



## IMPORTANCE AND PRODUCTION STRATEGIES OF CASTOR IN INDIA-A REVIEW

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### ABSTRACT

*Castor is cultivated around the world because of the commercial importance of its oil. India is the main producer of castor in the world. Castor plant is well adapted to practically the whole country, except for some extreme areas (too low water availability or too much rain). Castor keeps being an alternative for the semi arid region but much more technology is requested to make it largely exploited. India is one of the largest producers of castor seeds and accomplishes about 90% demand of the international market. Its seeds are not only used to extract the oil but also for preparing medicines. Owing to the numerous uses of castor seeds only, it is a popular plant of India. This plant is grown in three different Indian states namely Andhra Pradesh, Gujarat and Rajasthan. In Gujarat, castor seed is grown on a large scale with the sowing season being the monsoons while the harvesting season being winters. Most of the production comes from Gujarat followed by the other two states. In Rajasthan also the castor seeds are sown around July-August and harvested around December only. After Gujarat, Rajasthan accounts to the largest production of the castor seeds and helps in fulfilling the requirements of the international market. In Andhra Pradesh, the method of cultivation is quite different because the sowing period is somewhat around the month of May or June while the crop is harvested in September. Around 8 months are consumed to sow and harvest the crop so as to get a higher and better yield. Though every state follows a different pattern of cultivation but still the months of July and August are best for cultivation. It is the time when the monsoon season is in its full*

*form and it becomes easy to sow the seeds as well. The farmers are now following newer methods of cultivation which are far better and help in fulfilling the demand of the local as well as the international market. Its oil is widely used and that is why, it is highly popular among the local people as well as the international customers as well. As it is a non edible crop, therefore, it can be grown easily and does not require any special conditions.*

**Key Words:** Castor Seed, Organic manure, Derivatives, Rainfall, India, Gujarat, Strategies, Castor Breeder

## **A Brief on Castor Plant**

Castor is a Latin word, also known as Palm of Christ and scientifically known as *Ricinus communis* L. The castor plant appears to have originated in eastern Africa, especially around Ethiopia and cultivated around the world because of the commercial importance of its oil. Castor is a small annual plant and crop duration is 7-8 months. It ranges from 1 to 7 meters in height. It has well-developed roots, with green and reddish stems which become hollow with age. The fruit is a spherical capsule with small grey seeds with brown spots. The fruit of the castor seed is either green or purplish and contains 3 oval shaped seeds per capsule. The seeds also contain a toxin known as ricin which is helpful in a number of ways. The seed is named after the toxin it contains. Its male flowers are usually yellow in color with creamy stamens while the female flowers have red stigmas.

It grows throughout the warm-temperate and tropical regions and flourishes under a variety of climatic conditions. India is the main producer of castor in the world. The Indian variety has an oil content of 48% and 42% can be extracted (which is rich in triglycerides called ricinolein), while the cake retains the rest.

## **Commercial Uses of Castor**

- Castor is a versatile, **renewable resource** having vast and varied applications such as lubricating grease, surfactants, surface coatings, telecom, engineering plastics, pharmacy, rubber chemicals, nylons, soaps, hydraulic brake fluids, paints and polymers and perfumery products. (**Castor Seed Crop Survey Report - February, 2015**).

- Castor meal has uses in agriculture as **organic manure**. Castor seed oil cake is very useful manure to crops. It is a very good fertilizer alternative containing optimum levels of nitrogen, phosphorous and potassium which is suitable for cultivation of paddy, wheat, maize and sugarcane (**Religare Retail Research – Castor Seed Survey Report 2014-15**).
- Its oil can be used on the **skin to overcome the dryness** because it is rich in healthy nutrients. There are lots of cosmetic products which are made from the castor oil because it is good for the skin. The castor seeds are also used in the fashion jewelry which is very popular among the girls. Sometimes, the oil can be used as a lawn care product to keep away from moles. (**Religare Retail Research – Castor Seed Survey Report 2014-15**).
- The derivatives are on par with petrochemical products for use in several **industrial applications**. In fact, they are considerably superior since they are from **renewable sources**, bio-degradable and **eco-friendly**. Hence, there are lots of uses of castor seeds. (**Religare Retail Research – Castor Seed Survey Report 2014-15**).

