

Enhancement of farmers' income by seed production of Open Pollinated Varieties of Carrot

Healthy, vigorous and true to type (genetically pure) seed is the basic requirement for commercial crop production for farmers. Good quality seed confirms to establish seed standards of germination, uniformity, genetic purity, free from seed born pathogen and other prescribed parameters. Timely availability of good quality seed is urgent need for food security of increasing population of India. Sowing of good quality seeds is primary requirement of growing good quality crop. Planting material and quality seed is critical to agricultural production because it contributes substantially to enhance crop yield as high as 30%. Thus, seed is a critical input for enhancing productivity of all crops. The response of all other inputs depends on improved seeds to a large extent and it can be further raised up to 45% with efficient management of other inputs. So, it is urgent need to replace poor quality seed with quality seeds of high yielding varieties.

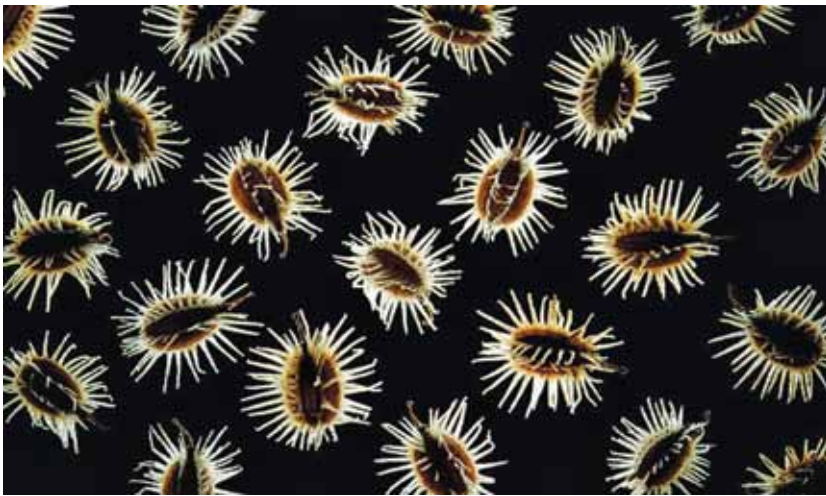
THE agriculture is backbone of rural economy. Seed is the basic and critical component among all inputs for sustainable crop production. It is estimated that quality of seed accounts for 20-25% of productivity. At present the total Indian traded seed market is ₹ 20,000 crore. Out of this total vegetable seed market including Open Pollinated varieties is ₹ 4000 crore. Vegetable seeds are considered as important enterprise for improving the livelihood of farmers and addressing the issues of self-sufficiency, food security and economic development of remote areas. Vegetable seeds give 3-5 times higher income as compared to alternative cereal crops, enabling farmers to buy at least three times more food as compared to growing traditional food crops on the same land. Most of the studies reported that vegetable seed production is more profitable than food grain crops. Requirement of vegetable seed production is increasing annually. The requirement of seeds of open pollinated varieties increased to 48,000 ton in 2005 from 30,550 ton in 2001-02. The worldwide production of vegetables has also doubled over the past quarter century and the value of global trade in vegetables now exceeds that of cereals. India is emerging as the second largest producer of vegetables (17.3 t/ha) after China (22.5 t/ha). In the past two decades, the vegetable production in India has been increased 2.5 times from 58.5 mt in 1991-92 to 146.5 mt in 2010-11. Increase in yield is mainly attributed to expanding areas under high yielding vegetable varieties and hybrids. Total cultivated area under vegetables has increased from 5.59 mha in 1991-92 to 8.49 mha in 2010-11. Finally, it leads to ever increasing demand for the quality vegetable seed. Seed production activities are enhancing income of farmer directly or indirectly. Approximately 0.17 million farmers are engaged in contract seed production through

different private seed companies. There is vast demand for vegetable seeds in the foreign countries. India is the ninth major exporter of fruit and vegetable seeds in the world thereby earning good foreign exchange reserves. The major seed importing countries from India are Pakistan, Bangladesh, Saudi Arabia, Netherland and Korean Republic. Fruit and vegetable seed exports consisted 3.37% of total horticultural exports from India in the year 2012-13. On an average one million people are employed in vegetable seed production activity. Thus, there is vast economic potential of seed production activity in India.

Open pollinated varieties seeds have significant importance for farmers due to contribution of 70% alone of total vegetable seed. Open pollinated varieties seeds are results of either natural or human selection for specific traits which are then reselected in every crop. The seed is kept true to type through selection and isolation. The flowers of open pollinated varieties are pollinated by bees or wind. Open pollinated varieties are beneficial for farmers than hybrid seeds because farmer himself can produce these varieties of seeds in less efforts by repeatedly sowing seeds. Open pollinated varieties are also less infested by diseases due to a little undetected variation between plants in the field in comparison to genetically identical hybrid varieties.

