

Agronomy – Kharif Crops

CASTOR

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CASTOR
Botanical name: *Ricinus communis* L.
Family: Euphorbiaceae
Chromosome number: 2n=20

Castor is one of the ancient and important industrial and non-edible oil crops of the world. It has the ability to grow under low rainfall and fertility conditions, and is most suitable for dryland farming. The oil content of the seeds varies from 50-55% in different varieties. The importance of oil arises from its richness (85-95%) of ricinolic acid. Castor oil is being used widely as a lubricant in high speed engines and aeroplanes, in manufacture of soaps, printing inks, varnishes, transparent paper, linoleum and plasticizers. It is also used for medicinal and lighting purposes. The oil cake is used as organic manures and plant stalks as fuel or as thatching material or for preparing paper pulp. Castor oil is also used as a purgative. In dyeing industries, it is used for preparation of 'Turkey red'.

Castor oil is used in many veterinary medicines. It is used externally as an emollient. It is also used as a soothing medium when dropped into the eyes of animals after removal of foreign bodies. In *eri* silk-producing areas, leaves are fed to *eri* worms. After extraction of oil, castor cake is valued as manure. It contains 6.4% N, 2.5% phosphoric acid and 1% K and some micronutrients. Castor is also valued for its anti-termite properties. The presence of ricin, and an allergen restrict its use as livestock feed.

Origin

Castor is believed to have most probably originated in Ethiopian-East African region. There are four centres of diversity for castor, viz. (1) Ethiopian-Eastern African, (2) North-West and South-West Asia and Arabian peninsular (3) Sub-continent of India and (4) China. In India castor is known from very early days and is referred in *Susruta Samhita* written over 2,000 years ago.

Botany

Castor is a tall branching perennial shrub growing to over 6 metre height. The cultivated types reach up to 1.0-1.5 m height. Leaves are large (10-60 cm across) and each leaf is divided into 7-9 triangular segments with toothed edges and conspicuous veins. The flowers are arranged on spikes in the forks of the upper branches with female flowers arranged at the top and male at the base. After pollination, female flowers develop into spiny fruits of 2.5 cm size across. Fruits have 3 segments, and each segment has a seed.





Castor Seed

Source: http://en.wikipedia.org/wiki/Castor_bean

Geographical Distribution

A native of Africa and Asia, and is now naturalized in Australia. It is abundantly seen along with courses and flood plains, disturbed or wasteland, and road sides. Castor cultivation confines to 40° latitude from equator on either side (N&S). India is the principal global

producer of castor followed by China and Brazil. The major castor producing countries of world are given in Table 1.

Table 1. Area, production and productivity of castor in producing countries of world (2004)

Country	Area (m ha)	Production (lakh tonnes)	Productivity (t/ha)
India	8.00	8.53	1.07
China	2.60	2.50	0.96
Brazil	1.65	1.28	0.78
World	13.48	13.09	0.97

Source: FAO Production Year Book, 2004

In the country during 2005-06, it is grown on 0.95 m ha with a production of 0.91 m tones. Of the total production, a 0.57, 0.16 and 0.15 m tonne is produced by Gujarat, Andhra Pradesh and Rajasthan respectively. Of the total castor oil production in the country (0.38 m tonnes) the domestic utilization is less than one third (0.12 m tonnes in 2005-06). The state-wise distribution for 2003-04 is given in Table 2

Table 2. Area, production and Productivity of castor in different states of India (2003-04)

State	Area (000, ha)	Production (000 t)	Productivity (kg/ha)
Andhra Prdaesh	291.0	132.0	454
Assam	1.5	0.6	400
Bihar	4.0	3.0	750
Gujarat	290.3	541.1	1864
Karnataka	17.0	14.0	824
Madhya Pradesh	1.1	0.4	364
Maharashtra	26.0	5.0	192
Orissa	17.7	8.6	486
Rajasthan	63.6	89.8	1412
Tamil Nadu	19.9	6.5	327
India	732.2	801	1094

Castor Zones in India

Castor growing areas fall into the following 5 zones in India.

1. Zone 1: Irrigated castor

Mehsana, Sabarkanta, Banaskantha and Kutch districts of north Gujarat and non-traditional areas of Sirohi and Pali districts of Rajasthan.

2. Zone 2: Rainfed castor

Telangana region of Andhra Pradesh comprising Nalgonda, Mahboobnagar, Ranga Reddy and Warangal districts; in non-traditional areas of Prakasam and Guntur coastal districts of Andhra Pradesh. Raichur, Chitradurga, Mandya, Mysore and Tumkur districts of Karnataka, Salem, Dharampuri, South and North Arcot districts of Tamilnadu; Korapur, Kalahandi, Dhenkanal and Ganjam districts of Orissa.