**Table No.1**

**Uses of Castor Oil & Castor Oil Derivatives**

<b>Industry</b>	<b>End Products</b>	<b>Castor Products Used</b>
Agriculture	Fertilizers – Organic Fertilizers	Castor Meal
Food	Surfactants Viscosity Reducing Additives Flavorings Food Packaging	Food Grade Castor Oil Polyoxyethylated Castor Oil
Textile Chemicals	Textile Finishing Materials Dyeing Aids Nylon, Synthetic Fibers & Resins Synthetic Detergents Surfactants, Pigment Wetting Agents	Ethoxylated Castor Oil Sulfonated Castor Oil / Turkey Red Oil Methyl 12-HAS
Paper	Flypapers Defoamer Water Proofing Additive Paper Coatings	Methyl 12-HAS Glycerine
Plastics & Rubber	Polyamide 11 (Nylon 11) Polyamide 6 Polyurethane Foam Plastic Films Adhesives Synthetic Resins Plasticizers	12-HAS Heptaldehyde Ricinoleic Acid Methyl Ricinoleate Sebacic Acid Undecylenic Acid Glycerine

	Coupling Agents Polyols	
Cosmetics & Perfumeries	Perfumery Products Lipsticks Hair Tonics Shampoos Polishes Emulsifiers Deodorants	Castor Oil Castor Oil Esters Undecylenic Acid Castor Wax Zinc Ricinoleate Heptaldehyde Heptanoic Acid Undecylenic Acid Heptyl Alcohol Ethyl Heptoate Heptyl Acetate
Electronics & Telecommunications	Polymers for Electronics & Telecommunications Polyurethanes Insulation Materials	Castor Oil Esters Polyols
Pharmaceuticals	Anthelmintic drugs Antidandruff Cathartic (Substance that accelerates defecation) Emollient Emulsifiers Encapsulants Expectorant Laxatives & Purgative Additives & Excipients	Glycerine Undecylenic Acid Zinc Undecylenate Enanthic Anhydride Calcium Undecylenate Hydrogenated Castor Oil
Paints, Inks & Additives	Inks Plasticizer for Coatings Varnishes Lacquers Paint Strippers Adhesive Removers Wetting & Dispersing Additives	Polyols Glycerine Dimer Acid Ricinoleic Acid Castor Oil Dehydrated Castor Oil (DCO)
Lubricants	Lubricating Grease Aircraft Lubricants Jet Engine Lubricants Racing Car Lubricants Hydraulic Fluids Heavy Duty Automotive Greases Fuel Additives Corrosion Inhibitors	Dimer Acid Ricinoleic Acid Castor Oil Esters Blown Castor Oil Heptanoic Acid Hydrogenated Castor Oil Hydroxy Amide Waxes 12 Hydroxy Stearic Acid Sebacic Acid Ethoxylated Castor Oil
Bio-fuels		

Source: <http://www.castoroil.in/uses/uses.html> Retrieved on 23.07.2016

## Current End Uses for Castor Oil & Derivatives

### 12-HSA

12 HSA (Hydroxystearic acid) is used in grease manufacture, plastics lubrication and as a raw material for the synthesis of more complex chemicals. It is used as a high hydroxyl castor based wax, as a wax ingredient.

When reacted with an ester, 12 HSA provides a hard finish for the automotive and small appliance industries.

Both HCO (Hydrogenated Castor Oil) and 12 HSA have enjoyed popularity with the growth of lithium complex greases, which are growing to be the largest segment of the grease market. These greases have excellent heat tolerance like the sodium greases and the water resistance of calcium greases. The addition of 12 HSA enhances the overall performance with better texture, improved heat stability and improved dropping points. It simplifies the grease manufacturing process because it no longer requires milling and homogenization steps that were normally used with lithium type greases.

12 HSA soaps are used in mineral oil-based multipurpose greases making it possible for grease to fill the requirements of a variety of needs in the automotive and truck greases.

*In cosmetics:* 12 HSA may be used for gelling liquid petroleum to produce brilliance. It may be incorporated into cold creams and vanishing creams to give a jelly-like feeling.

*In paints:* 12-HSA is reacted with acrylic esters to produce hard, durable thermosetting polymers used in high-quality automotive, industrial appliance and metal decorative finishes.

*In rubbers:* 12-HSA functions as an activator and internal lubricant for natural and synthetic rubbers.

### Nylon 11

*The process to make Nylon 11 from castor oil is quite involved and includes several reaction steps, but briefly, it is as follows:*

Castor oil is converted to methyl ricinoleate by treatment with methyl alcohol. Methyl ricinoleate is pyrolysed at high temperature yielding heptaldehyde, methyl undecylenate and a small amount of fatty acids. Methyl undecylenate is hydrolysed to produce undecylenic acid. When undecylenic acid is treated with hydrogen bromide in a non-polar solvent in the presence

of peroxide, reverse Markownikoff addition occurs and the main product is x-bromoundecanoic acid. This is then treated with ammonia to give x-aminoundecanoic acid, which is a crystalline solid. Aminoundecanoic acid is the starting material for nylon-11.