Carrot is highly cross pollinated crop in nature and demands extra efforts and caution for its seed production. Carrot belongs to two different groups based on climatic requirement, one is Asiatic type and another group is European type. Under, Indian conditions, only Asiatic groups are better suited for seed production.

Important varieties of carrot in India have been discussed here.



Umbel initiation and seed formation in carrot

Pusa Rudhira: Developed by ICAR-IARI, New Delhi. A tropical variety of carrot and roots take about 85-90 days for maturity after sowing. Roots have dark red colour with self core, 27 cm long and 3.4 cm diameter. Its leaves colour is dark and green. Plant height is about 65 cm with late bolting. Average root yield is 230 q/ha which is 50% higher yield over national check Pusa Kesar. Suitable for growing in NCR region.

Pusa Kesar: Roots are rich in carotene and have deep red colour. Self core is small, deep red in colour. Period of roots maturity is about 80-90 days after sowing. Average root yield is about 300 q/ha. Suitable for cultivation all over India.

Pusa Meghali: It has short tops with smooth roots, orange flesh, self coloured core and stumpy to slightly tapering roots. Variety is suitable for sowing early (August-September) as well as late (October-November). Its roots mature in about 110-120 days. Average yield 250-280 q/ha. Suitable for cultivation in Madhya Pradesh and Maharashtra.

Pusa Ashita: Developed by ICAR-IARI, New Delhi. This tropical variety is late bolter type. Maturity of roots is about 95-100 days after sowing. Roots have self black colour core with 26 length and 3.2cm diameter. Fresh carrots are suitable for making pickles, salad, juice, and kanji. Leaves show dark green colour while petioles show purple colour. Average yield of it is 300 q/ha. Gives more

than 30% higher yield over national check Pusa Kesar. Suitable for growing in NCR.

Pusa Yamdagni: It is temperate type variety of carrot. Roots attain edible maturity 90-100 days. After sowing crops take 86-130 days to harvest which is earlier than Nantes by a week. Roots are orange in colour with self coloured core, slightly tapering or semi stumpy with medium tops, rich in carotene. Root yield is 120 q/ha. Recommended for cultivation all over India.

Pusa Vrishti: Developed by ICAR-IARI, New Delhi. It is a new heat tolerant tropical carrot variety. It is suitable for early sowing beginning in July under North Indian plains. Root maturity is in about 85-90 days. Average yield 250 q/ha. Suitable for cultivation in NCR.

Selection 223: Developed by PAU, Ludhiana. Roots are orange in colour with light orange flesh.

No. 29 Developed by PAU, Ludhiana. Roots are long tapering and light red in colour.

Climate requirement

For proper vegetative growth and root development of Asiatic type, cooler or moderate cool climate is required. From seed production point of view, the area should be selected where rainfall is negligible during summer. A dry warm atmosphere is required for proper maturity and drying of seeds.

Table 1. Isolation distance (in m)

Mother Root Production		Seed Production Stage	
Foundation Seed	Certified Seed	Foundation Seed	Certified Seed
5	5	1000	800

Land requirement

The seed plot should be free from off types, volunteer plants, and weed species. The soil should be well drained.

Isolation requirement

To maintain genetic purity (trueness type) of the seeds, it is essential to maintain proper and recommended isolation distance because carrot is cross pollinated in nature, pollination is made by insects.

The seed field of a particular variety of carrot must be isolated from field of same variety but not conforming to varietal purity requirements and different varieties of carrot crop growing in that particular variety.

Rouging

Removal of dissimilar type of plants from the variety whose seed is produced is known as rouging. Following points are considered for rouging during seed production of carrot:

- Remove plants which show different type of foliage from foliage characteristics of the variety and flower colour whose seed production is made. Bolting type of plants is removed in seed to mother root phase and early bolting type of plants during mother root to seed phase.
- Diseases (*Cercospora*, *Alternaria* etc.) and insect pests (spider mites, aphids and lygus bugs) infected plants and blunted type plants are removed.
- After uprooting at maturity stage, only true to type roots are selected on basis of root shape, size, color and rest forked, cracked, light coloured, different coloured, rough surface, high hairy and green or purple shoulder coloured and mechanically damaged roots are discarded.

Main method of seed production of carrot in India:

In carrot, *Mother Root to Seed Method* is followed for seed production due to less attack of root rot disease in transplanted roots. The carrot roots with self core colour are only planted, keeping the crown exposed. Seed production through mother root to seed method has two stages i.e. (A) Mother seed production stage and (B) Seed production stage

A. Mother root production stage-A initial step of first season: Carrot seeds are sown in first season to produce mother roots which is called stecklings. The procedure of stecklings production is given here.

