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Organic Farming in Pigeonpea: BMPs, Problems and Opportunities

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Abstract

Organic farming is the adoption of non-chemical methods of nutrition, pest and disease control and encourages use of on-farm inputs. Pigeonpea is the most widely used leguminous crop for making dal in our daily diet. Though all are talking about organic farming across crops; but, development of best management practices is at infancy stage. Hence, this research based scientific report gives an overview of practices to be adopted, available opportunities and problems involved in organic pigeonpea production.

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is a popular leguminous crop predominantly grown under rainfed conditions during monsoon season across tropical and semi tropical regions of the world. It is cultivated as either a sole crop or mostly intercrop with cereals, oilseeds and fiber crops. It is a good candidate for crop rotations due to its ability to fix atmospheric N in the root nodules, add organic matter and restore/improve soil fertility. Though it is second next to Chickpea among all season pulse crops and is *numerouno* among *kharif* pulses. Its grains are nutritious and rich in protein (21.7%), carbohydrates, fibre, iodine and minerals and the essential amino acids like lycine, cystine and arginine, hence, popularly used as dal in South India. It is also used in preparation of *kheer* or *phirni* on special occasions. Its leaves are used as fodder for cattle and sticks/ stubbles are used for thatch, firewood, basket making and preparation of vermicompost (Figure 1). It is grown in an area of 4.8 Mha with a production of 3.6 million tonnes and a productivity of 751 kg/ha (Economic survey, 2019-20).

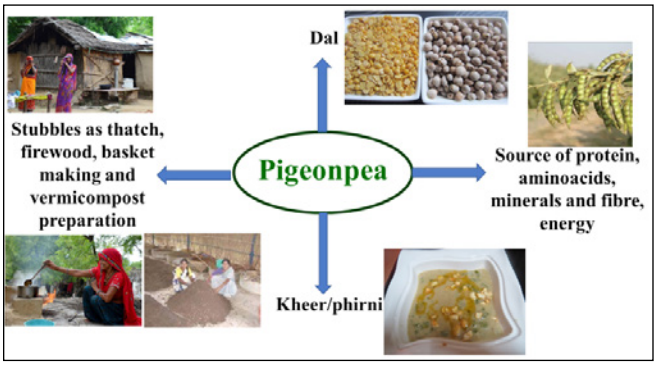

Figure 1: Multiple uses of Pigeonpea

Need for Organic Pigeonpea

Organic farming gained importance and momentum across the country in view of deleterious consequences of indiscriminate use of chemical inputs on soil, water,

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air, and health of human beings and livestock thus entire ecosystem (Ramanajnaeyulu *et al*., 2020). In general, organic farming is good for human health, economic prosperity and the environment besides enhancing the quality of food. Being the most source of *dal* in India and few inherent advantages, the demand for organic pigeonpea has been increasing, thus, there is a need for its' popularisation.

Best Management Practices for Organic Pigeonpea Production

Soils

Light textured red soils to medium textured black soils are suitable. Heavy textured black cotton soils with proper drainage facilities are also suitable for pigeonpea cultivation. Soils with near neutral pH are highly desirable.

Land Preparation

Deep ploughing is advocated during summer (Figure 2) as it helps to kill the hibernating pupae of insects, perpetuating fungal propagules and troublesome weeds by exposing them to the hot sun. This practice helps to reduce pest/ disease/ weed menace to a greater extent thus reduces the cost of cultivation. It also helps in retention of soil moisture. Before sowing, land has to be ploughed twice with cultivator and levelled by tractor drawn blade to make the land ready for sowing (Figure 2).

Figure 2: Summer deep ploughing for organic pigeonpea production

Varieties

Selection of variety is very important in organic farming. In the areas where length of growing season is short (120-150 days) and soils are light in texture, medium duration varieties with wilt resistance are desirable. For e.g., PRG-158 (Palemkandi) (Figure 3). On the other hand, in the areas where soils are heavy textured with medium to deep black nature, medium to long duration varieties with resistance to wilt and sterility mosaic have to be grown. For e.g., ICPL-87119 (Asha) and WRGE 97.

Figure 3: PRG-158 variety of pigeonpea under organic farming

Sowing: Seed Treatment, Seed Rate, Spacing and Sowing Date

Seeds @ 7.5-10 kg/ha should be treated with *Trichoderma viridae* @ 10 g/kg followed by suitable strain of *Rhizobium* and PSB biofertilizer (1.25 kg/ha each) before sowing (Figure 4). Sowing can be done starting from 15th June upto 31st July depending on the receipt of rainfall during *kharif* season. The seed should be sown at a spacing of 120×15 cm or 90×20 cm.

