



# Indian Farming

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# Hybrid seed production of castor hybrid 'DCH 177': A case study

**P Manivel<sup>1</sup>, A P Trivedi<sup>2</sup>, Vipin Chaudhary<sup>3</sup> And A J Prabakaran<sup>4</sup>**

*Directorate of Medicinal and Aromatic Plants Research, Boriavi, Anand, Gujarat 362 001*

*After introduction of the exotico pistillate line from Texas, USA namely TSP-10R, India initiated systematic research work on development of hybrid castor. The ICAR launched a project on hybrid castor in nineties and so far 12 castor hybrids have been released for commercial cultivation in India. The hybrid 'DCH 177' ('Deepak') was released by Directorate of Oilseeds Research (DOR), Hyderabad in 2000 and suitable for cultivation in rainfed areas of hot semi-arid Deccan plateau (Andhra Pradesh, Tamil Nadu and Karnataka) and irrigated areas of Maharashtra and Gujarat. This hybrid is produced by hybridization between the female parent 'DPC 9' and the male parent 'DCS 9'. The successful hybrid seed production of 'DCH 177' which was taken up at the Directorate of Medicinal and Aromatic Plants Research (DMAPR), Anand is reported in this article.*

**C**ASTOR is an important non-edible oil crop which has variety of uses from cosmetics to lubricants in jet engines and rockets. India is the leading producer of castor and is the first country in the world to exploit hybrid vigour on commercial scale. So far 12 castor hybrids have been released for commercial cultivation in India (Table 1). Among them the castor hybrid 'DCH 177' was developed and released during 2000 by Directorate of Oilseeds Research, Hyderabad for commercial cultivation in rainfed areas of Deccan plateau and irrigated area of Maharashtra and Gujarat. This hybrid involves 'DPC 9' as female parent and 'DCS 9' as male parent.

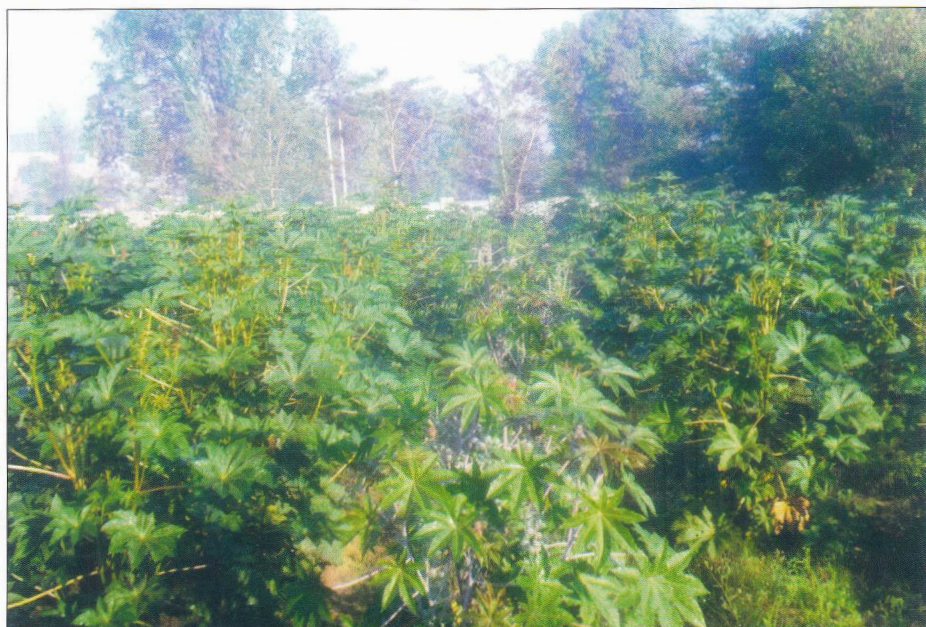
A case study on the hybrid seed production of 'DCH 177' taken at Directorate of Medicinal and Aromatic Plants Research, Anand is described below.

**Choice of field:** To have

maximum production, medium to deep sandy loam and heavy loams free from volunteer plants (castor plants from previous season's crop) are ideally suited for seed production. The soil of the experimental plot was sandy loam with good drainage and well suited for cultivation of castor.

The availability of assured irrigation throughout the crop growth period more particularly critical phase of crop growth, viz. primordial initiation and flowering in different sequential order branches. There was adequate irrigation facility for successful rising of castor crop in the farm.

