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PROSPECTS OF CULTIVATION AND MARKETING STRATEGY OF ALOE-VERA IN TELANGANA STATE

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INTRODUCTION

Study was conducted by CCS National Institute of Agricultural Marketing, Jaipur to understand the various dimensions of cultivation and marketing of aloe-vera in the state of Telangana. As it is aware that demand of aloe-vera is increasing globally due to changes in consumption pattern of consumers and to understand the substances prepared from the aloe vera and their use in our daily life. The products made from aloe-vera are safe for health and body. However, as known that in spite of having a great demand, the marketing of aloe-vera is very grey and complicated and very difficult to understand the supply chain of the marketing products at the level of the farmers. As a result farmers are facing difficulties in marketing of their produce due to lack of knowledge of marketing channels, packaging, grading, storage, collection process, primary processing and many more.

METHODOLOGY

The study conducted in Telangana state to find out the status of cultivation and marketing potential of aloe-vera crop. To collect the data from the study area following strategy was adopted. Data collected from farmers, mandies, manufacturers, traders, middlemen and cooperatives.

1. Sampling from village : Sampling of villages done to study the cultivation/collection practices of the aloe-vera farmers. Under this study only 4 districts (Rangareddy, Medak, Nalgonda and Mehaboob Nagar) from Telangana were selected for the purpose of study and to collect the data from bottom line.

2. Data collection from Mandies : The next part of survey is done to analyse the existing and potential market of the produces. For the same, the herbal market of the concerned produces were studied in major markets of Telangana to understand the demand-supply scenario, export and domestic market, consumer preference, industrial requirement and

procurement channel, Telangana's present share, price spread, mandi efficiency etc.

3. Data collection from industry : For industrial analysis, data collected from Dabur processing, Vijay Durga Wineries, KSM 66, GCC processing unit and other industrial organizations that include micro, medium and large organization. The sample size was approximately 10%.

Aloe-vera market scenario

Aloe-vera is cultivated for food, cosmetics, and beverages and for medicinal purpose. The extracts are used to formulate aloe-vera based products such as powders, gel, capsules, drinks and concentrates and is known to cure skin related ailments, cardiovascular diseases, weight loss and many more. The global market for aloe-vera extracts is anticipated to expand at a CAGR of over 7.7% in terms of value and 7.4%, in terms of volume during the forecast period. Factors such as increasing trend of consumers towards healthy lifestyle, coupled with increased usage of aloe-vera extracts as an ingredient by food, pharmaceutical and cosmetics industries is fuelling market growth across the globe.

Major Players

Some of the major players operating in Indian aloe-vera products market are Patanjali Ayurved Limited, Dabur India Limited, Shree Baidyanath Ayurved Bhawan Private Limited. The Himalaya Drug Company, Brihans Natural Products Limited, Aloe Veda Personal Care, Aloe-vera India, Khadi Natural, Forest Essentials, Nature's Essence Private Limited, FabIndia, Bright LifeCare Private Limited, Rattan Organic Foods Private Limited and Nourish Vitals etc.

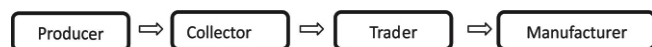
Post-harvest and Processing : Immediately after harvesting, the aloe leaves are tipped, tailed, and its spiny ridges are removed. For the extraction, juice is allowed to drain from the cut leaves into suitable vessels or it can simply be squeezed or grinded to get

the gel. There are other sophisticated ways to separate the gel without loss of the product quality.

The properties of aloe are in the concentration of all the elements that it contains and no particular extract or part of its components stands out individually in the health benefits of aloe-vera. For this reason, aloe gel is just the juice of the plant, cold processed with a minimum of authorized additives for its stabilization. In pharmaceutical laboratories, strict quality controls are carried out at each stage of processing in order to guarantee the condition of materials used and the final product.

Marketing Channel

The analysis of the collected data reveals that there is only one principal channel or route through which aloe-veraplants marketed from the producer (farmer) to the manufacturer. The major channel of distribution of plant observed as follows :



Important observation made from the field visit is that, for medicinal plants marketing, decentralized marketing channel is in effect in the selected study area where the middle men or wholesale purchasers purchases directly from the farmers in absence of physical market. In this instant case of marketing, farmers sell the produce to the collector from them the traders and manufactures purchase. In this channel final consumers were not traced out as these raw produce extracted from the aloe. Price realised at various stakeholders' level in the marketing channel is given below (Rs. /kg)

The price realised by the companies are quite high and depends on the quality of products like powder, tonic, power-pills, syrup and lapnum, soap, gel, syrup, face cream, shampoo and pharmaceutical product. The margin of the products are sometime more than 300-500% because of value addition and processing of product by the companies. Price realised by some major companies working in Telangana are more than 300-500%. The prevailing market rates of some herbal products made from aloe-vera manufactured by herbal companies are as under :

Aloe-vera raw material price at producer's level is in

the range of 5-6 per kg. The same material sold by the collector at the range of Rs. 10-12 per kg and traders selling at Rs. 14-19 per kg. After value addition at the manufactures level the different end products realising prices in the range of Rs. 300-5000 per one kg of aloe-vera.

Market margin and Price Spread

Marketing margin assists in understanding the difference between the price paid by the consumer and that obtained by the producer at the farm gate. It is also shows the difference in price of a commodity at different stages of the marketing system. Whereas commodity-price spread explains the difference between consumer and producer prices. The spread includes the marketing cost incurred by the intermediaries as well as their margin. Price spread analysis not only shows the marketing costs and marketing margins at different levels of marketing by different marketing agencies or channels but also show a clear picture of the entire system of marketing.

Price Spread

$$= \frac{(\text{Manufacture Price} - \text{Net price of producer})}{\text{Manufacture price}} \times 100$$

Field Experience

Aloe-vera is cultivated in Rangareddy, Medak, Nulgonda and Mehaboob Nagar district of Telangana. The initiative for extension of Aloe-vera crop in these districts was taken by Sh. Janardan Reddy with the support of Telangana State Medicinal & Aromatic Plant Board, Hyderabad. The buy-back arrangement for fresh pulp @ Rs. 21/- per kg was exercised between the group of farmers and M/s PatanjaliAyurved Ltd. Hardwar. As stated by the farmers, an agreement was done between both the parties with a condition that both will save the interest of each other. The 11 month duration crop, as observed during the field visit, was ready for harvest. However, no one could turned up from M/s PatanjaliAyurved Ltd. Hardwar to make an arrangement of purchase of aloe-vera crop as per agreement.

It was also observed from the field that farmers are growing local varieties of aloe-vera intercropping with local varieties of pulses called as Uluvacharu which is used for making sambhar a local dish. There is no fat and sugar in the local varieties of pulses, it is opined by

Table-1 : Value chain of aloe-vera

S. No.	Name of crop	Price realised by farmers (Rs. Per Kg)	Price realised by middleman (Rs. Per Kg)	Price realised by wholesaler (Rs. Per Kg)	Product made by the company	Local Market Linkage
1.	Aloe-vera	5-6	10-12	14-18	Soap, gel, syrup, face cream, shampoo, pharmaceutical product	Begum Bazar, Hyderabad, Bhaskara Bio-tech Pharma Company, Arogya Rama, Bio-Max, Youngever, Mediherbz and TSGCC

Table-2 : Prevailing market rates of products made from aloe-vera.

S. No.	Crop / Raw Material	Farmer (Rs./kg)	Collector (Rs./kg)	Trader (Rs./kg)	Manufacturer		Name of Product
					Volume	Price (Rs.)	
1	Aloe-vera,	5-6	10-12	14-18	250 ml	250	Ale-vera Juice
7	Aloe-vera	5-6	10-12	14-18	100 ml	120	Aloe-vera hair oil
12	Aloe-vera	5-6	10-12	14-18	50 ml	110	Aloe-vera skin care oil
13	Aloe-vera	5-6	10-12	14-18	10 ml	50	KumkumadiTailam
14	Aloe-vera	5-6	10-12	14-18	75 gram	100	Aloe-vera gel
15	Aloe-vera	5-6	10-12	14-18	75 gram	100	Aloe papaya gel
16	Aloe-vera	5-6	10-12	14-18	75 gram	100	Aloe saffron gel
17	Aloe-vera	5-6	10-12	14-18	75 gram	80	Aloe menthol gel
18	Aloe-vera	5-6	10-12	14-18	75 gram	80	Aloe jasmine hair gel
19	Aloe-vera	5-6	10-12	14-18	100 gram	40	Aloe-vera beauty soap (Saffron)
20	Aloe-vera	5-6	10-12	14-18	100 gram	40	Aloe-vera beauty soap (Jasmine)
21	Aloe-vera	5-6	10-12	14-18	100 gram	40	Aloe-vera beauty soap (Rose)
22	Aloe-vera	5-6	10-12	14-18	90 gram	75	Aloe-vera beauty soap (Sandal)
23	Aloe-vera	5-6	10-12	14-18	90 gram	30	Tulasi soap
24	Aloe-vera	5-6	10-12	14-18	125 ml	140	Aloe-vera shampoo

Table-3 : Price realised by various stakeholders(Rs./kg)

Crop	Producer	Collector	Traders	Manufacturers
Aloe-vera	5-6	10-12	14-19	300-5000 depending on the products



the farmer Sh. Buchuramulu, Village Kothularam, Mumugundu Mandal District Nalgonda. He has 5 acres of land having the drip irrigation facility and showing aloe-vera and other crops at the farm land and he has also opined that there is no need to change the variety of aloe-vera as variety available is performing well.

Local Market Experience

The local market of aloe-vera is available in and around Hyderabad those are hand holding with the farmers and support in procuring the raw material direct from the farmers. Important local market players are Bhaskara Bio-tech Pharma Company, Arogya Rama Genetics, Biomax, Youngever and Mediherbz. These companies are based at Hyderabad and providing the local support to the farmers because they are buying the raw material of various medicinal crops including aloe-vera directly from the farmers. Some time they are buying the raw material with the help of mediators / middleman at a very cheaper rate.

Local Market of Medicinal Herbs

Begum Bazar, Hyderabad is a common and local market for buying and selling of Herbal raw material. In this local market various small, medium and large exporter and importers are working and engaged in

Table-4 : Aloe-vera marketing margin (Rs.) for different end products.

Product	Producer price	Manufacturer price	Market margin in Rs.	Price spread (in %)
Aloe Vera Juice	6	1000	994	99.40
Gel products	6	1196	1190	99.49
Shampoos	6	1120	1114	99.46
Soaps	6	473	467	98.73
Hair oil	6	1200	1194	99.50

Table-5 : Local Value Chain.

S. No.	Name of Company	Raw Material Procured	Annual Demand	Product Profile
1.	Bhaskara Bio-tech Pharma Company	Aloe-vera and other medicinal crops	2-3 tone	Aloe-detox, Aloe-Noni, Aloe-vera Face wash and body lotion, hand-made cream, shampoo, hand wash, multipurpose gel etc.
2.	Arogya Rama	Aloe-vera and other medicinal crops	3 tone	Herbal Powder, soap, face cream, Juice, Cosmetics, Shampoos, Neem powder, Tulsi ark, Arjun churn etc.
3.	Genetics	Aloe-vera and other medicinal crops	2 tone	Aloe-vera juices, oils, gels and creams, handmade soap, bath powder, shampoos, soap, powder, honey herbal pack, hair pack.
4.	Bio-Max	Aloe-vera and other medicinal crops	2 tone	Aonla Juice, Powder, Triphala, Candy, Chutney etc.
5.	Youngever	Aloe-vera and other medicinal crops	3 tone	Juices, oils, gels and creams, handmade soap, bath powder, tooth powder, shampoos, soap, powder, honey herbal pack, hair pack, hair treatment kit and tablets and capsules.
6.	Mediherbz	Aloe-vera and other medicinal crops	1.5 tone	Shampoos, Face Pack, Cream, Hair Oil, Massage Oil, Powder, Lotion, Gel, Face Scrub, Pain reliving Oil, Herbal Mehndi, Anti pimple cream, fair glow, soap, skin care oil, face wash etc.

Table-6 : Average monthly price of aloe-vera (per kg)

Average monthly price of aloe-vera throughout India per kg											
March	April	May	June	July	August	Sep	Oct	Nov	Dec	Jan	Feb
37.3	35.8	39.3	36.6	31.6	34.5	36	46.6	45.6	35.4	34.4	34.6

procurement of different herbal raw material sourced from different part of the country. The farmers, tribal people and middle man are also come to meet out their requirement of herbal raw material like Aloe-vera, Aonla, Aswagandha, Soapnut, Tejpat, Cinnamon, other spices, gums, dry fruits and other Ayurvedic and Unani raw materials. During the visit to the market the interview was arranged at the shop of Sh. P. Ashok Kumar, the owner of M/s P. Kishan Lal Ashok Kumar, Exporter & Importer of different herbal product.

Marketing of aloe-vera at road side

It was new marketing initiatives observed at the road side under the banner of SSF Natural Drinks in a kiosk. Different kind of juices mix with Aloe-vera like Basil, Mint and lemon were available in the kiosk. There was lot of foot fall of the people walking through the road and were enjoying the healthy drink.

The owner of the kiosk interviewed and opined that fresh aloe-vera leaves procured from Chennai @ Rs.

30/kg including transportation and other costs. The owner of the kiosk was not aware that the aloe-vera is being cultivated in Nalgonda district itself. During the interview it was informed that he may purchase the fresh aloe-vera leaves from the local farmers growing



New marketing initiatives at road side for Aloe-vera in Nalgonda

aloe-vera in Kothularam village at cheaper price. He was selling aloe-vera juice with different flavour @ Rs. 40/- per glass and 1 ltr. @ Rs. 100/-. It is a new marketing initiatives for aloe-vera if a network is developed with the local farmers those are growing aloe-vera in the area. It was appraised to him if he purchased fresh aloe-vera leaves form the local growers he can not only minimise the cost of procurement but also will be a tool of marketing to the local growers and procure the fresh leaves form the local growers at a cheaper price say Rs. 15-20 per kg. This kind of small initiatives can enhance the localconsumption of aloe-vera in tern the demand of fresh aloe-vera leaves will be increased. This kind of kiosk can be open up at the level of district headquarters with a connectivity of local growers.

It is observed from the analysis of the given data of the average price of aloe-vera per kg are lowest average prices in the Jan-March Quarter and highest in the October-December Quarter followed by the July-September Quarter and April-June Quarter.

Although on an average, the price fluctuation is not too much throughout the year.

CONCLUSION

The biggest inefficiency in Aloe-vera value chain is low price received by farmers. The highest value addition in aloe-vera value chain happens during processing. Due to high perishability aloe-vera needs to be processed soon after harvesting. This limits the farmers to produce large quantity of aloe-vera without any buy back contract as there is no scope of local processing available for them in the block or district level. Out of all medicinal plants the farmers share in consumer price is least at present for aloe-vera. The demand for aloe-vera in drug and cosmetic industry is increasing everyday but in the form of extracts and gel. The farmers have the emergency to sell the raw leaves and traders or middlemen take the advantage of the situation. The farmers can be encouraged to produce large quantity of aloe-vera only if they have the scope of selling processed material.

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ASSESSING MARKET SIZE OF YANKY ON MANGO AND OTHER CROPS

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ABSTRACT

Present study titled “Assessing Market Size of Yanky on Mango and other Crops” in conducted in various districts of Uttar Pradesh and Karnataka to study the effect of Paclobutrazol on mango crop. During the study various distributors, dealers and farmers feedback obtained to know the current market size, market potential of Yanky in Uttar Pradesh and Karnataka. To suffice appropriate information to achieve objectives of the study, representative samples of 143 distributors, dealers and 288 farmers in 6 districts of Uttar Pradesh and 3 districts of Karnataka were interviewed. The data was collected through self-developed questionnaire after descriptive study. With Alternate bearing in Mango crop and inducing flowering in other crop such as pomegranate, citrus in agriculture, Paclobutrazol become a vital input. The attrition of farmers from one product to other or to say from one company to other draws the attention of all Agri-input companies to create new customer as well as retain the old, regular customers. Ichiban Crop Science Limited with impressive presence in Uttar Pradesh and Karnataka has huge market potential for increasing profitability of the business.

INTRODUCTION

Mango is grown almost in all the states of India. Uttar Pradesh occupies first position in the country. Other major producing states are Andhra Pradesh, Maharashtra, Karnataka, Bihar and Gujarat. Mango (*Mangifera indica* Linn) is the most important fruit of India and is known as “King of fruits”. The fruit is cultivated in the largest area i.e. 2,312 thousand ha and the production is around 15.03 million tons, contributing 40.48% of the total world production of mango. The main mango producing states in India are Uttar Pradesh (23.86%), Andhra Pradesh (22.14%), Karnataka (11.71%), Bihar (8.79%), Gujarat (6.00%) and Tamil Nadu (5.09%). Yanky is a product used for enhancing the flowering and fruit bearing in mango and reduced the vegetative growth which hindrance the fruit bearing.

Genesis of the study

The study was conducted during SIP (Summer Internship Project) being a 2nd year student of PGDM (ABM) in CCS NIAM and supported by Ichiban Crop Science Ltd., New Delhi to study the effect of Yanky on mango crop. Company was of the opinion to increase the sale of its product Yanky.

METHODOLOGY

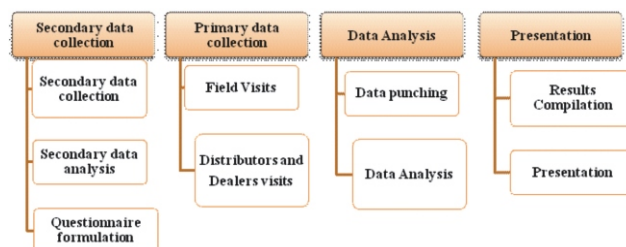
Primary Data : The study was exploratory in nature and thus schedules were developed to get relevant data

from various stakeholders ie. distributors, dealers and farmers.

Both quantitative and qualitative data collected from respondents of 6 districts of Uttar Pradesh and 3 districts of Karnataka. Data collected from 143 distributors and dealers; 288 farmers. Separate schedules were prepared for farmers and dealers. Snowball Sampling Method was used in the survey for data collection.

Project Data

The data for the purpose of the study collected from various stakeholders i.e. dealer, distributors and farmers, for which schedules were designed separately and nature of stakeholders. The primary data collected through personal interview followed by field visits.



Statistical Analysis :

The data collected from both the states of Uttar Pradesh and Karnataka analysed by using Microsoft excel tools.

The markets were selected based upon the area under potential in the districts.

Selection of Markets – The selection of market was done on the basis of importance and guidance given by the Territory Manager of the company.

Selection of Farmers : Since, Mango is a major fruit crop in Uttar Pradesh and Karnataka hence, both the states were considered for the purpose of the study. During the selection of states the network of distributors and dealers were also considered.

Selection of Distributors and Dealers : For the purpose of the study, major distributors and dealers of Ichiban Crop Science Ltd. were selected and dealers those not selling Ichiban products were also considered for comparison of market matrix and profile.

Area Covered

For the purpose of study two states *i.e.* Uttar Pradesh and Karnataka were selected and the details of selected districts from the states are as under :

Table-1 : Details of Districts selected for the study.

Name of the State	
Uttar Pradesh	Karnataka
Lucknow	Kolar
Meerut	Chikbalapur
Amroha	Dharwad
Muzaffarnagar	
Saharanpur	
Bijnor	

Need for Research

Identify the most used PACLOBUTRAZOL in that area.

Factors preferred by the farmers during purchase of chemicals.

Farmers understanding from companies' promotional activities.

Flow of the Study

Following process were adopted to do the Research Study and to draw the conclusion from the data collected from different stakeholders.

It is evident from the above table that mango hopper, shoot borer, fruit fly, stem miner, trunk borer were the major insects of mango crop followed by various disease like powder-mildew, anthracnose and mango malformation.

Ichiban product	Insects and Diseases
Othello gold	Hopper
Rangoon	Hopper
Zonata-super	Sucking pest, Borers
Battle ship	Anthracnose, Powdery Mildew

It is evident from the above table that insects and pests are occur in this month of July to October and it is a right time to use Ichiban product like Paclobutrazol and tap the major market in the selected region.

Many companies have majorly introduced the Paclobutrazol into the market so all distributors and dealers and most mango farmers are aware of the product called Cultar but the price is very high and unaffordable for them so they started alternate product which is cheaper and more quantity. Some local product is doing so well due to cheap price with same quantity as like big company Syngenta and Excel. Even the dealers are liking the local product as demand came from mango farmers instead of big companies' product.

The most marginal profit getting by dealer of selling Paclobutrazol is local product and Oswal which are

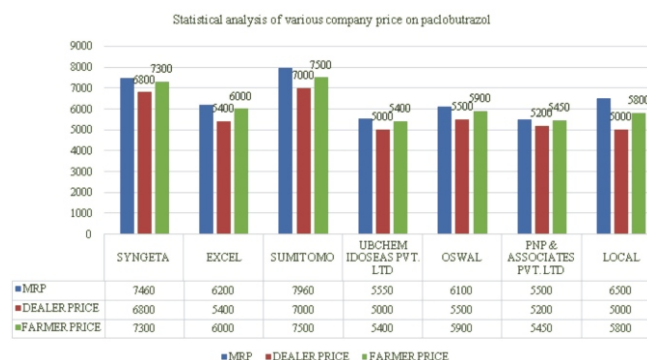
Table-2 : Mango crop profiling and stages of insect pest infestation.

Months	Stages	Insects pest	Diseases
January			Powdery mildew
February	flowering	Mango Hoppers & Midge	Anthracnose powdery mildew
April	Pea & Marble stage	Termite, Mango Hoppers, Shoot- borer, Leaf cutting weevil	Malformation
May	Fruit Maturity	Fruit fly	Bacterial canker Black tip Internal necrosis
June	Fruit harvesting		
July	Maturity in late varieties	Shoot borer, leaf cutting weevil	
August		Shoot gall maker, spider web, stem Miner	Red rust Anthracnose
October			Die-Back
November			Gummosis

Table-3 : Product of various company in the existing market.

Sl. No	Company	Trade name	Quantity	MRP (Rs.)	Dealer price (Rs.)	Farmer price (Rs.)
1.	Syngenta	Cultar	1 Ltr.	7460	6800	7300
2.	Excel	Clestar	1 Ltr.	6200	5400	6000
3.	Sumit Omo	Jika	1 Ltr.	7960	7000	7500
4.	Cheminovo	Lagan	350 ml.	350	300	350
5.	Oswal	Seltar	1 Ltr.	5550	5000	5400
6.	Ubchen Indoveseas	Boulter	1 Ltr.	6100	5500	5900
7.	PNP Pvt. Ltd.	Paclotar	1 Ltr.	5500	5000	5450
8.	Local	Salam-25	1 Ltr.	6500	5000	5800

mention below in details and even cheaper than other companies product with same quantity so farmer as well prefer the product as finance is the most constraint to them.



Feedback from farmers : Find out mango farmers continuous using Paclobutrazol because if they didn't use than the tree start dying and does not bear fruit in coming years so to avoid the problem they buy continuous but prefer cheaper and more quantity.

Reason : They apply after 2/3 month after harvesting *i.e.* October and November, it has applied 1 or 2 weeks after harvesting of the fruit which other company don't tell so one innovative which Ichiban can do or mention in the package for use. Ichiban has to think: price strategy how much MRP they are going to sell Yanky and in which quantity.

Potential market for Paclobutrazol in Uttar Pradesh :

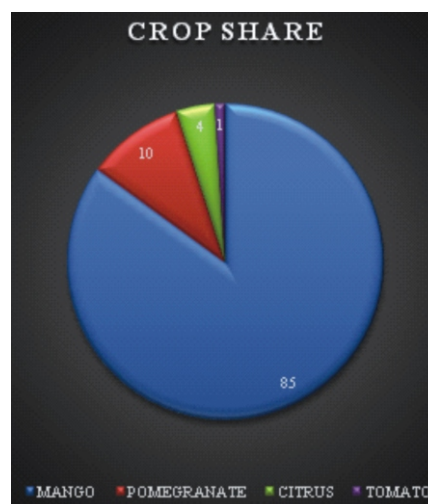
Market not yet exploited fully : None of the companies are well established and have a strong brand name except Syngenta and Excel company

No brand awareness among farmers : Most of the farmers are unaware of brand value in the districts and just use what dealers suggest. So, if we can tap dealers in this market, we can gain huge market segment in this region.

Socio economic condition of farmers : This factor plays a key role in purchasing power of farmers, as existing product like Cultar, Celstar, Lagan, Jika, Seltar, Boulter, Salam-25, Saclotar are costly input. In order to utilize the benefits of Paclobutrazol, firstly farmers should have the purchasing power of buying product.

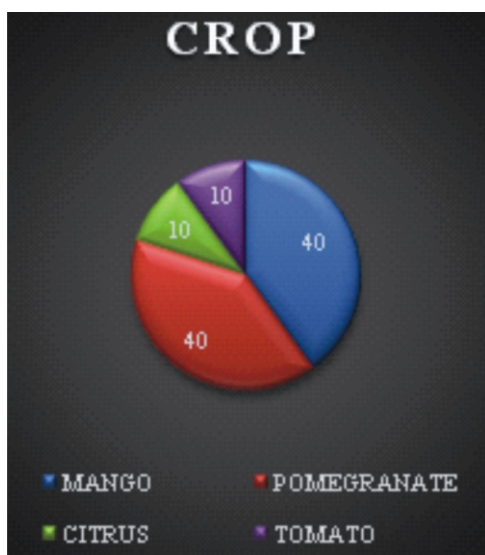
Potential market for Paclobutrazol in Karnataka:

With survey of 54 distributors, dealers and 89 farmers in 3 districts of Karnataka along with Territory Manager Mr. Anjanapa and Mr. Kallaiah, farmers stop using Paclobutrazol due to lack of irrigation and if they don't use the chemical consistently the mango plant don't bear fruits in coming years and show dying symptom of the tree. Some farmers, 2/3 years back they used even in pomegranate, citrus and tomato but due to the high price of the product they stop using the product.



Estimation of crop share in Uttar Pradesh using Paclobutrazol :

Based on the analysis most mango farmers in Uttar Pradesh used Paclobutrazol in Mango crop and few in other crops.



Estimation of crop share in Karnataka using Paclobutrazol past 2 years

Past two years they use Paclobutrazol not only in mango but also majorly use in pomegranate and few in another crop but farmer stop using Paclobutrazol in the state due to lack of irrigation.

Competitor profiling for marketing strategy

Paclobutrazol is one of the major profitable business product in Agri-input sector for mango crop hence, there is a tight competition between companies to hold the major market share in Uttar Pradesh and past 2 years in Karnataka states. To understand the dealer perception of how company is doing in the market, few parameters were considered in the survey and they are print and audio visual aids, shop branding, demonstration, brochure preparation, leaflets, crop seminars, farmers meeting, package attractiveness, mobile and social media marketing.

Syngenta strategies : The Company adopted the strategy to penetrate product in the market with the help of shop branding, crop seminars, farmers meeting and demonstrations.

Excel : The Company adopted the strategy to penetrate product in the market with the help of crop seminars, farmers meeting and demonstrations forcing territory manager and field staff to monitor sell of the product on day to day basis.

Cheminovo : Small quantity packaging. (It provides price to poor farmers but can hamper the sell other company product), it is failing strategy.

Smitomo : The Company adopted the strategy to penetrate product in the market with the help of shop branding, crop seminars, farmers meeting and demonstrations and avoid dumping of product in the dealer shop.

Ubchen Indoverseas : The Company adopted the strategy to penetrate product in the market with the help of demonstrations to dealers only.

Oswel : The Company adopted the strategy to penetrate product in the market with the help of less price strategy.

PNP Pvt. Limited : The Company generally use the strategy use of less price and visit the shop time to time for monitoring purpose by the sell staff.

Local : High margin strategy for dealers trying to cover both distributors and dealers and as well as retailers. Making aware through farmer meeting and demonstration.

Effectiveness of all the promotional activities:

Having strong relationship with distributors and dealers as they are playing main role in promoting the product :

Why?

As almost all mango farmers are not aware about the product, they take the suggestion of dealers what to use in their field those are facing problem in their crop field. When company have good relation with the dealers, they sell their product instead of selling other companies product and as well they promote the product telling the farmers that those are the best product comprising to other company product and company always prefer to target the progressive farmers.

Why?

They are the main influential people in the village as all the small and marginal farmers practice like progressive farmers do and fellow friends. Shop branding: by seeing the image of the product farmer incurred about those image products pasting on the wall of dealers and distributors. Crop seminars and farmers meeting telling about the benefit of the product and POP for the crop which is beneficial for the farmers as well reduce the cost of input and avoid the bad result of the product if they misuse with the product to some other crop and lead to crop damage

Table-4 : How company reaches to farmers.

Farmers' Meeting	Wall Paintings	Printed literature	Farm Events	Campaigning	Others
Local leader, Leaflets / printing material, Refreshment, Local language, Videos	Clear description Usage, Drop offs in public spaces	Detail information, Methods for usage, Dose.	Demonstrations, Field Visits.	TV/Radio advertisement	Dealer board, Company diary, Pens, Caps, T-shirts, Distributor board

ultimate having bad impression to the product as well as to company.

Lucknow with 31500 lt. have the highest sales of Paclobutrazol followed by Saharanpur 20000 lt. Meerut 8900, Amroha 7500 lt. Bijnore 7300 lt. Muzaffarnagar 5500 lt. and total sales 82700 liters in Uttar Pradesh. So, for the Ichiban first they need to target Lucknow district after that Saharanpur and so on. Factors preferred by the farmers those purchasing chemicals. i.e. Price factor so ICHIBAN has to think price strategy. Target Syngenta share from distributors and dealers to promote our product and to farmers.

At initiation to avoid the cost loss from company, first they need to target the progressive farmer to make more aware and doing a bit of more investment based on the past experience doing wall painting and so on by monitoring which is the best for the company through feedback of dealers and progressive farmers.

Hindrances in Paclobutrazol sales:

1. Farmer compare the product with the price of other competitors.
2. Product do not have any immediate results.
3. Farmer are not aware about the result of the produce as there are no visible results seen in plant.
4. Farmers who grow Mango prefer to use sprayer application of PGR.
5. Lack of trained FDO or subject matter specialist.
6. Lack of proper understanding about the product
7. Lack of product development activities.
8. Lack of awareness among the farmers.
9. The price of produce is very low in market.

Suggestion to grow business

Product : Combo packs of YANKY with other pesticide having high demand in that area. Product literature should be crop wise.

Price : Discount in YANKY for farmers who are buying ICHIBAN product alone with pesticides. Special price for high volume purchase.

Promotion : Gifts for farmers who are having a bulk purchase e.g. Sprayer, spade.

Advertisement: Emotional positioning – “BAHARAT KA MITTI JAPAN KA SHAKTI”

Place : All preferred distributors & dealers in strategically important markets should be covered. Ensure the availability of the product with Distributors & dealers 15 days before the season.

People : Increase the number of field staff and allocate them to cover market as well as village area. High quality and hardworking field staff. Feedback from Ichiban Dealers.

Need field demonstration of company product to enhance product sale.



Need to enhance field staff for better monitor in the field and product demonstration to farmers. If possible, try to make emotional or catchy product name in local name as farmers are unable to pronounce the name. Try to change packaging colour of DOREMON, POKEMON and DANGAL as farmer are hard to differentiate the product.

Key Takeaway

Business understanding of Agri-industry.

Promotional activities to attract customers.

Conceptional of people towards ICHIBAN and various company.

Field knowledge.

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AGRI INCUBATION CENTRE'S : A NEW WAY OF AGRIPRENEURSHIP DEVELOPMENT

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Agri startups are playing an important role in employment generation and capacity building of youth diverting in to agricultural sector. There are immense opportunities for young budding entrepreneurs in the field of agriculture for setting of agri incubation. Investors are also showing their interest in providing finance to the budding people who has some creative ideas which can turn into reality. And, also create some job opportunities in rural areas for the people. Ministries are also playing an important role in capacity building and nurturing them to boost up their business and expand it in the other areas. CCS NIAM is a knowledge partner for RKVY- RAFTAAR for implementing the project in various states and playing an important role in grooming the ideas of budding entrepreneurs and their capacity building. Ministry of Agriculture and Farmers Welfare entrusted the responsibility to CCSNIAM for expanding startup business in India. Four batches have been passed out from NIAM after successful completion of training-cum- capacity building programs and ready to expand their business. The young and energetic people are coming to this field, but in NIAM various retired fellows are also entering in the area of agri startups. It has been learned from the experience that there is a lot of opportunity in agricultural sector for setting up of startups in the sectors of food processing, supply chain of agribusiness, packaging, grading, preparation of pickles, dairying industry, fisheries, horticultural sectors like floriculture, sericulture, organic soil health tonic, fruits and vegetable processing and many more.

The Entrepreneurship

Entrepreneurship is the process of designing, launching and running a new business, which is often initially a small business. *Entrepreneurship* has been described as the “capacity and willingness to develop, organize and manage a business venture along with any of its risks to make a profit.” Entrepreneurship refers to the process of creating a new enterprise and bearing any of its risks, with the view of making the profit. It is an act of seeking investment and production

opportunity, developing and managing a business venture, so as to undertake production function, arranging inputs like land, labour, material and capital, introducing new techniques and products, identifying new sources for the enterprise.

Importance of Entrepreneurship

An entrepreneur is the person who sees a problem in the world and immediately focuses on creating the solution. They're the leaders that strike out on their own to improve society. Whether they're creating jobs or a new product, they constantly take action to ensure world progress.

Entrepreneurs create jobs : Without entrepreneurs, jobs wouldn't exist. Entrepreneurs take on the risk to employ themselves. Their ambition to continue their business' growth eventually leads to the creation of new jobs. As their business continues to grow, even more jobs are created. Thus, lowering unemployment rates while helping people feed their families.

Entrepreneurs create change : Entrepreneurs dream big so naturally some of their ideas will make worldwide change. They might create a new product that solves a burning problem or take on the challenge to explore something never explored before. Many believe in improving the world with their products, ideas or businesses.

Entrepreneurs give to society : While some have this notion of the rich being evil and greedy, they often do more for the greater good than the average person. They make more money and thus pay more in taxes which helps fund social services. Entrepreneurs are some of the biggest donors to charities and nonprofits for various causes. Some seek to invest their money in creating solutions to help poorer communities have access to things we take for granted like clean drinking water and good health care.

Entrepreneurs add to national income : Entrepreneurship generates new wealth in an economy. New ideas and improved products or services from entrepreneurs allow for the growth

of new markets and new wealth to be created in an economy. Adding to that, increased level of employment and earnings add to the national income.

