo*) is one of the most important cucurbitaceous vegetable crop growing all over India including Tropical, sub-tropical and temperate zone. It is a rich source of vitamins and minerals and is attacked by the number of insect pest; amongst them the Fruit fly, *Bactrocera cucurbitae* (Diptera: Tephritidae), Pumpkin beetles, *Aulacophora foevicollis* (Coleoptera: Chrysomelidae), Pumpkin caterpillar, *Diaphania indica* (Lepidoptera: Crambidae) and Snake gourd semilooper, *Plusia peponis* (Noctuidae: Lepidoptera) are most important insect pest which causes colossal damage to the crop and adversely effects the crop yields. To maximize the economic returns, various management strategies are adopted to manage these insect pests.

INTRODUCTION

Chappan Kaddu (Summer Squash) also known as **vegetable marrow** (*Cucurbita pepo*) is commonly growing vegetable in north India during the hot summer months. Summer squash is also known as bush squash, vegetable marrow, Vilayati Kaddu, Chappan Kaddu, Safed Kaddu (Thamburaj and Singh, 2001).The fruits may be green, whitish or irregularly striped green and whitish coloured. The plants are short lived annual, or perennial vines with branching tendrils and broad lobed leaves; they produces large yellow or orange coloured flowers, and a pepo fruit (berry with a thick rind) known as a pumpkin. The flesh is white with no cavity and the seeds are embedded in the flesh. The short stalk of the fruit is hard and deeply furrowed with 5 or 8 ridges and is only slightly swollen where it joins the fruit. They have a very bland flavor and can be stuffed with stuffing. The cultivation of Summer squash is gaining popularity in UT of J&K wherein it is especially grown during the summer months. This crop attacked by the numbers of insect pest which causes extensive damage; some of the important insect pest amongst them are discussed below.

1. Fruit Fly (*Bactrocera cucurbitae*) Diptera: Tephritidae

The melon fruit fly, *Bactrocera cucurbitae* (Coquillett) is distributed widely in temperate, tropical, and sub-tropical regions of the world. It has been reported to damage 81 host plants and is a major pest of cucurbitaceous vegetables. The extent of losses varies between 30 to 100 per cent, depending on the cucurbit species and the season.

Fruit fly Damage on Fruit

Adult Fruit fly on Chappan Kaddu

Maggots of Fruit fly

Pest abundance increases when the temperatures fall below 32°C, and the relative humidity ranges between 60 to 70 per cent (Dhillon *et al.*,). Each female on an average lays 58-95 eggs singly in clusters on the fruits and the egg period lasts for 1-9 days. The color of the maggots is dirty white and they pupate inside the soil. The fruit fly maggots feed on the internal tissues of the fruit which lead to premature fruit dropping, yellowing and rotting of the affected portion. The larval period lasts for 13 days in summer and about three weeks in winter. The adult longevity is of 14-54 days. The fruit flies are very serious pest of the cucurbitaceous crops. It is not easy to manage this pest because it feed inside the fruits.

Management

- All the fallen and damaged fruits should be collected and buried under the soil.
- After harvest, deep ploughing should be done in the field.
- Use ribbed gourd as trap crop and apply malathion 0.1% on congregating adult flies on the undersurface of leaves.
- Use poison baits in case of severe infestation.
- Apply the bait spray containing 50 ml of malathion 50 EC + 0.5 kg of gur/sugar in 50 L of water per ha. Repeated at weekly intervals. Keep the bait in earthen lids placed at various corners of the field.
- Use attractants like citronella oil, eucalyptus oil, vinegar (acetic acid), dextrose and lactic acid to trap flies
- Use fly trap: Keep 5 g of wet fishmeal in plastic container with six holes (3 mm diameter), two cm from the bottom of the bag. Add a drop (0.1 ml) of dichlorvos in cotton plug and keep it inside the bag. Dichlorvos should be added every week and fishmeal renewed once in 20 days (20traps/acre).

2. Pumpkin beetles (*Aulacophora foevicollis*) Coleoptera: Chrysomelidae

The grubs and adult beetles cause extensive damage to the crop. They create number of small holes in different parts of plant. Lower plant parts such as root and stem are attacked by the grubs, they bore inside the roots and underground stem. The adult beetles feed on the aerial parts of the plant and makes holes . In case of heavy damage, numerous small and big holes are seen in leaves and stems which lead to retardation in growth and development of the plant.

Grub

Adult

Female lays about 300 oval shaped eggs either singly or in batches in moist soil close to the plant. The eggs hatch within 6-15 days. After hatching, the dirty white coloured grub start feeding on the root and stem. The grub period lasts for 13-25 days; pupation takes place in thick-walled earthen chambers in the soil, at a depth of about 20-25 cm. The pupal period lasts 7-17 days. Life-cycle is completed in 26-37 days; the pest has five overlapping generations per year.

Management

- Deep ploughing exposes the different hibernating stages of the pest which are killed either by desiccation or get predated upon by the birds.
- Collection and destruction of adult beetles.
- Spray Malathion 50 EC @ 500 ml or Dimethoate 30 EC @ 500 ml / ha.

3. Pumpkin caterpillar (*Diaphania indica*) Lepidoptera: Crambidae

The caterpillar feed on the leaves which reduces its chlorophyll content, and leads to the folding of the leaves, makes the web and feed within. The larvae also cause damage the flowers, and too bore inside the developing fruits. Affected flowers bear no fruits; and infested fruits become unfit for human consumption.

Larva

Adult

The adult beetle has transparent white wings with broad and dark brown marginal patches and orange colored anal tuft of hairs in the female. Eggs are laid singly or in groups on the lower surface of the leaves. Egg, larval and pupal periods last for 3-6, 9-14 and 5-13 days, respectively. Larvae are elongate, bright green coloured with a pair of thin white longitudinal lines on the dorsal side. Pupation takes place in a cocoon in the flowers. The longevity of adult is 3 -7 days and total fecundity of female is up to 366 eggs.

Management

- Collected and destroy the caterpillars.
- Larval parasitoid, *Apanteles* spp. provides effective control of Pumpkin caterpillar
- Spray any of the insecticides *i.e* Malathion 50 EC @500 ml/ha or Dimethoate 30 EC @500 ml/ha

4. Snake gourd semilooper: *Plusia peponis* (Noctuidae: Lepidoptera)

The caterpillar cuts the edges of leaf lamina, folds it over the leaf and feeds from within leaf roll. The growth of the affected plant becomes retarded. The white coloured eggs are spherical in shape and are laid singly on the fresh leaves.

Larva

Adult

The larvae are light to dark green in colour with longitudinal white stripe and humped in last abdominal segments. The pupae go for pupation inside the leaf fold. The newly emerged moths have shiny brown forewings.

Management:

- Collect and destroy the caterpillars
- Encourage activity of parasitiods like *Apanteles taragamae, A. plusiae*
- Spray the insecticides i.e Malathion 50 EC @500 ml/ha

REFERENCES

Dhillon, M.K ; Singh, Ram ; Singh., Naresh, J.S and Sharma, H.C . 2005. The melon fruit fly, *Bactrocera cucurbitae*: A review of its biology and management. *J Insect Sci*. 5:40.

Thamburaj S., and Singh N., 2001, Textbook of vegetables, Tuber crops and Spices, Indian Council of Agricultural Research, New Delhi, 286p

Sustainable Livelihood through Small Ruminants: A Success Story of Rainfed Farmer in Karnataka

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Livestock component is an integral part of every farming system particularly in rainfed agro-ecosystem. It plays an important role in the sustainable livelihood of resource poor farmers, because of inherent risk involved in the crop farming due to uncertainty of rainfall and occurrence of recurrent droughts. Farm based enterprise like rearing of small livestock such as goat and sheep farming have a great potential to generate additional income and provide employment opportunities to farmers in a longer period of time. They are raised mainly for meat, milk, and skin and providing a flexible financial reserve (social security) in bad crop years for the rural population (Sastri 1997; Puskur *et al.,* 2004). Hence, farmers realized that integration of small ruminants like goat and sheep and fodder production within their limited land and water resources can provide better livelihood opportunities in drylands. Small ruminants are essential component of rainfed farming systems in semi-arid India since they can survive in most adverse climatic condition and withstand drought situations.

FARM BASED ENTERPRISE- SHEEP AND GOAT REARING

Netranahalli village in Molakalmur Taluk of Chitradurga District is a small village with 128 households. Agriculture is the primary livelihood activity of all the families. In the village, 80% belongs to small and 20% belong to medium farmer category. Farming is predominantly dominated by rainfed cropping system with complete depends on monsoon. Though agriculture is main occupation, farmers in this village resorted to farm based enterprise such as rearing of small ruminants ever since the farming is affected by prolonged drought and frequent failure of monsoon. Around 30 to 40 farm families in the village resorted to rearing of livestock particularly small ruminants of sheep and goats since small ruminants are important source of income as they serve as a lifeline to farmers especially during drought years by providing income and sustenance. Livestock production provides a constant flow of income and reduces the vulnerability of agricultural production (Holmann *et al.,* 2005). Further, Rearing of small ruminants is more profitable with assured and constant income (Misra *et al.,* 2000). Their plan of enterprise was to purchase of small ruminants (sheep and goats) of one to two months old at a cost of Rs. 3000 to 3500 per animal and feed them for period of four to six months in their backyard and selling in the market at remunerative price. In this way, they earn nearly about Rs. 10000 to 20000 per animal in time period of 4 to 6 months. Most of the farmers also involved in multiplication of animals through breeding program. Farmers usually called as ATM (Any Time Money) for enterprise of goat and sheep rearing since they can sell sheep and goats at their village and get the money immediately.

SUCCESS STORY OF RAINFED FARMER

Sri Shekhar, a progressive and innovative farmer from Netranahalli village in Molakalmur Taluk of Chitradurga District, Karnataka owning five acres of rainfed land. With the existing land and farm resources he used to cultivate field crops such as groundnut, sorghum, maize and ragi under rainfed conditions. Due to erratic and frequent failure of monsoon coupled with recurrent of drought he experienced huge financial loss as result of crop failure and decline in crop yields. Consequently farmer fails to repay the bank loan availed for agriculture purpose and ultimately fallen in vicious cycle of poverty. After few years, he comes up with new idea of rearing small ruminants like sheep and goats for the purpose of sustaining income and livelihood. For initiating new enterprise he approached Shree Kshetra Dharmastala Manjunath Skemabiruddi, Self Help Group (SHG) operates in his own village and it provide need based financial services at lower rate of interest for needy peoples. He took loan and started livestock rearing in his own backyard with two indigenous cows, four sheep and four goats.

According to him cows are domesticated mainly for milk for self consumption and sheep and goat reared for commercial purpose. He had undergone training with respect to animal husbandry at animal husbandry department located at Molakalmur taluka. With help of training program he involved in rearing and multiplication of animals through breeding program. His plan of business was to purchase small ruminants in local market and feed them for period of six months and sell them in big cities/market for lucrative prices especially in festive season. Accordingly, he used to earn money and make livestock profitable venture. According to farmer, net additional income generated due to rearing of ruminants in his own backyard was 3 to 3.5 lakhs annually apart from income earned through agriculture activities. For fodder purpose, farmer used to cultivate fodder sorghum, maize and high yielding variety of grasses like guinea grass in his one acre of land and prepares silage for feeding animals. Apart from cow dung farmer utilizes goat and sheep excreta as manure prepared through natural compost for his agriculture land. According to him, goat and sheep manure is rich source of nutrients especially nitrogen, prosperous and potassium helps for healthy plant growth, soil enrichment and enhances the crop productivity. The farmer further informed that he used to sell the excess quantities of manure in the local market as it fetches remunerative price in the market. In addition, the fur of sheep or goats is also in great demand in market especially for preparation of blankets explains Sri Shekhar, a progressive farmer.

Fig 1: Farm based enterprise (rearing of small ruminants at farmer backyard)

CONCLUSION

Rearing of small ruminants like sheep and goat in dryland ecosystem was a profitable venture especially for small and marginal farmers since it not only provides regular income and employment opportunities to farmers for longer period but also helps in successful crop management in dryland agro-ecosystem. The small ruminants are also crucial in ensuring food security under changing climatic situations as they provide households both with nutrition and disposable income.

REFERENCES

Holmann, F., Rivas, L., Urbina, N., Rivera, B., Giraldo, L. A., Guzman, S., Martinez, M., Medina, A. and Ramirez, G. (2005). The role of livestock in poverty alleviation: An analysis of Colombia. Livestock Research for Rural Development. 17(1): 1-15.

Misra, A. K., Reddy, B. M. K., Rekha, M.S., Reddy, G. S. and Singh, H. P. (2000). Sheep and goat farming in rainfed areas: Constraints and options for improvement on smallholder production systems. In: Thomas C K and Sastri N S R (Editors): Smallholder livestock production in developing courtiers. KAU, Thrissur, pp. 133-144.

Puskur, R., Bouma, J. and Scott, C. (2004). Sustainable livestock production in semi-arid watersheds. Economic and Political weekly, 39(31): 3477-3483.

Sastri, N. S. R. (1997). Livestock feeding situation in Andhra Pradesh: Options for improvement. Report No. 22/97, Indo-Swiss Project, Andhra Pradesh.

Modern Crop Improvement method and its Application

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Agriculture began into existence around 10,000 years ago, since then Homo sapiens have started using plants, crops trees, etc. for meeting their purposes and needs. In the starting the better performing plants with suitable characters were selected, besides this the useful characters which were produced naturally in plants were mated with certain plants by practicing human selection thus giving a break to natural selection. Plant modifications have begun with the discovery of Mendel's laws during the 19th century. The framework of DNA was discovered by Crick and Watson due to this knowledge on hereditary material has been increased, therefore novel methods directly focusing on DNA were started; firstly in 1960 by using Mutation breeding and in 1983 by using recombinant DNA technology. Great grip on genetics of plants led to the better methods on DNA examination and an improved version of prevailing techniques to reach the marker-assisted selection. Plant breeding is ambulatory and with the improvement in mechanization, a question arises regarding the necessity, risks and technical problems.

We should know how these techniques are going to work, how they generally vary from presently available methods, how these methods favour over conventional breeding practices.

MODERN CROP IMPROVEMENT METHOD:

1. Marker-assisted selection:

Now a day marker-assisted selection has become most acceptable in crop improvement programmes, this method by using biotechnological knowledge determines the presence or absence of specified genes. In most of the cases the DNA which should be isolated is taken from a portion of tissue of a leaf in the juvenile stage of the plant. This can be performed even at initial stages. Now a days 'seed chipping' is used. In this technology a small portion of the seed is cut off to get its DNA without causing any damage to the embryo or its ability to grow. This method fastens the breeding programme and facilitates the reduction in selection costs at a considerable rate.

2. Mutation breeding:

As we all know spontaneous mutations occur. Instead of waiting for these mutations scientists have begun their work in Mutation breeding during 1930 with the help of these breeding changes can be done at a much higher frequency to the plant DNA. During the late 19th century and early 20th century, by using x rays scientists began to work on changing genetic material the plant. Extensive initiatives were performed to export seeds in radioactive fields; otherwise utilization of EMS, the main purpose of this method is creating modifications to the DNA. Seeds are also sent into the outer environment to let them get exposed to the cosmic radiation. The Duram wheat, which is used in making sphagetties also gained characters which is the result of mutation breeding .Over the past 80 years, nearly about 3000 crop varieties have been created using mutation breeding method. The products of mutation breeding do not need specific labeling.

3. Genetic Modification:

From several hundreds of years man has been in a search of obtaining new traits in a plant or in the idea of combining numerous characters of interest into a single crop. Through Genetic modification we can bring together characters of interest into a single crop. If we consider the plant as a smart phone then then genetic modification is like addition of an extra app to it. When we compare Genetic modification with other methods it is more predictable, precise and controllable. There are 4 major applications of Genetic modification resistance to pests, resistance to virus, and resistance to drought and tolerance to herbicides. The original and the most natural method for genetic modification are based on ability of the bacterium *agrobacterium* to infest its DNA into the host DNA. The first genetic modification developed in tobacco plant this is engineered for resistance to herbicides. There are mechanical methods also for inserting DNA into the plant. Particle acceleration is the most important method which is also known as gene gun, biolistic and particle bombardment.

4. Grafting:

In these techniques the stem belonging to one species is grafted into root of other species. This method is mostly practiced in nurseries and in the field of horticultural crops. Most of the rose's varieties are result of this grafting method.

5. Reverse breeding:

The reverse process of making of F^1 hybrid is called as reverse breeding. In this the parental lines are recreated from the hybrid, from these recreated parental lines hybrids can be produced in other combinations.

6. Fast-track breeding for trees and shrubs:

This method is mainly used to shorten the juvenile phase of the plant and enable to cross-breed quickly. This type of breeding is done by using methods such as marker assisted selection to find the important genes responsible for a particular trait.

7. Agro-infiltration:

In this method the transfer of DNA to the plants is done with the help of *agrobacterium tumefactions* (a bacteria present in the soil). Agrobacterium is injected into the plants for the expression and production of concerned proteins. With the help of Agro-infiltration production of medicines in plants became possible.

8. Breeding through mutation:

DNA methylation by depending on RNA:

This is a type of gene slicing, we can also call this is as ceasing the expression of a gene. However with this technique no mutations occur at the DNA level and by this technique there is no incorporation of extra DNA into the genome of plants developed through this technique. But we are including this technique because at an epigenetic level hereditary changes are induced.

Oligonucleotide-directed mutagenesis:

This method is the improved form of mutation breeding. In the earlier version sudden changes in the DNA occur in this prediction is not possible whereas in oligonucleotide-directed mutagenesis specific number of DNA changes occur in which prediction is possible and pre-determined.

CRISPR/Cas:

By this method we can generate a mutation in the plant DNA in a previously determined place. This method is a form of location directed nuclease technology i.e. site directed nuclease technology (SDN). This method works on the principle of CRISPR/Cas defence mechanism of the bacteria against virus.

9. Cis-/intragenics:

Cisgenics:

As we all know all the GM crops which we are using now days are transgenic in nature. In transgenes is a specific DNA segment is added into the plant to get the desired result. The difference between the cisgenics and transgenics is that, in cisgenics the extra DNA segment originating from the plant with which the receiver plant can cross-breed. The meaning of Cis is ''within in the similar group of crossable category". Like crossing a Brinjal gene to Brinjal.

Intragenesis:

In intragenesis also same like cisgenics where the DNA segment is incorporated in the plant. Whereas in intragenesis the actual composition of the DNA is not conserved. Novel combinations of the present form of DNA are done with intragenesis.

10. GMO 2.0:

SDN-3:

This site directed nuclease -3 methods are used for comparatively big fragments of DNA to be inserted into the DNA of plant which is not possible with other SDN methods. This technology does not notify about the type of DNA to be introduced into the plant, this can be DNA of the same species or DNA of another species. With this technology there is a great advantage of determining in advance the exact location at which the extra DNA segment gets introduced into the plant DNA.

INFERENCE:

To make our food manufacturing system potential, imperishable and elastic we have to encourage new methods in plant breeding and cultivation practices. New techniques for the more efficient working will continued to be developed and breeders have to adopt these techniques. Being aware to the new production technologies and new products should be supported and form a feature of assuring environmental and food safety

REFERENCES:

Ahloowalia, B. S., Maluszynski, M., & Nichterlein, K. (2004). Global impact of mutation-derived varieties. Euphytica, 135(2), 187-204.

Citovsky, V., & Zambryski, P. (2000). Systemic transport of RNA in plants. Trends in plant science, 5(2), 52-54.

Deng, S., Dai, H., Arenas, C., Wang, H., Niu, Q. W., & Chua, N. H. (2014). Transcriptional silencing of Arabidopsis endogenes by single-stranded RNAs targeting the promoter region. Plant and Cell Physiology, 55(4), 823-833.

Grunewald, W., & Bury, J. (2015). The GMO revolution. Lannoo Campus.

Okuzaki, A., & Toriyama, K. (2004). Chimeric RNA/DNA oligonucleotide-directed gene targeting in rice. Plant cell reports, 22(7), 509-512.