'DCH 177' hybrid castor seed production plot at the DMAPR, Anand



<sup>1</sup>Principal Scientist, <sup>2</sup> Technical Officer, <sup>3</sup>Senior Scientist; <sup>4</sup>Principal Scientist, Directorate of Oilseeds Research, Hyderabad, Andhra Pradesh

**Isolation:** Castor is a highly cross-pollinated crop. The extent of cross-pollination mainly depends on the direction and velocity of wind which is the primary source of pollen dispersal. Besides wind, insects like honey bees, butterflies, moths etc. also play a role in pollen dispersal and result in increased out crossing leading to contamination of hybrid seed. The statutory isolation distance required for certified hybrid seed production of hybrid castor is 150 m. However, it was recommended 600 m as isolation distance for successful hybrid seed production with high purity. The hybrid seed production plot had an isolation distance of more than 1000 m around all the sides.

**Land preparation:** For good growth, castor requires fine tilth up to a depth of 45 cm. Hence, a deep summer ploughing was undertaken to break the hard pan of sub-soil, and will also help in better root penetration besides controlling weeds. The experimental land was ploughed well with disc plough and followed by the power tiller for a proper tilth. The planking was done and bunds were formed.

**Sowing time and season:** Time of planting has profound influence on sex expression in castor. While summer and *kharif* seasons provide ideal male promoting environment for undertaking seed production of male and female parents of hybrids and *rabi* (winter) is the most ideal season for taking up hybrid seed production as it is most conducive for production of female flowers. To get high yield in hybrid seed production of castor, August-September for western and northern states and September second fortnight for southern states are well suited dates for sowing. Sowing was done in the second fortnight of September 2008. The seeds of both 'DPC 9' and 'DCS 9' were received from Directorate of Oilseeds Research, Hyderabad for hybrid seed production plot. The sowing was taken up in an area of

1.0 ha of land.

**Row ratio and planting pattern:** The ratio of seed parent to pollen parent, spacing and direction of planting have distinct effect on hybrid seed yield. Normally, in hybrid seed production of castor, 3 females : 1 male with males in two rows all around the seed production plot. However, this ratio may vary from region to region, depending upon the weather condition, management and morphological features of parental lines. In this study adopted recommended row ratio, i.e. three rows of female parents ('DPC 9') surrounded by one row of male parent ('DCS 9') on either side (3:1) and two rows of males surrounded all around the field was done.

**Spacing and method of sowing:** Adoption of fairly wide spacing is suggested irrespective of stage of seed production for promoting maximum expression of genotypes and reaping full benefits. It is advisable to start with high initial population than what is recommended and later adjust the intra-row spacing at the time of rouging (30 to 70 days after planting) which coincides with flower initiation in the primary raceme. In the region, the recommended spacing for castor hybrid seeds production is 90 cm × 60 cm. However, with a view to do the intercultural operation using mini-tractor a spacing of 120 cm between rows and 60 cm between plants was adopted. The seeds were dibbled to a depth of 4 to 5 cm, covered with soil and to obtain better germination.

**Irrigation and nutrient management:** In general, the number and intensity of irrigation depends on soil type, its water holding capacity and crop season. It is advised that the moisture stress should be avoided during primordial initiation in various sequential orders. Otherwise, it leads to production of more male flowers in male and reversion of pistillate to monoecious in female lines. In the seed production plot,

irrigation was done immediately after sowing and the seeds germinated after 7-10 days after sowing. Initially the crop was irrigated at the time of sowing and 10 days after sowing, later the irrigation was done as and when required based on the available soil moisture conditions. Two hoeing, on 30 and 84 days after sowing were done. Two weedings were done during first week of November and last week of December 2008.

Nutritional requirement of seed production plots depends on soil, specific variety and parental material chosen for seed production. The recommended N, P, K at the rate of 80:50:0 was applied, of which 40 kg N as basal and remaining 40 kg N was applied at 90 days after sowing.

**Rouging:** To ensure high genetic purity of hybrid seed, it is essential to remove the off-types and volunteer plants from the female and male rows as soon as they are noticed. The details of rouging and the type of off types observed are presented in the Table 2.

**From male parental lines (DCS 9):** For male parents two rounds of rouging were done: first about 10 days prior to flowering and the second one coinciding with flowering.