Why Do People Become Entrepreneurs ?

What is entrepreneurship's appeal? With over 400 million entrepreneurs, entrepreneurship has an international appeal. Every entrepreneur has their own 'why' that drove them to dive into being their own boss. Whether entrepreneurs need more freedom or to make the world a better place, they all take control of their life by living life on their own terms. Here are a few of the reasons why people become entrepreneurs :

To change the world : Many entrepreneurs strive to make the world better. Whether entrepreneurs believe in space exploration, eliminating poverty or creating a practical but game-changing product, they ultimately build a brand in service of others. Some entrepreneurs use their business as a way to raise capital quickly to funnel into their noble causes. To social entrepreneurs, building an empire is about creating a better world for everyone.

They don't want a boss : Entrepreneurs often struggle with having a boss. They often feel suffocated, restricted and held back. Some entrepreneurs may feel that they have a more effective way of doing things. Others may dislike the lack of creative freedom. Ultimately, they become attracted to entrepreneurship to succeed on their own terms. Being the boss can be more fulfilling than having one. Check out 10 Obvious Signs You Should Be Working for Yourself.

They want flexible hours : Entrepreneurship is often popular around those who need flexible hours. Many people with disabilities often enjoy entrepreneurship as it allows them to work when they're able to. Parents with young children might also prefer entrepreneurship as it allows them to raise young children at home or pick them up from school without having to feel guilty about it. Students may also like the flexibility of entrepreneurship as their course workload might not allow them to work standard office hours.

They want to work from anywhere : Along with flexibility in working hours, entrepreneurship is popular among those who don't want to be tied down to a specific location. Entrepreneurs might not want to work from the same place every single

day, as it might get boring for them. So, if you're looking for the freedom to work from anywhere in the world, maybe the entrepreneur lifestyle is the right one for you.

They're risk-takers : Calculated risk taking and entrepreneurship go hand in hand. Entrepreneurs don't apply to jobs, they create them. With that comes risk. Whether it's the financial risk of starting your first brand or the risk from not knowing what to expect, business is risky. Entrepreneurs are often taking risks by trying things the average person won't, to do things the average person can't.

They can't get a job : Many stumble into entrepreneurship when they can't get a job. Getting fired, a lack of experience or a criminal record can prevent the average person from getting a job when they're desperate. Instead of being defeated by their situation, they create new opportunities for themselves. A new graduate might start an online store the summer after graduation to build up their resume. A parent who is seasonally laid off each winter might start a business to ensure they can continue feeding their family while keeping a roof over their heads.

They don't fit into the corporate environment : Entrepreneurs don't often thrive in corporate environments. It's often very restricting for their growth. They may dislike the lack of control they have in their role or the office politics. In general, you can spot an entrepreneur in a corporate environment as they're usually trying to gain more control in their role and learning their co-workers responsibilities to better understand how everything fits together.

They're curious : Entrepreneurs love finding out the answer to the question, 'what will happen if...' They're experimental. Entrepreneurs love learning. They regularly read business books to advance their knowledge. So naturally, entrepreneurship appeals to them because doing allows them to learn the most in the shortest amount of time. Their curiosity allows their continued growth.

They're ambitious : Those who love reaching difficult goals and milestones are made to be entrepreneurs. There's no limit to how much an entrepreneur can make and so they can always work to achieve higher levels of greatness. Since there's no limit to what they can achieve,

entrepreneurs constantly find themselves growing and achieving more than they ever imagined. When obstacles get presented in front of them, they find the workaround to their goal. Entrepreneurs are unstoppable.

What Are Entrepreneur Skills?

There are many skills required to start a business. Especially during the early stages of starting a business, entrepreneurs usually have to juggle multiple tasks at one time. That's how they end up learning new entrepreneurial skills. The most popular entrepreneur skills are marketing, business development, customer service, leadership, execution, resilience, focus, determination, talent acquisition, continuous learner. Want to find more popular entrepreneur skills?

Need for entrepreneurship in Agriculture and allied sectors are considered to be the mainstay of the Indian economy. They are the important source of raw material and demand for many industrial products, particularly fertilizers, pesticides, agricultural implements and a variety of consumer goods. They contribute nearly 22 per cent of Gross Domestic Product (GDP) of India. About 60 per cent of the population is dependent on agriculture for their livelihood.

Role of Agri Start-up

With 60 per cent of India's population still engaged in agriculture and allied activities, economists and policy makers often talk about the need for creating new work avenues and industries to shift a major segment of this population out of agriculture.

However, this is not the only solution to the economic woes of India's rural poor. Apart from generating new sources of jobs and income, it is equally important to bring about transformational change in the agribusiness sector to augment incomes, create more sub-industries within the agricultural sector and help the rural poor add to their agricultural resources.

Most agricultural outliers are forced to migrate to nearby towns and cities in search of work, often in the unorganized unskilled sector. This highlights the need for developing more innovative mechanisms in the rural economy that boost employment opportunities in the agri sector. The success of cooperatives in India, particularly Gujarat's Dairy co-operative and Maharashtra's sugar co-operative are examples of what

innovation and entrepreneurial thinking can do for the rural sector. Enterprising young entrepreneurs who have flooded urban India with start-ups in recent years have unfortunately neglected the rural economy. Or to put it this way, entrepreneurs who can transform the face of the rural economy have failed to emerge in rural India. Not only in developing alternative sources of employment, entrepreneurship can also help radicalize farming techniques and bring innovation to improve yields per hectare.

Objectives of RKVY-RAFTAAR Agribusiness Incubators (R-ABI)

- (a) To achieve "Lab to Land" by dissemination of new technology /varieties to farmers through promoting a culture of Agristartups.
- (b) To promote innovation, entrepreneurship and business creation in agriculture and allied sector by skill development, capacity building and technology scale up.
- (c) To create employment opportunities for youth in agriculture in the rural vicinity;
- (d) To promote an integrated approach for technology acquisition, R&D, commercial technology transfer and knowledge dissemination;
- (e) To facilitate evolution of an agri-startup ecosystem by support for cost effective, value added services including technical, legal, financial, intellectual property and regulatory compliance related services to agripreneurs;
- (f) To build a vibrant agri-startup ecosystem, by establishing a network between academia, financial institutions, industries and other related institutions;
- (g) Capacity building of existing agri-incubators as R-ABIs to achieve other related objectives;
- (h) To generate/provide innovative solution to meet local and global agriculture and business challenges, and competitiveness

Time for Agricultural Startups

As discussed above, India today is emerging as a major startup hub with the urban sector giddy with new entrepreneurial energy. Unfortunately, the agricultural sector has remained out-of-ideas and out-of-mind. The government has already initiated to offer attractive incentives including easy loans, insurance schemes and tax benefits to farmers-cum-entrepreneurs.

Developing entrepreneurs in agriculture can immensely benefit Indian economy by

Reducing the burden on agriculture

Generating employment opportunities for rural youth

Reducing the need for migration from rural to urban areas, thereby reducing pressure on urban cities etc.

Increasing individual and national income

Sectors where entrepreneurship can help the agribusiness :

1. Food processing

Agriculture-based industrial products account for half of all exports from developing countries. However, most of them involve exports of raw material as against developed countries whose exports mostly comprise processed goods. By continuing to operate at a low level of value chain, we are losing income and production. An entire food processing industry can be developed in rural areas, augmenting income and employment.

2. Floriculture

In a number of cases flower farming can be done on small tracts of land. In fact, bulks of flowers are cultivated on 'micro farms'. Farmers can utilize a part of their land to cultivate seasonal flowers alongside regular conventional crops.

But, this needs markets in the vicinity or processing and preservation units. Entrepreneurs having knowledge of flower cultivation and marketing can set up parallel industries in fertile rural lands.

3. Pisciculture

Fish farming is practiced by a lot of farmers to augment their incomes. However they do so on amateurish and small scale basis. A conscious business effort to develop small pond fish farms in rural areas can enable pisciculture to become a valuable sector in the rural economy.

4. Farm technology

Dependence on outdated and inefficient technologies lead to poor productivity and low income. While large scale farmers have adopted modern technology on a major scale in India, most small farmers still rely on age-old farming techniques with mostly manual methods.

A number of start-ups have created alternative channels to deliver inputs to farmers at low cost. Agro Star uses data, analytics, and artificial intelligence to power a standalone mobile app, a web service, and a customer call centre where farmers can obtain high-quality products for all of their farming needs. Most small farmers cannot afford to buy farm equipment, so start-ups such as EM3, Oxen, Gold Farm and Trringo are offering on-demand rentals and enabling farmers who own equipment to rent it to others.

Gold Farm, a virtual marketplace for tractors and farm implements, connects farmers who need equipment with farmers who own equipment, using a cloud-based platform that combines IOT-driven, farm-specific data with remote sensing imagery. Most small farmers lack access to collateral-free financing and crop insurance. Using reliable crop analytics, satellite imagery and machine learning, start-ups like Satsure, Amnex and CropIn are offering services that facilitate crop insurance for smallholder farmers that come with reduced premiums and more timely and accurate payouts. These agricultural start-ups, instead of focussing on specific commodities, address systemic bottlenecks in the agricultural sector. As a result, they have the potential to scale up nationwide. The growing maturity of these start-ups can be seen in their increasingly layered business models. Some online input suppliers have started offering financial services, and output procurement platforms are adding advisory services for farmers. This is a positive trend.



EFFECT OF FOLIAR APPLICATION OF MICRONUTRIENTS ON PHYSICAL QUALITY PARAMETERS OF GUAVA (*PSIDIUM GUAJAVA* L.) CV. LALIT

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ABSTRACT

The present investigation entitled “Effect of foliar application of micronutrients on physical quality parameters of Guava (*Psidium guajava* L.) cv. Lalit” was carried out at Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut, U.P. (India) during the year 2018-19. The experiment was laid out in Randomized Block Design having eight treatments with three replications. The details of treatments were as T₁-Control (water spray), T₂-Zinc sulphate (1.0 %), T₃ -Copper sulphate (1.0%), T₄-Borax (1.0%), T₅-Zinc sulphate (1.0 %) + Copper sulphate (1.0%), T₆-Zinc sulphate (1.0%) + Borax (1.0%), T₇-Copper sulphate (1.0%) + Borax (1.0%) and T₈-Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%). The maximum fruit length (7.7 cm), fruit width (7.24 cm), average fruit weight (135.33 g), fruit volume (122.33 ml), specific gravity (1.1 g/cm³) and fruit yield (22.67 kg/tree and 251.85 q/ha) were found in treatment T₈ (Zinc sulphate 1.0% + Borax 1.0% + Copper sulphate 1.0%) whereas the minimum values of above mentioned characters were observed in T₁ (control).

Keywords : *Psidium guajava*, Foliar application, Zinc, Boron and Copper

Guava (*Psidium guajava* L.) cv. Lalit is one of the most important tropical and sub-tropical fruit crops of India, which belongs to the family Myrtaceae. It is native of tropical America, stretching from Mexico to Peru and gradually become a commercial significance level of fruit crop in a several countries. In India, it has been introduced in early 17th century and gradually become a commercial crop all over the country. It is highly tolerant to alkaline and saline soil and it can be grown successfully even up to pH 8.5. It can with stand to the maximum temperature at 46°C, even with scanty annual rainfall of less than 25 cm.

The guava bears flower and fruits on current season growing twigs and highly cross pollinated crop and pollination occurs through insects especially honey bees. Fruits of guava developed from inferior ovary and exhibited double sigmoid growth curve. Fruit is many seeded berry. The fruit takes, nearly 4-5 months from flowering to maturity. The fruits colour change on maturity from dark green to yellowish green. The fruit is highly perishable and seasonal in nature. Mature fruits of guava are rich in vitamins, minerals and other nutrients. Guava fruit is considered as one of the delicious fruit. These fruits are consumed either fresh or processed in the form of products like jam, jelly, cheese, juice, nectar, ready to serve (RTS) etc.

Among the trace elements copper, zinc and boron play significant role in flowering and fruiting process, N-metabolism, hormonal movement and cell division. Boron and zinc increase the fruit set reduce fruit drop and improve fruit quality in various fruit crops (2). The present investigation was, therefore, undertaken to Effect of foliar application of micronutrients on physical quality parameters of guava (*Psidium guajava* L.) cv. Lalit”.

MATERIAL AND METHODS

The study was conducted at Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut, U.P. (India) during the year 2018-19. on five years old guava tree. The treatments comprised of Control (T₁), Zinc Sulphate – 1.0% (T₂), Copper sulphate (1.0%) (T₃), Borax (1.0%) (T₄), Zinc sulphate (1.0%) + Copper sulphate (1.0%) (T₅), Zinc sulphate (1.0%) + Borax (1.0%) (T₆), Copper sulphate (1.0%) + Borax (1.0%) (T₇) and Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%) (T₈). The experiment was laid out in R.B.D. with three replications.

Nutrient application and other orchard management practices were followed as per recommended package and practices for guava. Manure and fertilizer were

Table-1 : Effect of foliar application of micronutrients on physical quality parameters of guava (*Psidium guajava* L.) cv. Lalit.

Treatments	Fruit length (cm)	Fruit width (cm)	Average fruit weight (g)	Fruit volume (ml)	Yield of fruit per tree (kg)	Fruit yield (q ha ⁻¹)	Specific gravity
T ₁ Control	6.59	5.96	97.67	93.33	9.67	107.40	1.04
T ₂ Zinc sulphate- 1.0%	7.19	6.34	116.67	108.00	15.00	166.67	1.08
T ₃ Copper sulphate- 1.0%	6.67	6.32	111.67	105.33	13.00	144.44	1.05
T ₄ Borax - 1.0%	7.22	6.50	117.67	110.67	16.33	181.49	1.06
T ₅ Zinc sulphate (1.0%)+ Copper sulphate (1.0%)	7.28	6.61	119.33	112.33	17.00	188.88	1.06
T ₆ Zinc sulphate (1.0%) + Borax (1.0%)	7.56	7.21	121.67	115.33	21.00	233.33	1.05
T ₇ Copper sulphate (1.0%) + Borax (1.0%)	7.41	6.75	120.67	113.33	19.00	211.11	1.06
T ₈ Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%)	7.70	7.24	135.33	122.33	22.67	251.85	1.10
SEm±	0.01	0.02	0.73	0.58	0.60	6.62	0.01
CD (P=0.05)	0.04	0.07	2.13	1.69	1.74	19.38	0.02

applied in each treatment before flowering in the month of July for taking winter season crop. First spraying of micro nutrients was done before flowering (first week of July) and second after 15 days of 1st spray during 2018.

RESULTS AND DISCUSSION

The results of present study indicated that the combined application of Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%) (T₈) produced the fruits with larger size in respect of length (7.70 cm) and diameter (7.24 cm) which was statistically at par with Zinc sulphate (1.0%)+ Borax (1.0%) (T₆). The increase in fruit size was due to accelerated rate of cell division and cell enlargement and more intercellular space with the application of higher concentration of growth substances. Endogenous auxin is responsible for increasing fruit size in guava. The rapid growth of the fruit synchronized with the maximum amount of auxin present therein. The increase in length and diameter of guava fruit may be due to the combination of micro nutrients (zinc, boron and copper) appears to have direct role in hastening the process of cell division and cell elongation due to which size and weight of fruits would have improved. The results are in conformity with those reported by (1, 3, 4) in guava.

Present findings also revealed that the trees treated with combined spray of Zinc sulphate (1.0%) + Borax (1.0%)+ Copper sulphate (1.0%) (T₈) produced the heaviest fruits (135.33 g) which was statistically at par with Zinc sulphate (1.0%) + Borax (1.0%) (T₆). Increase in fruit weight may be attributed to the strengthening of middle lamella and consequently cell wall, which later may have increase the free passage of solutes to the fruits. The higher fruit weight due to combined application of combination of zinc, boron and copper may be attributed to their stimulatory effect on plant metabolism (3, 5).

Present findings showed that the increasing concentration of micronutrients alone or in combination gave the increased fruit volume over control. Maximum fruit volume (122.33 ml) was recorded with foliar spray of Zinc sulphate (1.0%) + Borax (1.0%)+ Copper sulphate (1.0%) (T₈) which was statistically at par with Zinc sulphate (1.0%) + Borax (1.0%) (T₆). This is due to that the zinc regulates metabolic activities, which increased stored

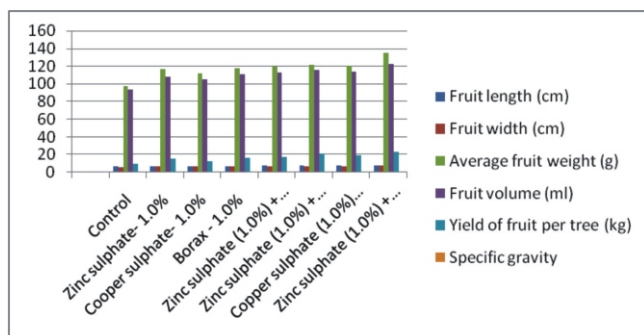


Fig. : Effect of foliar application of micronutrients on physical quality parameters of guava (*Psidium guajava* L.) cv. Lalit

food material in the tissue. These results are in close conformity to the finding of (6, 7).

The specific gravity (1.10) of fruit was highest in Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%) (T_8) which was statistically at par with Zinc sulphate (1.0%) + Borax (1.0%) (T_6) and Copper sulphate (1.0%) + Borax (1.0%) (T_{12}). The specific gravity is generally correlated with composition of tissue such as starch content of tubers, dry matter, juice content and total sugars. Thus, specific gravity of fruit can be used as maturity and quality index in many fruits. The specific gravity of the fruit depends on fruit density which may be affected by total seed contents of the fruit, rainfall and cultural practices. The results are conformity with the finding of (8, 9).

The fruit yield increased successively with the increase in the dose of combined foliar spray of zinc sulphate, borax and copper sulphate and gave maximum yield (22.67 Kg/tree) and 251.85 q/ha with combined application of Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%) (T_8) which was statistically at par with Zinc sulphate (1.0%) + Borax (1.0%) (T_6) and Copper sulphate (1.0%) + Borax (1.0%) (T_7). This was due to fact that borax spraying provides boron to the plant. It was believed that boron brings about inactivation of superfluous growth hormone by formation of complex compound. The importance of this element is improving the physiological activities of plant had been released but it is not clear whether it influenced directly or indirectly. These activities improve length and width of fruit which ultimately increase the yield of the fruit. The results are conformity with the finding of (6).

Further results revealed that the fruit yield was increased due to combined application of both the

nutrients (B & Zn). It might be due to significant increase in the fruit length, fruit diameter and diameter of the seed cavity which might be attributed to their stimulatory effect on plant metabolism and production of auxins. These results are more or less in conformity with the findings reported by (1, 9, 10).

CONCLUSION

The physical characters of guava plants have been significantly influenced by the foliar application of micronutrients. The maximum number of fruit length, fruit width, average fruit weigh, fruit volume, specific gravity and fruit yield were found in with the foliar application of Zinc sulphate 1.0% + Borax 1.0% + Copper sulphate 1.0%, whereas the minimum values of above mentioned characters were observed in T_1 (control). Therefore, it may be concluded that foliar spray of Zinc sulphate (1.0%) + Borax (1.0%) + Copper sulphate (1.0%) can be recommended to the guava growers for obtaining better yield and improve physical parameters of winter season guava fruits.

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A COMPARATIVE STUDIES OF QUALITY CONTROL PARAMETERS FOR *ADHATODA VASICA* NEES., *AZADIRACHTA INDICA* (LINN.) A. JUSS. AND *CALOTROPIS PROCERA* (AITON) COLLECTED FROM ECO-FRIENDLY AND NON ECO-FRIENDLY ENVIRONMENT

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ABSTRACT

Now a day's more demand of herbal drugs are common for disease treatment but lack of Knowledge of proper methodology and availability of herbal drug are promoting the practices of adulteration and substitution. The objective of the present study was to evaluate the quality parameter of samples of *Adhatoda vasica* Nees., *Azadirachta indica* (Linn.) A. Juss. and *Calotropis procera* (Aiton) collected from the Eco-friendly and Non eco-friendly environment. This study has been planned to observe quality control parameters like total ash content, acid insoluble ash, alcohol-soluble extractive and water-soluble extractive. The result of alcohol-soluble extractive and water-soluble extractive of Eco-friendly and Non eco-friendly environment has been found with a comparable difference. The Sample of *Adhatoda vasica* Nees., *Azadirachta indica* (Linn.) A. Juss. and *Calotropis procera* (Aiton) collected from eco-friendly environment showed alcohol-soluble extractive values 9.6%, 17.6% & 16% respectively and the sample of *Adhatoda vasica* Nees., *Azadirachta indica* (Linn.) A. Juss. and *Calotropis procera* (Aiton) collected from Non eco-friendly environment showed alcohol-soluble extractive values 8%, 22.4% & 23%. The Sample of *Adhatoda vasica* Nees., *Azadirachta indica* (Linn.) A. Juss. and *Calotropis procera* (Aiton) collected from eco-friendly environment showed water-soluble extractive values 23.2%, 24% & 25.6% respectively and the sample of *Adhatoda vasica* Nees., *Azadirachta indica* (Linn.) A. Juss. and *Calotropis procera* (Aiton) collected from Non eco-friendly zone showed water soluble extractive values 16%, 18.4% & 32%.

Key Words : *Adhatoda vasica* Nees., *Azadirachta indica* (Linn.) A. Juss. and *Calotropis procera* (Aiton), Quality Control Parameters.

INTRODUCTION

The relationship between plants and man has existed since antiquity and the use of plants as medicines is not new to man (1). *Adhatoda vasica*, also known as Malabar nut tree is part of the Acanthaceae plant family. It is a small evergreen, sub-herbaceous bush which grows commonly in open plains, especially in the lower Himalayas (up to 1300 meters above sea level), India, Sri Lanka, Burma and Malaysia (2). As per therapeutic property it is a good expectorant (3), anti-asthmatic and bronchodilator activity (4), aflatoxin-detoxifying compounds (5), anti-tubercular activity, anti-inflammatory activity and abortifacient (6), easy childbirth delivery (7), antibacterial (8), antihistaminic effect, moderate hypotensive activity, thrombopoietic activity (9), antiulcer (10), antidiabetic activity (11). *Azadirachta indica* A. Juss. Belonging to the family of Meliaceae is an important medicinal plant

used in the Traditional System of Medicine (12). *Azadirachta indica* A. Juss. tall, evergreen trees, native to India, is widely distributed throughout the Indo-Malayan region and is also found in tropical Africa (13). Anti-inflammatory, antipyretic, immunostimulant, hypoglycaemic, and antiulcer properties. It also has pregnancy interceptive, antimalarial, antifungal, antibacterial, antiviral, anticarcinogenic, antihepatotoxic, and antioxidant properties (14&15), analgesic (16). The plant, *Calotropis procera* (of family *Asclepiadaceae*), commonly known as Aak is used in many ayurvedic formulations like Arkelavana (17). It is a xerophytic erect shrub, growing widely throughout the tropical and sub-tropical regions of Asia and Africa. This plant is popularly known because it produces large quantity of latex (18). Analgesic, antitumor, antihelmintic (19), proteolytic, antimicrobial, larvicidal, nematocidal, anticancer, anti-inflammatory (20).

Table 1 : Macroscopic evaluation of AV/1 and AV/2.

Features	AV/1	AV/2
Colour	Dark green to green	Green to yellowish green
Odour	Characteristic	Characteristic
Taste	Bitter	Bitter
Size	9-28cm length and 4-10cm width	12-30 cm length and width 4-10 cm
Shape	Lanceolate	Lanceolate
Margin	Entire	Entire
Apex	Acuminate	Acuminate
Texture	Leathery	Leathery
Venation	Pinnate	Pinnate
Type	Simple	Simple

Table 2 : Macroscopic evaluation of AI/1 and AI/2.

Features	AI/1	AI/2
Colour	Green	Green
Odour	Indistinct	Indistinct
Taste	Bitter	Bitter
Size	4.8-5.2cm in length and 1.1-1.5cm in wide	4-5.2cm in length and 1-1.5cm in wide
Shape	Lanceolate	Lanceolate
Margin	Crenate	Crenate
Apex	Acute	Acute
Texture	Thin Papery	Thin Papery
Venation	Reticulate	Reticulate
Type	Compound	Compound

Table 3 : Macroscopic evaluation of CP/1 and CP/2.

Features	CP/1	CP/2
Colour	Green	Green
Odour	Characteristic	Characteristic
Taste	Bitter	Bitter
Size	6-14.5cm length and 4-10cm width	5-12cm length and 4.5-8cm width
Shape	Ovate	Ovate
Margin	Entire	Entire
Apex	Acuminate	Acuminate
Texture	Rough	Rough
Venation	Reticulate	Reticulate
Type	Simple	Simple

MATERIALS

Chemicals

Hydrochloric acid, methanol, and distilled water used in study were of analytical grade.

Plant samples

Samples of leaves of *A. vasica*, *A. indica* and *C. procera* were collected in early morning during month of April from medicinal plant garden, Dev Sanskriti Vishwavidyalaya Gayatrikunj – Shantikunj, Haridwar, U.K., India. The leaves of same sample were collected from Non Eco-friendly Zone of Haridwar, U.K., India.

All the samples were identified and authorised under the supervision of Department of Applied Medicinal Plants' Sciences, Dev Sanskriti Vishwavidyalaya.

The samples *A. vasica*, *A. indica* and *C. procera* were named as AV/1, AI/1 & CP/1 for eco-friendly zone and AV/2, AI/2 & CP/2 for non-eco-friendly zone respectively.

METHODS

Macroscopic evaluation

The macroscopic evaluation was studied by the method of Trease and Evans (21).

Physiochemical evaluation

The Physiochemical parameters of ash analysis, acid-insoluble ash and extractive values were determined as per standard Ayurvedic pharmacopoeial procedures (22&23).

Ash Analysis

2 gm. of powder was taken into silica crucible previously heated and weighed. The powder was evenly scattered in fine layer on bottom of the crucible. Then the crucible was heated in furnace at a temperature not exceeding 450°C until free from carbon, cooled and weighed. The percentage of total carbon free ash was calculated with reference to air-dried powder.

$$\text{Total ash} = \frac{\text{Ash obtained after calcination}}{\text{Plant material taken (gm)}} \times 100$$

Acid Insoluble Ash

Carbon free ash was boiled with 25 ml of 2 M hydro-chloric acid for 5 min, filtered through ash less filter paper, was washed with hot water, and then the filter paper was dried in oven, ignited in crucible previously weighed, cooled and weighed. The percentage of the acid insoluble ash was calculated with reference to the air-dried powder.

$$\text{Acid Insoluble ash} = \frac{\text{Acid insoluble Material}}{\text{Plant material taken (gm)}} \times 100$$

Determination of Percentage Extractives

About 5 gm. of air-dried powder was macerated with 100 ml of desired solvent such as water and alcohol

specified strength, in closed flask for 24h. The mixture was vigorously shaken at intervals during 6h. After 24h the solution was rapidly filtered without any loss of solvent. Then from the filtrate about 25ml of the solution was evaporated to dryness in a flat bottomed shallow porcelain dish, dried at 100°C and weighed. Then the percentage of solvent was calculated with reference to the air-dried drug.

$$\text{Soluble extractive (\%)} = \frac{\text{Dry extract}}{\text{Plant material taken (gm)}} \times 100$$

RESULT AND DISCUSSION

Macroscopic evaluation

According to World Health Organization, the macroscopic description of a medicinal plant is the first step towards establishing its identity and should be carried out before any other tests are undertaken (24).

Physiochemical Evaluation

The leaves of AV/1 & AV/ 2, AI/1 & AI/ 2 and CP/1 & CP/ 2 were tested for total ash, acid insoluble ash and extractive values, the result of those were presented in Table 4, 5 & 6 respectively. The Physiochemical evaluation of the leaves of AV/1 & AV/ 2 revealed that the leaves had acid-insoluble ash content is more in AV/2 as compared to standard values and results are comparable with the study of (2) and water-soluble extractive content is less in AV/2 as compared to standard values.

The Physiochemical evaluation of the leaves of AI/1 & AI/2 revealed that the leaves had total ash content is more in AI/2 as compared to standard values and

Table 4 : Quality parameters of AV/1 and AV/2

S.No.	Physicochemical Parameter Values	Observed Value AV/1(%)	Observed Value AV/2(%)	Standard Values (%)
1.	Total ash	13%	13.5%	Not More Than 21%
2.	Acid-insoluble ash	0.5%	1.5%	Not More Than 1%
3.	Alcohol-soluble extractive	9.6%	8%	Not Less Than 3%
4.	Water-soluble extractive	23.2%	16%	Not Less Than 22%

Table 5 : Quality parameters of AI/1 and AI/2.

S.No.	Physicochemical Parameter Values	Observed Values AI/1(%)	Observed Values AI/2(%)	Standard Values (%)
1.	Total Ash	9.5%	10.5%	Not more than 10%
2.	Acid-insoluble ash	0.5%	1%	Not more than 1%
3.	Alcohol-soluble extractive	17.6%	22.4%	Not less than 13%
4.	Water-soluble extractive	24%	18.4%	Not less than 19%

Table 6 : Quality parameters of CP/1 and CP/2.

S.No.	Physicochemical Parameter Values	Observed Values CP/1 (%)	Observed Values CP/2 (%)	Standard Values (%)
1.	Total Ash	14.5%	21.5%	Not more than 21%
2.	Acid-insoluble ash	1.5%	2.5%	Not more than 5%
3.	Alcohol-soluble extractive	16%	23%	Not less than 5%
4.	Water-soluble extractive	25.6%	32%	Not less than 24%

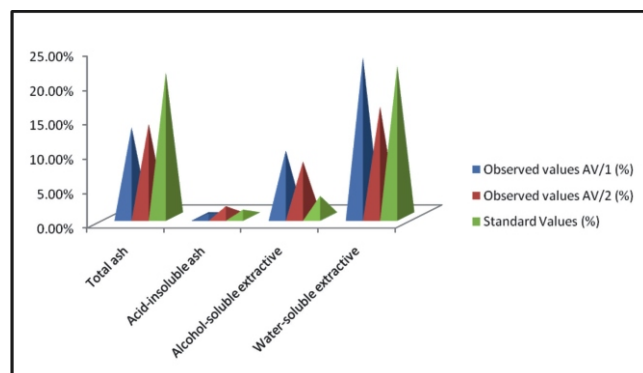


Fig. 1. Comparison of Standard & Observed value of the Quality parameters of AV/1 & AV/2

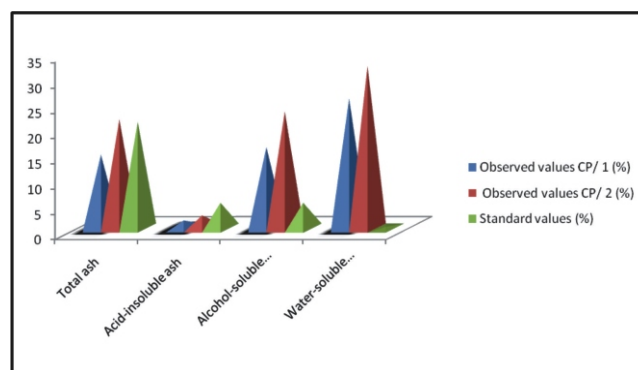


Fig. 3. Comparison of Standard & Observed value of the Quality parameters of CP/1 & CP/2

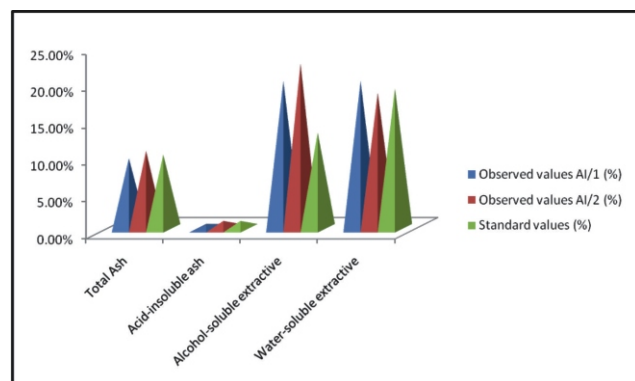


Fig. 2. Comparison of Standard & Observed value of the Quality parameters of AI/1 & AI/2

water-soluble extractive content is less in AI/2 as compared to standard values.

The Physicochemical evaluation of the leaves of CP/1 & CP/2 revealed that the leaves had total ash content is more in CP/2 as compared to standard values and acid-insoluble ash content is more in CP/2 as compared to standard values.

CONCLUSION

The Present study may be useful to supplement information with its standardization and in carrying out further research and revalidation of its use in the Indian System of Medicine; Ayurveda, Siddha, Unani and Homeopathy.

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MULTIFUNCTIONAL AGROFORESTRY SYSTEMS IN INDIA FOR LIVELIHOODS

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ABSTRACT

Agroforestry is emerging as a major land use activity in the country after agriculture and forestry. Traditional resource management adaptations such as agroforestry systems may potentially provide options for improvement in livelihoods through simultaneous production of food, fodder and firewood as well as mitigation of the impact of climate change. Land-use options that increase resilience and reduce vulnerability of contemporary societies are fundamental to livelihoods improvement and adaptation to environmental change. The multifunctional agroforestry systems in tropical region offer innumerable ecological benefits such as carbon sequestration, mitigation of climate change, enhancing soil fertility and water use efficiency, biodiversity conservation, biological pest control, sustainable land use, shelterbelt and windbreaks, microclimate amelioration, breaking the poverty and food insecurity circle, caveats and clarifications. To promote well-being of the society, management of multifunctional agroforestry need to be strengthened by domestication of useful species and crafting market regimes for the products derived from agroforestry systems. Strategy for using appropriate agroforestry systems to facilitate convergence of the synergistic techniques has been propounded for resurgence of sustainable rural livelihoods through natural resource resilience. Millions of farmers are dependent on agroforestry farming systems as a way of increasing and sustaining agricultural productivity, as a source of essential food, fuel wood, fodder and building materials and as a supplementary source of income that buffers instability in agricultural income. As forest resources have become increasingly scarce, poor small farmers have become more dependent on agroforestry systems to sustain their livelihoods. The recommendation for innovative Agro forestry is expected to be an incredible cost-effective option to boost the rural livelihoods of India, which suffer a lot due to multidimensional setbacks.

Key words : Biodiversity Conservation, Agroforestry, Food Security, Climate Change.