Wenzel, S., Flachowsky, H., & Hanke, M. V. (2013). The Fast-track breeding approach can be improved by heat-induced expression of the flowering locus t genes from poplar (*Populus trichocarpa* L.) in apple (Malus× domestica Borkh.). Plant Cell, Tissue and Organ Culture (PCTOC), 115(2), 127-137.

Biorational Pesticides: An Envirosafe Alternative to Pest Control

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ABSTRACT

Global agriculture is currently challenged to provide increasing supplies of food for a growing population due to the changing trends of insect attacks and climatic conditions. There is overwhelming evidence that the use of chemical pesticides have created many other serious problems like ecological backlashes in pest species, environmental pollution and degradation, threat to biodiversity conservation, loss of beneficial fauna (predators, parasites, pollinators *etc*) and human beings in particular. Keeping in view, the new generation of pesticides have attracted attention in pest management in recent years, Biorational pesticides as "third-generation pesticides" are derived from some natural source and impose minimum or no adversarial threats on the environment or beneficial organisms. Some examples of biorational pesticides are the microbial pesticide *Bacillus thuringiensis* (*Kurstaki*), neonicotinoids, avermectins, phenlpyrazoles, spinosyns, pyrroles, oxadiazines and various groups of insect growth regulators. With a narrower target range of pests, they also tend to have a more specific mode of action. This new class of pesticides are often designed to control a pest population to a manageable level rather than completely eradicate a target pest. These products have great potential for replacing the persistent conventional insecticides, confirming effective cost-benefit ratio, tackling ecological backlashes and ensuring food security with safe environment. The field of biorational pesticides is deep; consequently they are a source of both optimism and concern. However, these bio-products are not only winning the reliability of the market and end user; but also demonstrating their worth and potential in sustainable integrated pest management (IPM) program.

Keywords: Biorational Pesticides, Conventional Pesticides, IPM, Semiochemical, Biochemical.

INTRODUCTION

With the advent of the Green Revolution in the mid-1960s, there was a challenge to provide increasing supplies of food for a growing population and the repercussive commercialization of agriculture had induced the ascension of agricultural chemicals in India, to date. The chemical pesticides have been an indispensable part of agriculture in many developing countries like India, where the crop damage caused by insect pests often at very high levels i.e. 15-20% and unscientific method of application (Atreya, 2007; Devi, 2010; Shetty *et al.,* 2010; Rathee and Dalal, 2018). It is estimated that approximately 20,000 people dies every year due to pesticide consumption through their food in developing countries (Bhardwaj and Sharma, 2013)**.** Severe adverse effects of pesticides on the environment, toxicity to non-target organisms, problems of resistance reaching crisis proportions, and continuous public protests have driven demand for alternative pest control tactics (Pretty, 2009 and Horowitz *et al.*, 2009). The latest developments of the Biorational strategies in pest management including their specificity, safety to non-target organisms, particularly mammals, and utilization in low, sometimes minute, amounts have led to discover and develop newer and safer pesticides, particularly in the past few decades (Rosell *et al.*, 2008).

"Biorational pesticides" has only recently been proposed term derived from two words, "biological" and "rational" referring to pesticides that are synthetic or natural compounds effective against the target pest but are less detrimental to natural enemies (Hara, 2000 and Shi, 2000), although there is no official definition of this term. Moreover, "Reduced-risk" status has been given to Bio-rational pesticides by the Food Quality and Protection Act, 1997 that do one or more of the following: reduce pesticide risks to human health, non-target organisms, or environmental resources, or help make integrated pest management (IPM) more effective (Uri,1998). Operationally, a bio-rational agent should be reduced-risk, but many potential reduced-risk pesticides may not be viewed as bio-rational (Horowitz *et al.*, 2009). Stern *et al.*, 1959 and Stansly *et al.*, 1996 proposed that bio-rational agents should be envisaged as 'selective insecticides', which are nearly fully compatible with biological controls, if properly designed and deployed. The introduction of bio-rational products in the farming practices is a major component of IPM program that will reduced rates of chemical pesticides and prevent, or at least delay the development of resistance in target pests to both chemical pesticides and bio-pesticide toxins (Khater, 2012).

Classification of Biorational Pesticides:

The major classification of biorational pesticides include: microbials (viruses, bacteria, fungi and protozoa), plant-incorporated protectants (PIPs) (botanicals, essential oils), and bio chemicals (semiochemicals).

1. **Microbial Pesticides:**
   Microbial insecticides are products containing microorganisms or their by-products, which result in insect diseases. These biorational pesticides include bacteria, fungi, viruses and protozoans. These types of pesticides can control

many different kinds of pests, although each separate active ingredient is relatively specific for its target pests.

- **Bacteria:** The most widely used insecticidal bacterium is *Bacillus thuringiensis (Bt)*, that is gram-positive, spore-forming soil bacterium that produces parasporal, proteinaceous, crystal inclusion bodies during sporulation (Hofte and Whitely, 1989), pathogenic to larvae of certain insects, particularly lepidopterous insects, inducing mortality through infection. The resting stage, or endospore, of the bacterium contains endotoxins which are capable of paralyzing and lysing the insect gut, thereby causing mortality through starvation. There are several insecticides based on various sub-species of *Bacillus thuringiensis* Berliner (*Bt*), such as *B. thuringiensis israelensis* (*Bti*), with activity against mosquito larvae, black fly (simuliid), fungus gnats, and related dipterans species*; B. thuringiensis kurstaki* (*Btk*) and *B. thuringiensis aizawai* (*Bta*)with activity against lepidopteran larval species; *B. thuringiensis tenebrionis* (*Btt*), with activity against coleopteran adults and larvae; and *B. thuringiensis japonensis* (*Btj*) strain *buibui*, with activity against soil-inhabiting beetles. They are highly efficient, easily be mass-produced, easy to handle, stable when stored, cost-effective, pest specific, and safe to people and the environment and must be incorporated in IPM programs. Recently, use of new Series of closely related macro cyclic lactone derivatives produced as fermentation metabolites of *Streptomyces avermitilis*; includes Abamectin, Ivermectin and Emamectin benzoate. Also, spinosad which is used insecticide derived from the metabolites of the naturally occurring bacteria, *Saccharopolyspora spinosa* (Gavkare *et al.*, 2013).
- **Viruses:** Insects are attacked by many different types of entomopathogenic viruses that are obligate disease-causing organisms that can only reproduce within a host insect. Only Baculoviruses (BVs) have been used as pesticides (Szewczyk et al., 2009; Szewczyk et al., 2011) that are classified into two genera: Nuclear Polyhedrovirus (NPV) and Granulovirus (GV). BVs are responsible for the systemic or cell-to-cell spread of the virus within an infected insect. Baculovirus control of pest insect populations was demonstrated in the 1940's but the first viral insecticide registered was that of *Helicoverpa* (*Heliothis*) *zea* in 1971 under the trade names Viron/H and later Elcar (Ignoffo, 1973). Currently, *Autographa californica* NPV (AcNPV) is the choice for gene insertion or gene deletion research both in industry and academic institutions (Rosell *et al.*, 2008). A number of baculovirus insecticides have been registered and produced commercially (Moscardi, 1999), mainly for caterpillars, such as Gemstar LC (NPV of *Heliothis*/*Helicoverpa* spp. e.g., corn earworm, tobacco budworm, cotton bollworm); Spod-X LC (NPV of *Spodoptera* spp. e.g., beet armyworm); CYD-X and Virosoft CP4 (GV of *Cydia pomonella*, the

codling moth); and CLV LC (NPV of *Anagrapha falcipera*, the celery looper. This virus had been also developed for control of the tobacco budworm (*Heliothis virescens*), corn earworm (*Heliothis zea*) and *Heliothis armigera* on cotton, row crops, fruits and vegetables.

- **Fungi:** Many fungi are pathogenic to the insect host, and these are referred to as entomopathogenic fungi which either belong to the class Entomophthorales or Hyphoymycetes genera. The most notable fungi currently used to control insects such as*, Hirsutella thompsonii, Nomuraea rileyi, Verticillium lecanii*. *Beauveria bassiana*, *Beauveria brongniari*, *Metarhizium anisopliae*, and *Metarhizium flavoviride*, *Leptolegnia spp.,* and *Coelomomyces spp.* Under favourable conditions, the fungal infection and transmission is produced by asexual fungal spores or conidia that are dispersed throughout the environment in which the insect host is present. The spores germinate in the insect's blood and germinating mycelia gradually kill the host (Copping and Menn, 2000).
- **Protozoa and Nematodes**: Entomopathogenic protozoa are generally host specific and slow acting, often producing chronic infections characterized by a general debilitation of the host (Lacey and Goettel, 1995). The spore formed primarily microsporidia by the protozoan is the infectious stage in susceptible insect. They are ingested by the host and germinate in the midgut. Sporoplasm is then released invading target cells and causing massive infection to the host (Brooks, 1988).The most notable entomopathogenic protozoa belong to *Nosema* spp. and *Vairimorpha necatrix*. Among the *Nosema* spp., *Nosema locustae* is the only commercially available species of microsporidium, and marketed under several labels for control of grasshoppers and crickets. Furthermore, Entomopathogenic nematodes mostly from the genera *Steinernema* and *Heterorhabditis* are used where chemical insecticides fail, for instance in soil, galleries of boring insect pests or where resistance to insecticides has appeared (Ehlers, 2001). *Seiternema carpocapsae, Seiternema feltiae*, *Seiternema kushidai*, *Seiternema riobravis*, *Seiternema scapterisci*, *Heterorhabditis bacteriophora*, and *Heterorhabditis megidis* (Gaugler, 1997) are effective EPNs aganist flies, fleas, fungus gnats, coleopterous larvae particularly scarabs, mole crickets, root weevils, white grubs, lepidopterous larvae, including webworms, cutworms, armyworms, girdlers and wood borers sciarid flies, slugs, *etc* (Gaugler *et al*., 2000).

2. **Plant-Incorporated Protectants (PIPs):**

Plant-Incorporated Protectants also known as phytochemicals which are naturally occurring bioactive compounds obtained from plants or their derivatives. Several groups of Plant-Incorporated Protectants such as alkaloids, steroids, terpenoids, essential oils and phenolics from different plants have been reported previously for their insecticidal activities (Canyonb et al., 2005). The major plant families such as Myrtaceae, Lamiaceae, Asteraceae, Apiaceae, and Rutaceae are highly targeted for anti-insect activities against several insect orders. Some examples of their applications to crop protection like mosquito repellency (citronella oil), control of domestic pests (cockroaches, ants, fleas, *etc*.), *Varroa* mite control, as aphicides and acaricides (cinnamon oil) and urban insect control (eugenol-based products from basil or clove) and many more (Jacobson and Crosby, 1971; Isman *et al*., 2007).

3. **Biochemicals:**
   Biochemical pesticides comprised of naturally occurring substances such as plant extracts, fatty acids or pheromones, growth or mating disrupters, and so on that control pests by non-toxic mechanisms.
   - **Botanicals Pesticides:** Pyrethrum from *Chrysanthemum cinerariifolium* Vis. (Compositae), rotenone from *Lonchocarpus nicou* or *Derris elliptica* (Leguminosae), nicotine from *Nicotiana tabacum* (Solanaceae) and *Neem and azadirachtin-related tetranortriterpenoids* derived from *Azadirachta indica* (*Melia azadirachta*) and many more, are outstanding among other examples. However, these naturally derived compounds from the plants are easily biodegradable and have no ill-effects on non-target organisms. Neo-nicotinoids, a class of synthetic analogues of nicotine that are further classified into three groups namely: Chloronicotinyl compounds (Imidacloprid and Acetamiprid), Thionicotinyl group compounds (Thiomethoxam) and Furanicotinyl group compounds (Dinotefuran) (Gavkare *et al.*, 2013).

   - **Insect Growth Regulators:** Juvenile hormones (JH) and their analogs collectively called as insect growth regulators (IGRs) or insect morphogenetic agents that are used in insect pest management, also known as "third generation insecticides". The main functions of these compounds results in inhibition or abnormally acceleration of the normal growth and development of insects (Jacobson, 1982). IGRs are categorised into two based on mode of action: chitin synthesis inhibitors and substances interfering with the action of insect hormones. Chitin synthesis inhibitors includes benzoylphenylurea (diflubenzuron, triflumuron, teflubenzuron, hexaflumuron and novaluron), triazine/pyrimidine derivatives (Cyromazine, Dicyclanil), and buprofezin which affects the ability of insects to produce new exoskeletons when molting. A substance interfering with the action of insect hormones includes Ecdysteroid agonist (chromafenozide, tebufenozide, halofenozide, and methoxyfenozide), Juvenile hormone analogues (pyriproxyfen, fenoxycarb, Juvocimenes) and Antijuvenile hormones (Fluoromevalonate, Compactin, ETB, Piperonyl butoxide) that suppresses pupation and induces vitellogenesis during the reproductive stage of the insect (Eto *et al.,* 1990).

- **Pheromones:** Pheromones are a class of semiochemicals that insects and other animals release to communicate with other individuals of the same species. It may be used to monitor populations or in direct pest control strategies, mass trapping of insects, lure-and-kill, movement studies, detection of exotic pests and, mating disruption. Pheromones are used in monitoring for detection of incipient infestations of introduced or exotic insects, such as the Mediterranean and Mexican fruit flies (Heath *et al*., 1996), wood boring and bark beetles (Brockerhoff *et al*., 2006) or for detection of pests with constantly expanding ranges, such as the gypsy moth (Sharov *et al*., 1997), the pink bollworm (Baker *et al*., 1990) or oriental beetles (Alm *et al*., 1999). These are non-toxic and biodegradable chemicals that are used to manipulate the behavior of insect pests.
- **Inorganic and organic acid:** Potassium silicate, diatomaceous earth (DE, diatomite or kieselgur), mineral oils, sulfur, boric acid, sodium borate, silica gels, kaolin clay, soap spray and peracetic acid (PAA) are few examples of inorganic and organic substances well known for their insecticidal effect and easily biodegradable qualities.

MODE OF ACTION OF BIORATIONAL PESTICIDES:

Biorational pesticides give better control than conventional insecticides, that satisfies the demands of pest managers, farming communities and consumers to require pesticides with low to moderate mammalian toxicity; have broader spectrum of activity, safer for the environment and for beneficial insects; and required for certified organic farming practices. Many biorationals are not phytotoxic (toxic to plants), usually do not persist in the environment and much safer to handle, however, it is advisable to test a new product by first conducting experimental trial before applying on a large scale (Rajput *et al*., 2003; Khan *et al*., 2010; Ahmad *et al*., 2011; Sarwar, 2012). Due to its selective behaviour, they easily target pests and often cause immediate paralysis or cessation of pests feeding on crops. Most biorational pesticides are nerve poisons acting at specific target sites in the insect's nervous system. Some pesticides act similarly to the old nerve poisons that result knocking-down, rapid intoxication, lack of coordination, paralysis and death, and have higher affinity to insect receptors than to mammalian. The other pesticides affect specific systems, such as the molting processes, metamorphosis and the insect endocrinology system (Sarwar, 2015). The most of the biorational insecticides have diverse modes of action, show effectiveness against different strains of resistant species, with no evidence of cross-resistance, has assisted in managing resistance to insect pests and they can play an important role in Insecticide resistance management (IRM) strategies (Denholm *et al*., 1998). Biorational pesticides also known as low risk pesticides have relatively low detrimental effect on the environment and its inhabitants, and have little or no adverse effect on non-target organisms, thus illustrating them among important components in IPM program (Horowitz and Isaaca, 2004).

Role of Biorational pesticides in IPM (Integrated Pest Management):

In 1970s Integrated pest management (IPM) was developed to control the menace of pests and pesticides, when Rachel Carson in her classic book entitled *Silent Spring* (Carson,1962) raised voice against a number of direct and indirect consequences of chemical pesticides to the agriculture production system. IPM is the blending of all effective, economical and environmentally sounds pest management methods into a single but flexible approach to manage pests. Fortunately, public awareness about the negative effects of the chemical pesticides on nature and on natural resources, such as pollution, pesticide residues and pesticide resistance, have forced us to shift our focus on to more reliable, sustainable and environmentally friendly agents of pest control, the biopesticides or Biorational pesticides. Their relatively low risk for non-target organisms and the environment, their high target specificity and the versatility of application methods has enabled this important order of pesticides to be maintained globally for IPM strategies and insect resistance management programmes. Biorational pesticides when used in IPM programmes can greatly reduce the use of conventional pesticides, while the crop yield remains high. The most commonly used biopesticides are living organisms (bacteria, viruses and fungi) that are pathogenic for the pest of interest. These include biofungicides, bioherbicides and bioinsecticides. However, bio-pesticides may represent about 4.2% of the overall pesticides market in India (Das, 2014). So far 14 bio-pesticides have been registered under the Insecticide Act 1968 in India. It is expected that biopesticides will equalize with synthetics, in terms of market size, between the late 2040s and the early 2050s, but major uncertainties in the rates of uptake, especially in areas like Africa and Southeast Asia, account for a major portion of the flexibility in those projections (Olson, 2015). Therefore, different methods for the management of pests include cultural, biological and indigenous knowledge systems, the use of resistant varieties, the use of plant extracts, the use of pheromones and the minimal use of chemicals in an IPM system (Alabi *et al.*, 2006).

CONCLUSION

In view of, an emerging trends of pest attacks and ban imposed on the conventional pesticides, there is need to develop appropriate technologies and guidelines for judicious marketing and application of pesticides for crop production. As this regard, biopesticides (such as entomopathogenic bacteria, fungi, protozoa, nucleopolyhedroviruses and nematodes) have been proposed as a safer and ecologically friendly alternative to the synthetic pesticides.

REFERENCES

Alabi, O., Banwo, O. O. and Alabi, S. O. 2006. Crop pest management and food security in Nigerian agriculture. *Archives of Phytopathology and Plant Protection*, 39: 457–464.

Alm, S. R., Villani, M. G. and Roelofs, W. 1999. Oriental beetles (Coleoptera: Scarabaeidae): current distribution in the United States and optimization of monitoring traps, *Journal of Economic Entomology*, 92: 931–935.

Atreya, K. 2007. Pesticide Use in Nepal: Understanding Health Costs from Short- term Exposure. Working Paper No. 28-07. South Asian Network for Development and Environmental Economics (SANDEE), Nepal.

Baker, T. C., Staten, R. T. and Flint, H. M. 1990. Behavior-Modifying Chemicals for Insect Management, ed. by R. L. Ridgway, R. M. Silverstein, M. N. Silverstein and M. N. Inscoe, Marcel Dekker Inc., New York, pp. 417–436.

Bhardwaj, T. and Sharma, J. P. 2013. Impact of pesticides application in agricultural industry: An Indian scenario*, International Journal of Agriculture and Food Science Technology*, l4(8): 817-822.

Brockerhoff, E. G., Jones, D. C., Kimberley, M. O., Suckling, D. M. and Donaldson, T. 2006. Nationwide survey for invasive wood-borer and bark beetles (Coleoptera) using traps baited with pheromones and kairomones. *Forest Ecology and Management*, 228**:** 234–240.

Brooks, F. M. 1988. Handbook of Natural Pesticides. Microbial Insecticides, Part A, Entomogenous Protozoa and Fungi; ed. by C. M. Ignoffo, CRC Press, Inc., Boca Raton, FL, pp. 1–149.

Canyonb, D., Younesc, M. W. F., Abdel-Wahaba, H. and Mansoura, A. H. 2005. A review of botanical phytochemicals with mosquitocidal potential. *Environment International*, 3: 1149-1166.

Carson, R. 1962. *Silent Spring*. Fawcett Crest, New York.

Copping, L. G. and Menn, J. J. 2000. Biopesticides A Review of Their Action, Applications and Efficacy. *Pest Management Science*, 56: 651-676.

Das S. K. 2014. Recent development and future of botanical pesticides in India. *Popular Kheti*, 2: 93-99.