3. Zone 3:

River banks of Bhagalpur, Purnea and Munger districts of Bihar.

4. Zone 4:

Leafy and long duration perennial grown in backyards, wastelands and marginal lands for raising *eri* silkworm feeding in eastern India.

5. Zone 5:

On field bunds in coastal districts of Andhra Pradesh and Maharashtra, primarily as wind break.

Classification

Castor has a large number of cultivars or types. Papova (1930) divided the *Ricinus communis* into 6 sub-species on eco-geographical growing groups i.e. sub-species *africanus*; *chinensis*; *mexicianus*; *pericus*; *sanguineus* and *zanzibarinus*.

Climate

Castor is a hardy crop, and can be grown in wide range of climates of warm tropical regions with a rainfall of 250-750 mm. It performs best with moderate temperature (20-26°C) with low relative humidity and clear sunny days throughout the crop season. Areas with temperature > 40°C and <15°C are not conducive for castor cultivation. A frost free climate is a must for the crop. It can withstand drought also owing to deep root system and also due to light reflecting characteristics of stem and leaves that reduce heat load and improve survival under moisture stress. High rainfall at flowering and capsule formation stage is not conducive, as it promotes *botrytis* disease. Though the crop can not stand frost, but some annual cultivars can grow even at altitudes of 1200-2100 m, e.g., the Nilgiris, if sown in March-April. Perennial varieties are grown at still higher altitudes for shade in coffee estates.

Soil

Castor can be grown successfully on most of the soils except heavy clay and poorly drained soils. The soils with low water holding capacity (sandy soils) are also not suitable for castor cultivation. The soils with pH > 9.0 and < 4.0; EC > 4.0 dS/m and ESP > 20% are not suitable. Moderately fertile soils are preferred as high fertility induces excess vegetative growth, prolonged flowering and delayed to maturity, leading finally to poor yields.

In India, the soils where castor is grown with higher productivity include *chalka* (shallow) soils of Andhra Pradesh to deep sandy loams of Gujarat. In Orissa, Karnataka and Tamil Nadu, the soils are relatively deep. In the Malabar region of Kerala and South Kanara of Karnataka, it is cultivated in clayey rice fallows, while in Uttar Pradesh; it is raised in heavy loam soils. Castor is highly sensitive to soil salinity but genotypic variations are noticed in terms of salt tolerance and performance under salinity.

Land preparation

The slow initial growth coupled with its cultivation at wider row spacings calls for not only deep ploughing, but also a land preparation to arrest weed menace during cropping season. Hence, a deep summer ploughing is necessary for weed control and conserving moisture. This should be followed by 2-3 harrowings to break the clods and finally levelling of the field.

Seeds and Sowing

Seed rate and Spacing

The seed rate used for sowing behind the plough is 12 kg/ha. For hand dibbling, 8-10 kg/ha of seed will be sufficient. For intercropping, seed rate depends on sowing proportion of component crops.

The spacing varies with growth habit, duration of variety and time of sowing. Under rainfed conditions, early and medium duration cultivars are sown at a closer spacing of 90 cm x 45 cm as against wider spacing (90 cm x 60 cm) for long duration cultivars. However, narrow spacing (60 cm x 60 cm) is necessary for realizing higher yields under late sown situation. Under irrigated conditions also, 90 cm x 60 cm spacings are suitable. In Gujarat, long duration (10 months) crop with profuse branching and lateral spread are used and 180 cm x 180 cm is followed for higher yields (up to 6 t/ha). This wider spacing is also known to prevent *botrytis* grey rot incidence.

Before sowing, castor seed should be treated with thiram or agrosan GN @ 3 g/kg seed to prevent the incidence of root-rot and *Alternaria* blight. Seed treatment with carbendazim + *Tricoderma* at 10 g/kg seed + soil application of *Tricoderma* has been found most effective in preventing castor wilt. FYM and neem cake applications and seed treatment with *Tricoderma viridi* have also proved effective in reducing the incidence of *Alternaria* blight.

Time of Sowing

Time of sowing depends on the onset of monsoon. Generally the crop is sown during June-July. In Andhra Pradesh, optimum time of sowing is from second half of June to mid July. Owing to red hairy caterpillar menace in early sown crop, farmers usually sow the crop in July in this region. However, with the development of effective management technology for this pest, June sowings are increasingly adopted. In Karnataka, *kharif* castor is sown in April. In Gujarat, first fortnight of July is optimum for *kharif*, while for *rabi* crop, it varies from September-October. *Rabi* crop should be done sown when the soil temperatures are greater than 12°C.

Method of sowing

Castor is sown by dropping the seeds behind the plough under rainfed conditions. The method is followed in Andhra Pradesh and requires higher seed rate (12-15 kg/ha). However, under irrigated conditions, seeds are dibbled at required spacings. This is adopted in Gujarat. Owing to its epigeal mode of germination, seedling emergence is not a problem. In light soils, under rainfed conditions, deep sowing (8-10 cm depth) is preferred, while under irrigated situation and heavy soils, shallow sowings (6-8 cm) are ideal.