INTRODUCTION

Livelihoods security is one of the ultimate determinants of nation's wellbeing and overall development. India has reached very close to a situation where renewability of most of the natural resources has succumbed to the magnitude of overexploitation (1). The gravity of the affair is evident from the fact that livelihood concerns have been expressed in the very first two objectives of the National Environment Policy, 2006 of India (2) which in its very first principles, has recognized human beings as the centre of sustainable development concerns. The ever increasing anthropogenic dependence of the booming populations on ecosystem has outpaced the resilience of the natural resources. There is now ample evidence to establish that poverty reduction and economic growth can only be sustained if natural resources are managed on sustainable basis

(3). A significant segment of India's population, particularly the rural poor, depends on natural resources for subsistence. The livelihood crisis among rural poor in India has basically been fuelled by the incessant decline in productivity of forest and agriculture due to failure of natural resource resilience. A livelihood is a means of deriving a just and dignified living by the society, family and individuals. It comprises of the assets available to households (human, financial, physical, natural and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the society, households or individuals. A livelihood can be urban or rural depending upon the context in which families derive their living. A livelihood can be sustainable when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets both now and in the future, while not undermining the

Table-1 : Regional examples multifunctional agroforestry systems in India.

No.	Region	Challenge	Changes observed due to agroforestry
1.	Himalayas (Kurukshestra)	Improvement of sodic soils	Increase in microbial biomass, tree biomass and soil carbon; enhanced nitrogen availability
2.	Himalayas	Restoration of abandoned agricultural sites	Biomass accumulation (3.9 t ha^{-1} in agroforestry as compared to 1.1 t ha^{-1} in degraded forests); improvement in soil physico-chemical characteristics; carbon sequestration
3.	Western Himalayas	Reducing soil and water loss in agro-ecosystems in steep slopes	Contour tree-rows (hedge rows) reduced runoff and soil loss by 40% and 48% respectively (In comparison to 347 mm runoff, 39 Mg ha^{-1} soil loss per year under 1000 mm rainfall conditions)
4.	Sikkim Himalaya	Enhancing the litter production and soil nutrient dynamics	Nitrogen-fixing trees increased N and P cycling through increased production of litter and influenced greater release of N and P; nitrogen fixing species helped in maintenance of soil organic matter, with higher N mineralization rates in agroforestry systems
5.	Indo-Gangetic plains (UP)	Biomass production and nutrient dynamics in nutrient deficient and toxic soils	Biomass production ($49 \text{ t ha}^{-1}/\text{decade}$)
6.	Himalayas (Meghalaya)	Enhancing tree survival and crop yield	Crop yield did not decrease in proximity to <i>Albizia</i> trees
7.	Western India (Karnal)	Improvement of soil fertility of moderately alkaline soils	Microbial biomass C which was low in rice berseem crop (96.14 gg^{-1} soil) increased in soils under tree plantation (109.12 gg^{-1} soil); soil carbon increased by 11-52% due to integration of trees and crops
8.	Western India (Rajasthan)	Compatibility of trees and crops	Density of 417 trees per ha was found ideal for cropping with pulses
9.	Central India (Raipur)	Biomass production in N & P-stressed soils	<i>Azadirachta indica</i> trees were found to produce biomass in depleted soils
10.	Central India	Soil improvement	Decline in proportion of soil sand particles; increase in soil organic C, N, P and mineral N
11.	Southern India (Hyderabad)	Optimality of fertilizer use	
12.	Southern India (Kerala)	Growing commercial crops and trees	Ginger in interspaces of <i>Ailanthus triphysa</i> ($2500 \text{ trees ha}^{-1}$) helps in getting better rhizome development of ginger, compared to solo cropping

natural capital. Livelihood improvement through natural resource management seeks to understand individual or household strategies through which long-term progress is made towards a better quality of life. Land-use options that increase livelihood security and reduce vulnerability to climate and environmental change are necessary. Traditional resource management adaptations, such as agroforestry systems may potentially provide options for improvement in livelihoods through simultaneous production of food, fodder and firewood as well as mitigation of the impact of climate change. There is a need for intensified conservation efforts as well as growing products and generating services in agro-ecosystems. Tree-growing

in combination with agriculture (agroforestry systems) as well as numerous vegetation management regimes in cultural landscape (ethno-forestry systems), including individual farms, watersheds and regional landscape can be integrated to take advantage of the services provided by adjacent natural, semi-natural or restored ecosystems. Increasing the livelihood security and reducing the vulnerability call for societal adaptation. Such adaptations are possible when combined with traditional resource management systems. Agroforestry as a local adaptation, therefore, is a promising area of interest. This paper examines the multifunctional agroforestry systems in India as a potential option for livelihood improvement, climate

Table-2 : Ecosystem Services.

Ecosystem services	Definition
Provisioning services	Goods, such as food or freshwater, that ecosystems provide and humans consume or use, fuel-wood, fodder, timber, poles etc.
Regulatory	Services such as flood reduction and water purification, other hydrological benefits, micro-climatic modifications provided by agroforestry systems
Cultural	Intangible benefits, such as aesthetic enjoyment or religious inspiration and recreation.
Supporting	Basic processes and functions, such as soil formation and nutrient cycling and biodiversity conservation that are critical to the provision of the first three types of ecosystem services.

change mitigation, biodiversity conservation in agro-ecosystems as well as yield of goods and services to the society. Synthesis of the available literature also helps identify the remaining uncertainties and thus the future directions for research. Traditional resource management adaptations such as agroforestry systems may potentially provide options for improvement in livelihoods through simultaneous production of food, fodder and firewood as well as mitigation of the impact of climate change. The adverse impact of climate change may be more severely felt by the poor, who are more vulnerable than the rich. Appropriate policy responses combining agro-ecosystems as key assets can strengthen adaptation and help build the resilience of communities and households to local and global change.

CURRENT SCENARIO OF AGROFORESTRY IN INDIA

The forest and tree cover of India is 78.92 million ha, accounting for 24.01 per cent of the geographical area (4). Agroforestry is contributing to achieve the national goal, as the desired tree cover, from present less than 25 per cent to 33 per cent, in the country can only be achieved by planting trees in farm field/bunds, especially in states that have low tree cover. Agroforestry has an important role in reducing vulnerability, increasing resilience of farming systems and buffering households against climate related risk in addition to providing livelihood security (5). Agroforestry practices are said to be characterized by four “I” words: intentional, intensive, integrated, and interactive (6). The conservation and management of forests have been strengthened through various policies and legal frameworks, and the management of the forests is now oriented towards watershed function and ecosystem services (7). With the increase in area from 25.32 million ha to 53.0 million ha in the next forty years, agroforestry will be contributing

substantially in meeting the basic needs of the society through increased production and providing environmental benefits (8). Agroforestry supplies almost 72 per cent of the demand of fuel wood, 2/3 of the small timber, 70-80 % wood for plywood, 60-80 % raw material for paper pulp, 9-11 % of the green fodder requirement, besides meeting the subsistence needs of households for food, fodder, fruit, fibre, fuel and medicine etc. (8). Agroforestry can improve soil fertility, provide fodder, produce tree fruits, expand fuel wood supplies and produce a variety of wood products for farmers own use and sale without demanding additional land. Research results from different agro-climatic regions of the country show that the financial returns generated from agroforestry system vary greatly, but are generally much higher than the returns from continuous unfertilized food crops. The higher returns associated with agroforestry can translate into improved house holding nutrition. In next 40 years, it is expected that there will be substantial increase in area under tree cover *i.e.* Tree Outside Forest and a large portion of it will be devoted to agroforestry.

Trees in Agro-ecosystems

Agroforestry systems in India include trees in farms and a variety of local forest management and ethno-forestry practices. India is estimated to have between 14,224 million and 24,602 million trees outside forests, spread over an equivalent area of 17 million ha, supplying 49% of the 201 million tonnes of fuel wood and 48% of the 64 million m³ of timber consumed annually by the country. Forest Survey of India earlier has estimated that 2.68 billion trees outside forests exist over an equivalent area of 9.99 million ha. More recent estimates suggest that an equivalent area of 92,769 km² (*i.e.*, 2.82% of the geographical area) is under tree cover in India. The current growing stock has been estimated to be about 1.616 billion cubic metres. For these calculations the

tree cover has been defined as tree patches less than 1 ha with the canopy density >10%. In some states where good analyses are now available, the Haryana and Kerala are a case in point. With merely 3.5 percent of Haryana's area under forests, the state has become self-sufficient in small wood, fuel wood and industrial timber by establishing large-scale plantations on farmlands. Trees in agro-ecosystems have increased the extent of area under forest and tree cover to 6.63 percent. These plantations sustain about 670 wood-based veneer, plywood and board, manufacturing units, one large paper mill and about 4 300 sawmills that depend on agroforestry produce. Similarly, the case of Kerala suggests that the state has a surplus of 0.027 million m³ of wood in terms of consumption. While the total wood production in the state is 11.714 million m³, the forests provide only about 10 percent and trees in home gardens and mixed cropping multi-tier agroforestry system contribute to the remaining 90 percent. (Table 1)

(9) has categorized the ecosystem services into provisioning service, regulating service, supporting service, and cultural service (Table 2).

Agroforestry for resolving rural livelihood crisis in India

At a stage when the ecological censorship has acclaimed global unanimity, the rationale of deliberation on sustainable land-use through agroforestry, becomes very pertinent (10). A need for diversification in agriculture for improving economy and sustainability has been emphasized (11). Diversification of agriculture by other land use systems like forestry, animal husbandry, horticulture and fisheries etc., also has been envisaged, to make it more lucrative and ecologically sustainable (12). National Agriculture Policy- 2000 underlines a need for diversification in agriculture with the promotion of integrated and holistic development of rainfed areas on watershed basis and augmentation of biomass production through agro and farm forestry with community involvement. Recessions in national forestry and agricultural sectors have necessitated "multifunctional approach to agricultural farming practices" based on integration of interventions like forestry and animal husbandry into conventional agriculture. Indian Economy has been exposed to

challenges due to soaring population, widening demand-supply gap of livelihood essentials i.e. food, fodder, fuel, fruit and variety of NTFPs consequent to natural resource degradation and adverse climate change.

Agroforestry having synergistic integration of several production systems has accorded its' proactive adoption around the world, except India, where the pace of adoption are yet to achieve satisfactory level, due to various factors like predominance of small land holdings, inertia of farmers, complications in harvesting and marketing of timber trees, improper marketing facilities etc. The agroforestry has slowly been gaining ground in India and as per data (13) an area of 111,554 Km² (3.39% of the total geographical area of the country) of the country, is now under agroforestry, which have initiated bio-remediation of the socio-economic and eco-climatic crisis, for reverting rural livelihood sustainability. With a proven credential to boost livelihoods by augmenting agricultural risks, agroforestry enriches the soil by fixing nitrogen by leguminous trees, improves drainage, expedites soil enrichment by steady and efficient nutrient cycling, optimizes land productivity to enhance farming returns. Minimization of economic risks by high income generation and in cropping enterprises is one of the most prominent benefits of agroforestry. It provides long term investment opportunity, diversified land use, commercial tree cropping and best option for absentee landlords besides generating diversified on-farm employment, wood and Non-Wood Forest Produce (NWFP) and raw-material supply to forest based industries. Agroforestry supports large number of forest based industries besides offering lucrative direct returns and employment generation.

Carbon sequestration potential of agroforestry systems

Agroforestry, the practice of introducing trees in farming has played a significant role in enhancing land productivity and improving livelihoods in both developed and developing countries. Although carbon sequestration through afforestation and reforestation of degraded natural forests has long been considered useful in climate change mitigation, agroforestry offers some distinct advantages. The planting of trees along

with crops improves soil fertility, controls and prevents soil erosion, controls water logging, checks acidification and eutrophication of streams and rivers, increases local biodiversity, decreases pressure on natural forests for fuel and provides fodder for livestock. It also has the ability to enhance the resilience of the system for coping with the adverse impacts of climate change. The effectiveness of agroforestry systems in storing carbon depends on both environmental and socio-economic factors; in humid tropics, agroforestry systems have the potential to sequester over 70 Mg/ha in the top 20 cm of the soil. The carbon storage capacity in agroforestry varies across species and geography. Further, the amount of carbon in any agroforestry system depends on the structure and function of different components within the systems put into practice. The fact that agroforestry systems can function as both source and sink of carbon has been presented in literature. There is also clear evidence to suggest that the type of agroforestry system greatly influences the source or sink role of the trees. For example, agrisilvicultural systems where trees and crops are grown together are net sinks while agro silvipastoral systems are possibly sources of GHGs. Practices like tillage, controlled burning, manuring, application of chemical fertilizers and frequent soil disturbance can lead to significant emissions of GHGs. According to the IPCC agroforestry systems offer important opportunities of creating synergies between both adaptation and mitigation actions with a technical mitigation potential of 1.1-2.2 PgC in terrestrial ecosystems over the next 50 years. Additionally, 630 Mha of unproductive croplands and grasslands could be converted to agroforestry representing a carbon sequestration potential of 391,000 MgC/yr by 2010 and 586,000 MgC/yr by 2040. The carbon in the aboveground and belowground biomass in an agroforestry system is generally much higher than the equivalent land use without trees (*i.e.* crop land without any trees). The potential to sequester carbon in aboveground components in agroforestry systems is estimated to be 2.1×10^9 MgCyear⁻¹ in tropical and 1.9×10^9 MgCyear⁻¹ in temperate biomes. Agroforestry systems can have indirect effects on carbon sequestration as it helps decrease pressure on natural forests that are the largest sinks of terrestrial carbon, they also conserve soils and thus enhance carbon storage in trees and soils. Effects

of agroforestry practices on the soil carbon pool indicated a rate of increase by 2-3 MgC/ha/yr. Estimations of carbon sequestration potential in various studies report an estimated potential of 6.3GtC and 0.7-1.6 GtC. The carbon sequestration potential of agroforestry systems has been established theoretically; however field measurements to validate these concepts are limited. The inherent variability in the estimates of potential carbon storage in agroforestry systems and the lack of uniform methodologies has made comparisons difficult. Few studies of specific agroforestry practices have proved potential for carbon sequestration.

Biodiversity conservation

The agro-ecosystem biodiversity can be affected due to abandoning traditional, locally adapted crop varieties and intercropping for high yielding monocultures (14, 15). Generally, agroforestry systems are closer to the natural forest systems (16). Agroforestry helps in conservation of ecosystem through improving soil and microclimate properties, reduced erosion, improved water quality and carbon sequestration (17, 18, 19, 20). Farmers practice agroforestry for gaining livelihood, income generation, risk management, food security and optimal use of available land, labour and capital (21). It is estimated that about 1.2 billion people (20%) of the world population depends directly on agroforestry products and services in developing countries which can provide goods and services, that can offset 5-20 per cent of deforestation (22, 23). Agroforestry represents the pinnacle of sustainable development and plethora of its uses has made it closer to the people. Many effective conservation organizations are now including agroforestry as a component in their programmes. In general, agroforestry plays five major roles in conserving biodiversity : (1) provides habitat for species that can tolerate a certain level of disturbance; (2) helps preserve germplasm of sensitive species; (3) helps reduce the rates of conversion of natural habitat by providing a more productive, sustainable alternative to traditional agricultural systems that may involve clearing natural habitats; (4) provides connectivity by creating corridors between habitat remnants which may support the integrity of these remnants and the conservation of area-sensitive floral and faunal species; and (5) helps conserve biological diversity by

providing other ecosystem services such as erosion control and water recharge, thereby preventing the degradation and loss of surrounding habitat (24). Agroforestry systems are considered as diversity enhancing land use system especially in the context of inter-species diversity as it brings together crops, shrubs, trees and in some cases livestock on the same piece of land (25). Agroforestry plantings provide expanded habitat for a wide range of species, from soil micro life to insects to mammals and have diversified and intensified agro-ecosystems to maintain and enhance biodiversity (26). Agroforestry systems have potential to support as high as 50-80 per cent of biodiversity of comparable natural system (27). Agroforestry conserve biodiversity within deforested, fragmented landscapes by providing habitats and resources for plant and animal species. It makes the landscape less harsh for forest dwelling species by reducing the frequency and intensity of fires and providing buffer zones to the protected areas (28). Agroforestry systems had bat assemblages that were as (or more) species-rich, abundant, and diverse as forests, contained the same basic suite of dominant species, but also contained more nectarivorous bats than forests. Agroforestry systems also harboured bird assemblages that were as abundant, species-rich, and diverse as forests. (29) reported species richness of tropical home gardens varying from 27 (Sri Lanka) to 602 (West Java). In an extensive survey of floristic and structural diversity of 402 home gardens from six regions across south western Bangladesh, Kabir and Webb (2009) reported 419 species (59% native), including six species of conservation concern. (30) have reported 122 species in home gardens of Barak valley of Assam, India. Similarly, 68 species were found in home gardens of Karnataka (31) and 127 species in Kerala (32). 74 species of different plants had been reported in the home gardens of North Bengal in addition to poultry, various milch and meat animals which are linked socially and economically to the owner (33) In addition to biodiversity conservation, agroforestry provide food security and enhances farm income through enhancement in the yield of products and services from biodiversity rich agro-ecosystems. In Indonesia 4 million of agroforestry not only yield rubber of US \$ 1.9 billion but also contain 250-300 spp. of plant (34, 35). In San Jose-the Milpa, three types of traditional agroforestry systems *viz.*,

slash-and-burn agriculture, cacao cultivation under shade trees and home gardens were found to meet the entire family requirements of food and wood and generated 62 per cent of family income in Maya community of Belize (36). (37) recorded 44 woody and 49 herbaceous species in the traditional agroforestry system of Tripura, North East India and these documented plants meets community day to day needs of food, timber as well as ethno-medicinal purposes. In addition to plant diversity, agroforestry systems also play an important role in increasing microbial, avian and faunal diversities. The greater diversity of birds and insect in agroforestry systems provide the beneficial service of pest reduction to adjacent crops (38, 39). Trees grown with crops improve the insect pest management options by providing habitat that can foster populations of natural enemies. (40) estimated natural enemy populations that live in natural and semi natural areas adjacent to farmlands can control more than 90 per cent of potential crop insect pests. (41) observed that cover crops (e.g. annual legumes and grasses) sustained lady beetles (Coleoptera: Coc-cinellidae) and other arthropods that are useful in the biological control of pests in pecan. (42) reported that earthworm densities were greatest next to poplar and white ash tree-rows, due to greater litter contributions.

Enhancing soil fertility and water use efficiency

Ecological intensification of cropping systems in fluctuating environments often depends on reducing the reliance on subsistence cereal production, integration with livestock enterprises, greater crop diversification, and agroforestry systems that provide higher economic value and also foster soil conservation. Maintenance and enhancement of soil fertility is vital for global food security and environmental sustainability. Although currently India is self-sufficient in terms of food production, for a population expected to rise further, the country will need to enhance both food production as well as tree biomass. The next green revolution and concurrent environmental protection will have to double the food production. Maintaining and enhancing the soil fertility of farmlands to grow food grains as well as tree biomass can help meet the demand in future. Ecologically sound agroforestry systems such as intercropping and mixed arable-livestock systems can

increase the sustainability of agricultural production while reducing on-site and off-site consequences and lead to sustainable agriculture. In regions where the green revolution has not been able make a dent due to lack of soil fertility, agroforestry may hold promise. A useful path, complementary to chemical fertilizers, to enhance soil fertility is through agroforestry. Alternate land-use systems such as agroforestry, agro-horticultural, agro-pastoral and agro-silvipasture are more effective for soil organic matter restoration. Soil fertility can also be regained in shifting cultivation areas with suitable species. For instance, a field experiment to study N_2 fixation efficiency suggests that planting of stem-cuttings and flooding resulted in greater biological N_2 fixation, 307 and 209 kg N ha⁻¹ by *Sesbania rostrata* and *S. cannabina* respectively. Thus, *S. rostrata* can be used as a green manure by planting the stem-cuttings under flooded conditions. Through a combination of mulching and water conservation, trees in agro-ecosystems may directly enhance crop yields of coarse grains. For instance, in the arid region of Haryana, the effect of *Prosopis cineraria*, *Tecomella undulata*, *Acacia albida* and *Azadirachta indica* on the productivity of *Hordeum vulgare* (barley) was found to be positive. *P. cineraria* enhanced grain yield by 86.0%, *T. undulata* by 48.8%, *A. albida* by 57.9% and *A. indica* by 16.8% over the control. Biological yield was also higher under trees than that in the open area. Soils under different tree canopies were rich in organic carbon content, moisture availability and nutrient status. Recent studies have found that multiple-use species such as *Bambusa nutans* have the potential to help in soil nutrient binding during restoration of abandoned shifting agricultural lands (jhum fallows) in Northeastern India under *B. nutans*. A comparison of jhum cultivation and agroforestry suggests that the latter is an option to address the challenges of slash-and-burn. A study of nutrient cycling, nutrient use efficiency and nitrogen fixation in *Alnus*–*Cardamom* plantations in the eastern Himalaya found that nutrient standing stock, uptake and return were highest in the 15-yr-old stand. Annual N fixation increased from the five-yr-old stand (52 kg ha⁻¹) to the 15-yr-old stand (155 kg ha⁻¹) and then declined with advancing age. Thus, *Alnus*–*Cardamom* plantations performed sustainably up to 15–20 years. There is robust evidence that agroforestry systems have the potential for improving water use efficiency

by reducing the unproductive components of the water balance (run-off, soil evaporation and drainage). Examples from India and elsewhere show that simultaneous agroforestry systems could double rainwater utilization compared to annual cropping systems, mainly due to temporal complementarity and use of run-off in arid monsoon regions. For instance, a combination of crops and trees uses the soil water between the hedgerows more efficiently than the sole cropped trees or crops, as water uptake of the trees reached deeper and started earlier after flood irrigation than that of the Sorghum crop, whereas the crop could better utilize topsoil water. Integration of persistent perennial species with traditional agriculture also provides satisfactory drainage control to ameliorate existing outbreaks of salinity. Agroforestry systems can also be useful for utilization of sewage-contaminated wastewater from urban systems.

Biological pest control

Agroforestry systems create a landscape structure that is important for biological pest control. In small-scale, subsistence agriculture in the tropics, traditional farming practices have evolved that provide a sustainable means of reducing the incidence and damage caused by pests, including nematodes. The biodiversity inherent in multiple cropping and multiple cultivar traditional farming systems increases the available resistance or tolerance to nematodes⁴⁸. In structurally complex landscapes, parasitism is higher and crop damage lower than in simple landscapes with a high percentage of agricultural use.

Breaking the poverty and food insecurity circle

Agroforestry could contribute to livelihood improvement in India, where people have a long history and accumulated local knowledge. India is particularly notable for ethno-forestry practices and indigenous knowledge systems on tree-growing. In terms of household income, Central Indian upland rice fields provide an illuminating economics. The farms often have an average of 20 *Acacia nilotica* trees per ha, of 1 to 12 years of age. Small farms have more tree density. At a ten-year rotation, these trees provide a variety of products, including fuel wood (30 kg/tree), brushwood for fencing (4 kg/tree), small timber for farm implements and furniture (0.2 m³), and non-timber forest products such as gum and seeds.

Thus, trees account for nearly 10% of the annual farm income – distributed uniformly throughout the year than in rice monoculture – of smallholder farmers with less than 2 ha farm holding. A combination of *Acacia* and rice traditional agroforestry system has a benefit/cost (B/C) ratio of 1.47 and an internal rate of return (IRR) of 33% at 12% annual discount rate during a ten-year period. In the northeast Indian State of Meghalaya, guava and Assam lemon-based agrihorticultural agroforestry systems (*i.e.* farming systems that combine domesticated fruit trees and forest trees) gave 2.96 and 1.98-fold higher net return respectively, in comparison to farmlands without trees. Average net monetary benefit to guava-based agroforestry systems was Rs 20,610/ha (US\$ 448.00) and to Assam lemon-based agroforestry systems, Rs 13,787.60/ha (US\$ 300.00). Such systems are most useful livelihood improvement strategies in the rain fed agriculture of Meghalaya. Similarly, the net present value for the different agroforestry models on six-year rotation in Haryana varied from Rs 26,626 to Rs 72,705 ha⁻¹ yr⁻¹, whereas the B/C ratio and IAR varied from 2.35 to 3.73 and 94 to 389% respectively. Thus, agroforestry has not only uplifted the socio-economic status of farmers, but also contributed towards the overall development of the region. There are numerous non-timber forest products collected from wilderness for subsistence and cash income. Often, harvesting is unsustainable because of lack of knowledge about silviculture of species and destructive exploitation strategies driven by market forces. Domestication of such species aimed at commercialization and production of valued products can reduce the pressure on natural ecosystems. Domestication of forest fruit trees and other species grown in agroforestry systems offers significant opportunity for livelihood improvement through nutritional and economic security of the poor in the tropics. The wild edible plants form an important constituent of traditional diet in Sikkim Himalaya, where about 190 species are eaten and almost 47 species are traded in local market. Wild edible fruit species have high carbohydrate content ranging between 32 and 88%. Such fruit trees can be taken up for domestication in agro-ecosystems on priority action. Trees in agroforestry systems can provide host to globally valued products and thus support livelihoods locally. A study of the 8-yr-old agroforestry intervention in Palamau District,

Jharkhand found that the community depended solely on rainfed farming and animal husbandry definitely gains positively by agroforestry interventions. Suitable community plantations of non-timber forest products in tribal areas such as Jharkhand can potentially serve the dual purpose of conserving useful species as well as livelihood improvement of local people. Such programmes in tribal areas have enhanced likelihood of success as communities are dependent on the wild resources for livelihood. In Jharkhand, trees in agro-ecosystems are particularly valued as host to insects that yield marketable products such as silk, lac products and honey. Woodcarving industry is emerging as an important source of income to local artisans worldwide. Promotion of species used in woodcarving industry facilitates long-term locking-up of carbon in carved wood and supports local knowledge. It therefore strengthens livelihoods. For example, Jodhpur, Rajasthan has emerged as a major centre of woodcarving, exporting woodcraft worth Rs 60 million annually, facilitated by traditional knowledge and skill, and growing tourism. Suitable agroforestry programmes may enhance the availability of wood in agro-ecosystems, thereby improving the ability of developing countries to participate in the growing global economy.

AGROFORESTRY FOR SUSTAINABLE LAND USE

Agroforestry is an age-old practice. Trees and shrubs are important in the traditional farming systems of the tropics, where woody species form a major component of the bush fallow system and are also widely grown in cropped land. Trees and shrubs benefit the farmer in three main areas :

1. Direct agricultural benefits (plant stakes, mulching materials, green manure, animal fodder and so on),
2. Environmental benefits (shade, soil erosion control, nutrient recycling, carbon sequestration and so on) and
3. Socioeconomic benefits (saleable commodities like timber, fruits, vegetables, cereals, building materials, and so on).

An economic and ecological interaction exists between the tree and non-tree components of the agroforestry system. It has not only benefited farmers, it also supplies raw material to the wood industry, generate

employment of various kinds thus benefiting millions in related economic activities like transportation, wholesale, retailing etc. It helps consumers with an affordable supply of wood and contributes to import substitution for timber and timber related products, which India imports worth thousands of crores of rupees a year. Agroforestry is as good, if not better, than degraded forests for environmental improvement, pollution control, etc., especially as it can be initiated in farmers' holdings in villages and nearer to urban conglomerations.

The Future

Although numerous issues are involved as discussed here, agroforestry systems are of multifunctional value. In India and other developing countries the path to sustainable development could be a decentralized planning and implementation of strategies that promote local biomass production in agroforestry systems. Such decentralized systems in India can provide critical inputs for livelihoods improvement and sustainable development. Along with mitigating the climate change agroforestry systems can at least partially meet the energy needs of 1 billion people in India through bioenergy options by a prudent use of agricultural residues and biomass generated in agroforestry systems. Biomass energy-based supply options can create rural wealth and employment necessary for livelihoods improvement and sequester large amount of carbon in a decentralized manner. Such a strategy would also ensure ecological, economic and social well-being. Thus, energy and food self-sufficient taluka (a small administrative unit) can be a new model of rural development in India. Agroforestry options for carbon sequestration are although attractive, as discussed earlier, they presents critical challenges for carbon and cost accounting due to dispersed nature of farmlands and dependence of people on the multiple benefits from agroforestry. Additionally, important concerns regarding monitoring, verification, leakage and the establishment of credible baselines also need to be addressed. Another challenge is incentives that promote tree-growing by rural people. Not everyone is willing to adopt agroforestry. We shall need effective strategy for connecting science to decision making to extend innovations among the people to adopt and maintain agroforestry.

In conclusion, in order to use agroforestry systems as an important option for livelihoods improvement, climate change mitigation and adaptation, and sustainable development in India, research, policy and practice will have to progress towards: (i) effective communication with people in order to enhance the agroforestry practices with primacy to multifunctional values; (ii) maintenance of the traditional agroforestry systems and strategic creation of new systems; (iii) enhancing the size and diversity of agroforestry systems by selectively growing trees more useful for livelihoods improvement; (iv) designing context-specific silvicultural and farming systems to optimize food production, carbon sequestration, biodiversity conservation; (v) maintaining a continuous cycle of regeneration-harvest-regeneration as well as locking the wood in non-emitting uses such as woodcarving and durable furniture; (vi) participatory domestication of useful fruit tree species currently growing in the wilderness to provide more options for livelihoods improvement; (vii) strengthening the markets for non-timber forest products, (viii) and addressing the research needs and policy for linking knowledge to action. Prevalence of a variety of traditional agroforestry systems in India offers opportunity worth reconsidering for carbon sequestration, livelihoods improvement, biodiversity conservation, soil fertility enhancement, and poverty reduction.

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EFFECT OF ULTRAVIOLET RADIATION ON PLANTS

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INTRODUCTION

Plants use sunlight for photosynthesis and, as a consequence, are exposed to the ultraviolet (UV) radiation that is present in sunlight. UV radiation is generally divided into three classes: UV-C, UV-B, and UV-A. The UV-C region of the UV spectrum includes wavelengths below 280 nm; these highly energetic wavelengths are effectively absorbed by ozone in the stratosphere and, thus, are not present in sunlight at the earth's surface. UV-C wavelengths will be removed from the light reaching the earth's surface so long as there is any ozone present (1). In contrast, UV radiation in the UV-B region, from 280 to 320 nm, does reach ground level. The UV-B portion of sunlight has received much attention in recent years because irradiation from this spectral region (especially 297 to 310 nm) will increase as the stratospheric ozone concentration decreases (2). Currently, ozone decreases result from chlorofluorocarbon contamination of the stratosphere. UV wavelengths from 320 to 390 nm, which make up the UV-A region of the spectrum, are not attenuated by ozone, so their influence will be unaffected by ozone layer reduction.

Like all living organisms, plants sense and respond to UV radiation, both the wavelengths present in sunlight (UV-A and UV-B) and the wavelengths below 280 nm (UV-C). All types of UV radiation are known to damage various plant processes. Such damage can be classified into two categories: damage to DNA (which can cause heritable mutations) and damage to physiological processes. There has been much speculation about how increased UV radiation exposure will affect plants, but as yet, there are no definitive answers. In this review, I will discuss the kinds of damage that UV radiation can inflict on plants, the mechanisms plants use to perceive and respond to UV radiation, and the ecological relevance of UV light

wavelengths that have been used in the experimental analysis of plant responses to UV radiation.

DNA DAMAGE AND REPAIR IN PLANTS

UV-C radiation has been used as a mutagenic agent in plants, and it is known to reactivate the maize *Mutator* transposable element. To prevent mutation and/or cell death, UV radiation-induced DNA damage must be repaired before DNA replication. Repair of UV radiation-induced lesions may be of particular importance in plant pollen, especially in wind-pollinated species. DNA damage must also be repaired to allow transcription.

Although UV-C damage is not physiologically relevant for plants growing in the sun, short-wavelength (UV-C) radiation from germicidal lamps has often been used to study DNA damage in animals and bacteria, as well as in plants. UV-C has been used because DNA has a strong absorption maximum in the UV-C range (at 260 nm); UV-C photons are highly energetic, and high levels of damage can thus be created quickly. Also, high-output UV-B radiation sources and spectroradiometers are expensive.

The best-studied UV radiation-induced DNA lesion is the cyclobutane-type pyrimidine dimer (CPD). Other types of DNA damage are the pyrimidine(6,4) pyrimidone dimer, diverse rare DNA photoproducts, and indirect types such as DNA-protein crosslinks and singlet oxygen damage (Peak and Peak, 1986). Several investigators have measured CPD DNA damage directly in plants or in plant cell cultures, but no other types of UV radiation-induced DNA damage have been reported in plants.

UV radiation-induced DNA damage can be repaired by three mechanisms: photoreactivation, excision repair, or recombination repair (Smith, 1989; Kornberg and Baker, 1992). CPDs can be repaired by all three methods, but the other UV radiation-induced DNA



lesions can be repaired only by excision or recombinational repair.

During photoreactivation repair, CPDs are monomerized by the enzyme photolyase. One distinctive characteristic of photolyases, including those that have been detected in plants (McLennan, 1987; Pang and Hays, 1991), is that they require 370 to 450 nm radiation as an energy source. Thus, CPD-type DNA damage is implicated in any UV radiation response that can be reversed by irradiation with 370 to 450 nm “photoreactivating” radiation. By this criterion, CPD formation is involved in UV-C-induced coumestrol production in *Phaseolus* (Beggs et al., 1985), induction of chromosomal aberrations in barley root tip cells (Cieminis et al., 1987), induction of DNA repair synthesis in petunia pollen (Jackson, 1987), and the inhibition of anthocyanin production in sorghum internodes (Hashimoto *et.al.*, 1991). Photoreactivation can be confirmed by measuring the concentration of UV radiation-induced CPDs before and after 370 to 450 nm light treatment; these measurements have not been reported for any of the above plant studies.

Other types of UV radiation-induced DNA base damage can be repaired by excision. Excision repair



can be divided into three steps: nicking of the damaged DNA near the site of the damage, removal of multiple bases in the damaged strand, and resynthesis to fill the gap. Excision has been measured in plant cells (McLennan, 1987), and an endonuclease that nicks DNA that contains CPDs has been partially purified from carrot cells (McLennan and Eastwood, 1986).

The third type of DNA repair, recombinational repair, has not been reported in plants. In this repair pathway, DNA lesions are bypassed during DNA replication, and the resulting gaps are filled in later using information from the sister duplex (Kornberg and Baker, 1992). Because most DNA replication in plants occurs in apical meristems and the surrounding cells, which are usually shielded from the sun by many layers of tissue, recombinational repair may not be particularly important in the repair of UV radiation damage in plants. Other, as yet undiscovered, repair strategies may exist in plants.