Denholm, I., Horowitz, A. R., Cahill, M. and Ishaaya, I. 1998. Management of resistance to novel insecticides. In: Ishaaya I, Degheele D (eds). Insecticides with novel modes of action: Mechanisms and application. Springer, Berlin, pp. 260-282.

Devi, P. I. 2010 Pesticidesin agriculture—A boon or a curse? A case study of Kerala. *Economic and Political Weekly*, 45: 26-27.

Ehlers, R. U. 2001. Mass production of entomopathogenic nematodes for plant protection. *Applied Microbiology* and *Biotechnology*, 56: 623–633.

Eto, M., Kuwano, E. and Kiguchi, M. 1990. Synthesis and anti-juvenile hormone activity of 1-neopentyl- 5-substituted imidazoles. *Journal of the Faculty of Agriculture Kyushu University***,** 35(1-2): 35-41.

Gaugler, R. 1997. Biological Control: A guide to Natural Enemies in North America, ed. by C. Weeden, T. Shelton and J. Hoffmann, http://www.nysaes.cornell.edu/ent/biocontrol/pathogens/ nematodes.html.

Gaugler, R., Grewal, P., Kaya H. K. and Smith-Fiola, D. 2000. Quality assessment of commercially produced entomopathogenic nematodes. *Biological Control*, **17**: 100–109.

Gavkare, O., Patil, M. U., Kulkarni, A. V. and Gupta, S. 2013. New group of insecticides. *Popular Kheti*, 1(3): 34-39.

Hara, A. H. 2000. Finding alternative ways to control alien pests - Part 2: New insecticides introduced to fight old pests. Hawaii Landscape, 4 (1): 5.

Heath, R. R., Epsky, N. D., Dueben, B. D. and Meyer, W. L. 1996. Systems to monitor and suppress Creatitis capitata (Diptera: Tephritidae) populations. *Florida Entomologist*. **79**: 144–153.

Hofte, H. and Whiteley, H. R. 1989. Insecticidal crystal proteins of *Bacillus thuringiensis*. *Microbiology Reviews*, 53:242-255.

Horowitz, A. R. and Isaaca, I. 2004. Biorational Insecticides– Mechanisms, Selectivity and Importance in Pest Management Programs. In: Insect Pest Management- Field and Protected Crops (A. R. Horowitz and Isaaca, I. eds.), pp. 1-28. Springer, Berlin, Heidelberg, New York.

Horowitz, A. R., Peter, C. E. and Isaac, I. 2009. Biorational Pest Control– An Overview. Springer Science and Business Media.

Ignoffo, C. M. 1973. Development of a viral insecticide: concept to commercialization. *Experimental Parasitology*, 33: 380-406.

Isman, M. B. and Akhtar, Y. 2007. Plant natural products as a source for developing environmentally acceptable insecticides. in: I. Shaaya, R. Nauen, & A.R. Horowitz (eds), *Insecticides Design Using Advanced Technologies.* Springer, Berlin, Heidelberg, pp. 235–248.

Jacobson M. and Crosby D. G. 1971. (eds.): "Naturally Occurring Insecticides," Marcel Dekker Inc., New York.

Jacobson, M. 1982. Plants, insects and man – their interrelatioships. *Economic Botany*, 36(3): 346-354.

Khan, M. H., Sarwar, M., Farid, A. and Syed, F. 2010. Compatibility of pyrethroid and different concentrations of neem seed extract on parasitoid *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammatidae) under laboratory conditions. *The Nucleus*, 47(4): 327-331.

Khater, H. F. 2012. Ecosmart Biorational Insecticides: Alternative Insect Control Strategies, Insecticides - Advances in Integrated Pest Management, Dr. Farzana Perveen (Ed.), ISBN: 978-953-307-780-2, InTech.

Lacey, L. A. and Goettel, M. S. 1995. Current developments in microbial control of insect pests and prospects for the early 21st century. *Entomophaga*, 40: 3–27.

Moscardi, F. 1999. Assessment of the application of baculoviruses for control of Lepidoptera. *Annual Review of Entomology*, 44: 257–289.

Olson, S. 2015. An analysis of the biopesticide market now and where is going. *Outlooks on Pest Management*, 26: 203–206.

Pretty, J. 2009. The Pesticide Detox, Towards a More Sustainable Agriculture. *Earthscan*, London.

Rajput, A. A., Sarwar, M., Bux, M. and Tofique, M. 2003. Evaluation of synthetic and some plant origin insecticides against *Helicoverpa armigera* (Hubner) on chickpea. *Pakistan Journal of Biological Sciences*, 6(5): 496-499.

Rathee, M. and Dalal, P. 2018. Emerging insect pests in Indian agriculture. *Indian Journal of Entomology,* 80(2): 267-281.

Rosell, G., Quero, C., Coll, J. and Guerrero, A. 2008. Biorational insecticides in pest management. *Journal of Pesticide Science*, 33: 103–121.

Sarwar, M. 2012. Competency of Natural and Synthetic Chemicals in Controlling Gram Pod Borer, *Helicoverpa armigera* (Hubner) on Chickpea Crop. *International Journal of Agricultural Sciences*, 2(4): 132-135.

Sarwar, M. 2015. The Killer Chemicals for Control of Agriculture Insect Pests: The Botanical Insecticides. *International Journal of Chemical and Biomolecular Science*, 1(3): 123-128.

Sharov, A. A., Liebhold, A. M. and Roberts, E. A. 1997. Methods of monitoring the spread of gypsy moth (Lepidoptera: Lymantriidae) populations in the Appalachian mountains. *Journal of Economic Entomology*, 9: 1259–1266.

Shetty, P. K., Hiremath, M. S. and Sreeja, K. G. 2010. Farmer seducation and perception on pesticide use and crop economies in Indian Agriculture. *Journal of Experimental Sciences*, 1(1): 3-8.

Shi, Y. F. 2000. Advances of insecticidal microorganisms. *Plant Protection*, 26: 32-34.

Stansly, P. A., Liu, T-X., Schuster, D. J. and Dean, D. E. 1996. Role of biorational insecticides in management of *Bemisia*, pp. 605–615, In: Gerling D, Mayer RT (eds.), *Bemisia 1995: Taxonomy, Biology, Damage, Control and Management*. Intercept Ltd., Andover, Hants, United Kingdom.

Stern, V. M., Smith, R. F., Van Den Bosch, R. and Hagen, K. S. 1959. The integration of chemical and biological control of the spotted alfalfa aphid. The integrated control concept. *Hilgardia*, 29(2): 81–101.

Szewczyk, B., Lobo de Souza, M., Batista de Castro, M. E., Moscardi, M. L. and Moscardi, F. 2011. *Baculovirus* Biopesticides. *In M. Stoytcheva (ed.), Pesticides - Formulations, Effects, Fate*, InTech. pp. 25-36.

Szewczyk, B., Rabalski, L., Krol, E., Sihler, W. and Lobo de Souza, M. 2009. Baculovirus biopesticides - a safe alternative to chemical protection of plants. *Journal of Biopesticides*, 2 (2): 209-216.

Uri, N. D. 1998. Government policy and the development and use of biopesticides. *Futures*, 30: 409–423.

Pesticide Residue Management: Current Scenario and Innovations For Ecological Sustainability

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ABSTRACT

Pesticides are potentially toxic chemicals whose malicious effects have already appeared tobe a trojan horse to mankind. Indiscriminate use of these chemicals has led to almost all sorts of pollution and subsequent environmental degradation. The remnants of such toxic chemicals on agricultural producein high concentration can severely affect the health of a consumer. Presence of these deleterious chemicals in food commodities is also a major bottleneck for import and export. To combat this modern era disaster, various management tactics are being tried and tested regularly. In this article, we briefly reviewed the Indian scenario of pesticide poisoning and the strategies available to reduce the leftover toxicants on agricultural products.

1. INTRODUCTION

Currently, The global human population growth is 83 million annually *i.e.* 1.1% per year. The global census of 1 billion during 1800 surged up to 7.774 billion in 2020 and expected to cross 9.5 billion by mid-2020 [1]. The United Nations population statistics data ensures that the world population grew by 30% between 1990 and 2010 which is an addition of 1.6 billion humans in just 20 years with the highest increase in India (350 million) followed by China (196 million) [2]. The Food and Agricultural Organization (FAO) published a report in 2009 which shows that feeding a world population of more than 9 billion people in 2050 would require raising overall food production by 70 percent between 2005/07 and 2050. This also dictates a mandatory 2 fold increase in agricultural output in developing countries like India [3]. Increasing needs of food as a result of world population growth have led to intensive use of chemicals, particularly of fertilizers and pesticides to boost up the food production. However, indiscriminate (mis)use of pesticides makes way for the toxic residues to contaminate the environment, bioaccumulate in the food chain and pose a serious threat to public health. Moreover, the 'Maximum Residue Limit (MRL)' on different food commodities constitute a severe barrier to international trade. Indeed, there has been remarkable progress in recent decades to innovate green chemicals safer to the environment and non-target organisms but farmers in developing countries like India still extensively rely on inexpensive older molecules creating acute and chronic health hazards through direct exposure or impact of residues on food commodities [4].

2. IMPACT OF PESTICIDE RESIDUES (THE INDIAN SCENARIO):

The World Health Organization has defined the 'pesticide residue' as any substance or mixture of substances in the food of either humans or animals that is caused by the use of pesticides and any specified derivatives such as degradation and conversion products, metabolites, reaction products, and impurities that are considered toxic [5].

In India, the very first report of large scale pesticide poisoning was from Kerala in 1958, where over 100 people died due to consumption of wheat flour contaminated with parathion [6]. Later a multi-centric study conducted by Indian Council of Agricultural Research (ICAR)to assess the pesticide residues in selected food commodities collected from different states of the country (Surveillance of Food Contaminants in India, 1993), DDT residues were found in about 82% of the 2205 samples of bovine milk collected from 12 states. About 37% of the samples contained DDT residues above the tolerance limit of 0.05 mg/kg (whole milk basis). The highest level of DDT residues found was 2.2 mg/kg. The sample with residues above the tolerance limit was highest in Maharastra (74%), followed by Gujarat (70%), Andhra Pradesh (57%), Himachal Pradesh (56%), and Punjab (51%). Data on 186 samples of 20 commercial brands of infants formulae showed the presence of residues of DDT and HCH isomers in about 70 and 94% of the samples with their maximum level of 4.3 and 5.7 mg/kg (fat basis) respectively [7]. On average, the total DDT and BHC consumed by an adult were estimated as 19.24 mg/day and 77.15 mg/day respectively, fatty foods being the principal source of the contaminants [8]. According to another report, the average daily intake of HCH and DDT by Indians was projected to be 115 and 48 mg per person respectively, which were higher than those observed in most of the developed countries [9]. Rao *et al*., 2005 reported that 8040 patients were admitted due to pesticide poisoning from 1997-2002 and 1819 of them died in MGM hospital in Andhra Pradeshalone [10]. If this result is extrapolated considering reports from hospitals all over the nation the numbers will be unimaginable. For 25 years 22 lakh litres of Endosulfan was sprayed over fifteen thousand acres of land in Kerala affecting 5000 people and thousands of animal with neurophysiological disorders [11]. After a lot of conflicts between state and central government supreme court banned the pesticide in 2011. On July 17, 2013, heartwrenching news of insecticide poisoning from Bihar shook the entire country. 23 children died and more than 48 required medical treatment for consuming mid-day meal cooked with oil stored in containers contaminated by monocrotophos and organophosphate residues [12]. Class I pesticides which are designated as extremely and highly hazardous chemicals (Class Ia and Ib) by World Health Organizations(WHO) -and banned in more than 45 countries accounted for 30%

of India's total consumption of pesticides during 2015-16 [13]. According to a CSE (Centre for Science and Environment) report in 2013 the local retailers, agricultural institutes and state agriculture departments have been involved for years in the erroneous recommendation of pesticides on crops for which the concerned pesticides are not recommended. As a result, the unavailability of 'pesticide and crop-based MRL values and waiting period' (determined by FSSAI) led farmers to market their produce contaminated with residues.The recent draft notification by Govt. of India, titled 'Banning of Insecticides Order 2020', prohibits the import, manufacture, sale, transport, distribution and use of 27 pesticides, including popular chemicals likeAcephate, Atrazine, Butachlor, Captan, Carbofuran, Chlorpyriphos, 2,4-D, Deltamethrin, Monocrotophos. Now, this will add burden to poor farmers as the import of substitute chemicals will aggravate the retail price of new pesticides. Such a situation demands novel strategies to combat the problem of toxic residues on agricultural produce to ensure better health, sustainable environment and economic growth.

3. MANAGEMENT OF PESTICIDE RESIDUES:

3.1. **Food processing**:

Food processing treatments such as washing, peeling, canning or cooking can contribute to a significant reduction of pesticide residues. The processes include baking, bread making, dairy product manufacture, drying, thermal processing, fermentation, freezing, infusion, juicing, malting, milling, parboiling, peeling, peeling and cooking, storage, storage and milling, washing, washing and cooking, washing and drying, washing and peeling, washing peeling and juicing and winemaking.

Washing can effectively rinse offpesticide residues deposited on the surface but the effectiveness is inversely proportional to the days after spray application as much of the chemical leftover tend to move inside the cuticular waxes and deeper layers of tissue with passing days [14]. Hot washing with detergent is more efficient than cold washing in eliminating surface residues. Hot costic washes in industrial-scale can efficiently remove or degrade hydrolysable pesticides during commercial peeling operations [15].

Peeling fresh fruits such as avocado, bananas, citrus, kiwifruit,mango and pineapple achieves virtually complete removal of residues from the fruit. Substantial data is showing non-detectable residues edible inner portion of fruits to support this statement. However, fruits like apples, tomatoes which can also be consumed as a whole required to be thoroughly washed before consumption. Residues of parathion in oat or rice grains were reduced eight folds on hulling [16]. Husking and polishing of rice reduced pirimiphos-methyl residues at the rate of 70 percent and 90 percent, respectively [17]. Husking alone resulted into 99 percent reduction of tetrachlorvinphos residues in corn[18].

Rates of degradation and volatilization of residues are increased by the heat involved in cooking. In a study with radiolabelled chlorothalonil residues, cooking under open conditions resulted in 85 to 98 percent losses by volatilization whereas, under closed conditions resulted in hydrolysis of 50% residue only [16]. Chemicals which are relatively less volatile and stable to hydrolysis such as DDT and synthetic pyrethroids, the elimination of residues may be slow and in fact, the toxic residues may increase in concentration due to loss of moisture.

Freezing in contrast to heating may be a way forward for reducing residues from food commodities. Refrigerated tomatoes showed a steady decline of residue from 5 to 26 percent after six days and 10 to 31 percent after 12 days of pesticide contamination [19]. By increasing the time of refrigeration there is a gradual increase in reduction of pesticide residues. After three days of freezing, HCB, lindane, DDT, dimethoate, profenophos and pirimiphos-methyl decreased by 4.91, 6.32, 4.07, 13.0, 11.5 and 9.35 percent, respectively [20].

3.2. **Ozonation**:

Among the different strategies used for food decontamination, ozone (O_3) can be a promising agent to degrade toxic xenobiotics through oxidation. Unstable ozone rapidly degrades to diatomic oxygen (O2) releasing free oxygen atom (O·) which readily reacts with harmful toxic residues and oxidize them to harmless bi-products. Studies carried out with ozone-based domestic vegetable cleaner by Chen *et al.,* 2013 showed that the residue removal efficiencies were 75 percent for chlorfluazuron and 77 percent for chlorothalonil from contaminated vegetables when the ozone production rate was 500 milligram per hour. A moderate reduction of 60 percent for Chlorfluazuron and 55 percent of Chlorothalonil residues was achieved when the ozone production rate was half of the previous [21]. Vegetables, when immersed in ozone microbubbles solution (OMBS) can be virtually made free from loads of pesticidal residues. It was experimentally proven to be effective to remove high concentration of fenitrothion from lettuce, cheery tomatoes and strawberry [22].

3.3. **Gamma irradiation**:

Gamma irradiation has huge potential as a technology to eliminate or degrade pesticidal residues from agricultural produce, especially vegetables and fruits to be exported outside the country. Gamma irradiation is generated by the decay of radioisotopes like Cobalt 60 with resultant release of high energy photons which can be employed for degradation of various pollutants including pesticide residues. Ionizing gamma radiation reduced the residues of pirimiphos-methyl (0.05 ppm in potatoes at1 kGy, 1 ppm in grapes at 2 kGy and 0.1 ppm in dates at1 kGy), malathion (8 ppm in grapes at 7 kGy) and cypermethrin (2 ppm in grapes at 7 kGy) to below maximum residue limits (MRLs)[23].Studies carried out by Hossain *et al.,* 2013 revealed the potential of gamma irradiation to clean samples contaminated with chlorpyrifos which also indicated a directly proportional relationship between dosage of gamma irradiation and removal of pesticide residues [24].

3.4. **Bioremediation**:

Bioremediation is a novel technology which employs different species and strains of organisms, especially microbes (both naturally occurring and genetically engineered) for degradation and removal of contaminants, pollutants or toxins from, soil, water and other environments reducing the persistent hazard of harmful chemicals. Microbes use pesticides as their carbon sourceand microbial metabolism (catabolism) results in mineralization of such contaminants in simple non-harmful end products like H_2O and CO_2. In contrary to complete degradation or catabolism, microbes may co-metabolize pesticides while feeding on substances contaminated by pesticides; this is also termed as incidental metabolism [25]. Various genera of gram-negative and gram-positive bacteria isolated from soils are active in degrading pesticides. They include *Pseudomonas*, *Sphingomonas*, *Burkholderia*, *Alcaligenes*, *Acinetobacter*, *Flavobacterium*, *Arthrobacter*, *Nocardia*, *Rhodococcus*, and *Bacillus*. Several genera of fungi are important in pesticide metabolism, including *Phanerochaete*, *Penicillium*, *Aspergillus*, *Trichoderma*, and *Fusarium* [26]. Examples of some reaction by microbe include the following [27]:

1. Hydrolysis—Carbaryl → 1-naphthol; chlorpyrifos → diethylthiophosphoric acid
2. Oxidation—Aldrin → dieldrin; parathion → paraoxon; fipronil → fipronil sulfoxide
3. Reduction—DDT → TDE (DDD); parathion → amino parathion
4. Dehydrochlorination—DDT → DDE; γ-HCH → γ-PCCH (pentachlorocyclohexene)
5. Isomerization—Dieldrin → photodieldrin 6. Other reactions—γ-HCH → α-HCH

Besides the use of microbes, some plants also exhibited remarkable pesticide degradation properties which can be used for bioremediation or more specifically phytoremediation.Herbicide-tolerant plat like *Kochia sp*. Can enhance microbial degradation of herbicides in the rhizosphere. 45% reduction of atrazine, 50% reduction of metolachlor and 70% degradation of trifluralin was achieved in a 14 days experiment [28]. Planting *Ricinus communis* can remove 25-70% of persistent organic pollutants from soil including insecticides like DDT, heptachlor, aldrin, hexachlorocyclohexane [29]. Mixed cropping of ryegrass, alfalfa, white clover, rapeseed can remove 89% pentachlorophenol from contaminated soil [30].

3.5. **Organic Agriculture**:

Organic agriculture has its roots in India since millennium as traditional farming practices adopted by rural growers from generation to generation but the production was not sufficient to feed the entire nation. Though Green revolution has made India a self-sufficient country from a food deficient one, intensification of agriculture over years caused huge degradation of the delicate balance between different components of the ecosystem by several ways, accumulation of harmful pesticidal residues being one of them. Here comes the importance of re-introduction of organic farming which excludes the use of synthetic chemicals andensures a holistic sustainability of economy and ecosystem. The four principles of organic farming as advocated by the International Federation of Agriculture Movement (IFOAM) [31] are:

1. It should be based on living ecological system and cycles, work with them, emulate them and help sustain them.
2. It should build on relationships that ensure fairness with regard to the common environment and life opportunities.
3. It should be managed in a precautionary and responsible manner to protect the health and well being of current and future generations and environment.

4. Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

According to the last published report on the website of APEDA, Ministry of Commerce, GOI, India produced around 1.70 million MT (2017-18) of certified organic products which include all varieties of food products namely Oil Seeds, Sugar cane, Cereals & Millets, Cotton, Pulses, Medicinal Plants, Tea, Fruits, Spices, Dry Fruits, Vegetables, Coffee etc. The total volume of export during 2017-18 was 4.58 lakh MT. The organic food export realization was around INR 3453.48crore (515.44 millionUSD). Organic products are exported to USA, European Union, Canada, Switzerland, Australia, Israel, South Korea, Vietnam, New Zealand, Japan etc. In terms of export value realization Oilseeds (47.m6%) lead among the products followed by Cereals and millets (10.4%), Plantation crop products such as Tea and Coffee (8.96%), Dry fruits (8.88%), Spices and condiments (7.76%) and others [32].

5. CONCLUSIONS:

The human population will never stop multiplying and so the demand for food. Organic agriculture without the use of synthetic chemicals is certainly a great way to restore ecological sustainability and support economic growth through national and international marketing of residue-less organic products but its potential to meet the steadily growing demand of food is a matter of concern among scientists and policymakers. More use of safer green chemicals in an integrated pest management approach, employing microbes and plants for chemical degradation and adoption of the aforesaid post-harvest technologies can slow down the accumulation of harmful chemicals in both the food and environment but the changing climate and high rate of resistance to chemicals can intensify the current problem. We hope this article will make agriculture students and scholars think critically and promote research to find novel ways to manage the toxic residues from the applied chemicals on agricultural produce.

REFERENCES

https://www.worldometers.info/world-population/

https://web.archive.org/web/20110507035406/http://esa.un.org/unpd/wpp/unpp/Panel_profiles.htm

Food and Agriculture Organization. (2009). How to Feed the World 2050. High-Level Expert Forum.

Ecobichon, D. J. (2001). Pesticide use in developing countries. *Toxicology*, *160*(1-3), 27-33.

Mani, M., Shivaraju, C., & Kulkarni, N. S. (2014). Pesticide residue management in grapes. In *The Grape Entomology* (pp. 181-186). Springer, New Delhi.

Karunakaran, C. O. (1958). The Kerala food poisoning. *Journal of the Indian Medical Association*, *31*(5), 204-7.

Aktar, W., Sengupta, D., & Chowdhury, A. (2009). Impact of pesticides use in agriculture: their benefits and hazards. *Interdisciplinary toxicology*, *2*(1), 1-12.

Kashyap, R., Iyer, L. R., & Singh, M. M. (1994). Evaluation of daily dietary intake of dichloro-diphenyl-trichloroethane (DDT) and benzene hexachloride (BHC) in India. *Archives of Environmental Health: An International Journal*, *49*(1), 63-66.

Kannan, K., Tanabe, S., Ramesh, A., Subramanian, A., &Tatsukawa, R. (1992). Persistent organochlorine residues in foodstuffs from India and their implications on human dietary exposure. *Journal of Agricultural and Food Chemistry*, *40*(3), 518-524.

Srinivas Rao, C. H., Venkateswarlu, V., Surender, T., Eddleston, M., & Buckley, N. A. (2005). Pesticide poisoning in south India: opportunities for prevention and improved medical management. *Tropical Medicine & International Health*, *10*(6), 581-588.

https://thelogicalindian.com/story-feed/awareness/incessant-pesticides-use/?infinitescroll=1

Idrovo, A. J. (2014). Food poisoned with pesticide in Bihar, India: new disaster, same story. *Occupational and environmental medicine*, *71*(3), 228-228.

https://www.downtoearth.org.in/news/agriculture/vidarbha-s-toxic-trail-59173

Street, J. C. (1969). Methods of removal of pesticide residues. *Canadian Medical Association Journal*, *100*(4), 154.

Farrow, R. P., Lamb, F. C., Cook, R. W., Kimball, J. R., & Elkins, E. R. (1968). Removal of DDT, malathion, and carbaryl from tomatoes by commercial and home preparative methods. *Journal of Agricultural and Food Chemistry*, *16*(1), 65-71.

http://www.inchem.org/documents/jmpr/jmpmono/2001pr12.htm

Desmarchelier, J. M. (1988). Iodometric calibration of organophosphorus insecticides and measurement of hydrolysis products. *Pesticide science*, *22*(3), 277-286.

Fahey, G., E. Gould and E. Philip. 1969. Removal of gardona and azodrin from vegetable crops by commercial preparative methods. J. Agri. Food Chem. 17: 1205-1206.

Abou-Arab, A. A. K. (1999). Behavior of pesticides in tomatoes during commercial and home preparation. *Food chemistry*, *65*(4), 509-514.

Farrow, R. P., Lamb, F. C., Cook, R. W., Kimball, J. R., & Elkins, E. R. (1968). Removal of DDT, malathion, and carbaryl from tomatoes by commercial and home preparative methods. *Journal of Agricultural and Food Chemistry*, *16*(1), 65-71.

Chen, J. Y., Lin, Y. J., &Kuo, W. C. (2013). Pesticide residue removal from vegetables by ozonation. *Journal of Food Engineering*, *114*(3), 404-411.

Ikeura, H., Kobayashi, F., & Tamaki, M. (2011). Removal of residual pesticides in vegetables using ozone microbubbles. *Journal of Hazardous Materials*, *186*(1), 956-959.

Basfar, A. A., Mohamed, K. A., & Al-Saqer, O. A. (2012). De-contamination of pesticide residues in food by ionizing radiation. *Radiation Physics and Chemistry*, *81*(4), 473-478.

Hossain, M. S., Fakhruddin, A. N. M., Chowdhury, M. A. Z., &Alam, M. K. (2013). Degradation of chlorpyrifos, an organophosphorus insecticide in aqueous solution with gamma irradiation and natural sunlight. *Journal of Environmental Chemical Engineering*, *1*(3), 270-274.

Gour, T. B., & Sridevi, D. (2012). *Chemistry, Toxicity and Mode of action of Insecticides*. Kalyani Publishers.

Ou, L.T., Pesticide biodegradation, in Encyclopedia of Microbiology, 2nd edn., Lederberg, J., Ed., Vol. 3, Academic Press, San Diego, CA, 2000, p. 594.

Simon, J. Y. (2014). *The toxicology and biochemistry of insecticides*. CRC press.

Anderson, T. A., Kruger, E. L., & Coats, J. R. (1994). Enhanced degradation of a mixture of three herbicides in the rhizosphere of a herbicide-tolerant plant. *Chemosphere*, *28*(8), 1551-1557.

Rissato, SR, Galhiane, MS, Fernandes, JR, Gerenutti, M., Gomes, HM, Ribeiro, R., & Almeida, MVD (2015). Evaluation of Ricinus communis L. for the phytoremediation of polluted soil with organochlorine pesticides. *BioMed research international* , *2015* .

Hechmi, N., Aissa, N. B., Abdenaceur, H., &Jedidi, N. (2014). Evaluating the phytoremediation potential of Phragmites australis grown in pentachlorophenol and cadmium co-contaminated soils. *Environmental Science and Pollution Research*, *21*(2), 1304-1313.

Deshmukh, M. S., & Babar, N. (2015). Present status and prospects of organic farming in India. *European Academic Research*, *3*(4), 4271-4287.

http://apeda.gov.in/apedawebsite/organic/Organic_Products.htm

Renal Function Assessment by Various Renal Tests

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ABSTRACT:
Kidney plays several vital roles in maintaining the health of the animal. One of the most important jobs is to filter waste materials from the blood and expel them from the body as urine. The kidneys also help control the levels of water and various essential minerals in the body. The kidney function testing is useful in assessing the condition of the animal health status. Kidney function tests are simple procedures that use either the blood or urine to help identify issues in the kidney. The kidney function tests are done in order to estimate the glomerular filtration rate (GFR) as it indicate how kidneys are clearing waste from the body. Various tests areBlood urea nitrogen (BUN) or non-protein nitrogen (NPN), creatinine, urinalysis, endogenous and exogenous creatinine clearance, urine protein/creatinine clearance, water deprivation test, antidiuretic hormone test and fractional electrolyte clearance.

Keywords: Animals; Blood; Glomerular filtration rate; Kidney function tests; Urine.

INTRODUCTION

Kidney plays a major role in regulating the internal environment of the body.
The functions of kidney include:
1. Retention of water and electrolytes in a negative body balance.
2.Elimination of water and electrolytes in a positive body balance.
3.Excretion or retention of hydrogen ions to maintain blood pH within permissible limits.
4. Retention of certain substances such as amino acids, hormones, vitamins, plasma proteins and glucose.
5.Removal of certain end products such as urea, creatinine and allantois.
6.Production of renin and prostaglandins.
7.Help in activation of vitamin D.

Kidney function tests in common use for clinical purposes:

A. Blood urea nitrogen (BUN) or non-proteinnitrogen (NPN)

B. Creatinine
C. Urinalysis
    1.Specific gravity
    2.pH
    3.Protein
    4.Microscopic examination of sediment
D. Endogenous and exogenous creatinine clearance
E. Urine protein/creatinine clearance
F. Water deprivation test
G. Antidiuretic hormone test
H. Fractional electrolyte clearance

GENERAL CONSIDERATIONS:

A. Purpose of kidney function tests

1.Determine the nature of an impairment of renal function

a) Urinalysis is usually the only test that provides diagnostic assistance.

b) Only in the case of severe renal disease is it possible to detect abnormal function, as the kidney has tremendous reserve capacity.

(1) Only when more than 50% of the nephrons are not functioning is it possible to diagnose a renal impairment.

2.Determine the extent of an impairment of renal function

a) It is best to perform serial tests to determine the extent than an abnormal kidney function is reversible or to follow the course of chronic kidney impairment.

3. Renal function test provides part of the evidence upon which a prognosis should be based. Serial determinations, rather than single tests, are more reliable for purposes of prognosis.

B. Determination of the non-protein group of nitrogenoussubstances, especially urea and creatinine, is important because significantly increased values are usually the result of accumulation of these substances in the blood because of defective kidney elimination.

1. Nitrogen containing constituents of blood
   a. Protein
      (1) Albumin
      (2) Globulin
1. Non protein nitrogenous substances
      Metabolic waste products
      (1) Urea
      (2) Creatinine
      (3) Uric acid
      (4) Creatine
      (5) Amino acids
      (6) ammonia

(I)BLOOD UREA NITROGEN:

This test is used to evaluate the ability of the kidneys to remove nitrogenous waste from the blood.

Formation –urea is the principal end product of catabolism of protein formed by the liver

Interpretation

1.Normal values range from 10 to 30 mg/dl

2.Low values

a) Protein malnutrition

b)Hepatic insufficiency-ability of hepatic cells to form urea is one of the last functions to fail when extensive hepatocellular damage occurs.

c) Dietary protein restriction.

d) Late pregnancy and over hydration.

3. Increased values

A. Prerenal causes-elevations are seldom over 100mg/dl.

(1)Reduced renal blood flow

(a)Congestive heart failure

(b)Shock-hypotension plus diversion of blood from the kidneys

(2) Factors that reduce net filtration pressure in the glomerulus

(a)Hypotension

(b)Shock

(c)Adrenocortical insufficiency

(d)Heart failure-some types

(e)Increased protein osmotic pressure

(f)Dehydration (severe)-protein exerts a strong force to prevent fluid from leaving the glomerular capillaries

B. Renal disease-elevation of the BUN will occur when approximately 70% of the nephrons are non-functional

(1) The correlation between the BUN level and the severity of the renal disease is usually fairly good if one considers the duration of the condition.

C. Post renal uremia

(1)Perforation of the urinary system allowing urine to escape

(2)Obstruction of the urinary system

(a) Obstruction of only one ureter will not result in uremia unless the opposite kidney is impaired.

(II) CREATININE:

A. Formation- creatinine is formed in the metabolism of muscle creatine and phosphocreatine

1.Not affected by dietary protein , protein catabolism ,age , sex , or exercise

B. Excretion-

1. Since it is not excreted or absorbed by the renal tubules to any degree, it can be used as a rough index of the glomerular filtration rate.
2. The quantity excreted depends upon the skeletal muscle mass and renal function.
3. Creatinine is eliminated more easily than urea nitrogen, so that an increase is not seen as early as the increase in urea nitrogen when there is renal impairment.

C. Interpretation

1. Normal values range from 1 to 2 mg/dl.
2. Low values have no significance.
3. Increased values
   a. The glomerular filtration rate is reduced when creatinine is over 2mg/dl.
   b. As with the BUN, there is only a rough correlation between the degree of elevation and the degree of renal impairment
   c. In addition to primary renal disease, creatinine will be elevated in prerenal and post renal uremia.
   d. For prognosis purpose, serial determinations are superior to a single test.
   e. In either renal disease or failure, neither creatinine nor BUN is sensitive.
   f. Fewer non renal factors influence creatinine than influence BUN, but the creatinine test is technically more difficult to perform

(III) URINE PROTIEN/ URINE CREATININE RATIO:

Ratio less than 0.5 is normal, between 0.5 to 1.0 is doubtful but greater than 1.0 is abnormal.

In dogs suffering from glomerulonephritis, the values range from 1 to 40 and even higher.

Dogs suffering from renal amyloidosis,the values are usually higher than 10.0.

(IV) WATER DEPRIVATION TEST:

In non azotaemic patients, the test is useful to evaluate renal functions.

In dehydrated animals, if the urine is not concentrated the animal has failed the test and further water deprivation could be highly dangerous.

(V)ANTIDIURETIC HORMONE TEST:

This test is performed when patients cannot concentrate urine after water deprivation or in patients in which water deprivation is risky.

(VI) FRACTIONAL ELECTROLYTE CLEARENCE:

As concentration of electrolytes in the urine reflects glomerular filtration, tubular reabsorption and tubular secretion, this test is used to evaluate tubular function.

CONCLUSION

There are many different tests to determine renal function for an effective and proper assessment. Although, Glomerular filtration rate is the best overall indicator of kidney function. Tests of renal function have utility in identifying the presence of renal disease, monitoring the response to kidney treatment and determining the progression of renal disease. Moreover, creatinine is a more reliable indicator of renal function than BUN because it is less influenced by other factors such as diet and hydration.

REFERENCE

1. Veterinary clinical diagnosis by laboratory methods. By: R.S Brar, H.S Sandhu and A.Singh
2. Outline of veterinary clinical pathology by : MAXINE M.BENJAMIN
3. www.kidney.org
4. North American journal of medical sciences.

Role of Farmer Producer Organizations (FPOs) in coping with Covid-19

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Abstract:
Every year, Indian farmers face risks such as low rainfall, price volatility and rising debts. But risks from the COVID-19 pandemic has put new challenges in front of a sector that is already under threat. The nationwide lockdown came at an unfortunate time for farmers, as it was the harvest season for the *rabi* crop. The lockdown created both a shortage of labour and equipment. Covid-19 will have both short and long-run effect on the rural economy in India. Few of the FPOs addressed the problem by collective action by procuring the vegetables like brinjal, bitter gourd, okra, snake gourd, drumstick, tomatoes and others from the farmers, took the same in vans to sell to individual households. If vegetables were in limited supply or were not available, FPO bought them from nearby local markets and supplied to the customers.By approaching consumers directly, farmers marketed their produce because of which the farmers share in consumers rupee was increased.

INTRODUCTION

Small and marginal farmers constitute the largest group of cultivators in Indian agriculture; 85% of operated holdings are smaller than or about two hectares and amongst these holdings, 66% are less than one hectare. Small and marginal farmers contribute significantly to the total value of crop output. The Situation Assessment Survey of Farmers 2003 (NSS 59th Round) data shows that marginal and small farmers account for 29 and 22 percent of total output.

Though India has become self-sufficient in food production, Indian farmers are still poor. They face multi-fold problems of lack of technical knowledge, information, marketing skills and the resources to meet the requirement of formal markets. So, they fail to efficiently market their produce. One of the potential alternatives for efficient marketing is mobilizing farmers for group action for arranging inputs and marketing their produce in a collective way.

In India, there are many legal forms of organizations through which primary producer can organize themselves. A producer organization is a generic name that represents different forms of community organizations such as large cooperatives, Primary Agricultural Credit Society (PACS), Self-Help Groups (SHGs), Federation of SHGs, Common Interest Groups (CIGs), Farmers Club, Producer Company, etc. However, a producer company is a special case of producer organization that is registered under Section IXA of the companies Act, 1956. Farmer producer organisations are defined because the groups of rural producers coming together to make organisations so as to pursue specific common interests of their members, developing technical and economic activities that benefit their members and maintaining relations with partners operating in their economic and institutional environment.

Small Farmers' Organizations like cooperatives and FPOs are expected to reinforce incomes, reduce costs of input purchases alongside transaction costs, create opportunities for involvement in value-addition including processing, distribution and marketing, enhance bargaining power and supply access to formal credit.

Formation of Farmer Producer Organizations (FPOs): Farmers has got to mobilize into village-level Farmer Interest Groups (FIGs), which are being federated into registered FPOs. Besides empowering farmers through collective action, these grassroots bodies will emerge as nodal points for the transmission of cultivation technology, inputs and credit and pooling their production to leverage the market for better prices. The SFAC (Small Farmers Agribusiness Consortium), SERP (Society for Elimination of Rural Poverty) and NABARD (National Bank for Agriculture and Rural Development) was encouraging the formation and promotion of FPOs in the states.

OBJECTIVES OF FARMER PRODUCER ORGANIZATIONS (FPOS):

The primary objective of mobilizing farmers into member-owned producer organizations, or FPOs, is to reinforce production, productivity and profitability of agriculturists, especially small farmers within the country. The participant farmers are going to be given the required support to spot appropriate crops relevant to their context, provided access to modern technology through community-based processes including Farmer Field Schools; their capacities are going to be strengthened and that they are going to be facilitated to access forward linkages with reference to technology for enhanced productivity, value addition of feasible products and market tie-ups. Farmers are going to be organized into small neighborhood informal groups which might be supported under the programme to make associations/organizations relevant to their context including confederating them into FPOs for improved input and output market access also as negotiating power.

Benefits of FPOs:

• Cost of production are often reduced by procuring all necessary inputs in bulk at wholesale rates.

- Aggregation of produce and bulk transport reduces cost, thus, enhancing net of the producer.
- Building the size through produce aggregation enables to require advantage of economies of scale and attracts traders to gather produce at farm gate.
- Access to modern technologies, facilitation of capacity building, extension and training on production technologies and ensuring traceability of agriculture produce.
- Post-harvest losses are often minimized through value addition and efficient management useful chain.
- Regular supply of produce and internal control is feasible through proper planning and management.
- Price fluctuation are often managed; if there are practices like contract farming, agreements, etc.
- Easy in communication for dissemination of data about price, volume and other farming related advisories.
- Access to financial resources against the stock, without collaterals
- Easy access of funds and other support services by the govt / donors / service providers, and Improved bargaining power and social capital building.

CONCLUSIONS

The best practices and unique interventions of the farmers' organizations which have led to their success and continuous growth may be extracted and popularized for adoption by other farmers' organizations as well as Farmer Producer Organisations (FPOs) are effective tools for collective action of farmers.

REFERENCES

Agarwal, B. 2010. Rethinking agricultural production collectivities. Economic and PoliticalWeekly. 45(9): 64-78.

Bachke, ME. 2010. Are farmers organizations a good tool to improve small-scale farmerswelfare? http://www.iese.ac.mz/lib/publication/II_conf/CP7_2009_Bachke.pdf.

Chand, R., Prasanna, PAL and Aruna, S. 2011. Farm size and productivity: Understanding thestrengths of smallholders and improving their livelihoods. Economic and PoliticalWeekly. 46(26,27): 5-11.

Mondal, A. 2010. Farmers' Producer Company (FPC) concept, practices and learning: Acase from action for social advancement, Financing Agriculture. 42(7): 29-33.