**Table No.2**

**Castor Oil Use in Cosmetics & Perfumeries**






<u>End Products</u>	<u>Castor Products &amp; Derivatives Used</u>
a) Perfumery Products	a) Castor Oil
b) Lipsticks	b) Castor Oil Esters
c) Hair Tonics	c) Undecylenic Acid
d) Shampoos	d) Castor Wax
e) Polishes	e) Zinc Ricinoleate
f) Emulsifiers	f) Heptaldehyde
g) Deodorants	g) Heptanoic Acid
	h) Undecylenic Acid
	i) Heptyl Alcohol
	j) Ethyl Heptoate
	k) Heptyl Acetate

Source: <http://www.castoroil.in/uses/uses.html> Retrieved on 23.07.2016

**Castor Seed Production**

Castor is cultivated in 30 different countries on commercial scale, of which India, China and Brazil are the major growing countries. These countries account for 90% of the world's production. Historically, Brazil, China and India have been the key producing countries meeting global requirement. India is the leader in global castor production and dominates in international castor oil trade. (Castor Seed Crop Survey Report - February, 2015)

**World Production of Castor Seed**

Country	Harvest Season	Production ('000/T)		Yield (T/ha)		Harvest Area ('000/Ha)	
		14 -15P	13 -14	14 -15P	13 -14	14 -15P	13 -14
 Ethiopia	Oct-Dec	11	13	0.80	0.93	14	14
 Brazil	Jun - Sept.	45	16	0.44	0.18	101	87
 China PR	Sept. - Jan.	40	50	0.87	0.88	46	57
 India	Jan. – May	1270	1190	1.22	1.23	1040	970
 Thailand	Nov-Jan	11	12	0.85	0.88	13	14
<b>Other Countries</b>		94	93	0.61	0.61	154	153
<b>World</b>		<b>1471</b>	<b>1374</b>	<b>1.08</b>	<b>1.06</b>	<b>1368</b>	<b>1295</b>

Source: Oil World Hamburg, Germany

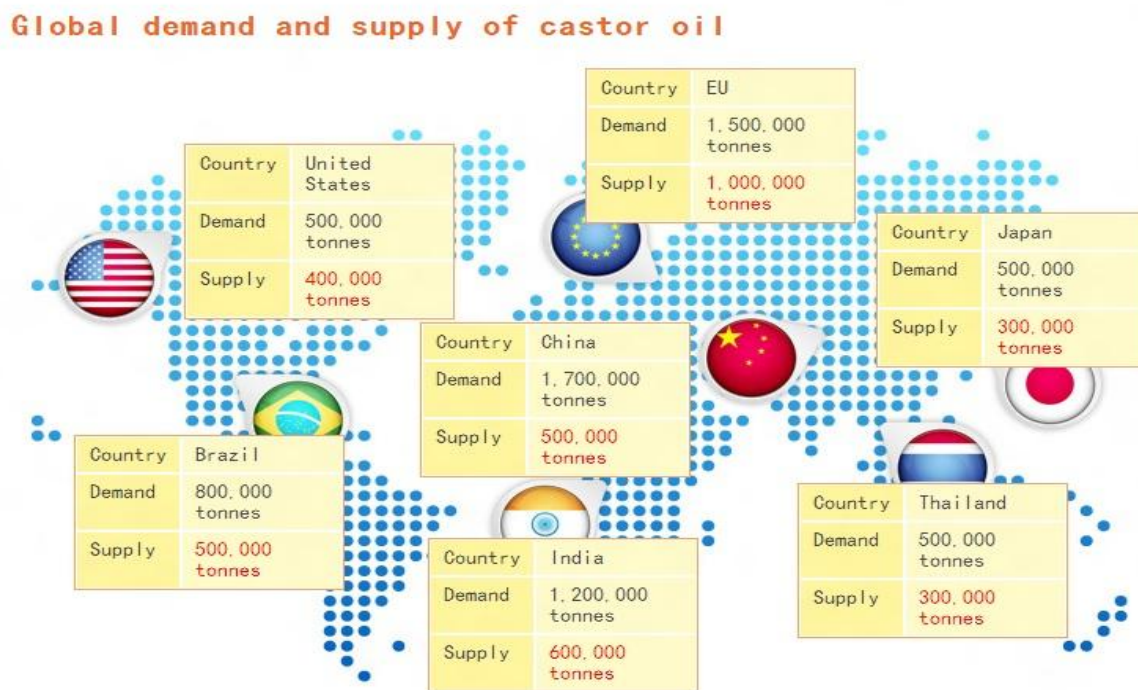
India is contributing around 85% of world's total production and dominating the global trade with a share of more than 9% from the country. India produces around 10 lakh tonnes of castor seed and around 5.5 lakh tonnes of castor oil. India meets more than 80% of the demand of castor oil, thereby enjoying a dominant position in the world castor scenario.

