RECOMMENDATIONS FROM THE WORKSHOP

1. Priority areas for horiticulture in the state are:

   i) Promotion of Commercial floriculture.

   ii) Area expansion under high density fruit plantation.

   iii) Intensive Vegetable cultivation for quality production.

   iv) Promotion of crop diversification through multitier production system.

   v) Promotion of hi-tech nurseries for large scale production of quality planting material. Block nurseries & progeny orchards in the state to be rejuvenated with polyhouse facilities.

   vi) Establishment of backward and forward linkages for promotion of medicinal and aromatic plants.

   vii) Develop data base for location specific / zone-wise planning.

   viii) System approach in Vegetable & Fruit crops.

   ix) Regular training & upgradation of knowledge / skill.

   x) Promotion of INM / IPM in crops.

   xi) Developing processing technologies

   xii) Marketing network.

   Human resources development in horticulture (production, processing, marketing) should be a regular component. For this, University, I.C.A.R. & State Institutions to work together.

2. Crop plan (vegetable, fruit & flower) should be zone-wise. Execution of the plan should be integrated with involvement of local institutions & district / block level officers under the guidance of State Department.

3. Market oriented development of horticultural commodities should be the approach. For this auction yards, refrigerated cargo vehicles should be started.

4. State should establish Agro-processing units at each district / Zone to encourage the farmers / farmer-groups in taking up horticulture as a livelihood option.

5. Hi-tech and tissue-culture to be promoted to meet the requirement of the State for supply of quality planting materials.

6. Export oriented organic horticulture should be promoted with involvement of private sector.

7. Promoting horticulture in the watersheds is important. In each watershed, prioritization of the area under agriculture, horticulture, fishery & other enterprises should be done based on farmers, need & perception & agro-ecological situations.

8. Post harvest management should receive greater attention as fruits & vegetables are of perishable nature. Establishment of cold storage facility will help.

9. Approach should be to increase area under high value crops & value addition. Protected cultivation will help in promoting these.

10. Mushroom cultivation should receive more attention for nutritional security of people. Training of rural women & providing market facility will be required to promote this.

11. Nutrient management in horticulture crops is poor. There is need to promote INM with greater use of P & K. Lime to neutralise soil acidity, quality compost to enrich soil quality & use of secondary & micronutrients based on soil tests will help to sustain soil health.

12. State should take immediate steps to

   (i) Operationalise AEZ for vegetables

   (ii) Creating a data base on horticulture

   (iii) Strengthen the infrastructure & develop a seed policy.

13. Use of drip & spinkler irrigation, mulching, root trainers, should be promoted in block nurseries for greater dissemination of knowledge among farmers.

Priorities of Horticulture Development in Jharkhand

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Horticultural crops are profitable diversification options for better land use, improved productivity, increased employment opportunities, better economic return and nutritional security. It has played an important role in the national economy through production of 45.5 million tonnes fo fruit and over 88.62 million tonnes of vegetables. India is the second largest producer of fruits and vegetables, next only to Brazil and China, respectively. The land topography and agro-climate of the country suits well for various fruits, vegetables, flower, medicinal and aromatic plants and plantation crops which have ability to achieve sustainability, increase employment, improve environment, provide enormous export potential and above all achieve self sufficiency and nutritional security. Lot of emphasis on diversification of horticultural crops in the country has been given during the last one decade.

The State of Jharkhand is endowed with approximately 8 lakh hectare of uplands and mild climate having immense potential for diversification under horticultural crops. Presently, the state is producing 405 thousand tonnes of fruits and 2219 thousands tonnes of vegetables from an area of 32.7 and 144.6 thousand hectare, respectively (Table 1). Horticultural crops cover only 8.6% of the cropped area in the state with productivity parallel to national productivity.

Considering the productivity potential and vast area, a well thought out plan of action is therefore needed to be formulated and implemented to achieve at least 15% of the total cropped area (250 thousand hectare) under different horticultural crops by the tenth Five Year Plan. In the way of doubling the area under horticultural crops, the crop mileages and existing infrasuctural support-irrigation, storage, transportation, marketing and processing has to be taken into consideration. As a matter of fact, the State at present, do not have irrigation and other infrastructure facilities needed for quantum shift in area under vegetable and floriculture. Therefore, the option lies with only fruit crops and fruit crop based multi-tier cropping system which requires comparatively low input and investment.

Table 1 : Area, production and productivity of horticultural crops in Jharkhand (2000)

Crops	**Area (,000ha)**	**Production (,000 MT)**	**Productivity (Tones/ha)**
Mango	7.57	89.93	11.88
Guava	5.09	63.00	12.38
Banana	0.28	54.94	19.62
Citrus	5.52	55.16	10.00
Other fruits	14.24	141.86	9.96
Total fruits	32.7	404.89	12.38
Potatoes	38.12	359.54	9.42
Onion	11.35	227.05	20.00
Other vegetables	95.11	1632.11	17.16
Total vegetables	144.58	2218.70	15.35
Total horticultural crops	177.28	2623.59	8.57

Source: Directorate of Statistics & Evaluation and Department of Agriculture, GOB, Patna

Keeping in view the strategic geographical conditions including climate suitable for quality production of horticultural commodities, high volume of round the year production, high domestic demand and easy availability of labour at comparatively low rate, wide product base, an attempt has been made to fix the possible priorities for horticulture development in the state.

Priorities of horticulture development

1. Zoning of the state based on suitability of the crops

The entire state of Jharkhand has been divided into 3 agro-climatic zones which have been further divided into 6 sub zones (Table 2) to consider the actual potential of the area for different horticultural crops.

Table 2: Districts, their ecological specialties and suitable horticultural crops in the proposed sub-zones of Jharkhand

Sub Zone	Districts, their ecological specialties and suitable horticultural crops
I	**Ranchi, part of Hazaribagh, Lohardaga, Gumla and Simdega having moderate temperature during summer, rainfall 1300-1500 mm, no gaseous pollution.** *Fruits* : Litchi, mango, guava, strawberry, sapota, custard apple, jackfruit, papaya, bael *Vegetables* : Brinjal, cabbage, capsicum, cauliflower, chilli, tomato, peas & beans, root crop, leafy vegetable and cucurbits, off season temperate vegetable. *Flowers* : Carnation, gerbera, rose, Chrysanthemum, marigold.
II	**West Singhbhm, East Singhbhum and Saraikela having relatively warmer & humid climate, high rainfall and climate affected by sea changes** *Fruits* : Mango, guava, cashewnut, banana, jackfruit, custard apple, tamarind *Vegetables* : Brinjal, cabbage, capsicum, cauliflower, chilli, tomato, peas & beans, root crop, leafy vegetable and cucurbits
III	**Garhwa, Palamau, Chatra and Latehar having dry climate with less rainy months** *Fruits* : Aonla, citrus, guava, bael, karonda *Vegetables* : Brinjal, cabbage, capsicum, cauliflower, chilli, tomato, peas & beans, root crop, leafy vegetable and cucurbits. *Flowers* : Marigold
IV	**Koderma, Giridih, Dhanbad, Bokaro and part of Hazaribagh having warmer climate, medium rainfall and high concentration of injurious gases** *Fruits* : Aonla, guava, karonda, bael, jamun, custard apple, tamarind *Vegetables* : Brinjal, cabbage, capsicum, cauliflower, chilli, tomato, peas & beans, root crop, leafy vegetable and cucurbits *Flower* : Marigold, rose chrysanthemum *Medicinal plants* : *Solanum kharianum, carisa augustalia, plantago ovate, vinca rosea* *Spices* : Ginger, turmeric, corriander *Vegetables seed production* : Onion, cauliflower, peas, beans, brinjal, cucurbitaceous crops and tomato
V	**Deoghar, Jamtara, Dumka, Godda, Sahebganj and Pakur having warmer climate with high rainfall** *Fruits* : Mango, jackfruit, tamarind, custard apple and chiraunji *Vegetables* : Brinjal, cabbage, capsicum, cauliflower, chilli, tomato, peas & beans, root crop, leaf vegetable and cucurbits *Flowers* : Rose, tube rose, marigold *Medicinal plants* : *Asafoetida, costus, dioscorea* *Aromatic plants* : Eucalyptus, vanilla, mentha, pelargonium, patcholi, aniseed *Mushroom* : Tropical mushroom during rainy season and European mushroom under controlled conditions *Vegetable seed production* : Cauliflower, Onion, peas, beans, brinjal and tomato
VI	**Pat area of Gumla and Lohardaga hills having cooler region on altitude above 2000 ft** *Fruits* : Pear, peach, low chilling apple, loquat *Vegetables* : Brinjal, cabbage, capsicum, cauliflower, chilli, tomato, peas & beans, root crop, leafy vegetable and cucurbits *Flower* : Terestial orchids, bulbaceous flower and chrysanthemum *Medicinal Plants* : Dioscorea floribunda and tulsi (*basil*)

2. Area expansion under horticultural crops

Considering the 183 thousand hectare targeted area under increase by the end of next plan period, the estimated area under fruits should be increased upto 1,50 thousand ha. from existing 32.7 thousand ha. and area under vegetable and floriculture from 144 thousand hectare to 2,10 thousand ha. This all together will cover about 15% of the total cropped area of the state.

3. Special area programme for selected pockets

Certain areas of the state like higher altitude sites have potential for off season vegetable production and vegetable seed production. These areas should be given special thrust for development of quality produce.

4. Promotion to intensive cropping system

The uplands of Jharkhand are the potential areas for watershed development. In the selected watersheds of the region, intensive cropping based on fruit plant needs to be promoted. In the lower catchment of the watershed, fruit crop based multi-tier system incorporating vegetables as inter crop and high density planting of fruit orchard needs to be promoted.

5. Vegetable seed production and processing

Production of quality seeds of vegetables particularly onion, French bean, okra, brinjal, tomato, cowpea and pea is highly remunerative venture for newly created state of Jharkhand. Technologies for seed production in vegetables for this region are available which can be adopted at large scale to uplift the region's economy through establishment of **Seed Villages.** The added advantage of this enterprise is the utilization of family labours for production of much remunerative commodities which will sustain and uplift the farmer's economy. It is estimated that 450 tonnes of seeds of different vegetables are presently required for domestic market. The seed production areas would require support for seed grading, treatment, packaging and storage for its promotion.

6. Hi-tech nursery and Micro propagation

Since the region has immense potential for fruit production, assured supply of quality planting material of different fruit plants has great scope. The region has the added advantage of mild climate supported with medium-high rainfall where nurseries can flourish better. Availability of manpower will also facilitate the enterprise in the region. Apart from fruits, ornamental plants can also be propagated and distributed in large scale. It is projected that if horticulture development is taken in right earnest the number of fruit crop saplings required will be 20-30 lakhs every year for at least 10-15 years. Establishment of **Propagation Villages** for mass multiplication of the fruit plant needs high priority. Commercial plant propagation through tissue-culture to meet the growing demand is the need of hours. Setting up a micro propagation unit for propagation of cultivars of different horticultural crops to meet the demand is also essential. This will generate employment for the rural youth and improve their economic condition. Micro propagation linked with commercial cultivation of flowers for domestic and export market would bring quantum change in the present state of art on floriculture.

7. Promotion of export oriented fruit, vegetable and ornamental gardening

The region possessing mild tropical climate and well drained soil and often suitable climate for cultivation of a number of fruits, vegetable and ornamental crops (Table 3) which have better export potential. These crops and commodities needs to be promoted at commercial scale.

Table 3 : Export oriented horticultural commodities from Jharkhand

Commodities	National Market	International Market
Fruits	Litchi, Aonla, Mango, Custard Apple Jackfruit, Guava, Tamarind	Litchi, Aonla, Tamarind
Vegetables	Pea, French bean, Tomato, Cauliflower, Cucumber, Okra, Parwal, Beans, Chilly, Early potato, Coriander leaf	Pea, French bean, Tomato, Okra
Ornamental	Roses, Gladiolus, Gerbera, Orchids, China aster, Foliage plants, Marigold, Dahlia	Roses, Gladiolus, Gerbera, Orchids
Low volume high value crops	Mushroom (Oyster, button), Spices (Ginger, turmeric)	Button mushroom, Ginger, Turmeric

8. Emphasis on commercial floriculture

Hi-tech floriculture of the potential crops provides better opportunities for high profit. These include roses, carnation, gerbera, orchids, lillies, gladiolus for export market and marigold, chrysanthemum, gladiolus, gerbera, tuberose, dahlia, golden rod etc. which offer immense potential for internal market. The type of cut flowers available under protected cultivation in the region is of world class. Different floral products like dry flowers, floral extracts (natural dyes) have immense potential in the international market. Development of onward linkages with International market will open up a new era in commercial floriculture.

9. Promotion of medicinal and aromatic plants production and marketing

The region has large forest cover which serves as reservoir for large number of medicinal and aromatic plant species. Systematic collection, conservation and utilization of these plants to cure different diseases will be helpful in establishing industries based on these plants in this region. At the same time, systematic production of medicinal and aromatic plants in multi-tier horticulture production system on the basis of contract farming to start with would be profitable.

10. Round-the-year mushroom-culture-unit

The Jharkhand state has mild climate which is well suited to cultivate different types of mushrooms. The raw material like paddy straw is abundantly available in the region which can be utilized for rearing mushrooms whereas its waste can be used for production of vermicompost - an excellent source of organic matter for crops, fruits, vegetables and nursery management. A blend of temperate and tropical mushroom needs to be promoted for making mushroom production a profitable allied enterprise.

11. Promotion of low volume high value crops

Several spices and condiments like turmeric, ginger, saunf, tej patta (bay leaf), etc. can be grown profitably in Jharkhand. Mushroom is most paying low volume high value crop which can be effectively grown in the region. Metropolitan city like Kolkata is potential market and located at short distance.

12. Establishment of cold storage

There is need to establish multi purpose, multi chamber cold storage in this region for the storage of surplus fruits and vegetables. Setting up of Hitech cold storage will be

highly profitable. This will regulate the market, useful to provide produce during off season and subsequently increase production. Setting up of this facility would in turn be helpful in handling of horticultural produce for distant market and also for export of horticultural crops.

13. Establishment of processing industries

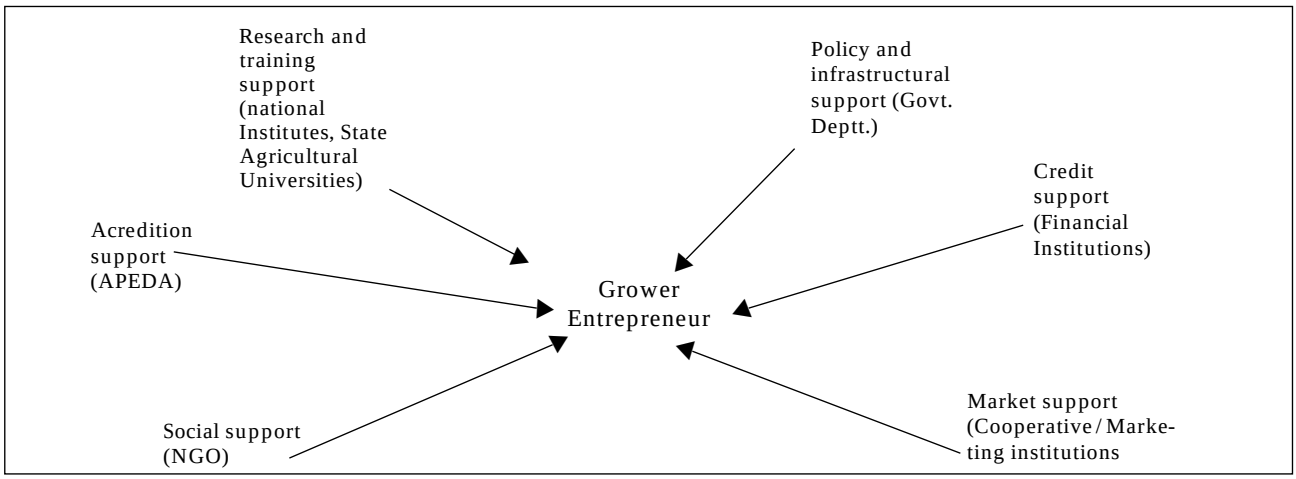
The state has abundance of raw material of different local fruits and vegetables throughout the year. The notable among are aonla, mango, litchi, tamarind, and jackfruit among the fruits and tomato, cauliflower, cabbage, mushrooms among vegetables. The horticulture produce faces a glut situation when it arrives at the market and the farmers resort to distress sale due to perishability. It has been estimated that 37% of our highly perishable horticulture crops are wasted due to lack of post harvest management and cold chain infrastructure which account a great annual loss. Establishment of processing industries will be highly helpful to utilize the surplus produce during the season (Table 4). The processed / value added product can meet the requirement during off season. This will not only regulate the market but also enhance the production in this region.

Table 4 : Availability of horticultural produce in Jharkhand for Processing Industry

Fruits/Vegetables	Availability period	Processed Product
Elephant Foot Yam	August - December	Pickle
Elephant Foot Yam	October - January	Chawanpras, Preserved Candy, Beverage, Jam, Pickle and Dehydrated fruits
Mango	March - August	Pickle, Beverage, Pulp, Pectin from peel, Kernal powder
Guava	August - February	Jelly, Beverage, Toffee
Litchi	May - June	Litchi nut, Beverage, Aril slices
Jackfruit	February - July	Dried flakes, Pickle, Canned, Roosted seed
Custard apple	September - October	Custard paste, Dried custard pulp powder
Tamarind	April - May	Dehydrated pods, Pulp, Kernal powder
Bael	March - May	Beverage, Preserve, Slice
Tomato	November - June	Ketchup, Puree, Pulp
French bean	September - December	Canned, Pickle
Cauliflower	Round the year	Canned, Dehydrated, Pickle
Cabbage	September - May	Canned, Dehydrated, Saurkrau
Cucumber	March - July	Sliced, Canned
Pea	December - April	Canned
Bhendi	April - September	Brined, Canned
Lime and lemon	February - December	Pickle, Beverage, Marmalade

14. Integration of promotional effort by different agencies

Concerted and integrated support from different agencies to the entrepreneur / grower holds the key for the success of fruit processing sector in the state. Figure-1 indicates the role that can be played by different agencies in supporting the entrepreneur / grower for the development of good processing sector in the state.



Conclusion

Horticulture has to play an important role in the development of Jharkhand. The favourable environmental conditions, virgin soils and abundance of skilled manpower in this area offer an immense scope for growing horticultural crops. Apart from major fruit crops (mango, litchi, banana and guava) emphasis is required to be given on growing drought tolerant fruit crops like aonla, bael, custard apple, fig and tamarind which can be grown successfully under rainfed condition. The seed production of various vegetable crops and plant propagation of fruit crops should be taken on priority basis to meet the growing demand. Special emphasis should be given for selecting high yielding varieties suitable for high density in fruits and for growing off season in vegetable crops to enhance the farm production. Promotion of fruit crop based multi-tier cropping system to minimize risk and improved livelihood needs to be addressed at priority basis. It is needless to mention that the present economy is market driven and through value addition in horticultural crops farmers can be benefited. In this respect industrialization of processing sector assumes the foremost role. Development of some of the basic industries such as cold storage, processing units, setting up micro propagation and bio fertilizer / bio pesticide units are essentially needed. The dissemination of the technologies with an effective collaboration and participation between the Industrialist on one side and National Research Institutions, State Agriculture Universities State Agriculture Departments, State Horticulture Departments, Horticultural Board, Extension agencies and NGO's working in Jharkhand will not only lead to boost up production and productivity of horticultural crops but also support the horticulture based industries to bring prosperity in the region.

Greenhouse Cultivation of Cut Flowers

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The system of growing plants under a transparent cover is known as greenhouse cultivation. Greenhouses are the structures covered with transparent and translucent materials that permit the solar radiations to pass through but trap the outgoing radiations emitted from the objects within. The cultivation of cut flowers in greenhouse heavily relies on the environmental manipulation to achieve higher yields and better quality than outdoor production. Greenhouses provide desirable conditions for optimum growth and development of cut flowers and the number of cut flowers is increasing every year.

The greenhouse commonly employed for the cultivation of cut flowers provide protection from rains, winds, excessive sunlight, insects, birds, etc. Greenhouse alongwith soilless culture is becoming more popular in the developed countries such as United States, Canada, Western Europe and Japan. In order to satisfy market demand, cut flower offer is continuously diversifying and increasing. Worldwide, there has been a sudden spurt in greenhouse production of cut flowers in the last decades.

Present state of greenhouse industry worldwide

During 1997, the total greenhouse area in Japan was 52,571 hectare with a 2% annual increase. Vegetable crops occupy maximum area (69.9%), followed by flowers (16.4%) and fruits (13.7%). The important cut flowers cultivate are chrysanthemum, carnations, roses and lilies. Rose cut flowers are actively grown in rockwool culture in Japan.

Protected cultivation of cut flowers forms an indispensable part of Dutch economy. The bulk of Dutch flowers grown under glass is exported. The total greenhouse area is around 10,800 ha, divided into vegetables (4500 ha), flowers (4400 ha) and pot plants (1100 ha). The greenhouse cultivation is mainly concentrated near Aalsmeer. It has been reported that 900 ha area is under rose, orchids and anthurium which are grown primarily on soilless media while chrysanthemum is grown on soil.

In Belgium, the total greehouse area is about 2250 ha. Out of this 650 ha is under flowers and pot plants. The important cut flowers cultivated are rose, canation, chrysanthemum and gladiolus.

Greenhouses occupy an area of 4,500 - 5,500 ha in India. The cut flowers viz., rose, chrysanthemums, carnation, gerbera and lily are successfully grown in greenhouse. Moreover, the cut flowers obtained so are of better quality and ideal for export. In India, greenhouse cultivation of cut flower is mainly concentrated in Western and Southern States. In Northern parts of the country greenhouse cultivation is not cost effective because of extremities of temperature regimes in summer and winter. Among the different states, Maharashtra is leading in greehouse cultivation of flowers. Cut flower cultivation is mainly concentrated near Bangalore, Pune, Nasik and Hyderabad.

Media for Greenhouse

The following is a description of some of the most commonly used amendments for the production of greenhouse cut flowers.

Peat and Peat - Like Materials

Peat moss is formed by the accumulation and deposition of plant materials in poorly drained areas. The type of plant material and degree of decomposition largely determine its value for use. It is costly and may have weed seeds. Although the composition of different peat deposits vary widely, four distinct categories are:

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Hypnaceous moss **-** mainly consists of the partially decomposed remains of hyprum, polytrichum and other mosses of the Hypnaceae family. Although it decomposes more rapidly than some other peat types, it is suitable for media use.

Reed and Sedge **-** consist of moderately decomposed remains of rushes, coarse grasses, sedges reeds and similar plants; generally less acidic and contain relatively few fibrous particles. The rapid rate of decomposition, fine particle size and insufficient fiber content make reed and sedge peats unsatisfactory for growing media.

Humus or Muck - it is decomposed debris of finely divided plant materials of unknown origin. Humus often contains large quantities of slit and clay particles. Due to its rapid rate of decomposition and particle size, humus is considered to be unsatisfactory for growing cut flowers.