Singh, S. 2012. New markets for smallholders in India–Exclusion, policy and mechanisms,Economic and Political Weekly. 47: 95-105.

Regulated Farming in Telangana: A Way towards Sustainable Agriculture

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Abstract:
Regulated farming policy was a new initiative taken up by government of Telangana and it was implemented from vanakalam, 2020-2021. The government is encouraging majorly red gram, cotton and fine varieties of paddy, soyabean, turmeric and maize as intercrop in turmeric and vegetables to attain the self-sufficiency in the state of Telangana.

INTRODUCTION

Agriculture is one among the foremost critical sectors of the Indian economy. Growth and development of agriculture and allied sector directly affect well-being of individuals at large, rural prosperity and employment; and it forms a crucial resource base for variety of agro-based industries and agro-services. While the entire production and productivity is being constantly augmented, it's essential to supply the farming community with better marketing facilities with suitable infrastructures so as to enable them in getting remunerative prices for their produce.

Prior to independence, the main concern of the govt policy associated with agricultural marketing was to stay the costs of food for the consumers and agro-raw materials for the industry in restraint. However, after independence, the necessity to guard the interest of farmers and to supply them incentive prices to reinforce the assembly of agricultural commodities was also felt. Recognizing the defects like losses to the farmers in terms of undue low prices, higher costs of selling and considerable physical losses of the produce within the agricultural marketing system which the farmers had to face, the govt , with a view to establishing a mechanism to watch the market conduct, introduced from time to time several mandatory regulations. Regulation and development of primary agricultural produce markets was haunted as an institutional innovation and construction of well laid out market yards was considered as an important requirement for regulating the practices in primary wholesale markets.

History of agriculture produce market regulation programme in India dates back to British period as raw cotton was the primary farm produce to draw in the eye of the govt due to anxiety of British rulers to form available the supplies of pure cotton at reasonable prices to the textile mills of Manchestor (UK). Consequently, first regulated market (Karanja) under Hyderabad Residency Order was established in1886 within the Country and therefore the first legislation was the Berar Cotton and Grain Market Act of 1887, which empowered British Resident to declare anywhere within the assigned district a marketplace for sale and buy of agricultural produce and constitute a committee to supervise the regulated markets. This Act became the model for enactment in other parts of the country. An important landmark within the agricultural marketing scene within the country has been the advice of the Royal Commission on Agriculture, 1928 for regulation of selling practices and establishment of regulated markets. of the measures taken to enhance things was to manage the trade practices and to determine market yards within the countryside. In pursuance, Government of India prepared a Model Bill in 1938 and circulated to all or any the States but not much headway was made till independence. Later, most of the States enacted Agricultural Produce Markets Regulation (APMR) Acts during sixties and seventies and put these operational. All primary wholesale assembling markets were brought under the ambit of those Acts. Well- laid out market yards and sub-yards were constructed and for every market area, an Agricultural Produce Market Committee (APMC) was constituted to border the principles and enforce them. Thus, the organized agricultural marketing came into existence through regulated markets.

Organized marketing of agricultural commodities has now been promoted within the country through a network of regulated markets. The basic objective of fixing of network of physical markets has been to make sure reasonable gain to the farmers by creating environment in markets for fair play of supply and demand forces, regulate market practices and attain transparency in transactions. To cope up with the necessity to handle increasing agricultural production, the amount of regulated markets has been increasing within the country. These regulated markets are wholesale markets. Besides, the country has 20580 regulated markets. Considering the importance of regulated marketing, Telangana government introduced regulated farming in 2020 kharif by guiding the farmers in cultivating the crops based on the food habits of the people and those having high demand in the marketsand they have to follow the administration's directions on the cropping pattern. The government also informed to the farmers that who have not cultivated the crops as suggested by the government should not be given the 'RythuBandhu' (an agriculture investment support scheme) benefits and they also should not be paid the Minimum Support Price for their produce. This policy measures have been taken to make agriculture profitable in Telangana state.

The major crops that have to be given the importance in regulated farming are red gram, cotton, paddy and maize. Red gram is the second important pulse crop in the India and the major redgram producing states are Maharashtra, Karnataka and Madhya pradesh. According to the 3rd advance estimates, Telangana stood in 5th place in 2019-2020 which accouts to an area of 7.30 lakh acres with 2.67 lakh tonnes of production. But the states consumption requirement was 5.00 lakh tonnes so there exists a gap of 2.33 lakh tonnes in the state of Telangana. Hence, farmers have been suggested to increase the red gram area from 7.3 lakh acres to 10 lakh acres on 2020-2021 because its demand, ability to produce high economic yield under soil moisture deficit which makes it an important crop in rainfed and dry land agriculture. The minimum support price was Rs. 6000 per quintal for the red gram crop which was remunerative and the farmers income levels will be increased if they cultivate the red gram crop.

Next crop which was given the importance was cotton. India ranks first position in terms of area and production in 2019-2020. Due to Covid-19, world consumption decreased by 13 Million Bales and the 2020-21 projections indicated that globally there was 3.01% of reductions in area and production of cotton hence it there is a greater pressure on cotton crop. In Telangana it was cultivated in an area of 52.55 lakh acres and production was 68.58 lakh bales in 2019-2020. Hence, it was suggested to grow cotton crop. As the Telangana cotton is in good demand nationally and internationally the state government has decided to increase the cultivation are up to 70 lakh acres against 52.55 lakh acres cultivated in the last year.

Fine varieties of paddy were encouraged and Telangana Sona (RNR 15048) of Professor Jayashankar Telangana State Agricultural University variety was encouraged because of its low glycemic index (GI) which is useful for therapeutic diet that helps in the reduction of blood glucose. Hence, it was suggested to cultivate this variety to an extent of 10 lakh acres.

It was also suggested to cultivate Maize as intercrop in Turmeric and discouraged the Maize as sole crop because of low international demand and more available stocks i.e., 76.4 lakh tonnes. It was also suggested to grow soybean, Mirchi, turmeric, vegetable in the same extent of land as last year.

CONCLUSIONS

Government proposed cultivation of crops in the state in a regulated manner so the farmers can escape suffering losses by cultivating the same crop in an excess amount and the heavy losses due to overgrowing the same crops and dumping them in markets results in lower profits as most of those crops have low demand will be curtailed by regulated farming.

References

http://www.dmi.gov.in/Documents/Brief%20History%20of%20Marketing%20Regulation.pdf

https://www.deccanherald.com/national/south/agriculture-experts-advise-telangana-to-implement-govt-regulated-farming-836200.html https://krishijagran.com/news/regulated-farming-for-better-profits-says-telangana-chief-minister-k-chandrashekar-rao/

https://www.thenewsminute.com/article/how-farmer-producer-companies-addressed-agricultural-lockdown-challenges-tn-128406

Virtual Water Trade - Indian Scenerio

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India is a water-stressed nation. India stands at 13th position in the Water Stress Rankings according to the study conducted by World Resource Institute (WRI). India has a total geographical area of 329 Mha having an annual precipitation of 4000 Billion Cubic Meters with wide temporal and spatial variation. Based on the 2011 Census figures, the per capita water availability has declined about 70 per cent of that from 1951. The Irrigation potential created in the country from major and medium irrigation projects has increased from 9.7 Mha in 1951 to 47.97 Mha, by the end of XI Plan (Central Water Commission, Annual Report -2016 -17).

The water resources potential of the country is about 1869 Billion Cubic Meters (BCM), out of which only about 1123 BCM can be put to beneficial use due to various constraints of topography and uneven distribution (Central Water Commission, Annual Report -2016 -17). The uneven distribution of rainfall and topographical constraints causes a high spatial variation in water availability in various parts of India. In this regard, NWDA (2006) suggested the Inter Basin Water Transfer (IBWT) from the surplus rivers to deficit areas as the most effective way to reduce the regional imbalance in the availability of water. Virtual water trade is considered as one of the effective alternative to the physical transfer of large quantities of water from the flood prone to the water scarce areas.

VIRTUAL WATER TRADING –CONCEPTS AND FACTS

The term **Virtual water**, introduced by Tony Allan (1993) is used to represent the hidden volume of water used for the complete production of a good or service. Virtual water is otherwise known as 'embedded water' of 'embodied water'. For example, 1 kg of wheat requires 1350 litres of water and 1 kg of rice requires 3000 litres of water (UNESCO-IHE-Water Footprint). The total amount of water required to produce commodity depends on the prevailing production conditions, including place and time of production and water use efficiency (Hoekstra 2003). Meat is the largest virtual water consuming product. The total amount of virtual water for the production of meat includes the water for growing feed crops for the cows, water used during slaughtering and the water used during the processing of meat.

Virtual water trading refers to the hidden flow of water during the importing and exporting of commodities between nations. For example, if a country imports wheat instead of producing it domestically, each kilogram of the imported wheat saves 1350 litres of real indigenous water. On the other hand, the country which exports wheat losses 1350 litres of indigenous water for each kilogram of the exported grain. Therefore, the water scarce countries can preserve the available water by importing water intensive goods, rather than producing them domestically. Nowadays, virtual water trading is considered as one of the possible alternatives to conserve the indigenous water resources.

Hoekstra and Hung (2002) employed the concept of **'water footprint'** which represents the total volume of water needed for the production of the goods and services consumed by the inhabitants of a country. The water footprint can be divided into an internal water footprint (use of domestic water resources) and an external water foot prints (use of water resources elsewhere). The use of groundwater and surface water for the production of a commodity comes under blue component of the water foot print. The green component of water foot print covers the use of rain water for crop growth. The water required to dilute the water that is polluted during the production of the commodity is known as gray component.

Indian Scenario

India is one among the largest global water users. With many states in India facing water scarcity, there is a concern over sustainable water use in agriculture for food and livelihood security, in addition to, water security (Schultz and Uhlenbrook, 2007). India has largest extent of rain fed agriculture in the world, which indicates the higher contribution of green water footprint to agriculture production (Government of India, 2012c). Chapagain and Hoekstra (2004) reported that India has exported 42.5 Gm^3/yr of virtual water during the period 1997–2001 with crop trade contributed 76%, livestock 8% and industrial products 16%, whereas out of total import, 81% trade was related to crop, 2% to livestock and the remaining 17% to industrial products. India's main export items include cereals, tea, coffee, cotton, cashew nuts and sugar, which are all water intensive products.

According to the Food and Agricultural Organization statistics, India became world's largest sugar producer in 2018/2019. India is the second largest producer of rice and wheat in 2018/19. According to the latest estimates from the US Department of Agriculture (USDA), India will surpass China to become the world's largest cotton producer in 2019-20 seasons. Thus, major part of the available indigenous fresh water is utilized for the production of these water intensive crops, otherwise can be imported from resource rich nations. If this trend continues, it will lead to a slow and irreversible loss of water sustainability and ultimately leads to water scarcity. In the near future, India may become unable to satisfy the water needs of its 1.37 billion populations. This situation can be avoided to a certain extent by considering the virtual water as a key factor during the trading of commodities.

REFERENCES

Allan, John Anthony, 1993. "Fortunately There are Substitutes for Water, Otherwise our Hydro-Political Futures Would be Impossible.", *Priorities for Water Resources Allocation and Management*, 13–26.

Chapagain A. K., Hoekstra A. Y. 2004. "Water footprints of nations". *Value of Water Research Report Series* No. 16, UNESCO-IHE, Delft, The Netherlands.

Hoekstra, A. Y., 2003. "Virtual water trade". *Proceedings of the International Expert Meeting on Virtual Water Trade*, IHE, Delft, The Netherlands.

Hoekstra, A.Y., Hung, P.Q., 2002. "Virtual water trade, a quantification of virtual water flows between nations in relation to international crop trade". *Value of Water Research Report Series* No.11, UNESCO-IHE, Delft, The Netherlands.

Schultz and Uhlenbrook, 2007. "Water security,What does it mean,what may it imply?". *Value of Water Research Report Series.* UNESCO-IHE, Delft, The Netherlands.

Desert Locust: A Nightmare for Small Indian Farmers

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ABSTRACT

The desert locust (*Schistocerca gregaria*) is one of the devastating pest causes great loss to agriculture. The migration takes them downward where winter, spring and summer rains falls for breeding. This year heavy invasion of this pest is due to heavy rains in the main locust breeding area followed by the cyclonic storm amphan aided a large migration of the swarms towards the eastern part of India from Rajasthan.One sq. mile of locust consumes about 200 ton of food per day, which can threaten global security. The constant surveillance on the pest activity via GPS,GIS, RAMSES, elocust2 gives idea about invasion. New technologies in form ofadvanced ULV sprayer can control the pest efficiently. *Metarhiziumacridum* and *Paranosema locustae*are the most effective bioagent against locust. The early prevention technique can be useful in preventing damage to major agricultural zones and helps protect crop of small farmers.

Key words: Locust**,** Amphan,GPS, GIS, RAMSES, elocust2, ULV

INTRODUCTION

Alongside a global pandemic, India prepares to fight yet another battle for food security. Unlike the micron-sized virus, however, the new threat is millimetres in size but millions in number: the desert locust. Cataclysmic locust invasions have been recognized as a major threat to agriculture and mankind since from ancient times. The infestations of locusts which devastate vast areas of land with diverse vegetation including wild plants, pastures, forests and cultivated plants at different stages vary greatly from year to year and from country to country resulting in heavy crop losses and also setting in motion a chain reaction with far reaching effects such as famine, disruption of trade, abandonment of cultivation, diversion of labour, heavy expenditure on control measures and so on. Different locust species are present in nature including, Desert locust, *Schistocerca gregaria*, Migratory locust, *Locustamigratoria*, Red locust, *Nomadacrisseptemfasciata*, Bombay locust, *Patangasuccincta*among them Desert locust is the most troublesome. Globally, about 64 countries representing approximately 30 million square kilometersis subject to ravages of the desert locust during plague period. During recession when desert locust population occurs at low densities infestation is confined to about 16million square kilometers arid areas in 30 countries of North Africa, Middle East and Northwest India. These countries were subjected to periodical invasions of locust swarms which attacked almost all varieties of natural and cultivated vegetation often resulting in famines and immense economic losses. As per the Union agriculture ministry data locust damaged crops worth 10 crore during 1926-31 plague cycle, and about Rs 2 crore during 1940-46 and 1949-55 plague cycle. Locust invasions are dramatic, sudden, cover large areas in a short period and almost all green in their path is destroyed. It is the destructive potential which is dreaded as locusts come so suddenly in such large numbers and swarm across international boundaries and due to this reason locust invasion attract so much public attention and cause international concern. Locusts are invertebrate animals with highly migratory habits, marked polymorphism and voracious feeding behavior. They are able to take rapid advantage of the climate and geography can survive in temperature range from 0 degree to 60 degree and can speed up or slow down their life cycle.

BIOLOGY AND LIFE CYCLE OF DESERT LOCUST

Life cycle of the desert locust consists of three stagesegg, nymph and adult and duration of the life is 2-6 months on an average.The eggsare laid by females in pods in the moist sandy soil at a depth of about10 cm. Egg pods are laid at intervals of 7-10 days. Gregarious femalesusually lay 2-3 egg pods, each with about 60-80 eggs. Solitarious females mostly lay 3-4 times. Each pod contains 100-160 eggs. The period of incubation decreases from about 70 days at 19 degrees centigrade to 10-12 days at 32-35 degrees centigrade. After completing the incubation period, the eggs hatch and nymphemerges. There are five instars in gregarious population and 5-6 instars in solitarious individuals. In each instar there is growth of nymph and the colour of the solitarious hopper is green throughout all instars but the gregarious hoppers have characteristic colouration of black and yellow. The rate of development of nymph is mainly dependent on temperature, from about 22 daysunder hot conditions to over 70 days under cool. Fifth instar hopper moults into the adult state. This change is called fledging and young adult is called a fledgling. After this there is no further moulting and the adult cannot grow in size but gradually increase in weight. Fledglings gradually become hard and able to fly. Locusts in this condition are called immature adults. The period of sexual maturity of adults is very variable. If conditions are suitable, the adults may mature in 3 weeks. Young immature gregarious adults are pink but old ones may become dark red or brown under cool condition(Sharma, 2014).

MIGRATORY BEHAVIOR OF DESERT LOCUST

The desert locust exhibit two distinct behavioral phasesthe solitary phase, when individual actively avoid one another andthegregarious phase when they form marching hopper bands and swarms. Both of these stages of gregarious phase, hopper bandsand swarms are capable of devastating crops and pastures (Uvarov, 1966). Aseries of complex interaction between suitable weather with high survival rates andthe lush green vegetation and the behavior wherein there is an increasein the rate at which hairs on the back legs are touched by other locustsin a group is responsible for change from the solitary to gregariousphase (Simpson, 2001). The desert locust only migrates to invasion areas in the formof swarms once they begun to gregariseas crowding releases serotonin, promoting rapid movement and a varied diet, spawning mass migration[5]. Dense groups that havestrong cohesion among individuals migrate long distance together areswarms and their size may range from less than one to 300 sq. miles.The biggest swarm recorded in India being 1200 sq miles. One sq. mileof locust swarm may weigh about 150-200 tones and consumes 200tones food daily. The swarms have been known to travel over 250 kmin a day and as much as 4500 km in a month and may fly 2000 km at astretch and at height of 7000 ft. and fly generally at the speed of 12-15km per hour and on an average 9-12 hours per day, generally move intoareas of low level convergence of winds (Inter Tropical ConvergenceZone) and move down wind, fly during day time and settle by nightfall.En route mature ones settle on ground for breeding while those not yetmature fly on. A copulating and laying swarm usually stay in the samearea for 3-4 days.

Plague cycle in India

The attack of this pest used to occur in a sort of 'cycle' a period of 5-6 consecutive years of widespread breeding and swarm production and damage to crops, called the Plague period, followed by a period of 1-8 years of little activity called the Recession period, again to be followed by another spell of plague and so on. Since 1863, ten such locust plagues at intervals of 1-8 years have occurred in India (Tratalos*et al*., 2010).

Reason behindcurrent locustinvasion in India

The large-scale breeding and swarm formation,takes place only when conditions turn very favorable in their natural habitat, i.e. in desert and semi-arid regions. These areas should get rains that will produce enough green vegetation to enable both egg laying and hopper development.It appears that such conditions have been there since the start of this year. The main locust breeding areas in the Horn of Africa, Yemen, Oman, Southern Iran and Pakistan's Baluchistan and Khyber Pakhtunkhwa provinces recorded widespread rains in March-April. East Africa, in fact, had its wettest rainfall season this year in over four decades even during October-November.The hopper bands and immature adult groups resulting from this large-scale breeding itself a product of unusually heavy rains are the ones that started arriving in Rajasthan during the first fortnight of April.Subsequently, there has been arrival of swarms from the main spring-breeding areas. And these swarms have come not only to western Rajasthan, but also moved to the eastern parts of the state and even Madhya Pradesh and Maharashtra. Much of this movement, it seems, was aided by the strong westerly winds from Cyclone Amphan in the Bay of Bengal.Thus, we have had two meteorological drivers behind the current locust invasions: one, unseasonal heavy rains in the main spring-breeding tracts in March-April, and, two, strong westerly winds.

MANAGEMENT OF DESERT LOCUST

Preventive method

All countries affected by desert locust generally adopt preventive control strategy in order to reduce the frequency, duration and intensity of plague. The preventive strategy consists of regular survey to get prior information before invasion. Recent improvements at the national level include use ofcomputers, GPS, GIS tools and e-locust2. The new products based onsatellite imagery that can distinguish sparsely vegetated locust habitatsfrom bare soil with reasonable reliability are transferred electronicallyfrom FAO to national locust unit to plan surveys. This information passes on to the farmers to take adoptive control measures by spraying poisonous chemical and by digging trenches to restrict locust movement before invasion. Adoptive control measures would be taken when ETL crosses 10,000 hoppers/ha or 4-5 hoppers/bush(Sharma, 2014).