Castor seed is not exported but castor oil and meal are exported. Exports of oil and meal are rising steadily. Meal exports are doubled during the past five years. India being the single largest producer oil castor production in the world becomes the major source of castor products.

**Major Export destinations:** South Korea, Taiwan and France

Following Chart shows the “Demand and Supply” of Castor Oil

### Major Countries in the World



Chinese demand is highest. 70% castor oil is imported. ∴ Many Chinese companies have closed down due to shortage of supply.

**Source:** <http://www.castoroilworld.com/statistics-market-demand-future-trend/> Retrieved on 23.07.2016

In India Gujarat, Rajasthan and Andhra Pradesh contribute 96% of the total castor seed production. Gujarat is the chief producing state, having a share of 75% of domestic production, followed by Rajasthan and Andhra Pradesh.

### **Global Castor Oil and Indian Monopoly**

India, as the largest producer and exporter of castor oil in the world, is responsible for almost 83.65% of total global exports in this segment. Its main trading partners in this specific sector are China, Europe, Thailand and Japan. China has been one of the biggest growth drivers for castor oil due to its demand for sebacic acid (a basic industrial chemical compound) which is developed from this oil. China currently imports 30.67% of its total castor oil requirement, valued at \$215.87 million, from India. However, despite these glorious numbers, India continues to be a price taker and not a price setter in the global castor oil market. One major reason being that India became the largest producer of the seed by default.

**Table No.3**

#### **Supply and Demand of Castor Oil – 2015**

**(Rupees in 000'Tonnes)**

<b>Country</b>	<b>Production</b>
India	860.2
China	20
Brazil	76
<b>Total</b>	<b>880.2</b>
<b>Imports</b>	
China	230
Europe	151
USA	50
Thailand	18
Brazil	5
<b>Total</b>	<b>454</b>



<b>Exports</b>	
India	470
<b>Total</b>	<b>470</b>

Brazil, which in the 70s was the largest producer of castor seeds in the world, moved away from this seed to soybean which has a higher yield and greater export demand for both its seeds and oil. So did other major countries, leaving India with a virtual monopoly.

**Table No.4**  
**Region-wise Indian Exports of Castor Oil - 2015**

<b>COUNTRY</b>	<b>YEAR</b>		
	<b>2014</b>	<b>2015</b>	<b>2016 (Est.)</b>
<b>Europe</b>	111135 MT	124330 MT	125000 MT
<b>USA</b>	42943 MT	46893 MT	46000 MT
<b>China</b>	161655 MT	192050 MT	192000 MT
<b>Others</b>	95064 MT	72895 MT	95000 MT
<b>Total (a)</b>	410797 MT	436168 MT	458000 MT
<b><u>Stock Transfer</u></b>			
<b>Europe</b>	6600MT	14500 MT	-
<b>Malaysia</b>	12405 MT	41805 MT	-
<b>Total (b)</b>		19005 MT	56305 MT
<b>Gross Total (a+b)</b>	<b>429802 MT</b>	<b>492473 MT</b>	<b>458000 MT</b>

**Source:** \*Nielsen India estimates, # other states Maharashtra, Karnataka, Tamil Nadu, and Orissa

**Table No.5**  
**State-wise Area, Production and Yield of Castor Seeds in India**

<b>State</b>	<b>Estimated Area*</b> <b>Under Crop ('000 ha.)</b>			<b>Estimated Production* ('000</b> <b>tones)</b>			<b>Estimated Yield*</b> <b>(Kg / ha.)</b>		
	<b>2014-15</b>	<b>2013-14</b>	<b>2012-13</b>	<b>2014-15</b>	<b>2013-14</b>	<b>2012-13</b>	<b>2014-15</b>	<b>2013-14</b>	<b>2012-13</b>
<b>Gujarat</b>	689	573	666	1007	843	967	1454	1471	1452
<b>Rajasthan</b>	185	148	157	165	161	200	859	1085	1274
<b>Andhra Pradesh</b>	111	153	222	75	102	150	674	668	674
<b>Other States #</b>	42	42	51	24	24	30	560	571	588
<b>Total</b>	<b>1027</b>	<b>916</b>	<b>1096</b>	<b>1232</b>	<b>1130</b>	<b>1347</b>	<b>1229</b>	<b>1233</b>	<b>1229</b>