Sphagnum moss - is the dehydrated remains of acid-bog plants from the genus *Sphagnum* (i.e. *Spapillosum).* It is light in weight and has the ability to absorb 10 to 20 times its weight in water. Sphagnum moss contains specific fungistatic substances, which accounts for its ability to inhibit damping - off of seedling. Sphagnum moss is perhaps the most desirable form of organic matter for the preparation of growing media. It has good CEC. Drainage and aeration are improved in heavier soils while moisture and nutrient retentions are increased in lighter soils.

Cocopeat - is manufactured by decomposing coconut fibre for 3-4 months in water tank. It has good porosity, drainage and root spread with minimum resistance. Other media are compost, leaf mould and synthetic aggregates like polyserene flakes. Generally media are prepared by mixing different components based on judging relative advantages and disadvantages.

Wood Residues

Wood residues constitute a significant source of soilless growing media. Nitrogen depletion by soil microorganisms, during the decomposition process, is one of the primary problems associated with wood residues. However, supplemental applications of N to the growing media can make most wood residues valuable amendments.

Leaf Mould **-** maple, oak and sycamore are among the main leaf types suitable for the preparation of leaf mould. Layers of leaves and soil are composted together with small amounts of nitrogenous compounds for approximately 12 to 18 months. Leaf mould can effectively improve the aeration, drainage and water holding properties of a growing medium.

Sawdust **-** the species of tree from which sawdust is derived largely determines its quality and value for use in a growing medium. Several sawdusts, such as walnut and non-composted redwood are know to have direct phytotoxic effects. The high cellulose and lignin content along with insufficient N supplies creates depletion problems, which can severely restrict plant growth.

Barks **-** are primarily a byproduct of the pulp, paper and plywood industries. Suitable particle size is obtained by hammer milling and screening. This produces a material, which is suitable for use in container medium.

Bagasse

This is a waste by product of the sugar industry. It may be shredded and / or composted to produce a material, which can increase the aeration and drainage properties of container media. Because of its high sugar content, rapid microbial activity results after the incorporation of bagasse into a medium. This decreases the durability and longevity of bagasse and influences N levels. Although bagasse is readily available at low cost (usually transportation), its use is limited.

Sand

Sand, a basic component of soil, has particle size from 0.05 mm to 2.0 mm diameter. Fine sand (0.05 mm - 0.25 mm) do little to improve the physical properties of a growing medium and may result in reduced drainage and aeration. Medium and coarse sand particles are those which provide optimum adjustments in media texture. Sand is least expensive of all inorganic amendments. This results in high

transportation costs. Sand is a valuable amendment for both potting and propagation media.

Perlite

This is a silicacious mineral of volcanic origin having pH of 6.8. The grades used in container medium are first crushed and then heated until the vaporization of combined water expands it to a light powdery substance. Lightness and uniformity make perlite very useful for increasing aeration and drainage. Perlite is very dusty when dry and has a tendency to float to the top of a container during irrigation. It has also been shown that perlite contains potentially toxic levels of fluorine. it can not be used for fluorine sensitive plants. Although costs are moderate, perlite is an effective emendation for growing medium.

Vermiculite

Vermiculite is chemically hydrated magnesium iron silicate. The expanded, plate like particles, which are formed, have a very high water holding capacity and aeration and drainage. Vermiculite has excellent exchange and buffering capacities as well as the ability to supply potassium and magnesium. Although vermiculite is less durable than sand and perlite, its chemical and physical properties are very desirable for container medium.

Preparing Soilless Growing Media

An ideal growing medium should be porous and well drained, yet rentive of sufficient moisture to meet the water requirements of plants between irrigations; relatively low in soluble salts, but with an adequate exchange capacity to retain and supply the nutrients necessary for plants growth; free from harmful soil pests; pathogenic organisms, soil insects, nematodes and weed seeds; biologically and chemically stable following pasteurization; primarily free from organic matter that releases ammonia when it is subjected to heat or chemical treatments.

Recommended Growing Media

There are some media formulations which may be used as a base. The following is a several list of most commonly used soilless mixtures :

Commonly used soilless mixtures for greenhouse crops

Volume / Vol. Ratio	Components
2:1	Peat, Perlite
2:1:1	Peat, Perlite, Vermiculite
2:1	Peat Sand
3:1:1	Peat, Perlite, Vermiculite
2:1:1	Peat, Bark, Sand
2:1:1	Peat, Bark, Perlite
3:1:1	Peat, Bark, Sand

Water for greenhouse should have EC of 0.75-1.50 ds/m and pH 6.0 - 7.0. Watering along with fertilizers (fertigation) is normally done in automatic controlled systems. This practice is generally followed in greenhouses. Greenhouse parameters are controlled by manual semi-automated or fully computerized system. Below mentioned are the greenhouse cultivation practices of important cut flowers in the domestic as well as the international trade.

Anthurium

Anthuriums are easily cultured, have attractive foliage and under ambient conditions produce long lasting flowers round the year. *Anthurium andraeanum* is a florist Anthurium valued for its long lasting spikes while *Anthurium Scherzeri* is an important pot plant. In *A. andraeanum,* about 3 to 8 flowers / plant / year could be obtained at an interval of 85-107 days. For proper growth and development, 50-90% shading is required depending upon the cultivar and age of the plant. Warm humid temperature is necessary for initial plant growth. Night temperature of 18^0C is optimum. Night temperature beyond 22^0C will result in poor colour of the spathes. Enriching the atmosphere with 900 $m1/m^3$ CO_2 improved and advanced plant growth by 3 weeks in *A. scherzerianum* cv. Arndt's Flamenco. Ideal growing medium should provide sufficient moisture, nutrients and aeration along with good anchorage. Different growing media viz., organic matter (i.e. wood shavings, badges, parchment) volcanic cinder or an artificial medium (i..e. rockwool, polyphenol foam etc). have been tried for anthurium cultivation. In U.S.A., volcanic cinder is

mostly used because of its availability and low cost. In India, it has been observed that cocopeat as well as combination of leaf mould and cocopeat increased the number of branches / plant, suckers / plants, flowers / plant, inflorescence longevity and quality in anthurium (*A. andraeanum)* cv. Temptation under 75% shade net.

Carnation

Carnation is one of the leading flower crops in the international trade of cut flowers. Floral induction is determined by light intensity. It is a quantitatively long day plant. Photoperiod is very important in early days of plant growth. Under low light intensity floral industion is slow and more leaves are produced. However, rate of flower development is not influenced by light intensity. The optimum day temperature should be 16^0C while night temperature 10^0C. The CO_2 concentration of 500 ppm increases flower production by 10-30%. The pH of the medium should be 6.0 - 7.0. It can be planted directly in the soil containing at least 25% decayed organic matter; a bit of lime and super-phosphate or bone mill should also be added to the soil before planting. It would be beneficial to or a slight channel between rows at planting time so that water will sink into the roots wihtout setting on the stems. Fertigation is done with N 250 ppm, P_20_5 100 ppm and K_20 200 ppm. Irrigation is given once in 3 days in summer and at 10 days in winter. Pinching is done above sixth node from the bottom. Disbudding is done when apical bud is 1.5 cm in diameter. *Fusarium* wilt is a major disease problem in carnations. Soil solarization for nearly 7 weeks is recommended for control of *Fusarium oxysporum f.sp. dianthi.* Saprophytic forest fungi, *Trichoderma viride, T. harzianum, Penicillium adametzii, P. funiculosum* and *P. nigricans* can be effectively used for the biocontrol of *F. oxysporum f. sp. dianthi.* Combination or simultaneous application of both protective (propineb) and systemic (triforine) fungicides could be best strategy for the control of fairy ring spot caused by *Heterosporium echinulatum.* Harvesting is done at tight bud and paint brush stages depending upon the requirement. Thus, 200 and 250 flowers / m^2 are obtained of standards and spray types of carnation. Soft terminal cutting (10-15 cm long) may be used for propagation. Planting is done at a distance of 15 cm x 15 cm (49 plants / m^2).

Chrysanthemum

Florist chrysanthemum *(dendranthema x grandiflorum)* belongs to family Asteraceae. This is a leading flower crop in Japan and China. In India, it occupies a place among five commercial flower crops. Chrysanthemum is a short day plant requiring and $9^1/_2$ hour dark period for flower initiation are $10^1/_2$ hour dark for flower development. For optimum growth and development, day temperature should be 16^O C. High temperature increases pedicel length and delays flowering while low temperature prevents bud formation, delays flowering, increases leaf number, promotes basal rowsetting, reduces internodal length and increases flower diameter. Various reports are available that flowering in chrysanthemum can be controlled by manipulating photoperiod and using growth regulators but the number of days for flowering varies with cultivars and temperature regimes. Application of GA_3 (100 ppm) at 45 days of transplanting under 50% shade increased duration of flowering, length of flower stalk and yield per plant in cultivar "Vasantika". Flower components respond differentially to day length i.e. ray florests develop under long days and disc florets develop under short days. This can be used commercially to get best quality blooms. It has been reported by various workers that short days followed by 8 - 15 long days, then resuming short days until maturity produces flowers with more ray florets than under short days. Under greenhouse conditions, 35-40% more yield of flowers could be obtained along with two times more vase life than field grown flowers. CO_2 concentration is 700-900 ppm. Black out and artificial lighting are followed to control day length. Plants can be grown on wide range of growing media such as bark, soil, peat, perlite, sawdust, rockwool, etc. The pH of the medium should be 6.0-6.2 The cutting 4-6 cm long is used for planting. Fertigation is done with N 200 ppm, P_2O_5 200 ppm and K_2O_5 200 ppm and K_2O 200 ppm. Irrigation is given in 3-10 days depending on soil and weather conditions. Pinching and disbudding at proper stages are followed for spray and standard types of chrysanthemums, respectively. Cut flowers should be harvested when buds begin to show colour. Flower yield of spray types varies from

60-100 flowers / m^2 and standards from 30-64 flowers / $m^{2.}$

Gerbera

Gerbera is one of the most commercial cut flowers in the international flower markets. High light intensity is essential during seeding growth because flower initiation commences after two or three leaves are visible. Plants can be successfully raised in a temperature range of 18^0-27^0C. A low temperature of 13^0C favours axillary vegetative shoots and results in higher flower number later. Toot zone heating at a temperature of 21^0C can be followed to maintain the production of cut flowers. Pure coconut fibre or cocopeat can be reliable source for growing cut gerbera. In Turkey, growing media viz., peat+pumice (1:1v/v) for gerbera cut flower was found to be the best for obtaining highest number of flowers/plant i.e., 59.3%. Gerbera "Mammut" cut flower of good quality and longevity could be obtained on coirpith substrate as well as plants sprayed with GA3 200 ppm twice at monthly intervals starting from 90 days after planting. The pH of the media should be 6.0 - 7.0. The total dissolved salts in water should not be more than 1200 ppm. Fertigation should be done with N 260 ppm, P_2O_5 180 ppm and K_2O 390 ppm. The greenhouse environment can be enriched with 600-800 ppm CO_2 for getting higher flower yield and long stalks if supplementary light is used. Yield varies from 250-300 flowers/m^2/year. Cut flower are harvested when outer row of disc florets is perpendicular to the stalk.

Lily

A number of hybrids and cultivars are grown for cut flowers and potted flowering plants. It has been reported that maintaining night temperatures at 15^0-25^0 C during vegetative growth state and at 10^0-13^0C from vegetative to reproductive development stage will be a key for increasing the number of flower buds on plants. Once flower initiation commences in Asiatic hybrids, light intensity and duration have a little role to play, which is temperature dependent. During summer season, 75% shading net and during winter 50% shading net should be used. Early and good quality flowers could be obtained if atmosphere is enriched with 1000 ppm CO_2 along with supplementary lighting at 20W/m^2. The ideal growing media should be will drained, fluoride free, sterilized and having a pH of 6.0. Fertile soil should be avoided, as it is fluoride contaminated. Bulb size should be 10/12 for Asiatic hybrids and 10/18 for Oriental hybrids for optimum flowering. Plant density should be 50-60 bulbs / m^2. Irrigation is given @ 10 liters / m^2 / day. Cut flowers are harvested at coloured bud stage.

Rose

Rose is one of the leading cut flowers in international cut flower trade. Among the different groups, hybrid teas constitute the largest number of cultivars grown for cut flowers. Light is one of the prime factors in greenhouse cultivation of roses. Day temperatures for greenhouse production of roses range from 20^0-24^0C. On cloudy days, day temperature should be maintained at 20^0-21^0C. On cloudy days, day temperature should be maintained at 20^0-21^0C while on rainy days it should be maintained at 24^0-28^0C. Quality cut roses could be obtained with maximum and minimum temperatures of 25^0C and 15^0C, respectively. In order to prevent the water loss, relative humidity during the day should be maintained at about 70-80%. At high humidity, mildew attack is more. The concentration of CO_2 should be 1000-2000 ppm. Plants can be actively raised hydroponically on rockwool, coirdust or cocopeat, perlite etc. The pH of the media should be around 5.5-6.0. Coal bottom ash; hardwood bark (3:1, 2:1 and 1:1 by volume) is one of the potential media for growing greenhouse roses. In "First Red" cut roses, increase in shoot length, flower neck length and total stem length were observed with spray of 300 ppm GA_3 at 15 days after pruning followed by monthly intervals. Rose can be effectively planted in soil and copeat. Planting distance varies with class and variety. Generally 7-13 plants per m^2 is ideal. Minimum daily water requirement of rose varies from 2 to 8 liters of water, depending on weather conditions. Nutrients vary to medium used but normally it is applied through fertigation @N200 ppm, P_20_5 150 ppm and K_2O 200 ppm. Rose should be harvested at tight-bud stage. Yield of 150-300 stems/m^2/year depending on variety is obtained.

Conclusion

Greenhouse production must satisfy high standard of product quality (in terms of composition, mechanical properties, post-harvest behaviour, health value) and environment protection (through the reduction of nutrient and pesticide release). It may be concluded that if proper management of greenhouse in terms of temperature, photoperiod and photo-intensity, media, nutrition and irrigation (fertigation), humidity, CO_2 enrichment, pest control and growth regulation through PGRs is done as per the requirement, one can generate highest possible yield.

Thrust Areas

1. The interactions between greenhouse crops and their environment in relation to the formation of product quality and the protection of environment must be investigated.

2. The design of management tools of the protected cultivation system aimed at reducing their environmental impact and improving the quality of their products.

3 New speciality cut flowers and unexploitnous flower species must be studied.

Prospects of Fruit Processing and Export in Jharkhand

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The face of fruit processing industry is fast changing and the value added processed products holds immense promise in bolstering the national economy by reducing the significant post harvest losses and providing quality nourishment to millions of consumers at affordable cost. The importance of processed value added fruit products in generating foreign revenue through export also needs to be exploited. Jharkhand has good natural resource base with a high production of fruits. The important fruits of this state are mainly under tropical and subtropical groups. The post harvest scenario of fruits is not much encouraging and it is needed to look more closely at some basic aspects of the post harvest management of fruits, so as to utilize the advantage of the high production and productivity and reduce the post harvest losses. Therefore, it is necessary to process the considerable quantity of these fruits into varied forms, mainly different types of the value added products by employing different methods of the fruit preservation. Thus, the seasonal glut and the significant post harvest losses due to poor shelf life of this large production base of fruits in this state, can profitably be exploited by driving the processing industry to adopt suitable/novel preservation techniques and making the processed and value added products of fruits and popularizing them in the domestic and international markets, as part from our country, there is also a great demand of quality processed fruit products in foreign countries particularly in European countries mainly in off season fruits and it is needed to take appropriate steps by both public and private sectors (particularly entrepreneurship development) to explore and exploit the possibilities and potentials of fruit processing in this state.

Introduction

The developing state of Jharkhand is blessed with the agro-climatic conditions, favouring the production of a wide range of tropical and sub-tropical fruits. The important ones are mainly under tropical (Jackfruit, Aonla, Bael, Ber, Custard apple, Jamun, Tamarind, Mahua, Mulberry, Karonda, Monkey fruit etc.) and subtropical (Mango, Guava, Citrus, Banana, Litchi, Papaya etc.) groups. With the adoption of high yielding varieties and improved techniques, the production and productivity of fruits has increased but side by side we have not developed suitable measures for the post harvest handling and processing of the produce, resulting post harvest losses in the tune of 25-30 per cent and ultimately, all the significant efforts made for increasing the production are going in vain.

The advantage of the high production and productivity of the fruits can be exploited to produce a variety of processed foods or value added items in large quantities. At present, the quantities of various processed foods produced in the State is negligible in comparison to the potentials. The same is the situation at national level and only about one percent of the total fruits and vegetable grown in this country are being used for processing, while it is more than 30 per cent in the countries like Philippines, Brazil, U.S., Malaysia and Thailand. So there is an urgent need to look more closely at some basic aspects of post harvest management and processing. There is also need to develop new products from the highly perishable produce and popularize them not only in domestic market but also in international level. Hence, there is an urgent need to look more closely at some basic aspects of the post harvest management of fruits and exploit the actual potentials.

Methods of fruit processing:

The varied methods used for fruit processing / preservation are physical methods, chemcial methods, by fermentation medhods and may be the judicious combination of one or more of these methods. Under physical methods the hi-tech used mainly for (i) preservation by cold i.e. by removal of heat (refrigeration, freezing, dehydro freezing and carbonation), (ii) by thermal processing i.e. by addition of heat (stationary pasteurization, sterilization, flash pasteurization), (iii) by dehydration i.e. by removal of water / moisture (dehydration, freeze drying, foam mat drying, puff drying) and (iv) by irradiation (dosing with U.V. rays, ionizing radiation). The chemical methods of preservation are done by addition of acid, by salting or brining, by addition of sugars and heating, by

addition of chemical preservatives, etc. Preservation by fermentation (yeast fermentation) is also age old and important method. In many cases the main classes of preservation methods have been employed for synergistic preservation.

Processed value added fruit products:

The production of fruits is increasing every year. Fruit processing and preservation will take care of seasonal gluts and all the wastes, occurring in spite of all improvement in the distribution of marketing of fresh produce.

The ever increasing demand of processed fruit products is mainly due to following reasons (i) rapid urbanization (ii) advancement of the middle class families and their increased purchasing power (iii) change in the food habits (iv) dying out of the age old practice of fruit preservation in homes (v) increasing demands in the domestic and freign markets (vi) processed products fetches more price than their fresh ones. The cumbersome and tedious processes of preservation are now simplified by the advancement of the new techniques and tools. New machines perform the job in more simplified and hygienic manner.

Future strategy:

Considering the vast scope for the development of agro-food industries and the variety of benefits associated with them, the Government has taken number of steps including creation of the Ministry of Food Processing Industries to cater to the requirements of agro-food industries. Large houses have been allowed to enter in this field. Further action has to be taken to impart dynamism in the agro-food industries sector. The thrust areas for their development have to be identified and policies chalked out. Problems of demand constraints should be possibly minimized, all steps should be taken to ensure supply of adequte quantity of raw materials. Attempts must be made to upgrade the quality of raw material. Establishment (or location) of processing industries should be based on the agro-climatic and cropping pattern map of the state.

It should also be based on optimum economic viability and integration of production and processing. The Government should also allot land to these units or permit the industry to acquire land on long lease for cultivation and suitably amend the land laws, if necessary. Units for commercial farming / contact farming, cooperative farming should also go in along with the development of allied infrastructures facilities like packing houses, cold storage chain, proper transportation etc. The food processing industries should be given incentives, as it contribute towards increasing food supplies without any additional demand on land by preventing heavy losses. Adequate finance at reasonable rates along with subsidy should be provided to these industries. Effective marketing promotion of the processed products at domestic as well as export market. The Research and Development infrastructure should be strengthened. Financial assistance could also be provided for upgrading, updating or modernizing and appending the allied infrastructure facilities.

The entrepreneurs should have the strong will power and nature to have concerted effort on attainment of higher quality, safety and nutrition, development of substitutes for scarce raw material and other inputs, new and safe chemical preservatives, upgradation of traditional food technologies and emphasis on establishment of new, efficient and cost effective processing machinery and simulated production.

The other aspect of concern is that the plan or project proposal should have the scope for efficient disposal and recycling of fruit wastes, which could be a source of atmospheric pollution and contamination, would provide vital nutritional components to our foods and bring down the cost of production of processed foods besides minimizing the pollution hazards.