Cultural measures

- Digging of trenches to restrict the movement of locust swarms
- Digging up egg pods or plowing fields infested with egg pods
- Scattering straw over roosting sites and then burning it

Mechanical measures

- Lightening fires or making noise to prevent swarms from settling in crops
- Use of flame throwers
- Beating or trampling on the hoppers

Biological control

Fungus*Metarhiziumacridum* and the microsporidian *Paranosema locustae*(formerly Nosema locustae) are successfully used against locust for its management. The mycopesticide*Metarhiziumacridum*available in market in the trade name of Green muscle are most effective in management of locust.

Chemical control

The locust swarm take rest on tree branches during night time so appropriate pesticides spraying at that time will be most effective for locust control.Bendiocarb, chlorpyrifos,diflubenzuron, fenitrothion, fipronil,lambda-cyhalothrin, malathion,teflubenzuron,triflumuron are some important chemicals which are most effective against locust. Water based sprays using ULV sprayers @5 L/hectare are most effective in managing locust.The advantage of ULVequipment is that it producesvery small droplets,which ensures evencoverage with lowvolumes (FAO, 2014).

Barrier treatment

In addition to overall blanket sprays, some insecticidesare considered efficacious as barrier treatmentsfor controlof locusts.Pesticide application in barriers i.e., 300 to 500 m apartby aircraft flying into the wind as a result the marching locust bands pass through the treated barrierspickingup a lethal dose which restricts their further movement (Bahana and Byaruhanga, 1999)

RAAT-Reduced agent and area treatment

Pest management strategy in which treated swaths are alternated with untreated swaths.RAATs aim to provide untreated areas (refugia), contributing to increased survivalof nontarget organisms, including parasites and predators (Lockwood and Schell, 1997).

CONCLUSION

Desert locust is one of the most destructive and notorious pest and have the capacity to threaten global food security by causing extensive damage to agriculture. The pest become more destructive when the climatic factors are congenial for its growth. The immeasurable damage that can be done by this notorious pest can be tackled by constant monitoring and surveillance through new advanced technologies using GPS and GIS tools. Thus, we can say that early prevention strategy has the potency to prevent damage to major agriculture zone in invasion area. So, forewarning can help the small farmers to protect the crop of the small farmers on one hand and the grazing grounds for the livestock on the other hand.

REFERENCES

Bahana, J. W. and Byaruhanga, E. K., 1999. Advances and review of strategies for red locust plague prevention: thecontrol of red locust, *Nomadacrisseptemfasciata* (Serville) into the 21st century. *Insect Sci. Appl*., 19:265–72

Food Agric. Org UN. 2014. Evaluation of field trials data on the efficacy and selectivity of insecticideson locusts and grasshoppers: report to FAO by the Pesticide Referee Group. Rep., Rome, Italy

Lockwood, J. A. and Schell, S. P., 1997. Decreasing economic and environmental costs through Reduced Areaand Agent Insecticide Treatments (RAATs) for the control of rangeland grasshoppers: empirical resultsand their implications for pest management. *J. Orthoptera Res*., 6:19–32

Sharma, A., 2014. Locust Control Management: Moving from Traditional to New Technologies – An Empirical Analysis. *Entomol.Ornithol. Herpetol*., 4: 141.

Simpson, S. J., Despland, E., Hägele, B. F. and Dodgson, T. (2001). Gregarious behaviorin desert locusts is evoked by touching their back legs. *Proc. Natl. Acad. Sci.USA*98: 3895-3897.

Tratalos JA, Cheke RA, Healey RG, Nils Chr. Stenseth (2010) Desert locustpopulations, rainfall and climate change: insights from phenomenologicalmodels using gridded monthly data. Clim Res 43: 229-239.

Uvarov, B. (1966) Grasshoppers and locusts. A handbook of general acridology,Vol 1. Cambridge University Press, Cambridge

Nematode Borne Viruses: A Silent Pathogens on Destruction of Crop Production

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ABSTRACT

Nematode borne viruses a black page in crop protection, because it was happened due to avoid the gathering knowledge and lack in this area. Naturally, two families of nematodes *viz*., Trichodoridae and Longidoridae transmitted the viruses like tobravirus and nepovirus. Both type of nematodes transmitted the viruses by their specialized form of feeding apparatus and their retention sites produced chemical compounds were associated with virus infection and recombination with high specificity of viral genomes RNA1 (infection) and RNA2 (transmission) in both viruses (tobravirus and nepovirus) by encoding gene protein 2b and 2c. Protein 2b is essential for transmission because it binds with cuticular linings of odontostyle and oesophagus, remaining protein 2c is not involved in the transmission. Using, integrated approaches *viz*., exclusion, physical, chemical and biotech were effective against nematode borne viruses and managed their transmission at better way.

Key Words: Tobravirus, Nepovirus, RNA1, RNA2, *X. index*, *L. elongatus*

INTRODUCTION

Virus, is a sub-microscopic living organism only lives on living organisms like, plants, humans and animals. So, it was referred as 'obligate parasites' due to their survival, replication and infection only depending upon living things. Under earth, up to now 6000 viral species were identified and causing the several diseases in all living things. Among them, plant viruses are grouped under 73 genera with families. Annually, they caused 60 billion US $ losses in major agricultural crops around worldwide. Initially, virus's survival, replication and infection mostly depending with transmission. Viral transmission and infection are coordinating with multi-way progresses to nature of transmission and viral genomic architecture. Naturally, plant viruses transmitted through several ways like insects, human, mechanical, fungi and nematodes. Out of these, nematode-borne transmission is a big way of transmission but exposure of knowledges and approaches are in scientific way as very least level due to low interest of contribution in certain portions.

Generally, nematodes are microscopic thread-like organisms presents in poly-tier ecosystem. Typically, they are most abundant in soil ecosystem associated with crop rhizosphere. In soil – ecology, nematodes were consisted the amount of 1-10 million individuals / m^2. Nematodes play a moderate to severe constraint in major crop production under field conditions. They causing severe growth retarding, chlorosis, defoliation, drying of twigs and immature fallen of fruits due to formation of root knots and changes in root morpho – textures with blocking of nutritional transportation and retarded the plant physiological abilities. The nematodes were highly variable depending upon the morphological structures, lifestyle, behavioural habitat of feeding and survival nature. In agriculture, plant-parasitic nematodes are causing economical impact in wider range. At globally, 20,000 nematode species were reported among them, 10% nematodes are plant-parasitic nature and causing economic loss from 5 - 12% in major crops per year.

Symptomatology

Naturally, nematode borne viruses causing initially infect the roots and produce typical symptoms *viz*., stubby root, root knot, gridling of collar regions, ring spots, chlorosis, yellowing, up normal twigs growth, small leaves and unmatured fallen of fruits.

Nematode – virus relationships

Till 1958, no clear report was documented in relationships of nematode – virus on several crops but current period, 30 nematode species were reported that transmit 15 different viruses. These viruses are classified into two families *viz*., *Trichodoridae* (tobraviruses) and *Longidoridae* (Nepoviruses). The Out of these two families, *Trichodoridae* consisted with 2 genera like *Trichodorus* and *Paratrichodorus*. Both genera considered with 75 nematode species, only 14 species have been noticed to be virus vectors. Majorly, three species of tobraviruses (rod shaped) contributed in this nematodes (Trichodorids) transmission *viz*., tobacco rattle virus (TRV), pea early browning virus (PEBV) and pepper ringspot virus (PRSV). Remaining family of Longidoridae consisted with three genera of *Xiphinema, Longidorus* and *Paralongidorus* with 350 species. Longidorids are majorly transmitted the nepoviruses (spherical particles) *viz*., grapevine fanleaf virus, tomato ringspot virus, tobacco ringspot virus and strawberry latent ringspot virus etc. these viruses belonged under subfamily of Comoviridae and Secoviridae (Table 1).

MECHANISMS OF NEMATODE -VIRUS TRANSMISSION

In feeding progress, nematodes are varied due to their own feeding style and the presence of the parts between nematode to nematode. Naturally, they injecting the root cuticular cells and make path upto inner portion and draw the nutrition sources. Before diagnosis, a well-known knowledge's in the biological and morphological systems are essential for to discriminated between the symptoms and nematodes.

Table 1. List of plant parasitic nematode – borne viruses for major crops

Nematodes family	Nematodes	Virus type	Viruses
Trichodoriade	*P. allius, P. minor, T. cylindricus*	Tobravirus	Tobacco rattle virus
	Paratrichodorus anemones, T. primitivus		Pea early browning virus
	P. minor		Pepper ringspot virus
Longidoridae	*X. americanum, X. californicum*	Nepovirus	Tomato ringspot virus Tobacco ringspot virus, Cherry rasp leaf virus, Peach rosette mosaic virus
	X. diversicadatum		Strawberry latent ringspot virus Arabis mosaic virus
	X. index, X. italiae		Grapevine fanleaf virus
	L. arthensis		Cherry rosette virus
	L. martini		Mulberry ringspot virus
	L. apulus, L. fasciatus		Artichoke Italian latent virus
	L. elongatus		Raspberry ringspot virus Tomato black ring virus

Initially, it was studied through morphological and feeding behaviour. In Trichodoridae, transmission varied between males and females by reproductive systems *viz*., length of vagina, vaginal sclerotized pieces and presence of advulvar lateral body pores (female); absence of wing like extensions on tails, development of copulatory and spicule suspensor muscles (males). The life span of Trichodoridae varies with Longidoridae (few months to years) unlike, Trichodoridae when attained the favourable atmospheric conditions its reproduction was immediately occurred and formed a huge community compared than Longidoridae.

In viral transmission, was occurred in the all stages of the nematodes from egg to adult, it indicates, that whole transmission was happened through tissues of the body associated with internal cuticular regions of the feeding apparatus during moult. Under Trichodoridae, during feeding a solid curved tooth or spear (onchiostyle) used to penetrate the root cell wall and secretions of fluids from oesophageal glands passed into plant via root cell and absorbed the nutrition and moved away. During this time, tobravirus particles was moved into nematode body through cuticular lining of the oesophagus with pH alteration. Some glandular secretions disturbed the virus particles and 10-25% were became alive. But continuous feeding from plant to plant sufficient viable particles were retained in the nematode body due to cytoplasmic streaming.

In Longidoridae, the feeding apparatus like a hollow, retractable tube (odontostyle) surrounded by a guiding sheath with ring. At posterior end, the odontostyle connected by cuticular odontophore to the oseophagus. When nematode feeding the root tip the virus particles are moved from plant root cortical cells to odontostyle and it stayed between odontostyle and guiding sheath (*L. elongatus* - Raspberry ringspot virus, Tomato black ring virus; *Xiphinema* spp. - Grapevine fanleaf virus particles attached with cuticle lining of lumen at odontophore).

Virus specificity

Virus transmission through nematodes are characterized as high specificity and association between them. It has been noticed on retention sites (feeding apparatus) of nematodes biological systems with biosynthesis of chemical compounds. The chemical compounds synthesis in nematodes retention sites determined by both viruses (tobravirus and nepovirus) two different genomes *viz*., RNA1 and RNA2 with association of serological properties of viral coat protein. Out of these two, RNA1 is 6.8kb size and carries four genes encoding proteins involved in virus replication, cell to cell movement and inhibited the RNA silencing. RNA1 is able to infect plants, moving systematically in vascular systems and not able to produce coat protein (only for infection). In RNA2, 1.8-3.9kb size and especially for recombination. In tobraviruses, two nonstructural proteins (protein 2b and 2c) encoded by RNA2 and involved in transmission, one of these protein 2b essential for viral transmission, because it binds with virus particles and properly mediates their attachments with oesophageal wall. Remaining one protein 2c was not affected the viral transmission in PEBV and TRV when it was absent also. So, both are determining the virus specificity for transmission. In Nepoviruses, specificity has been determined through coat protein (CP) association with genomic protein of viral RNAs.

Management

Exclusion

It's an initial progress for avoidance of incidence from one region to other. To avoid the seed sources or seedling materials from affected area to new zones. Follow the guidelines of quarantine authorities' regulations have been blocked the entry and occurrence of nematode borne viruses incidence (Ex. Grapevine cuttings from France, seed potatoes from Nilgiris, Banana suckers from Thailand and Srilanka).

Physical

Generally, it was easiest and not cost effective, soil up to 5 cm depth solarized through polythene sheets with mulching at 50-55˚C for 5 mins were effective against Longidoridae and Trichodoridae nematodes.

Chemical

Usually, nematicides (D-D) dichloropropane – dichloropropene, methyl bromide and dazomet; soil sterilants such as, oxime carbamates through soil drenching was controlled the nematodes population without killing due to inhibit the nervous activity and feeding progress.

Biotechnology

Using RNAi technology was implemented against with TRV, PEBV and GFLV in France.

FUTURE APPROACHES

By using climatic oriented cultivars and soil based technological implementation in agriculture is to avoid the nematodes incidence and controlled the nematode borne transmission in all crops.

CONCLUSIONS

In crop protection, nematode borne viruses and their diseases are in shadow pages due to least interest or avoiding it. This less interest occurred due to lack of knowledge in nematodes and relationships, least incidence crop preferences. But this nematode borne viruses changing a low to severe form into one stage. So, before we gaining knowledges and break-relationship chain is most effective and avoiding these viral incidences in major crops.

REFERENCES

Chitwood, D. (2003). Research on plant-parasitic nematode biology conducted by the United States Department of Agriculture - Agricultural Research Service. *Pest Mgt. Sci*., 59 (6- 7): 748-753.

Gill, H. K. and Mcsorley, R. (2010). Effect of integrating soil solarization and organic mulching on the soil surface insect community. *Florida Entomol*., 93: 308-309.

Macfarlane, S. A., Neilson, R. and Brown, D. F. J. (2002). Nematodes. *Adv. Bot Res*., 36: 169-198.

Roberts, A. G. (2014). Plant viruses: soil-borne, In: Virology. Jhon Wiley and Sons (eds.). *eLS*, Chichester. p. 1-13.

Soil Health: Understanding the Concept

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ABSTRACT

When we see the role healthy soil plays in our lives, the foremost documented and imperative advantage of healthy soil is crop production, may it's agronomic crops or horticultural crops also. Healthy soil is filled with organisms that convert dead matter and minerals into vital plant nutrients. Healthy soils can absorb and store water, which acts as a mock reservoir during dry stints. The rationale behind this is often organic matter makes soil form stable soil aggregates, or crumbs. Even many antibiotics are often developed from bacteria found in soil. Scientists are trying to find soil bacteria in natural areas for this purpose. Soil is additionally utilized in a spread of industries: china dishes are made up of soil and even clay is employed for beauty products. Soil also acts as a strong water filtration tool. Thus healthy soil can do sort of favours to human kind. But we've to concern about what makes soil healthy within the first place.

INTRODUCTION

Soil health is an integrative property that reflects the capacity of soil to reply to agricultural intervention, in order that it continues to support both the agricultural production and therefore the provision of other ecosystem services. The main challenge within sustainable soil management is to conserve ecosystem service delivery while optimizing agricultural yields. It's proposed that soil health depends on the upkeep of 4 major functions: carbon transformations, nutrient cycles, soil structure maintenance and therefore the regulation of pests and diseases. Each of those functions is manifested as an aggregate of a spread of biological processes provided by a diversity of interacting soil organisms under the influence of the abiotic soil environment. It's going to be concluded that quantifying the flow of energy and carbon between functions is an important but non-trivial task for the assessment and management of soil health. There are two ways during which the concept of soil health (or the closely related concept of soil quality) has been considered, which may be termed either 'reductionist' or 'integrated'. The previous is predicated on estimation of soil condition employing a set of independent indicators of specific soil properties—physical, chemical and biological. This approach has been much discussed and well reviewed by Doran et al. 1994, Doran

& Jones 1996 and Van-Camp et al. 2004. It recognizes the likelihood that there are emergent properties resulting from the interaction between different processes and properties. Our definition of soil health springs from a context which we accept as an important feature of sustainable agriculture, namely that agricultural production shouldn't prejudice other ecosystem services that humans require from agricultural landscapes. Thus, our working definition is that 'a healthy agricultural soil is one that's capable of supporting the assembly of food and fibre, to a level and with a top quality sufficient to satisfy human requirements, along side continued delivery of other ecosystem services that are essential for maintenance of the standard of life for humans and therefore the conservation of biodiversity'.

INTEGRATED CONCEPT OF SOIL HEALTH

SOIL AS A SYSTEM

Soil is undeniably a really complex system. It's going to be described as a multicomponent and multifunctional system, with definable operating limits and a characteristic spatial configuration. Within a continuum of possibilities, there are recognizable soil types that originate counting on variations in factors, like parent material, climate and topography, which largely determine the dominant physical and chemical properties. There are recognizable soil types that originate counting on variations in factors, like parent material, climate and topography, which largely determine the dominant physical and chemical properties. These have often been altered, however, by agricultural interventions, like drainage, irrigation, use of lime to change soil reaction and additions of plant nutrients. However, there's an associated change within the local soil structure and topology of the pore network which is that the microbial habitat that affects the distribution and availability of water, delivery of substrate and gases to the organisms and removal of metabolic products from their vicinity, with subsequent consequences for the microbial activity.

SOIL AS A HABITAT

The ecosystem services provided by soil are driven by soil biological processes, but our concept of soil health embraces not only the soil biota and therefore the myriad of biotic interactions that occur, but also the soil as a habitat (Young & Ritz 2005). Indeed, it's the porous nature of soils that governs such a lot of their function since the physical framework defines the spatial and temporal dynamics of gases, liquids, solutes, particulates and organisms within the matrix, and without such dynamics there would be no function. The capacity for self-organization are often recognized as an important component of soil health, which relies on the presence of appropriate constituents and sources of energy to drive biological processes.

FACTORS CONTROLLING SOIL HEALTH

SOIL TYPE

Particular soil types form in response to the character of parent material, topography and environmental factors, like climate and natural vegetation. Past land management by humans can alter natural soils considerably, for instance by loss of surface horizons thanks to erosion, alteration of soil water regime via artificial drainage, salinization thanks to poor irrigation practices, loss of natural soil organic matter caused by arable production or contamination. Thus, land-use and management are the controlling factors for soil health.

ORGANISMS AND FUNCTIONS

There's some experimental evidence that there could also be threshold levels of soil biodiversity below which functions decline (e.g. van der Heijden et al. 1998; Liiri et al. 2002; Setälä & McLean 2004). However, in many instances, this is often at experimentally prescribed unrealistically low levels of diversity that rarely prevail in nature. Many studies demonstrate high levels of functional redundancy in soil communities (e.g. Setälä et al., 2005). It are often argued that prime biodiversity within trophic groups is advantageous since the group is probably going to function more efficiently under a spread of environmental circumstances, thanks to an inherently wider potential. More diverse systems could also be more resilient to perturbation since if a proportion of components are removed or compromised in how , others that prevail are going to be ready to compensate.

CARBON AND ENERGY

The energy that drives soil systems springs from reduced carbon that's ultimately derived from net primary productivity. Carbon is that the common currency of the soil system, and its transfer with associated energy flows is that the main integrating factor.

NUTRIENTS

Nutrients are a controlling input to the soil system and therefore the processes within it. Their levels and transformations are critical to soil health. After carbon, the cycling of nitrogen and phosphorus to, from and within the soil system most affects its dynamics and therefore the delivery of ecosystem services, including agricultural production.