**Source:** \*Nielsen India estimates, # other states Maharashtra, Karnataka, Tamil Nadu, and Orissa

## **Solvent Extractors' Association of India (SEA) estimates**

Solvent Extractors' Association of India (SEA) has estimated castor seed production to rise by 10 per cent stand at 1.39 million tonnes for the year 2015-16. As against this, in 2014-15, castor seed production stood at 1.27 million tonnes.

As one of its activities, SEA conducts castor crop estimation in Gujarat, Rajasthan and Andhra Pradesh every year. For the same, SEA had commissioned Nielsen India to conduct a crop estimation study for the commodity in producing states.

As per the latest SEA report, sowing of castor seed crop increased to 1.13 million hectares this year as against 1.10 million hectares in last year. Apparently, reduced water availability led to farmers turning castor crop sowing this year.

"Monsoon was not good in castor producing states mainly in Gujarat. Castor does not need much water which increased the area translating into higher production this year," the association stated.

As per the report, castor seed production in Gujarat will increase by 8 per cent to 1.15 million tonnes as against 1.06 million tonnes of last year. Area under castor crop registered higher by 6 per cent to 781,000 hectares which was stood at 734,000 hectares in 2014-15.

**At Andhra Pradesh and Telangana**, castor production has been estimated to be up by five per cent to 79,000 tonnes as against 75,000 tonnes. Sowing also gained from 111,000 hectares to 114,000 hectares.

However, for the Rajasthan, the report stated a negative production due to decline in sowing area. SEA report estimated 13 per cent fall in production to 144,000 tonnes for the year 2015-16 in Rajasthan. Last year production was 165,000 tonnes.

**(Ref: Solvent Extractors' Association of India (SEA) estimates for 2015-16)**

### **Strategies**

#### **A) Castor Seeds Growing States in India & Best Season**

India is one of the largest producers of castor seeds and accomplishes about 90% demand of the international market. Its seeds are not only used to extract the oil but also for preparing medicines. Owing to the numerous uses of castor seeds only, it is a popular plant of India.

This plant is grown in three different Indian states namely Andhra Pradesh, Gujarat and Rajasthan.

### **Irrigated Castor**

In Gujarat, castor seed is grown on a large scale with the sowing season **being the monsoons** while the harvesting season **being winters**. Most of the production comes from Gujarat followed by the other two states.

In Rajasthan also the castor seeds are sown around **July-August** and harvested around **December** only. After Gujarat, Rajasthan accounts to the largest production of the castor seeds and helps in fulfilling the requirements of the international market.

### **Rain-fed Castor**

In Andhra Pradesh, the method of cultivation is **quite different** because the sowing period is somewhat around the month of **May or June** while the crop is harvested in **September**.

*Around 8 months are consumed to sow and harvest the crop so as to get a higher and better yield.*

As Andhra Pradesh receives **insufficient rainfall**, hence the growing cycle is different than the other states and this is the reason that the seeds are sown during the months of May. Apart from the above three states, other Indian states also contribute towards the production of the castor seeds. Some parts of the Maharashtra, Tamilnadu, Karnataka and Odisha states are also said to grow the castor seeds but the average production is **quite low** and thus it is able to accomplish the domestic needs only.

### **B) District-wise Crop Yield of Gujarat and Andhra Pradesh**

Though every state follows a different pattern of cultivation but still the months of **July and August are best for cultivation**. It is the time when the monsoon season is in its **full form** and it becomes easy to sow the seeds as well.

**Table No.6****District-Wise Estimated Area, Yield and Production of Castor Seed in Gujarat (2014-15)**

<b>District</b>	<b>Estimated Area</b>	<b>Estimated Yield</b>	<b>Estimated Production (‘000 Tones)</b>
Banaskantha	135	1813	245
Sabarkantha	38	1849	70
Mehsana	78	1381	108
Patan	117	1614	189
Gandhinagar	26	1760	46
Kutch	93	474	44
Surendra Nagar	68	788	54
Jamnagar	8	760	6
Rajkot	10	855	9
Vadodara	27	1568	42
Kheda	13	1710	22
Ahmedabad	48	1789	86
Panchmahal	2	1890	4
Morbi	28	800	22
Others	42	1050	44
<b>Total</b>	<b>733</b>	<b>1351</b>	<b>990</b>

**Source:** Area Data as per GOI and Yield as per Religare Research after Field Survey

*Mehsana and Banaskantha* are the largest castor producing districts in Gujarat

Gujarat weather, an inevitable part of the geography of Gujarat, has certain characteristics that mark it special among the other western regions of India. Gujarat weather is marked by an arid and dry climate, with a little bit of rain during the monsoons.