Table : Various types of processed products from important fruits of Jharkhand

S. No.	Name of the Fruit (Scientific name)	Name of the processed products		
1.	**Mango** *(Mangifera indica)*	Canned, Juice, Powder, Slices	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam Jelly, Marmalades, Pickles, Toffee,
2.	**Guava** *(Psidium gujava)*	Canned, Juice, Powder, Slices	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly, Pickles
3.	**Citrus** ***(Citrus sp.)***	Canned, Juice, Powder	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly, Marmalades, Pickles, Toffee,
4.	**Banana** *(Musa sp.)*	Canned, Juice, Powder, Slices, dried chips	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly
5.	**Litchi** *(Litchi chinensis)*	Canned, Juice, Litchi powder, Slices Dried nuts, frozen litchi,	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly, Sweets, Pickles, Puddings
6.	Papaya *(Carica papaya)*	**Canned, Juice, Powder, Slices, dried** nuts	**Squash, Syrup, Nectar, Cordial,** Beverages (RTS), Wine	**Jam, Jelly**
7.	Jackfruit *(Artocarpus heterophyllus)*	Canned, Juice, Powder, Slices	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wines,	Jam, Jelly
8.	Aonla (*Embellica officinalis)*	Juice, Powder, Slices, dried nuts	Preserves, Candy, Squash, herbal syrup, Nectar, Cordial, Beverages (RTS), Wine,	Herbal Jam, Sauce (mixed), Sweets, Pickles, Chutney, Toffee, Shreds
9.	Bael (Aegle marmelos)	Powder	Preserves & Candy (Mature green fruits), Squash, Cider, Beverages (RTS), Toffee, Slab	Jam, Jelly

Table : Various Types of Processed Products from important Fruits of Jharkhand

S. No.	Name of the Fruit (Scientific name)	Name of the processed products		
10.	**Ber** *(Zyzyphus marutiana)*	Canned, Juice, Powder, Slices dried nuts	Squash, Syrup, Nectar, Cordial, Beverages (RTS), Wine	Jam Jelly, Pickles
11.	**Custard apple** *(Annona squamosa)*	Canned, Juice, Powder	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly
12.	**Jamun** (Syzygium cuminii)	Canned, Juice, Powder, Slices, dried nuts	Squash, Syrup, Nectar, Cordial Beverages (RTS), Vinegar, Wine	Jam, Jelly
13.	**Tamarind** *(Tamarindus indica)*	Canned, Juice, Powder, dried nuts	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly, Pickles, Chutney, Toffee
14.	**Mahua** *(Bassia latifolia)*	Canned, Juice, Powder	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly
15.	**Mulberry** *(Morus alba & M. nigra)*	Canned, Juice, Powder, Slices	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wine	Jam, Jelly, Pickles, Chutney
16.	**Karonda** *(Carissa carandas)*	Canned, Juice, Powder, Slices dried nuts	Squash, Syrup, Nectar, Cordial Beverages (RTS), Wines	Jam, Jelly, Pickles Chutney
17.	**Monkeyjack** (*Artocarpus lakoocha)*	Canned, Juice, Powder, Slices,	Squash, Syrup, **N**ectar, Cordial Beverages (RTS)	Jam, Jelly, Pickles

Table : Important nutrient elements of fruits (per 100 g of edible part)

S. No.	Name of the Fruit (Scientific name)	Mois-ture (g)	Protein (g)	Fat (g)	Mineral (g)	Fibre (g)	Carbo-hydrate (g)	Energy (Cal)	Ca (mg)	P (mg)	Fe (mg)	Carotene (mg)	Vit. C (mg)
1.	Mango ***(Mangifera indica)***	81.0	0.6	0.4	0.4	0.7	16.9	74	14	16	1.3	2743	16
2.	Guava ***(Psidium guajava)***	81.7	0.9	0.3	0.7	5.2	11.2	51	10	28	1.4	-	212
3.	Citrus (Lime, Lemon) ***(Citrus sp.)***	84.6	1.5	1.0	0.7	1.3	10.9	59	90	20	0.3	15	63
4.	Banana *(Musa sp.)*	**70.1**	**1.2**	**0.3**	**0.8**	**0.4**	**27.2**	**116**	**17**	**36**	**0.9**	**78**	**7**
5.	Litchi *(Litchi chinensis)*	**84.1**	**1.1**	**0.2**	**0.5**	**0.5**	**13.6**	**61**	**10**	**35**	**0.7**	**-**	**31**
6.	Papaya *(Carica papaya)*	**90.8**	**0.6**	**0.1**	**0.5**	**0.8**	**7.2**	**32**	**17**	**13**	**0.5**	**666**	**57**
7.	Jackfruit *(Artocarpus heterophyllus)*	**76.2**	**1.9**	**0.1**	**0.9**	**1.1**	**19.8**	**88**	**20**	**41**	**0.5**	**175**	**7.0**
8.	Aonla *(Embellica officinalis)*	**81.1**	**0.5**	**0.1**	**0.5**	**3.4**	**13.7**	**58**	**50**	**20**	**1.2**	**9**	**500**
9.	Bael ***(Aegle marmelos***	61.5	1.8	0.3	1.7	2.9	31.8	137	84	50	0.6	55	8

Table : Important nutrient elements of fruits (per 100 g of edible part)

S. No.	Name of the Fruit (Scientific name)	Mois-ture (g)	Protein (g)	Fat (g)	Mineral (g)	Fiber (g)	Carbo-hydrate (g)	Energy (Cal)	Ca (mg)	P (mg)	Fe (mg)	Carotene (mg)	Vit. C (mg)
10.	**Ber** ***(Zyzyphus marutiana)***	81.6	0.8	0.3	0.3	-	17.0	74	4	9	1.8	21	76
11.	**Custard apple** ***(Annona squamosa)***	70.5	1.6	0.4	0.9	3.1	23.5	104	17	47	1.5	-	17
12.	**Jamun (Syzygium cuminii)**	83.7	0.7	0.3	0.4	0.9	14.0	62	15	15	1.2	48	18
13.	**Tamarind** *(Tamarindus indica)*												
14.	**Mahua** *(Bassia latifolia)*												
15.	**Mulberry** *(Morus alba & M. nigra)*	86.5	1.1	0.4	0.6	1.1	10.3	49	70	30	2.3	57	12
16.	**Koronda** *(Carissa carandas)*	91.0	1.1	2.9	0.6	1.5	2.9	42	21	38	-	-	110
17.	**Monkeyjack** *(Artocarpus lakoocha)*												6-16

Production Technology of Some Important Medicinal Plants

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In recent years the importance of medicinal plants has increased due to more than one reason - high cost of medicines, side effects, unavailability in rural areas, prolonged use and temporary relief. Unlike allopathic medicines the herbs act in almost magical ways - spasm may relax, pains vanish, constipation overcome, nervousness recede, headaches disappear, allergies counteracted and so on.

Throughout the world, several thousand plants have been and are still used for medicinal purposes by herb doctors, dwellers in primitive places who are forced to depend on the native plants of the vicinity.

The medicinal plants are mostly found in forest areas. Only few plants are being cultivated. The plants collected from the forest find ways to shipment and processing of the crude material carried on in the USA and some European countries.

The medicinal value of the drug plant is due to the presence in the plant tissue of some chemical substances or substances that produce a definite physiological action on the human body. The most important of these substances are alkaloids, glycosides, essential oils, resins, mucilages, tannins, gums and compound of carbon, hydrogen, oxygen and nitrogen. Some of these materials are powerful poisons and as such the preparation and administering of the drugs should be left entirely in the hands of skilled pharmacists and physicians.

Export possibilities

India is a veritable emporium of medicinal plants and there is a vast potential for export of medicinal plants from our country. According to Exam Bank report a favorable policy frame work will be required to promote commercial cultivation research and development for increased export of medicinal plants.

Medicinal plant trade in India is estimated to be worth Rs. 550 crores (1997-98) per year. The value of global trade in medicinal plants has been put at over US $ 60 billion per year. India's total turn over is of Rs. 2300 crore of Ayurvedic and herbal products.

The export market for medicinal plants appears to be growing faster than the Indian domestic market at the rate of 7 per cent per annum. Now a days there is renewed world wide interest in natural medicines and over uses in food and cosmetic industries with good prospect for export of medicinal plants from India. For example, the Isabgol husk and seeds, the global demand for these has doubled to 16000 tonnes during 1985 to 1995. India will have to be at home in its marketing skills with suitable strategies capable of catering to the dynamic market requirements supported by appropriate policy frame work. It is imperative to evolve a national policy in medicinal plant conservation. For long term conservation and management of medicinal plants, *in situ* network would have to be integrated with regular forestry and wild life management in the country. There is a need to promote nation-wide network of medicinal plant nurseries in order to ensure immediate availability of plants and planting materials to various user groups like farmers, plant breeders, horticulturist, industry and conservation organizations besides research workers for evolving new drugs.

Cultivation of medicinal plants in Jharkhand region

Seeing the export market as well as domestic consumption, many herbs can be successfully cultivated in this region. In fruits Aonla, bael, papaya (Papain), citrus, custard apple are few which have much medicinal value. Trees like Hara, Bahera, Neem, Ashok, Mahua, Palas, Chandan, Babool, Amaltas are few which have great curetic properties being grown in the Jharkhand. Likewise Tulsi,

Gheekuwar, Chiraita, Sada Bahar, Sarpgandha, Kutki, Gulaichi, Pipari, Ashwagandha, Musli, Brahmi, Gugul, Kalmegh, Satavari are some of the plants which can be profitably taken up. Aromatic plants such as Pudina, Lemon grass, Citronella, Palma rosa, Geranium can also be taken up. A short description of cultivation of some medicinal plants are being presented for reference.

Ashwagandha (Withania somnifera)

Family - Solanaceae

Part used - Roots

Uses - Hiccup, cough, dropsy, Rheumatism, Female disorders, Tonic, alternative, aphrodisiac

Alkaloid isolated from Ashwagandha

Tropine, Pseudotropine, Hyprine, Cuscohygrine, Anaferine, Analygrine, Piperidine, thiosinamine etc.

Cultivation

Soil - Light loam with good drainage; pH 7 to 8, can be grown in lower pH and land unsuitable for others.

Climate - Rainy season crop, require dry climate in winter, rainfall upto 1000mm

Seed - 5 to 6 kg per hectare
10 kg per hectare for direct sowing

Medicinal Plants - Their Utility & Economics

1. Ashwagandha

Scientific Family Withania somnifera, Solanaceae

Plant parts used - Roots

Uses: arthritis, asthma, bronchitis, cancer, cold, cough, cystitis, debility, Diarrhea, Dropsy, Fever, Hypertension, Nerves, Mental

Cropping season - July to February

Economics of cultivation /hectare ($2^1/_2$ acres)

Preparation of land	-	1500/-
Seeds (5 kg) & sowing	-	1000/-
F.Y.M & Fertilizer	-	1500/-
Irrigation	-	500/-
Thinning & weeding	-	1000/-
Crop protection	-	500/-
Harvesting & Grading	-	2500/-
Misc	-	1500/-
		Rs. 10000/-

Return

Dry roots 6qt @ 6000/qt	-	36000/-
Seed 30 kg @ 100/kg	-	3000/-
		3900/-

Net income 39000/- 10000/- = 29000/- per ha
or 11500/- per acer

2. Kalmegh

Andrographic paniculate - Family Accanthaceae

Plant parts used - whole plant

Uses: astringent, anti inflammatory, dysentery, diarrhoea, cholera, fever, diabetic, bronchitis, itches, influenza, hypertension, piles, gonorrhoea, jaundice, dyspepsia, anthdnuntie

Cropping season - June - July

Economic of cultivation / ha

Cost of seed (800g)	-	2000/-
Raising nursery	-	500/-
Land preparation	-	2000/-
FYM + Fertilizer	-	2500/-
Transplanting of Seedings	-	1000/-
Irrigation	-	1000/-
Harvesting (2 harvest / yr)	-	1500/-
Drying & Packing	-	1500/-
Misc	-	1000/-
		Rs. 13000/-

Return : Herbs 35 Qt @ Rs 1500 / Qt. - 47500/-

Net return 47500 - 13000/- = 34500 / ha or 13000/ acer

3. Brahmi

Bacopa monnieri - Family Scroplulariaceae

Plant parts used - Whole plant

Uses : nerve tonic, insanity, epilepsy, mental

disorder increasing memory, aperient, diaretic, asthma, rheumatism, inflammation of joints, fever cardiotonic, snake bite.

Cropping season - Rainy season - perennial crop.

Economics : per ha.

Preparation of land	-	2000/-
FYM - 250 Qts.	-	12000/-
Fertilizer	-	2000/-
Transplanting of cuttings	-	2500/-
Planting material	-	5000/-
Irrigation (5 - 10 times)	-	5000/-
Wedding (2-3 times)	-	3500/-
Harvesting (2 times)	-	3500/-
Drying, Storing & Packing	-	10000/-
Misc.	-	3500/-
		Rs. 50000/-

Return per ha

Shade dried yield from first harvest	60 Qt
Shade dried yield from second harvest	40 Qt
Total dry matter	100 Qt
Gross return @4000/- per Qt-	4,00,000/-
Net return 400000 - 50000 =	350000/- ha
	or 140000/- acer

4. Chamomile

Matricaria Chamomile

Plant parts used - flower

Uses: antiseptic cream for wound healing expectorant, carminative, anthelmintic sedative, diauretic

Oil - Hair dyes, dermatitis pre clothing, flavoring alcoholic & non alcoholic drinks increams & baked foods, high grade perfumes

Planting season - October

Cost of production per ha

Cost of Seed (600 g)	-	600.00
Nursery preparation	-	500.00
Land Preparation	-	2000.00
FYM	-	2000.00
Transplanting	-	1000.00
Irrigation	-	1500.00
Weeding	-	1800.00
Harvesting of flowers	-	13500.00
Drying of flowers	-	1000.00
Misc	-	1100.00
		Rs. 25000.00

Return 10Qts @ 500/Qts - 50000/-

Net Profit - 25000/ ha or 10000 / acer

Income from oil yield 5 kg @ 30000/kg - 1,50,000/-

Cost of distillation & Transporting 25000/-

Net profit / ha 1.00 lakh or 40000 / - per acer

5. Marigold

Tagetes minuta

Plant parts used - whole above ground

Planting time - October

Uses: Perfumery, Pharmaceutical, Diuretic, Purgative, Intestinal Parasites

Flowers - Stomatic, aperient, diaretic, diaphonetic

Economics/ ha:

Cost of seed (600 g)	-	1000/-
Nursery raising	-	500/-
Land preparation	-	2000/-
Manures & fertilizer	-	2000/-
Transplanting of seeding	-	1500/-
Weeding & Hoeing	-	1500/-
Irrigation	-	1300/-
Harvesting (cutting)	-	1500/-
Transporting & distillation	-	2500/-
Misc.	-	1000/-
		15000/-

Income (Return) :

Harvesting at peak of flowering by March end 30-40 cm above ground

65 kg oil @ 1000/kg - 65000/-

Net Profit 65000 - 15000/- = 40000/- per ha or 16000/ acer

6. Safed Musli

Chlorophysum borrivillianum

Family Liliaceal

Plant parts used - Roots

Uses - General weakness, increasing milk, diseases after delivery, sextonic, diabities

Economics of cultivation/ ha:

Cost of planting material (10 Qts)-300000

F Y M, Compost 10 trolly	-	15000
Land preparation (4 times)	-	4000
Raising of beds (30 cm)	-	5000
Fertilizers & soil tonic etc.	-	5000
Weeding & hoeing (3 times)	-	6000
Irrigation (Several times)	-	15000
Plant protection	-	2000
Harvesting & peeling & drying	-	95000
Transporting, packing etc.	-	5000
Care & Maintenance, Misc.	-	5000
		462000

Return:

Dried Musli 1- Qt @ 1000/- per kg	-	1000000
Planting material	-	100000
		1100000/-

Net Profit - 11 lakh - 4.62 lakh = 6.38 lakh / ha or 2.5 lakh / acer

7. Satawar

Asparagus racemouses

Family Liliaceae

Plant parts used - Root

Uses : Diabetes, General Debility, Seminal debility, Lencorrhoea, Diarrhoea, Anemia, Increasing breast milk.

Season of growing - May - June - $1^{1}/_{2}$ yr crop

Economics of cultivation / ha

Cash of Seed	-	1800
Nursery raising	-	500
Land preparation	-	2000
Manures & Fertilizer	-	3000
Transplanting of Seedling	-	1500
Weeding, Hoeing etc (3 times)	-	3000
Irrigation (2 times)	-	1200
Harvesting, Peeling Drying & Grading	-	5000
Transporting	-	500
Misc.	-	1000
		20000

Return 700 - 800 of fresh roots

70-80 Qt dry roots @ 20/- per kg - 1,60,000/-

Net return - 1,60,000 - 20000

= 1,40000/- per ha or 74000/- per acer

8. Ra-tanjot (Jatropha)

Jatropha curcus

Family Enphorbiaceae

Plant parts used seed

Uses : Oil from seed mixed with diesel to run vehicle, soap making, lubricant, candle making, plastic & synthetic fibre and dye. Jatrophin - cancer, oczyma and skin disease. Root bark - Rhenumatism, Inflammation, Cough and TB. Twigs - Swellings, Chronic Dysentery, Ulcer.

Economics :

Planting distance - 2x2 mt.

Per hectare No of plants 2500

Life of Plants - 30-40 Yrs.

Yield Year	Quantity	Income
1st yr.	250 kg.	2500
2nd yr	1000 kg	10000
3rd yr	2500 kg	25000
4th yr	5000 kg	50000
5th yr	8000 kg	80000
6th yr	10000 kg	1,00,000

- Plant is not eaten by the animals

- Jatropha oil is used directly in the vehicle.

Production Technology of Some Important Aromatic Plants

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India having a vast area of land with varied climatic conditions, is widely suited for aromatic plants. The foreign exchange earned by India in 1998-99 from the export of Aromatic and Medicinal plants was over US $ 3000 million. Among the aromatic plants *Mentha* occupies the first position in production, followed by lemon grass, citronella, palmarosa, geranium, jasmine, basil and lavender etc. Vanilla, citrus and mint oil occupy first, second and third position respectively in consumption of flavour and chemical constituents. Jasmine oil is priced at Rs. 20000-30000 per kg internationally, as against Rs. 10000-15000 in the country. The international price of rose oil is about Rs. 1.0 - 1.5 lakh per kg. However, the annual export of the derviatives of aromatic plants is to be turn of Rs. 600-700 million. There is need to do research and development to achieve higher production and quality in aromatic plants.

The cultivation, marketing, extraction, storage and conservation of aromatic plants should be taken under consideration for its sustainable production. At present we depend only on natural resources or on forest, that are limited. So, there is need to train farmers in cultivation technology of some important aromatic plants, which are area specific and demand based.

There are many advantages of growing aromatic plants:

- Provide employment opportunity
- High potential for foreign exchange
- Scope for agri-business
- Value added, and
- Efficient utilization of natural resources

Aromatic plants provide raw materials for the manufacture of

1. Flavour : In icecreams, candies, chewing gum and baked food.
2. Herbal : As cooling, gastro - stimulant and syrups
3. Cosmetic : In creams, talcum powder, body lotions, after shave lotions, detergents and soaps.
4. Perfumery : Scenting of shampoos, soaps, face creams and liqueurs.
5. Oil : Pain relieving balms and hair oils.

The cultivation of some important aromatic plants which are best suited for the Jharkhand state are discussed below:

A. Mint *(Mentha spp.)*

Family : Labiateae

Part used : Leaves and flowers

Uses : Vomiting, diarrhoea, nausea, headache, pain, cooling and fastro-stimulant properties, food flavour, confectionery, cosmetics, beverages and related industries.

Cultivation :

Soil and climate :

Preferred well drained, rich in organic matter, good water holding capacity, 6.0 to 7.0 soil pH, average annual rainfall of 950-1050 mm, 15 to 25^{0}C temperature is ideal for its cultivation

Propagation : Two ways

1. Through suckers: Grown in nursery, about 100 kg suckers are divided into small pieces each bearing at least one node, rooted plants are ready for transplanting in 30-40 days; transplanting is done in the month of March-April.

2. Through stolens: Fresh juicy stolens, 4-5 cm long, with 2-4 growing points, planted in furrow at spacing of 40x10 cm depth not more than 5 cm in the soil, planting is done between mid January to mid February, 3-4 q of stolens is enough for one ha.

Fertilizer: FYM @ 25 to 30 tonnes / ha
NPK @ 50:75:40 kg / ha
BHC @ 25 kg at land preparation

Crop rotation: Mint - maize - potato
Mint - early paddy - potato
Mint - late paddy - sweet potato

After care : 6-9 irrigation during dry season before first harvest; frequency depends upon the soil texture, water holding capacity and weather conditions; first weeding is done at the height of 15 cm.

Harvesting : Generally harvested when it comes to flowering, maturity attained after 105-110 days of sprouting, January-February planted crops ready for first harvest by the end of June and second harvesting is possible in September - October.

Yield: 15 t / ha, 50 kg oil / ha

Disease and pest :

Rotting - Plants should be treated with
fungicide before transplanting.
Semilooper - Quinalphos spray @ 0.05%
Caterpillar - Endosulphan @ 0.07%
Aphid - Dimethoate @ 0.05%

Economics : Cost of inputs Rs. 6000
During crop year - 50.00 kg oil
Average rate - Rs. per kg 450
Total produce in Rs. 22500
Profit in Rs. / year / acre - Rs. 8000

B. Geranium (*Pelargonium graveolens*)

Family : Geraniaceae

Part used : Leaves and branches

Uses : Scenting soaps, manufacturing perfumes, creams, talcum powder and body location.

Cultivation :

Soil and climate: Deep well drained, fertile, slightly acidic, sandy loam to clay loams soils, 5.5 to 8.0 soil pH. Grown under mild subtropical and sub-temperate climate, average annual rainfall of 1500 mm, optimum temperature of 5 to 23^0C.

Nursery raising: Propagated through stem and root cuttings, raised during early spring, 10-15 cm long terminal stem cuttings with 2-4 nodes, dipped in IBA (2000 ppm) or IAA (200 ppm) solution before planting, 80 sq. m. area sufficient to plant a ha, beds should be raised and are laid out in 3 m x 1.5 m size, 3-4 week old plants are ready for transplanting.

Transplanting: Field prepared to a fine tilth, planted at 60x60 cm or 60x45 cm spacing, 30000 cuttings are required for planting in one ha.

Fertilization : FYM @ 25 tonnes / ha
NPK@ 100:30:60 kg / ha

After care : 1-2 hoeing and weeding when plants grow tall and bushy pruning helps in bushy growth, Tock-25 preferred as pre-emergence weedicide in rainy season, during summer irrigation given at 10-15 days interval.

Harvesting : First year harvested once i.e. 6 month after planting when they have flowered, thereafter harvested thrice or four times annually.

Yield : 25000 per ha plants gives 150-180 qt. leaves that gives approximately 15 kg oil.

Economics : 25000-30000 Rs. / year / ha profit
Oil yield - 20-30 kg / ha / year
Oil price - 3500-4000 / kg
Gross profit - 70000-120000 / ha / year

C. Lemon grass *(Cymbopogon flexuous)*

Family : Geraniaceae

Part used : Whole plant

Uses : Scenting soaps, cosmetics, disinfectant, citial produced is starting material for manufacturing of ion-one and Vit.A.

Cultivation :

Soil and climate : They are very hardy, drought tolerant and adopted to a wide variety of soils, tolerate alkalinity to some extent, soil should be well drained, medium to highly fertile soil is preferred, warm tropical climate, average annual rainfall of 2500-3000 mm high temperature and sunshine increases its oil content.

Seedling raising : Commercially propagated through seeds, sown in nursery during April - May, 4-6 kg seeds sown in raised beds are enough for planting in one ha, seeds germinate in 5-6 days, 60 days old seedling is ready for transplanting.

Transplanting : Two month old seedlings are planted in well prepared field, 40 x 15 cm or 60 x 45 cm distance should be maintained, maintained 4 years in irrigated field and 6-8 years as rainfed, allow 3-4 coppicing of leaves in a year.

Fertilization : FYM @ 2 tonnes / ha
NPK@ 150:40:40 kg / ha

After care : 1-2 intercultures in the first year and one such interculture is given after 30 days of each harvesting, earthling up improves tillering, irrigation at frequent intervals in dry season.

Harvesting : Two harvesting in first year, first at 90 days after transplanting and 2nd at 70-80 days after 1st harvesting, cut at 20 cm above ground and left for withering for 4-6 hr in field, 3rd harvesting in second year.

Yield : 18-20 tonnes / ha as rainfed crop and 25-30 tonnes / ha as irrigation crop producing 80-100 kg and 150-180 kg oil per kg, respectively from well manured field.

Disease and pests: Shoot borer - spray Monocrotophos @ 0.05%
Spittle bug - Spray Quinalphos @ 0.05%
Aphid - Monocrotophos @ 0.05%
Termite - Drench with chlorpyriphos @ 0.1%

Economics : Cost of input in Rs. 3600
Sub-sequence year Rs. 11,200
Average rate - Rs. 150 per kg.
Total produce in Rs. 39,450
Profit in Rs / year per acre - 12,350

Farmers growing aromatic plants require a distillation unit, so that the oil may be extracted easily. The cost of setting up a distillation unit on a small scale, is rupees one lakh to one and half lakhs. Jharkhand is very much suitable for growing these crops. Over and above there is a need for research on the perfection of the production technology.

Integrated Plant Nutrient Supply (IPNS) : Importance and Impediments

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Definition of Integrated Nutrient Supply Programme (IPNS)

Refers to combined use of fertilisers, organic manure, crop residues, green manures and biofertilisers (Rhizobium, N-fixers, P-solubilisher) for obtaining high yields and for environmental safety.