PLANT PHYSIOLOGICAL RESPONSES TO UV-B RADIATION

Many different plant responses to supplemental UV-B radiation have been observed (Tevini and Teramura, 1989). The best studies have increased UV-B levels to simulate conditions that would exist with a defined reduction in the ozone layer (typically 10 to 20%). As a control, the same lamps are shielded with a plastic film that absorbs all UV-B wavelengths. Thus, all parts of the spectrum except the UV-B region are held constant. Although with this system it is possible to determine whether a response results from supplemental UV-B, the mechanism by which that response occurs may not be obvious. For instance, changes seen after supplemental UV-B radiation include biomass reductions (Tevini *et.al.*, 1981; Lydon *et.al.*, 1986; Sullivan and Teramura, 1988), decreases in the percentage of pollen germination (Flint and Caldwell, 1984), changes in the ability of crop plants to compete with weeds (Barnes *et.al.*, 1990), epidermal deformation (Tevini *et.al.*, 1981), changes in cuticular wax composition (Tevini and Steinmuller, 1987), and increased flavonoid levels (Tevini *et.al.*, 1981, 1991a; Beggs and Wellman, 1985).

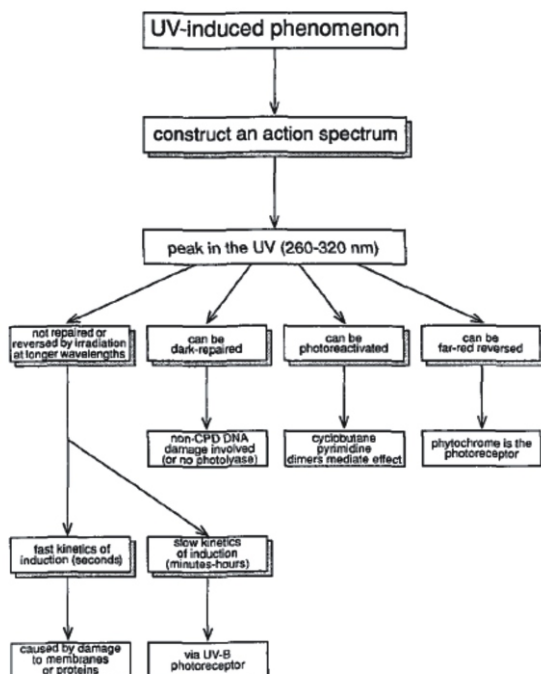
These changes could result from any number of primary UV-B events: DNA damage, direct photosynthetic damage, membrane changes, protein



destruction, hormone inactivation (Tevini *et al.*, 1989, 1991b), signal transduction through phytochrome (which photoconverts in response to UV-B) (Pratt and Butler, 1970), or signal transduction via a UV-B photoreceptor. To determine precisely which factor or factors are involved, the action spectrum (*i.e.*, the level of response at each wavelength) and the kinetics of the response must be established. Figure 1 outlines some steps in determining the mechanism of action of a particular UV radiation response. Fluence-response curves are necessary to create an analytical action spectrum that can identify the chromophore involved (Coohill, 1992). Even if no one factor can be identified as the cause of a UV-B-induced effect (for example, if the action spectrum for plant growth has multiple overlapping peaks), a complex action spectrum can be used to estimate the change expected from a given amount of ozone depletion. Measurement of the lag time between irradiation and appearance of a response can provide information about the mechanism of the response. For example, direct DNA damage is detectable shortly after irradiation, whereas chalcone

synthase (CHS) gene expression requires many minutes.

Some detailed mechanistic information is available for five UV-B responses: photomorphogenesis, auxin inactivation, ATPase destruction, photosynthetic damage, and flavonoid induction. Photomorphogenesis is a radiation-induced change in plant form. UV-B enhancement alters the growth of several plant species but does not reduce shoot dry weight (Barnes *et al.*, 1990). An action spectrum of the first positive phototropism (curvature) of the alfalfa hypocotyl has demonstrated that UV-B contributes to the response; plants were kept in red light to isolate this response from the similar response through phytochrome (Baskin and Lino, 1987). A cucumber mutant that lacks light-stable phytochrome (Lopez-Juez *et al.*, 1992) has also been used to measure photomorphogenesis after UV-B treatment; UV-B inhibits hypocotyl growth (Ballare *et al.*, 1991). However, because this mutant has some residual phytochrome function (Whitelam and Smith, 1991), the action of phytochrome in this UV-B response cannot be excluded. In the experiments with cucumber,



shielding the actively growing tissues from UV radiation did not affect the magnitude of the decrease in hypocotyl length, so direct effects on cell division or elongation would not explain the UV-B-induced growth inhibition. Recovery after return to uninducing conditions was rapid, again suggesting a true photomorphogenic response to UV-B.

Another UV radiation response is the inhibition of epidermal cell elongation in sunflower seedlings by UV-B and UV-C radiation (Tevini *et al.*, 1989). This inhibition results from the photooxidation of indoleacetic acid to 3-methylenoxidol, which inhibits hypocotyl elongation. The inhibitory effects of photooxidation of indoleacetic acid were seen in vitro and in vivo (Tevini *et al.*, 1989).

A third UV radiation response for which there is some mechanistic information is the destruction of a rose cell plasma membrane ATPase by UV-B radiation. The action spectrum of this response peaks at 290 nm (Murphy, 1983), and the fluence-response curve shows that this response occurs at fluences that are typical of sunlight (Imbrie and Murphy, 1984). The inactivation of ATPase probably results from singlet oxygen-mediated destruction of tryptophan residues in the ATPase protein (Imbrie and Murphy, 1984).

Another well-studied response to UV-B radiation is

damage to the photosynthetic apparatus. Photosystem II is the UV-B-sensitive component, but the action spectrum of the UV-B effect does not suggest a specific target molecule (Renger *et al.*, 1989). Damage is assessed by measuring the increase in variable chlorophyll fluorescence; an increase in fluorescence can be observed after doses of UV-B radiation in the physiologically relevant range (Tevini *et al.*, 1991a).

Perhaps the most general plant response to UV-B radiation is activation of the flavonoid biosynthetic pathway. Flavonoids and/or anthocyanins are induced by UV-B exposure in all 14 plant species tested (Tevini *et al.*, 1981; Beggs and Wellman, 1985). Flavonoids and anthocyanins absorb UV radiation, and they generally accumulate in the epidermis, where they could keep UV radiation from reaching photosynthetic tissues (Hahlbrock and Scheel, 1989). The epidermis blocks transmittance of 95 to 99% of incoming UV radiation (Robberecht and Caldwell, 1978). Induction of flavonoids in rye seedlings can prevent UV-B-induced damage to photosynthesis (Tevini *et al.*, 1991a), which suggests that UV radiation protection is one of the functions of these pigments. This could be tested directly using mutants that are defective in the accumulation of flavonoids.

How does UV radiation activate flavonoid expression? Possible receptors for anthocyanin and flavonoid induction after UV-B exposure have been analyzed in sorghum and parsley. The action spectrum for anthocyanin induction in sorghum has several maxima, indicating that both phytochrome and a separate UV-B photoreceptor are involved in anthocyanin induction. There is no peak in the blue region of the spectrum, ruling out the involvement of a blue light



photoreceptor. The action spectrum peak (263 nm) for anthocyanin inhibition is photoreactivatable, and this inhibition does not involve phytochrome (Hasimoto *et al.*, 1991). Phytochrome, a blue light photoreceptor, and a UV-B photoreceptor have all been shown to be involved in flavonoid induction in parsley (Bruns *et al.*, 1986); in fact, a white light source that contains all these wavelengths is usually used to induce parsley flavonoids. Feeding riboflavin to parsley cells increases the UV-B induction of CHS, a key enzyme in the flavonoid biosynthesis pathway. This result suggests that the UV-B photoreceptor might be a flavin (Ensminger and Schafer, 1992).

Deletion analysis of the CHS promoter has identified a DNA segment that is responsible for light induction of this gene (Schulze-Lefert *et al.*, 1989; Block *et al.*, 1990). A protein that binds to this DNA segment has also been characterized (Weisshaar *et al.*, 1991). DNA elements in the CHS promoter that allow UV radiation inducibility have also been characterized in petunia and *Antirrhinum* (Staiger *et al.*, 1989; van der Meer *et al.*, 1990). These DNA elements have in common only a motif that is present in the promoters of many plant genes, not just in light-inducible genes. We still know little about the signal transduction pathway between interception of UV radiation photons and induction of flavonoid biosynthetic gene expression.

Responses to UV-B are also induced by other biotic and abiotic stresses. For example, genes that encode enzymes involved in early steps of flavonoid and phytoalexin biosynthesis, including phenylalanine ammonia-lyase and CHS, are induced by both fungal elicitors and wounding, as well as by UV radiation (Fritzscheier *et al.*, 1983; Hahlbrock and Scheel, 1989). In the case of CHS induction in parsley, fungal elicitor treatment is epistatic to the UV radiation induction (Lozoya *et al.*, 1991), and heat shock overrides both of these (Walter, 1989). CHS may be an integrative branchpoint in phenylpropanoid metabolism.

USE OF UV-C AS A MODEL DAMAGING AGENT

Is UV-C radiation an acceptable model for more ecologically relevant wavelengths in studies of DNA repair or other plant responses? Action spectra for DNA damage in *E. coli* are biphasic in the UV-B range, with a short-wavelength, UV-C-type contribution

(from direct DNA damage) and a long-wavelength contribution (from indirect DNA damage) (Peak and Peak, 1986). Provided that UV-B induces both direct and indirect damage in plants as well, and given that UV-C induces direct damage only, UV-C is not a good substitute for UV-B. For example, in animal cells, the contribution of CPDs to total DNA damage falls from 90% at 254 nm to about 50% at 313 nm and to nearly zero at 350 nm (Kantor, 1985).

There is as yet no information about the relative proportions of direct and indirect damage at various wavelengths in plants. However, for higher plants living in sunlight, photoreactivating wavelengths are present in sunlight at such high fluence that few CPDs should accumulate, provided that the plants contain photolyase. Even if there is a severe depletion of the ozone layer, resulting in increases in the level of shorter wavelength radiation reaching the earth's surface, photoreaction capacity is sufficient to eliminate CPDs before permanent DNA damage occurs (Beggs *et al.*, 1985). This suggests that direct, non-CPD DNA damage and indirect DNA damage are more ecologically relevant, but these types of damage are not the major products of UV-C radiation. Detection of repair processes in plants should not be affected by these differences, but measurements of repair capacity will be biased when UV-C is used to induce damage. If these limitations are acknowledged, UV-C can be used as a model radiation for studies of certain types of DNA damage and repair in plants.

Is UV-C a useful model for plant responses to UV radiation other than DNA damage and repair? Some UV radiation responses have been measured in both the UV-C and UV-B regions of the spectrum, including tissue damage (Bornman *et al.*, 1986), induction of carotenoids and polyamines (Tevini and Teramura, 1989; Kramer *et al.*, 1991), damage to the photosynthetic apparatus (Kulandaivelu and Noorudeen, 1983), phototropism (Baskin and Lino, 1987), ATPase destruction (Murphy, 1983; Imbrie and Murphy, 1984), unscheduled DNA synthesis in pollen (Jackson, 1987), and anthocyanin and flavonoid induction in parsley, sorghum, and peanut callus (Wellman, 1971; Fritzscheier *et al.*, 1983; Hashimoto *et al.*, 1991). In each case, the response to UV-C differs from the UV-B effect. In the case of tissue and photosynthetic damage, qualitatively different

responses to the two types of UV radiation were observed. In the studies of phototropism and ATPase destruction, two separate activities were found, one responsive to UV-C and one to UV-B. Furthermore, UV-C and UV-B have opposite effects on carotenoid levels (Tevini *et.al.*, 1981; Campos *et.al.*, 1991) and anthocyanin levels (Hashimoto *et.al.*, 1991). Therefore, as a general rule, UV-C is not a useful model for physiological responses induced by UV-B.

FUTURE DIRECTIONS

Although many plant responses to UV radiation have been reported, complete mechanistic details of most of these responses have not been elucidated. Certain types of analysis are necessary to fully understand any UV radiation response; a decision tree for analyzing what mechanisms mediate an induction is presented in Figure-1. An action spectrum is critical in defining which chromophore (DNA, a UV-B photoreceptor, cryptochrome, or phytochrome) may be involved and whether more than one chromophore mediates the response. A kinetic analysis is also crucial. The length of the lag time before the appearance of the response can indicate whether the response results directly from photon interaction with a target (e.g., CPD formation) or from changes in gene expression. Other important parameters include determining whether the response can be photoreactivated (if it can, it probably involves CPDs), whether excision repair of the DNA (in the dark) can reverse the effect (in which case it would involve non-CPD DNA damage, provided there is photolyase present), and whether the effect is far-red reversible, a feature diagnostic of phytochrome involvement.

An additional, important approach to dissecting plant responses to UV radiation is genetic. Mutants that are defective in one or more responses to UV radiation and second-site suppressors of these mutants will be very useful in defining the steps in the signal transduction pathway. One step in this direction is a *Chlamydomonas* mutant that has no photoreactivation capacity (McLennan, 1987). Arabidopsis mutants with increased or decreased sensitivity to UV-B radiation have been found by several laboratories; it would be helpful to have a UV-B photoreceptor mutant analogous to the blue light photoreceptor mutant (Khurana and Poff, 1989).

Increased UV radiation levels from ozone layer reduction will reach plants, and plants will respond. Much more work will be required to define the exact mechanisms of the various UV-B-induced responses. Even with mutants, sound physiology will be required to fully understand each response. Thus, the action spectra and kinetics of any UV-B response should be analyzed. In particular, action spectra of the various kinds of DNA damage and more information about photosensitizers and other ways to produce indirect DNA damage are needed. In addition, many compounds that act as photosensitizers come from plants, but very little is known about the effects of such endogenous photodamaging molecules (Spikes, 1989). It would also be useful to know more about DNA repair mechanisms-rates, capacity, and what enzymes repair what kinds of damage. Finally, two unexplored areas concern tissue and developmental differences in UV radiation responses and how tissue responses are integrated to increase plant survival.

CONCLUSION

This type of damage another disease DIEBACK but damage cannot be recovered. In case of damage due to U.V radiation , the damage is recovered soon.

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PACKAGING : CUSTOMER'S PREFERENCE FOR SUSTAINABLE SUPPLY CHAIN

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ABSTRACT

Today environmental pollution is the main problem which we face every day .To overcome this problem, the production houses should include concepts of Green in to their supply chain. Environmental concern has become an important factor these days, so we are in need of practicing supply chain concern towards environment. People with increase in environmental concerns leads to the attention to concept of Green Supply chain management. The supply chain revolution of the 1990s has made it evident that the business best practices call for integration of environmental management with ongoing operations. In early 1990's the environmental impacts of production were the main reason for commitment to the greening of supply chain management. Nowadays people are getting more conscious about the issues of environmental and food security. They are keen to know about the whole process of product manufacturing of their company and how green their supply chain is. Green Supply chain management includes procurement, transportation, packaging, and reverses logistics. This paper highlighted the customer's overview about the manufacturing of the product. As the use of plastic is a major problem across the globe and people are concerning more about their health so they prefer the companies who are sustainable to their whole process of manufacturing. For this a small survey is done about the concern of customers for the sustainability of the product. The paper is specially targeted on the packaging of companies.

Key words : environmental, sustainable, green supply chain management, manufacturing, food security, packaging, procurement, transportation, reverses logistics.

INTRODUCTION

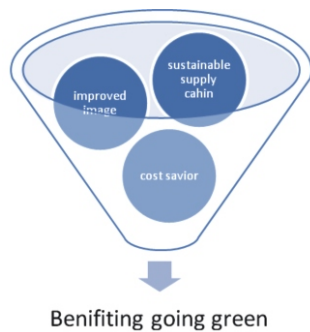
As the time has changed and environment concern is the top most priority of everyone so there is a need to adopt such methods which are eco friendly and beneficial to the environment. In earlier days only separate organization units has a responsibility on their shoulder for ensuring the excellence in the development of product , the ongoing process , several operations, logistic process, several operations , marketing and waste management. Today the thing has changed. After the revolution of 1980's and the supply chain revolution of 1990's, it is become necessary to adopt GSM in the ongoing operations. GSM has gain lot of interest because of the rapid deterioration of environment and high level of pollution. It has become the alarm situation to everyone whether it's a manufacturer or customer to adopt GSM in the supply chain management. GSM has got a great attraction among manufacturer, researcher and also to the customer also as it practices and integrate environment on each and every level of product process. Buying raw material, logistic. Packing, transport, at each and every step environment

has kept in mind. It's manufacturer responsibility to take care of GSM when they are planning the product design , buying raw material, , overall process, logistic etc but manufacturer has a external pressure also to attain sustainable solution because of the customers demand and requirement.

In the U.S.A., an estimated 75% of consumers claim that their purchasing decisions are influenced by a company's environmental reputation, and 80% would be willing to pay more for environmentally friendly goods. Customer has shifted their demand to those product which follow GSM practices. the main part of the GSM as the customer get the idea of the company by their packaging of the product. Customers demand for food safety is concern very much so they want their food packaging in such a way that it fulfills the environment safety for example the food should be packaged in such a way that it can be recycle or it should not be in plastic and should be easily disposable.

Profiting From Being Green

Going green is not beficiable to customer, it is also benefited to manufacturer also-



1. Sustainable Supply Chain

By sustainable supply chain a company gets more customers as the company is giving what they want by spending as little money as possible while accomplishing that. Many in the supply chain world assume that fast, low-cost supply chain options are incompatible with a green supply chain. This, however, may not be the case. That's because green initiatives can often be cost savers. For example when waste is minimized, so too are the costs associated with purchasing and disposal.

2. Improved Public Image

The more green your supply chain practices, the more it become a public relations and marketing boon. If customers know that you're saving the planet x-number of tons of packaging material.

3. Cost savior

Designing and implementing a greener supply chain is truly a win-win-win scenario for your company because waste is driven from it. When waste is driven from your supply chain (or any process), the cost of that process is reduced. When costs are reduced - everybody's happy. Consumers will notice, too, and you might see other positive benefits.

Customer's view for sustainability

RESEARCH METHODOLOGY

In this study 250 people are surveyed. Purposive sampling was done for the survey. Questionnaire was prepared to answer the questions. Some questions are dichotomous and some are descriptive. Survey was done to study the behavior of plastic packaging of their food. If plastic is used for the food how do customer react on that. How much customer is concern for the food safety?

Type of customer	Concern for food	Not concern for food
Professional	80%	20%
Home maker	60%	40%

For the study both professional and home maker are studied. It is found in the study that 80% professionals have tendency to check the packaging of food whenever they buy or order something online but they do not return it if it is in plastic because of no other option. But yes they want to buy their food to be safe.

Customers are even ready to pay more for their food safety. 60 % of home makers are concern for the food safety because of the awareness. But yes, they want their food to be safe. 40% of home maker are not aware of the packaging of their food.

Interpretation

Study shows that customer shows their concern for food safety. Packaging of food safety ratio is quite good. Customers are even ready to pay more for it. Customer's demand obviously makes pressure on manufacturer to manufacture food plastic free. It's not about the producer or other organization to bear it but today customers are also ready to contribute to safe their planet.

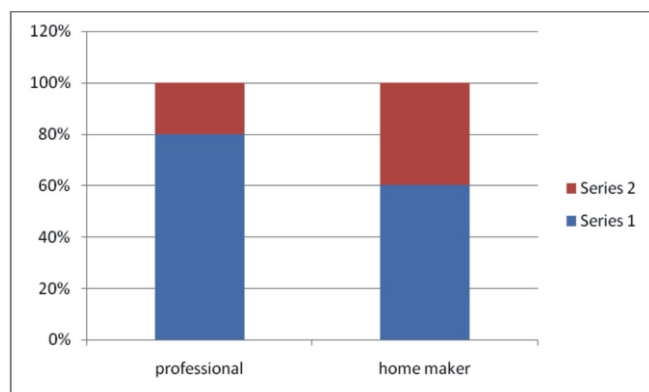
Government's efforts for sustainability

Understanding the precarious situation, the Government of India go through a series of activities and events that aim to generate substantial public interest as well as participation.

Initiatives like pan-Indian plastic clean-up drives across public spaces, national reserves and forests along with simultaneous beach clean-up activities are in the series. However, many breakthrough moves have already been initiated by various states across the country to cut down plastic consumption.

Here are some initiatives taken across the country where municipalities, the state administration and the common public joined hands to tackle the plastic crises at their own level.

1. Mooted by the Suchitwa Mission the idea envisioned by the concerned authorities was to make government departments set an example for a clean environment. Government offices in Kerala made the switch to ink pens and steel cutlery to ensure articles



like plastic water bottles, disposable teacups and plastic carry bags are no longer used across the office premises.

2. As per a brilliant initiative helmed by Kerala's Suchitwa Mission, 28 fishermen from the Neendakara harbour have been engaged in not just finding fish but also plastic that either gets stuck in the fishing nets or floats in the sea. In last 10 months since the project was launched, they have managed to recover 25 tonnes of plastic waste.

3. Maharashtra, earlier this year, became the first state to ban use of all kinds of single-use plastics. On March 23, 2018, it announced the ban on manufacture, usage, transport, distribution, wholesale and retail sale and storage and import of plastic bags with handle and without handle, and the disposable products manufactured from plastic and thermocol (polystyrene) such as single-use disposable plastic products used for packaging food in hotels, non-woven polypropylene bags used to store liquid, plastic packaging of fresh food items and food grain material etc.

CONCLUSION

The use of plastic is indeed a problem that is central to existence on earth and requires immediate collaborative action before it is too late to save our planet. Whether a producer or a customer all have to make take hand in hand to face the challenge. Customer awareness and demand can pressurize produce to produce only that thing which is eco friendly and good for their health.

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PLANT CELL CULTURE—A POTENT TOOL TO ENHANCE THE CROP PRODUCTIVITY AND HELPS FARMERS TO GENERATE EXTRA INCOME

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ABSTRACT

In the present era Biotechnology is emerging as powerful tool in different area of modern science including agricultural biotechnology including many others, of them plant tissue culture is playing a pivotal role to increase quality and enhance production. Commercialization aspect of plant tissue culture technology cannot be ignored as it will help to boost the farmer's income. Many scientific institution and universities are playing leading role for quality improvement and yield enhancement in different cereals, medicinal and ornamental crops. Present paper is an efforts to highlights the major role of plant biotechnology and cell culture technology to boost farmers income.

Key words : Plant cell culture, Biotechnology, Commercialization, Farmer's income.

INTRODUCTION

Agriculture continues to play a leading role in the socio-economic development of India. Due to this reason, the Government of India has prioritized this sector, and strategically supported it as the main driver towards achieving the country's development goals. Despite this policy support, the yield and production of many crops, for example, has remained stagnant over the last couple of years. The stagnation in production has been attributed to many factors; key among them are decline in soil fertility, climate change, diseases, pests and limited availability of disease resistant varieties.

Biotechnology provides powerful tools for improvement of agricultural productivity hence increasing food security in countries like India with land limitations. One of the most important tools utilized in biotechnology is tissue culture, which has many advantages, one being the large numbers of disease-free planting materials that can be propagated within a short time and space. Others include round the year production of planting materials, higher survival chance of tissue culture plantlets in the field, uniformity in growth and significant increase in yield and quality, making this propagation method the most amenable to commercial agriculture.

Biotechnology program was introduced in 1986 in India under the umbrella of establishment of DBT by Government of India. Since then, a lot has been

achieved, as shown below, not just in tissue culture but also in another research theme on plant diseases diagnostics and/or characterization. In essence, therefore, the program implements projects/activities geared towards utilizing modern technologies to improve agricultural productivity hence increasing food security. Since then many institutes, colleges and centers were established in different parts of country that participated in biotechnological research including plant cell culture research. They are contributing in development of elite germplasm which helps in the quality and yield enhancement.

Role of biotechnology to enhance farmer's income

Recent breakthroughs in biotechnology have led to rapid progress in understanding the genetic basis of living organisms, and the ability to develop products and processes useful to human and animal health, food and agriculture, and industry. In agriculture, there is increasing use of biotechnology for genetic mapping and marker-assisted selection to aid more precise and rapid development of new strains of improved crops and livestock. Other biotechnology applications such as tissue culture and micropropagation are being used for the rapid multiplication of disease-free planting materials. New diagnostics and vaccines are being widely adopted for the diagnosis, prevention, and control of animal and fish diseases.

Biotechnology has given us a new tool to improve food security and reduce poverty. This development is encouraging since the Green Revolution technologies,

which have doubled food production and reduced poverty during the past four decades, have already run their course in entire India. Conventional breeding, widely used during the Green Revolution era, no longer provides needed breakthroughs in yield potentials, nor the solution to the complex problems of pests, diseases, and drought stress. That is particularly true in the rainfed areas where the poor are concentrated. The challenge is how to use new developments in biotechnology together with information technology and new ways of managing knowledge to make the complex agricultural systems of Asia more productive and sustainable.

Biotechnology, broadly defined, includes any technique that uses living organisms, or parts of such organisms, to make or modify products, to improve plants or animals, or to develop microorganisms for specific use. It ranges from traditional biotechnology to the most advanced modern biotechnology. Biotechnology is not a separate science but rather a mix of disciplines (genetics, molecular biology, cell culture, biochemistry, embryology, and cell biology) converted into productive processes by linking them with such practical disciplines as chemical engineering, information technology, and robotics. Modern biotechnology should be seen as an integration of new techniques with the well-established approaches of traditional biotechnology such as plant and animal tissue culture, food production, fermentation products and processes, and production of pharmaceuticals and fertilizers.

Emerging biotechnologies present a new era in technical change in agriculture worldwide. Agricultural biotechnology with the extensive use of plant tissue culture provides new methods for responding to world food production problems. Many of the commodities important to developing countries are largely ignored in the private biotechnology research programs of industrialized countries, so public efforts are needed to ensure that the promise of increased food and fiber production can be made a reality for those who need them most. One objective of the Agricultural Biotechnology for sustainable productivity is to mutually enhance institutional capacity for the use and management of biotechnology research to develop environmentally compatible, improved germplasm (Bio Link, 1991). The crop plants of today had their origins in the fields of early farmers who selected plants with desirable traits and maintained cultivars to meet agricultural needs. Controlled matings

(hybridization) of plants through the sexual process is the cornerstone of classical plant breeding. By repeated hybridization and selection, new traits have been introduced into varieties already proven successful in agriculture. However two major limitations exist with classical plant breeding. The first is an extraordinarily large degree of variability from which a low frequency of desired plants must be identified. Second, the gene pool is generally limited to the same or closely related species. Much of modern biotechnology is devoted to overcoming these limitations, by speeding up the reproduction of elite plants of known desirable genetic characteristics, and by identifying useful genes and finding techniques to introduce them into plants that could not occur through classical breeding.

The key components of modern biotechnology are

(i) Genomics : The molecular characterization of all genes in a species.

(ii) Bioinformatics : The assembly of data from genomic analysis into accessible forms, involving the application of information technology to analyze and manage large data sets resulting from gene sequencing or related techniques.

(iii) Transformation : The introduction of one or more genes conferring potentially useful traits into plants, livestock, fish and tree species.

(iv) Genetically improved organism.

(v) Genetically modified organism (GMO).

(vi) Living modified organism (LMO).

(vii) Molecular breeding : Identification and evaluation of useful traits in breeding programs by the use of marker-assisted selection (MAS);

(viii) Diagnostics : The use of molecular characterization to provide more accurate and quicker identification of pathogens; and

(ix) Vaccine technology : The use of modern immunology to develop recombinant deoxyribonucleic acid (rDNA) vaccines for improved control of livestock and fish diseases.

Plant tissue culture research status

Apart from carrying out research for development on the two core themes of tissue culture and plant diseases diagnostics and/or characterization, biotechnology program has set out a wider and cross-cutting goal of establishing/upgrading research infrastructure for

agricultural research scientists to conduct cutting-edge research for development. For the past many years, some tissue culture laboratories that were earlier constructed were upgraded and/or expanded. These are linked to a good number of screen houses and soil-less aeroponic systems to handle plantlets coming from them. As time went by, after establishing the program, there was a strategic decision to upgrade a plant pathology laboratory help in monitoring of planting materials from tissue culture laboratories for diseases and, more importantly, carry out research on disease diagnostics/characterization to understand their nature the farming systems, especially the epidemics. Plant cell culture technique may provide a way to enhance yield of crop plants such as Banana, Sugar cane, vegetables and ornamental species.

Enhancing productivity through development and dissemination of cell culture technologies

Tissue culture is the *in vitro* culture of plant parts under sterile conditions and controlled environment in order to generate whole plants (plantlets). Plant regeneration is normally through two pathways: somatic embryogenesis and micro-shoot induction. Somatic embryogenesis refers to the direct formation of embryos from cells.

Tissue culture has been practiced for thousands of years as a means of regenerating large numbers of whole plants from cuttings or slips as an alternative to propagation from seeds. Biotechnology has resulted in the development and use of hormones and nutrient media to enable recalcitrant species to be regenerated and otherwise improve tissue culture. Micropropagation is a type of tissue culture in which plant cells are cultured in the laboratory to multiply them and their constituent genes. The multiplied cells can then be used to produce literally millions of regenerated genetically identical plantlets for distribution to plant breeders or farmers.

During the past seven years, biotechnology program carried out research to develop and optimize tissue culture protocols for *in vitro* production of disease-free superior varieties of vegetatively propagated crops. Many protocols have been developed for sugarcane, potato, banana, wheat and carnation at SVPUA&T, Meerut and many other cell culture laboratories of the country. These are now ready use to produce (commercial production), and disseminate, disease-free planting materials for these crops. For example, the nucleus stock (mother stock) used to produce the larger part of potato seeds produced in the

country comes from tissue culture. This is the same thing with banana, albeit at a lower level than potato. For example, about few thousand plantlets of potato plantlets have been produced and injected in the downstream supporting mass production systems involving a soil-less aeroponics)and screenhouse minituber (pre-basic seed) production in many parts of the country. Since these have a multiplier effect on production of seed, the end result is tens of millions of disease-free seeds produced and disseminated to farmers. Specifically, aeroponic system is far superior since one plantlet from a laboratory can yield 50 minitubers compared to only 6 produced under the conventional screen house system.

Although banana tissue culture has not produced the same amount of plantlets as potato, it has produced enough nucleus stock to be used in a downstream production system called macro-propagation, which massively produces plantlets for re-distribution to farmers. As a matter of fact, this technology, together with the aeroponic system for potato has been disseminated to farmers and other private investors in India through training. Improved banana varieties produced by tissue culture have played a key role in aiding rehabilitation and improvement of banana plantations across the country.

Facilitating plant diseases management through accurate diagnosis and characterization

Plant diseases have, for the last couple of years, been one of the major causes of crop losses in India. This has been exacerbated by the recent phenomenon of negative effects of climate change. Empirical evidence suggests that understanding of diseases plays a central role in their management. It is actually common sense that you cannot fight an enemy you have no information on. Biotechnology program coordinates research activities aimed at understanding the nature of diseases attacking crops in our farming systems through their characterization using advanced modern scientific tools. After understanding them, the program then crafts diagnostics protocols for routine disease surveillance across the country. Surveillance is especially critical for new disease outbreaks to curtail their further spread to non-affected areas.

Disease diagnostics is also employed to ensure quality control in any tissue culture laboratories. This is done through indexing of plantlets leaving laboratories, screen houses and right before they are distributed to farmers; basically the entire seed value chain. This helps to ensure that all the planting materials

distributed to farmers are disease free. Thus, the program handles plant diseases on two fronts: indexing planting materials at research stations and diagnosing disease problems from farmers' fields.

Future Strategies to enhance crop production

The Indian Government has made substantial investments in biotechnology research so far. Bringing Indian biotechnology products to market will require substantial investments from Indian and overseas investors. The worldwide trend is that large companies are becoming major players in developing biotechnology products and in supporting product-related biotechnology research.

In the years ahead, biotechnology R&D should produce a large number of new, genetically improved plant varieties in India, including cotton, rice, brassica, pigeonpea, mungbean, ornamentals and wheat. Tissue culture regeneration protocols for important species such as mango, saffron, citrus, and ornamentals will lead to major commercial activities. Micropropagation technology will provide high-quality planting materials to farmers. It is hoped that environmentally friendly biocontrol agents and biofertilizer packages will be made available to farmers in such a way that they can produce them in their own fields. The country should be in a position to fully exploit medicinal and aromatic plants on a sustainable basis.

The establishment of *ex situ* gene banks to conserve valuable germplasm and diversity; and a large number of repositories (referral centers for animals, plants, and microorganisms) should be possible. Information technology and biotechnology together should become a major economic force. It is expected that plants functioning as bioreactors could produce large numbers of proteins of therapeutic value, and many other important items.

CONCLUSION

To achieve the goal of self-reliance in modern biotechnology R&D, India will require a strong educational and scientific base; clear public understanding of the value of new biotechnologies, and

involvement of society in many of these ventures. India has a large research and educational infrastructure comprising more than 60 agricultural universities, 300 central and state universities, and more than 600 national laboratories and research institutions. It should therefore be possible to develop capabilities and programs so that these institutions act as regional hubs for the farming community, obtaining direct feedback from farmers about new technological interventions. It will be equally important to establish strong partnerships and linkages with industry, from the time of the discovery until the packaging of the technology and commercialization are achieved.

Modern tissue culture facilities were developed in 2007 with the department of Agricultural Biotechnology at SVP University of Agriculture & Technology, Meerut. Due to this reason, there is a great scope for mass propagation of disease-free plants in several important vegetatively grown crops such as sugarcane, banana and carnation in future.

