भाकृअनुप
ICAR

Indian Farming

APRIL 2012

- Groundnut – an oilseed crop rich in nutritional and medicinal properties
- Livestock based integrated farming systems

Indian Farming **62**(1): 9–11, 14, April 2012

Breeder seed production

of pistillate castor line DPC 9 – A Case Study

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The identification of completely pistillate plants and presence of exploitable heterosis paves the way for systematic research efforts on hybrid castor in India. The ICAR launched a project on hybrid castor and so far 12 hybrids were released for commercial cultivation. The production of hybrid castor is quite beneficial proposition. Hence, the production and supply of high quality seeds of parental pistillate lines assumes importance to meet the increasing demand of quality hybrid seeds.

SEED production in castor requires highly skilled and specialized process because of the characteristic breeding system and complexity of sex mechanism it has. India was the first country to exploit hybrid vigour on commercial scale. So far, 12 hybrids have been released for commercial cultivation. All the hybrids were released based on 2-line breeding system where female line has an environmentally-sensitive pistillate mechanism. Hence, the maintenance of pistillate mechanism requires specialized skills. The ultimate yield and returns to seed producers and the quality of hybrid seed supplied to the commercial castor growers and the success of hybrid seed production programme depend on a number of factors, namely the source of parental seed used, method of maintenance and multiplication employed for producing nucleus, breeder and foundation seed under specific situations or season under which the production is taken up and the extent of recovery of stable pistillate plants in seed production plots. In Gujarat, where, castor seed production is highly organized, a large number of foundation and certified seed plots are sometimes far less than what is expected. Poor isolation and/or impure parental seed, particularly those of the female pistillate lines leading to a high proportion of monoecious plants and early reverts

DPC-9 female castor breeder seed production plot at Gujarat.

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Interspersed male flowers

Non-spiny (off type)

Monoecious plant (Off-type)

owing to moisture stress, defective and incomplete rouging are the major problems. Hence, the production of highly genetically pure female pistillate parental seed is most important.

In conventional methodology of female seed production, pistillate line is maintained by allowing the 20-25% population of monoecious plants of female as the pollen source and harvesting the seeds only from the pistillate plants for seed purpose. In this process, the progeny of the seed thus produced exhibited a large proportion of monoecious plants in the seed production plots. Hence, the Directorate of Oilseeds Research, Hyderabad and Sardar Krushinagar Agricultural University, Dantiwada suggested a modified method of seed production for production of seeds of high genetic purity with very high proportion of pistillate plants. The following are the method designed for producing breeder seed female parents in castor (Conventional and modified methods).

Conventional method

- As per the prevailing standards, 20-25% monoecious plants are allowed in seed production plots to ensure adequate pollen supply to pistillate plants.
- Prior to flower opening in primary raceme (at least 2-3 days), remove all deviants from diagnostic characters especially node number up to primary raceme, nature of internodes, bloom, leaf shape, etc.
- At flower opening in primary raceme, identify pistillate plants conforming to diagnostic morphological characteristics of the female line and tag them at the base of primary raceme with red or any colour thread.
- Examine all monoecists and rogue-out those which have exclusively male flowers beyond three whorls from the base of the spike.
- Plants with interspersed staminate flowers, if any should be retained subject to the condition that the retained plants fulfill all other prescribed standards.
- Count the ultimate number of female and male plants in each row and remove the monoecious plants over and above the stipulated percentage.
- Examine the labeled or tagged female plants regularly for possible reversion to monoecism in secondary, tertiary and quarternary order racemes. Remove the tag as and when the female plant reverts to monoecism up to 4th sequential order of the branches.
- On maturity, harvest the female plants bearing the tags and keep a picking-wise seed in separate lots after proper drying, packing and labeling.

Modified method

- Unlike in the conventional method, rogue-out all monoecious at least 2 to 3 days earlier to flowering in the primary raceme.
- Verify individual female plants for various morphological characters particularly the number of nodes up to primary raceme.
- Most of the female flowers on primary raceme fail to set fruits consequent to non-availability of pollen.
- A host interspersed late male flowers however, sprout on primary as well as subsequent order raceme in about 35 to 50%

female population which provides sufficient pollens for the later developed female flowers on same raceme as well as later sequential order racemes.