Normally, the Gujarat weather is divided into three major seasons:

1. The winter season
2. The summer season
3. The monsoon season

Winters in Gujarat are mild, pleasant and dry. The day temperature in winter is around 28.33 °C and at night is 11.66 °C. Summers are extremely hot, with the day time temperature being 46.11 °C, and the night temperature being 32.22 °C. In Gujarat, monsoon is generally hot and utterly humid. The temperature at day is 37.77 °C but at night it falls down to 26.66 °C. Sometimes severe flood also occurs in some parts of the region during monsoon.

Based on soil characterization, rainfall, temperature and eight agro- climatic zones in Gujarat have been identified. These are following:

**Table No.7**

**Soil Characterization, rainfall, temperature and eight agro climate zones of Gujarat**

Agro Climatic Zone	Type of Soil	Rain Fall (mm)
South Gujarat (Heavy Rain Area)	Deep Black with Few patches of Coastal alluvial, lateriate and medium black	1,500 and More
South Gujarat	Deep Black Clayey	1,000–1,500
Middle Gujarat	Deep Black, Medium Black to loamy sand	800 -1,000
North Gujarat	Sandy loam to sandy	625 – 875
Bhal & Coastal Area	Medium black, poorly drained and saline	625 – 1,000
South Saurashtra	Shallow medium black calcareous	625 – 750
North Saurashtra	Shallow medium black	400 – 700
North West Zone	Sandy and saline	250 – 500

Average annual rainfall is 798 mm. Range of rainfall during last 10 years indicate the minimum 647 mm per year to maximum 1291 mm per year.

**Source:** [http://nfsm.gov.in/blog/gujarat\\_agriculture.aspx](http://nfsm.gov.in/blog/gujarat_agriculture.aspx) Retrieval date on 23.07.2016

**Table No.8**

**District-Wise Estimated Area Yield and Production of Castor Seed in Andhra Pradesh (2014-15)**

District	Estimated Area	Estimated Yield	Estimated Production ('000 Tones)
Guntur	0.7	513	4.0
Kurnool	32.0	490	16.0
Anantapur	10.0	642	6.0
Prakasam	2.5	513	1.0
Others	1.0	600	1.0
Total	46.2	527	27.0

**Source:** Area Data as per GOI and Yield as per Last Five Years Average

### C) Other Contributing Factors

Growing castor seeds are quite simple and that is why, India is the largest producer of this seed. The types of climatic conditions needed for its growth are ideal in India and so its production is very high. One of the most important requirements for growing these seeds is the **tropical climate**. It loves heat and humidity and does best in regions where both are ample. India, gifted with an ideal climatic condition, has recorded to produce of close to 8,50,000 tonnes of castor seed. The other factors contributing to castor production are:

- Castor is drought tolerant and grows well in a wide range of rainfall and climatic conditions. It requires moderately high temperatures with low humidity throughout the growing season to produce maximum yields. The castor crop duration varies 7 to 8 months depending upon the variety.
- It is cultivated in the arid and semi-arid regions in the world.
- It thrives in a wide range of soils and requires well distributed rainfall of 500-600 mm throughout the crop period.
- In India, it is sown in Jun-Aug and harvesting commences around Dec-March.

### D) Castor Seed Varieties & Hybrids

**Table No.9**

**Some Short Term (Annual) Varieties Tested in East Africa**

Variety	Time To Maturity
II23	7-10 Months
UC53	7-10 Months
Baker 44	5-7 Months
Baker 22	5-7 Months
Lynn	5-7 Months

**Source:** Comprehensive Castor Oil Report – A Report on Castor Oil and Castor Oil Derivatives – updated April, 2016

**Advantages of annual varieties:** Higher yield potential, seeds seldom shatter and have uniform hull strength and thickness.