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BIOTECHNOLOGICAL TECHNIQUE FOR IMPROVEMENT OF ORNAMENTAL CROPS

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ABSTRACT

Plant biotechnology plays an important role in mass production of improved crop varieties as well as their genetic improvement. It develops business processes and products, using recombinant DNA, gene transfer, embryo manipulation, plant regeneration, cell culture, monoclonal antibodies and bio-processed engineering, and biologically active substances such as food additives, dyes, pharmaceuticals, Helps in the production of bio-Pesticides for the benefit of man and society. The development of techniques of molecular classification through RAPD and RFLP in genomic analysis and classification has opened up new options for germplasm characterization of ornamental plants such as roses, haptiolas, orchids, ornamental pods, anthurium, gerbera, gulgenvia and cut-offs. genetic engineering. Flowers (pink to white chrysanthemum) become easier. Transgenic plants are now available in haptiolus, petunia, rose, carnation, orchids, gerberas, etc. Bioreactor technology is the need of the hour which can cut the cost of production of plants. It is clear to develop new varieties produced by cross-hybridization, mutation breeding and reverse mutation or in combination through genetic mutations. Secondary metabolites from cell culture have been established for the synthesis of codeine (*Papaversomniferum*), quinine (*Cinchona liturgiana*), pyrethrin (*Crescentheim urn cineraphyrium*), taxol (*Taxisbactata*), rutculin (*Rata spans ..*) and bain and papain. Somatic embryogenesis is a powerful tool for the improvement of jewelery, not only in relation to the spread of clots, but also for other biotechnological applications. It has been successfully used in crop improvement, such as Enthurium, Alstroemeria, Hadiolus, Iris, Lilium etc. Artificial (encapsulated) seeds contain somatic embryos, which are covered with a protected gel, also known as somatic embryogenesis. Ovule culture is now applied in Freesia for the production of embryonic culture and interspecific hybrids in Alstroemeria, in Alstroemeria and Cyclamen. Thus, it is clear that the application of various strategies to biotechnological approaches offers immense opportunities for improvement in ornamental plants.

Keywords : Plant Biotechnology, Alstromeria, Cyclamen, RAPD, RFLP

INTRODUCTION

Biotechnology is broadly defined as any technology that uses living organisms. Bacteria, viruses, fungi, yeast, animal cells, plant cells, etc. to make or modify a product. It makes plants and animals or engineered microbes better for specific uses to make products of value to humans and society. It develops commercial processes and products using techniques of recursive DNA, gene transfer, embryo manipulation, plant regeneration, cell culture, monoclonal antibodies and bio-processed engineering.

Plant biotechnologies play a very important role in ornamental gardening through various biotechnological methods such as microbial, genetic modification, genome sequencing, molecular breeding, bio reactors and plant architectural modification. It has wide applications of ornamental gardening. Providing

resistance to various abiotic and biotic stresses, creating novel colors, creating luminescent flowers, delaying, developing fragrant flowers, changing flower characters, producing biologically active substances, such as food additives, dyes, pharmaceuticals, Biopesticides, etc.

Applications of biotechnological methods in floriculture

Micropropagation: Micropropagation or tissue culture has wide applications in ornamental horticulture for its preservation and conservation of genetic resources, improvement as well as multiplication and propagation of virus free plants. *Anthuriumandreanum* and *Ascherzianum* are two ornamentals widely propagated through tissue culture. Micropropagation protocols for various foliage plants, rose, bougainvillea etc. have also been standardized. Success of the micro-propagation pilot plants in India have been

achieved by Tata Energy Research Institute in New Delhi, National Chemical Laboratory in Pune, A.V. Thomas & Co. (AVT) at Manalaroo (Kerala), ITC Agro Tech, Kerala, Indo-American Hybrid Seeds (IAHS), Bangalore, Southern Petroleum Chemical Industries Corporation (SPIC), Euro-India Biotech Ltd. in collaboration with Haryana Agro-Industries Cooperation. These institutions functions as Micro-propagation Technology Parks which serve as a platform for the effective transfer of technology to the entrepreneurs, training and the demonstration for mass multiplication of horticulture crops and trees.

Production of Virus-free Plants : About 10 per cent of viruses transmit through seeds. In some cases, they are confined to seed coat (e.g. TMV) or internally seed-borne (in legumes). Tissue culture technique can be utilized for the production of virus free plants using meristem culture or chemotherapy.

Multiplication : Rapid multiplication of rare and elite genotypes independent of season, it is faster than seed propagation, dioecious species can be favourably

availability of material for export and germplasm exchange.

Preservation/conservation : Germplasm preservation or conservation is important in plant improvement and for conservation of important genes. Tissue culture is an attractive alternative for maintaining germplasm of important floriculture crops that are vegetatively propagated or those in which male sterility exists as it facilitates germplasm exchange, helps in quarantine, minimizes storage areas requirements and generates disease and pest free plant materials. Meristems protect against pathogens and diseases and natural environmental hazards for easy germplasm exchange, shipment and plant quarantine and germ protection for long term storage. Germplasm conservation and characterization of flower crops for conservation of plant genetic resources. Maintenance of field gene banks *i.e.* in-situ conservation of germplasm is very difficult and risky. For safe movements of germplasm, the in vitro technique is very easy. The development of techniques of molecular taxonomy RAPD and RFLP in genomic analysis and classification has opened up new options for germplasm characterization.

Improvement : Improving somaclonal variation, embryonic and oval culture, protoplast culture, floriculture through somatic hybridization, other culture reduces time and cost for different types of development. Haploid generation through ether and pollen culture helps to increase homogeneous plant populations in a shorter time frame, which also helps in artificial selection during crop improvement because they are phenotypically similar. New flies developed through the double halo system are related in some crops. The production of homogenous dual haploid lines saves four years as compared to the conventional method. Fetal rescue enables distant success in cases where the fetus is miscarried. Somaclonal variation leads to growth of plants with improved characteristics, which are beneficial and which can be further grown into varieties. Somatic embryos can form from any gametophytic or sporophytic tissue in embryonic, nuclear cells, integuments (rutaceae), or even epidermis, parenchymatic cells of petioles, secondary phloem. Selection at the cellular level for disease resistance, salt tolerance, herbicide tolerance, cold tolerance, metal toxicity tolerance, disease eradication, etc.

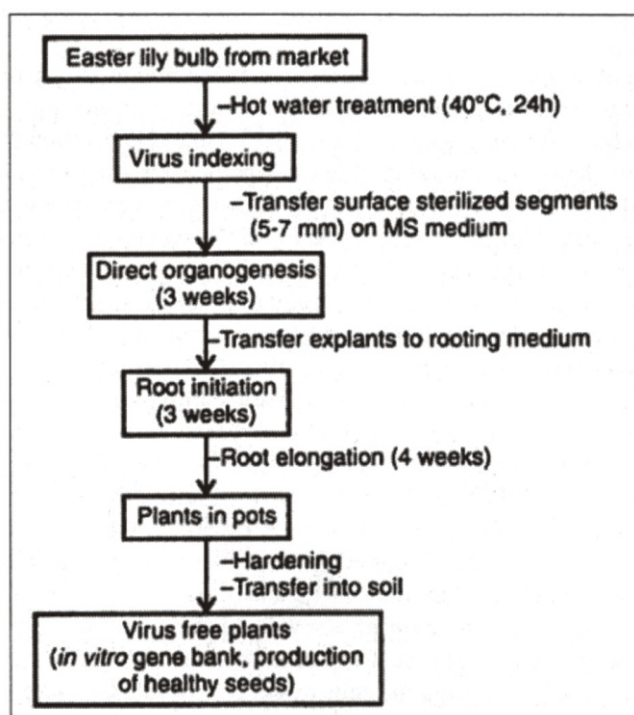


Fig.-1 : Outline for production of virus free plants of Easter Lily.

multiplied, avoiding field infections of diseases and environmental hazards like cold, heat, frosts, floods, water logging, hail etc. easy pathogen elimination,

reduces the time to develop a new variety. Somaclonal variants can be easily distinguished from whole plant populations, reducing the period between selection and release of new varieties. Screening and isolation of somaclonal variants is the most accurate and easiest. Somaclonal variants can be easily identified that produce high biochemicals or screen variants with the use of efficient nutrients in disease resistance, stress resistance, or quantitative characters for various toxins, salts, herb cells. By exposing. This saves the long process of developing an advanced variety because it efficiently screens a large number of cells in a short time.

Improvement of hybrids : The development of cell fusion and somatic hybridization solved the problem of plant incompatibility and increased the scope of production of new varieties within a short period of time.

Genetic modification : Genetic modification can be done for the color of flowers that have been made in rose (blue rose) and carnation (blue carnation-moon series), for delays, for plant architecture, fragrant flowers, luminescent flowers , Altered floral characters, abiotic and biotic stress viruses, RNAi technology, male sterility and fertility restoration, herbicide tolerance, resistance to phening / antibodies The resistance of Tirodk RNA, RNAi technology, induction of male sterility and fertility restoration, herbicide tolerance, Phanning/antibodies.

Breeding and Genetic transformation : Economic method is vegetative propagation. New varieties are produced by cross-hybridization and mutation breeding separately or in combination. Mutation breeding can change a dominant trait to a recessive one mostly. Mutation breeding produces a “subtractive” one-point improvement. Mutations involve a change from dominance to recessiveness. In chrysanthemum, pink is dominant and yellow is recessive. Pink-flowered cultivars useful for mutation breeding material. White-flowered cultivars frequently give yellow flowered mutants. But the reverse mutation has rarely been observed. Similar to mutation breeding, genetic transformation is useful way of making a one-point improvement of a trait in original cultivars bred by cross-hybridization. Genetic transformation produces an “additive” one point improvement. It

modifies target traits by direct incorporation of related genes. Genetic transformation produce changes from dominance to recessiveness and vice versa. Methods of transformation allow the introduction of specific traits in the genome of the host plants. Petunia was the first transgenic ornamental plant. At least 30 ornamental species are transformed including anthurium, begonia, clover, chrysanthemum, gerbera, orchids, iris, petunia, saintpaulia, gentian, lavender, and roses. Recently, several genes coding to specific traits were isolated. Among them, there are included those related to the flowering and plant architecture, as well as genes associated with the biosynthesis of pigments, of compounds that confer fragrance, and those involved with the increase in the shelf life, especially for cut flowers.

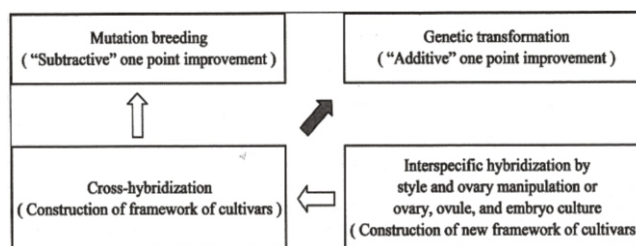


Fig-2 : Advantage of genetic transformation compared with the traditional breeding method

Transgenic Plants : The plants in which a functional foreign gene has been incorporated by any biotechnological methods that generally not present in plant, are called transgenic plants. Transgenic plants contain certain selected traits such as herbicide resistance, insect resistance, virus resistance, seed storage protein, modified ripening, modified seed oil, agglutinin. The future need of transgenic plants is being looked up as bioreactor for molecular farming.

Development of New Colours

The colours of the flowers, leaves, and fruits are important traits in the ornamental plants. Pigment like anthocyanins, which are a class of flavonoids, are responsible for red, violet and blue colours. The synthesis of pigments may be altered by the modulation of genes involved in the biosynthetic pathways. In the synthesis of flavonoids, the enzyme chalcone synthase (CHS) is very important.

The structures of anthocyanidins (a), anthocyanin (b) and pelargonidin (c). The color of anthocyanidins depend in part on the substituents attached to ring B.

Table-1 : Transgenic plants produced by different methods.

	Plants Groups	Transgenic plant species
1.	Gymnosperms	<i>Picea glauca</i>
2.	Angiosperms	
	(i) Monocots	<i>Asparagus</i> sp.
	(ii) Dicots	<i>Petunia hybrida</i> , <i>Helianthus annuus</i> , <i>Lotus corniculatum</i> , <i>Digitalis purpurea</i> , <i>I. purpurea</i> , <i>Dianthus caryophyllus</i> , <i>Vaccinium macrocarpon</i> , <i>Chrysanthemum</i> sp., <i>Rosa</i> sp., <i>Populus</i> sp., <i>Azadirachta Indica</i> .

Table-2 : Transgenic plants generated.

Species	Species	Species	Species
<i>Agapanthus</i> sp.	<i>Alstroemeria</i> sp.	<i>Antirrhinum majus</i>	<i>Anthurium andraeanum</i>
<i>Begonia</i> sp.	<i>Calanthe</i> sp.	<i>Campanula</i> sp.	<i>Cattleya</i> sp.
<i>Chrysanthemum morifolium</i>	<i>Cyclamen persicum</i>	<i>Cymbidium</i> sp.	<i>Datura</i> sp.
<i>Delphinium</i> sp.	<i>Dendrobium</i> sp.	<i>Dianthus caryophyllus</i>	<i>Doritaenopsis hybrids</i>
<i>Eschscholzia californica</i>	<i>Euphorbia pulcherrima</i>	<i>Eustoma grandiflorum</i>	<i>Forsythia intermedia</i>
<i>Gentiana</i> sp.	<i>Geranium</i> sp.	<i>Gerbera hybrida</i>	<i>Gladiolus grandiflorus</i>
<i>Hemerocallis</i> sp.	<i>Ipomea nil</i>	<i>Iris germanica</i>	<i>Kalanchoe</i> sp.
<i>Lavatera</i> sp.	<i>Lentopodium alpinum</i>	<i>Linum</i> sp.	<i>Lilium</i> sp.
<i>Lobelia erinus</i>	<i>Nierembergia scoparia</i>	<i>Ornithogalum</i> sp.	<i>Osteospermum</i> sp.
<i>Pelargonium</i> sp.	<i>Petunia hybrida</i>	<i>Phalaenopsis</i> sp.	<i>Rhododendron</i> sp.
<i>Rosa</i> sp.	<i>Rudbeckia hirta</i>	<i>Saintpaulia ionantha</i>	<i>Torenia forunieri</i>
<i>Verbena hybrida</i>	<i>Verticordia grandis</i>		

Table-3 : Effects of ring substituents on anthocyanidin colour.

Anthocyanidin	Substituents	Colour
Pelargonidin	4'-OH	Orange red
Cyanidin	3'-OH; 4'-OH	Purplish red
Delphinidin	3'-OH; 4'-OH; 5'-OH	Bluish purple
Peonidin	3'-OCH ₃ ; 4'-OH	Rosy red
Petunidin	3'-OCH ₃ ; 4'-OH; 5'-OCH ₃	Purple

Table-4 : Natural Products from plants and their associated industries.

Plant product	Plant species	Industry	Industrial uses
Diosgenin (steroid)	<i>Dioscorea deltoidea</i>	"	Antifertility agent
Quinine (alkaloid)	<i>Cinchona leitgeriana</i>	"	Antimalaria
Digoxin (glycoside)	<i>Digitalis lanata</i>	"	Cardiac tonic
Scopolamine (alkaloid)	<i>Datura stramonium</i>	"	Antihypersensitive
Vincristine (alkaloid)	<i>Catharanthus roseus</i>	"	Antileukaemic
Pyrethrin	<i>Chrysanthemum cinerariaefolium</i>	"	Agrochemical Insecticide
Quinine (alkaloid)	<i>C. ledgeriana</i>	Food & drink	Bittering agent
Jasmine	<i>Jasminum</i> sp.	Cosmetics	Perfume
Saffron	<i>Crocus sativa</i>	Food	Flavoring/coloring agent
Taxol	<i>Taxus brevifolia</i>	Pharmaceutical	Ovarian and breast

Note that an increase in the number of hydroxyl groups shifts absorption to a longer wavelength and gives a bluer color. Replacement of a hydroxyl group with a methoxyl group (OCH₃) shifts absorption to a slightly shorter wavelength, resulting in a redder color.

For accumulation of Secondary metabolites like flavonoid, carotenoid and betalain compounds. Several chs genes have been cloned from *Petunia hybrida*, snapdragon and pines. An application of these techniques is the introduction of the native chs gene in anti-sense orientation and lead to a decrease in the levels of anthocyanin, cloned chs gene modified the

original colour of rose, gerbera, torenia and chrysanthemum. Anthocyanin colour is influenced by many factors, including the number of hydroxyl and methoxyl groups in ring "B" of the anthocyanidin. Suppression of biosynthetic genes involved in flower color formation is an important approach for obtaining target flower colours. In *Torenia hybrida* the flower's colour was successfully modulated by RNA interference (RNAi) against chs. By using each of the coding region and the 3'-untranslated region of the chs mRNA as an RNAi target, exhaustive and gene-specific gene silencing were successfully

Table-5 : Secondary metabolites produced through cell suspension culture.

Plant species	Secondary metabolites
<i>Acer pseudoplatanus</i>	Flavonols and phenolics
<i>Catharanthus roseus</i>	Serpentine
<i>Daucus arota</i>	Anthocyanin
<i>Datura stramonium</i>	Tropane
<i>Lithospermum erythrorhizon</i>	Shikonin
<i>Mentha canadensis</i>	Menthol, terpenes
<i>M. piperata</i>	Menthol
<i>Morinda citrifolia</i>	Anthraquinones
<i>Nicotiana tabacum</i>	Tobacco alkaloids, quinone
<i>N. rustica</i>	Nicotine
<i>Panax ginseng</i>	Saponines
<i>Populus nigra</i>	Anthocyanins
<i>Rosa gallica</i>	Essential oil
<i>Ruta graveolens</i>	Furanocoumarins
<i>Scopolia japonica</i>	Peptides
<i>Solanum lacinalium</i>	Solasaline
<i>Vinca minor</i>	Indole alkaloids

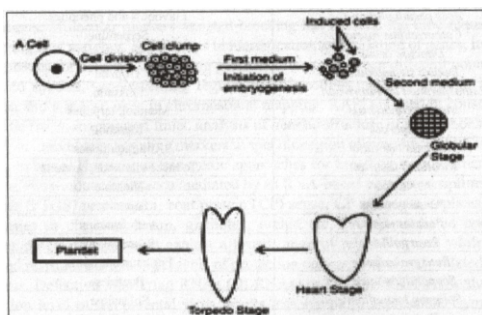
Table-6 : Secondary Metabolites from Immobilized Plant Cells.

Source of cells Immobilized	Substrates	Methods
<i>Catharanthus roseus</i>	Alginate, agarose, polyacrylamide,	Immobilized in Inert substratum
<i>Digitalis lanata</i>	Alginate	do
<i>Morinda citrifolia</i>	Alginate	do

induced, and the original blue flower colour was modulated to white and pale colours. These results indicate that RNAi is quite useful for modulating flower colours of commercially important garden plants. The carotenoids pigments are a class of isoprenoids responsible by the yellow, orange and red colours in several flowers. The genetic mechanisms controlling that biosynthetic pathway have not observed in flowers till date.

Development of novel fragrance in flowers :

Improving floral scent is one of the goals. The aroma of a flower can contain as few as seven different oils, such as in snapdragon (*Antirrhinum majus*), or as many as 100 such as in orchids. In snapdragon flowers, the volatile ester methyl benzoate is the most abundant scent compound, a novel S-adenosyl-L-methionine: benzoic acid carboxyl methyltransferase (BAMT), the final enzyme in the biosynthesis of methyl benzoate, and characterized its corresponding cDNA.



Post-harvest biotechnologies : The quality and post-harvest life of many plants and flowers are often reduced by the presence of ethylene in the environment. Ethylene has a variety of deleterious physiological effects, such as bud, flower or leaf abscission and senescence. In the ethylene biosynthetic pathway, there are two key enzymes: ACC-synthase and ACC-oxidase, which are involved in the ACC cyclization and subsequent conversion to ethylene. It has been possible the modification in the levels of this hormone through the introduction of genes involved in the synthesis of ACC-synthase or ACC-oxidase in anti-sense orientation. Other possibility is the introduction of genes associated to ACC degrading enzymes thus interrupting the ethylene biosynthetic pathway. Effects of ethylene may be altered reducing the ability of the plant to perceive it. In rose, cloned cDNA fragments of three Rh-ACSs (*Rosa hybrida* — ACC Synthase) and one Rh-ACO (*Rosa hybrida* — ACC Oxidase) genes that were designated as Rh-ACS1, Rh-ACS2, Rh-ACS3 and Rh-ACO1 respectively. Additionally, Northern-blotting analysis revealed that among three genes *acs*, ethylene-induced expression patterns of Rh-ACS3 gene corresponded to ACS activity and ethylene production.

Genome sequencing/Identification of genes :

Control of flower development studies showed the existence of network of internal signalling pathways

that operates in response to endogenous and environmental signals. This network enhances the activation of genes associated to flower identity, resulting in the developmental control of floral organs. The genes that control the identity of floral organs are classified as the followings: type “A”, which controls the identity of sepals and petals; type “B”, which control petals and stamens; type “C”, which controls stamen and carpel. Orthologs of genes ABC have been isolated in *Antirrhinum*, *petunia* and *gerbera*. Homeotic mutants of *primula* have been intensely studied, elucidate the mechanisms controlling the flowering architecture.

Molecular markers assisted breeding : Molecular markers have wide areas of applications. Molecular markers assisted breeding has reduced the time required for developing new varieties. RFLP helps in identification and isolation of genes, it is used in diagnostics for diseases, measuring genetic diversity between different populations or related species, supplementing regular plant breeding methods through indirect selection and it is also used in chromosomal mapping, RAPD is used in construction of genetic maps, mapping of traits, analysis of genetic structure of populations, finger printing of individuals, targeting markers to specific region of genome, identification of somatic hybrids. The various transgenic approaches for breeding woody ornamentals includes, Virus-induced resistance mediated by an RNA-based post-transcriptional gene silencing (PTGS) mechanism, coat protein (CP) sense, CP antisense, replicase sense viral genes in *chrysanthemum*, *gladiolus*, *orchid* etc. Protein-mediated resistance provides moderate protection against a broad range of related viruses while RNA-mediated resistance offers high levels of protection only against closely related strains of a virus. Defective interfering RNAs (DI-RNAs) or DNAs (DI-DNAs) reduces the replication level of the parental virus results less symptom expression. *Cymbidium* ringspot virus (CymRSV) DI-RNA protects transgenic *N. benthamiana* against CymRSV infection. Naturally-occurring DI-DNA in *Ageratum* yellow vein virus protects infections of *Ageratum conyzoides*.

Production of Secondary Metabolites : Secondary metabolites from Cell Cultures are produced in bioreactors. New route of synthesis to established

products (e.g. codeine, quinine, pyrethroids), route of synthesis to a novel product from plants difficult to grow or establish (e.g. thebain from *Papaver bracteatum*) can be manipulated through different biotechnological approaches.

Large scale yield of secondary metabolites from cultured plant cells can be increased simply by changing the physiological and biochemical conditions from growth medium. Methods applied are the use of immobilized plant cells provides a stable and uniform environment. Methods for immobilization includes immobilization of cells of subcellular organelles (entrapment in some matrix such as alginate, polyacrylamide and collagen or in combination of gels) or adsorption to an inert substrate such as glass beads.

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Encapsulated Seed : T. Murashige, U.S.A. for the first time gave the concept of artificial seeds. Artificial (encapsulated) seeds are the somatic embryos covered with a protecting gel. Water soluble gels (hydrogel) must be used as the protective gel. Usually Na/Ca alginate (a product of brown algae) is selected for encapsulation purpose because it is less toxic to embryos and easy to handle.

Somatic Embryogenesis : Embryo production is a characteristic feature of the flowering plants. Embryoids have also been artificially induced in cultured plant tissues, besides zygote. Somatic embryogenesis was first induced in suspension culture and callus culture of carrot. Somatic embryogenesis has been induced in vitro *Pinus ponderosa*.

Pollen biotechnology for overcoming interspecific crossing barriers : Crossing barriers occur frequently when intra or interspecific crosses are attempted. These barriers are the result of incompatibility and incongruity. The nature of the barrier determines the method to be used to overcome the specific barrier.

A range of techniques such as bud pollination, stump pollination, use of mentor pollen and grafting of the style have been applied successfully to overcome pre-fertilization barriers. In vitro methods in the form of ovary, ovary slice, ovule and embryo culture are being used to overcome post-fertilization blocks which cause endosperm failure and embryo abortion.

Techniques for overcoming stigma' and stylar barriers using in vitro techniques : Lily is a model plant for style manipulations and in vitro culture methods. In lily, crossing barriers can be overcome using cut-style pollination, but mostly in one cross direction only. The stylar graft technique was applied successfully in order to improve the cut-style technique. In this method, pollen grains are deposited on a compatible stigma. After one day, the style of the pollen donor is cut 1-2 mm above the ovary and grafted on the ovary of another plant. Style and stigma are joined in vivo using a piece of a straw filled with *L.longiflorum* stigmatic exudate or are stuck together with only the exudate. In vitro a piece of 'water agar' is placed on the style.

Techniques for overcoming post-fertilization barriers : In some crops, the ovary is large and slicing the ovary in small parts and influencing them, is a better option for rescuing the young seedlings in vitro. This technique is referred to as 'ovary slice culture'. When the mismatch between embryo and endosperm development starts very early and ovary culture and/or ovary slice culture fails, ovules can be dissected out of the ovaries and be cultured in vitro. Ovary culture has been applied in many species *Lilium*, *Nerine* and *Tulipa* for the production of interspecific hybrids.

Ovule culture : ovule culture is an easy and fast method. This technique is applied in *Alstroemeria* and *Cyclamen* for the production of interspecific hybrids.

Embryo culture : Embryo culture can be applied successfully in crosses in which pollinated flowers can stay on the plant for a notable time, before natural abscission occurs. This method has been applied in *Alstroemeria* and *Freesia*.

Techniques for overcoming F₁ sterility : Barriers occurring after a successful embryo rescue are hybrid breakdown and F₁ -sterility. Hybrid breakdown results in the loss of the hybrid before flowering and is a result

of the unbalanced new gene combinations. F₁ -sterility of interspecific hybrids is very common and among others may be the consequence of reduced chromosome pairing during meiosis. Breeding at polyploid levels is widely used in interspecific hybridization programmes of many ornamental crops such as *Alstroemeria*, *Chrysanthemum*, *Freesia*, *Gladiolus*, *Lilium*.

Chromosome doubling : Interspecific F₁ -hybrids may display sterility owing to lack of chromosome pairing during meiosis. This sterility hampers further breeding. Somatic (mitotic) chromosome doubling may induce homologous pairing of chromosomes and restores fertility. Colchicine is used successfully to produce fertile allotetraploids *Lilium* and marigold. As an alternative for colchicine, oryzalin, a herbicide with anti-mitotic activity, is recently used successfully.

CONCLUSION

Thus, it is apparent that application of different strategies of biotechnological approaches provides immense opportunity for the improvement in ornamental plants. Plant biotechnologies play a key role in the massive production of improved crop varieties as well as their genetic improvement. Development of techniques of molecular taxonomy through RAPD and RFLP in genomic analysis and classification has opened up new options for germplasm characterization. Micro-propagation of ornamental plants such as rose, gladiolus, orchids, ornamental foliage, anthurium, gerbera, bougainvillea and genetic engineering of cut flowers (pink to white chrysanthemum) become easy. Transgenic plants are now available in gladiolus, petunia, rose, carnation, orchid, gerbera etc. Secondary metabolites from cell culture has been established for the synthesis of codeine (*Papaversomniferum*), quinine (*Cinchona leitgeriana*), pyrethrin (*Chrysanthemum cinerariaefolium*), taxol (*Taxusbacata*), rutacultin (*Ruta Sp.*) and thebain (*Papaverbracteatum*) etc. Somatic embryogenesis is a powerful tool for the improvement of ornamentals, not only with regard to clonal propagation but for other biotechnological applications as well. Ovule culture is now applied in *Alstroemeria* and *Cyclamen*, embryo culture in *Alstroemeria* and *Freesia* for the production of interspecific hybrids.

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STEREOCHEMICAL AND BIOLOGICAL STUDIES IN DINITROPHENOLE COMPLEXES WITH BENZOFURATHIO-SEMICARBAZIDE LIGAND

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ABSTRACT

Present work deals with the preparation and characterisation of complexes of Co(II) Ni(II), Mn(II), Cu(II) and Zn(II) dinitrophenates with benzofuro-2-carboxy-phenyl thiosemicarbazide and benzofuro-2-carboxy [4'-chlorophenyl) thiosemicarbazideligands. The structure of newly prepared metal complexes were established with elemental analysis, magnetic, spectral and electrolytes conductance studies. The prepared complexes and ligands were also screened for their antifungal and antimicrobial studies. Transition metal complexes formed by Schiff bases have been amongst the most widely studied coordination compound. Thiosemicarbazones and their complexes show a great variety of biological activity (24-29).

Keywords : Benzofurathio-semicarbazide Ligand, magnetic moment, antifungal activity, stereochemical, antimicrobial activity.

INTRODUCTION

The coordination chemistry of transition metals and their derivatives has gained much importance in recent years mainly because of their biological importance (1-3). The metal thiosemicarbazone compounds are emerging as a new class of experimental anticancer chemotherapeutic agents (4) which shows inhibitory activity against most of the cancers through inhibition of a crucial enzyme obligatory for DNA biosynthesis and cell division (5-6). The complexes of manganese play an important role in photochemical reaction (7). Nitrogen, Oxygen and sulphur donor ligands possess a range of biological applications such as antitumour (8), antiviral (9), antibacterial (10), antimalarial (11) and antifungal activities (12).

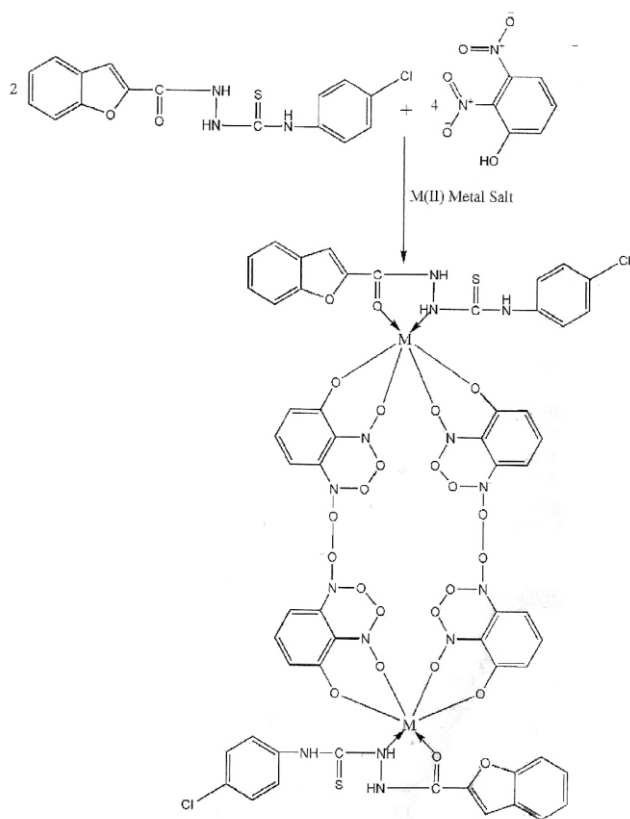
Mixed ligand complexes of transition metals containing ligands with N.S. and N.S.O. donors are known to show interesting stereochemical, electrochemical and electronic properties (13-15). Semicarbazones and thiosemicarbazones are amongst the most widely studied nitrogen and oxygen/sulphur donor ligands. Besides, thiosemicarbazones, in the last two decades have emerged as an important class of sulphur ligands particularly for transition metal ion. The real impetus towards developing their coordination chemistry is their physicochemical properties (16-18) and significant biological activities (19, 20). The chemistry

of ruthenium is recently receiving a lot of importance (21, 22) mainly due to their fascinating electron-transfer and energy transfer properties displayed by the complexes of this metal.

Transition metal complexes formed by Schiff bases have been amongst the most widely studied coordination compound. Metal complexes with ligands capable of coordinating with two or more sites with metal ions have evoked much interest in the field of coordination chemistry (23).

Thiosemicarbazones and their complexes show a great variety of biological activity (24-29). In recent years thiosemicarbazones have been used for the analytical determination of metals (30). Chelation behaviour and electronic properties of aromatic and aliphatic thiosemi-carbozones obtained by organic moieties having biological (31-36).

Thiosemicarbazides and thiosemicarbazones are active against viruses, protozoa, smallpox, various kinds of tumour etc. Crim and Petering (37) found that not only the thiosemicarbazone but its metal chelates are also active against cancer. The metal complexes of thio-derivatives of hydrazine have occupied an important place in the development and progress of coordination chemistry. Several workers (38, 39) have discussed metal complexes of thiosemicarbazide and thiosemicarbazone. However, survey of literature revealed that except few scattered references (40-45), no work has yet been done on the complexes with



Preparation of metal complexes of thiosemicarbazide and dinitrophenate.

thiosemicarbazide ligands containing the 2-substituted benzofuranhydrazide moiety. Therefore it is worthwhile to prepare and study the synthesis of benzofuro-2-carboxy-phenyl thiosemicarbazide and benzofuro-2-carboxy-[4'-chlorophenyl] thiosemicarbazide and their complexes.

The present chapter deals with the preparation and characterisation of complexes of Co(II), Ni(II), Mn(II), Cu(II) and Zn(II) dinitrophenates with benzofuro-2-carboxy-phenyl thiosemicarbazide and benzofuro-2-carboxy[4'-chlorophenyl] thiosemicarbazide ligands. The newly prepared complexes were characterised by their elemental analysis, magnetic, spectral and electrolytes conductance studies. The prepared complexes and ligands were also screened for their antifungal and antimicrobial studies.

EXPERIMENTAL

All the reagents used were of chemically pure or analytical reagent grade. All the solvents used were distilled and purified according to standard methods reported in literature.

PREPARATION OF LIGANDS

The phenyl thiocyanate/ p-chlorophenyl isothiocyanate (0.5 mole) in alcohol (10 mole) was added to ethanolic (20 ml) solution of benzofuran-2-Corbohydrazide (1.7g 0.5 mole) with stirring. The reaction mixture was refluxed on water bath for about 6 hrs. The solid thiosemicarbazide started separating after few minutes. The product was filtered out and was washed successively with alcohol. The product formed was crystallized from alcohol and dried in vacuum over fused CaCl_2 .

PREPARATION OF COMPLEXES

Metal complexes were prepared by adding (0.1 mole) of aqueous metal (II) dinitrophenates to 0.1 mole of the ligand in 50ml of alcohol. The reaction mixture was refluxed on water bath for about four hours during refluxing complexes started separating out. The solution was concentrated and cooled to room temperature. The crystalline light coloured complexes were filtered out, washed with water and alcohol to remove the unreacted salt and ligand.

RESULT AND DISCUSSION

Analytical data of newly prepared complexes shows 1:2 Stoichiometry of complexes. All the complexes are stable upto 150°C showing that they are non hygroscopic and are solution common organic solvents.

INFRARED STUDIES

The thiosemicarbazide ligands exhibit three bands in the region $3441\text{--}3400$, $3365\text{--}3277$ and $3130\text{--}3072\text{ cm}^{-1}$ assigned to (^4NH), (^2NH) and (1NH), respectively, in view of the earlier reports (17, 18). In the spectra of the complexes, the bands due to (^4NH) shift to higher wavenumber side by about $10\text{--}20\text{ cm}^{-1}$ and in some complexes it remains unaltered indicating non involvement of nitrogen of (^4NH) group in coordination with metal ions. The band due to (^2NH) shift to lower wave number side by about $20\text{--}30\text{ cm}^{-1}$ in all the complexes and this band becomes weak in the complexes suggesting the coordination of nitrogen of (^2NH) group. The bands observed in the region $3130\text{--}3072\text{ cm}^{-1}$ remains practically unaltered or shift slightly to higher side indicating no coordination.