- Observe all plants regularly for any reversion to monoecism up to 4th order raceme and rogue-out the off-types. However, the pistillate plants reverting to monoecism in 5th sequential order onwards can be allowed in the population as supplement pollen source.
- Collect the seeds from all female plants and keep the picking-wise seed lots separately after proper drying and labeling.

Case study

A case study conducted using the modified method of pistillate parent castor seed production of DCP-9 at Directorate of Medicinal and Aromatic Plants Research, Anand is described below:

DPC-9 is the female of the notified castor hybrid DCH 177 was multiplied with proper isolation. The breeder seed stage I of the female parent DPC-9 was received from Directorate of Oilseeds Research, Hyderabad for the breeder seed production plot sowing in an area of 0.64 ha was taken up during March 2007. The spacing followed was 120 cm between rows and 45 cm between plants. The recommended N, P, K at the rate of 80:60:0 was applied. Initially the crop was irrigated once in 10 days, later the irrigation was done as and when required based on the available soil moisture conditions.

Isolation

Castor seed production is entirely a cross-pollination process and it is absolutely essential to avoid undesirable pollen in seed production. The extent of cross pollination mainly depends on the direction and velocity of wind which mainly influences the pollen dispersal. However, on rainy days pollen movement/dispersal is greatly reduced. Besides wind, honeybees, butterflies, moths etc. also play an active role in pollen dispersal and result in variable levels of outcrossing leading to contamination during hybrid seed production. The statutory isolation distance required for breeder seed production of parental pistillate seed production is 1000 m or more. In the breeder seed plot, an isolation of >1,000 m was maintained.

Roguing

To ensure high genetic purity of female DPC-9 seed, it is essential to remove the off-types and volunteer plants as soon they are noticed. First two rounds of rouging were done for off types based on morphological characters like stem colour, inter-node type, leaf shape, bloom, node up to primary raceme, sex expression, branching etc. Based on the inspection of primary raceme, all the monoecious plants were pulled out before flower opening. Further, every female plant was inspected regularly for any possible reversion to monoecism at secondary and tertiary orders and all such plants removed and destroyed as soon as detected. This process continued every day till all the plants of DPC-9 commenced flowering up to the tertiary order.

The types and total number of off-types removed from breeder seed production plot is presented in Table 1.

Table 1. Types and number of off-types removed (Total plant population was 16065)

Types	No. of plants removed	Off-types (%)
Red colour stem	2	0.01
Red colour stem (long internode)	2	0.01
Tall plants with longer internode (green stem and open type leaves)	9	0.06
Double bloom	96	0.60
Monoecious racemes in the primary order racemes	940	5.85
Monoecious racemes in the secondary order	301	1.7
Monoecious racemes in the tertiary order	33	0.20
None spiny capsules	2	0.01
Total Off-type plants		8.44%

Monitoring

The breeder seed plot was monitored by the breeders from Directorate of Medicinal and Aromatic Plants and Directorate of Oilseeds Research, Hyderabad. The monitoring team was satisfied with the genetic purity of the crop, isolation and condition of the crop.

Harvesting, threshing and processing

The harvesting of individual spikes was done when the capsule colour changed from green to yellowish-brown and a few capsules of the spike started drying. The premature harvesting was avoided since that may result in poor germinability and delayed harvesting leading to shattering of dried capsules. The harvested seed was dried and stored in gunny bags in separate lots where no other castor seed was stored and labeled inside and outside. The seeds were cleaned, graded and packed. From 0.64 ha a total of 149 kg of quality seeds were obtained after cleaning and grading.

Grow-out test

The grow-out test was done at DOR, Hyderabad. The genetic purity of each seed lot is confirmed by following appropriate testing procedure and seeds had more than 96% genetic purity.

Economics of Pistillate DPC-9 female breeder seed production

An expenditure of ₹ 18429 was incurred. A total income of ₹ 22350 was obtained as per present rate of ₹ 150 kg. Hence, a net profit of ₹ 3921 was obtained from the present seed production plot (0.64 ha). When compared with the conventional seed production, the

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