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Organic Farming Technologies for Arid Horticulture

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1. INTRODUCTION

In India, about 62% of cropped area is rain fed, where there is little or no use of fertilizers and other agro-chemical due to poor resources with small holding farmers. Thus promotion of organic farming in India is advocated initially in the arid and semi-arid areas of the country in some selected crops like ber, pomegranate, aonla custard apple, tamarind, fig and other minor fruit of economically importance. Rather than promoting organic farming en masse, it would be appropriate to carefully delineate areas or crop where fertilizer use is nil or nominal or demarcate export oriented crops that can give reasonable yield of high quality produce without the use of chemicals. It is worthy to mention that arid fruit and vegetable crops hold great promise in this regard.

From the limited research carried out, there is a definite promise for organic farming of fruit and vegetable crops in arid region. In horticulture, it is easier to manage fruit crops organically than vegetable and flower crops due to perennial growth habit. The arid fruit crops which are considered high valued health food and being easily grown organically for years are the best suited for organic cultivation, e.g., custard apple, fig, jamun, tamarind, pomegranate, aonla, sapota, guava, citrus and ber. Therefore, in future more efforts are needed to standardize organic techniques in these crops.

2. COMPONENTS OF ORGANIC FARMING

There are large number of organic sources of nutrition and among them green manuring, composting, biofertilizer, organic cakes, vermicompost and biodynamic are important. Among the different components of organic farming, the use of bio-fertilizers is currently gaining interest as a cheap, safe alternate to conventional chemical fertilizers. Bio-fertilizers are bacterial cultures such as *Rhizobium* from leguminous and Azotobactor and Azosprillum from non-leguminous crops and have the capacity of fixing nitrogen from the atmosphere. Similarly the phosphate solubilizing bacteria (PSB) have proven utility in making unavailable soil phosphorus in to available form. *Azosprillum* has been recommended in a number of crops for increasing the production and productivity of crops. Nitrogen fixing systems offer an economically attractive and ecologically sound means of reducing external inputs and improving internal resources. *Azotobactor* is a common soil bacterium, which is present widely in Indian soils.

Soil organic matter is the important factor that decides the growth of these bacteria. Poor organic matter content in the Indian soils is a limiting factor that not only affects the proliferation of the bacteria in soils but also limits its N-fixing capacity. *Azospirillum* is a group of bacteria found in loose association with the root system of many crop plants. These bacteria grow better under reduced oxygen levels. They fix nitrogen from 10–40 kg/ha. *Azospirillum* inoculation helps the plant in better vegetative growth saving nitrogenous fertilizers by 25–30%. In the sand soil ecosystems of India, pioneer plants are subject to deficiency in major nutrients (N, P and K) and organic matter, wide fluctuation in soil moisture and temperature. It is widely accepted that arbuscular micorrbizae are important for the establishment, growth and survival of seedlings particularly in marginal habitats, where the symbiosis improves stress tolerance as well as conserves soil structures. Mycorrhizal associations are believed to help plants grow. The potential for manipulating mycorrhizal associations to increase productivity in plantation, forestry or plant establishment during ecosystem recovery after severe disturbance are major focus of research initiatives. There is much interest in their potential utilization in agriculture and horticulture

3. PROSPECTS OF ORGANIC FARMING IN HORTICULTURE

The green revolution in India though markedly enhanced the food production and brought some major food security in the recent years in horticulture sector it has ushered in the use of : (a) heavy doses of fertilizers, neglecting organic manures and soil amendments, (b) herbicides, pesticides and fungicides to control weeds, pests and diseases, and (c) growth regulators to monitor growth and yields and improved quality and half life to an unprecedented scale. These modern intensively costly practices seem to etched into the system eternally while undermining our resources and drastically changing our environment effecting our health and happiness. In this context to restore our natural resources, to safeguard our environment and to obtain pesticide residue free-fruits, vegetables, spices and other commodities, organic farming is

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now regarded as the best solution. Production of fruits (59 MT), vegetables (113 MT), spices (3.0 MT) and other horticultural crops on 9% of the total cultivated area under all crops consumes around 24% of the pesticides used in the country. Some portion of these crops are exported. Even if 40–45% of the area under these crops is raised organically, it can redress the ecological disaster to a great extent. Besides these crops fetch a high premium of 20–30% in vegetables and some times 100–200% in fruits.

Pests and diseases have to be controlled by a combination of intercrops, rotations, mechanical cultivation, use of botanical and biological methods, etc. other general practices depending upon the situation and crops. Solarized soil inoculated with VAM and *Trichoderma* is useful in nurseries. The bio-agent Trichoderma can be used for seed treatment, potting mixtures and main field.

4. IMPACT OF ORGANIC FARMING IN ARID HORTICULTURAL CROPS

Cropping System: Crop rotation and intercropping are the key components to obtain success in organic farming Cultivation of host plant as inter-crop or in rotation may lead to increase in the harmful pathogens as against this inter-cropping with leguminous crop may increase availability of nitrogen and ultimately increase the yield and improve the quality of fruits. Saia oats (*Avena strigosa*) and Sudan grass were investigated as rotation crops for strawberry and interplant as companion crop [1]. Production of rotation crop suppressed the densities of the pathogens, weeds and white grub. It has been found that inter-cropping of marigold reduced the parasite as compared to sole crop of guava. Integration of two methods, i.e., use of bio-agents preferably with *Aspergillus niger* or *T. harzanium* and inter-cropping with crop like marigold or turmeric effectively control the guava wilt.