- Looked for deviants if any for various diagnostic morphological characteristics like stem colour, inter-node type, shape of leaves, bloom characteristics in relation to the parameters specified for male parent and remove them.
- Since the flower initiation extended over a period of 10 to 15 days, carried out second round of rouging for three to five round at intervals of two to three days to avoid any possible leftovers.

**From the female lines ('DPC 9'):** First two rounds of rouging was 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. Further every female plant was inspected

regularly for any possible reversion to monoecism at secondary and tertiary orders and all such plants were pulled out and destroyed as soon as detected. This process continued every day till all the plants in female rows commence flowering. Since, it is not necessary to remove the whole plant if the reversion to monoecism occurs after tertiary and higher orders, the specific spike is pulled out well before anthesis and throw beyond the permissible isolation distance to avoid contamination. Otherwise, it may serve as pollen source to other pistillate racemes and result in reduced per cent of hybrid in certified seed production plot.

**Synchronization:** Synchronization of flowering of seed and pollen parents ensures higher seed production. However, in most of the hybrid combinations the parental lines differ in growth duration. The synchronization of flowering was obtained by the following method.

**Seeding interval:** Since the male and female parents are differing in their growth duration, the female line 'DPC 9' was sown first and the male parent 'DCS 9' was sown 1 week later and they came to flowering at the same time and hybrid seed was produced.

**Monitoring:** The seed plot production was regularly monitored by the seed production team at the DMAPR. The breeder from DOR, Hyderabad also visited and monitored the seed production plot during flowering and pod formation stage and satisfied with the genetic standard of the crop, isolation distance and general condition of the crop.

**Harvesting, threshing and processing:** To keep high purity, utmost care was taken while harvesting the hybrid seed and pollen parent lines. The change of capsule colour from green to yellowish brown and drying of few capsules in the spike is an indication of maturity of whole spike and found to be ideal

**Table 1.** Salient features of the released hybrids of castor in India

Hybrid	Female parent	Male parent	Year of release	Yield (Kg/ha)	Suitable area
'GAUCH 1'	'VP'	'GAUC-1'	1973	1,520	Irrigated areas of Gujarat and rainfed areas of Southern India
'GCH 2'	'VP'	'JI'	1985	1,750	Irrigated areas of Gujarat
'GCH 4'	'VP'	'48-1'	1993	2,230	Dry as well as irrigated conditions; under sandy loam, red and black soils of Karnataka
'GCH 5'	'Geetha'	'SH 72'	1996	2,500	Irrigated areas of Rajasthan and Gujarat
'DCH-32'	'LRES 17'	'DCS 5'	1998	1,800 (RF) 2,800 (I)	Rainfed areas of hot semi-arid Deccan plateau (Andhra Pradesh, Tamil Nadu and Karnataka) and irrigated areas of Maharashtra
'GCH-6' (JHB 665)	'JP 65'	'JI 96'	1999	1,398 (RF) 2323 (I)	Irrigated castor growing areas of Gujarat, Maharashtra and Rajasthan
'PCH 1'	'VP-1'	'PCS 124'	1999	2,000 (RF)	Rainfed areas of AP
'TMVCH 1'	'LRES 17'	'TMV 5'	1999	1,403	Suited to both pure and intercropping situations of Salem, Namakkal, Erode and parts of Trichy and Pudukottai district in Tamil Nadu during <i>kharif</i> season
'DCH 177'	'DPC 9'	'DCS 9'	2000	1,500 (RF) 2,000 (I)	Rainfed areas of hot semi-arid Deccan plateau (AP, TN and Karnataka) and irrigated areas of Maharashtra
'RHC-1'	'VP 1'	'TMY 5-1'	2002	1,200 (RF) 2,000 (i)	Rainfed areas of AP, Tamil Nadu, Orissa, irrigated areas of Rajasthan and Maharashtra
'DCH 519'	'M 574'	'DCS 78'	2006	1,736	All India, matures in 105-110 days and has resistance to <i>Fusarium wilt</i> and leaf hoppers.
'GCH 7'	'SKP 84'	'SKI 215'	2007	3,500	Gujarat. Resistance to wild and tolerance to white fly, jassids, thrips.