Components of IPNS

- Fertilisers
- Manurers: including FYM, compost & bulky manures
- Crop residues and green manuring
- Biofertilisers
- Rhizobium (legumes in cropping system)
- Other N fixing microorganisms
- Blue green algae (BGA)
- P solubilisers
- Azolla

IPNS means involvement of combination of two or more than 2 components of IPNS

Usefulness of Manures and Crop Residues

- Supply nutrients including secondary & micro
- Contribute to soil productivity by acting as store house for nutrients
- Increase O.M. Status in soils. This helps in turn in:
- Increasing soil ability to retain nutrients against leaching
- Improving physical properties of soil
- Reducing effects of soil compaction
- Improving water holding capacity of soil
- Improving chemicals properties of soil
- Improving biologicals properties of soil

Bulky manurers are always beneficial, so use should be as supplemental rather than substitution

Strategy in use of organic manures

Farmers understand importance of organics. The need is to educate them on:

(i) Complementary use in agriculture

(ii) Conserve them scientifically

(iii) Preferable use in cash crops

(iv) Use for biogas production

However, they may enhance weed infestation.

N-fixation in soil by different green manuring crops

Crop	Season	Green matter (q/ha)	N content in green matter (%)	N added in soil (q/ha)
Sannhemp	kharif	152	0.43	84.0
Dhaincha	kharif	144	0.42	77.1
Moong	kharif	57	0.53	38.6
Lobia	kharif	108	0.49	56.3
Guar	kharif	144	0.34	62.3
Senji	rabi	-20-6-	0.51	134.4
Khesti	rabi	88	0.54	61.4
Berseem	rabi	ill	0.43	60.7

Bio-Fertilisers

Refer to use of micro-organisms in free-living state or in symbiotic association with plant for meeting nutrient requirements of crops.

Bio-fertilisers are bio-innocultants containing micro-organisms beneficial to agricultural production in terms of nutrient supply. The two types are:

1. N2 fixers (symbiotic or non-symbiotic)
2. P solublisers - They make native P more available and do not add any P to the soil

The commonly used bio-fertilisers are:

- Rhizobium ..... in legumes for N fixation from atmosphere
- Azotobacter ..... in non-legumes for N fixation from atmosphere
- Azosprillum ..... fixes 10-15 kg N / ha
- Blue green algae ..... fixes 20-30 kg N / ha
- Azolla ..... an aquatic water fern in ponds production upto 330 t / ha = 840 kg N / ha / yr

used as:

(i) green manuring
(ii) Cropping in rice
(iii) for preparation of compost

- P solublising microbes eg Aspergillus Pseudomonas

Bio-fertilisers are living organisms. Therefore, for their proper functioning, optimum environment, soil and supply of nutrients are essential.

Concerns of Manures, Bio-fertilisers, Crop residues

- Quantity available suffers because of:
- cow-dung used as fuel;
- crop residue used as cattle feed
- Quality aspect:
- nutrients content of manures / residue
- stage of decomposition of manures

Azolla Use:

- Inoculated in field
- Direct addition in field
- Composting and then use in field

Estimates of availability of bulky manures:

1 m population	=	0.25 m. to. dry faeces
1 m. cattle	=	1.2 m. t. dry dung / year
Cattle dung	=	2 billion tonne
Urban compost	=	6.64 m.t.
Rural compost	=	279.66 m.t.
Nutrients potential from cattle dung	=	7 m.t. NPK (3.44 N + 1.31 P205 +2.21 K20)
Crop residues	=	270 m.t. (1 / 3 can be recycled)

Crop residue increases 1.2 - 1.5 m.t. with every m.t. increase in grain production

Nutrients potential from crop residues = 5.6 - 8.1 m.t. NPK

Organic resource can contribute = 17-19 m.t. NPK but can supply at least = 3.9 - 5.7 m.t. NPK

Extent of availability in India (1996-97)

Compost, (lakh t,)

Urban	Rural
48.281	1325.31

Area under green manuring (lakh ha) = 22.51

Modern technology for increased agricultural production does not mean that bulky organic manures etc. should be ignored. Organics are useful sources for supply of nutrients and have many other advantages when applied to soil. Therefore combined use of organic manures and inorganic fertiliser need to be encouraged. However, in this, fertiliser will continue to be the dominant contributor for meeting plant nutrient requirements of crops for increasing agricultural production.

Importance of IPNS in horticulture : IPNS is more relevant in horticulture as bulky manures especially FYM and fertilisers are recommended for all horticultural crops as per Package of Practices.

Questions

(i) It is difficult to raise O.M. status in warmer climates.
(ii) Immobilization of nutrients with addition of fresh crop residues in soil.
(iii) Preparing quality compost.
(iv) Organic farming

AVERAGE CHEMICAL COMPOSITION (%) OF SOME ORGANIC MANURES

		Nitrogen (As N)	Phosphate (As P2O5)	Potash As K2O
I.	Bulky organic manures			
	Farmyard manure	0.5-1.5	0.4-0.8	0.5-19
	Compost (Urban)	1.0-2.0	1.0	1.5
	Compost (Rural)	0.4-0.6	0.3-0.6	0.7-1.0
	Green manures (various averages)	0.5-0.7	0.1-0.2	0.6-0.8
II.	Oil cake			
	(a) Non-edible cake			
	Castor cake	5.5-5.8	1.8-1.9	1.0-1.1
	Mahua cake	2.5-2.6	1.8-1.9	1.8-1.9
	Karanj cake	3.9-4.0	0.9-1.0	1-1-1.4
	Neem cake	5.2-5.3	1.0-1.1	1.4-1.5
	Safflower cake (undecorticated)	4.8-4.9	1.4-1.5	1.2-1.3
	(b) Edible cake*			
	Coconut	3.0-3.2	1.8-1.9	1.7-1.8
	Cotton seed (Decorticated) cake	6.4-6.5	2.8-2.9	2.1-2.2
	Cotton seed (Undecorticated) cake	3.9-4.0	1.7-1.9	1.6-1.7
	Groundnut cake	7.0-7.2	1.5-1.6	1.3-1.4
	Unseed cake	5.5-5.6	1.1-1.5	1.2-1.3
	Niger cake	5.1-5.2	1.8-1.9	1.3-1.4
	Rapeseed cake	5.1-5.2	1.8-1.9	1.1-1.3
	Sesamum or till cake	6.2-6.3	2.0-2.1	1.2-1.3
III.	Manure of animal orign			
	Dried blood	10.0-12.0	1.0-1.5	0.6-0.8
	Fish manure	4.0-10.0	3.0-9.0	0.3-1.5
	Bird guano	7.0-8.0	11.0-14.0	2.0-3.0
	Bonemeal (Raw)	3-4	20-25	-
	Bonemeal (Steamed)	1.0-2.0	25-30	-
	Activated sludge (Dry)	5.0-6.5	3.0-3.5	0.5-0.7
	Settled sludge (Dry)	-2.0-2.5	1.0-1.2	0.4-0.5
	Night soil	1.2-1.3	0.8-1.0	0.4-0.5
	Human urine	1.1-1.2	0.1-0.2	02.-03
	Cattle dung and urine mixed	0.60	0.15	0.45
	Horse dung and urine mixed	0.70	0.25	0.55
	Sheep dung and urine mixed	0.95	0.35	1.00

Source : *(1) C. N. Acharya (1957), Organic Manures, LC.A.R. Review Series No. 2.*
(2) J. A. Do (1955), Manures Manufing, W.A.R. Farm "edn No. 7.
(3) Van Slyke (1953), Fertffser and Crop Producdon, Pubfished by Orange Jodd. Pubfishing, Co. New Yark.

Method for collection of representative Soil Sample for Horticulture Crops

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Soil test is chemical test of a soil sample to know the extent of food elements available to a crop.

Advantages: The advantages of soil testing are that it serves as a guide for intelligent and judicious use of fertiliser, gives information about the intensity of acidity, alkalinity or any other abnormality in the soil and helps in planning and maintaining good soil management programme. Soil testing also helps in determining the effect of past fertilisation on soil and predicting future needs and enables comparison of soil fertility over time and helps to evaluate depletion or build up of soil fertility with fertiliser use and cropping.

Soil testing ensures balanced use of inputs keeping into consideration the native soil fertility status. When the soil tests low, higher amount of fertiliser is needed but when the soil test is high, lower amount of fertiliser is added. **The full impact of soil testing in actual farming in developing countries is still to be realized.**

Soil tests are not the whole answer to fertility problem; they only point out where the problem exists. Also soil test recommendations have to be developed for different crops and crop rotations. An important considerations on soil testing is: how the soil samples has been collected. The soil sample must be representative of the field. A poor sample is worse than none at all and no test can be better than the soil sample itself.

I. Sample For Orchard Plantation

1. Since the nutritional status and other conditions of the subsoil are equally important for the growth of fruit trees, land for garden plantation should be sampled to a depth of 2 meter starting from top to 15 cm and then each 30 cm layer. Soil samples can be taken by using either a soil auger or digging a 2 meter deep pit.
2. Collect samples separately for each layer, that is, for top 0-15 cm layer, 15 to 30 cm layer, 30-60, 60-90, 90-120, 120-150, 150-200 cm depth. If you find hard pan or a layer of concretions, note its depth and thickness and collect a separate sample from this layer.
3. In addition, take a sample of the crust on the surface itself separately.
4. Carefully label each sample separately indicating the depth of layer from which sample has been collected.
5. Pack samples separately in clean cloth bags and send them for testing.

II. Sampling From Established orchard for Fertiliser Use

Where to sample :

- Take the soil samples under area between the tree trunk and the drip line. This is the area where the fertilizers have been applied or are to be applied.
- The time to take soil or media samples is determined by the information desired.
- Samples for determining fertilizer needs of annuals should be taken sufficiently in advance of planting to allow time for analysis and return of the results from the laboratory.
- Divide the basin area in four quarters. Collect sample, at least one and preferably two or more in each quarter of the area under the tree selected, and make a composite sample for analysis.

Nutrients Deficiency Symptoms in Horticulture Crops

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The appearance of plant has long been a clue to its nourishment or lack of it. When a plant badly needs a certain plant food, it shows starvation signs called deficiency symptoms or hunger signs. **These symptoms are nutrient specific and show different patterns in crops for different essential nutrients.**

It is helpful to keep in mind that some nutrients are more mobile while others are relatively "immobile" in the plant.

When there is a deficiency of a "mobile" nutrient, the symptoms usually occur in the lower or older leaves of the plant. This is because the "mobile" nutrients move out of the older leaves to the younger part of the plant. *Typically, the "mobile" nutrients are nitrogen, phosphorus, potassium and magnesium.*

In general, the symptoms caused by deficiencies of an "immobile' nutrient will occur on the upper or younger leaves. The older leaves will remain green and free of symptoms because these immobile nutrients do not move or translocate from them. *Typically, the "immobile" nutrients are sulphur, calcium, iron, zinc, copper, boron, manganese and molybdenum.*

Deficiency symptoms

Nitrogen (N) Plants are light green and growth is stunted. The lower leaves may be affected first, but other leaves follow, with later yellowing and drying up or firing and final shedding of the lower leaves.

In tree crops, the leaves are often small, pale in color and may appear on an part or all of the plant.

Phosphorus (P). Plants are often small and growth is stunted, but in many crops the leaves are darker green than norma. The leaves and sometimes the stems may developed root systems. The stalks are weak and lodging is common.

Seed and fruit are small and shriveled. Plants possess low resistance to disease. In the case of legumes, the first signs of potassium deficiency are often small white spots or yellowish dots around the outer edges of the leaves. Later the edges turn yellow and die.

Magnesium (Mg). Magnesium deficiency symptoms appear first on lower (older) leaves. It appears first as a light, yellowish, fadded discoloration with the veins remaining green. In crops such as corn the leaves are yellowish or very light striped while veins remain green. In some crops, as the deficiency progresses, a reddish-purplish color develops with green veins.

The pattern is distinct and characteristic and can usually be identified after some, experience in observation. It is more likely to occur in acid sails.

Calcium (Ca). Calcium deficiencies are not often seen in the field because secondary effects, associated with high acidity limit growth first.

Leaves may be cup-shaped and crinkled, and the terminal buds deteriorate with some breakdown of petioles.

Fruits may break down at the blossom end. Calcium deficiency is known to be associated with "blossom-end rot" in tomatoes and other crops.

Iron (Fe). Iron deficiency shows up as a very light pale leaf color with veins remaining green, usually first appearing on younger leaves; but severe deficiency may result in the entire plant showing such symptoms.

It can easily be mistaken for manganese and also occurs on high pH soils. The interveinal chlorosis in iron is often whiter than manganese.

Zinc (Zn). Symptoms appear first on the younger leaves and other plant parts. Some crops are much more likely to show the symptoms, and they have been defined on these. In corn, the deficiency is called "white bud" because the young bud may turn white or light yellow while the leaves show bleached bands, or a striping.

Other symptoms include rosette of pecans; "little leaf' of fruit trees; brown spots with yellowing leaf tissues in legumes; and small, pointed, yellow mottled leaves in citrus.

Copper (Cu). Organic soils are most likely to be copper deficient, since copper is fixed in unavailable forms in these soils.

Common symptoms of copper deficiency include die-back in citrus and blasting of onions and vegetable crops. When vegetable crops show copper hunger, the leaves lose turgor and develop a bluish-green shade before becoming chlorotic and curling. Also the plants may fail to flower, and there is often excessive leaf shedding.

Manganese (Mn). Symptoms first appear in younger leaves, with yellowing between the veins and sometimes brownish-black specks.

The deficiency is sometimes confused with magnesium; however, it usually appears first on the newer (upper) leaves while magnesium occurs on older or all leaves. Best way to distinguish is to check soil properties. Manganese deficiency is more likely if the soil pH is higher and is soils higher in organic matter during cool spring months when soils are waterlogged. Liming history is important.

Boron (B). Boron deficiency generally stunts plant growth - the growing point and the lower leaves first.

In many crops the symptoms of boron deficiency are well defined and quite specific, such as crooked and cracked stem in celery, corky core in apples.

Molybdenum (Mo). Molybdenum deficiency symptoms show up as general yellowing and stunting of plant. In fact, this deficiency can cause nitrogen deficiency in legumes because the soil bacteria on legumes must have molybdenum to help nitrogen from the air.

A soil test helps because molybdenum becomes more available as the soil pH increases. So liming may often correct the deficiency. This is not an easy deficiency to identify just from visual symptoms without a soil or plant test and a history of treatment.

Key for recognizing nutrient deficiency symptoms in crops :

(i) Translocated nutrients: Colour change in lower leaves

(ii) Nutrients not translocated : Colour change in upper leaves terminal bud dies.

Calcium	Emergence of primary leaves delayed, terminal-buds deteriorate. Leaf tips may be stuck together.
Boron	Leaves near growing point yellowed, growth buds appear as white or light brown dead tissue.

Terminal bud remain alive

Sulphur	Leaves, including veins, turn pale green to yellow, young leaves first.
Zinc	Pronounced interveinal chlorosis on citrus and bronzing of leaves. On corn, broad white to yellow bands appear on the leaves on each side of the midrib. Plants stunted, shortened internodes. New growth may die.
Iron	Chlorosis first appears in young leaves at the tips of the

	shoots, the leaf colour changes uniformly to yellow. With the uniformly to yellow, with the exception of the veins, brown spot or dead tissue appears when severely deficient.
Manganese	Leaves yellowish-graiy or reddish gray with green veins, marginal and interveinal chlorosis, the chlorotic leaves retain their normal shape.
Copper	Young leaves uniformly pale yellow, may wilt and wither without chlorosis. Clustered growth in cereal crops, grainless heads.
Chloride	Wilting of upper leaves, then chlorosis.
Molybdenum	Young leaves wilt and die along margins. Chlorosis of older leaves due to inability to properly utilize nitrogen.

Deficiency symptoms always indicate severe starvation and therefore the crop may have suffered before the deficiency symptoms appear. Many crops start losing yields and quality well before deficiency signs start showing. This yield limiting condition is called “Hidden Hunger” which refers to a situation in which a crop needs more of a given nutrient and yet has not shown any deficiency symptom. The nutrient content is above the deficiency symptom zone but still considerably below that needed for optimum crop production. In this case, significant responses can be obtained with application of nutrients even though no recognizable symptoms have appeared. To overcome such conditions, it is always recommended to confirm deficiency problem with other diagnostic techniques.

Facts about visual symptoms:

- Deficiency symptoms are specific.
- Symptoms disappear with application of the deficient nutrient only.
- Symptoms should be confirmed with one of the other methods.

Learn to identify nutrient deficiency symptoms, but

- Some symptoms are clear, others are not.
- They are not always clearly defined.
- Indicates severe starvation.
- Crops start losing yield well before deficiency symptoms appear.

Fertilizer Use and Environment Quality

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Sixteen nutrient elements are essential for plant growth; and they are:

Non-mineral Elements - C, H, O;

Macro Mineral Elements - N, P, K;

Secondary Elements - Ca, Mg, S and

Micronutrients - B, CI, Cu, Fe, Mn, Mo, Zn.

All the essential nutrients required for food, feed and fiber production are involved with the quality of our environment. Collectively, they enhance both the productive potential and environmental integrity of farm enterprises when used in adequate and balanced amounts.

Plant nutrients promote a more vigorous, healthy and productive crops; one which develops greater root systems, more above-ground residue, quicker ground cover, greater water use efficiency and higher resistance to crop stresses produced by drought, pests, cold temperatures and date of planting.

Although the essential plant nutrients play a vital role in providing adequate food supplies and protecting our environment, some pose an environmental risk with improper management. The two nutrients most often associated with mismanagement and non point source environmental concerns are N and P. This is especially so because of low use efficiency which is 30-50% for N and 10-30% for applied P.

Nitrogen: Nitrogen is subject to plant removal, leaching, volatilisation and denitrification. For environment concern, the forms of N involved through different processes are:

Leaching ..... as NO3

Folatilisation ..... as NH3 and

Denitrification ..... as gaseous forms of N like NO, N20, N2.

Most of the concern about N in the environment is due 'to the potential movement of unused or excess nitrate-N through the soil profile into groundwater (leaching). Because of its negative charge, nitrate N is not attracted to the various soil fractions. Rather, it is free to each as water moves through the soil profile.

All N sources (commercial, legumes, crop residues, animal manures and soil organic matter) are readily converted to nitrate form in soils. Thus, all are subject to leaching into ground water unless utilised by a growing crop or retained in the ammonium-N. form, through management practices.

Fertiliser nitrogen undergoes soil transformations dependent upon several factors, including moisture, temperature, soil pH, soil aeration, etc. The overall result is no net gain or loss of N in nature. The process is known as the "nitrogen cycle".

Phosphorus : has been associated with environmental effects primarily through eutrofication of lakes, bays and non-flowing water bodies. Eutrophication is the response of a water body to over-enrichment by nutrients. That enrichment may be natural or man made. Eutrophication symptoms are algal blooms, heavy growth of aquatic plants, algal mats and deoxygenation (exclusive of oxygen).

The fact is that P is extremely immobile in soils. It is held (adsorbed) very strongly by surfaces of iron were erosion and sediment loss are stopped, P loses are minimised. It has been estimated that 30% of soil loss from erosion occurs in 10% of the crop land. More cultivation creates more risk for erosion and increases nutrient losses.

Potassium, Calcium, Magnesium and Sulphur : Potassium (K) in water has no detrimental

health or environmental effects. Potassium is essential for human and animal health. Normal human dietary intake is from 2,000 to 6,000 milligrams of K per day, far above the content of water supplies, Potassium plays a vital positive environmental role because adequate supplies are essential for efficient utilisation of N and P, helping to keep these nutrients from water losses.

Calcium (Ca), Magnesium (Mg) and Sulphur (S) are not considered to be of environmental concern from agricultural sources. They are essential plant nutrients and must often are supplied by liming and fertilisation, based on soil and plant testing. As with other essential nutrients in short supply, they can decrease N and P use efficiency.

Micro-nutrients: Micro-nutrients are essential for crop growth and to human health. Applications of micro-nutrients, based on soil tests or plant analysis, have a positive environmental impact through their effects on improved crop yields and more efficient use of other nutrients. Importance of micronutrients is increasing as crop yields increase and as sustained agricultural production requires that they be replaced in the soil.

There is often confusion over chloride (CI), one of the essential micro-nutrients. It has been confused with chlorine, which is a poisonous gas and never found free in nature. Chloride occurs in nature as sodium chloride (NaCI), potassium chloride (KCI) and salts of other metals. Chloride has not been associated with environmental or health problems. Potassium chloride (muriate of potash) is an important K fertiliser. It contains about 47 per cent CI. Sodium chloride (common table salt) is over 60% CI.

Practices that Ensure Environmental Safety for Nitrogen

Leaching Losses: To avoid leaching loss, applied N must be either utilised by crop or retained in the soil. Another approach is that there should be regulated nitrification. Remember that N from all sources (including commercial fertilisers, legumes, crop residues, animal manures, sewage sludge and soil organic matter) is readily converted to nitrate form in the soil. When fertiliser N is applied at rates that do not exceed the economic optimum, its direct contribution to nitrate leaching is small.

Nitrogen stabilsers block the conversion of NH_4 to NO_3 and thus keeping the more stable NH_4 form in the soil. Nitrification inhibitors retard the conversion of ammonium N to nitrate N. When used with appropriate rates of commercial N fertiliser or animal manure, they can increase N uptake by the crop. The inhibitors hold N in the crop rooting zone so it is available for crop uptake even under wet soil conditions that move nitrates deeper into the soil and out of the reach of crop roots. Research shows, that corn, wheat, cotton, grain, sorghum and many other crops use ammonium readily and tend to take up more total N when ammonium is available along with nitre. In addition to the environmental benefit, nitrification inhibitors increase yield potential and the efficient use of N applications an economic benefit.

The practices that reduce the potential for NO_3 leaching are:

- Use of NH_4 - N fertilisers
- Incorporation of fertilisers
- Use of nitrification inhibitors

Denitrification Losses: The practices to reduce denitrification are:

- Avoid use of NO_3 sources
- Use nitrification inhibitors
- Use slow release N sources or coated N materials
- In rice, apply N in soil reduced zone

When erosion is stopped, P losses are minimised. Therefore, approach has to be to control erosion and thereby P losses to environment will be minimised. Therefore, always follow practices that increase residue in soil. This will run-off and soil erosion and thereby P losses.

A more rapid crop canopy closure results from better plant nutrition. It reduces the erosive energy of raindrops, improves moisture use efficiency, and reduces weed pressure. Phosphorus available at early growth stages is especially important for early canopy development.

Vigorous growth of plants both above and below ground helps to hold soil in place, improves water infiltration and water use efficiency and increases yields.

The soil erosion losses in India re estimated as 6000 m.t. per year resulting in nutrient loss of 5.37 - 8.4 m.t. and 30-40 m.t. of food-grain loss. In this, soil loss per unit area is 16.3 t/ha/year against permissible limit of 5-12.5 t/ha/year.

Fertiliser Use vis-a-vis Soil Degradation

For environmental safety and conservation of natural resources, the concern for soil degradation is relevant. The grouping of soil degradation in relation to fertiliser use can be:

(1) soil erosion

(2) changes in chemical properties of soils including development of salinity and alkalinity

(3) changes in physical properties of soils and

(4) changes in biological properties of the soil.

For residual effect on soil reaction, fertilisers can be:

- acidic

- alkaline or

- neutral and therefore

The long term use of a particular fertiliser can affect soil reaction. However, the changes in soil reaction can be counteracted. Residual acidity due to fertilisers can be ameliorated by liming and alkalinity by using various amendments.

