In India, about 62 per cent 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. In horticulture, it is easier to manage fruit crops organically than vegetable and flower crops due to perennial growth habit. The arid horticultural 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, ber, khejri, moringa etc. Vegetables are rich and cheap source of vitamins and mineral which act as a protective food in daily diet and they are also consumed raw as a salad and are major source of fibre in diet, however, vegetable crops are vulnerable to disease and pests, therefore they need chemical sprays to protect from them. Similarly, for getting optimum yield, they need chemical fertilizers. Thus in commercial vegetable production with the increase in chemical inputs, the risk of degradation of environment and residue problems has increased. Therefore, it is needed to grow vegetables organically. The concept of organic farming is to demonstrate the effectiveness of low cost agriculture, thereby increasing the net income from successive crops and not only texture and diseases, use of resistant varieties, better soil management practices like solarization, mulching, cover cropping, intercropping, crop rotations and use of pheromones. Therefore, efforts are made in this communication to focus on the research work done on these aspects in fruit and vegetable crops in India. For getting success in the organic farming, 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’s involved in the development of horticulture, extension agencies and the farmers themselves.

**Key Words:** Organic farming; Horticulture; Vegetable production; Fruit production

**INTRODUCTION**

Four decades of “Green Revolution” based technologies of high yielding varieties, chemical fertilizers, pesticides, fungicides and herbicides and irrigation enabled rise in agricultural production in India and led to self-sufficiency. However, the negative consequences of high input agriculture, which envisage large chemical inputs and few carbon additions, on long term profitability and resource sustenance, are now beginning to appear. This includes: Wide spread soil erosion, salinization, decline in soil quality due to reduction in soil organic matter content, poor soil fertility, poor surface water quality, reduced water infiltration rates and unfavorable soil tillth, pesticide pollution, desertification, loss of biodiversity and adverse effects on human health. Hence presently there is a growing interest to practice alternative agricultural system that are less exploitative, less dependent on non-renewable fossil fuels like fertilizers pesticides, etc., which can conserve the precious soil and water resource and protect the environment and human health. Organic farming is therefore an alternate farming strategy that focuses on soil health, environmental protection and human health by largely excluding the use of synthetic chemical and with minimum use of off-farm inputs.

**LITERATURE REVIEW**

In India, about 62 per cent 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, anola, custard apple, tamarind, fig and other minor fruit of economically importance. Rather than promoting organic farming en masse, it would be appropriate carefully delineate areas or crop where fruit of economically importance. Rather than promoting organic farming en masse, it would be appropriate carefully delineate areas or crop where fruit of economically importance. Rather than promoting organic farming en masse, it would be appropriate carefully delineate areas or crop where fruit of economically importance. 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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.

Vegetables are rich and cheap source of vitamins and mineral which act as a protective food in daily diet. They are also consumed raw as a salad and are major source of fibre in diet. However, vegetable crops are vulnerable to disease and pests, therefore they need chemical sprays to protect from them. Similarly, for getting optimum yield, they need chemical fertilizers. Thus in commercial vegetable production with the increase in chemical inputs, the risk of degradation of environment and residue problems has increased. Therefore, there is need to grow vegetables organically today.

During the last two decades, organic agriculture has emerged as a very dynamic alternative farming system in several countries of the world. This has been necessitated as a result of the adverse effect of inorganic agriculture making excessive use of inorganic fertilizers, pesticides and chemicals necessary to achieve high yields of various crops. Green revolution started on soil rich in organic carbon and the response to applied fertilizers was spectacular. With passes of time, green revolution—showing symptoms of degeneration of soil fertility and deterioration in environmental quality. Excessive use of plant protection chemicals and imbalanced use of fertilizer has further resulted in escalation of the above problems including exorbitant cost on cultivation due to low nutrient efficiency. Such an approach has resulted in change in soil structure, imbalances in soil microorganism and organic matter increased salinity, sodicity, affect water holding capacity of soil and brought in health and environmental problems related with pesticides residue.