The weak bands observed in the regions 2780-2810 cm^{-1} are assigned to stretching vibrations of intra molecular hydrogen bonding between CO and ^2NH group (19). The absence of any band above 3500 cm^{-1} due to (OH) and 2600-2500 cm^{-1} due to (SH) suggest that ligand exists in thioketo form. The strong bands observed (20) at 1659 and 1675 cm^{-1} in free ligands are assigned to (CO) vibrations. These bands shift to lower wave number side by about 30-50 cm^{-1} in all the metal complexes. This suggests the coordination of oxygen with metal ions. The positive shift of (N-N) bands observed at 1010 cm^{-1} and 1020 cm^{-1} in free ligands are shifted to higher wavenumber side by 10-15 cm^{-1} in the complexes thereby showing the coordination of the one of the nitrogen atoms of hydrazinic moiety in bonding (21).

The thioketo (C=S) band observed in the region 737-720 cm^{-1} shows no shift in the metal complexes compared with free ligands. This shows sulphur atom of (C=S) has not taken part in coordination. The thioamide²² bands observed in the regions 1540-1520, 1360-1340, 1080-1050 and 740-700 cm^{-1} due to amide I, II, III and IV respectively, remain unaltered or do not show considerable change in the complexes suggesting the non-involvement of (C=S) group in bonding with metal ions.

COBALT(II) COMPLEXES

The observed magnetic moment for Co(II) complexes have been found to be 4.87 B.M. it has been used as a criterion to determine the type of geometry around the metal ion. This value suggests an octahedral geometry for Co(II) complexes (38).

The electronic spectra of Co(II) complexes shows two bands at 17860 and 19610 cm^{-1} . These two bands are assigned to $^4\text{T}_{1g}(\text{F}) \rightarrow ^4\text{T}_{2g}(\text{F})$ (λ_2) and $^4\text{T}_{1g}(\text{F}) \rightarrow ^4\text{T}_{2g}(\text{F})$ (λ_3) transition respectively in an octahedral environment (39). The band λ_1 could not be observed. However, λ_3 would be calculated using band fitting method (40). The octahedral geometry (41) is further supported by the value of ligand field parameter like Dq, B^1 , and % and LFSE comes to be 949 cm^{-1} , 824 cm^{-1} 0.85, 15.06 and 16.27 respectively. Racah parameter value from the free ion value 971 suggests measure of covalent character of the M-L bond.

NICKEL(II) COMPLEXES

The present six coordinated Ni(II) complexes exhibit a magnetic moment 2.95 B.M. expected for two unpaired electron in an octahedral field. The electronic spectra of Ni(II) complexes indicate an octahedral geometry. Although the complexes formally have D_{uh} symmetry, the electronic spectra in the range 8000-8300 cm^{-1} and magnetic moment value is of typical of octahedrally coordinated Ni(II) complexes. The observed energies of three spin-allowed transitions, $^3\text{A}_{2g} \rightarrow ^3\text{A}_{2g}$ at 8500, $^3\text{A}_{2g} \rightarrow ^3\text{T}_{1g}(\text{F})$ at 14000 and $^3\text{A}_{2g} \rightarrow ^3\text{T}_{1g}(\text{P})$ at 24000 cm^{-1} agree well with those predicted from Licher and Ballhausen energy level diagram for Ni(II) in a ligand field of octahedral symmetry. The ligand field parameter 10 Dq was taken equal to the observed energy of the first triplet transition (λ_1) and the Racah parameter B was calculated by substitution of (λ_1), (λ_2) and (λ_3) band energies in the secular equation.

Further more observed value of 1.64 for ratio is in accord with commonly reported value of 1.60-1.70 for Ni(II) complexes of octahedral symmetry. The value of 10 Dq, B, C, β , comes to be 8500 cm^{-1} , 853 cm^{-1} , 3412, 0.82 respectively.

MANGANESE(II) COMPLEXES

Mn (II) ion has d^5 electronic configuration and is capable of forming spin free as well as spin-paired complexes. Since the half filled d-shell is quite stable, so spin free complexes are more predominant. The equilibrium constant for their formation in aqueous solution are not high as compared to those for divalent cations of succeeding elements (Fe^{2+} and Cu^{2+}) because of its largest size. It has no ligand field stabilization energy in its complexes which are susceptible to oxidation. In the present study Mn(II) complexes have magnetic moment value 5.20 B.M. corresponding to five unpaired electrons indicating its spin free octahedral geometry. Owing to d^5 electronic configuration, the same type of energy level diagram applies whether the metal ion is surrounded by tetrahedral or octahedral environments. Their spectra differ chiefly in terms of positions of bands and the value of their extinction coefficients.

Mn (II) complex exhibits bands of low intensities near

18000, 20885 and 24530 cm^{-1} assignable 10^6A_{1g} $^4T_{2g}$, $^6A_{1g}$ $^4A_{1g}$ (4E) and $^6A_{1g}$ $^4A_{1g}$ (4G) transitions, respectively, suggesting its octahedral structure. The values of $10Dq$, B, C, and $\lambda/10Dq$ comes to be 1263, 743, 2972, .77 and 1.16 respectively.

COPPER(II) COMPLEXES

The magnetic moment value of Cu (II) complexes generally lie in the range 1.75-2.20 B.M., irrespective of stereochemistry. The room temperature magnetic moment value suggest the paramagnetic nature of Cu(II) complexes containing an unpaired electron. The increased value of magnetic moment than the spin only value (1.73 B.M.) new be due to spin-orbit coupling. The observed magnetic moment value of Cu(II) complexes suggest, the distorted octahedral geometry. The Cu(II) complexes show broad asymmetric band at 14290 cm^{-1} . The broadness of the band may be due to dynamics John-Teller distortion. The above observation suggest that Cu(II) complexes has distorted octahedral structure.

ZINC(II) COMPLEXES

Zn (II) ion shows d^{10} configuration and usually attains tetrahedral geometry using sp^3 hybridisation but the possibility of forming penta coordination (sp^3d) and hexa-coordination (sp^3d^2) can not be ruled out. Zn(II) complexes are diamagnetic, since d-d transition are not possible. Their magnetic moment values lie in the range 0.15 to 0.24 B.M. indicating the absence of unpaired electron. In the present case the value comes to 0.19 B.M. The elemental analysis and magnetic moment value suggest octahedral geometry of Zn (II) complexes.

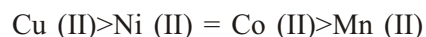
FUNGICIDAL ACTIVITY

Metal ions are important in fungicidal action, since many of them form complexes with ligands containing sulphur, nitrogen and oxygen as electron donors. Mathews suggested that the toxic action of the metal ion is due to the formation of unionised complexes between anions present at some surface and metal ions. Danielli and Davies proposed that tightness of covalent bonding of the ion to the surface ionic groups of cell is the important factor. The toxic action of heavy metals is based on the properties of these ions for denaturing the properties. Antimetabolites produced by test cells

may synthesis of catabolic and biosynthesis enzymes. Activity of endogenous enzymes may be stimulated by fungicides that act in place of co-factors in the enzyme system. Fungitoxic properties of the metal ions seem to be greater against mycelial and conidial parts of fungi than against heavy walled spores. Biologically active metals play a key role in the structural organisation and activation of enzymes. Nickel activates many enzymes and stabilises RNA and DNA against thermal denaturation.

Antifungal activity of the free ligand and their complexes were determined against *Drechlera Tetramera*, *Alternaria alternata* and *fusarium-oxysporum* at different concentrations of 500, 200 and 100 ppm using three replications in each case are recorded in table. The analysis of the fungicidal result showed as definite pattern existing between fungi toxicity and chemical structure. The result indicates that in untreated controls the test fungi grew, on the other hand the growth of fungi are inhibited well by all the complexes. It may be concluded that the ligand possess good fungicidal activity against all the three fungi where as the NH_2 group plays a significant role in toxicity possibly by serving as ligand in chelate formation.

From the data it is clear that among all the metal complexes tested for their antifungal activity Cu(II) complexes are most active fungicides, it is due to inactivation of enzymes. Generally fungitoxicity enhanced with increase of the dose of complex. The fungitoxicity increases with increase of concentration. However, a correlation between toxicity of metals and their ability to form stable chelates revealed the following order



It is evident from the fungicidal activity data that toxicity of Ni(II) and Co(II) complexes is almost equal and Cu(II) complex possess maximum fungitoxicity.

BACTERIAL SCREENING

Antimicrobial action of the compounds under investigation was studied against *Bacillus Cereus* and *Escherichia Coli* by Agar plate diffusion technique (43), using DMF as solvent at 100 g ML concentration. Tetracycline was used as a saturated. The metal complexes are potent than the ligand.

Much higher activity has been recorded for Mn(II), Cu(II) and Zn(II) complexes against B. Cereus (zone of inhibition being 25, 23 and 21 mm respectively. while Co(II) and Ni(II) complexes show low to moderate activity (18-20 mm) against both the Bacteria.

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MODELING AND SOFT COMPUTING BASED SPEED CONTROL OF BRUSHLESS DC MOTOR

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ABSTRACT

This paper presents the modeling and controlling of a fuzzy logic controller (FLC) for achieving improved dynamic performance of the Brushless DC (BLDC) motor drive. The performance of fuzzy and the PI controller based BLDC motor drives is investigated under the different operating conditions such as change in reference speed, parameter variations and the load disturbance. BLDC motors are used in industrial control, automation and instrumentation system applications. Based on other applications the conventional controllers like P, PI and PID controllers are used in the BLDC motor drive control systems to achieve the desired level of transient and steady state responses. However, the major problem in the conventional PI controller there is some variations in the parameter and some load disturbances are occur and do not yield the better transient and the steady state responses under the operating conditions. In this paper, the modeling and controlling of fuzzy logic controller is presented its performance and it compared with the PI controller shows the error capability and usefulness of the fuzzy controller in the control applications.

Keywords : Brushless dc motors (BLDC), Fuzzy logic controller (FLC), Digital signal processor (DSP), Pulse width modulation (PWM).

INTRODUCTION

BLDC motor drives are popular in electric vehicles, chemical industrial applications, robotics, and defense application. In recent years the Brushless dc motors are preferred as small horsepower control motors due to their compact size, high efficiency, low maintenance and reliability in operation (1). Conventional PID controllers are being used for some control applications. Practical applications requires near exact mathematical modeling (2) of machine to designing the controllers.

The responses of the system are found to be highly nonlinear and complex (3). As the linear systems are approximated to obtain their mathematical model and the controller are designed for such systems may give the satisfactory as dynamic responses and the transient steady state responses but there is no optimum responses (4). In some of the literature, the system parameters never changes during the operating conditions it has been assumed but for the practical applications the mechanical parameter such as the

inertia and the friction changes due to their decoupling inertia elements.

The phase resistance of the BLDC motor slightly changes due to their terminal resistance where there are some changes in winding resistance and on-state resistance of the semiconductor switching devices due to temperature changes during operating conditions. The ratio of no load based on the full load friction and the inertia changes (5) from 10-20 times due to decoupling inertia for the positioning applications. The disadvantage for the conventional controllers is load disturbance and the parameter variations etc. The system parameters are such designed that it can provide better transient steady state responses while remain unchanged. In all the system the parameters varies practically for their responses during the operation. this paper deals with the modeling and controlling of fuzzy logic controller based BLDC motor, which compare its performance with the conventional PI controller based brushless DC motor using TMS320LF2407A digital signal processor. Finally experimental results are presented (6). At different operating conditions these controllers is

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investigated for parameter variations and load disturbances.

The modeling of BLDC motor and the different control schemes are discussed in this paper in (7). The dynamic performance of the BLDC motor system, the effect of change in motor parameters is discussed in (8), (9). In the PI controller several tuning methods are described in (10). For the desired results, the several tuning methods are suggested in (11) and hence in these methods are adapted for determining PI controller for the parameter gain. While modeling and the dynamic performance analysis of fuzzy logic control (FLC) for various applications in the BLDC motor drive are presented in (12). The PID based method for the determination of PI controller parameters for achieving the dynamic performance is discussed in (13). It also based some control schemes to compensate for the dynamic uncertainties in the motor drive. Conventionally the motor used for industrial purposes is brush type of the dc motor drive. Still in the fractional 40 hp range available in the ac motor includes the induction and the brushless dc motors (14). BLDC motor utilizes a trapezoidal back EMF and the rectangular stator currents to generate a constant electric torque. Traditionally Hysteresis current controller or pulse width modulation (PWM) current controller is employed to obtain the near rectangular currents flowing into the motor.

Digital control schemes and the pulse width modulation for the BLDC motor controller for the electric drive application are discussed in (15). The performance of BLDC motor for different operating condition, with the necessary improvement in the motor drive is discussed in (16). However the proposed controller which improves the dynamic performance and there is no variation and load disturbance in the motor drive system.

BLOCK DIAGRAM OF PROPOSED MODEL

The Fig.1 illustrates the blocks of BLDC motor using FLC speed controller. The motor drive consists of reference current generator, speed controller, position sensor, the PWM current controller, where the motor and IGBT are based on current controlled voltage source inverter. The speed of the motor is compared with the reference value and the speed error is processed in Fuzzy logic controller. The output for this

controller is utilized as the reference torque and limit is put on the speed controller output based on the maximum permissible currents through winding. While reference current generator block generates the three phase reference currents utilizing the limited peak current magnitude decided by the position sensor and controller. The reference currents have the shape

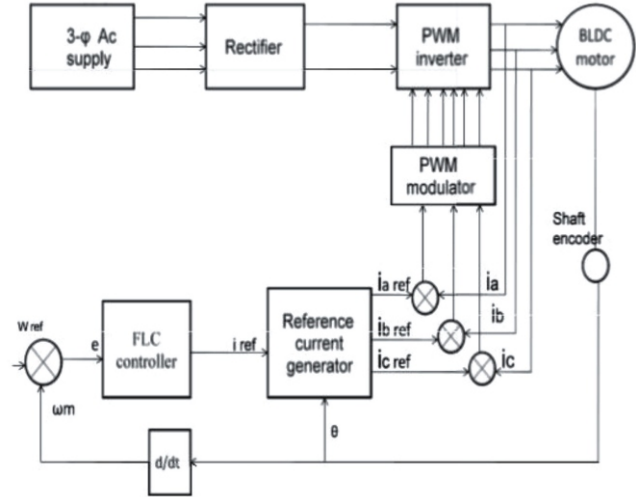


Fig.-1 :Block Diagram of BLDC Motor using FLC

of quasi-square wave in phase with respective back EMF and nature of developed torque is constant unidirectional. The motor currents and the reference currents are compared and the switching signals are generated to drive the inverter devices.

MODELLING OF BLDC MOTOR DRIVE

The BLDC motor drive system which consists of IGBT inverter based on the stator phase winding have constant self-inductance and equal resistance, where the ideal power semiconductor devices are assumed. During the unsaturated mode of motor the devices are assumed ideal and the iron losses are negligible. The phase inductance, phase resistance, and BLDC motor inertia which determine the parameter variation and the load disturbance as to design the conventional controllers. Speed response of the brushless DC motor drive decides the required parameter variation. The magnitude of the three phase current is determined by the reference torque.

$$i_{ref} = \frac{T_{ref}}{K_t}$$

Where K_t is the torque constant. K_t depends on the

rotor position and the reference current generator generates the three phase reference current. The Hysteresis current controller maintains the switching signals. In the three phases references currents, switching condition of the inverter output voltage is shown below.

$$V_a = \frac{1}{3}[2S_a \ S_b \ S_c]$$

$$V_b = \frac{1}{3}[S_a \ 2S_b \ S_c]$$

$$V_c = \frac{1}{3}[S_a \ S_b \ 2S_c]$$

The drive system utilized here consists of FLC speed controller, PWM current controller, the reference current generator, BLDC motor and an IGBT inverter. All these components are designed and connected for simulation in real time environment. The Hysteresis current controller generates the switching signals the inverter and the hysteresis-band PWM is basically instantaneous feedback current control limit which generates the PWM where the actual current on the continuous basis tracks the command current within the predefined band limit. Sine wave generated by the control circuit is compared against the reference current. The input variable is change in speed error and speed error, and is calculated by the controller with error. The output variable is the torque component of the reference current i_{ref} .

CONTROLLING OF BLDC MOTOR DRIVE

It needed the rectangular stator current while controlling the speed of the BLDC motor drive system to produce a constant electric torque. With the small parameters variation technique observer is developed for the speed and position measurements. The state of art is the speed enhancement which depends upon the flux linkage and electromotive force. It enables the performance prediction over the wide range of operating conditions. Hall Effect sensor is utilized which senses the rotor position because Controller must direct the rotor rotation, sensors senses the relative position of rotor w.r.t. stator and generate the requires logic. The controller contains 3 bi-directional drives to high current dc power which are controlled by a logic circuit.

Advanced control is employed by a microcontroller to

control speed, manage acceleration and the fine tune efficiently. The phase resistance changed by speed responses also affects the system drive, hence require a suitable controller to improve the dynamic performance. In FLC controller the response of the speed which reduce overshoot and the steady state error to the application requirements. The trapezoidal back emf waveform depends on speed and the rotor angle as shown in Fig. 2.

In this FLC based BLDC motor drive system is developed their performance during different conditions to step up the reference speed with different system parameters. Its insensitive to parameter variations and load disturbance and also it enhance the dynamic capabilities of the motor drive.

IMPLEMENTATION OF FUZZY CONTROLLER

The FLC is designed based on a simple analogy between the control surfaces of the FLC and a given PI controller for the same application. Depending on right tuning fuzzy logic controller has a better quality of the speed response when compared to PI control. In case of BLDC motor usually speed control is achieved by using PI controller. PI controllers are popular in the

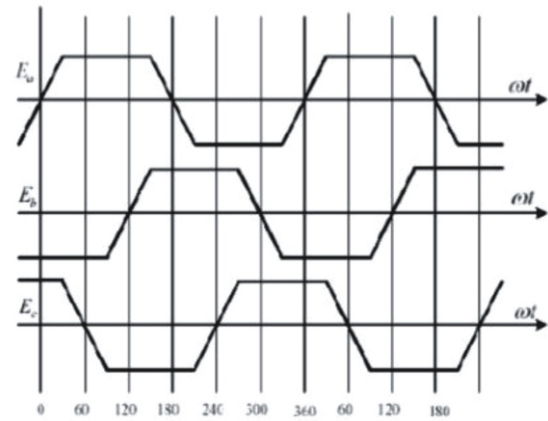


Fig-2 : Three phase trapezoidal back emf of BLDC motor

industries due to their simple design and ease of application; these controllers are ineffective in cases such as the nonlinearity, parameter variations and load disturbances. Moreover the Proportional-integral controllers require exact mathematical models. However In the FLC controller can perform with nonlinear systems. The design of traditional control system essentially based on the linear mathematical model of plant. Adaptive characteristics are inherent in

Fuzzy logic controller. Hence a relatively robust performance is achieved by system with load disturbances and uncertainty parameters variation. Fuzzification interface measures the values of input variable. During fuzzification input data converts into suitable linguistic values. The inputs of the fuzzy controller are expressed in several linguistic values. As shown in Fig.3 the seven triangular fuzzy membership function are utilized.

As these levels can be described as Positive big (PB), Positive medium (PM), Positive small (PS) Negative small (NS), Negative medium (NM), Negative big (NB) or in other levels. Fuzzy set describes Each level.

Fuzzy set is a generalization of the indicator function in classical sets In fuzzy Membership Function. Fuzzy logic control emphasis on the degree of truth as an extension valuation. Often degrees of truth are confused with probabilities, in reality they are conceptually different, because unlike probability dependency on condition the fuzzy truth tells membership in defined sets,. Knowledge Base comprises data base and a rule based linguistic control.

The rule base characterized the control policy and control targets. Control policy is implemented domain experts knowledge by means of a set of linguistic control rules. Kernel of FLC is the Decision Making

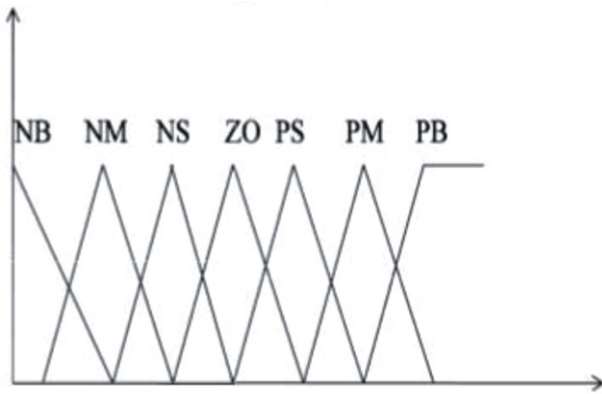


Fig: 3 Seven Level s Fuzzy Membership Function

logic. Human decision making capability can be simulated based on fuzzy concepts and of inferring fuzzy control actions employing fuzzy implication and the rules of inference. The frequent revaluation of the stored data states leads to inference engine control, hence control scheme dynamic structure of the

program. Unlike most of traditional procedural control the computation is more a qualified data driven.

Table.1 is used to achieve the given rules. Based on the behavior of human operators and error, fuzzy variables selected the fuzzy rules base that can assure the stability and steady state with relatively low error.

In fuzzy logic defuzzification is the process of producing a quantifiable result from given fuzzy sets for corresponding membership degrees. These will have a certain number of rules which transform a number of variables into fuzzy rule designed as to decide the pressure to apply the certain predefined result. Defuzzification is interpreting into predefined specific decision or real values. The processing stage based on IF-THEN statements comprises a group of logic rules, where its IF part is known the antecedent and the THEN part is known as the consequent. Typical fuzzy control systems have several rules.

Table-1 : Fuzzy Rule Base

e/ce	NB	NM	NS	ZO	PS	PS	PB
NB	NB	NB	NB	NM	NS	ZO	PS
NM	NB	NB	NB	NM	NS	ZO	PS
NS	NB	NB	NM	NS	ZO	PS	PM
ZO	NB	NM	NS	ZO	PS	PM	PB
PM	NS	ZO	PS	PM	PB	PB	PB
PB	ZO	PS	PM	PB	PB	PB	PB

The membership function for input variable of change in error, error and the output variable of the reference torque are as in fig. Here the Fuzzy Membership Function for Input Variable as input1 is shown in the Fig5. The Fig.4 shows the Fuzzy Membership Function for Input Variable as Variation in Error. Output Reference Torque as output variable is shown in the Fig.6.

To improve the dynamic capability and to overcome the problem the FLC is preferred. The fuzzy logic controller requires two inputs, the error in speed in the speed obtained by difference between the reference speed and actual speed another input is error change, which is the change between present error and previous error. Fuzzy logic controller gives the output based on the inputs to trigger the inverter switch Input to fuzzy

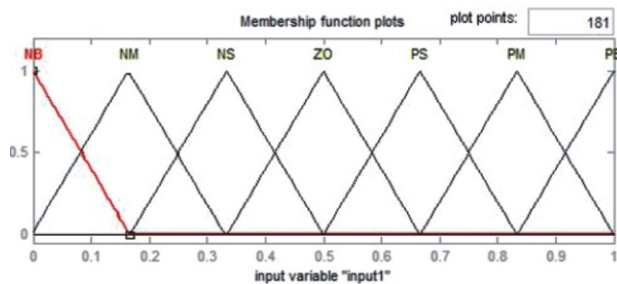


Fig-4 : Input Variable Error as Fuzzy Membership Function

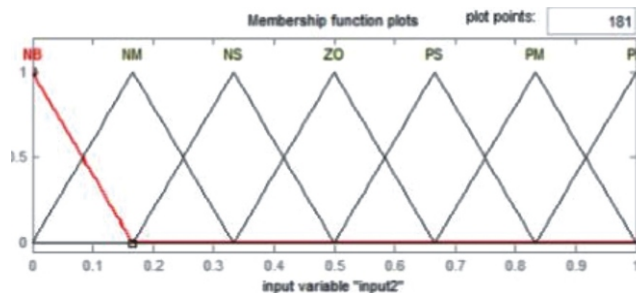


Fig-5 Fuzzy Membership Function for Input Variable Change in Error

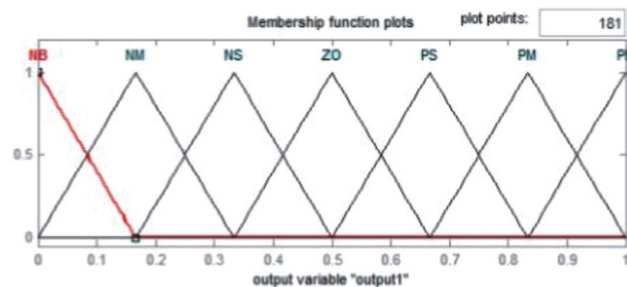


Fig.6 Fuzzy Membership Function for Output Reference Torque

logic controller changes when the load changes. Indicator function in classical sets is generalized by membership function of fuzzy sets. The membership functions utilized are of error change, error, and reference torque.

SIMULATION MODEL OF PROPOSED METHOD

Closed loop fuzzy controller model is simulated, designed and is presented below. Fuzzy logic controller is used to simulate diagram of BLDC motor as shown in Fig. 7. The gate pulses are applied from the hall signals and the DC source is applied to the inverter input. Inverter output is applied to the BLDC motor. Fuzzy logic controller is used Instead of PI controller for the speed regulation. The speed error is applied as the input for the Fuzzy controller. Fuzzy Logic Controller output is utilized as a reference current

signal generation which when compared with the actual current gives hysteresis controller.

RESULTS AND DISCUSSION

The speed response of the brushless DC drive system using FLC controller is as shown in Fig.10. The reference speed is set at 400rpm with the motor at rest stage with a settling time 0.02 seconds. Motor speed reaches the reference speed with a % overshoot of 6.667 with PI speed. The phase currents during the time of starting getting transient due to zero initial phase back emfs of machine. When the speed reaches reference speed, phase currents attains the reference current. For fuzzy logic controller the motor speed attains reference speed with settling time of 0.03

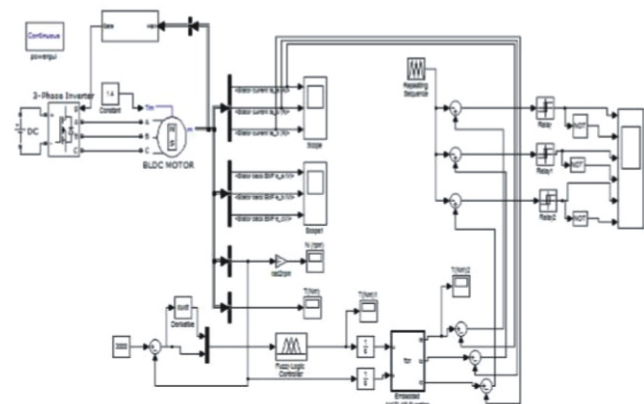


Fig-7 Simulation Diagram of BLDC motor using Fuzzy Logic controller

seconds, without any considerable overshoot and zero steady state error in speed. And phase currents are attaining to steady value, when actual current attains the reference value of current.

The speed of the BLDC motor attains 3000rpm. The electromagnetic torque variation of BLDC motor using fuzzy logic controller and the maximum value of rotor speed is 31 rpm. Time taken by rotor speed is to settle is 2.23sec. When using fuzzy logic controller in the feedback circuit based on its present error, it performs the operation and gives the output quantity. The speed response of the BLDC drive with FLC speed controller of the drive is faster than that of PI controller response. The PI controller shows an overshoot in speed, which is not desirable. The drive takes highest of permissible current to start the motor from standstill condition. The result clearly proves that the response of the drive is relatively faster with FLC controller than that of the PI

controller. Improved speed response in this work is of great value to industrial applications.

CONCLUSION

The FLC controller is designed for the BLDC motor drive to enhance the dynamic performance and to improve the speed characteristic of the drive. The simulation has been carried out for various operating conditions using FLC controller & conventional PI controller. The simulation results from the two controllers are compared on the basis of rise time & settling time for steady state and for dynamic state for sudden variation in load and set speed change. A FLC controller has been employed for the speed control of

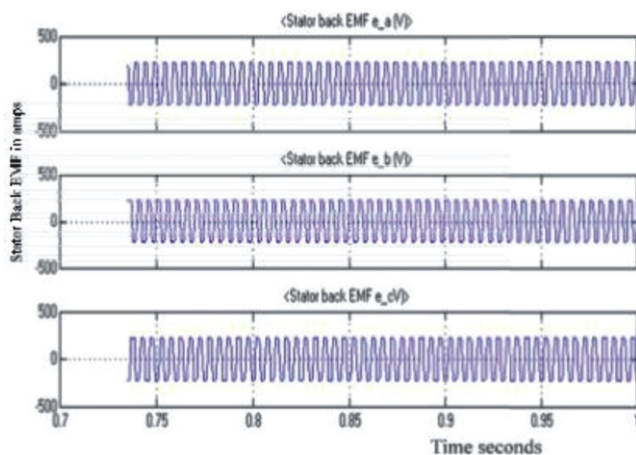


Fig.-8 Stator currents variation of BLDC motor using FLC

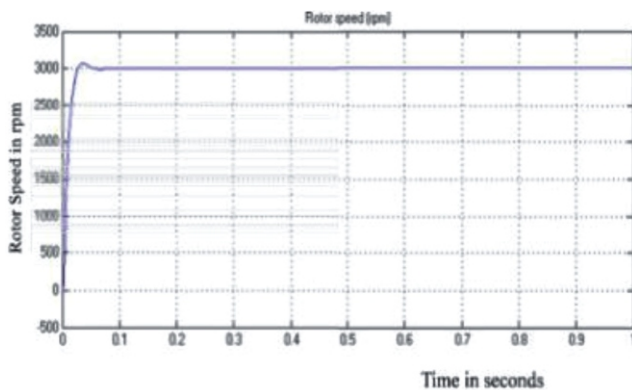


Fig.-9 Stator Back EMF of BLDC motor using FLC

BLDC motor drive and the performance of a fuzzy controller is improved. Effectiveness of the controller is proved by performance prediction capability over a wide range of operating conditions. Fuzzy logic controller enhances the quality of the speed response compared to conventional PI controller. While using

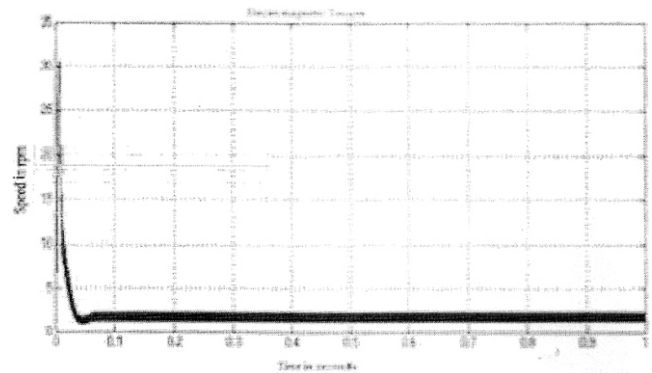


Fig: 10 Speed Response of BLDC motor using FLC

FLC Controller the dynamic capabilities is enhanced and based on the advantages parameter change and load perturbation are controlled. Thus the results by the FLC Controller are better than the conventional PI controller.

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EFFECT OF VARIOUS CONCENTRATION OF ZINC AND BORON ON GROWTH AND YIELD ATTRIBUTES OF OKRA (*ABELMOSCHUS ESCULENTUS* L. MOENCH) CV. PUSA SAWANI

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ABSTRACT

The present investigation entitled “Effect of micro-nutrient on growth flowering and yield of Okra (*Abelmoschus esculentus* L. Moench) cv. Pusa Sawani” was carried out during the summer season in 2009 at Horticulture research farm department of Horticulture Choudhary Charan Singh University Campus Meerut (UP). The experiment was laid out in randomized block design (RBD) with different concentration of Zn and B as well as nine different treatment combinations were used. From the results it was found that the treatment of Zinc and Boron @100 ppm significantly increased the height of plant, number of leaves per plant. When Zinc and Boron @100 ppm were applied separately the okra took only 42 days for the appearance of first flower and 46 days for days taken for appearance of first pod in comparison to treatment @ 50 ppm Zn and Boron which take (43, and 48) and (42.5 and 46.7 days) respectively. Thus the results clearly indicates that Zn and Boron (Zn and B) individually as well as in combination (Zn X B) significantly affected different growth and yield attributes.

Key words : Zn , Okra, Flower, Boron.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is a herbaceous, hairy annual plant belonging to the Malvaceae family. The leaves are heart shaped, flower with a crimson center, fruit or pod is tapering trianguled capsule and also is known as Bhindi in hindi, lady finger in English speaking country and Bamyan or Bamiyat in Arabic speaking country. India has the first position in the okra production. The estimated area under vegetable crops in our country is 10,238,000 ha (2016-17) with a production 178172,000 tons in which the area and production of okra is 507,000 ha and production is 6003,000 tons (1).

Okra finds a prominent place among vegetables in Indian homes. According to Aykroyd (1941) Okra pod contain water 88%, carbohydrate 7.7 %, protein 2.2 %, fat 0.2 %, fiber 1.2 %, mineral matter 0.7%, vitamin A-58 IU/100gm, vitamin C- 16 mg/100gm. Tender pods are eaten as boiled in the form of sliced and fried pieces and also used for thickening soup and gravies because of their high mucilage content. Mucilaginous extract of green stems are commonly used in India for clarifying sugarcane juice in Gur

product manufacturing and paper industry. The fruits have various medicinal values too. It aids in fever, chronic dysentery, catarrhal attacks, irritable states of the genito-urinary organs such as dysuria, gynorrhoea, leucorrhoea and in all cases attended with scaling pain and difficulty in passing urine.