Fertiliser use improves soil fertility, which is vital to overall productivity. Fertilisers promote crop growth, thereby providing quick soil cover. The benefits from rapid crop canopy include reduced erosive energy of raindrops and thus less erosion. Fertiliser use also increases root growth, which in turn improves organic matter status of the soil. Increase in organic matter benefits the soil in many ways. It improves physical conditions, increases water -holding capacity, regulates plant nutrients, improves soil filth and decreases erosion losses. High crop yields that produce more residues have a positive effects in reducing water runoff and soil erosion by wind and water.

In India, the current fertiliser nutrients use is 86.7 kg/ha of cropped area. At this level of fertiliser use, there is hardly any risk of soil degradation. However, we must continue to monitor the effect of increasing levels of fertiliser use on different components of soil degradation and devise measures to rectify the ill effects.

Additional Issue

- Contamination of soil with heavy metals from fertilisers

Recent Trends in Nutritional Managements in Horticultural Crops

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With population pressure building up, life expectancy and standard of living improving every day, the need for intensification of agro-horti-systems is ever increasing. Increasing land under cultivation has limited scope now. Crop diversification to grow horticultural crops at the cost of field / grain crops is another development. Harnessing marginal / degraded lands by adopting horti-silvi-pastoral systems in another potential area that holds promise. Whatever be the approach, the farmers have to increase the agricultural production more and more by using higher and higher inputs of fertilizers, pesticides and other agrochemicals. They have to grow improved varieties of crops and use more of fuel-consuming farm machinery. These are certain threats to soil health and that of atmosphere and ground waters which can be broadly termed as the agro ecosystem. In the longer run, the sustainability of farming practice becomes weaker and weaker. Emergence of more and more nutrient deficiencies by crops with time is a pointer to this problem. Some of the recent trends in nutritional management in this back drop are discussed here.

Integrated Plant Nutrition Supply (IPNS) System :

To develop intensive multiple cropping systems using the minimum input of fertilizer and farm fuel to reduce the hazards of modern agriculture is the essence of IPNS (also called Integrated Nutrient Management, INM). It aims at minimizing the use of chemical fertilizers and supplementing plant nutrient needs from other sources.

Components of IPNS :

1. Soil Fertility Management :

This is of paramount importance as an imbalance in nutrient management adversely affects soil fertility. To keep a balance between the nutrients removed from the system in terms of fruits / prunings and those returned through manures and fertilizers, the crop / animal residues should be recycled to the maximum extent. In addition, there is need to apply copious amounts of FYM / vermicompost / compost. Green manuring and green leaf manuring is most effective to restore and develop soil fertility. When practised scrupulously, the dependence on inorganic fertilizer inputs can be minimized.

2. Use of Biofertilizers:

There are several bioagents which enrich the soil. Blue green algae, Azolla, Azotobacter, Azospirillum are important for augmenting N supply. Rhizobium symbiotically fixes atmospheric N. Phosphorous solubilizing bacteria facilitate releasing P from fixed / less-soluble forms. Mycorrhiza acts in association with plant roots symbiotically and are known to aid in P and Zn nutrition of plants.

3. Agronomic Manipulation:

A holistic management of agronomic practices is necessary to minimize input use efficiency.

(i) *Maintenance of optimum plant population of crop plants:* In-situ grafting of scions in the case of fruit plants and raising seedlings in trays containing cups under protected conditions instead of raising the plants in conventional nurseries ensures better crop stand, uniformity and good vigour.

(ii) *A[[rp[roate time and method of fertilizer application :* This refinement in fertilizer use is to essentially improve fertilizer utilization and in some cases, can reduce

fertilizer inputs. For instance, placement of superphosphate at 5 cm depth below seed / plant rows led to a saving of P-input by 40% in brinjal and 20% in onion and tomato among large number of vegetables tested. In the case of N, increasing the number of split applications to 'Arka Vikas' tomato, from 2 to 3 and postponing the N application by 10 days after transplanting reduced 25% of N-input with no loss in yield.

(iii) *Source of plant nutrients:* Due to compulsions of fertilizer pricing policy, farmers find attractive to use DAP in place of straight fertilizers and ignore K fertilization. This practice should be avoided to overcome P-build up and related Zn-deficiency and other imbalances.

(iv) *Crop and its variety: There* is a considerable range of nutrient efficiency among varieties of the same crop. While some are highly responsive to nutrient inputs under high-input intensive while others are sustainable under marginal or low-input intensive production systems. Salt / alkali tolerant crop varieties are also available to harness problematic soils.

(v) *Time of seeding/planting:* Appropriate time of planting ensure better crop stand, vigour and thereby improve nutrient use efficiency.

(vi) *Water management:* Since soil moisture is the main vehicle of nutrient dynamics and absorption by roots, improved irrigation with drip irrigation should be adopted. In many crops, fertilization practices have been standardized which enhance nutrient use substantially and save on fertilizer inputs compared to application of solid fertilizers.

(vii) *Weed control:* Needless to say weeds compete with crops for both water and nutrients adversely. These can be effectively controlled by weedicides or plastic mulches.

The gains of such agronomic manipulation are manifold.

(i) Gains of natural resources by reduced use of chemical fertilizers and saving of gas, naphta, phosphate rock, elemental s, deposits and thermal / electrical energy;

(ii) Economic gains by way of reduced investment on chemical fertilizer which increases the scope of diverting the money saved to the purchase of both seed, farm machinery and animal resources;

(iii) Environmental gain due to reduced gaseous losses of NH_3, oxides of N and elemental N and leaching of NO_3 leading to lower pollution of ground water; and above all.

(iv) Social gains in terms of more jobs for production of biofertilizers and more rural labour employment for making compost, its transportation and application.

When adopted successfully, IPNS can lead surely to a ecofriendly sustainable agriculture in our country.

Organic farming :

With increasing awareness of the hazards of unscrupulous fertilizer and pesticide practices, organic farming concept and practice has emerged. By a total avoidance of all inorganic farm inputs, the protagonists of organic farming promise to build the soil, protect water quality, save energy, reduce health risk, protect farm workers from hazard of chemicals, support a true economy and promote bio-diversity. While a wholesale conversion to organic farming is an impossibility, use of adequate amounts of fertilizers and pesticides is indispensable to produce sufficient food needs and support the economies of majority of farmers.

Organic farming avoids or largely excludes the use of synthetic fertilizers, pesticides, growth regulators, livestock feed additives and genetically

modified (GM) crops. It solely depends on the use of crop residues, animal manures, green manures, off-farm organic wastes, crop rotation incorporating legumes and biological pest control to maintain soil productivity.

The practice of organic farming involves conversion of the present farms to organic farms over a period of 3 years and get the entire production process certified by a Government recognized agency. In view of a definite demand for organically grown foods, some special areas like North-eastern India for certain fruit and spices crops organic farming is possible. However, the following myths attached to this concept need to be investigated and answered.

Myth No. 1 Organic food tastes better and is of superior quality.

Myth No. 2 Organic food is more nutritious and safer

Myth No. 3 Organic farming is ecofriendly

Myth No. 4 Organic farming improves soil fertility and chemical fertilizers deteriorate it.

Myth No. 5 Organic farming sustains higher yields.

Myth No. 6 Enough organics are available to replace chemical fertilizers.

While it may be disastrous to adopt organic farming *in toto* it will be appropriate to boost the practice of (a) composing technology, (b) recycling of on-farm and off-farm organic residues, (c) biogas technology meet the fuel needs of rural sector and (d) green leaf manuring by harvesting green matter from agroforestry / social forestry / forest areas.

Fruit Based Multi-tier Cropping Systems for Sustainable Production in Uplands

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The fruit crops viz. Mango, Litchi, Aonla and Jackfruit are planted at wider spacings since they grow tall and spread wider during the course of their development. The space available between two plants can profitably be used for growing filler fruit plants having comparatively low gestation period, lesser canopy size and small life span, like guava, custard apple, citrus, papaya etc. Further, the space between two rows of fruit plants can effectively be utilized for growing vegetables, pulses, cereals, oil seeds and flowers. The adaptation of such multi-tier cropping system in rain fed uplands could be sustainable during initial stage of orchard. Later on shade tolerant crops like turmeric, ginger and yams can be included for cultivation in order to get more income per unit of area.

Base fruit and their cultivars

The base fruit crops and their cultivars recommended for growing in the Eastern Plateau region are given below:

Filler fruit crops and their cultivars:

The fruits having smaller canopy size and shorter life span can be used as filler plants in between the plants of base crop. These fruits start yielding earlier compared to base fruit crops. The cultivars of filler fruit crops suitable for region are given below

Fruit	Recommended cultivars
Guava	Sardar, Allahabad Safeda Arka Mriduula
Custard apple	Balanagar, Arka Sahan
Papaya	Pusa Dwarf, Pusa Nanha
Lime	Kagzi
Lemon	Assam lemon

Apart from the above, forestry and medicinal plants can also be included as filler plants.

Fruit	Period of maturity	Recommended cultivar
Mango		
Early	May, 20-30	Bombay Green, Rani Pasand, Zarda, Zardalu
Mid-early	May, 30-June, 10	Himsagar, Gopal Bhog, Kishan Bhog
Mid	June, 10-30	Langra, Dashehari, Safed Maldah
Mid-late	June, 20-July, 5	Mahmood Bahar, Mallika
Late	June, 25-July, 20	Amrapali, Chausa, Fazli
Very late	July, 20-August 10	Katki
Litchi		
Early	May, 10-22	Shahi, Ajhauli, Green
Mid	May, 20-25	Rose Scented, Early Bedana, CHES-2
Mid-early	May, 25-June, 10	Swarn Roopa, China, Late Bedana
Late	June, 5-10	Poorvi
Aonla	October-December	Narendra Aonla-7, Kanchan
Jack Fruit	May-August	Khajva, CHES-1, CHES-2

Intercrops and their cultivars:

Vegetables, pulses, cereals, oil seeds and flowers can also be cultivated in the available space in an orchard. Recommended cultivars of these intercrops suitable for the region along with their production techniques are given below.

Crop	Sowing/ planting time	Planting distance (cm)	Fertilization (kg/ha)			Recommended cultivar
			N	P_2O_5	K_2O	
Cowpea	June-July	40x15	60	50	50	Arka Garima, Pusa Barsati Birsa Sweta
French bean (pole-type)	June-July	40x15	50	40	40	Swarn Lata, Birsa Priya
French bean (pole type)	August-	40x10	80	50	50	Pant Anupama, Swarn Priya
French bean (bush type)	August-September	40x10	80	50	50	Pant Anupama, Swarn Priya Arka Komal, Contender
Okra	June-July	40x20	120	80	60	Arka Anamika, Arka Abhay, Parbhani Kranti
Elephant foot yam	May	75x75	125	50	120	Gajendra, Santragachi
Sweet potato	May-June	60x20	75	50	75	Gauri, Sankar, Pusa Safed Sree Bhadra
Turmeric	May-June	40x20	80	60	60	Suguna Sudarshana, Suvarna, Rajendra, Soniya
Ginger	May-June	40x20	80	60	60	Suprabha, Suruchi, Surbhi, China, Naida
Merigold	June-July	50x30	25	25	20	Yellow Drop, Golden Drop Double Lemon
Gerbera	June	30x20	50	40	40	Thalasa, Tara, Sunset
Paddy	June	30, in rows	70	40	20	Birsa Gora - 102, Birsa Dhan -105, Vandana, Kalinga
Finger millet	June	20x15	40	30	20	Birsa Madua-1, Birsa Madua-2
Niger	August	30x5	20	20	20	Birsa Niger -1, Utakmond
Black gram	July	20x10	20	40	20	T-9, Pant U-19, Birsa Urad-1
Pigeon Pea	June-July	60x25	40	40	20	Birsa Arhar - 1, Lakshmi, T-21

Land preparation and transplanting :

Base fruit trees require wider plant spacing as they grow tall and attain a large canopy. Hence, planting distance of 10x10 m is recommended. Filler crop trees require comparatively, less spacing (5x5m) as they develop into smaller canopy. Accordingly, 100 plants of base fruit and 300 plants of filler fruit crops can be accommodated in one hectare area. The filler crop trees start fruiting from the second year itself, hence, support is provided for management of the orchard during initial stage.

For planting of base and filler fruit trees pits of 90 cm^3 and 60cm^3 size, respectively are dug during the period from April-May. With the onset of monsoon pits are filled by mixing 15 -20 kg F.Y.M., 1 kg Karanj or Neem cake, and 60g NPK mixture along with 15 - 20 g Furadan - 3 G, in the upper half soil of the pit and filling it in the lower part of the pit. After one or two rains when the soil gets settled, planting of fruits is done.

Intercropping:

Intercrops like vegetables, flowers, pulses, oil seeds or cereals are sown / transplanted between two rows of filler or base fruit crop. Hence, during the initial years of orchard establishment more area is available for intercropping. Filler crop plants are removed once the full development of base fruit crop takes place. With the increasing of shade in the orchard, intercrops tolerant to shade like turmeric and ginger can be introduced. Field experimentations done at HARP, Ranchi have shown promising results in this direction.

Pruning and maintenance of fruit trees:

The transplanting works should be completed at the earliest possible with the onset of monsoon. This facilitates better root development of fruit plants, thus increasing the percentage of survival. Gaps if any may be filled with new plants as and when required. Weeding and hoeing operations should be done from time to time for proper development of the plants. The orchard must be provided with proper drainage system so as to take out the excess rain water. Young plants may be protected from cold by providing dry grass/ polythene cover upto 3-4 years of planting. In order to provide proper frame to the tree, pruning is very important. All the branches emerging upto the height of 80 cm from the ground level are removed for formation of the main rank and after 3-4 branches are left to give rise to secondary branches. In case of guava the height of main trunk is kept at 30-40 cm from the ground level.

Manure and fertilizer application:

For better growth and development of fruit plants, it is necessary to provide them with proper nutrition. During the initial 2-3 years each base fruit plant should be provided with 30 kg well rotten farm yard manure along with 2.0 kg karanj/neem cake, 200g urea, 150g S.S.P. and 150 g M.O.P. per year. With the increasing age the dose may be increased by 10 kg farm yard manure, 1.5 kg karanj/neem cake, 150 g urea, 100g S.S.P., and 50g M.O.P. per plant per year. Accordingly, a 15 year old fully developed fruit tree will be given about 80-100 kg farm yard manure in addition to 2.0 kg karanj/neem cake, 2.0 kg urea, 1.5 kg S.S.P. and 0.8 kg M.O.P. per year.

For filler crop plants under 3 years age a dose of 1.5-2.0 kg karanj/neem cake, 150g urea, 150g S.S.P. and 150g M.O.P. in addition to 25-30 kg farm yard manure per plant per year will be needed which could be increased to 30-40 kg farm yard manure, 3.0 kg karanj/neem cake 1.0 kg urea 0.8 kg S.S.P. and 0.4 kg M.O.P. per tree per year for a fully developed tree. Half the dose of fertilizer along with full quantity of manure and cake may be applied to the trees in June. The remaining quantity of fertilizers can be applied in the orchard in September followed by a light irrigation if there is no adequate moisture in the soil. Application of agricultural lime at the rate of 3-4 kg per tree once in 3 years has been found beneficial in acid soils of this region. Zinc deficiency in fruits can be corrected by application of 150-200 g of Zinc Sulphate per tree in the month of September along with fertilizers applied.

Irrigation and mulching:

During the initial stages of orchard, plants require regular irrigations. Irrigating the plants at 15-20 days interval in winter and 8-10 days interval in summer season will be optimum. Mulching the plants after rainy season has been found helpful in conserving moisture in the soil. A fruiting tree of litchi does not require irrigation from the month of December till fruit set. Mango needs irrigation during the time of fruit development. Therefore, irrigation in the orchard should be done as per the requirement.

Flowering and fruiting :

Base fruit trees should be allowed for fruiting only after 3-4 years, whereas yield from filler fruit plants can be taken from the second year onwards. Spray of insecticides at the time of flowering in insect pollinated fruits is harmful, therefore, care must be taken while using the insecticides, in the orchard.

Managing Acid Soil for Higher Production of Horticultural Crops

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Soil related constraints in Jharkhand agriculture

1. Soil acidity in about 4.0 lakh hectares
2. Low organic matter content of soils.
3. Secondary & micronutrient deficiencies in intensively cropped & vegetable growing areas.
4. Soil erosion of varying intensity in about 30% areas of cultivated soils.
5. Not much awareness on soil testing & soil test based nutrient use of crops.
6. Poor soil biological environment.
7. Increased mining of nutrients from agricultural soils.
8. Negative plant nutrient balance in soils under agriculture

EXTENT OF DEFICIENCY OF PLANT NUTRIENTS IN SOILS OF JHARKHAND

District/sub region	% Soils Deficient			
	Potassium	**Sulphur**	**Boron**	**Molybdenum**
Ranchi	30.2	61.8	36	84
Singhbhum	48.5	55.0	36	58
Palamau	5.0	27.5	46	38
Dumka	29.0	48.7	ND	ND
Gumla	ND	57.0	ND	ND
Lohardaga	ND	53.0	ND	ND

ND : Non-delineated areas

NUTRIENT DEFICIENCY IDENTIFIED IN CROPS AND CROPPING SYSTEMS IN JHARKHAND

	System/Area	**Nutrient deficiency problems**
1.	Intensively vegetable growing areas	Boron, calcium, sulphur & molybdenum
2.	Rice-fallow	Phosphorus, potassium
3.	Soyabean-wheat, groundnut-wheat, rice pea	Phosphorus, sulphur, calcium
4.	Groundnut + pigeonea	Phosphorus, calcium, boron
5.	Rice - vegetables	Potassium
6.	Maize-wheat	Nitrogen, phosphorus

AGRICULTURALLY IMPORTANT DISTRICTS HAVING ACID SOILS (PH <5.5)

State	Area (Lakh ha) under cultivation (Soil pH <5.5)	Districts having Acid Soils
Assam	15.39	Dibrugarh, Sibsagar, Lakhimpur, Bongaigaon Nagaon, Kamrup, Darrang, Goalpara, Cachar, Jorhat, Golaghat, Tinsukia, Sonitpur etc.
NEH Region	13.00	States of Arunachal, Manipur, Meghalaya, Nagaland Tripura, Mizoram, Sikkim
West Bengal	15.00	Bankura, Medinapur, Purulia, Birbhum, West Dinajpur Jalpaiguri, Murshidabad, Burdwan, Cooch behar, Malda
Orissa	16.00	Cuttack, Kendrapara, Jagarsinghpur, Jajpur, Dhenkanal, Anugul, Koraput, Nawarangpur, Khurda, Nayagarh, Puri, Mayurbhanj
Jharkhand	4.00	Dumka, Jamtara, East Singhbhum, Ranchi, Gumla, Garhwa
Himachal Pradesh	0.75	Kangra, Kullu, Mandi, Simla, Solan
Kerala	32.00	Trivandram, Alleppey, Eranakulam, Thrissur, Palghat, Cannonory
Maharashtra	0.20	Ratnagiri, Thane

Chemistry & Management of Acid Soils

Acid Soils

1. Soils having low pH.
2. Base unsaturated soils

Managing Acid Soils

1. Addition of amendments.
2. Manipulation of agricultural practices.
3. Growing acid tolerant plant species & varieties.

Lime Requirement

4 factors govern this:

i) Required change in pH
ii) Buffer capacity of soil
iii) Chemical composition of liming material
iv) Fineness of liming material

A fine textured acid soil requires much larger quantity of lime than does a sandy soil or loamy soil with the same pH value.

Acid forming factors

1. Acid granite rocks as parent material.
2. Leaching of bases due to high rainfall.
3. Nitrogenous fertilizer AS

Liming materials		**Industrial wastes**
Carbonate forms -	marl, oyster , shells, basic slag lime stone	Steel mill slag Blast furnace slag
	Calcite $CaCO_3$	Lime sludge from paper mills
	Dolomite - $CaMg(CO_3)_2$	
Oxide-	Burned lime / quick lime CaO	

$CaCO_3$ + Heat ------> CaO + CO_2

SOIL SAMPLING FOR FERTILITY EVALUATION HORTICULTURAL CROPS :

S. N.	Crops	Depths at which samples to be taken (cm)	Place of sampling
1.	Fruit crops	0.0 - 45.0	Midway between trunk and drip-circle
2.	Vegetable crops	0.0 - 22.5	Middle of rows in standing crops
3.	Flower crops	0.0 - 22.5	Middle of rows in standing crops
4.	Medicinal and Aromatic crops	Herbs : 0.0 - 22.5 Trees : 0.0 - 45.0	Middle of rows in standing crops Midway between trunk and drip circle
5.	Plantation crops (Coconut, arecanut)	0.0 - 45.0	Midway between trunk and drip circle

Ideal pH for vegetable crops

Cabbage	- 5.5 to 6.6
Tomato	- 6.0 to 7.0
Brinjal	- 5.5 to 6.0
Onion	- 5.8 to 6.5
Potato	- 5.5 to 7.5
Cauliflower	- 6.0 to 6.5
Pea	- 6.0 to 7.5
Parwal	- Neutral soil
Capsicum	- 5.4 to 6.8

Nutrients needing more attention

Cole crops	- Potassium, Boron, Calcium
Bulb crops	- Potassium, Sulphur, Magnesium
Leafy vegetables	- N & P
Fruit vegetables	- B, S
Leguminous vegetables	- Ca, P
Cucurbits	- NPK
Root crops	- K, Mg, S
Tuber crops	- K, Mg, s
Okra	- K,P

INM packages

Cabbage : 25 t FYM / ha

150 kg N + 125 kg P_2O_5 + 100 kg K_2O / ha

Lime: 2 to 4 q / ha in line sowing

Tomato : 25 t FYM / ha

250 kg neem cake

120 kg N +80 kg P_2O_5 + 50 kg K_2O / ha

Lime : 2 to 4 q / ha in line sowing.

Lime pelleting for Acid Soil

The soil where the pH is less than 6.0, seed pelleting is beneficial. The quantity of lime for effective and economic use is required for small seeds 40 - 50 g / kg and for medium and big size 30 - 40 g / kg seed.

Pelleting has to be done after seeds has been treated with inoculant and when the seeds are wet the pelleting materials are dusted in such a way so that each seed gets a layer of lime.

Proposed Technology package for Acid Soil Management

Land Situation

Rainfed uplands / Rainfed medium land / irrigated upland or medium land with pH<5.50.

Lime application rate

2 to 4 q ha^{-1} SMP method of determination of lime requirement of soils should be adopted by STLS.

Source of Lime

Calcite, dolomite, Basic slag or any other source available locally in finely ground form.

Method of lime application

Application of lime in furrows to be done along with basal dose of fertilizers (part of N + full dose of P and K) before sowing of seeds

Fertilizer schedule

Balanced dose of NPK to be used. In irrigated area, full recommended dose of NPK for crops and in rainfed areas 50 to 75% of the recommended NPK fertilizers.

Crops & Crop sequence

Liming should be done for each crop. In line sown crop, the dose of lime or any soil ameliorant may be 2 to 4 q ha^{-1} depending on soil texture and pH.

Heavy textured soils and soils with high organic matter content will have higher lime requirement.