- Preparation of land:* Frequent pulverization of soil is essential for carrot field. It is achieved by tith of soil through continuous deep ploughing, harrowing followed by leveling. Carrot crop requires deep, loose soil for better development of their roots.

ii. Fertilizer and manure requirement:

- Apply 15-20 tonnes well decomposed farm yard manure per hectare into soil and mix well before sowing.
- At the time of sowing add 40-50 Kg phosphorus and potash per hectare.
- In standing crop of carrot add 75-100 Kg ammonium sulphate per hectare, one or two times after weeding.

iii. Source of seed: Seed (Nucleus/Breeder's/Foundation) must obtained from a source approved by seed certification agency.

iv. Seed rate: Seed rate of 8-10 Kg is enough for sowing of one hectare land. The carrot's roots produced from one hectare land are sufficient for transplanting of 3-4 hectare land under seed production.

v. Time of sowing: The sowing of seeds of carrot seed depend on suitable climate conditions and duration of variety. The suitable time of carrot sowing is mid July to mid August.

vi. Method of seed sowing and spacing: Seed sowing on double row ridge is best method for proper root development of roots of carrot than flat method.

- For this, double row ridge of 75 cm are made.
- Seeds are treated with Thiram /Capton/ Carbendazim @ of 2 gm /Kg seeds. Seeds are sown in line by using hand and covered by soil.
- Just after sowing of seed, field is irrigated to keep soil moist till germination. Seed germinate in 7-8 days.
- Thinning is also essential for proper growth and maintains a distance of 6-7 cm between plant to plant on a plant height of 5-6 cm.

vii. Irrigation: Irrigate field at an interval of 8-10 days as per moisture condition of soil.

viii. Intercultural operations: In the early stages of soil, weeding and hoeing should frequently be done. Carrot requires 2-3 hoeing for effective weed control. One earthing up by end of September, or early October will keep the crop clean till the close of autumn, when it is uprooted for planting.

ix. Plant protection: Spray Rogor 30 EC .05% solution for control of carrot weevil, spotted leaf hopper and carrot rust fly.

x. Harvesting of roots: Uproot the plants, when they have fully developed roots.

xi. Selection of roots for transplanting:

Selection of roots for transplanting is made on basis of :-

- Character of tops (short or heavy)
- Colour of skin (red/purple/black/creamy)
- Colour of shoulder (greenish is discarded)

- Shape and size of roots
- The colour of flesh, colour and size of the core are most important characters to be considered.
- The core (xylem) should be very small and self core colour.
- The core should be same colour as the flesh (phloem).

B. Mother Root to Seed Production Stage-Second season (Autumn season)

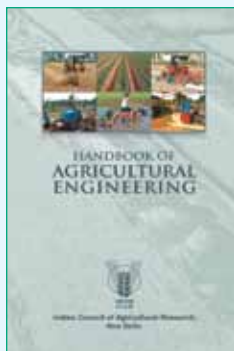
- Preparation of land:* Land should be prepared by repeated ploughing, harrowing followed by leveling.
- Selection of roots (Steckling preparation):* It is very significant and crucial stage for producing genetically pure and high quality seed. Root of carrot become ready for steckling preparation in 90 days. Mother roots raised in an acre (0.25 hectare) are sufficient to plant four acre (1 hectare) of seed production. Roots should be true to type and carefully selection should be done on the basis of uniformity in shape, size and colour. Carrot roots with similar to core colour (self core) are selected. After selecting true to type roots, steckling are prepared by chopping off 3/4th of the root and 2/3rd of the leaf portion. This facilitates better establishment of steckling, leading to more number and better shoot growth for obtaining higher seed yield.
- Method of transplanting of steckling and spacing:* Generally transplanting of roots for seed

production is made on flat plot. The roots of carrot are transplanted at a distance of 75 cm from row to row and 30 cm from plant to plant.

- Intercultural operation:* One weeding during March and another hoeing and earthing up during April-May is required.
- Rouging:* Rouging should be made at bloom stage. Early bolting type and off type plants should be removed.
- Harvesting:* Seeds of carrot are harvested by handpicking. The best time for harvesting is when the secondary umbels are fully ripe (turn completely brown) and tertiary umbels begin to turn brown. Generally harvesting should start when 60-70% seeds become brown. Since carrot crop ripens unevenly. So, 2-3 handpicking should be made.
- Threshing:* After sun drying, the heads are threshed and cleaned. After cleaning, the seed is rubbed by hand to remove the brittles on the surface and graded by means of sifters and sieves.
- Seed yield:* The seed yield per hectare is 500-600 Kg.
- Storage:* Store the seed at 8% moisture content.

For further interaction, please write to:

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TECHNICAL SPECIFICATIONS

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