Figure 4: Seed treatment with Rhizobium and PSB in organic pigeonpea production

Nutrient Management

During off-season i.e. summer (April-May), dhaincha/ sunhemp green manure crop has to be grown and incorporated *in situ* well ahead of sowing season (Figure 5). It helps to preserve soil organic carbon thus

enhances carbon sequestration besides reducing soil alkalinity. Further, addition of good quality tank silt @ 100 t/ha before sowing, also helps in better moisture retention and soil fertility. Nearly 5.0 t of finely powdered FYM/ha has to be applied uniformly over the field and incorporated into the soil during ploughing. Vermicompost @ 2.5 t/ha has to be applied in two equal splits at 30 and 60 DAS (Figure 6) in a plough furrow besides the crop row followed covering with soil during inter-cultivation. 50 kg P_2O_5/ha has to be applied through rock-phosphate obtained from mineral source. Further, at the end of crop season, the left over stubbles may be incorporated *in situ* into the field (Figure 7), so that it adds organic matter and enrich soil fertility.

Figure 5: Incorporation of dhaincha green manure in situ in organic pigeonpea field before season

Figure 6: Application of Vermicompost for top dressing in organic pigeonpea production

Figure 7: Incorporation of left over pigeonpea stubbles

Water Management and Dead Furrows

Crop is grown under rainfed conditions, hence, doesn't need irrigation. But, in the event of long dry spells, one or two life saving irrigations will help to enhance the yield. Care should be taken such that the organic field is totally bunded on all four sides to avoid water flow from other fields and also outflow from organic field to other fields nearby. If inorganic fields are located on upper side of this organic field, they can also be separated by making deep dead furrow with the help of disc/MB plough.

Weed Management

Herbicides are not allowed in case of organic farming. Hence, integrated weed management excluding chemical methods of control should be adopted. It includes cultural, mechanical and biological methods as detailed below.

Cultural: Clean cultivation, sanitation, optimum crop stand and hand weeding.

Mechanical: One to two times need based hand hoeing (line weeding) and inter-cultivations with cattle pair/ tractor drawn blade/ mini tractor drawn rotavator will help manage the weeds (Figure 8).

Figure 8: Mechanical inter-cultivation with mini tractor drawn rotavator in organic pigeonpea

Biological: Release *Zygogramma bicolorata* if *Parthenium* is dominant.

Plant Protection

IPM practices excluding chemical control methods are to be adopted.

Cultural: Summer ploughing, field sanitation, use of weed free seed, maintaining crop weed free, use of pest/ disease resistant/ tolerant varieties (PRG-158 and Asha are resistant to wilt), removal and burning of wilt/ mosaic disease affected plants.

Mechanical: Hand picking or dislodging of the larvae by shaking the plants followed by collection and killing.

Biological/ Non-chemical: Monitor the pest status with Phermone traps @ 10/ha (Figure 9). *Trichogramma* twice at weekly interval @ 65000/ha, arrange bird perches @ 10/ha and, spray NPV (500 LE/ha) and Bt (1 kg/ha), use neem oil @ 5 ml/lit or NSKE @ 50 g/lit (Figure 10).

Figure 9: Bird perches and Pheromone traps and Spinosad spray

Figure 10: NPV for control of Heliothis and Spodopetra

Use of Green Insecticides: Spray Spinosad @ 0.3 ml/lit against most important and damaging pests of pigeonpea viz., *Maruca*, *Helicoverpa* and *Spodoptera.*

Harvesting and Storage

Harvesting should be done when at least 90% of the pods are fully matured, by cutting the plants just above the ground level and kept in a threshing floor. After complete drying, seed should be separated from the pods and dried in the sun till it reaches safe/ optimum moisture content of 8-10 % to avoid loss of viability due to increased grain respiration and attack of storage insects and pests. Properly dried seed can be safely stored by mixing with dried neem leaves or ash.

Seed Quality: Organically produced seed has more or less equal protein (20%) and reducing sugars (0.3%) with that of inorganic ones.

Yield and Price

Though in the initial stages, the yield of organic pigeonpea was less. However, nearly 20% improvement in yield was observed in organic pigeonpea over inorganically grown pigeonpea in a span of 4-5 years. The market rate offered for organically produced pigeonpea is double than that of inorganically produced pigeonpea (Table 1 and Figure 11).