Organic Farming in Horticulture : Issues and Strategies

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Development in horticulture is changing fast in the context of globalization as well as with a focus on enhancing productivity of crops and income in the hand of small and resource poor farmers. Moreover, production and protection technologies have to be socially responsible. According to WHO estimate, one million poisoning and 20,000 deaths globally occur due to pesticides every year, out of which half of the poisoning and three quarter of the deaths occur in the developing world. Keeping in view the ecological concerns regarding residual toxicity due to indiscriminate and excessive use of chemical fertilizers, pesticides and their harmful effects on soil microflora and biodiversity, there is urgent need for paradigm shift in farming system and organic farming has been sought to be the answer.

The knowledge of organic farming is inherent in the ancient agricultural systems of India and elsewhere. Organic farming curtails heavily the off-farm synthetic inorganic inputs and relies mainly upon the low cost on-farm biological inputs. Organic farming can be defined as an integrated, sustainable, ecofriendly and socially just farming systems which include management of nutrients through use of bio-fertilizer, vermicompost, manures etc.; management of pest and diseases by biological, cultural, physical, mechanical means; adoption of appropriate cropping system including agroforestry; management of livestock including apiculture; water management; and some socio-economic intervention.

Indian initiative

To promote organic farming for export, Government of India has constituted a National Steering Committee under the Secretary Commerce with representation from Ministries of Agriculture, Environment, Food Processing Industry, Science and Technology and Rural Development. NSC released the National Programme for Organic Production in April 2000 covering National Standards based on IFOAM, EU Standards and Codex Standards. NSC also approved accreditation policy and procedures and designated APEDA, Spices Board, Tea Board and Coffee Board as accreditation agencies.

Potentials of organic farming

As per the estimates of ITC, Geneva, the world market of organic food products in 1997 recorded retail sales of 10,500 million US$. More than 130 countries in the world which include 30 countries in Africa, 30 in Asia, 20 in Central America and Caribbean, 10 in Latin America, 5 in Australasia and Pacific, most of European countries besides USA and Canada produce certified organic food products. Organically produced horticultural products in the developing countries include fresh and processed fruits and vegetables, dry fruits, nuts, coffee, tea, cocoa, spices and herbs. In India, non-certified organic farms producing fruits and vegetables exists all over the country. According to APEDA reports, certified organic farms all over the country produce mango, banana, pineapple, cashew nut, sapota, litchi, custard apple, walnut, melons and vegetables in more than 2500 acres of land. Keeping in view the vast potential, there is immense possibility of area expansion in favour of organic farming.

Constraints in adoption of organic farming

- Lack of awareness among the farmers about the advantages of organic farming
- Long gestation period for conversion of conventional farms into organic farms
- Lack of organized domestic market for organically produced horticultural commodities

- Non-availability of market information / intelligence and lack of marketing support to the small farmers engaged in organic farming
- Non-availability of incentives through competitive pricing of organic foods
- Lack of proper quality control of biological inputs like biofertilisers and biopesticides.
- Lack of proper legislation, inspection and certification for horticulture produce of organic farming
- Lack of infrastructural facilities act as road block in harnessing the potential of organic farming in virgin, tribal and forest lands

Components of organic farming: Different components of organic farming have been presented in Figure 1 and each component has been discussed below.

Nutrient management

It involves nutrient management through tapping of all biological resources like greenmanures, manures, compost, biofertilisers, vermicompost, crop residues. Important biofertilisers and nitrogen fixers like *Rhizobium*, *Azotobacter, Azospirilium*, phosphate solubilisers like *Pseudomonas*, *Bacillus* and vesicular arbuscular mycorrhiza (VAM). Seed treatment with biofertiliser has opened up great promise in providing plant nutrients in an economic way. Use of biofertilisers in vegetable crops recorded saving of 20 to 72 kg N / ha besides increasing the yield to the tune of 3 to 18%. Bioconversion of available farm resources using efficient strains of earthworm like *Eisenia foetida* and *Eudrilus eugeniae* for production of vermicompost should essentially form a part of organic farming. Vermicompost is a non hazardous, ecofriendly and supplies plant nutrients in a balanced manner. Agro-industry based byproduct / waste materials like coir pith, press mud, sago industry waste, cotton waste is also available in large quantities for bioconversion. Some of the notorious and proliferous weeds like water hyacinth, ipomoea, perthenium etc. can also be composed using earthworms and microbes and utilized as organic manures for horticulture production.

Pest management

Organic farming principally advocates bio-intensive pest management along with physical, cultural and mechanical method of pest management. This method of controlling pest make use of target specific, economically viable and ecologically sound bio-pesticides involving parasites, predators and microorganisms, pheromone trap, botanicals, cropping system approach of pest and disease avoidance. Some of the biopesticides developed for commercial production are *Trichoderma, Trichogramma, Chrysoperla, Cryptolaemus,* and Nuclear Polyhedrosis Virus (NPV). Biological seed treatment through use of fungal (*Trichoderma* and *Glicladium)* and bacterial (*Pseudomonas* and *Bacillus)* biopesticides has opened up great possibility of managing diseases. Such treatments provide economical and relatively nonpolluting delivery system. Botanicals like *neem (Azadirachta indica)* seed karnel extract should form the first step in any pest control exercise in organic farming. Introduction of specific crops in the system also helps to check the pest attack on the main crop. Two such successful systems for examples are: (1) growing of one line of marigold after 20 lines of tomato which helps to save tomato from the attack of fruit borer caused by *Helicoverpa;* (2) planting of two lines of mustard after 16 lines of cauliflower or cabbage helps to save the vegetables from the attack of diamond back moth. For effective pest control, trap crop should be sown in the nursery 15 days earlier to main vegetable crop. In first case colour of the flower attracts fruit borer of tomato while diamond back moth is attracted to mustard because of glucosinoid present in mustard.

Water management

Since organic farming advocates the use of microorganism and other biological sources, water management is vital for harnessing synergies of biological sources with plant requirement. Limited availability of irrigation water coupled with the growing concern for ground water depletion warrants for its most efficient utilization. Main objectives of efficient water management are (i) high water use efficiency (ii) good quality of crop and (iii) sustenance of soil resource. Water management through community based watershed approach

including rainwater harvesting and *in-situ* moisture conservation is an important component of organic farming. Mulching effectively recycle organic wastes, minimize evaporative loss of water, checks weed infestation, reduces surface run off and erosion, maintain favorable moisture and temperature regimes in soil and improves bio-physico-chemical environment of soil leading to better crop yield and quality.

Cropping system

Cropping system involving legume grown either in sequence or as intercrop / companion crop raised for green-manuring / fodder / grain along with main horticultural crop proves an excellent opportunity to restore and sustain the fertility / productivity of soils. Avoidance of pest and disease is possible to a large extent through cropping system approach including trap / banker / ecofeast crops, which either divert or check the pest by enhancing the population of natural enemy (predator, parasites or insect pathogens). Agri-horticulture / Hortisilvi-pastoral system with the integration of horticultural / perennial woody trees with crops / pastures is most suitable technology for increasing total productivity of food, feed and fuel and thereby reducing the risk of farming. It also helps in more efficient utilization of sunlight, moisture and plant nutrients than is generally possible either by agriculture alone or forestry exclusively.

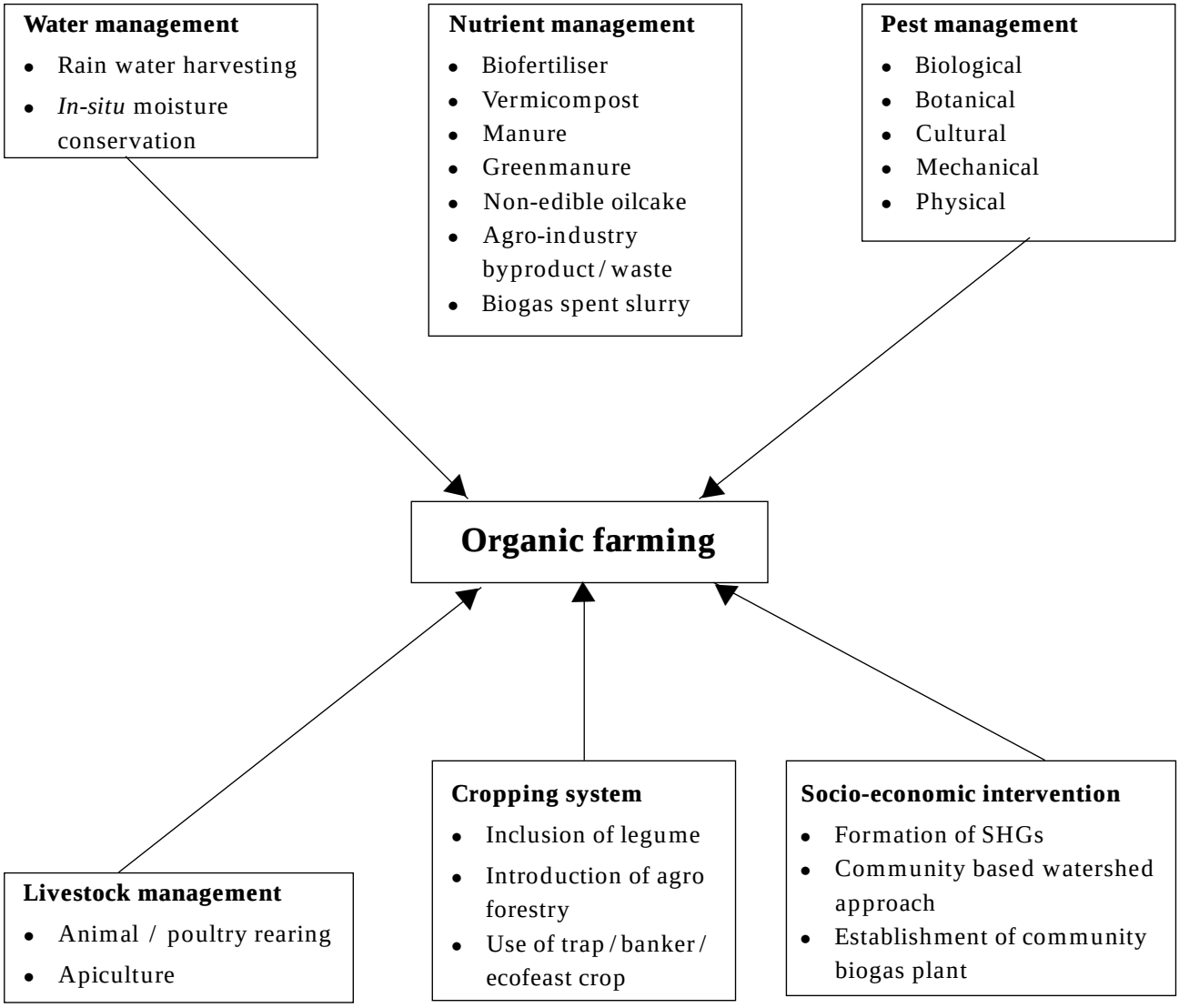

Fig 1. Components of organic farming

Live stock management

Live stock management should form an integral part of organic farming and animal / poultry manures thus available should be diverted to the nutrient supply chain. Apiculture as a part of organic farming not only provides additional income in the hands of farmers but also increases the population of natural pollinator for higher productivity of crops.

Socio-economic intervention

Community based approach of implementation of organic farming system should be the essence of organic farming. Community based watershed management is the nucleus of any farming system and organic farming is no exception. A superior method of utilizing livestock excreta is through establishment of community based biogas plants. Apart from solving fuel crisis for the farming community, the biogas-spent slurry can be used for nutrient management. Self-Help Groups of the farmers at village level should be organized for effective implementation of organic farming system.

Conclusion

Farmers have yet another tool and dimension to produce horticultural crops through adoption of organic farming system. Organizing Self Help Groups of the farmers at village level and strengthening of R&D linkage through interface of Krishi Vigyan Kendras and Self Help Groups in a participatory mode can foster dissemination and adoption of organic farming technology. Integration of pragmatic biodynamic organic practices prevalent in rural areas can further accelerate the adoption process. To make it a success, community based approach of inspection and certification of organic food and local marketing through rural women's leadership is warranted. Besides, reliable organized market with competitive pricing of organically produced horticultural products coupled with insurance option to cover the risk associated with organic farming is a must. The new tools available for accessing bank credit such as financing Self Help Groups, *kisan* credit cards, contract farming, pledge loans, venture capital financing should be made available to the organic farming practitioners.

Development of Horticulture Based Farming System in Jharkhand

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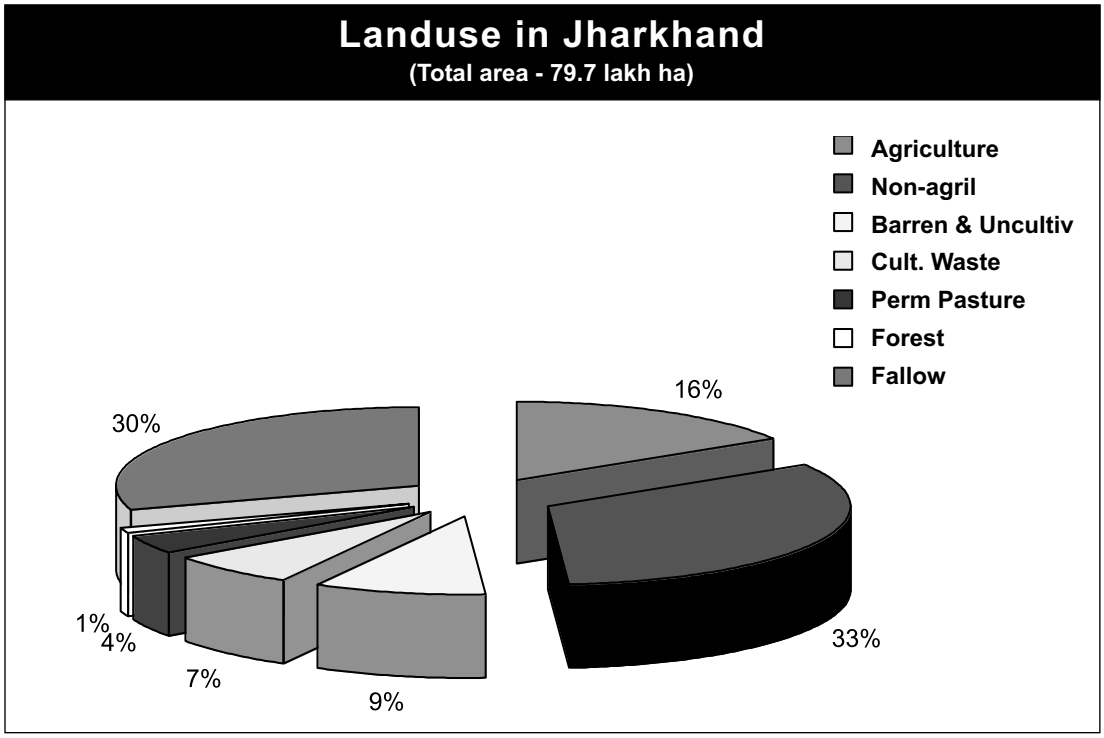
The economic status of any state is determined from the consumption of horticultural produce by the inhabitants. The nature as such provides our fruits and vegetable need from the forest. The population of Jharkhand is dominated by the tribals. As they live in the vicinity of the forest, they have access to the seasonal fruits and vegetables. But the urban dwellers are dependent upon horticultural products from the farms. As such there is a deficit up to 250g / day in food grains per head in the state so there must be deficit in intake of horticultural product by the people of Jharkhand. It is therefore imperative to increase the production and the productivity of the horticultural crops in the state. There is a scope to cover 21 lakh hectare under horticultural crops.

The land distribution pattern is such that 97.69% of the state is village area, where as only 2.30% area is urban. In total 23.11 area is under forest cover. So during the consideration for horticulture development is made we must take it for granted to have the development in the village area. But at the same time to produce high value horticultural crops attention must be given to the urban area.

The climatic condition and the preference of local inhabitants is favorable for taking up horticulture as a mean for secured livelihood. It is not an option but a compulsion for the majority of the population.

BARE FACT - Horticultural Compulsion

- 33% of total area under agriculture
- % of area irrigated to Net Area sown - 7.6%
- Irrigation potential as per sources available - 17%
- 83% of agril. area remains rainfed (27% of total area)



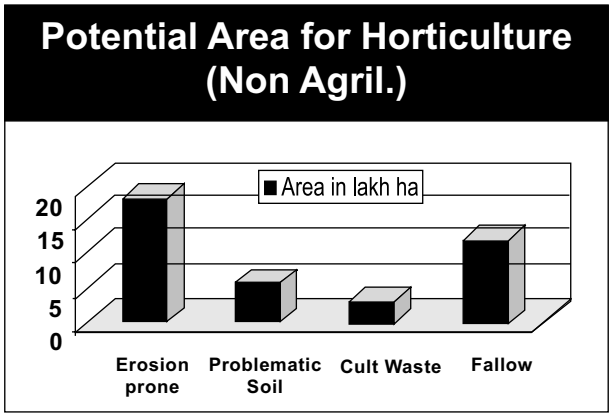
- 15% of total area remains either fallow or waste
- 42% of total area can be exploited under dryland Horticulture

The system of farming in Jharkhand is rainfed forest based farming system and is a tree linked livelihood because of the tribal dominated population. The major tribes namely Oraon, Munda, Santhal are having agriculture as their main stay. The land is sloppy mostly upland that to rainfed, so they have no other alternative than to go for dryland horticulture. It is a nature's gift to them as blessings in disguise. The whole state is suitable for horticulture based land use system. Dryland horticultural system is quite remunerative and if properly practiced can provide livelihood support to a five member family from one hectare land.

Horticultural Suitability

- Rainfall - 1340 mm
- Higher solar radiation per unit area
- Well drained slopes
- Tree linked livelihood (Tribals)
- Favorable bio-climate and altitude
- Wider species option (subtropical & tropical)
- Past history of cultivation

Before the formation of Jharkhand, Ranchi used to send fresh vegetables to W.B. Orissa and Uttar Pradesh and is continuing to do so. Because of the existing opportunities horticulture should be the remunerative enterprise. Horticulture will increase the per capital income of the farmer and entrepreneur.



Horticultural Opportunities

- Well distributed road and rail network
- Air transport facility
- Good market (Mines townships)
- Skilled Human resources
- Resource Institutions

Horticulture can be taken up in 21.07 lakh ha. Dry land horticulture is an avenue for consideration

It can be achieved in several ways such as increasing the area, increasing the productivity of the crops in existing area, bringing about change in the cultivation practice i.e. converting to hi-tech horticulture, providing assured market for the produce by minimizing the number of middlemen, so that the farmers will get their proper share.

Greening of Gray Areas

- Rainfed sloppy upland
- Culturable wasteland
- Watersheds
- Medium and low land otherwise engaged
- Farm bunds
- Roadside avenues
- Mining fills
- Jhoom affected land
- School, temple, church, panchayat samiti, other institutional & industrial area premises
- River banks
- Private land, common property, Govt. land will be included in the area expansion process

At the time of taking up such a project in a massive way a missionary spirit is needed. Therefore all the related activities should be converged and a single line approach is to be ascertained. There are several schemes operating in the state for poverty alleviation objectives through the Government and non government agencies. Special projects under Government of India, World Bank support are being operated in the state. DRDA, ITDA, ATMA and other projects can also back this activity of greening the gray areas. Food for work can also expedite the

process. The industrial house will cooperate in covering their barren land with horticultural crops. The academic institutions besides the Agricultural University will provide impetus to the project as one of their most important activity. The banks must support the project and extend financial backup to the stake holders.

The project will come to existence with the following process which has been given below for step by step activity.

Process:

- Need assessment
- Prioritization
- Organizing groups in the community for mind set
- Selection of individuals (Resource Rich)
- Forming groups of small holders and Resource poor farmers
- Provision for backward and forward linkages starting from selection of crop to processing & marketing of produce.
- Provision for input supply including technical input
- Provision for incentives to Entrepreneurs
- Outsourcing of existing farms and estates
- Strengthening infrastructure for sustainability
- Regular monitoring, constraint analysis and reviews

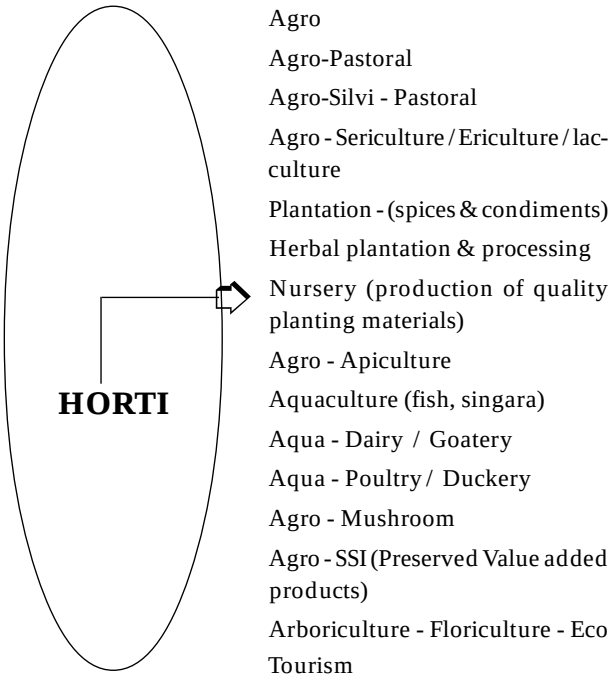
The project must satisfy the following considerations before operating. If all the points rank high, then it is expected that the project will be successful and will become sustainable.

Sustainable Horticulture Development in Jharkhand

- Technical feasibility
- Social acceptability
- Economic viability
- Technology transferability
- Inter disciplinary approachability
- Stake holders minimal dependability
- Infrastructure supportability
- Training cost affordability
- Administrative manageability
- Political back-ability
- Gender sensitivity
- Environmental sustainability

Under the circumstances Horticulture based farming system is only available alternative. Farming system as a concept takes in to account the component of soil, water, crops, livestock, labour and other resources with the farm families at the center managing agricultural and non-farm avocations. The farm family functions with in the limitations of its capability and resources, the sociocultural setting and the interaction of these components with physical, biological, socio-economic factors.

Horticulture Based Farming Systems Jharkhand



In these systems the fruit crops are raised with other crops covering the land surface to restrict the soil and water erosion. Besides fruit crops like mango, guava, litchi, cashewnut, jackfruit, the other crops namely pulses like arhar, cowpea, beans, dangarrani, oilseeds like ground nut, niger, gingely etc; vegetables like tomato, chili, okra, capsicum, cole crops, cucurbits, the flowers like roses, marigold, gladioli, tuberose, jasmine, crossandra etc are raised

in the kharif season in various horticulture based farming systems. For achieving higher production and productivity it is required to resort to modern method of cultivation using proper package of practices in traditionally grown crops and at the same time the newly introduced crops like vanilla, spices, medicinal and aromatic plants to the system. The livelihood development it also aims at improving the socio-economic condition of the farm families. The subsidiary occupations such as rearing of mushroom, apiculture, garland making from flowers produced, making jam, jelly, pickles, squashes & dehydrated products while preserving the fruit and vegetables for earning additional bucks.

The agro-climatic condition of Jharkhand is suitable for growing off season vegetables. There is also scope for developing horticulture for export. Roses, Gerbera, Carnation, Gladioli, and cacti can be raised under protected condition for internal and export market.