**Disadvantages of annual varieties:** Pest susceptibility

**Table No.10****Important Castor Varieties Used by Gujarat and Andhra Pradesh are:**

State	Variety	Hybrid
Andhra Pradesh	Aruna, Bhagya, Sowbhagya, Kranti (PCS-4), Jwala, DCS-9 (Jyothi), Kiran (PCS-136), Haritha (PCS-124).	
Gujarat	GAUC-1, VI-9, S-20, J-1andGCH 7	CH-1, GCH-2, GCH-3, GCH6, SHB-145, GCH-7 and(SKP 84 x SKI 215

**E) Latest varieties and hybrids**

Sl. No	Name of the variety/ hybrid/inbred line developed by ICAR Institute/ Dte./NRCs	Year of notification	Pedigree	Salient features	Area of Adaptability	Contact details
<b>CASTOR</b>						
1	Aruna	V	1976	A INDUCED MUTANT OF H.C. 6	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	AP, Karnataka, Orissa, Rajasthan  IARI regional station, Hyderabad

2	GAUCH -1	H	1976	Selection from S-20 inbred line	Yield (kg/ha) – 1200-1300 Days to maturity (1 <sup>st</sup> picking)– 100-110 Oil content (%) – 46-47	Gujarat	AICRP Centre (castor), ORS, JAU, Junagadh
3	TYPE-28	V	1978	A SELECTION FROM BOMBAY COLLECTION.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
4	TYPE-3	V	1978	DEVELOPED BY SELECTION.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
5	TARAI-4	V	1978	DEVELOPED BY SELECTION.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
6	SOUBHAGYA	V	1978	A SERIVATIVE OF THE CROSS	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) -	AP	DOR, Hyderabad



				BETWEEN ARUNA X SHORT MUTANT.	1985 Days to maturity – 100-110 Oil content (%) – 48-50		
7	KALPI-6	V	1978	DEVELOPED BY SELECTION	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
8	GIRIJA	V	1978	DEVELOPED BY SELECTION FROM THE EQARLY MATURING MATERIAL FROM ANAND.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
9	CH-1	H	1978	Selection from GCH-3	Yield (kg/ha) – 1000-1200 Days to maturity ( 1 <sup>st</sup> picking)– 90-100 Oil content (%) – 48-49	Punjab, Haryana	CCSHAU, Hisar
10	BHAGYA	V	1978	A DERIVATIVE OF THE CROSS BETWEEN HIGH OIL LINE X EXOTIC M.I.415	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	AP	DOR, Hyderabad

11	KISAN	V	1982	A DERIVATIVE OF THE CROSS BETWEEN SPANISH IMPROVED X B-31.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
12	RC-8	V	1982	A MUTANT FROM RC-1188.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
13	VIJAPUR INBRED-9	V	1984	A SELECTION FROM S-20.	Tolerant to wilt & root rot & resistant leafhopper Yield (kg/ha) - 1985 Days to maturity – 100-110 Oil content (%) – 48-50	All India	
14	TMV-5	V	1985	SA2/ S2 48-2 inbred line	Yield (kg/ha) -920 Days to maturity – 140-150 Oil content (%) – 47-49	Tamil Nadu	Castor Breeder Oilseeds Research Station, TNAU, Tindivanam (TN)
15	GCH-2 (VHB-150)	H	1986	VP-1/JI-35	Resistant to root rot Yield (kg/ha) - 1700 Days to maturity – 100-110 Oil content (%) – 47-49	Gujarat	AICRP Centre (castor), ORS, JAU, Junagadh

16	GCH-4 (SHB-18)	H	1988	VP-1 X 48-1	Resistant to leafhopper Yield (kg/ha) – 1800-2000 Days to maturity – 100-210 Oil content (%) – 48-50	All India	Castor Breeder Main Castor & Mustard Res. Stn. S.D. Agricultural University Sardar Krishinagar -385 506, Gujarat
17	AKC-1	V	1995	Mass selection from B-7 variety	Tolerant to semilooper & capsule borer Yield (kg/ha) - 1200 Days to maturity – 90-100 Oil content (%) – 45	Maharashtra	Castor Breeder Dr.Panjabrao Deshmukh Krishi Vidyapeeth Akola-444 104, Maharashtra
18	DCS-9 (Jyothi/REC-9)	V	1995	240/ Bhagya, inbred line	Tolerant to wilt Yield (kg/ha) – 1000-2400 Days to maturity – 90-100 Oil content (%) – 49	Rainfed areas of A.P., Tamil Nadu and Karnataka	Castor Breeder Directorate of Oilseeds Research, Rajendranagar,Hyderabad – 500 030
19	GC-2 (SKI-273)	V	1996	1-21/VI-9, inbred line	Tolerant to wilt Yield (kg/ha) – 1200-2100 Days to maturity – 90-100 Oil content (%) - 47-49	Gujarat	AICRP Centre (castor), Castor and Mustard Research station, SK Nagar, SKDantiwada Agricultural University,Gujarat
20	TMV-6 (TVC31/RV74)	V	1997	VP-1/RC962, inbred line	Moderately resistant to wilt, <i>Alternaria</i> leafspot, rust, tolerant to leafhoppers, semilooper capsule borer Yield (kg/ha) - 930 Days to maturity –	Tamil Nadu	Castor Breeder Tapioca & Castor Res. Station TNAU, Puthiragoundanpalayam Yethapur – 636 119 Attur (Tq), Salem Dist. Tamil Nadu