**Concept of organic farming**

There is no single definition for organic farming as the term refers to a movement rather than to a single policy. As per USDA, 1980 report “organic farming can be defined as: Production systems which avoid or largely exclude the use of synthetic compound fertilizers, pesticides, fungicides and herbicides and use of resistant varieties, better soil management practices like solarization, mulching, cover cropping, intercropping, crop rotations and use of biocontrol agents for controlling pests and diseases, use of resistant varieties, better soil management practices like solarization, mulching, cover cropping, intercropping, crop rotations and use of pheromones. Therefore, efforts are made in this communication to focus on the research work done on these aspects in fruit and vegetable crops in India. For getting success in the organic farming, 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’s involved in the development of horticulture, extension agencies and the farmers themselves.

**Key Words:**

- Organic farming
- Horticulture
- Vegetable production
- Fruit production

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green manure, off farm organic wastes, mechanical cultivation, minerals bearing rocks and aspects of biological pest control insects, diseases and weeds. The philosophy is to feed the soil rather than the crops to maintain soil health and it is a mean of giving back to the nature what has been taken from it. In nature farming some groups have emphasized the use of microbial preparation in addition to Nature farming. Under organic farming the term organic is not merely intended to refer to the type of input used, but implies to the concept of the farm as a living organism, in which all the components such as soil, water, climate, microorganism, plant, animal and human as a whole is involved. Recently Codex Committee on Food Leveling has defined organic agriculture as a holistic food production management system, which promotes and enhances healthy agro-ecosystem, including biodiversity, biological cycles and soil biological activity. In India, organic farming is essential alternative for saving of finance by small farmers, eco-friendly and helps in improvement of soil fertility and will facilitate the Government on trimming gradually the subsidy on fertilizer.

Prospects of organic farming

- Sustainability in soil health.
- Effective soil moisture conservation.
- Improvement of soil quality and self-life of produce.
- Effective land use through utilizing interspaces of crops for cover cropping and green manuring.
- Reduced environmental hazards and improved public health.
- Increased farm income through export earnings and tapping elite domestic market.
- Rural employment generation.

An organic system is probably more dependent than conventional system on the integration of the major management factors: Crop, soil and livestock management. Though organic farmers use for fewer purchased external inputs. Farmers must carefully consider crop rotations, soil fertility and management when planning a transition to organic farming. Organic farming techniques will help to increase the soil organic matter content of soils, thus reducing the bulk density and decreasing compaction. Soil organic matter is one of the important components of the soil. Various organic manures like farm yard manure, compost, green manure, etc. that are added to the soil from time to time further added to the store of organic matter.

Components of organic farming

There are large number of organic sources of nutrition and among them green manuring, composting, bio fertilizer, organic cakes, vermicomposting 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 Azotobacter and Azospirillum 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 phosphorous in to available form. Azospirillum has been recommended in a number of crops for increasing the production and productivity of crops. Nitrogen fixing systems offer an 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 Azotobacter, Azospirillum 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. Tamarind seed pelleting with Azospirillum in combination with seedling inoculation of VAM at 5 g per poly pot aided the production of elite seedlings in the nursery.

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.

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 and pesticides in major crops and soil biological activity, (b) pesticides and fungicides to control weeds, pests and diseases, and, (c) growth regulators to monitor growth and yields and improved quality and self-life to an unprecedented scale [1]. 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 in organic farming now regarded as the hope of the nation.

Production of fruits (59 MT), vegetables (113 MT), spices (3.0 MT) and other horticultural crops on 9 per cent of the total cultivated area under all crops consumes around 24 per cent of the pesticides used in the country. Some portion of these crops exported. Even if 40-45 per cent 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 per cent in vegetables and sometimes 100-200 per cent in fruits.

Impact of organic farming in arid horticultural crops

Cropping systems

Crop rotation and intercropping are the key components to obtain the success in organic farming. Interference of host plant as intercrop or in rotation may lead to increase in the harmful pathogens as against this intercropping with leguminous crop may increase availability of nitrogen and ultimately increase the yield and improve the quality of fruits. Saia oats (Avena striata) and Sudan grass were investigated as rotation crops for strawberry and interplant as companion crop [2]. Production of rotation, crop suppressed the densities of the pathogens, weeds and white grub. It has been found that intercropping of marigold reduced the parasite as compared to sole crop of guava. Integration of two methods i.e. use of bioagents preferably with Aspergillus niger or T. harzanium and intercropping 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.