Any form of social or economic development is like life itself, ultimately dependent on the biosphere, a complex "whole" which sustains a multitude of living species in a variety of media. It is held in balance by interwoven and often interdependent ecosystems whose stability is maintained by flows of energy (derived from the sun), the recycling of nutrients and the interaction of animate organisms and inanimate matter.

Sustainability means every generation should inherit a similar natural environment. Therefore Sustainable Development may be defined as the development process that meets the needs of the present without compromising the ability of the future generations to meet their own needs. Sustainable Horticultural Development may be the outcome of following practices like: Organic Methods of farming, Ability of the horti system to overcome stress, Resource management to satisfy human need without degrading the quality of environment, preserving soil quality and the ecological integrity of the system and achievement of growth in horticultural production while maintaining natural capital intact. Farming System Research Approach is one of the alternatives available to address the issues relating to Natural Resource Management and Sustainable Development. Our experience in working for the past four years in Jharkhand indicate that Horticulture based landuse system can be alternative to the existing system, at the outset, for sustainable horticulture development in the state.

Integrated Management of Soil Borne Diseases

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Introduction

Plant Pathogens in soil borne diseases always exhibit complex dynamics due to the involvement of soil and the micro organism inhabiting it and therefore demands special treatments in its management. The activity of micro organism in soil is affected by many factors such as temperature, moisure level, and composition of microflora, aggressiveness of organisms in determining the presence or absence of an organism in a particular soil. Population of antagonists automatically results in the reduction of other microorganism. Nutrients influence the multiplication of organism and the absence of essential metabolites can result incomplete eradication. In addition there are other factors like the production of enzymes, toxin and certain bio-products of organism. Insect and rematodes are other biotic agents present in the soil. All these factors individually or collectively determine the soil microflora and disease intensity and complicate pathosystem which is not encountered in air borne diseases. Thus the need to consider soil borne disease management separately is essential.

Integrated diseases management

Integrated Disease Management (IDM) relies on simultaneous manipulation of a number of available strategies of reducing a plant disease with least damage to environment. The losses caused by plant diseases are reduced when information regarding the crop, its pathogen, the environmental conditions, ecosystem relationship etc. is used in developing a disease management strategy.

The strategies of integrated disease management comprises of the cultivation of resistant / tolerant cultivates, adoption of agronomic practices resulting in less diseases, preserving and promoting the activities of natural antagonists and use of chemical pesticides wherever necessary to reduce pathogen population to non-damaging levels. Components of IDM are discussed hereunder with special reference to work done at Horticulture & Agro Forestry Research Programme, Ranchi.

1. CULTURAL PRACTICES

Cultural practices such as sanitation, crop rotation, green manuring, soil amendments, deep ploughing, time and depth of sowing have helped to increase productivity of a crop. In crops where fungicide usage is not profitable due to low returns, these practices are the only available alternatives to reduce diseases. In addition efficacy of resistant cultivars, application of fungicides and biological agents can further be improved to a more lasting and economic by modifying the cultural practices.

a) **Sanitation :** Sanitation is the process that eliminates, reduces or completely excludes the primary inoculum that initiates the disease, thereby delaying the epidemics. Plant and field sanitation (disinfestations, eradication, roughing, pruning and defoliation) are essential for the management of plant diseases. Sanitation is a standard practice in reducing incidence of late blight of potato and early blight of tomato. Quick decomposition of fallen infected leaves of apple by spraying urea, and destruction of canker affected citrus twigs are the normal practices.

b) **Crop rotation :** Crop rotation is the repeated sowing of same crop in cycle, intercepted with other crops periodically. This is one of the most important and long established practices for management of soil borne diseases caused by specialized pathogens. Continuous cultivation of same or related crops lead to perpetuation and

building up of the soil borne pathogens. In a properly planned rotation any crop is intercepted with non-host crops. Rotation modifies the soil environment to make it unfavourable for the survival and growth of pathogen. Pathogens surviving in vegetative phase can be eradicated in less time but those producing resting structure requires longer rotation. Rotation with non-host crop is very effective in managing disease like black rot of crucifers, common blight of cassava, halo blight of beans, bacterial blight of soyabean, soft rot of vegetables and common scab of potato etc.

At HARP, Ranchi crop rotation with okra-maize - radish, ragi-French bean okra, maize-carrot-cucumber significantly reduced the primary inoculum of *Ralstonia solanacearum* in soil indicating either maize or ragi should be included in the crop rotation for management of wilt disease of tomato.

c) **Soil amendments :** Any substance added into the soil to improve its structure and texture is called an amendment. Green or dry crops residues, oil cakes, saw dust and types of meals are used as soil amendments. There exert their influence by changing aeration, porosity, temperature and water holding capacity of the soil which results in rapid root extension, balanced availability of nutrients and better plant vigour. All these changes indirectly reduce the prevalent diseases. Their effect includes germination of pathogen propagules followed by starvation, microbial lyses and increase in general fungibactriostatis.

At HARP, Ranchi soil amendment with karanj cake @ 10 a/ha or lime 25 a/ha applied 15 days earlier to transplanting was standardized for management of bacterial wilt disease of tomato. In these treatments evidence for strong bactriostatis was recorded.

d) **Soil solarisation :** Soil solarisation aims to control diseases by eradicating or reducing the inoculum existing in soil prior to planting. It involves the use of heat as a lethal agent by capturing solar energy with traps like polythene soil mulches. In addition to high temperature there are effects like changes in the physical structure & chemical composition of soil, moisture level, gas composition and shift in microbial population.

At the time of solar heating the soil is kept wet to increase thermal sensitivity of resting structures and improve heat conduction. It is carried out during the period of high temperature and intense solar radiation. Solar heating becomes more effective when combined with application of *Trichoderma harzianum*.

At HARP, Ranchi solarisation of nursery beds for 6 weeks during summer resulted into significant suppression of damping of pathogens and healthy and vigorous seedling were produced in rainy season in case of tomato and brinjal. The technology has been extended to the farmers's field.

e) **Tillage and land preparation :** Soil cultivation before sowing helps in reducing pathogen population by either burial of inoculum deep into the soil or its drying in top exposed layers. Deep ploughing of crop residue which harbour the pathogen is more effective in reducing source of infection. These practices were found useful in delaying the epidemics of *Helmnthosporium maydis* on maize, root rot and wilt of garden peas caused by *Pythium ultimum* and *Fusarium solani* f.sp. *pisidi*. Planting in the soil raised above the surrounding area and staking which keeps the foliage and fruits of tomato contributes significantly in managing the buckeye rot at Horticulture & Agro Forestry Research Programme, Ranchi. Staking reduced unmarketable fruit yield by 16.6%

f) **Weed control:** Both host and non - host weeds favour disease development by influencing the factors resulting in more inoculum. This includes shading the soil and serving as organic substract or food base for infection of the host crop. These also change the crop micro-climate and affect soil microflora. *Heterotylenchus dihystra* the spiral nematode implicated in enhancement of wilt disease in guava has been recorded to survive on several weed hosts in orchards in eastern India.

g) Plant density: Density of plants in a particular area directly affects the microclimate and thus influence spread of the disease. Wider spacing of plants was found to reduce incidence of *Fusarium oxysporum* f.sp. *ciceri* on gram. However, in the wilt disease of guava, caused of *F.oxysporum* f.sp. *psidi,* pathogen did not exhibit significant differences in the rate of causing the wilt but higher plant density was preferred at this station in order to have higher number of trees surviving in the long run.

2. BIOLOGICAL CONTROL

Soil is full of different types of microflora including plant pathogens but there is never total mortality of plants. It is due to the influence of few factors which are responsible for keeping the biological balance in the soil. Beneficial microorganism present in the rhizosphere restrict the growth of soil borne pathogens because of various reasons, which include production of antifugal substances by them, their action as mycoparasite and siderophore production through secretion of different types of enzymes. Biological control of soil borne pathogens with antagonistic fungi and bacteria has been under intensive investigation for last two decades in India. This method has gained considerable attention and appears to be promising as a viable supplement or alternative to chemical control. Host plant resistance and cultural practices contribute to it. But, at present Biological Control Agents (BCA) accounts for about one percent of the World market as crop protectant due to its innate difficulties in registration and marketing, though analysists foresee a quantum jump to as high as 50 percent of the total market.

Antagonist microorganism that can be grown in the rhizosphere, are ideal bio control agents, as the rhizosphere provides the frontline defense for roots against the attack of pathogens. Soil micro flora consists of resident or introduced antagonists. Resident microorganism is the microorganism which is natural inhabitant of soil, the rhizosphere or other sites occupied by the pathogen. They are either managed or fostered by various cultural practices to increase their population level.

Several microorganism including fungi like *Trichoderma* spp, bacteria and actinomycetes act as antagonist against many pathogens. *Trichoderma* and related genus produce chitinase enzyme extracellularly, which is responsible for lyses of pathogenic fungi. Other fungi like Gliocladium virens are good antagonists. *Aspergillus niger* AN 27 has been demonstrated to be good antagonist to *Fusarium oxysporum* f.sp. *psidi* at Horticulture & Agro Forestry Research Programme, Plandu, Ranchi.

Exogenous application of biopesticide Kalisena SL (*Aspergillus niger* str A N 27) in wilt sick alfisols of Chotanagpur caused significant reduction of propagules of native saprophytic and pathogenic *Fusarium* SPP. within 24 months. The rhizosphere population (cfu / g soil) of *A. niger* str. A N 27 increased from 1956 to 5340 (in T_1, the lower dose) and from 6480 to 10325 (in T_2 the higher dose) whereas the population of *Fusarium* spp. declined from 2366 to 1825 (T_1) and from 2512 to 950 (T_2). The antagonistic or suppressive ability of *A. Niger* is of considerable importance. The result significantly correlated between, the days taken to wilt vs. rate of growth of *Fusarium* sp., rate of growth of *Fusarium* sp vs. disease progression rate, days taken to wilt vs. disease progression rate and the negative growth of *Fusarium* vs. growth of *Aspergillus niger.* Application of this information in the management of wilt disease of guava appears to hold high promise.

Mycorrhiza, another group of organism representing symbiotic fungal association with plant root which normally help the plant in uptake of relatively immobile nutrient such as Phosphorus and zinc are not knows to help in reducing soil borne diseases. These fungi provide protection to root by various methods like utilizing surplus carbohydrates, protecting rhizosphere micro-organism. Studies conducted at Horticulture & Agro Forestry Research Programme, Plandu, Ranchi suggested that root system having mycorrhizal associations are less susceptible to attack by soil borne pathogen than the non-mycorrhizal system.

3. CHEMICAL CONTROL

In spite of all disadvantages associated with the use of chemicals, these continue to be a part of package of practices in all crops for increasing their productivity, though their use against soil borne diseases are still limited.

The choice and frequency of application of chemical in soil depends upon factors like properties of the chemical compound and nature and ecology of target organism. Various application methods like soil drenching, broadcasting, furrow system and seed treatment are in use. Benomy, one of the widely used benzimidazole has been found effective against diseases like *Fusarium* wilt of carnation, wiltof strawberry, cotton and tomato, etc. A related compound carbendazim is equally effective against serious soil borne diseases. However, chemical fungicides have not been effective in management of wilt disease of guava.

4. HOST RESISTANCE

Growing resistant plant is one of the most practical, effective and economical approach to suppress the plant diseases. These not only reduce the crops losses but lessen the expenditure incurred in disease control as well as reduce pollution hazard. For certain specific diseases like root rot and wilt, this is the only method of control available so far. The major problems encountered are existence of variability amongst pathogen, breaking down of resistance, and incomplete knowledge of inheritance of resistance.

Resistance in any crop can last longer and prove most effective if it is supplemented with chemical and cultural methods. Presently in many crops and soil borne pathogen comminutions, regular attempts are being made to identify sources of resistance. Bacterial wilt resistance in tomato and brinjal has been conferred at our research station and high yielding resistant varieties have been evolved. These include Swarna Naveen, Swarna Lalima, Arka Abha and Arka Alok in tomato, Swarna Mani, Swarna Shree, Swarna Pratibha and Swarna Shyamli in brinjal. These varieties have made impressive headway in the farmers's fields in Jharkhand, Bihar, W.B., Orissa, M.P., Chattisgarh etc.

Conclusion

The integrated management of soil borne disease management differs in different types of crops i.e., perennial or annual. In perennial fruit trees emphasis is given in the early stage in nursery or in field to get disease free start. Seed beds are solarised and root stock resistant to soil borne pathogens are selected. The strategy for annual crops like vegetables, flowers and cereals etc. is different.

Use of healthy and treated seeds along with the sanitation is the first step to reduce the inoculum. Crop rotation is the next important component of IDM. Time, depth of sowing and other cultural methods which contribute towards the improvement of seedlings and crops should be clearly worked out. Solarisation can become standard practice in raising vegetable and flower nurseries. Use of resistant cultivars wherever available supported with other measures which argument the production and suppress the pathogen are profitable. A continuous search of these factors by using modern techniques of biotechnology is also essential since we are working in a dynamic situation of host, pathogen and environment interaction.

Integrated Pest Management in Vegetable Crops

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- Insect pests and diseases are major constraints to achieve higher productivity. About 26 per cent losses occur due to pest and diseases alone estimated at Rs. 29,000 crores (Puri, 1997)
- As a result, higher doses and more toxic mixtures were used to achieve the desired kill of the pests.
- The indiscriminate and injudicious use of pesticides has eroded the ecological sustainability and has resulted
- Problems of residue
- Development of insecticide resistance
- Induction of secondary pest problems
- Resurgence of target species
- Killing of non target insects (natural enemies, pollinators and saprophytes)
- Contamination of the environment
- Only a small amount of the pesticides (<1%) applied to a crop, reaches the target pests and the remaining (<99%) enters different components of the environment to contaminated soil, water, air, food, forage and other commodities.
- Nearly 100 per cent of human population has been found to contain some residues of pesticides like DDT and HCH.
- The major source of human exposure to pesticides is food, but drinking water, inhaling air and dermal contact with pesticides may also leave residues in humans.
- Monitoring surveys in different parts of India indicated that all type of food products viz., cereals, pulses, vegetables, fruits, animal products, vegetable oils, milk and milk products, spices and honey were found to be contaminated with pesticides.
- In many cases, the residues were above the legal maximum residue limits (MRLs)
- Twenty percent of the market samples of non fatty food commodities were found to have residues above MRL of 0.05 mg / kg.
- In India, even human breast milk samples were found to be contaminated with high levels of residues of DDT, HCH and aldrin.
- In case of vegetables, a number of samples were found to contain residues of some commonly used organophosphorus, trizophos etc. above the prescribed MRLs (Dhaliwa et. a., 2000).
- Pesticides in tea, coffee and vanaspati have affected our export of these commodities.
- There is also a market for export of cotton fabrics and garments devoid of pesticide residues in Japan, Europe and America.
- More than 500 insect pests become resistant to one or more insecticides. Pests like DBM, gram pod borer, tobacco caterpillar (*Spodopetera litura*) have developed cross resistance and multiple resistance to many insecticides (Puri, 1997)
- **Diamond back moth -** Developed resistance to several classes of insecticide in India
- ***Mzyus persicae*** (Sulzer) - minor pest upto 1950s has become serious pest of brinjal, crucifers, potato, tomato, chilli, pepper and cole crops in TN, AP and Karnataka.
- Resurgence of *M. persicae* in chillies and brinjal due to application of cypermethrin, and deltamethrin. These insecticides also cause

resurgence in mite *Polyphagotarsonemus latus* (Banks) (Srinivasan and Krishnamoorty, 1993).

- Outbreak of **Tomato fruit borer,** *Helicoverpa armigera* due to indiscriminate use of insecticides.
- ***H. arimegra,*** *Plutella xylostella* (Linn.) and *Thysanoplusia orichalcea* (Fab) become major pests of off-season vegetable crops.
- Increasing incidence of *H. armigera* alongwith *Spodoptera litura* (Fab.) recorded on many other vegetables in different parts of the country.
- **Cotton whitefly,** *Bemisia tabaci* (Gen.) - Severe form on tomato and other vegetables.
- **Cotton aphid,** *Aphis gossipy* Glover - serious on cucurbitaceous and malvaceous vegetables.
- Recently American leaf miner, *Liriomyza trifolii* (Burgess) was observed on tomato crop in Karnataka.
- **Beanfly, *Ophiomyia phaseoli* (Tyron) - serious** on peas and French beans in Southern India.
- A number of pod borers - more serious on leguminous vegetables *Adisura atkinsoni* Moore on field beans and *Lampides boeticus* (Linn.) on peas.
- Besides Jassid, *Amrasca biguttula* (Ishida) and fruit borer, *Earias* spp. and stemfly, *Melanagromyza hubisci* Spencer - serious damage on okra in Karnataka.
- It was only after this wide spread failure of chemical control measures during the late eighties, search for alternatives of toxic chemical pesticides for the control of the pests population got some momentum (Sehgal, 1997).
- The approaches aimed at achieving this objective were collectively termed as Integrated Pest Management (IPM).
- IPM refers to an ecological approach in pest management in which all available necessary techniques are consolidated in a unified program, so that pest populations can be managed in such a manner that economic damage is avoided and adverse side effects are minimized (NAS, 1969).
- According to Bakhetiya (1988), IPM is the development of a set of management tactics or practices that maintain pest populations at a level, which does not cause significant economic losses.
- Pesticide intervention has to be minimal or a last resort and other measures are given due consideration.
- IPM is the main tool, which aims at preventive as well as curative measures.
- In short, IPM is a way of farming starting from land preparation to harvest.
- IPM is the approaches initiating from land preparation to storage (Prasad 2004)

Mechanical control

- Collection and destruction of fallen infested fruits is effective against fruit flies and fruit borers.
- Handpicking is useful for the management of hairy caterpillars, gram pod borer, leaf rollers, tobacco caterpillar, cabbage butterfly, mustard sawfly, epilachna beetle etc.
- Overhead irrigation reduced the pest population of cauliflower.
- Installation of bird perches

Physical methods of control

- Clean the seeds properly.
- Sun drying to vegetable seeds on pucca floor before storage.
- After drying, the seeds should be mixed with dried Neem leaves @ 2 kg / 100kg seed and kept in airtight container.

Cultural control

- Deep summer ploughing.
- Destruction of crop residues.

- Application of Neem cake/Karanj cake 15-20 days before sowing.
- Application of FYM and lime 15 days before sowing.

Selection of tolerant/resistant/least susceptible varieties.

- **Tomato** - The entries/varieties tolerant to fruit borer (*H.armigera)* are Ac-95, No. 128, 133, 135, Heinz 1370, Sabour prabha, H-67, H-68, Angurlata, Punjab Chhuhara, Parkar, Bonus.
- **Okra -** The entries/varieties tolerant of leaf hopper are:- Varsha Uphar, Selection-2, AE-22, Early long green, AE-27, IC-75, Siswal Local-2. **Shoot and fruit borer** - AE 57, PMS-8, Parkin's long green.
- **Okra** entries tolerant to *Earis spp. are:*- Narnaul specia, Perkin's Long green, Versha Uphar, Rashmi Sagar, Siswal Local-2.
- **Brinjal:** Less susceptible genotypes to leaf hooper (*Amrasca biguttula* biguttula Ishida) are Manjari gota, H-4, Pusa purple Round. **Shoot and fruit borer:** Pant Samrat, Pusa Purple cluster.
- **Bitter gourd:** Karela collection 1, Faizabad-1 (Tolerant to fruit fly).
- **Bottle gourd:** NB-29
- **Chilli :** Aphid and Jassid - Pusa Jwala
- **Seed treatment:** with minimal dose of insecticides.
- Imidacloprid 70WS @ 5ml1/kg seed against leafhopper.
- Chlorphyriphos 20EC @ 5-10m1/kg seed against termites.

Intercropping

- Cauliflower harboured significantly lower number of DBM larvae when it was intercropped with corriander (Prasad and Premchand, 1978).
- *Pieris rapae* on cabbage were significantly reduced when it was surrounded by companionate plants like onion, dwarf marigold (York and Guin, 1981).
- Snap beans *(Phaseolus vulgaris)* was less damaged by larvae of *Epilachna Varivestris* Muls. When dwarf marigold were planted round the plot of snapbeans.
- Lower incidence of insect pests on cauliflower was recorded in intercropping system with marigold or coriander (Sathi, 1997).
- Significantly lower incidence of insect pests viz., jassid, aphid, whitefly, epilachna beetle, Bihar hairy caterpillar and shoot and fruit bore was recorded on brinjal intercropped with marigold (Prasad, U.K. 1997).
- Tomato intercropped with cabbage has been reported to inhibit or reduce egg laying by DBM. A planting pattern of one row cabbage and one row of tomato (cabbage planted 30 days later than tomato), afforded maximum reduction of DBM moth and leafwebber larvae on cabbage (Srinivasan, 1994)
- **There are number of examples from Latin America, where intercropping has helped to prevent outbreaks of several insect pests.**

Trap cropping

- Row of maize at a distance of 8-10 meter should be grown in the field of cucurbitaceous plants. During the night, the fuit fly adults rest on the maize plants which can be killed by spraying insecticides.
- Trap crop serve as pest nursery for the target pest.
- Some highly mobile natural enemies may be attracted to and aggregate on the trap crop just as on their host or prey.
- Okra can be used as a trap crop around cotton to protect from jassid, American bollworms and spotted bollworms.
- Marigold and *Nicotiana rustica* L. grown as trap crops are also preferred hosts of *H. armigera.*
- Planting of castor as trap crop diverts the

population of *Spodoptera litura* (Fab.) from cotton (Dhawan, 1999).

- Successful management of fruit borer (*H. armigera)* on tomato through trap cropping at IIHR, Bangalore.
- African tall marigold (cv Golden Age) nursery is raised 15 days earlier to tomato and 40 day old marigold and 25 day old tomato seedling are simultaneously planted in the field. One row of marigold is alternated after every 16 tomato rows. Fruit borer moths lay eggs predominantly on the buds and flowers of marigold.
- It has been observed that marigold has an added attraction potential for the serpentine leafminer, *Liriomyza trifolii* (Burgess)
- About 10% fruit infestation in trap cropping system may be protected by NPV spraying (250 LE / ha).
- Growing paired rows of bold seeded mustard as a trap crop at the beginning and after every 25 cabbage rows. Among the paired rows, the first is sown 15 days prior to cabbage planting while the second is sown 25 days after planting this attracts up to 80-93% DBM for colonization. Besides it attracts almost entire population of *C. binotalis, H. undalis* and bugs.
- Indian mustard sprayed with Bacillus thermogenesis products at 750g a.i. / ha for controlling severe attack of DBM and shoot borer, H. undalis and NPV sprays at 250-375 LE / ha against S. Litura (Arora et al., 2000).

Use of barrier

Mango mealy bug can be effectively managed by applying polythene band (30cm) on trunk or branches with application of grease on the lower end to fill space between trunk. This band should be applied before hatching of eggs in December.

- For the management of aphids / viruses on chilli, raising of seedlings in insect proof cages.
- Use of maize as a barrier crops in the field and spraying with effective insecticides when vectors are first seen.

Crop rotation:- Generally, crop rotation is the most effective against pests that have a narrow host range and dispersal capacity.

Nutrient management :- Application of potash and sometimes phosphorus also, either singly or in combination with nitrogen results in lower incidence of many insect pests.