I, Irrigated; RF, rainfed

**Table 2.** Type and frequency of off-types observed in 'DCH 177' castor hybrid seed production plot at DMAP, Anand (total population 16065 female plants)

Character	Off type	Number of plants observed	% off type
From female parent			
Stem colour and bloom	Green stem (VP-1 type) zero bloom	28	0.17%
	Red stem 0 bloom	16	0.09%
	Red stem 1 bloom	29	0.18%
Inflorescence	Monoecious in the primary raceme/spike	52	0.32%
	Converted monoecious in the secondary spike/raceme	23	0.14%
	Converted to monoecious in the tertiary spike/ raceme	20	0.12%
Spike/Capsule	Non spiny	2	0.01%
Total off-type (%)			1.03%
From male parent			
	Nil		

stage for harvesting. The pollen parent and seed parent were harvested separately and threshing was also done separately in the separate

threshing floor. Harvested hybrid seeds from female parent are dried to permissible moisture level and stored in a separate room where no other

castor seed was stored or kept. The seeds were then sent to the Directorate of Oilseeds Research, Hyderabad for further cleaning, grow-out-test, packing and dispatching.

**Grow-out test:** The grow-out test was done at the Directorate of Oilseeds Research, Hyderabad. The genetic purity of 96.25% was observed and only 3.75% female type plants in the hybrid progenies were obtained and it indicated that the hybrid seed produced were of high quality (minimum acceptable genetic purity for certified seed production is 85%).

#### General observations

- The seed plot was in good condition. However the seed setting was poor in the tertiary and fourth order, as might be due to the low flower availability in the male during this period.
- There were little more ill-filled seeds in the female line than male lines and that reduced the hybrid seed yield considerably.

#### Economics of hybrid seed

**production:** In general the production of hybrid castor is a beneficial proposition. A total of 540 kg of hybrid seeds (from female parent) was obtained and were sent to DOR, Hyderabad. After final cleaning and sieving, 434 kg of good quality hybrid seed was obtained. Also 285 kg of seeds from the male parent 'DCS 9' was obtained and sold @ Rs. 30 per kg which got Rs

**Table 3.** Morphological characters of male and female parents of 'DCH 177'

Character	'DPC 9' (Female)	'DCS 9' (Male)
Growth habit	Normal, medium	Normal, medium
Stem colour	Green	Red
Bloom	Zero	Double
Growth habit	Normal	Normal
Branching	Divergent	Divergent
Number of nodes up to primary raceme		
Range	9-12	10
Mean	8-10	9
Nature of internodes	Elongated	Medium
Leaf shape	Flat	Flat, anthocyanin pigmentation on the young leaves and hypocotyls
Nature of spike	Compact	Conical spike with cam pact arrangement of capsules
Nature of capsule	Spiny	Green and spiny
Sex expression	Monoecious	Dioecious
Seed size	Medium bold	Medium bold brown seeds
1000-seed weight (g)	256.5	290.0 g
Oil content (%)	48.5	48.5%
Maturity (first picking)	90-100	90-100 days
Resistant to major diseases	Resistant to Fusarium wilt	Resistant to Fusarium wilt
Resistant to major pests	Susceptible to leaf hoppers and capsule borers	

8,550. DOR has fixed the cost of hybrid seed as Rs 80 per kg and Rs 34,720 was obtained from hybrid seeds. Hence, the total income was of Rs. 43,270 from both hybrid seeds and male parent produce. An expenditure of Rs. 35,417 was incurred towards cost of cultivation (includes land preparation, seed cost, sowing, irrigation, roughing, manures, fertilizers, inter culture operations, plant protection measures, harvesting, threshing and cleaning). Hence, a net profit of Rs 7,854 was obtained from the present seed production plot.

#### SUMMARY

So far 12 castor hybrids have been released for commercial cultivation in India. Among them the castor hybrid 'DCH 177' was developed and released during 2000. A case study on the hybrid seed production of 'DCH 177' taken at Directorate of Medicinal and Aromatic Plants Research, Anand has been described. In general the production of hybrid castor is a good beneficial proposition. A total of 540 kg of hybrid seeds were obtained from 1 ha plot. A net profit of ₹ 7,854 was obtained from the seed production plot. ■

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Directorate of Information and Publications of Agriculture  
Indian Council of Agricultural Research  
Krishi Anusandhan Bhavan I,  
Pusa, New Delhi 110 012