IMPACTS OF AGRICULTURAL PRACTICE ON SOIL HEALTH

To maximize yields of food and fibre, a spread of agricultural management processes are imposed on the ecosystem, including artificial inputs like chemicals and tillage. These practices and inputs supplement or maybe 'substitute' for biological functions that are seen as inadequate or inefficient for achieving required levels of production. The agricultural management practiced within the years immediately after clearing may serve to either exacerbate or ameliorate the processes of change put in situ during the conversion phase. The intensity of agricultural intervention varies enormously across different farming systems, and should be expected to possess both quantitatively and qualitatively different impacts on the soil health system. Different soils in several climatic and topographic situations could also be more or less resilient to the introduction of agriculture. Flat alluvial soils in areas without extremes of climate are less likely to degrade quickly compared with shallow soils on steep slopes where rainfall could also be intense. After clearing the natural vegetation to determine agricultural fields, all the main soil properties whereby we describe its health are changed, largely negatively. After a period of continuous cultivation they reach a new, dynamic, equilibrium. This has been most substantially documented in terms of the decline in soil organic matter content over the years immediately following clearing and therefore the initiation of cultivation (Leigh & Johnston, 1994). The soil food cycle can also be substantially changed. Experiments showed that inoculation with a various group of the native soil macrofauna resulted within the 're-engineering' of this soil to breed a friable soil structure (Chauvel et al. 1999; Barros et al. 2004). The form and extent of substitution may be a potential hazard to soil health, with the three most frequent practices being industrial pesticides (substituting for biological pest control), mechanical tillage (substituting for biological regulation of soil structure) and inorganic fertilizers (substituting for organically and biologically driven nutrient cycles). In sight of the high degree of interconnectedness between functions described earlier, the utilization of energy and/or chemical products to exchange , bypass or modify any particular biological function are often expected also to possess significant consequences for other functions that haven't been targeted. The effects of excessive quantities of fertilizers are on process rates instead of any direct toxic effects. A really important indirect impact is that the incontrovertible fact that high fertilizer input use is usually related to reduction within the quantity of organic matter input. The presence of high concentrations of ammonium inhibits organic process and stimulates nitrification. High levels of some nitrogenous fertilizers can cause acidification in some soils and consequent effects on the soil biota.

AGRICULTURAL MANAGEMENT FOR SUSTAINABLE SOIL HEALTH

The integrated nature and high diversity of the soil health system may contribute a big degree of resilience under conditions of disturbance, particularly at lower (largely microbial) trophic levels. Nonetheless, the conversion of natural vegetation to agricultural land leads to major changes in both physical organization and community structure within the soil, including species loss and changes in dominance among the surviving biota. This then becomes the resource with which agriculture must work and any targets should realistically be set in reference to the potential equilibria in agricultural systems instead of the natural systems from which they're derived, as has sometimes been advocated.

Sustainable management of soil health requires the setting of criteria for acceptable levels of soil-based ecosystem functions and especially the balance between the food production functions and other supporting conservation , water flow and quality, crop, livestock and human health control, and greenhouse emission emissions. The established principles for establishing and maintaining soil fertility are familiar. These include inputs of organic interest meet demand for carbon and energy supply to the soil biota, balanced with the nutrient demand of the crops and therefore the development of integrated (i.e. organic plus inorganic) nutrient management systems where inorganic fertilizers are utilized in precise dosage together with equally carefully designed practices of organic matter management that conserve nutrients and levels of soil organic matter. These principles are according to those needed to support soil health, then capacity to deliver a variety of ecosystem services, within the context of the integrated description of the soil system. Additionally , however, the upkeep of continuous vegetative cover and especially rooting systems as advocated in some integrated farming practices (Tilman et al. 2002; Sanchez et al. 2004) also will promote a healthy soil, via an associated continuous feed of carbon substrate below ground. Generally , intensive mechanical tillage and pesticide use should be kept to a minimum. Despite the good sort of biophysical and socio-economic circumstances that require to be accommodated, a working hypothesis for sustainable agriculture could also be advanced that 'agriculture are often productively and profitably practised without impairment of soil health'. A more cautious assertion that recognizes the truth behind such a target is that 'some degree of trade-off between the optimization of 1 ecosystem function (in this case food or fibre production) and others (e.g. water quality, carbon sequestration) is suitable and indeed inevitable in any managed landscape'.

REFERENCES

Doran J.W, Jones A.J., editors. Methods for assessing soil quality. *SSSA special publication. vol. 49. ASA; Madison, WI*: 1996.

Doran J.W., Coleman D.C., Bezdicek D.F, Stewart B.A, editors. Defining soil quality for a sustainable environment. *SSSA special publication. vol. 35*. *ASA; Madison, WI*: 1994.

Van-Camp, L., Bujarrabal, B., Gentile, A. R., Jones, R. J. A., Montanarella, L., Olazabal, C. AND Selvaradjou, S.-K. 2004 Reports of the technical working groups established under the thematic strategy for soil protection, vol. 5 Monitoring. *EUR 21319 EN/5, pp. 653–718*. *Luxembourg, Europe: European Communities.*

Kibblewhite M.G., Ritz, K., and M.J Swift, 2008, Soil health in agricultural systems. *Philosophy Transactions Royal Society Lond B Biological Science vol.363(1492).*

Young I.M, Ritz K. The habitat of soil microbes. In: Bardgett R.D, Usher M.B, Hopkins D.W, editors. Biological diversity and function in soils. *Cambridge University Press; Cambridge, UK:* 2005*. pp. 31–43*.

van der Heijden M.G.A, Klironomos J.N, Ursic M, Moutoglis P, Streitwolf-Engel R, Bollr T, Wiemken A, Sanders I.R. Mycorrhizal fungal diversity determines plant biodiversity, ecosystem variability and productivity. *Nature*. 1998; 396:69 –72.

Setälä H, Berg M.P, Jones T.H. Trophic structure and functional redundancy in soil communities. In: Bardgett R.D, Usher M.B, Hopkins D.W, editors. Biological diversity and function in soils. *Cambridge University Press; Cambridge, UK:* 2005. pp. 236–249.

Setälä H, McLean M.A. Decomposition rate of organic substrates in relation to the species diversity of soil saprophytic fungi. *Oecologia*. 2004;139:98–107.

Liiri M, Setala H, Haimi J, Pennanen T, Fritze H. Relationship between soil microarthropod species diversity and plant growth does not change when the system is disturbed. *Oikos*. 2002; 96:137–149.

Leigh R.A, Johnston A.E. CAB International; Wallingford, UK: 1994. *Long-term experiments in agricultural and ecological sciences*.

Chauvel A, Grimaldi M, Barros M.E, Blanchart E, Sarrazin M, Lavelle P. Pasture degradation by an Amazonian earthworm. Nature. 1999; 389:32–33.

Barros M.E, Grimaldi M, Sarrazin M, Chauvel A, Mitja D, Desjardins D, Lavelle P. Soil physical degradation and changes in macrofaunal communities in Central Amazonia. *Appl. Soil Ecol*. 2004; 26:157–168.

Sanchez J.E, Harwood R.R, Willson T.C, Kizilkaya K, Smeenk J, Parker E, Paul E.A, Knezek B.D, Robertson G.P. Managing carbon and nitrogen for productivity and environmental quality. *Agron. J.* 2004; 96:769–775.

Tilman D, Cassman K.G, Matson P.A, Naylor R, Polasky S. Agricultural sustainability and intensive production processes. *Nature*. 2002; 418:671–677.

Culture techniques for natural fish food organisms

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Despite adaptation of different techniques to formulate commercial larval feed and to reduce the quantity of feed required, the worldwide use of live food in finfish and shellfish larval rearing tank is still considered as one of the best nutrient source and is expected to remain so in near future. Live feed organism specially includes phytoplankton (plant origin) and zooplankton (animal origin) grazed upon by fishes. In food chain, phytoplankton occupies first trophic level and zooplankton occupies second trophic level because phytoplanktons are generally eaten by zooplankton. Live has the ability of swim in water column and they are constantly available for finfish and shellfish larvae.The success in the production of fish fingerling is largely depended on the availability of the live food organisms for fry and fingerling, which contains all the nutrients required for the growth of fish seed such as proteins, lipids, carbohydrates, vitamins, minerals etc. and hence live foods are commonly known as “living capsules of nutrition”. Altricial fish larvae where digestive system is rudimentary lacking a stomach, they cannot ingest and digest (due to lack of digestive enzymes) formulated diet as first foodbut they can ingest live food organisms because live food organisms has digestive enzymes which can digest themselves. Live foods are usually abundant in the pond having well fertilized green water. The green colour water of the pond indicates presence of phytoplankton and other natural organisms.

Apart from microalgae, artemia (Brine shrimp), rotifers, copepods etc. are commonly used live food for larval rearing. Rotifers are suitable for the earliest stage of fish and shrimp larvae because of their small size but they required labour-intensive culture practice (Dhont. J *etal.,* 2013). Zooplankton in natural food web constitutes a major part of the diet for marine fish larvae and it is believed that copepods can meet the nutritional requirements of fish larvae (Evjemo. *et al.,* 2003).

The mouth size of first feeding larvae restricts the size of the food particles which can be digested. Mouth size of the larvae is depends on the body size, which in turn is influenced by egg diameter and the period of yolk sac absorption. In industrial larviculture of fish and shellfish, three groups of live diets are widely used:

- Microalgae of 2 to 20 μm for bivalves, penaeid shrimps, fish larvae, rotifers, copepods etc.
- Rotifer of 50-200 μm for crustaceans, marine fish.
- Artemianauplii of 400-800 μm for crustaceans and fish.

For selection of live food some points should be considered. These are: the food must be accept by the larvae; size of the food must be suitable for larvae; the feed should have nutritional value (especially Highly Unsaturated Fatty Acids) for growth and survival; the feed can be digested by the larvae, food organism must be hardy and they must capable to reproduce rapidly in controlled condition.

Infusoria:

Infusoriaare mostly microscopic but some larger protozoans (infusoria) can be seen by the naked eyes. Their small size, ranging from 25-300 μm makes them an ideal live food for young fry which have just consumed their yolk sac. This includes protozoans and ciliates.. They obtain holozoic nutrition from algae,bacteria and detritus. Freshwater species includes Paramecium and Stylonichia and marine water species includes Euplotes (20-35 ppt), Febrea..

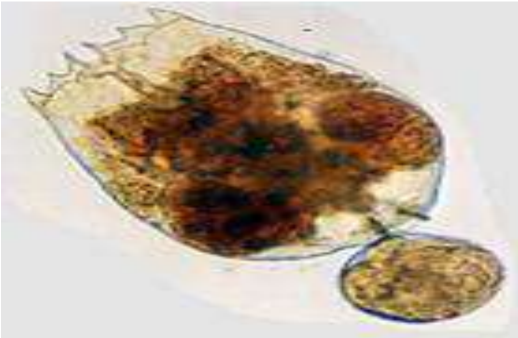
Culture of freshwater infusoria

Lettuce, cabbage, banana peels, milk, potato etc. are commonly used media for infusoria culture. Add 2-3 dried banana peeling or rotting lettuce leaves or raw white potato in de-chlorinated filtered water in an aquarium or glass jar. To prevent entry of mosquitoes and files, cover the container with a cloth or net. Water will turn milky and also emit foul smell after 2-3 days due to the multiplication of a large number of bacteria causing decay of banana peelings or rotting lettuce leaves or raw white potato. A layer of slime will be formed on the water surface. The water will turn clear, becoming transparent with light yellowish colour in about 4 to 5 days because of the floating spores of infusoriain the air which have settled on the water surface. The culture is now ready for feeding the early stages of fish larvae.

Culture by using hay infusion:

Take dry hay (straw) into a pan and pour boiling water over it.Transfer the hay together with water to a jar or aquarium. After this, repeat the process as described under banana pealing method above.

Rotifers:



Rotifers (commonly called wheel animalcules) are microorgansims (100 to 2500 microns) that are readily found in aquatic and semi-aquatic habitats.Rorifers arecommon in freshwater environments and most rotifers are around 0.1–0.5 mm long. The epidermis contains densely packed keratin proteins known as the lorica. Mastax is the characteristic organ of rotifers which help in grinding of the ingested particles. There are 2 strains of Brachionus, these are: *B. rotundiformis* or S- type (lorica length: 100-210 µm; the optimal temperature for growth is 28-35 ^{o}C) and *B. plicatilis* or L-type (lorica length: 130-340 µm; the optimal temperature for growth is 18-25 ^{o}C). The water quality parameters required for growth of rotifers are:

Salinity:optimal reproduction can only take place at salinities below 35 ppt.

Dissolved oxygen: Rotifers can survive in water containing as low as 2 ppm of dissolved oxygen

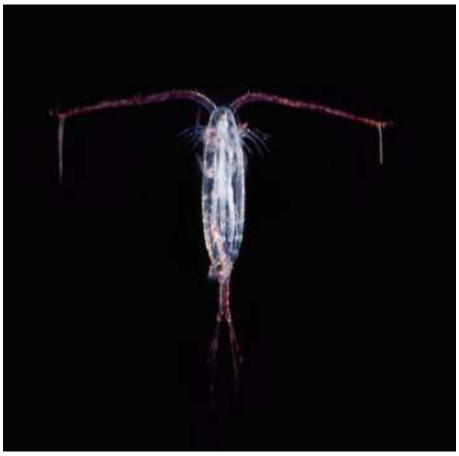
pH: Rotifers live at pH-levels above 6.6

Ammonia (NH3): The NH_3/NH_{4+} ratio is influenced by the pH and temperature of the water. High levels of un-ionized ammonia are toxic for rotifers but NH_3 concentrations below 1 mg.l-1 appear to be safe

Culture: The rotifers for stock cultures can be obtained from the wild or commercial hatcheriesor from research institutes and the inoculum should first be disinfected whichconsists of killing the free-swimming rotifers but not the eggs with a cocktail of antibioticsor a disinfectant.Then the eggs have to separate from the dead bodies on a 50 µm sieve and incubated for hatching and the offspring used for starting the stock cultures.

FRP tanks of capacity 200-500 L is inoculated with chlorella @ 10- 20 × 106 cells per ml. Introduce rotifer @ 25 – 50 individuals per ml. When the rotifer density reaches to 100 – 150 individuals per ml 50% is harvested. The other half is harvested and transferred to another tank containing chlorella. The vacated first tank is thoroughly cleaned and prepared for chlorella culture for the next.

Copepods



Copepods are common zooplankton of freshwater and brackishwater. The length of adult copepods have a length between 1-5 mm. the head of the copepods has a naupliar eye and uniramous first antennae that are generally vary long. Planktonic copepods are mainly suspension feeders on bacteriaand/or phytoplankton. To survive adverse environmental conditions a diapause stage is present in the development of the copepods. Harpacticoid copepods are less sensitive and have more tolerant to extreme changes in environmental conditions (i.e. temperature: 17-30°C;salinity: 15-70 g/l) than calanoids.

There are outdoor production systems that can produce large numbers of copepods. Copepod eggs could be collected in large numbers and stored for months, like *Artemia*(brine shrimp) and rotifer cysts. Photoperiod and temperature largely determine the production of copepod resting eggs. Laboratory production of these eggs is possible, but has not yet proved to be economically feasible.

Turbot and red snapper, consume more copepod nauplii than rotifers and prefer copepod nauplii because of the differences in size and swimming patterns of the two prey types.

Tubifex:

Tubifex worms feed on decaying organic matter, vegetable matter ,detritus,which commonly available in segment drains. Tubifex worm is a hermaphrodite, because it has both male (testes) and female (ovaries) organs in the same animals but they become mature at different times and thus self-fertilization is avoided.Tubifex can be easily cultured on mass scale in containers with pond mud at the bottom, blended with masses of bran, bread, decaying vegetable matter. Continuous mild water flow is to be maintained in the container, with a suitable drainage system. After the arrangement of the system, the container is inoculated with Tubifex worm which can be obtained from nearby muddy canals or sewage canals. Within 15 days, clusters of Tubifex worm develop and this can be removed with mud in masses by means of a spade and kept in large wide mouth plastic container

Artemia:

The optimal conditions for Artemiahatching are:

Temperature: above 25^{o}C with 28^{o}C being optimum;

Salinity: 5 ppt (1.030 density);

Aeration: constant illumination (example: two 40- watt fluorescent bulbs for a series of four 1-liter hatching cones); and

pH:8.

Hydrate the dry cysts in natural salt water. Use a funnel-shaped container and keep the cysts in continuous suspension by aerating from the bottom of the container for one hour.

After hydration, the dry cysts which are deflated become round-shaped. Full hydration is necessary to insure that the inner part of the dry cyst shell will be completely exposed when the decapsulation solution is added. Decapsulation solution used to prepare using 1N NaOH, sodium hypochlorite (NaOCI) and seawater.Allow the hydrated cysts to react with the hypochlorite for 7–15 minutes. Keep the temperature below 40°C by adding ice cubes to the suspension or by using a water bath to prevent damage of embryo. A colour change of the cysts from brown to white to orange usually indicates that the reaction is complete.

Drain the suspension of decapsulated cysts into a fine-mesh sieve and to remove the smell of hypochlorite rinse immediately with seawater.Decapsulated cysts may be fed directly to the cultured species or stored in saturated brine solution at low temperature.

Incubate the decapsulated cysts for 24–48 hours in natural seawater at a density not more than 5 grams cysts/ liter of incubation medium. For optimum hatching, maintain the water quality parameters as given above. Provide continuous illumination of about 1000 lux (40-watt flourescent light tube, 20 cm away from the hatching container). Maintain the dissolved oxygen at levels close to saturation.

After 15-20 hours of incubation, most of the cysts will be hatched and there will be a colour change in the culture from brown to orange and pinkish orange nauplii will be seen swimming. A siphon can be used to remove debris and nauplii from the bottom. A 100-120 micrometer screen is used to collect the nauplii, washed with clean water and placed in a small volume of water. Contaminants and hatching metabolites can be removed by washing and nauplii can be harvested for feeding.

Harvesting of napulii

REFERANCE

Anuraj A, J Raymond Jani Angel, Venkatesh R Thakur, T Sivaramakrishnan, A K O Ratheesh, ArunJyothiBaruah, Kirubasankar R and Dam Roy S (2015). Live food organisms in aquaculture. CIARI, Port Blair, PP. 1-20.

Das, P., Mandal, S. C., Bhagabati, S. K., Akhtar, M. S., & Singh, S. K. (2012). Important live food organisms and their role in aquaculture. *Frontiers in aquaculture*, *5*(4), 69-86.

Dhont, J., Dierckens, K., Støttrup, J., Van Stappen, G., Wille, M., &Sorgeloos, P. (2013). Rotifers, Artemia and copepods as live feeds for fish larvae in aquaculture. In *Advances in aquaculture hatchery technology* (pp. 157-202).Woodhead Publishing.

Yoshimura, K., Usuki, K., Yoshimatsu, T., Kitajima, C., & Hagiwara, A. (1997).Recent development of a high density mass culture system for the rotifer Brachionus rotundiformisTschugunoff. *Hydrobiologia*, *358*(1-3), 139-144.

Constraints and future strategies of adoption of the green manuring practice

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GREEN MANURE

Green part of leguminous/non-leguminous plants grown in the field and incorporated into the soil is called as green manure. Green manures, also known as fertility-building crops, can widely be defined as crops grown for the benefit of the land. Green manure is a cheap and rich source of plant nutrients such as macro (N, P and K) and micronutrients (Zn, Fe, Mn, Cu, Mo etc.). It increases the soil fertility and productivity. These crops are sunnhemp, dhaincha, legume crops /non-leguminous crops etc. which adds organic matter and Nitrogen to the soil and also improves physical properties of soil.

Green manure is of two types

1. Green manuring
   By cultivating green manure crops in the field and incorporating them into its green stage in the same field, is designated as green manure.
   Examples of green manuring crops: *Sesbania aculeata* (Dhanicha), *S. rostrata* (Root and stem noduleted dhaincha), *Crotolaria juncea* (Sunnhemp), *Melilotus alba* (Senji), *Vigna radiata* (Moong bean), *Vigna sinensis* (Cowpea), *Cymopsis tetragonoloba* (Guar) Lentil (*Lens culinaris*) etc.
2. Green leaf manuring: it is the application of green leaves and twigs of trees, shrubs and herbs collected from elsewhere especially waste land fields, bunds and forests to the field. Forest tree leaves are the main source for green leaf manure e.g. *Azadirachta indica* (Neem), *Madhuca indica* (Mahua), *Glyricidia*, *Pongamia glabra* (Karanj), *Sesbania grandiflora*, *Indigofera spp*. (Indigo), Subabool etc.
   Plants at flowering stage contain the greatest bulk of succulent organic matter with low C: N ratio. The incorporation of the green manure crop at this stage allows a quick liberation of N in available form. Green manuring gives approximately 60-80 kg N/ha.