- High levels of nitrogen fertilizers significantly increase the incidence of most of the insect pests.

Water management: Flooding of fields has been recommended for reducing the attack of cutworms, armyworms, termites, white grubs etc.

Management of fruit fly

- **Field sanitation:** all infested fruits, whether on the tree or fallen on the ground, should be collected and buried deep into the soil.
- **Ploughing of the soil:** Pupation and overwintering of fruit fly takes place in the soil. Ploughing during winter months in the orchard, expose the pupae against sunlight and predators.
- **Bait sprays:** 20ml malathion 50WP +200g gur in 2 litre water kept in flat container.

  Or Applying the bait sprays containing 20ml malathion 50EC and 200 g sugar / gur in 20 litre water. Repeated at weekly interval in severe infestation

Male Annihilation Technique

- Cotton wicks soaked in soya powder +2g gur or 2 ml vegetable juice +1.0ml methy1 eugenol+1.0 ml malathion were suspended in Steiner type traps. The baited traps kept suspended on trees, bamboo or stick at about 1.5 m high under the shade. The impregnated cotton wicks were changed at fortnightly intervals and the number of flies annihilated.
- Soil application of neem cake 50gm per plant at flowering is effective.
- Foliar spray of fenthion 0.05% with 5% jaggary at fruit formation / ripening is very effective.

Biological control

- Indigenous NEs proved effective
- **Predators:** *Scymnus epius* West. against mealy bugs *Scymnus sp.* against mealy bugs
- Parasitoid *Cephaleta brunniventris* Mots against, scale insect,

  Anicetus ceylonesis Howard against scale insect and

  Anagyrus dactylopii (Howard against grape mealy bug.
- **Cabbage:** Indigenous parasitoid *Apanteles plutellae* (Kurdy) against DBM moth on cabbage in Gujarat and Karnataka.
- Hill region of TN-70% parasitism of DBM moth
- **Tomato:** Release of egg parasitoid *Trichogramma brasiliense* (Ashmead) @ 4000 adults ha^{-1} $week^{-1}$ for 6 weeks suppressed the attack of fruit borer on tomato

Neem based insecticides

Repelin, Neemark, Weligro, Neemrich, Neem oil 50% (3ml/lit.), NSKE.

- Karangin

Bipopesticides

Halt, Biolep, Biobit

HanPV, Spodoptera NPV

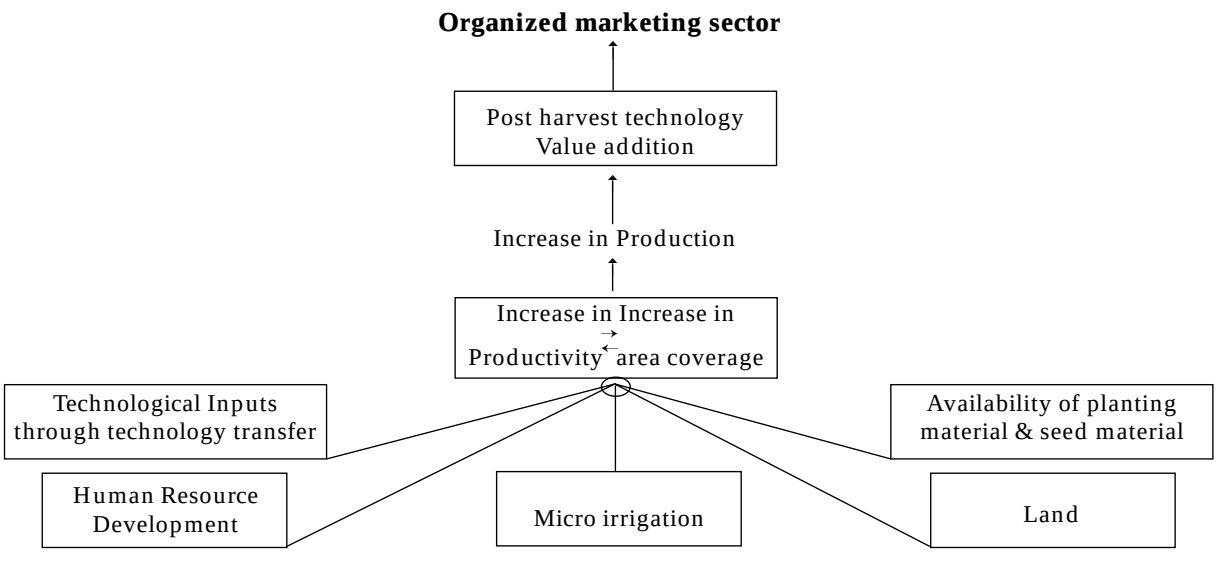
	Compatible	**Larvae/MRL**
i.	HaNPV at 300 LE/ha + endosulfan 500/ha	2.4
ii.	Endosulfan 1 L/ha	6.13
iii.	Untreated control	10.0

Proposed Organisation of Horticulture Sector in Jharkhand

Government of Jharkhand
Department of Agriculture & Cane Development
Directorate of Horticulture

Thrust Areas

- Area expansion under horticulture crops.
- Strengthening of planting material and seed production system.
- Development of backward linkages.
- Development of forward linkages.
- Micro irrigation and fertigation.
- Technology transfer.
- Research and Development
- Hi-tech horticulture



Development of AEZ

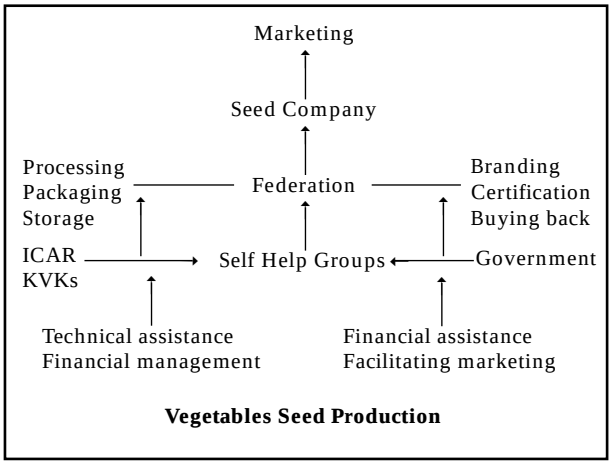
- Cool chains.
- Refrigerated cargo vehicles.
- Auction yard.
- Agri-business co-operative centre
- Agro processing centre

Rejuvenating the infrastructure

- Block nurseries.
- Pregency orchards.

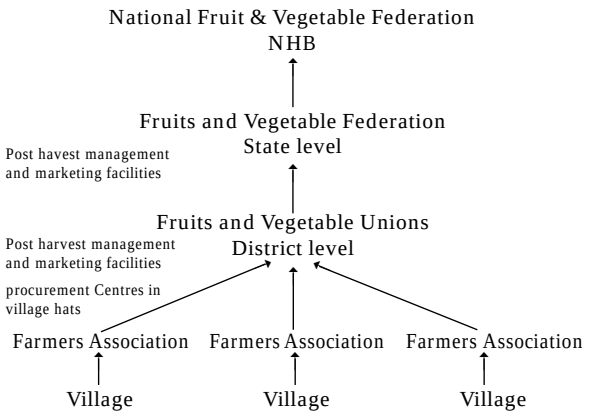
Creating infrastructure

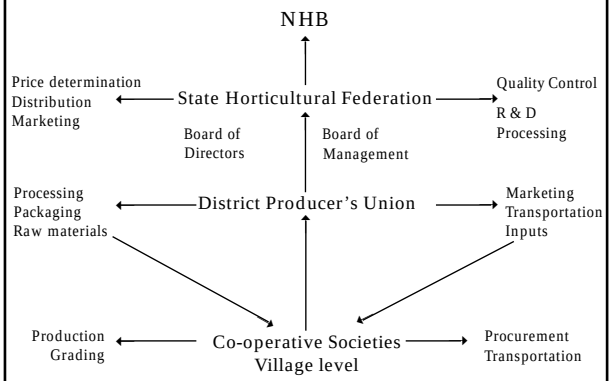
- **Hi-tech nurseries.**
- **Propagation villages.**
- **Temporary nurseries.**
- **Micro irrigation**

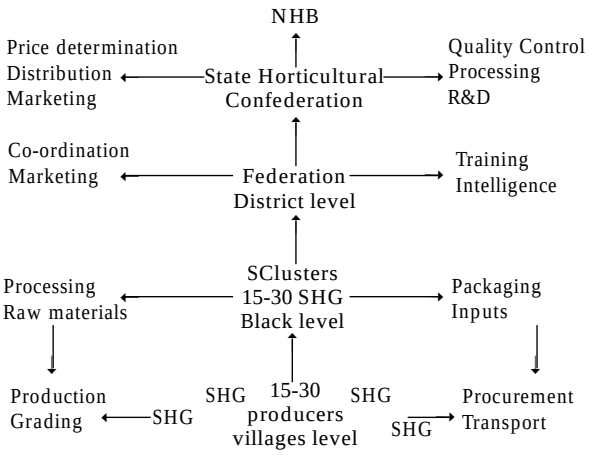


Vegetables Seed Production

Strengthening the Backward Linkages







Technology Transfer

- Basic technology.
- Commercial horticulture
- Hi-tech horticulture

Research and Development

- SAU
- ICAR
- MST
- DBT
- OTHERS

National Horticulture Technology Mission

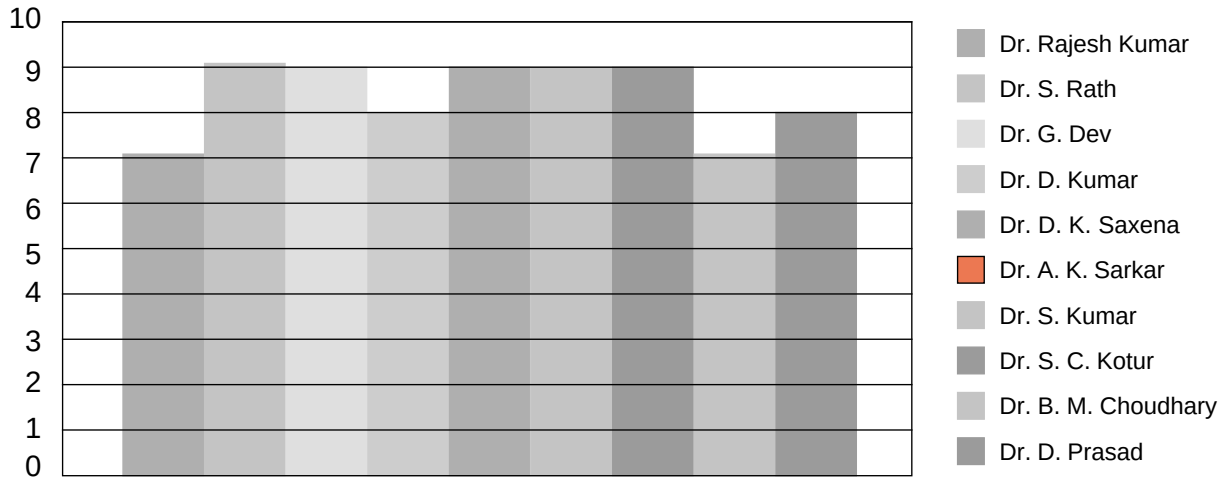
- Mini mission - I
- Mini mission - II
- Mini mission - III
- Mini mission - IV

The Final Goal

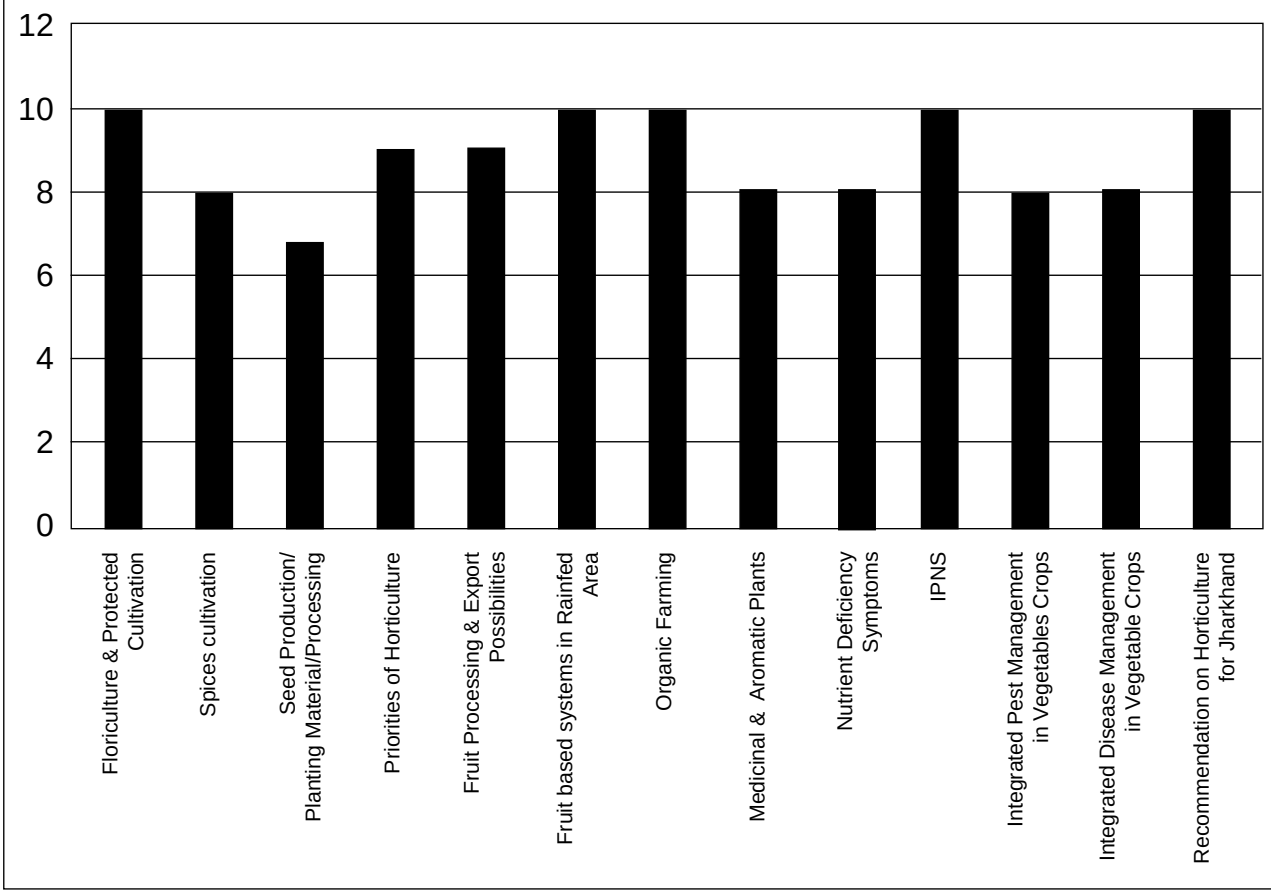
Area expansion
High quality produce & products
High productivity
Produce & Product channelisation

Emergence of Horticulture
as
Driving factor
in
State Economy

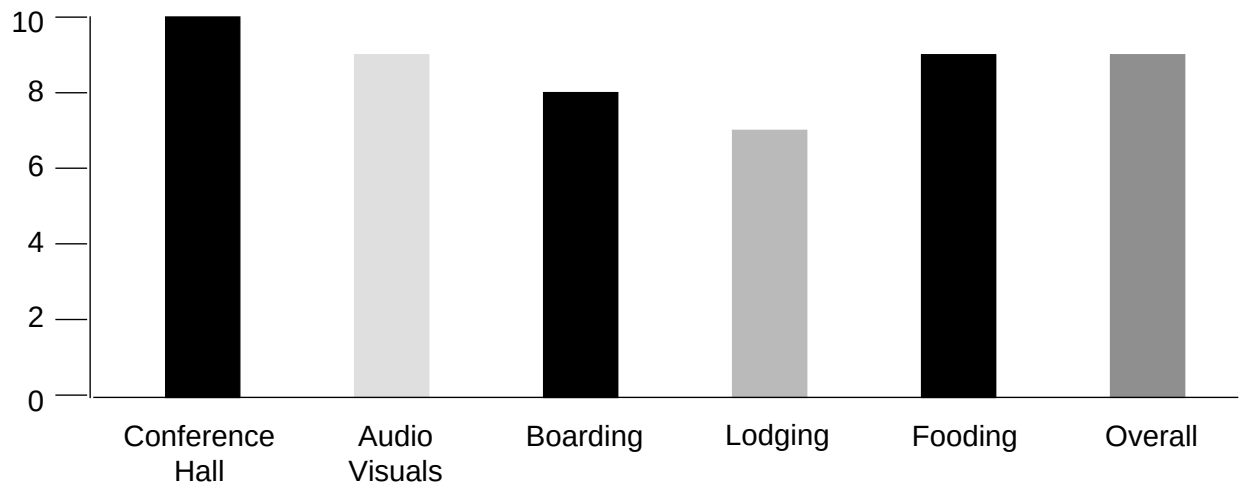
Feedback (Course Faculty)



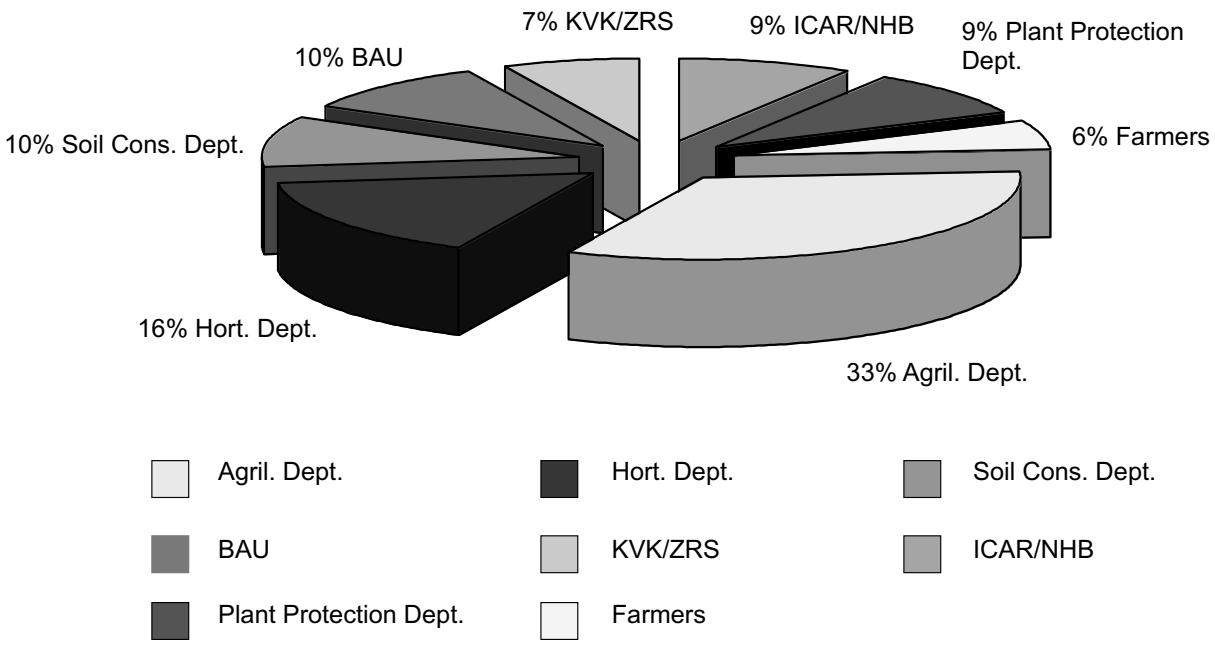
Feedback (Course Subject)



Feedback (Facilities Provided)



PARTICIPATION PROFILE



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60.	*Dr. Rajesh Prasad Singh*	R.A., HARP, Plandu, Ranchi
61.	Dr. Subash Chandra Swain	R.A. (HORT), RRTS, OUAT, Semiliguda, Orissa

COURSE FACULTY

S. No.	Name	Designation & Address
1.	*Sri. V. Jayaram*	Director (Agriculture), Govt. of Jharkhand
2.	*Dr. D. K. Saxena*	Director (Horticulture), Govt. of Jharkhand
3.	Dr. A. K. Sarkar	Director, SAMETI, Jharkhand
4.	*Dr. R. L. Mishra*	Project Coordinator (Floriculture) IARI, New Delhi
5.	*Dr. S. Kumar*	Principal Scientist & Head, HARP, Plandu, Ranchi
6.	*Dr. G. Dev*	Ex. Professor, PAU, Ludhiana & Consultant IMPHOS (India), Ludhiana (Punjab)
7.	*Dr. Sabyasachi Rath*	ADR, RRTTS (OUAT), Semiliguda, Koraput, (Orissa)
8.	*Dr. S. C. Kotur*	Principal Scientist, IIHR, Bangalore (Karnataka)
9.	*Dr. B. M. Choudhary*	Chairman (Horticulture), BAU, Ranchi
10.	*Dr. D. Kumar*	Head, Coffee Res. Institute, Zimbabwe
11.	*Dr. Rajesh Kumar*	NRC for Litchi (ICAR), Muzaffarpur, Bihar
12.	*Dr. Ranvir Singh*	Sr. Scientist, HARP, Plandu, Ranchi
13.	*Dr. B. N. Mohanty*	Manager (Horticulture), TATA Steel, Jamshedpur
14.	*Dr. Devendra Prasad*	Chairman (Entomology) BAU, Ranchi

FOREWORD

GOVT. OF JHARKHAND

DEPARTMENT OF AGRICULTURE & CANE DEVELOPMENT

GOVT. OF JHARKHAND

Nepal House, Doranda, Ranchi - 834001

Sri A. K. Sarkar, I.A.S.
Secretary

Horticulture sector is one of the important sub sectors of agriculture, having ample scope for expansion in the State of Jharkhand. The total area occupied by various plantation and horticulture crops in the State is about 2.57 lakh ha, with an estimated total production of 37.8 lakh tonnes. Considering the agro climatic suitability and future prospects, Government of Jharkhand, has programmed to implement various schemes for the promotion of this sector. Improved cultivation technologies need to be adopted and popularized for improving the productivity. Plastic covered cultivation techniques need to be promoted since possibility of bringing additional area under cultivation is remote. Improvement in seed/planting materials, post harvest management, developing marketing infrastructure will give a boost to horticultural crops in the State.

The State has planned to set up of Agri-Export Zone (AEZ) for horticultural crops. This will help to achieve desired export orientation. The workshop was a major step towards the above direction. Aim was to orient the district level officers of agriculture, horticulture & soil conservation departments towards latest technologies available in different fruit & vegetable crops.

The workshop proceedings will help in taking stock of technological advancements in horticulture sector & devise strategies to meet future needs. I am sure that all functionaries who are involved in the development of Horticulture in the state will make full use of this proceeding. The task of preparing this manuscript would not have been possible without the untiring and meticulous help extended by SAMETI. I convey my appreciation to Director, SAMETI for this compilation.

(A. K. Sarkar)

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GOVT. OF JHARKHAND

SUSTAINABLE DEVELOPMENT

OF

HORTICULTURAL CROPS

(Proceedings of State Level Workshop held from
September 27th - October 1st, 2004)

Organized by

Dept. of Agriculture & Cane Development, Govt. of Jharkhand
SAMETI, Jharkhand,
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