Studies conducted at MPKV, Rahuri showed increase in yield to the extent of 8.87 t/ha in acid lime and 7.7 t/ha in sweet orange with application of bio-fertilizers (VAM @ 500 g + PSB 100 g + Azospirillum 100 g + T. harzanium 100 g per plant). Furthermore, application of organic manures viz., FYM, vermicompost and neem cake resulted in to highest juice content (49 %) with the highest TSS (15.5° Brix) in pomegranate. Similar results were obtained in aonla. In typical arid conditions of western Rajasthan, application of vermicompost, cattle manure and sheep manure gave the higher fruit yield and better quality parameters over inorganic production in pomegranate fruit crops. The fruit yield increased by 55, 60 and 78 per cent on the application of cattle manure, sheep manure and vermicompost, respectively over application of chemical fertilizers. The juice content (55 %) and TSS (15.5° Brix) were maximized on the application vermicompost which

Sharma, et al.
were 56 per cent higher over inorganic fertilizer application. The application of bulky manure increased water holding capacity of sandy soils and water use efficiency by pomegranate fruit crops at CIAH, Bikaner [4]. Hiwale [5] reported 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. Oil cakes were found were found helpful in increasing the soil health and fruit yield of pomegranate [6-8]. Semiwood hard cuttings of pomegranate cv., Ganesh, Jyoti and RCR-1 treated with Trichoderma harzaniun record maximum rooting, number of leaves [9]. 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 [10]. 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 phytochemical parameters of guava than that of N fixers under acid soils of Chotanagpur region [11]. Fruit yield and quality of guava improved on the application of Azospirillum and vermicompost in comparison control treatment [12]. Experiment on sweet orange revealed that with addition of vermicompost (20 kg/tree)+neem cake (8 kg/tree) with organic plant protection gave additional yield of 8.22 t/ha (Tables 1 and 2).

### TABLE 1

**Effect of organic and inorganic N application on yield and quality of pomegranate cv. Ganesh**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fruit yield (kg/plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FYM</td>
<td>8.23</td>
</tr>
<tr>
<td>Castor cake</td>
<td>8.2</td>
</tr>
<tr>
<td>FYM+castor cake</td>
<td>8.84</td>
</tr>
<tr>
<td>FYM+castor cake+urea</td>
<td>10.75</td>
</tr>
<tr>
<td>Urea</td>
<td>5.8</td>
</tr>
<tr>
<td>CD (5%)</td>
<td>2.19</td>
</tr>
</tbody>
</table>

*Note: Source: Hiwale [5].*

### TABLE 2

**Effect of organic/biodynamic treatments on yield and quality parameters of guava**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield (kg/tree)</th>
<th>TSS (%)</th>
<th>Acidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>vermicompost</td>
<td>11.45</td>
<td>11.2</td>
<td>0.13</td>
</tr>
<tr>
<td>Vermivash+FYM</td>
<td>5.9</td>
<td>9.67</td>
<td>0.23</td>
</tr>
<tr>
<td>FYM+Azotobacter</td>
<td>7.88</td>
<td>10.2</td>
<td>0.28</td>
</tr>
<tr>
<td>FYM+Azospirillum</td>
<td>8.61</td>
<td>9.8</td>
<td>0.29</td>
</tr>
<tr>
<td>Chemical fertilizers</td>
<td>8.09</td>
<td>8.2</td>
<td>0.24</td>
</tr>
</tbody>
</table>

*Note: Source: Ram and Nagar [12].*

**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., in grape, technique 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 [13]. The decomposition of organic mulch materials in soil helps to increase the organic carbon content and availability of nitrogen [14,15]. Organic mulch materials (maize straw, paddy straw, grasses, subabool lopping, rice husk) encouraged plant growth, reduced moisture evaporation and also regulated soil temperature in aonla orchard under semi-arid conditions of Gujarat [16]. Plant growth in aonla was maximized with sugarcane trash and paddy straw mulches and proved cheaper and maintains soil energy as compared to black polythene mulch [17-19]. Maximum plant height, spread and fruit yield were recorded full moon terracing and subabool lopping as compared to control at semi-arid condition of Gujarat (Table 3) [20].

### 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., 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 provide as an alternate to chemical pesticides in controlling pests of arid fruit crops. The nematode and soil borne pathogens can be effectively controlled by means of Trichoderma viridae+Pseudomonas, neem cake (Table 4).