Fertilization: In addition to the common cultural practices, organic production of fruit entails proper nutrient management. Thus the most important aspect of organic fruit production is supply of nutrients through organic sources. The concentrate organics like oil cakes, bone/fish meal will be useful in supplying major nutrients. Bio-fertilizers like *Azotobactor*, *Azosprillum* and PSB are of immense use in supplying unavailable nutrients and have immense importance in fruit production. Green manuring not only helps to improve soil health but also is useful in reduction of weed intensity.

Studies conducted at MPKV, Rahuri showed increase in yield to the extent of 8.87 /ha in acid lime and 7.7 t/ha in sweet orange with application of bio-fertilizers (VAM @ 500g + PSB 100 g + Azosprillum 100 g + T. harzanium 100 g per plant). Furthermore, application of organic manures viz., FYM, vermi-compost and neem cake resulted in the highest juice content (49%) with the highest TSS (15.5 ºBrix) in pomegranate.

The maximum plant height and fruit yield was recorded in plants treated with the combination of FYM (50%) + castor cake (25%) + urea (25%) in pomegranate cv. Ganesh in semi-arid condition of Gujarat (Table 1) [2]. Oil cakes were found helpful in increasing the soil health and fruit yield of pomegranate. Semi-hard wood cuttings of pomegranate varieties viz., Ganesh, Jyoti and RCR–1 treated with *Trichoderma harzanium* recorded maximum rooting and number of leaves. In typical semi-arid condition of Karnataka, inoculation of VAM fungi resulted increase in fresh weight of biomass and leaf nutrient content of papaya. Treatment of alkaline soil with distillery effluent encouraged growth of aonla and also improved soil conditions. Application of P solubilizers significantly increased the fruit weight and Vitamin C content of guava over control. P solubilisers were found to have more beneficial influence on fruit yield and physico-chemical parameters of guava than that of N fixers under acid soils of Chotanagpur region [3].

Table 1: Effect of organic and inorganic N application on yield and quality of pomegranate cv. Ganesh

Treatments	Fruit yield (kg/plant)
FYM	8.23
Castor cake	8.20
FYM + castor cake	8.84
FYM + castor cake + urea	10.75
Urea	5.80
CD (P = 0.05%)	2.19

Source: Hiwale (2004)

Plant Growth Regulator: Plant growth regulators have immense importance in quality improvement of fruit crops. However, use of these chemicals is not permitted in organic cultivation Therefore, specific technique should be evolved for quality improvement, e.g., in grape, techniques like berry thinning, stem girdling, cane girdling, paper wrapping, spreading shade net etc. Similar techniques need to be standardized in other fruit crops.

Mulch: Data revealed that in aonla-guava cropping system under salt affected soil conditions, organic mulches (sugarcane trash) improved the plant growth, besides stabilizing soil temperature and reduced the frequency of irrigations and weed intensity. The decomposition of organic mulch materials in soil helps to increase the organic carbon content and availability of N [4-5].

5. BIOLOGICAL & CONTROL MEASURES FOR DISEASES AND PESTS

Biological control of pests and diseases has now been widely adopted in several fruit crops. Research outcome on orchard management showed high promise of some, e.g., *Verticillium lecanii* for control of mealy bug, thrips, white fly and scales in pomegranate, grape, guava and custard apple (4-6 g/l). Furthermore NSKE @ 5 % spray also provides an alternate to chemical pesticides in controlling pests of arid fruit crops. The

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nematode and soil borne pathogens can be effectively controlled by means of *Trichoderma viridae* + Paecilomyces, neem cake (Table 2).

Table 2: Evaluation of bio-agents against guava wilt

Treatments	Average wilt (%)	% control
Pencillium citrinum	47.33	52.67
Aspergillus niger	21.66	78.34
Trichoderma harzanium	24.66	75.34
Control	100.00	0.00

Source: [6].

Control of diseases is the most limiting factor on organic fruit production and hence selecting resistant varieties or rootstocks is of prime importance. Growers should practice sanitation by cleaning up debris, avoiding the incorporation of plant material of same crop carrying diseased plants and removing disease vectors. In organic farming a good defense against plant disease is to maintain the crop in good health and vigour but not the excessive nutrients and moisture.

6. WEAKNESSES OF ORGANIC FARMING

Before initiating organic cultivation one shall consider following weaknesses of organic farming in fruit and vegetable crops in and region, availability of organic materials, initial yield gap, heavy load of pests and diseases, no concrete organic means to control diseases once appeared, only prevention is way of controlling diseases.

Strengthening, required in Organic Farming on development of resistant varieties suitable rootstocks, standardization of organic mulch, effective combination of organic manures, standardization of organic practices (e.g., girdling berry thinning, wrapping with papers, disease forecasting unit).

7. CONCLUSION

Organic agriculture is an alternative and appropriate management system intended to guarantee sustainable production system of safe food with minimum environmental impact. Fruits and vegetables can be considered to be highly prospective for organic farming since they are consumed fresh. Organic production of arid horticultural crops will be successful if sufficient biomass can be generated in and around the farms. Development of biogas plants and agro-forestry for providing alternate source for fuel, addition of crop residues, green manuring, recycling of on farm wastes and enhancing nutrient value of manures through proper composting, particularly vermicompost, adoption of crop rotation involving legumes, etc. are some of the strategies that will definitely help to promote organic farming of horticultural crops in arid region. In order to ascertain and guarantee the consumer or the importer that the produce is genuinely raised organically, the producer has to follow IFOAM basic organic standards.

Organic standards, certification, labeling and inspection are more important for organically grown fruit and vegetable crops. Let our people, and generations to come breathe in healthy air, savour unpolluted fruit and vegetables and enjoy nature. In this context let us strive to pool all our indigenous knowledge on safe horticulture practices and evolve new organic farming technologies for which concentrated efforts are needed from the scientists, planners, personnel involved in the development of horticulture, extension agencies and the farmers themselves.

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