Table 1: DO's and DON'T's in organic pigeonpea production

Particulars	DO's and DON'T's
Chemical fertilizers	
DAP/Urea/SSP/other chemical fertilizers	X
Rock phosphate (from mined source)	√
Micronutrients (mixing with FYM/organic manures only) as basal based on soil test values	√
Organic manures	
FYM/Compost/Vermicompost	√
Green manuring	√
Seed treatment	
Inorganic pesticides	X
Biofertilizers/biological products (Rhizobium/ PSB/Trichoderma)	√
Weed control	
Deep ploughing	√
Intercultivation	√
Hand weeding	√
Herbicides	X
Organic mulches	√
Plant protection	
Neem oil/NSKE	√
NPV/Bt/*Trichogramma*	√
Spinosad	√
Inorganic pesticides	X
Bird perches	√
Pheromone traps	√
Storage	
Inorganic pesticides	X
Neem leaves/ash	√

SWOT Analysis

Strengths/ Opportunities for Organic Farming

- Pigeonpea can fix 69-100 kg N/ha per season and a net N

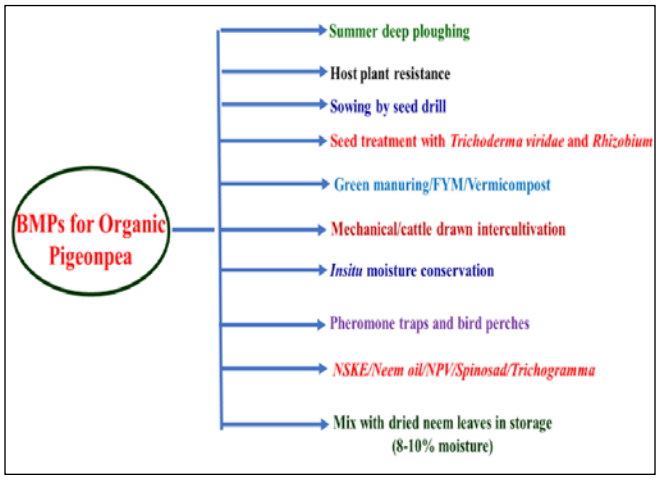

Figure 11: Best Management Practices for production of organic pigeonpea

contribution of 2 to 60 kg/ha depending on the genotype and edapho-climatic conditions (Rao and Dart, 1987; Myaka *et al.,* 2006) and thus can help economize mineral N to be added. Further, it requires less N per ha (20 kg N/ha) which is generally applied as basal and no further top dressing. Application of this N dose through application/ incorporation of FYM/ vermicompost is easy due to less bulkiness as compared to that of other cereals and fiber crops (120 kg N/ha in rice and cotton to 180-200 kg N/ha in maize).

• It adds organic matter to the soil through leaf fall, nodules on roots, and incorporation of stubbles.

• Its deep root system helps in extracting the nutrients and moisture from deeper soil layers by breaking the hard pans and improving soil structure, thus, it is considered as '*biological plough'.*

• Less incidence of pests and diseases thus non-chemical control is easy.

• Good scope for easy weed control through animal drawn or mechanical inter-cultivation due to wider row spacing (120-180 cm).

• Ever increasing demand for pigeonpea dal across many Asian countries.

• The market price for organic pigeonpea dal (Rs. 200-250 per kg) is double than that of conventional one (Rs. 100-120 per kg) in shopping malls in cities thus fetches good income for growers if marketing strategy is properly followed.

• Encouragement by government through promotion of cluster approach under PKVY (Paramparagath Krishi Vikas Yojana) and organization organic melas (generally organized during January every year at Public gardens in Hyderabad).

• Availability of agronomic package for complete mechanization in pigeonpea.

• High minimum support price (MSP). E.g. Increased MSP from Rs. 3200.00 (2011-12) to Rs. 5800.00 per quintal (2019-20).

Problems/ Weaknesses/ Threats

• Lack of availability of good quality well decomposed organic manures like FYM and vermicompost in sufficient quantity due to decline in livestock animals.

• Application of 50 kg P_2O_5/ha through organic sources is difficult. It has to supplied through rock-phosphate (from mined source only), but, its availability is difficult and that too costly (Rs. 10-12 per kg).

• Less productivity and high cost of production during initial stages will be a double loss for the farmers.

• Market price is neither high nor assured/ uniform at all places.

• Lack of effective non-chemical control measures against *Maruca*, *Helicoverpa*, *Spodopetera*, wilt and sterility mosaic.

• Lack of dal mills at village/ cluster level.

Conclusion

No doubt organic farming has been proved to be a viable option for promoting chemical free agriculture across crops, more particularly in food grain crops. Pigeonpea being a low input and drought resistant leguminous crop fits well under organic farming. However, initial low yields and more production cost have to be offset by offering premium price by the government so that producers don't incur loss. Further, proper backward and forward linkages must be set up for assured market price and income for the growers. The producers groups must be linked to nearby research stations and FPOs for transfer of technology, setting up of dal mills, facilitating easy organic certification and marketing of organic produce.

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