Varieties

The varieties of castor recommended for different states of India are given below.

Varieties and hybrids of castor recommended for different states

State	Variety	Hybrid
Andhra Pradesh	Aruna, Bhagya, Sowbhagya, Kranti (PCS-4), Jwala, DCS-9 (Jyothi), Kiran (PCS-136), Haritha (PCS-124)	
Uttar Pradesh	Kalpi-6, T-3, T-4	
Gujarat	GAUC-1, VI-9, S-20, J-1	CH-1, GCH-2, GCH-3, GCH-6, SHB-145, GCH-7
Tamil Nadu	TMV-1, TMV-2, TMV-3, TMV-5, SA-1, SA-2, TMV-4, Jyothi, CO-1	TNAUCH-1
Karnataka	Jwala (48-1), RC-8, Jyothi	
Maharashtra	AKC-1, Girija	GCH-6
Rajasthan		GCH-6, RHC-1
Haryana		CH-1
Punjab	Pb. No.1	
For all States	Gujarat castor-2	DCH-32 (Deepti) DCH-177 (Deepak) GCH-4, GCH-5, DCH 519

Recently released varieties / hybrids

DCH 519: A hybrid (M 574 x DCS 78) released for both irrigated and rainfed conditions for entire country in 2006 with a yield of 1.5 and 2.0 t/ha respectively. This variety is spiny with triple bloom and is resistant to *Fusarium* wilt.

GCH 7: A hybrid (SKP 84 x SKI 215) released for Gujarat for irrigated conditions with 2.45 t/ha yield and is resistant to nematode and wilt complex

Manures and Fertilizers

Hybrids and irrigated crop require more fertilizers than a variety and rainfed crop. Among organic manures, 15-20 t/ha of FYM application is desirable both under rainfed and irrigated conditions for moisture conservation besides supply of nutrients. The recommended dose of fertilizers under rainfed conditions is 40:40 kg/ha of N:P₂O₅. All the P along with 50% N is applied at the time of sowing at the last harrowing. The remaining N is top-dressed after first weeding 30 DAS. Under irrigated conditions, 40 kg/ha each of P₂O₅ and K₂O and a higher dose of N (150 kg/ha) may be required. The N is applied in 3 equal splits at sowing, first

hoeing and pre-flowering stages. Among sources of P, single superphosphate is preferred as it supplies Ca and S also.

Water management

Castor though can tolerate moisture stress, but responds well to irrigation. The crop performance is poor, when the crop experiences moisture stress from seedling to flowering stages. Hence, under irrigated conditions, 2-3 irrigations are given during this critical period. If only one irrigation is available, it should be given at flowering stage. Irrigations should not given during maturity stage, as it results not only in delayed maturity, but also new vegetative growth. In periods of high rainfall, provision of drainage is highly essential.

Weed management

The initial 50-60 days after sowing (DAS) is critical period of crop-weed competition. After a thorough and deep land preparation, the crop requires 2 hoeings either manual or mechanical 25 and 50 days after sowing. Pre-plant incorporation of fluchloralin or pre-emergence application of pendimethalin @ 1 kg/ha is effective in controlling grasses as well as broad-leaved weeds. The above herbicides integrated with one hoeing 50 DAS may provide most satisfactory weed control in castor.

Cropping Systems

Castor being a tall statured crop, finds place as shade crop for turmeric and also in coffee estates. It is also grown as trap crop for pests. Castor is grown as a sole crop in rotation with wheat and linseed, and also grown mixed with cotton, groundnut, pigeonpea, greengram, sorghum, pearl millet and cowpea.

Intercropping of castor with pigeonpea reducing the incidence of *Spodoptra litura*. Intercropping with groundnut in 1:2 row proportion gives higher net returns under Kerala conditions.

Harvesting and Threshing

It takes about 145-280 days to mature. Harvesting is done when capsules turn yellowish. However, all the spikes do not mature at the same time. The central spike on the main rachies mature first, and thereafter the spikes on the side branches start maturing. Therefore, 2-3 pickings may be needed for harvesting the crop. The spikes should be dried in the sun for 4-5 days and then threshed.

Yield

Depending upon the agro-climatic conditions and crop management practices adopted, the improved hybrids/varieties may yield 2.0-2.5 tonnes of seed/ha. The oil to seeds crushed is 37% and cake to seeds crushed is 63%.

The yield attributes (range) of castor is as below.

Attribute	Value
<i>Capsules/plant</i>	80-120
<i>Seeds/capsule</i>	3
<i>1,000 seed weight (g)</i>	100-150