MATERIALS AND METHODS

The present investigation was carried out during the summer season in 2009 at Horticulture Research Farm Department of Horticulture, Choudhary Charan Singh University Campus Meerut (UP). The experiment was laid out in randomized block design (RBD), with three Replication. After deciding the site for experiment, land was irrigated to have optimum moisture condition and the field was well prepared and divided in desirable no of plot. It was followed by sowing of seed at a distance of 30 × 30 cm. Different concentration of Zn and B as well as different treatment combinations used. Where Z₁-50ppm, Z₂-100ppm, B₁-50ppm, B₂-100ppm, C₀- control The treatments involved in the study were nine in numbers i.e. T-1 (Z₁B₁), T-2 (Z₁B₂), T-3 (Z₀B₁), T-4 (Z₂B₂), T-5 (Z₁C₀), T-6 (Z₂C₀), T-7 (B₁C₀), T-8 (B₂C₀), T-9 (C₀) were sprayed at 30 days

Table-1 : Impact effect of foliar application of different level of Zinc and Boron on growth, flowering and yield parameters of Okra (*Abelmoschus esculentus* L. Moench) cv. Pusa Sawani.

Treatment	Height of plant (cm)	Number of leaves/ Plant	Days taken for appearance of first flower	Days taken for appearance of first pod	Number of pods/ Plant	Length of pods (cm)	Fresh weight/ pod	Weight of pod/plant
Z ₁ 50PPM	66.01	16.85	43.00	48.00	10.00	10.53	5.74	70.64
Z ₂ 100PPM	68.15	19.10	42.00	46.00	9.87	11.42	6.10	76.43
B ₁ 50PPM	64.23	17.63	42.5	46.7	9.30	11.23	5.56	70.79
B ₂ 100PPM	67.63	19.00	41.9	47.00	10.00	11.29	5.81	72.84
Control C ₀	55.62	15.10	44.00	49	8.50	10.26	5.44	62.73
SEm±	0.311	0.202	0.111	0.077	0.153	0.105	0.077	0.321
CD at 5%	0.907	0.594	0.335	0.264	0.477	0.218	0.250	0.980

Table-2 : Interaction effect of foliar application of different level of Zinc and Boron on growth, flowering and yield parameters of Okra (*Abelmoschus esculentus* L. Moench) cv. Pusa Sawani.

Treatment	Height of plant (cm)	Number of leaves/ Plant	Days taken for appearance of first flower	Days taken for appearance of first pod	Number of pods/ Plant	Length of pods (cm)	Fresh weight/ pod	Weight of pod/ plant
Z ₁ B ₁	68.67	18.10	41.4	45.30	10.20	11.21	5.81	71.21
Z ₁ B ₂	71.50	19.57	40.7	44.43	10.43	11.70	5.92	73.06
Z ₂ B ₁	75.46	19.43	40.47	44.60	11.10	11.73	6.42	76.88
Z ₂ B ₂	79.43	21.00	39.00	44.10	11.70	13.13	6.57	81.83
Control C ₀	55.67	15.10	44.00	49.00	8.50	10.26	5.44	62.73
SEm±	0.311	0.202	0.111	0.077	0.153	0.103	0.077	0.321
CD at 5%	0.907	0.594	0.335	0.264	0.477	0.218	0.250	0.970

stage after sowing in the plot according to treatments, while in control, distilled water was sprayed. Five competitive plants were marked in each plot per replication and observations were recorded on these plants for Height of the plant, Number of leaves per plant, Days taken appearance of first flower, Days taken appearance of first pod, Number of pod Per plant, Length of pod, Fresh weight/pod, Weight of pod/plant. The statistical analysis of the data was done by R.B.D. method of experiment and the method "Analysis of variance" and the treatments compared with the help of critical differences.

RESULTS AND DISCUSSION

The favorable responses of different micro-nutrients viz. - Zinc and boron each at 50ppm and 100 ppm concentration were found on growth, flowering and yield of okra. The maximum height of plant 79.43 cm. was recorded in the treatment T-4 (Z₂B₂), where as the minimum height (55.62cm.) of the plant was observed in the control treatment T-9 (C₀). The reason for increasing in plant height by Zinc may be that it helps in the synthesis of tryptophan which is the precursor of Auxin (IAA) and which promotes the stem

elongation. An Increase in plant height with the application of Boron could be explained as due to its indispensable role in Photosynthesis, respiration and nitrogen metabolism. The result revealed that Zinc and Boron increased the height of plant. The result of the present study divulged with the result of (2) in papaya, (3) in (4) in celery plant. The application of Zinc and Boron in their different combinations was found to have a significant role on the number of leaves per plant. The maximum number of leaves per plant (21.00) was noticed in the treatment T-4 Zinc and Boron @ 100 ppm, while minimum number of leaves per plant (15.10) with control treatment T-9 (C₀). It might have been due to the enhancement of cell division and ultimately overall increase in growth. The application of Boron might have increased the translocation rates of sugars into different plant parts which is a basic material for the growth of particular organs. The Similar finding observed by (5) in okra, (6) in potato, (7) in tomato. Spraying of micro-nutrients Zinc and Boron produced early visibility of flowers in okra plants. The application of Zinc and Boron in their different combinations was found to have a significant role on the early visibility of flower

in okra. When the application of Zinc and Boron applied with in combination at higher concentration (100 ppm) gave the response to earliest flowering 39 days, whereas Z_1B_1 (Zinc and Boron @ 50 ppm) delay the flowering as 41.4 days and the control treatment T_9 (C_0) take the maximum days 44 days. The reason for the early visibility of flower with the application of Zinc might be due to the synthesis of tryptophane which is the precursor of Auxin (IAA) that promotes early flower initiation in different plants. Application of Boron had remarkable effect on the early visibility of flower due to their role as an activator in different enzymes acting as early flower inducers. The result of the present study divulged with the result of (8) in cucumber and (9) in *Gladiolus*. The minimum days for first pod appearance 44.10 days was recorded with foliar application of Zinc and Boron With a combination of (100 ppm) in the treatment T_4 (Z_2B_2), where the maximum days (49 days) for the first pod appear was observed in the control treatment T_9 (C_0). Beside Zinc and Boron influenced the no of days for appearance first pod compare to control treatment. The result revealed that Zinc and Boron minimized the no of days for fruiting in plants. The result of the present study divulged with the result of (9) in cucumber and (9) in *Phaesolus vulgaris*. The reason for early fruiting with the application of Zinc might be due to the help in reproductive process of plant and also help in development of reproductive organs of plant. Boron had a significant effect on the early appearance of pod which may be due the help in getting the pollen germination and as it play a positive role in cellular differentiation in plants. The application of micro-nutrients Zinc and Boron individually or in combination show the effect on number of pod/plant. It is conform from table (1) & table (2) that zinc @ 100 ppm and Boron @100 ppm significantly increase the number of pod/plant (9.87 and 10 respectively) as compared to control (8.5). The table (2) reveals that Zinc and Boron applied with combination of Z_2B_2 (1

00 ppm Zinc and 100 ppm Boron) gave the maximum no of pod/plant (11.70), followed by Z_1B_1 (50 ppm Zinc and 50 ppm Boron) 10.20 pods/plant. It is clearly indicate that Zinc and Boron (Z and B) individually as well as in combination (Z X B) significantly increase the number of pod/plant as compared to control. These results are quite comparable with the findings of (5) in

okra, (10) in okra and (9) in French bean. The getting maximum no of pod per plant could be explained as due to the enhanced cell division in zinc applied plants. The increased number of pods per plants by might be due to the help in the mobilization of food material from leaf to required palaces. It is indicate from table (1) that zinc @ 100 ppm and Boron @100ppm significantly increase the length of pod (11.42 cm and 11.29 cm respectively) as compared to control (10.26 cm.). The table (2) reveals that Zinc and Boron applied with combination of Z_2B_2 (100 ppm Zinc and 100 ppm Boron) gave the maximum length of pod (13.13 cm.), where as Z_1B_1 (50 ppm Zinc and 50ppm Boron) gave the length of pod (11.21 cm.) It is clearly shown that Zinc and Boron (Z and B) individually as well as in combination (Z X B) significantly increase the length of pod as compared to control. The result also confirm with the findings of (5) and (10) on okra. The length of pod was greatly influenced by the application of micro-nutrients viz-Zinc and boron, singly as in their combinations. The reason for increasing the length of pod by zinc might be due to the help in enhancement of cell division, cell elongation and ultimately an increase in pod length. Increasement in pod length by the application of Boron might be due to as it helps in cell elongation processes and in nitrogen and carbohydrate metabolism. According to the data present in table(1) that Zinc @ 100 ppm and Boron @ 100ppm significantly increased the fresh weight/pod 6.11 g and 5.81 g, respectively as compared to control 5.44 g. Table (2) reveals that that Zinc and Boron applied with combination of Z_2B_2 (100 ppm Zinc and 100 ppm Boron) gave the maximum fresh weight/pod 6.57 g, where as Z_1B_1 (50 ppm Zinc and 50 ppm Boron) gave the less fresh weight/pod 5.81 g as compared to Z_2B_2 combination. It is clearly shown that Zinc and Boron (Z X B) individually as well as in combination (Z X B) show the significantly Increasement in fresh weight/pod as compare to control. The foliar application of micro-nutrient viz-Zinc and Boron singly as well in combination markedly influenced the weight of pods. The application of Zinc under higher concentration (100 ppm) increased maximum weight of pods followed by Boron. The combine application of micro-nutrients was found superior over individually application as well as control. The Increasement in fresh weight of pod what attributed to the Increasement

in length and diameter of pods. The similar findings were also reported by (11) on Capsicum. (12) on okra. (13) on phaseolus vulgaris and (10) on okra. According to the data presented in the table the application of Zinc @ 100 ppm and Boron @ 100ppm, significantly increased the weight of pod/plant 76.43 g and 72.84 g, respectively as compared to control 62.73 g. Table reveals that Zinc and Boron applied with combination of Z_2B_2 (100 ppm Zinc and 100 ppm Boron) gave the maximum weight of pod/plant 81.83 g, where as Z_1B_1 (50 ppm Zinc and 50 ppm Boron) gave the less weight of pod/plant 71.21 g as compared to Z_2B_2 combination. It is clearly shown that Zinc and Boron (Z X B) individually as well as in combination (Z X B) show the significantly Increase in weight of pod/plant as compare to control. As regarding the weight of pod per plant, it increase with all the micro-nutrients applied singly or in combination. The application of Zinc Under higher Concentration (100 ppm) produce maximum weight of pods par plant followed by Boron. Combine application of zinc and Boron under concentration (100 ppm) was found superior over individual application and control. The increment in weight of pod per plant was attributed to the increase in Pod length, pod diameter, weight per pod, and number of pod per plant. The findings are in conformity with those of (5) Okra and, (10) on okra and (7) on tomato.

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STUDY OF PLANT GROWTH REGULATORS FOR MULTIPLICATION OF GILOY (*Tinospora cordifolia*)

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INTRODUCTION

Tinospora cordifolia commonly named as Giloy, Its belonging to the family *Menispermaceae* is a genetically diverse, large, deciduous climbing shrub with greenish yellow typical flowers, found at higher altitudes. In racemes or racemose panicles, the male flowers are clustered and female are solitary. The flowering season expands over summers and winters. A variety of active components derived from the plant like alkaloids, steroids, diterpenoid lactones, aliphatics, and glycosides have been isolated from the different parts of the plant body, including root, stem, and whole plant. Medicinal plant species are getting endangered status at an increasing rate owing to urbanization, deforestation and uprooting of complete plants to procure plant extract for the production of medicines by pharmaceutical companies (Mohammaed MS & Kumar B V, 2012). Consequently, these plants have been losing their status from their natural habitat. *T. cordifolia* also agonizes from poor seed set and poor germination in its natural habitat. Stem cuttings, though useful for propagation, are dependent upon weather conditions for proper growth. Over exploitation has led to the acute scarcity of this plant to meet the present-day demand. Because of over utilization from natural environment and application in medicine (de Wet B., 2011), its conservation and varietal improvement through various strategies like tissue culture, agro forestry, genetic engineering and reproductive biological techniques is paramount. This plant species has also been listed in prioritized medicinal plant of agro climatic zone 8 (Madhya Pradesh, Uttar Pradesh & Rajasthan) by National Medicinal Plant Board, (NMPB), New Delhi, India (Kala C P & Sajwan B S., 2007). India is bestowed with enormous biodiversity of medicinal plants. Among them *Tinospora cordifolia* has a wide array of bioactive principles as well as it has been proven medicinally

important plant, have not received considerable scientific attention.

Plant Material

In this study, mature nodal segment of Giloy (*T. cordifolia*) having auxillary bud were collected from different parts of the city. Mature nodal segment of *Giloy* was used as source of explants. Shoot tips were collected to be used as explants for micropropagation. This plant was collected for further research in department of Biotechnology, Keral Verma Subharti College of Science, Swami Vivekanand Subharti University, Meerut.

Inoculation of explants

After proper sterilization of explants, the explants were brought to clean laminar air flow cabinet immediately and inoculated on experimental media under aseptic condition. All the cultures were kept in growth chambers at $25 \pm 2^{\circ}\text{C}$ under 16 hr illumination of cool white fluorescent tubes with light intensity of 4000 lux except In some experiments otherwise explained. A total of 50 cultures were raised for each treatment and the experiments were repeated twice.

Culture Establishment

Shoot tips about 0.5 cm in length were inoculated on MS media, supplemented with different concentrations (0.5, 1.0, 2.0 and 3.0 mg/l) of growth regulators (BAP and KIN). After 25 days, shoots were sub-cultured on same medium for multiplication. Percent response of explants, number of days required for shoot induction, number of shoots formed and shoot length were periodically recorded. Final data were collected and analyzed after 60 days of inoculation.

Rooting and Acclimatization

In vitro regenerated shoots were excised and planted on half strength MS medium supplemented with 1.0 mg/l IAA and IBA for rooting, after they attained a height of 2-3 cm. MS medium with double the usual

concentration of sucrose was used for rooting. The rooted plantlets were gently pulled out of the medium, washed in running tap water and any remains of medium sticking to roots were carefully removed. The plantlets with well-developed roots were then transferred to small plastic pots having sterilized soil and sand mixture (1:1). For initial 15 days, the pots were covered with transparent polythene bags to maintain high humidity; then the bags were punctured for air circulation. Plants were watered with $\frac{1}{4}$ WP salt solutions on alternate days. After this, the pots with plantlets were transferred to Polyhouse for further hardening.

RESULTS AND DISCUSSION

Tinospora cordifolia commonly named as Giloy, Its belonging to the family Menispermaceae is a genetically diverse, large, deciduous climbing shrub with greenish yellow typical flowers, found at higher altitudes. Medicinal plant species are getting endangered at an increasing rate owing to urbanization, deforestation and uprooting of complete plants to procure plant extract for the production of medicines by pharmaceutical companies. Many modern medicines such as Digitalis, Vinblastine, Aspirin, Quinine and Paracetamol had their origin from the natural compounds of medicinal plants viz., foxglove (*Digitalis purpurea*), Madagascar periwinkle (*Vincarosea*), willow bark (*Salix* spp.), Quinine bark (*Cinchona officinalis*).

Recently, the plant is of great interest to researchers across the globe because of its reported medicinal properties like anti-diabetic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritis, anti-oxidant, anti-allergic, anti-stress, anti-leprotic, anti-malarial, hepatoprotective, immune modulatory and anti-neoplastic activities.

Giloy (*Tinospora cordifolia*) is a medicinal plant its uses in different areas mainly focused area is medicinal valuable plant. It has the different types of medicinal curable like-Anti-Diabetic Activities, Immuno-modulatory Activities, Anti-toxic Activities, Anti-HIV Activities, Anti- Cancer Activities, Anti-Microbial Activities, Anti-Oxidant Activities, etc.

The plant culture was raised in MS Media (Murashige and Skoog) with different concentrations of growth

regulators. The observations, as recorded from various combinations.

Giloy is emerging as a multipurpose plant with diverse medicinal attributes. Due to its enormous medicinal and phytochemical importance, this plant species has been highly exploited for commercial purposes. At present, the species is facing rarity in natural habitats of India. The species deserve more evaluation for its therapeutic value using sophisticated tools and techniques. This review highlighted only a few aspects of investigation on this plant species. Biomedical study on the species and information based on metabolomics besides other biotechnological investigations including molecular characterization of diverse germplasm constitute the future scope of the review of this crop.

The effect of cytokinins (BAP and KIN) on shoot tip explants, time taken for bud initiation was also reduced, at higher concentration, the response of explants was decreased. From all these observations, it was concluded that explants cultured on MS medium took longer time for bud initiation. This media proved better in terms of time of bud initiation, number of shoots and enhancement of shoot length in *Tinospora cordifolia*. Similar results shown by *Tornero et al.*, 2000 and *Sharma and Vashistha*, 2010 in different crops. Whichever of the two cytokinins tried, BAP was more effective than KIN for percent response of explants, time taken for shoot bud induction and number of shoots on both the media. Similar observations were made by *Martin et al.* (2005) in *Dendrobium* hybrids and *P. santalinus*.

In rooting formation, No rooting was observed on half-strength MS basal medium until the medium was supplemented with auxins. For rooting, IBA was found to be more effective than IAA and it induced healthy and elongated roots.

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GENETIC VARIABILITY HERITABILITY AND GENETIC ADVANCE ANALYSIS IN OAT (*AVENA SATIVA* L.)

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ABSTRACT

The experiments were conducted at Students Instructional Farm and in seed technology laboratory of CSAUA&T, Kanpur over two growing Seasons of Rabi during 2016-2017 and 2017-18. A total of twenty five genotypes of oat were evaluated under field for sixteen and controlled conditions for four traits to measure the genetic variability. All of the genotypes were characterized according to twenty quantitative and seed traits. The genotypes differed significantly for all the traits studied and relatively wide range of mean for all traits indicated the presence of variation among the tested genotypes. High phenotypic and genotypic coefficient of variation, high heritability coupled with genetic advance as percent of mean based on pooled analysis revealed for seedling dry weight per plant and seed vigour index indicating that simple selection could be effective.

INTRODUCTION

The common oat (*Avena sativa* L.) is a cereal crop grown primarily its grains. Oats are suitable for human consumption and also used as live stock feed and fodder in forms of green and dry. This crop has three naturally occurring ploidy levels are known within the genus, like diploid ($2n=2x=14$ having A and C genome), tetraploid ($2n=4x=28$ with AB and AC genome) and hexaploid ($2n=6x=42$ containing ACD genome) and belongs to family gramineae or poaceae. (6). Oats are one of the highly nutritious cereals for human use, but suffer due to the advantage of large proportion of hulls (20-30%) which need to be removed from the grains. In human health point of view, the use of oat meal/whole grain in breakfast lower the cholesterol levels prevent heart failure enhance immune response to infection and stabilize blood sugar. On the other hand, it is also used as medicinal ingredient to protect against cancers and heart diseases, enhance immune response to infection, stabilize blood sugar, smooth skin conditions and other ailments, as well as use as an antispasmodic, a diuretic, an emollient, a nerve tonic, a supplement, an aphrodisiac, and a stimulant. Oat mostly recognized as an animal feed but oats may also be consumed by human in different ways, such as oat grain is an ingredient in a wide range of food products including breakfast cereals, porridge, cookies, breads and muffins, crackers, snacks, beverages, meat extenders

and baby foods. For further improvement in any breeding programme, always there is need to evaluate the material available to find out the good lines for breeding and hybridization purpose. Different agronomic traits have been used as prime objective to evolve new breeding materials. The choice of breeding programme depends mainly on variability available and stable performance of genotypes in the basic material or available with breeder. Genetic variation within and between population crops species is major interest of Plant Breeders. In order to genetic diversity the genotypic profile of oats in U.P. it is necessary to identify and evolve more number of genotypes having high potential of grain and fodder yield and quality through application of well and systematic breeding programme.

MATERIALS AND METHODS

The experiments were carried out at Students Instructional Farm and seed technology laboratory of CSAUA&T, Kanpur over two growing Seasons of Rabi during 2016-2017 and 2017-18. A total of twenty five genotypes namely; CSOFSC12-2, CSOFSC11-5, Kent, CSOFSC11-4, CSOFSC11-1, CSOFSC12-1, UPO212, ANDO1, JHO03-91, CSAOSC12-1, ANDO2, OS403, OS344, OS1, SKO105, NDO25, JHO2007-2, CSAOSC14-6, SKO101, JHO2007-2, JHO03-93, NDO612, OS6, JHO851 and JHO99-2 collected from different geographical origins were evaluated in RBD with three replications under field

Table 1 : Analysis of Variance Mean sum Square for Yield and its Contributing Traits in oat on based Pooled Analysis.

S.V.	D.F.	DF	DM	BYPP (g)	NRTTP	LL (cm)	LW (cm)	PH (cm)	NNPP	NLPP	BYPP (g)
Rep.	2	0.92	1.31	64.82	0.44	51.58	0.03	1.09	0.05	0.10	3.13
Treat.	24	5.18**	11.86**	1208.14**	4.82**	25.96**	0.06**	69.23**	0.22**	0.29**	0.99**
Error	48	0.11	0.14	107.59	0.26	2.50	0.00	2.44	0.04	0.05	0.03
Rep.	2	13.84	0.99	0.05	7.08	14.36	0.07	0.76	0.00000	0.07	0.05
Treat.	24	128.60**	0.70**	0.78**	17.64**	7.60**	8.07**	33.71**	0.00013**	0.77**	0.19**
Error	48	8.83	0.05	0.03	0.62	0.61	0.16	0.97	0.00002	0.03	0.01

DF= Days to flowering DM= Days to maturity BYPP= Biomass yield per plant (g) NRTTP= Number of Reproductive Tillers per plant LL= Leaf length (cm) LW= Leaf width (cm) PH= Plant height (cm), NNPP= Number of Nodes per plant NLPP= Number of Leaves per plant BYPP= Biological yield per plant (g) NSPMS= Number of seeds per main spike DWPP= Dry weight per plant TW= Test Weight HI= Harvest Index (%) SL=Spike Length (cm) SG= Seed Germination (%) SLL= Seedling length (cm) SDWPP= Seedling dry weight SVI= Seed Vigour Index SYPP= Seed Yield per Plant (g)

Table 2 : Estimates of Phenotypic, Genotypic Coefficients of Variation, Heritability and Genetic Advance in oat on based pooled Analysis.

Characters	GCV (%)	PCV (%)	Heritability (%)	Genetic Advance	GA as % mean
Days to 50% Flowering	1.48	1.53	93.54	2.59	2.95
Days to maturity	1.73	1.77	96.53	4.00	3.51
Biomass yield per plant (g)	11.63	13.22	77.32	34.70	21.06
Number of reproductive tillers per plant	10.23	11.08	85.14	2.34	20.44
Leaf length(cm)	7.11	8.17	75.79	5.02	12.76
Leaf width (cm)	7.69	8.58	80.35	0.25	14.19
Plant Height (cm)	3.75	3.95	90.11	9.23	7.34
Number of nodes per plant	4.57	5.96	58.86	0.38	7.22
Number of leaves per plant	5.12	6.63	59.68	0.45	8.15
Biological yield per plant (g)	4.93	5.16	91.50	1.11	9.72
Number of seeds per main spike	8.51	9.40	81.88	11.78	15.86
Dry weight per plant (g)	5.41	5.95	82.80	0.87	10.14
Test weight (g)	12.38	13.13	88.95	0.97	24.05
Harvest Index (%)	7.78	8.20	90.13	4.66	15.22
Spike Length (cm)	5.25	5.90	79.30	2.80	9.63
Seed germination in percent	1.96	2.02	94.32	3.25	3.92
Seedling length (cm)	15.90	16.60	91.81	6.52	31.39
Seedling dry weight per plant	25.46	27.43	73.20	0.01	41.36
Seed vigour index	25.90	26.39	89.06	0.96	48.41
Seed yield per plant (g)	7.05	7.47	89.07	0.48	13.70

condition except germination in percent, seedling length, seedling dry weight and seed vigour index traits. Each line was grown in a row of 4 meter length apart 30 cm line-line and plant to plant spacing of 10 cm and under controlled condition ten plants were used for seed characters. Recommended package of practices were followed to raise a good crop under field condition. The data were recorded on five and ten for seed traits randomly selected plants in each plot for sixteen traits and four seed traits namely; days to 50%

flowering, days to maturity, plant height (cm) numbers of reproductive tillers per plant, biomass yield per plant (g), leaf length (cm), leaf width (cm), number of leaves per plant, number of nodes per plant, spike length (cm), number of grains per spike, grain weight per main spike (g) 100 seed weight (g) biological yield per plant (g), harvest index (%), dry weight per plant (g) and seed yield per plant (g.) For analysis work computer software windostat was used which uses the following for further detailed analysis. Analysis of

Variance was calculated by formula of (8) and Fisher (2), Heritability, GCV and PCV as per given formula by (1), Genetic advance by suggested method of (4).

RESULTS AND DISCUSSION

The pooled analysis of variance for randomized completely block design with resopesct to twenty five genotypes were exhibited significant differences among the genotypes used in the present study for all twenty characters studied, indicating the sufficient genetic variation among the genotypes for all the traits (Table-1). The magnitude of PCV was greater than the corresponding GCV for all the characters indicating importance of environment in expression of characters. On the basis of result Out of 20 characters studied seed vigour index, and seedling dry weight per plant showed high GCV and PCV. High heritability coupled with high genetic advance as percent of mean was observed for seed vigour index, seedling dry weight per plant, seedling length, test weight, biomass yield per plant and number of reproductive tillers per plant, which revealed that these traits might be under control of additive gene effects and therefore they are more reliable for effective selection (Table-2). These results for some or more traits were conformity with the findings of the earlier scientists (3, 5, 7, 9-11).

CONCLUSION

Based on this study genetic variable genotypes among different traits which can utilize directly for selection of best performing for high seed yield and cultivars may be recommended for cultivation under diverse environmental conditions.

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APPROACH FOR ENHANCE THE FARMERS' INCOME THROUGH HORTICULTURE

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INTRODUCTION

Intend to upgrade the horticulture along with Indian agriculture, the government of India set a goal to double the farmers' income by 2022 as horticulture is a very important sector in Integrated Farming System (IFS). The Indian agricultural land covers an area of 140.0 million hectares out of which, 17% of area is dedicated to horticultural crops that contributes to 30% of total agricultural GDP (gross domestic product). The horticulture crop production surpassed food crop production for the first time during 2013-14. For the last 5 years horticultural produce is surpassing the produce of other agricultural commodities, which stood at 271 MT this time and 25.87 million hectare of horticultural land produced 314.67 MT (*Indian horticulture database, 2018-19*) of produce, which is a good trend. Honey production is a potential sector in horticulture; hence apiculture should be integrated with fruit and vegetable production for increasing the income of farmers. This is only due to non-availability of quality planting material, dwindling status of natural resources, abundance of resource poor farmers and low adoption of modern technologies. The challenge is to enhance productivity by increasing the factor productivity of all the horticultural production inputs, and at the same time sustaining it by adoption of good practices and precision farming principles. The Horticulture is diversified to cover different sub-sectors for examples- vegetables, fruit crops, spices, flower crops, plantation crops, medicinal & aromatic plants and mushrooms. The horticulture section is doing well in India when compared with others food crops, since it fetches good price because of its nature of seasonality. Generally there are three ways in which income of farmers may be enhanced viz. increasing the gross income, reducing the cost of cultivation and stabilizing the income and arrange the market facilities. Reduction in cost of inputs will instantly reduce the cost of production resulting the improvement in the return. Use of soil testing which

promoted by the government through introduction of soil health card can help considerably in proper land use and identification of nutrient and water requirements for optimum crop productivity. The estimation of the potential profits can be drawn by the fact that a farmer producing wheat of 1 kg gets 10 times higher prices for the same produce in horticulture section. And fruits like banana fetches as much as 30 folds more remuneration. Flowers can draw up to 30-35 times of remuneration. Considering this high potential, the concept of improving and doubling farmers income can work magically with horticultural crops. There is a need of shift from traditional crops and cropping pattern. Export in Indian horticulture section has been gaining heights. Every other fruit/vegetable type uses different process/method for the protection and preservation of produce. Uses the farmers' practices are a) deeply ploughing of agricultural land during hot summer, b) use of good quality crop seeds, c) follow crop rotation and the organic farming. The advancements also face gaps when we talk of storage houses for potato, tomato and onion, which are considered to be need base magic crops. The first and foremost thing for improving farmers income is to create market for farmers and provide market access and links for growing their business. The three crops potato, onion and tomato makes or breaks the industry. We should have a calendar of production for the various crops and analyze their condition likewise. Alternative sources of income along with horticultural crops should be looked into, like Apiculture, where-in the bees also helps in the pollination and also draws extra income for the farmers.

Schemes started by central and state government

(1) Mission for Integrated Development of Horticulture (MIDH) : The govt. is also promoting Mission for Integrated Development of Horticulture (MIDH) scheme for the holistic growth of the horticulture sector covering fruits, vegetables, root &

tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa and bamboo. Starting with nursery development, covering sustainable irrigation practices, emphasizing on subsidies for storage structures till market linkages, all the prospects are taken care of, under MIDH. Fruits and vegetables, our source of vitamins and nutrients; Spices, the king ingredient of Indian food which has an eminent position in our culture, extending from North to South India; Garlands and flowers beautifying every event and festival makes one of most interesting arms. There are a number of programmes which are being implemented by Government of India towards increasing farmers' income. The Government of India (GOI) contributes 60%, of total outlay for developmental programmes in all the states except states in North East and Himalayas, 40% share is contributed by State Governments. In the case of North Eastern States and Himalayan States, GOI contributes 90%.

(2) Million farmers' School program (Kisan Pathshala) : Ever since Indian honorable Prime Minister Narendra Modi ji announced his target of doubling the farmers' incomes by 2022 at farmers rally in Uttar radish in 2016, the central govt as well as severe state governments have remained occupied with developing ways and means to achieve this target the proposal deadline. The UP government's Million Farmers School (MFS) program is one such innovation effort to enhance farmers' incomes through dissemination of agriculture related information on technology and modern farming methods. MFS also popularly known as 'Kisan Pathshala' is an extension program that government of up initiated in 2017 with a view to encourage the use of modern farming techniques, to make farming more profitable, sustainable and resilient. MFS integrates various facets of agricultural knowledge into a packed format and delivers it through village-level training to farmers across all districts in state. The main objective of MFS is to impart agricultural knowledge and techniques to farmers which in turn can increase agriculture /Horticulture crops-to promote the poly house cultivation to get more profits in off-season, improve soil health and promote integrated and diversified farming system. Previous strategy for development of the horticulture sector in India focused primarily on

raising horticultural output and improving the food security. This strategy did not explicitly recognize the need to raise farmers' income and did not mention any direct measure to promote farmers' welfare. As a result the income of the cultivators remained low still after the 70 years of independence which is evident from the incidence of poverty among farm households. Realizing the need to pay special attention for the welfare of farmers and to reduce agrarian distress our Indian government set a goal to double farmers 'income by 2022.

The farmers' income can be made double by a number of measures which is broadly divided into five categories-

(a)Enhancing income by elaborating productivity

Improving the agriculture productivity in rainfed regions which comprises about 50% of total arable lands

Diversification towards high value horticultural crops

Use of biotechnology in crop and livestock production

Increase in cropping intensity

Promote to value added products

(b) Agri-Input and Water channel

Reducing the crop losses

Integrated water use policy

Fertilizer subsidy and rationalizing the Fertilizers subsidy and rationalizing the NPK pricing

Farm Mechanization

Facilitation of micro-irrigation in horticulture sector in rainfed areas

(c) Integrated Farming system (IFS)

Promotion of low volume and high value horticulture crops

Promotion of poultry farming and dairy husbandry

(d) Definite policy measures

Diversification of agriculture in 1st green revolution states like Punjab, Western Uttar Pradesh and Haryana

Establishing special agriculture zones like cardamom of Sikkim & spices for Kerala

Strengthening food agriculture program

(e) Greater market price recognition

One major stumbling block in the promotion of horticulture is the lack of cold storage facilities. There are not enough places where farmers can store fruits and vegetables. This also makes it difficult to transport the products over long distances. Improving agricultural infrastructure like storage system to reduce the storage losses. The launch of National Agriculture Market requires easing of norms of licensing to enable seamless participation of buyers from across the country, movements of goods without restriction, harmonization of tax laws (including a uniform GST), standardization of grades and recognition of electronic trades.

Reducing the post harvest losses

Value addition to horticulture crops

A few crops have great potential for value addition. Potato production in India has ranged between 52.58 million tonnes from 2.18 million hectare area. Prices disruption when production touches the higher end of that range. If 5-7 mt were to be absorbed for use in the mid-day meals as processed potato flake-based products, a massive new food industrial segment would emerge. Additionally, if the government were to mandate that all wheat flour sold in the country carries 5 per cent potato flour, the problem of glut in potato production can be overcome.

Appropriate policy strength

Diversification of horticulture with mushroom cultivation, apiculture, sericulture, backyard farming as well as poultry farming

Ensuring availability of quality seeds including hybrids of Vegetable crops, flowers and planting material of fruit trees for better quality and yield

Rejuvenation of unproductive and old fruit orchards

Revisiting zones for different crops keeping into account the changing climate particularly in hills

Advancement of organic farming practices in vegetable and fruit production

Encouragement of off season vegetables and flowers in protected condition

Proper post harvest management of produces in order to reduce the spoilage

Increase in cropping intensity

Value addition of vegetables, flowers, medicinal & aromatic plants as well as spices. (Oleoresin, dye, medicine, perfumery and dry flower etc)

Strengthening Organic Food Programme for India

Improvement site specific integrated nutrient and pest management

Resource use efficiency or saving in cost of production

Requisite to Double Farmers' Income

Prior planning for development of the agriculture sector in India has focused primarily on raising agricultural output and improving food security. Farmers' income also remained low in relation to income of those working in the non farm sector.

The strategy did not explicitly recognize the need to raise farmers' income resulting in low income of farmers.

This can have an adverse effect on the future of agriculture in the country, leading to food insecurity.

India also witnessed a sharp increase in the number of farmers suicides due to losses from farming, shocks in farm income and low farm income.

The low farm income is forcing more and more cultivators, particularly younger age group, to leave farming.

However, there is need to double farmers' income to promote farmers' welfare, reduce agrarian distress and bring consistency between income of farmers and those working in non-horticultural profession.



INTEGRATED NUTRIENT MANAGEMENT FOR THE YIELD AND QUALITY OF BOTTLE GOURD

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ABSTRACT

The present investigation was carried out at Horticulture Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut 250110, U.P. India. The experiment was conducted in Randomized Block Design with three replications using cv. Pusa Naveen, with treatments, two kinds of organic manures (FYM and vermicompost) alone and in combination with two kinds of bio-fertilizers (Azotobacter and PSB) and reduced doses of chemical fertilizers were tested in comparison with control i.e. without any nutrient application. On the basis of results, the application of 50% RDCF (50:25:25 NPK kg ha⁻¹) + 2.7 t ha⁻¹ FYM + 1.62 t ha⁻¹ vermicompost and Azotobacter, PSB each 5 kg ha⁻¹ to the crop found to be sound integrated practice, where it recorded maximum vine length (552.66 cm), fruit set percent (48.35%), yield per vine (7.31 kg), yield per hectare (381.61q). According to the B : C ratio, the treatment T₁₂ was found to be profitable and remunerative.

