

Enhancement of Farmer's Income by Seed Production of Open Pollinated Varieties of Carrot

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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. 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. Timely availability of good quality seed is crucial for food security of increasing population of India. The response of all other inputs depends on improved seeds to a large extent and it can be further raised up to 45 per cent with efficient management of other inputs. So, it is essential to replace the poor quality seed by using quality seeds of high yielding varieties. 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 farmers himself can produce these varieties seeds in less efforts by repeatedly sowing seeds of them. Open pollinated varieties are also less infested by diseases due to a little undetected variation between plants in the field in comparison to genetically identically 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.



Figure: Umbel initiation and seed formation in carrot

Important Indian varieties of carrot, their novel and distinguish characteristics are as follows:

- (1) **Pusa Rudhira:** Developed by ICAR-IARI, New Delhi. Roots have dark red in color with self core, 27 cm long and 3.4 cm diameter. Leaves color is dark and green. Plant height is about 65 cm with late bolting. Average root yield is 230q/ha which is 50% higher yield over national check Pusa Kesar. Suitable for growing in NCR region.
- (2) **Pusa Kesar:** Roots are rich in carotene and have deep red in color. Self core with small deep red in color. Period of roots maturity is about 80-90 days after sowing. Average root yield is about 300q/ha. Suitable for cultivation in all over India.
- (3) **Pusa Meghali:** It has short tops with smooth roots, orange flesh, self colored 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.
- (4) **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 color core with 26 length and 3.2cm diameter. Fresh carrots are suitable for making pickles, salad, juice, and kanji. Leaves show dark green color while petioles show purple color. Average yield of it is 300 q/ha. Gives more than 30% higher yield over national check Pusa Kesar. Suitable for growing in NCR.
- (5) **Pusa Yamdagni:** It is temperate type variety of carrot. Roots attain edible maturity 90-100 days. Roots are orange in color with self colored core, slightly tapering or semi stumpy with medium tops, rich in carotene. Root yield is 120 q/ha. Recommended for cultivation all over India.

- (6) **Pusa Vrishti:** Developed by ICAR-IARI, New Delhi. It is a new heat tolerant tropical carrot variety. It is suitable for early sowing from July under North Indian plains. Roots attain maturity in about 85-90 days. Average yield 250 q/ha. Suitable for cultivation in NCR.
- (7) **Selection 223:** Developed by PAU, Ludhiana. Roots are orange in color with light orange flesh.
- (8) **No. 29:** Developed by PAU, Ludhiana. Roots are long tapering and light red in color.

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.

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.

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

Table: Isolation distance (in m)

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

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 and flower color from the characteristics of the variety. Bolting type of plants to be removed from seed to mother root phase and early bolting type of plants during mother root to seed phase.

- Remove diseased and insect pests infected plants and blunted type plants.
- After uprooting roots at maturity stage, select only true to type roots on the basis of root shape, size, color and discard rest forked, cracked, light colored, different colored, rough surface, high hairy and green or purple shoulder colored and mechanically damaged roots.

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. Carrot roots with self core color are only planted, keeping the crown exposed. Seed production through mother root to seed method has two stages:

(A) Mother root production stage- 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 as follows:

- (i) 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 require deep, loose soil for better development of their roots.
- (ii) Fertilizer and manure requirement:**
 - Apply 15-20 tones 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 obtain from a source approved by seed certification agency.
- (iv) Seed rate:** Seed rate of 8-10 Kg vary on seed size 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.
 - Treat seeds with Thiram /Captan/Carbendezim @ of 2 gm /Kg seeds. Seeds are sown in line by using hand and covered by soil.
 - Just after sowing of seed, irrigate field to keep soil moist till germination. Seeds get germinated 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.
- (viii) **Intercultural operations:** In the early stages, weeding and hoeing should be done frequently. 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.
- (ix) **Plant protection:** Spray Rogor 30 EC 0.05% 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:-
- Character of tops (short or heavy)
 - Color of skin (red/purple/black/creamy)
 - Color of shoulder (discard greenish ones)
 - Shape and size of roots
 - The color of flesh, color and size of the core are most important characters to be considered.
 - The core (xylem) should be very small and self core color.
 - The core should have same color as the flesh (phloem).
- (B) **Mother Root to Seed Production Stage-** Second season (Autumn season)
- (i) **Preparation of land:** Land should be prepared by repeated ploughing, harrowing followed by leveling.
- (ii) **Selection of roots (Steckling preparation):** It is very 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 selection should be done on the basis of uniformity in shape, size and color. After selecting true to type roots, stecklings 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.

- (iii) **Method of transplanting of steckling and spacing:** The roots of carrot are transplanted at a distance of 75 cm from row to row and 30 cm from plant to plant.
- (iv) **Intercultural operation:** One weeding during March and another hoeing and earthing up during April-May is required.
- (v) **Rouging:** Rouging should be done at bloom stage. Early bolting type and off type plants should be removed.
- (vi) **Harvesting:** Harvest the seeds manually. The best time for harvesting is when the secondary umbels are fully ripe (turn completely brown) and tertiary umbels begin to turn brown. Start harvesting when 60-70% seeds turn brown. Since carrot crop ripens unevenly. So, 2-3 pickings should be done.
- (vii) **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.
- (viii) **Seed yield:** The seed yield per hectare is 500-600 Kg.
- (ix) **Storage:** Store the seed on 8% moisture content.