### TABLE 4

**Evaluation of bio-agents against guava wilt**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Average wilt (%)</th>
<th>% control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillium citrinum</td>
<td>47.33</td>
<td>52.67</td>
</tr>
<tr>
<td>Aspergillus niger</td>
<td>21.66</td>
<td>78.34</td>
</tr>
<tr>
<td>Trichoderma harzaniun</td>
<td>24.66</td>
<td>75.34</td>
</tr>
<tr>
<td>Control</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

*Note: Source: Mishra et al., [17].*

Control of diseases is the most limiting factor on organic fruit production and hence selecting resistance 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.

In vegetable the application of FYM @ 20 t/ha was significantly superior in increasing the head size, and head yield as compared to recommended dose of NPK in cabbage [21]. Highest net income with the cost benefit ratio of 6.81 was found with FYM application in moringa based cropping system in semi-arid condition of Gujarat [22]. Vermicompost resulted in significant increase in plant height, number of leaves, leaf area index and gave 24% higher tuber yield in comparison to control [23]. The experiment on organic cultivation of cabbage revealed that maximum yield was produced with inorganic fertilizers but it was at par with that produced by organic package consisting @ 20 t/ha of FYM+neem cake (250 kg/ha)+soil treatment with Trichoderma+Azospirillum+PSO+NSKE+tray crop of mustard. The experiment on organic cultivation of bitter gourd revealed that maximum yield was produced with organic manure treatment consisting of neem cake+poultry manure+vermophos+ sulphate of potash+Azotobacter+Azospirillum+PSB+FYM+NSKE that control (Tables 5 and 6).

### TABLE 5

**Organic cultivation of cabbage**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield (q/ha)</th>
<th>B:C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic package</td>
<td>300</td>
<td>2.6</td>
</tr>
<tr>
<td>Inorganic with trap crop</td>
<td>329</td>
<td>4</td>
</tr>
<tr>
<td>Recommended as STCR with trap crop</td>
<td>346</td>
<td>4.13</td>
</tr>
</tbody>
</table>
TABLE 6
Organic cultivation of bitter gourd

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield (q/ha)</th>
<th>B:C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>FYM+poultry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>manure+vermiphos+SOP+Package</td>
<td>250</td>
<td>1.83</td>
</tr>
<tr>
<td>Neem cake+poultry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>manure+vermiphos+SOP+Package</td>
<td>263</td>
<td>1.98</td>
</tr>
<tr>
<td>Control (RDF+FYM)</td>
<td>232</td>
<td>1.66</td>
</tr>
</tbody>
</table>

Studies conducted on effect of mulches on onion during Kharif revealed that maximum yield was obtained in the sugarcane trash mulch with 40.70 per cent increase over the control and maximum B:C ratio (Table 7).

TABLE 7
Effect of mulches on onion during kharif season

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield (q/ha)</th>
<th>B:C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black polythene mulch</td>
<td>28.5</td>
<td>1.57</td>
</tr>
<tr>
<td>White polythene mulch</td>
<td>23.96</td>
<td>1.66</td>
</tr>
<tr>
<td>Wheat straw mulch</td>
<td>26.65</td>
<td>5.06</td>
</tr>
<tr>
<td>Sugarcane trash mulch</td>
<td>28.69</td>
<td>6.63</td>
</tr>
<tr>
<td>Control</td>
<td>20.39</td>
<td>4.21</td>
</tr>
</tbody>
</table>

Weaknesses of organic farming

Before initiating organic cultivation one shall consider following weaknesses of organic farming in fruit and vegetable crops in arid region.

1. Availability of organic material.
2. Initial yield gap.
3. Heavy load of pests and diseases.
4. No concrete organic means to control diseases once appeared.
5. Only prevention is way of controlling diseases.

Strengthening required in organic farming

1. Development of resistant varieties.
2. Suitable rootstock.
3. Standardization of organic mulch.
4. Effective combination of organic manures.
5. Standardization of organic mulches (e.g., girdling, berry thinning, wrapping with papers).
6. Disease forecasting unit.

CONCLUSION

Organic agriculture system is an alternative and appropriate management system intended to guarantee sustainable production system of safe food with minimum environmental impact. Fruit and vegetables can be considered to be highly prospective for organic farming since they 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 agroforestry 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 be definitely help to promote organic farming to 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. Parallel to the advantages of organic farming, there are some limitations of this kind of agriculture, which will be focused during the presentation of this paper.

REFERENCES