Keywords : Bottle gourd, FYM, biofertilizer, vermicompost, Azotobacter, PSB.

INTRODUCTION

Bottle gourd belong to cucurbitaceae family, cucurbitaceae family is a large group of vegetable crops. It is extensively grown in tropical and subtropical world wide. Cucurbitaceae family consist a large number of vegetable viz. Cucumber, melons, pumpkin, squash and gourd. Among gourds, bottle-gourd (*Lagenariasiceraria L*) commonly known as calabash, white gourd, long melon, New guinea bean and Tasmania bean. Bottle gourd is commonly grown kharif and summer season through the country. However, during winter season fertilizer play important role in growth and good quality fruit in bottle gourd. Therefore, nitrogenous and phosphatic fertilizer contribute a lot fulfilling the nutrient requirement but their excessive chemically fertilizer caused health and ecological hazard and deteriorate physiochemical properties of soil. Some nitrogenous substance like urea absorbed by plant root or convert nitrates which are absorbed. Therefore, find an alternate or complementary source of nutrients that may enhance the yield without having adverse effects on soil properties and fruit quality. Farm yard manure (Organic manures) and vermicompost and biofertilizer (bio-inoculants) produce organic acids which have the capacity of holding cation and anions so integration of

nitrogenous fertilizers with organic manures and bioinoculants is more beneficial in releasing cations slowly to the plants. Hence, Addition of organic manures and biofertilizer maintain buffer soil pH and help availability of nutrient to the plant. Since no work has been done by the former on integration of chemical fertilizer with bio-inoculant in bottle gourd, so the experiment was conducted to find out the integrated effect of chemical fertilizers in combination with organic manures and bio-inoculants for obtaining a the high economic return on growth yield and quality of bottle-gourd.

MATERIAL METHODS

The trial was carried out at Horticulture Research Centre and analytical work was carried out at Soil Science Laboratory, Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut, during the year 2017-2018. A soil of the experiment plot was sandy texture, low available nitrogen (152.40 kg/ha) and medium in phosphorus (22.30 kg/ha) and potassium (110.80 kg/ha).

A plot size of 5x4 m² was maintained and plants were spaced at 0.50 x 0.50 m thereby keeping 20 plants per plot. The cultivar used for trials was Pusa Naveen. All the cultural practices were applied. All the

Treatment No.	Treatment details
T1	100:50:50 N:P:K kg/ha.(Recommended Dose of Chemical and fertilizers)
T2	10 t/ha FYM
T3	6 t/ha Vermicompost
T4	10 t/ha FYM + 5 kg/ha Azotobacter + 5 kg/ha PSB
T5	75% RDCF + 1.62 t/ha Vermicompost + 5 kg/ha Azotobacter + 5 kg/ha PSB.
T6	50% RDCF + 3.4 t/ha Vermicompost + 5 kg/ha Azotobacter + 5 kg/ha PSB
T7	25% RDCF + 4.91 t/ha Vermicompost + 5kg/ha Azotobacter + 5 kg/ha PSB.
T8	25% RDCF + 7.6 t/ha FYM + 5 kg/ha Azotobacter + 5 kg/ha PSB
T9	50% RDCF + 2.7 t/ha FYM + 1.62 t/ha Vermicompost + 5 kg/ha Azotobacter + 5 kg/ha PSB.
T10	Control.

characters studied like length of main vine (cm), Number of days required to bear 1st Female flower, Sex ratio, Number of fruits/vine, Fruit set (%), Yield per vine (kg), Yield per hectare (q), Length of fruit (cm), Diameter of fruit (cm), Average weight of fruit (gm) and B:C ratio was subjected to statistical analysis using variance technique as described by (1).

RESULT AND DISCUSSION

The growth parameters like main vine length, intermodal length etc., increased significantly with reduction of inorganic fertilizers in combination with organic manures and biofertilizers over the exclusive application of organic manures, chemical fertilizers and combined application of both. The vine length was observed to be maximum (552.66 cm) with application 50% RDCF + 2.7 t/ha FYM + 1.62 t/ha Vermicompost + 5 kg/ha Azotobacter + 5 kg/ha PSB in combination with FYM 2.5 t ha⁻¹, vermicompost 1.65 t ha⁻¹, azotobacter 5 kg ha⁻¹ and PSB 5 kg ha⁻¹ i.e. T9. Similar results were also obtained from (2, 3).

The results obtained in respect of the days required to bear the female flower, the treatments found to be the significant. The minimum days (47.12) for female flower were recorded in the treatment 75% RDCF along with vermicompost and biofertilizers i.e. T7. However, maximum number of days required to bear first female flower was recorded in the treatment T10 and T3. The results obtained in respect to the number of

Table 1 : Impact of different organic, inorganic and biofertilizers on growth characters of Bottle gourd.

Treatment No	Main vine length (cm)	No. of days required to bear 1st Female flower	Sex ratio	Fruit set (%)	Average weight of fruit (gm)	No. of fruit/vine	Yield per vine (kg)	Yield per hectare (q)	Length of fruit (cm)	of fruit (cm) Diameter of fruit (cm)	B:C Ratio
T1	394.30	50.40	3.75	60.35	475.70	7.94	6.45	298.71	27.80	7.00	2.00
T2	309.45	54.60	6.00	46.35	358.60	7.12	3.25	180.50	23.40	6.00	1.35
T3	332.28	55.42	4.88	51.20	370.18	5.90	4.85	231.10	25.74	4.94	1.93
T4	360.20	54.36	5.70	50.85	388.45	7.10	4.00	251.00	26.12	6.18	2.00
T5	500.40	44.93	2.60	66.69	754.23	10.64	7.20	364.96	34.28	8.25	2.50
T6	474.59	46.98	3.45	65.61	620.35	11.00	7.10	354.72	30.00	6.85	2.70
T7	437.55	49.80	4.57	61.97	535.19	9.69	6.30	335.10	30.20	7.00	1.96
T8	412.20	50.55	4.01	60.00	502.31	8.96	6.60	326.19	28.41	6.91	2.74
T9	552.66	47.02	2.62	75.00	711.85	13.54	7.31	381.61	33.95	7.40	2.64
T10	291.33	57.00	8.29	48.35	330.97	4.76	3.42	171.06	20.93	4.86	1.56
	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	
	25.54	2.29	-	3.35	32.20	0.68	0.43	16.36	1.60	0.36	
	74.56	6.68	-	9.79	94.01	2.00	1.27	47.75	4.67	1.05	

female and male flower per vine, the treatments found to be significant. The sex ratio of female to male flower was found the minimum in treatment T5. However, the sex ratio was found to be maximum in treatment T10. This result was similarly found by (4, 5). The results obtained in respect to yield parameters like the number of fruit per vine, fruit set percent per vine, yield per vine (kg) and yield per hectare (q), treatments shown significant differences. The maximum number of fruits per vine (13.54) were found in treatment T9 with the application of 50 kg N, 25 kg P₂O₅, 25 kg K₂O ha⁻¹ dose of fertilizers in combination with the application of FYM 2.5 t ha⁻¹, vermicompost 1.62 t ha⁻¹, Azotobacter 5 kg ha⁻¹ and PSB 5 kg ha⁻¹. However, a minimum number of fruits (4.76) per vine were recorded in T10 i.e. Control. The fruit set percent was recorded maximum (75.00) in treatment T9 while treatments T7 and T6 were found at par. The minimum number of fruit set percent (48.35) was recorded in T10 i.e. Control. The results of the present investigation are in apparent with the finding by (6, 7). Maximum fruit weight (754.23 g) recorded in treatment T5 was found to be at par with T9 (711.85 g) and T6 (620.35 g). The minimum fruit weight (330.97 g) was recorded in T10. The maximum yield per vine and yield per hectare recorded in the treatment T9 i.e. 50:25:25 Kg NPK ha⁻¹ + FYM 2.7 t ha⁻¹ + Vermicompost 1.62 t ha⁻¹ + treatment with PSB @ 5 kg ha⁻¹ and Azotobacter @ 5 kg ha⁻¹. This may be due to the application of inorganic, organic and biofertilizers, similar result obtained by (2, 8). The results obtained in respect to quality parameters like a length of fruit (cm), a diameter of fruit (cm) and average fruit weight (g), the treatments found to be the significant. The maximum length of fruit (34.28) was recorded with the application of 75% RDCF along with vermicompost and biofertilizers i.e. T5 was found to be at par with T9 (33.95 cm) and T7 (30.20 cm), While minimum (20.93 cm) was recorded in T10 i.e. Control. With regard to fruit diameter, the maximum (8.25 cm) fruit diameter was obtained in the treatment T5 was found to be at par

with T9 (7.40 cm). However, minimum (5.36 cm) was recorded in T10 i.e. Control. A significant effect of INM on length, diameter and average fruit weight of bottle gourd fruit was also reported by (2, 3).

CONCLUSION

On the basis of results, the treatment T12 i.e. 50:25:25 kg NPK ha⁻¹ + 2.7 t ha⁻¹ FYM + 1.62 t ha⁻¹ vermicompost + 5 kg ha⁻¹ Azotobacter + 5 kg ha⁻¹ PSB shown maximum result, which was at par with treatment T7 (75:37.5:37.5 kg NPK +1.65 t ha⁻¹ vermicompost +5 kg ha⁻¹ Azotobacter + 5 kg ha⁻¹ PSB). Treatment T9 was found to be profitable and remunerative as per the B:C ratio (2.64).

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PROCEEDINGS

The 3rd Global Meet on Science and Technology for Ensuring Food and Nutritional Security (GMST-2019) was held at ICAR-National Research Center on Seed Spices Ajmer (Rajasthan), India on 01-03, December 2019. The international conference was organized by Hi-tech Horticultural Society, Meerut (UP) and Prerna Foundation, Meerut (UP) India in collaboration with Society for Recent Development in Agriculture, Meerut (UP), India, ICAR- Indian Institute of Farming System Research, Meerut (UP), India, Jyoti Vidhyapeeth Women's University, Jaipur (Rajasthan), ICAR- National Research Center on Seed Spices Ajmer (Rajasthan), Motherhood University, Roorkee (U.K.), Department of Horticulture, SVP University of Agriculture and Technology, Meerut (UP), India and New Age Mobilization, New Delhi, India.

Inaugural function :

More than 400 participants from various parts of India were participated in the conference. The inaugural session of the conference was held on 01.12.2019. Dr. S.K. Malhotra, Agriculture commissioner, Govt. of India, New Delhi was the chief guest of the function. Dr. J.S. Sandhu, Vice Chancellor, SKN Agri. University, Jobner (Raj.), Dr. Raj Kumar, Vice Chancellor, UP. University of Medical Sciences, Saifai (UP) and Dr. T. Jankiram ADG (Hort.) ICAR, New Delhi were also present in the inaugural function as guest of honor. Beside these Dr. P.L. Saroj, Director ICAR-CIAH, Bikaner (Raj.), Dr. Gopal Lal Director, ICAR-NRCSS, Ajmer (Raj.) and Dr. A.S. Panwar, Director, ICAR-IIFSR, Meerut (UP) were also present on the dais of the inaugural function. Dr. B.R. Singh, Organizing Director of the conference was presented the formal vote of thanks.

In the very first of the inaugural function, Dr. Gopal Lal Director, ICAR-NRCSS, Ajmer (Raj.) apprised about the NRCSS and conference. Dr. Bijendra Singh. Organizing Chairman of the conference welcomed the distinguished guest and other delegates of GMST-2019 and also highlighted about the progress and conference organized by the Hi-tech Horticultural Society, Meerut (UP) and Prerna Foundation, Meerut (UP) India followed by remark by guest of honors, J.S. Sandhu, Vice Chancellor, SKN Agri. University, Jobner (Raj.), Dr. Raj Kumar, Vice Chancellor, UP. University of Medical Sciences, Saifai (UP) and Dr. T. Jankiram ADG (Hort.) ICAR, New Delhi. The abstract book of the conference in the form of souvenir was also released by the distinguished guest.

A total of 49 awards were given by Hi-tech Horticultural Society, Meerut (UP) to the scientists, students, social workers and farmers for their contribution in the field of agriculture and allied sciences. The following were the recipients of the awards:

1. Rajesh Pilot Memorial Award-2019

1. Dr. R. K. Mittal, Vice Chancellor, SVP University of Agriculture and Technology, Meerut (UP)
2. Dr. S.K. Malhotra, Agriculture Commissioner, Ministry of Agriculture, Co-operation and Farmer Welfare, Govt. of India, New Delhi-12

2. Hukum Singh Memorial Award-2019

1. Dr. Raj Kumar, Vice Chancellor, Uttar Pradesh University of Medical Sciences, Saifai, Etawah (UP)
2. Dr. J.S. Sandhu, Vice-Chancellor, SKN Agriculture University, Jobner (Rajasthan)
3. Dr. Rouhangiz Hayati Dahiya, President, Jyoti Vidyapeeth Women's University, Jaipur (Rajasthan)
4. Dr. Narendra Sharma, Vice Chancellor, Motherhood University, Roorkee, Haridwar

3. Life Time Achievement Award-2019

1. Dr. T. Janki Ram, ADG (Horticulture), ICAR, New Delhi
2. Dr. Gopal Lal, Director, NRCSS, Ajmer (Rajasthan)
3. Dr. P. L. Saroj, Director, ICAR-CIAH, Beechwal, Bikaner (Rajasthan)
4. Dr. Ramesh Kumar, Ex Director, Directorate of Floriculture and Landscaping, New Delhi-12

4. Outstanding Achievement in Horticulture Award-2019

1. Dr. K.P. Singh, Principal Scientist, Division of Floriculture and Landscaping, IARI, New Delhi-12
2. Dr. Prabhat Kumar, Principal Scientist, Division of Floriculture and Landscaping, IARI, New Delhi-12

5. Honorary Fellowship Award-2019

1. Dr. Ram Swaroop Meena, Principal Scientist (Plant Breeding), ICAR-NRCSS, Ajmer (Rajasthan)
2. Dr. V. P. Singh, Professor (Horticulture), GB Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand)

6. Fellowship Award-2019

1. Dr. Ashok Kumar, Professor (Soil Science), Department of Soil Science, SVP University of Agriculture and Technology, Meerut (UP)-250110
2. Dr. R.S. Sengar, Professor (Ag. Biotech), Department of Agricultural Biotech, SVP University of Agriculture and Technology, Meerut (UP)-250110
3. Dr. Rajesh Kumar, Associate Professor (Horticulture), GB Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand)

7. Distinguish Scientist Award-2019

1. Dr. Sangita Bansal, Principal Scientist, Division of Tissue Culture, NBPGR, New Delhi-12
2. Dr. Alka Singh, Professor (Floriculture and Landscape Architecture), Navsari Agricultural University, Navsari, Gujarat
3. Dr. Satya Prakash, Professor and Head, Department of Horticulture, SVP University of Agriculture, Meerut (UP)
4. Dr. S.K. Yadav, Principal Scientist (Horticulture), NBPGR, New Delhi-12

8. Scientist of The Year Award-2019

1. Dr. Vipin Kumar, Associate Director (Horticulture), Department of Horticulture, SVP University of Agriculture and Technology, Meerut (UP)
2. Dr. Aastik Jha, Assistant Breeder Scientist, Department of Horticulture, SASRD, Nagaland University, Nagaland
3. Dr. Renu Yadav, Assistant Professor-II, Amity University, Noida

9. HTHS Gold Medal Award-2019

1. Dr. Manoj Kumar Singh, Associate Professor (Horticulture), SVP University of Agriculture and Technology, Meerut (UP)

10. Young Scientist Award-2019

1. Dr. Poonam Kashyap, Sr. Scientist (Horticulture), ICAR- Indian Institute of Farming System Research, Modipuram, Meerut (UP)
2. Dr. Deepa Samant, Scientist (Horticulture), ICAR-CHES, Bhubaneswar (Odisha)
3. Dr. R.S. Meena, Sr. Scientist (Plant Breeding), ICAR-NRCSS, Ajmer (Rajasthan)
4. Dr. Lalit Bhatt, Assistant Professor (Vegetable Science), GB Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand)

11. Young Scientist Associate Award-2019

1. Dr. Reshu Chaudhary, Guest Faculty, College of Horticulture, SVP University of Agriculture and Technology, Meerut (UP)
2. Dr. Shiv Lal, Sr. Scientist (Horticulture), ICAR-NRCSS, Ajmer (Rajasthan)
3. Dr. Jyothi R., Scientist (Horticulture), ICAR-KVK, ARS Campus, Gangawati, Koppal, (Karnataka)

12. Young Fellow Award-2019

1. Dr. Shailesh Kumar, Asstt. Professor
2. Dr. Ravindra Chavan, Research Associate, ARS, Bidar, UAS, Raichur (Karnataka)
3. Dr. Ashish Kumar, Assistant Professor (Horticulture), MIET, Meerut (UP)

13. Best Researcher Award-2019

1. Dr. Deepak Kumar, Department of Agriculture, Govt. of UP, Muradabad (UP)

2. Dr. Rakesh Kumar, Manager, Nuziveedu Seeds, Jaipur (Rajasthan)

14. Best Thesis Award-2019

1. Kohima Noopur, College of Horticulture, TNAU Coimbatore

15. Student Achiever Award-2019

1. Km. Archi Gupta, Ph.D Scholar, Department of Horticulture, SVPUAT, Meerut (UP)
2. Mr. Rajat Kumar Ph.D Scholar, Department of Horticulture, SVPUAT, Meerut (UP)
3. Prerna Singh, Ph.D Scholar, Jyoti Vidyapeeth Women's University, Jaipur (Rajasthan)
4. Mr. Muzeev Ahmad, Ph.D Scholar, Department of Horticulture, SVPUAT, Meerut (UP)
5. Mr. Akshay Kumar, Ph.D Scholar, Department of Horticulture, CCS University, Meerut (UP)
6. Mr. Kauleshendra Pratap Singh, Ph.D Scholar, Department of Horticulture, SVPUAT, Meerut (UP)

16. Women Farmer Innovative Award-2019

1. Mrs. Neelam Tyagi, Progressive Farmer, Muradnagar, Ghaziabad (UP)

17. Progressive Horticulture Farmer Award-2019

1. Sh. Kailash Choudhary, Progressive Farmer, Organic Vegetable Production, Village-Keeratpura, Jaipur
2. Sh. Ajay Dutt Upadhyaya, Progressive Farmer, Organic Fruit Vegetable Production, Village-Makreda, Ajmer
3. Sh. Harkaran Paroda, Progressive Farmer, Seed Spice and Vegetables, Village-Dang, Ajmer
4. Sh. Kan Singh Nirwam, Progressive Farmer, Organic Horticulture, Village-Zorkidhani Godhan, Sikar.

The conference comprised 05 technical sessions and 02 parallel poster sessions which covers the themes of the conference and these were evaluated by the committee members Headed by Dr. Y.S.Shivay, Dr. Satya Parkash and others.

The session wise brief reports of the conference are summarized as below :

Technical session I :

Chairman : Dr. Raj Kumar, VC, UPUMS, Saifai (UP)
Co-Chairman : Dr. S.R.Singh, Dy. Director, NIAM, Jaipur (Raj.)
Rappoorteurs : Dr. V.P.Singh, GBPUAT, Pantnagar (UK)
Dr. Satya Prakash, SVPUAT, Meerut (UP)

In this session the first lead lecture was delivered by Dr. Gopal Lal, Director, ICAR-NRCSS, Ajmer on technology development and dissemination of seed spices. He informed that the institute developed 24 varieties of different crops of seed spices and suggested that intercropping of cumin+ cabbage and spices crops production in intercropping with ber, aonla or guava give higher profitability. Second lead lecture was delivered by Dr. P.L. Saroj, Director, ICAR-CIAH, Bikaner. He pointed out that the policies for arid region development with horticultural intervention have been formulated and now the support from government is required. The third consecutive lecture was delivered by Dr. R.H. Dahiya, VC, Jyoti Vidhyapeeth Women's University, Jaipur and pointed out that the participation of womens in development of waste land and pasture land is very much required. Another lectures in this session was delivered by Dr. Alka Singh from Agriculture University, Navsari (Gujrat), Dr. D.S.Gujjar from IARI, New Delhi, Dr. Ravinder Kumar from CPRI Shimla, Dr. Besii Hriziio from Karnataka, Dr. Rahul Kumar, CPRI, Shimla and Dr. P.Suntha, YSR University, Andhra Pradesh on various topics of agriculture and allied sciences.

Technical session II :

Chairman : Dr. B.R. Singh, VC, SVPUA&T, Meerut (UP)
Rappoorteurs : Dr. D.S.Gujjar, ICAR-IARI, New Delhi
Dr. S.S.Meena, ICAR-NRCSS, Ajmer

In this session six papers were presented by Dr. S.S. Meena, NRCSS, Ajmer, Dr. O.P. Aishwath, NRCSS, Ajmer, Dr. B.R. Chaudhary, CIAH, Bikaner, Dr. B.K. Mishra NRCSS, Ajmer, Dr. Shyam Sunder Dey, IARI, New

Delhi and Dr. Reeta Bhatia, IARI, New Delhi and all the papers were based on inputs use impacts on growth and yield of spices, vegetables and floricultural crops.

Technical session III :

Chairman : Dr. P.L.Saroj, ICAR-CIAH, Bikaner (Raj.)
Rappoorteurs : Dr. Vipin Kumar, SVPUAT, Meerut (UP)
Dr. S.K.Yadav, ICAR- NBPGR, New Delhi

A total of 12 papers including 04 lead/invited papers and 08 oral presentation were presented in this session by Dr. Y.S. Shivay, IARI, New Delhi, Dr. A.S. Panwar, IIFSR, Meerut (UP), Dr. Raj Kumar, UPUMS, Saifai (UP), Dr. R.S. Kureel, Agriculture University, Ranchi (Jharkhand), Dr. Sangeeta Bansal, NBPGR, New Delhi, Dr. A.K. Verma, Dr. Deepa IIHR, Bangalore, Dr. Kohima Nupoor, SKUAST, Jammu, Dr. Neha, Motherhood University, Roorkee, Dr. Era Malhotra, NBPGR, New Delhi, Dr. S.K.Yadav, NBPGR, New Delhi and Dr. R.D. Meena, NICSS, Ajmer. These papers cover various aspects of food security, input management, Medical sciences and horticultural crops.

Technical session IV :

Chairman : Dr. Dr. Y.S. Shivay, IARI, New Delhi
Rappoorteurs : Dr. Arvind Kumar, SVPUAT, Meerut (UP)
Dr. Manoj Kumar Singh, SVPUAT, Meerut (UP)

A total of 07 papers including 01 lead/invited papers and 10 oral presentation were presented in this session by Dr. S.R. Singh, NIAM, Jaipur (Raj.), Dr. H.K. Sharma, DRMAR, Bharatpur (Raj.), Dr. Shiv Lal, NRCSS, Ajmer (Raj.), Dr. Ravindra Singh, NRCSS, Ajmer (Raj.), Dr. Sharda Chaudhary, NRCSS, Ajmer (Raj.),

Technical session V :

Chairman : Dr. Dr. Bijendra Singh, SVPUAT, Meerut (UP)
Rappoorteurs : Dr. Arti Bhardwaj, SVPUAT, Meerut (UP)
Dr. Ravinder Kumar, CPRI, Shimla (HP)

A total of 06 papers including 01 lead/invited papers and 10 oral presentation were presented in this session by Dr. Murlidhar Meena, NRCSS, Ajmer (Raj.), Dr. Anmol, LPU, Jalandhar (Punjab), Dr. Suraj Kumar, UPUMS, Saifai (UP), Dr. Yogesh Kumar, NDRI Karnal (Haryana), Dr. Harshita, DGR, Junagarh (Gujrat) and Dr. N.K.Meena , NRCSS, Ajmer (Raj.).

Beside these technical sessions, 02 poster sessions on different themes of the conference were also organised and 35 posters were displayed and briefed by concerned scientist/students.

Valedictory function :

The valedictory function of the conference was held on 02.12.2019. Dr. B.R. Chaudhary, VC, Agriculture University, Jodhpur was the chief guest of the function. Dr. P. Chandra Shekharan DG, NIAM Jaipur, was also present as a guest of honor of the function. Dr. Gopal Lal, Director NRCSS, Dr. P.K.Rai, Director, ICAR-DRMR, Bharatpur and Dr. Bijendra Singh, Organizing Chairman were also present on the dais of the function.

Society of Recent Development in Agriculture, Meerut (UP) also facilitate to 49 scientists/ students/ farmers/social reformers by presented the various awards for their contribution in different fields. The brief summary of awards is as follows:

1. Dr. Lakhi Ram Memorial Award-2019

1. Dr. R.S. Kureel, Vice Chancellor, Birsa Agriculture University, Ranchi, Jharkhand
2. Dr. B.R. Choudhary, Vice Chancellor, Agriculture University, Jodhpur (Rajasthan)

2. Dr. Nonihal Singh Memorial Award-2019

1. Dr. A. K. Singh, DDG (Horticulture), ICAR, New Delhi-12
2. Dr. P.S. Pandey, ADG (Education), ICAR, New Delhi-12
3. Dr. A.S. Panwar, Director, ICAR- Indian Institute of Farming System Research, Modipuram, Meerut (UP)

3. Life Time Achievement Award-2019

1. Dr. P. Chandra Shekhar, Director General, NIAM, Jaipur (Rajasthan)
2. Dr. Ramesh Mittal, Director, NIAM, Jaipur (Rajasthan)
3. Dr. Rajendra Kumar, Ex Director General, UP Council of Agricultural Research, Lucknow
4. Dr. B.R. Singh, Dean College of Technology, SVP University of Agriculture and Technology, Meerut (UP)

4. Outstanding Achievement in Agriculture Award-2019

1. Dr. S.R. Singh, Dy. Director NIAM, Jaipur (Rajasthan)
2. Dr. Yashvir Shivaya, Principal Scientist, ICAR- New Delhi-12
3. Dr. Munish Gangwar, Professor (Agronomy), CSA University of Agriculture and Technology, Kanpur (UP)
4. Dr. Suraj, Professor and Head, Physiotherapy, Uttar Pradesh University of Medical Sciences, Saifai, Etawah (UP)

5. Fellowship Award-2019

1. Dr. Amod Sharma, Professor (Ag. Economics), Department of Agricultural Economics, Nagaland University, Nagaland
2. Dr. Suresh Kumar Maurya, Assistant Professor (Vegetable Science), GBPUAT, Pant Nagar, Udham Singh Nagar (Uttarakhand)
3. Dr. Raghav, Prop President, Jayoti Vidhyapeeth Women's University, Jaipur (Rajasthan)
4. Dr. O.P. Chowdhary, Principal Scientist (Entomology), Department of Entomology, CCS-HAU, Hisar (Haryana)

6. Distinguish Scientist Award-2019

1. Dr. M.L. Mehriya, Assistant Professor (Agronomy), Agriculture University, Jodhpur (Rajasthan)
2. Dr. Anand Naik, Asstt. Professor (Soil Science and Ag. Chemistry), College of Agriculture, Kalaburgi, UAS, Raichur (Karnataka)

7. Smt. Rewati Singh Memorial Award-2019

1. Dr. Anuradha, Meerut College Meerut (UP)
2. Dr. Mini Amit Arrawatia, Director Research, Jayoti Vidhyapeeth Women's University, Jaipur (Rajasthan)

8. Scientist of The Year Award-2019

1. Dr. Arvind Kumar, Associate Director (Horticulture), Department of Horticulture, SVP University of Agriculture and Technology, Meerut (UP)
2. Dr. K.K. Jha, Professor & Head, Department of Agricultural Extension, Nagaland University, Nagaland

9. Kunwar Saxena Bahadur SRDA Award-2019

1. Dr. Achal Kiran, NAS College, Meerut (UP)
2. Dr. P.S. Tiwari, Professor (Ag. Engineering), KVK, Hastinapur, Meerut (UP)
3. Dr. Sweta Singh, Assistant Professor (Agricultural Engineering), SKN Agriculture University
4. Dr. Subhas, NAS College, Meerut (UP)

10. R.S. Yadav SRDA Award-2019

1. Dr. Moni Verma, Guest Faculty, College of Horticulture, SVP University, Meerut
2. Dr. Rakesh Tiwari, SMS (Soil Science), KVK, Hastinapur, Meerut (UP)
3. Dr. Naveen Chandra, SMS (Plant Protection), KVK, Hastinapur, Meerut (UP)
4. Dr. Dan Singh, Associate Professor (Ag. Extension), Department of Agricultural Extension, SVP University of Agriculture, Meerut (UP)

11. SRDA Gold Medal-2019

1. Dr. Aditya Singh, Guest Faculty, College of Horticulture, SVP University, Meerut (UP)

12. Young Scientist Award-2019

1. Dr. Dhara Singh, Sr. Scientist (Soil Sciene), Water Technology Centre, ICAR-IARI, New Delhi-12
2. Dr. Harpreet Singh, Assistant Agronomist, RRS, Punjab Agricultural University, Gurdaspur (Punjab)
3. Dr. Ramanna Koulagi, Assistant Nematologist, PAU, Ludhiana (Punjab)
4. Dr. Sarvesh Kumar, Associate Professor, Soil and water Conservation, CSAUAT, Kanpur (UP)
5. Dr. Rajesh Kumar Mahawar, Assistant Professor (PBG), Mechanized Agriculture Farm, Kota Agricultural University, Kota (Rajasthan)

13. Young Scientist Associate Award-2019

1. Dr. A.K. Prusty, Sr. Scientist (Aquaculture), ICAR- Indian Institute of Farming System Research, Modipuram, Meerut (UP)
2. Dr. Aarti Bhradwaj, Guest Faculty (Microbiology), SVPUAT, Meerut (UP).
3. Dr. Ravindra Kumar, Scientist (Plant Pathology), CPRI, Shimla (HP)
4. Mr. Manraj Yadav, Lecturer (Agronomy), M.B. College of Agriculture, Tonk (Rajasthan)
5. Mr. Champa Lal Regar, Lecturer (Horticulture), M.B. College of Agriculture, Tonk (Rajasthan)

14. Young Fellow award-2019

1. Dr. Shailja Katoch, Assistant Professor, College of Veterinary Science, SVPUAT, Meerut
2. Dr. Suman Rani, NAS College, Meerut
3. Dr. Mukesh Kumar Yadav, Assistant professor (Ag. Economics), SKN Agriculture University, Jobner (Rajasthan)
4. Dr. Ranjeet Kumar, Assistant Professor (Entomology), Bihar Agricultural University, Sabour, Bihar
5. Dr. Hanuman Prasad Verma, Technical Assistant (Agronomy), Mechanized Agriculture Farm, Kota Agricultural University, Kota (Rajasthan)
6. Dr. Yogesh Kumar, SMS, Agro metrology, KVK, NDRI, Karnal

15. Student Achiever Award-2019

1. Mr. Durgesh Kumar, CSA University of Agriculture and Technology, Kanpur (UP)
2. Mr. Raghvendra Singh CSA University of Agriculture and Technology, Kanpur (UP)
3. Mr. Sumit Raj, CSA University of Agriculture and Technology, Kanpur (UP)
4. Km. Shanti , Division of Genetics, IARI, New Delhi-12

16. Progressive Agriculture Farmer Award-2019

1. Sh. Munna Lal Yadav, Progressive Farmer, Organic Agriculture, Village-Pachar, Jaipur
2. Sh. Suresh Patel, Progressive Farmer, Dairy Farming/Agriculture, Mada (Tema Phala), Dungarpur, Rajasthan
3. Sh. Laxamn Bhanaji, Progressive Farmer, Spices crops, Village-Amarthun, Banawara, Rajasthan
4. Sh. Baluram Meena, Progressive Farmer, Vegetable and Spices, Village-Nogonva, Pratapgarh, Rajasthan.

On last day of the conference on 03.12.2019, the participants were visited to the research cum instructional farm, local excursion and various places of Ajmer for upgrading their knowledge and skills in respective fields.

GLIMPES OF CONFERENCE



Inaugural of conference by making Saraswati pooja by dignitaries



Dr. J.S. Sandhu receiving the Hukum Singh Memorial Award-2019



Dr. S.K. Malhotra receiving Rajesh Pilot Memorial Award-2019



Dr. Bijendra Singh presenting the progress of society



Dr. S.K. Malhotra delivering the guest lecture



Dr. B.R. Singh receiving the Life Time Achievement Award-2019



Dr. Raj Kumar receiving Hukum Singh Memorial Award-2019



Dr. R. Hayati Dahiya receiving the Hukum Singh Memorial Award-2019



Dr. Vipin Kumar receiving Scientist of The Year Award



Dr. S.K. Yadav receiving Distinguish Scientist Award -2019



Ms. Kohima Nupoor receiving Best Thesis Award-2019



Ms. Archi Gupta receiving Student Achiever Award-2019



Dr. M.K.Singh receiving HTHS Gold Medal Award-2019



Dr. Alka Singh receiving Distinguish Scientist Award-2019



Dr. Satya Parkash receiving Distinguish Scientist Award-2019



Ms. Purna Singh receiving Student Achiever Award-2019



Smt. Neelam Tyagi receiving Women Farmer Innovative Award-2019



Dr. T. Jankiram receiving Life Time Achievement Award-2019



Farmer of Rajasthan receiving Progressive Horticulture Farmer Award-2019



Dr. Ramesh Kumar receiving Life Time Achievement Award-2019



Dr. B.R. Chaudhary receiving Dr. Lakhi Ram Memorial Award-2019



Dr. Ashok Kumar delivering the invited lecture



Dr. S.R. Singh receiving Outstanding Achievement in Agriculture Award-2019



Dr. Arti Bhardwaj receiving Young Scientist Associate Award-2019



Dr. Arvind Kumar receiving Scientist of The Year Award 2019



Officials of technical session covering the lectures



Ms. Ridhdi Bist receiving appreciation certificate



Dr. P. Chandra Shekhar, receiving Life Time Achievement Award 2019



Farmers interacting with scientists



Participants making on spot registration



Participants attending the conference



Releasing the souvenir of the conference



Dr. Gopal Lal delivering the guest lecture



Dr. Raj Kumar delivering the guest lecture



Dr. J.S. Sandhu delivering the guest lecture



Officials of technical session covering the lectures



Evaluation of poster by the committee members



Participants visiting the experimental fields