Advantages

1. **Nitrogen fixation**
   Green manures are often produced for adding nitrogen to the soil. This is the key source of nitrogen in organic farming systems, though it can be a way of reducing inputs for conventional farming.
2. **Nitrogen conservation**
   Maintenance of a green manure/cover crop is one of the best ways of preventing nitrate leaching.
3. **Making nitrogen available**
   A good green manure contributes significant quantities of nitrogen to soil. A lot of reasons are responsible for the supply of N. Bacteria and fungi undergo a process called mineralization in which complex compounds are converted into ammonium and nitrate ions. The amount of nitrogen released depends on the overall amount that has already been added to the soil.
4. **Improved soil physical, chemical and biological properties**
   Legumes usually decay rapidly and thus have relatively little effect on organic matter in the soil over the long term. Moreover, the few months after incorporation they do stimulate microbial development. Non-legumes, by comparison, usually break down relatively slowly with their residues having sometime a physical impact.
5. **Suppression of weeds**
   One of the major benefits of green manures is their ability to suppress weeds. Growing of green manure crops in rotation provides opportunity for suppressing weeds. Different management practices associated with growing a green manure (Example. Mowing and grazing) can also suppress the weeds. Green manure will compete with weeds for light, water, space, air and nutrients. Some green manure crops have allelopathic effects from exudation of specific chemical compounds which helps in smothering or inhibition of weed seed germination and establishment.
6. **Suppression of pests and diseases**
   Green manure crops can act as a inhabitants of predators. Intercropping of green manure crops especially legume/pulse crops can provide good opportunity for pest control.

Reasons for Non-adoption of the green manuring practice

1. **Double cropping**
   Growers do not want to take up manuring practice because all of their owned land is double-cropped and not economical in adopting green manure and losing one crop in the process. Because of unpredictability in tenure, farmers are not willing to take green manure and are not interested in improving soil health, a bulk of the cropped area is under rent. Consequently, contractual uncertainty contributed very greatly.
2. **Lack of irrigation facilities**

Green manure crop require more water for their growth and development. Lack of irrigation facilities also a major constraint in adoption of green manuring crop in rotation. Farmers did have some irrigated lands but they were double cropping this area and did not want to substitute green manuring activity for a season.

3. **Lack of knowledge**
   In following green manure crops, lack of awareness of the benefits of green manure crops may be a huge factor. Farmers felt that if they hold any land fallow to retain soil fertility and on that account did not take up green manure. These farmers need to be trained by setting up demonstrations about the usefulness of green manuring activity.
4. **Incompatability of the green manuring in crop rotations**
   Most farmers who practiced crop rotations like Groundnut-rice-lentil or gram followed by groundnut did not feel the need for green manure. Popular rotations adopted in a region therefore need critical assessment before proposing the method of green manuring for these areas.
5. **Incomplete preparation of land**
   Farmers believed that if the field was put under green manuring crop during the Kharif season it could not be adequately prepared for the ensuing rabi crop. After burying the crop at the period of 4-6 weeks would elapse for proper decomposition to occur. That also left very little time for fine seed bed preparation. This view of the farmers may have been unrealistic because of the planning of a fine seed bed. This view of the farmers was perhaps untenable, because preparation of the land depended upon their ability to carry on timely farmimg operations consistent with the adoption of improved agricultural practices.
6. **Role of competing crops**
   Many farmers felt that sowing operations of Kharif crops such as maize, groundnut etc. coincided with green manure crop sowing. They wanted more attention to the former kharif crops and found no or little time for green manure crop sowing. This view of the growers could be attributed again to their lack of awareness about the beneficial effect of green manuring practice.This view of the cultivators could again be attributed to their lack of awareness of the beneficial effect of green manuring practice. These cultivators would not face much difficulty in adjusting the time of operations of other crops vis-à-vis the green manure crop, if the importance of this practice clearly understood by them.
7. **Cost and non-availabilty of seeds**
   Non-availability of hybrid seeds of green manure is a major constraint in adoption of green manuring practice.

Strategies for changing non-adoption into adoption of green manure practice

1. **Front line demonstration**

Front line demonstration can be a good option for increasing interest of green manure to the farmers.FLD provides information about the benefits of green manure crops.

2. **Proper supply of green manure seed**
   Cost of seed is not difficulty in adopting the green manuring crops. It costs only Rs. Per acre which is not out of financial reach of the farmer. If the cultivator is convinced of the beneficial effects of the green manuring practice, he would not mind the cost of the seed and the problem of non-availability of the 'Dhaicha' seed could be solved by making the supplies available to the farmer right in the village and much ahead of the sowing season.
3. **Awareness**
   Awareness of benefits of green manure crop is very poor. So, proper knowledge of and beneficial effect of green manure crops among farmers and growers could be effective in adoption of green manuring practice.
4. **Advanced research in the field of R & D and education**
   To develop sound technology that fits well to different Agro-climatic situations and lies within the purchasable limit of farmers and providing proper education on how to grow green manure crops.
5. **More emphasis and support by government**
   Government should provide subsidies and incentives on purchase of seeds and equipments, to encourage and promote green manuring crop among farmers provides credit facilities with low interest rates and within short span of time and developing public-private partnership.
6. **Effective transfer of technology and proper training to the farmers**
   Most crucial task lies on extension department to spread information among farmers about green manuring through large scale field demonstration and by conducting training programs and counseling for farmers.

CONCLUSIONS

Following a brief overview of green manure practices, it can be concluded that green manure has emerged as a new approach for sustainable crop production through a variety of resource conservation technologies that prevents degradation of natural resources, preserves biodiversity and protects the environment. Green manure crop uses less input, improves soil health, maximizes profits and minimizes yields. Therefore, implementation of green manure crop is need of the hour to enhance system productivity and profitability while conserving the natural resources.

Nipah Virus – An Emerging Zoonotic Disease

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ABSTRACT

Nipahvirus or Nipah viral encephalitis is an emerging zoonotic disease. It is a negative - sense, non-segmented, single stranded RNA virus of the family of paramyxoviridae, genus Henipavirus and is closely related to hendra virus. The natural reservoir of Nipah virus is pteropid bats (flying foxes) also called fruit bats on the genus of Pteropus. Viral infection is mainly acquired by bats saliva, urine, faeces and birth fluids.Virus affected animals mostly having severe febrile encephalitis.First line of treatment is Ribavirin can reduce the mortality of acute Nipah encephalitis. Diagnosis may be done with polymerase chain reaction and serological test like Enzyme – linked immunosorbant assay.

Keywords: Nipah virus, Nipah viral encephalitis, Pteropid bats, Ribavirin.

INTRODUCTION

Nipah virus was first appeared in pigs at Malaysia and Singapore and humans are affected in Malaysia, Singapore, India and Bangladesh. The natural reservoir of Nipah virus are Fruit bats (Suborder- Megachiroptera) and insectivorous bats (suborder – Microchiroptera) in peninsular Malaysia is responsible for Nipah viral infection. In Malaysia there are 13 species of fruit bats (including 2 flying fox) and >60 species of insectivorous bats are present due to its high diversity of bats fauna Johara *et al*., (2001). Intermediate host of the Nipah virus is pigs. The first outbreak of Nipah virus appeared in Malaysian pig farm which contain high level of fruit tress which attracted by bats and leave their saliva, urine, faeces and birth fluids. Nipah virus infection is also affected in dogs, cats, horses and goats. The first human case of Nipah virus noticed in Kampung sungai Nipah, Malaysia in 1998. That's why the virus name noticed as Nipah virus. In 1999, pigs as well as human beings of some part of the Malaysia are affected by Nipah virus had the symptoms of acute encephalitis (Chua *et al*., 1999). In 2004, similar symptoms were noticed in Bangladesh peoples due to eating of fruits or raw date palm juice which is affected by saliva or urine of fruit bats. In Earlier reported cases of encephalitis in 265 peoples with 105 deaths in Malaysia and 11 encephalitis cases with respiratory illness and one death noticed in Singapore abattoir workers who handled pigs from outbreak areas of Malaysia (Chua *et al*., (2000). Outbreak of Singapore is inhibited by import of pigs from Malaysia were prohibited and in Malaysia, outbreak ended by culling of 1 million pigs in the outbreak areas. Nipah virus killed approximately 70% of the peoples infected in Bangladesh compared to 40 % in Malaysia. Virus transmits to 2 times to the west Bengal (Chadha*et al*., 2006) at the time of epidemic year in Bangladesh (2001 and 2007).

TRANSMISSION

Transmission of Nipah viral infection from infected secretions of bats to the pigs. The virus is believed to have jumped from fruit bats of the Pteropus species to domestic pigs paddocked under the trees where such bats roost. These contaminated fruits taken for humans and animals leads to infection of Nipah virus infected pigs can transmit disease by direct contact of their respiratory secretions to other animals.Peoples are affected by Nipah virus due to eating of fruits or raw date palm juice which is affected by saliva or urine of fruit bats.Contamination of drinking water infected with faeces, urine, parturition fluids. Virus can transmit from one person to another through respiratory droplets(Gurley *et al*., 2007).

SIGNS AND SYMPTOMS

Animals:

40% of the mortality mostly occurs in piglets. However morbidity is high in all age groups of animals. Nipah virus mostly affects the respiratory as well as the nervous systems. It is also called as porcine respiratory and encephalic syndrome (PRES) and Barking pig syndrome (BPS). Common symptoms of muscle tremor with limb weakness and laboured breathing can occur. CNS infection leads to head pressing, twitching, trembling, muscle fasciculation, nystagmus, tetanic spasms, seizures and respiratory infection leads to nasal discharge, open mouth breathing, convulsion and death can occur (Hooper *et al*., 2001). In dogs distemper like symptoms are noticed with pyrexia, dyspnoea and purulent oculo – nasal discharge.

Humans

Generally, Nipah virus infection can be asymptomatic to nonspecific influenza like symptoms can appear. Some common signs of fever, headaches, sore throat, confusion, disorientation, vomiting and muscle pain (myalgia), and segmental myoclonus are occur. Nipah virus can affect the CNS leads to severe vasculitis of small blood vessels result in endothelial damage, Hypertension, tachycardia and rapid deterioration with irreversible hypotension which leads to death. In severe cases, respiratory infection leads to dyspnoea(Wong *et al*., 2002). In advance cases, fatal encephalitis (inflammation of brain tissue), drowsiness, dizziness, altered consciousness and neurological signs are appearing finally coma within 24 – 48 hours.

Case Definitions

Suspect Nipah Case

Person from a area/ locality affected by a Nipah virus disease outbreak who has:

- Acute Fever with new onset of altered mental status or seizure and/or

- Acute Fever with severe headache and/or
- Acute Fever with Cough or shortness of breath

Probable Nipah Case

Suspect case-patient/s who resided in the same village where suspect/confirmed case of NIPAH were living during the outbreak period and who died before complete diagnostic specimens could be collected

OR

Suspect case-patients who came in direct contact with confirmed case-patients in a hospital setting during the outbreak period and who died before complete diagnostic specimens could be collected.

Confirmed Nipah Case

Suspected case who has laboratory confirmation of Nipah virus infection either by:

- Nipah virus RNA identified by PCR from respiratory secretions, urine, or cerebrospinal fluid.
- Isolation of Nipah virus from respiratory secretions, urine or cerebrospinal fluid.

Definition of a Contact:

A Close contact is defined as a patient or a person who came in contact with a Nipah case (confirmed or probable cases) in at least one of the following ways.

- Was admitted simultaneously in a hospital ward/ shared room with a suspect/confirmed case of Nipah virus disease
- Has had direct close contact with the suspect/confirmed case of Nipah virus disease during the illness including during transportation.
- Has had direct close contact with the (deceased) suspect/confirmed case of Nipah virus disease at a funeral or during burial preparation rituals
- Has touched the blood or body fluids (saliva, urine, vomitus etc.) of a suspect/confirmed case of Nipah virus disease during their illness
- Has touched the clothes or linens of a suspect/confirmed case of Nipah virus disease

These contacts need to be followed up for appearance of symptoms of NipahV for the longest incubation period (21 days), or preferably double incubation period, of 42 days.

DIAGNOSIS

Incubation period in pigs is approximately 4 to 14 days, human beings at 4 to 20 days and some cases reported in 45 days.The current infection can be diagnosed by high or four fold rises in specific IgM or IgG antibody (Ab) was detected in serum sample by Enzyme – linked immunoassays (ELISA) and modified ELISA developed based on relative reactivity of sera with Niv antigen.Tissue samples from necropsy – showed micro-infraction in CNS.Blood and cerebrospinal fluid samples taken at before death of affected animals to culture the virus.The vero cells inoculation with cerebro spinal fluid (CSF) samples taken from the fatal cases of encephalitis causing a syncytial formation. The RT- PCR – in that RNA was extracted from human brain tissue (Fatal cases only). Two sets of primers were used for RT-PCR reaction (Chadha *et al*., 2006).

- Primary set NVNBF – 4 (5' – CAATGGAGCCAGACATCAAGAG-3') and NVNBR4 (5'-CATAGAGATGAGTGTAAAAGC-3') amplified a 159 nucleotide (nt) region of the N gene of Niv.
- Primer set of NVBMFC1 (5'- CAATGGAGCCAGACATCAAGAG- 3') and NVBMFR2 (5'- CGGAGAGTAGGAGTTCTAGAAG-3') amplified a 320 nt-region of the M gene of Niv.
- The recommended samples in humans are:
  - Throat swab in viral transport medium
  - Urine 5 ml in universal sterile container
  - Blood in red vacutainer (5ml)
  - CSF (1-2 ml) in sterile container

DIFFERENTIAL DIAGNOSIS

In earlier time the pigs which are affected by the Nipah virus had respiratory illness and it was ascribed as Japanese encephalitis (JE). JE is a mosquito born disease which is mostly endemic in a particular area where the pigs are mostly present. Pigs are the amplifying host of the JE (Chua *et al*., (2000).Symptoms which appear in the humans were distinct or deferred from JE. Nipah virus is differ from the JE by mostly affected the adult rather than children, members of the same households are mostly affected so, the viral infection had higher attack rate. But in JE, symptomatic encephalitis can occur in only 1 in 300 affected peoples but in Nipah virus affected peoples all had encephalitis. The Nipah virus outbreak is related to hendra virus but it had a clear-cut difference from hendra virus (Rogers *et al*., 1996). Hendra virus transmitted from horse and all affected animals had respiratory infection with severe menigo - encephalitis(Field *et al*., 1997) (Osullivan *et al*., 1997).But in all Nipah virus animals do not had pulmonary involvement (Hooper *et al*., 2001).

PREVENTION AND CONTROL

- Transmission of Nipah virus can be effectively controlled by strict hygienic measures such as avoid consumption of partially bat eaten fruits and undercooked meat of infected animals.
- Avoid direct close physical contact of affected peoples
- Wear proper mask which contain NH-95 grade while attending patients with symptoms
- Proper sanitation of hands at regular interval
- Avoid visitors to enter the farm
- Proper cleaning of contaminated areas with using of 4% sodium hypochlorite.
- Proper isolation and quarantine period for the farm.
- Mass eradication of the infected animal in the farm and after culling proper burial site are selected and disinfected with chlorinated lime.
- Educative campaigns should be created to make public aware of this viral zoonotic diseases.

- Most important biosecurity measures to avoid the likelihood of the bats reservoir coming into contact with pigs.

TREATMENT

Currently there is no known treatment or vaccine available for either human or animals. Intensive supportive care with treatment of symptoms is the main approach to managing the infection in people.

There is no proven treatment recommended for Nipah virus disease. Some observational data suggests that Ribavirin may be of use in reducing mortality among patients with encephalitis caused by Nipah virus disease. There is no data/evidence of its usefulness as a prophylactic drug (Chong *et al*., 2001).

There are research project going on by using Monoclonal antibodies as treatment for Nipah Virus disease.

Systemic treatment only now currently available, there is no proper vaccination and drug available for treating the virus.

First line of treatment is Ribavirin can reduce the mortality of acute Nipah encephalitis(Chong *et al*., 2001).

REFERENCE

Chadha, M.S., Comer,J.A., Lowe, L., Rota, P.A., Rollin, P.E., Bellini, W.J., Siazek, T.G.K. and Mishra, A.C. 2006. Nipah virus associated encephalitis outbreak, siligiri, India. *Emerging infectious diseases.*12(**2**): 235.

Chong, H.T., Kamarulzaman, A., Tan, C.T., Goh, K.J., Thayaparan, T., Kunjapan, S.R., Chew, N.K., Chua, K.B. and Lam,S.K. 2001.Treatment of acute Nipah encephalitis with ribavirin.*Official Journal of the American, Neurological association and the child neurology society.* 49(**6**): 810-813.

Chua, K.B., Bellini, W.J., Rota, P.A., Harcourt, B.H., Tamin, A., Lam, S.K., Ksiazek, T.G., Rollin, P.E., Raki, S.R., Shieh, W.J., Goldsmith, C.S., Gubbler, D.J., Roehrig, J.T., Eaton, B., Gould, A.R., Olson, J., Field, H.,Daniels, P., Ling, A.E., Peters, C.J., Anderson,L.J. and Mahy,B.W.J. 2000. Nipah virus: A recently emergent deadly paramyxovirus.*Sciencemag.org* 288(**5470**): 1432-1435.

Chua, K.B., Goh, K.J., Wong, K.T., Kamarulzaman, A., Tan, P.S.K., Ksiazek, T.G., Zeki, S.R., Paul, G., Lam,S.K. and Tan,C.T. 1999. *The Lancet* 354(9186): 1257-1259.

Chua, K.B., Lam, S.K., Goh, K.J., Hooi, P.S., Ksiazek, T.G., Kamarulzaman, A., Olson, J. andTan, C.T. 2001. The presence of Nipah virus in respiratory secretions and urine of patients during an outbreak of Nipah virus encephalitis in Malaysia. *J. Infection* 42(**1**): 40 - 43.

Field, H., Halpin, K. and Young, P. 1997. An overview of equine morbilivirus and bat paramyxovirus in Australia. The OIE/FAVA epidemiology programme: special session on emerging disease, cairns, Australia.

Gurley, E.S., Montgomery, J.M., Hossain, M.J., bell, M.A., Azad, K., Islam, M.R., Mola, M.A.R.,. Carroll, D.S., Ksiazek, T.G., Rota, P.A., lowe, L., Comer, J.A., Grolla, A., Felolmann, H., Luby, S.P., Woodward, J.L. and Beriman, R.F., 2007. Person to person transmission of Nipah virus ain a Bangladeshi community. *EmergingZoonotic Diseases* 13(**7**): 1031.

Hooper, P., Zaki, S., Daniels, P. and Middleton, D. 2001. Comparative pathology of the diseases caused by Hendra and Nipah virus. *Microbes and infection* 3(**4**): 315-322.

Johara, M.Y., Field, H., Rashdi, A.M., Morrissy, C., Heide, B.V., Rota, P., Adzhar, A.B., White, J., Daniels, P., Jamaluddin, A. and Ksiazek, T. 2001. Nipah virus infection in bats (order chiroptera) in peninsular Malaysia.

Osullivan, J.D., Allworth, A.M. and Peterson, D.L. 1997. Fatal encephalitis is due to novel paramyxovirus transmitted from horse. *Lancet* 349: 93-95.

Rogers,R. J., Douglas, I.C and Baldock, F.C. 1996. Investigation of a second focus of equine morbilivirus infection in coastal Queensland.*Aust.Vet*. 74: 243-244.

Wong, K.T., Shieh, W.J., Kumar, S., Naroin, K.,.Guarner, W.A.J., Goldsmith, C.S., Chua, K.B., Lam, S.K., Tin, C.T., Goh, K.J., Chong, H.T., Jusoh, R.,Rollin, P.E., Ksiazek,T.G. and Zaki,S.R. 2002. Nipah virus infection: pathology and pathogenesis of an emerging paramyxoviral zoonosis. *The American Journal of Pathology* 161(**6**):2153-2167.