					110-120 Oil content (%) – 52		
21	GCH-5 (SHB-145)	H	1997	GEETA /SH-72	Resistant to wilt, jassids Yield (kg/ha) - 1740(RF)/2820(IR) Days to maturity – 110-120 Oil content (%) – 50	All India	Castor Breeder Main Castor & Mustard Res. Stn. S.D. Agricultural University Sardar Krishinagar -385 506, Gujarat
22	DCH 32 (Deepti)	H	1998	LRES-17/REC-5	Resistant to jassids and leaf hoppers Yield (kg/ha) – 1030-2460 Days to maturity – 85-95 Oil content (%) – 48	Rainfed areas of A.P., Karnataka, TN, MS and Orissa	Castor Breeder Directorate of Oilseeds Research, Rajendranagar,Hyderabad – 500 030
23	Kranti (PCS-4)	V	1999	(PB-1/151-B)//(JC-44/413A), inbred line	Moderately tolerant to semilooper and resistant to drought Yield (kg/ha) - 1365 Days to maturity – 110-120 Oil content (%) – 48-50	Andhra Pradesh	Castor Breeder Regional Agril. Research Station, ANGRAU, Palem-509 215 Mahaboobnagar, Andhra Pradesh
24	TMVCH 1	H	1999	LRES-17/TMV-5	Resistant to leaf hoppers and jassids and moderately resistant to <i>Botrytis</i> Yield (kg/ha) - 1200 Days to maturity – 160-170	Rainfed areas of Tamil Nadu	Castor Breeder Tapioca & Castor Res. Station TNAU, Puthiragoundanpalayam Yethapur – 636 119 Attur (Tq), Salem Dist. Tamil Nadu

					Oil content (%) – 49		
25	GCH 6 (JHB-665)	H	1999	JP 65 X JI-96	Tolerant to <i>Macrophomina</i> root rot & wilt Yield (kg/ha) – 1400-2300 Days to maturity – 95-210 Oil content (%) – 48	Rainfed & irrigated late kharif regions of Gujarat, Rajasthan and Maharashtra	Castor Breeder Oilseeds Research Station Junagadh Agril. University Junagadh-362001, Gujarat
26	DCH 177	H	2000	DPC-9 x DCS-9 (Jyothi)	Moderately resistant to wilt Yield (kg/ha) – 1500-1600 Days to maturity – 90-180 Oil content - 49	Tamil Nadu, Karnataka, AP and Maharashtra	Castor Breeder Directorate of Oilseeds Research, Rajendranagar, Hyderabad – 500 030
27	RHC 1	H	2002	VP-1 X TMV-5-1	Yield (kg/ha) – 2500-3000 Days to maturity – 90-120 Oil content – 49	Rainfed and irrigated areas of Rajasthan	Castor Breeder Agricultural Research Station, RAU, Mandor– 342 304, Jodhpur, Rajasthan
28	Haritha (PCS 124)	V	2004	PPL-4 X 48-1, inbred line	Resistant to wilt Yield (kg/ha) – 1400-1600 Days to maturity – 90-120 Oil content (%) – 48-51	Rainfed areas of Andhra Pradesh	Castor Breeder Regional Agril. Research Station, ANGRAU, Palem-509 215 Mahaboobnagar, Andhra Pradesh
29	Kiran (PCS 136)	V	2004	Selection from JI-1-130-1 inbred line	Tolerant to <i>Botrytis</i> and jassids Yield (kg/ha) – 1200-1500 Days to maturity –	Rainfed areas of Andhra Pradesh	Castor Breeder Regional Agril. Research Station, ANGRAU, Palem-509 215 Mahaboobnagar, Andhra

					90-180 Oil content (%) – 49		Pradesh
30	DCH 519	H	2006	M -574 X DCS -78	Resistant to wilt and jassids Yield (kg/ha) – 1700-2000 Days to maturity – 100-180 Oil content - 49	Both rainfed and irrigated areas, all over the country	Castor Breeder Directorate of Oilseeds Research, Rajendranagar,Hyderabad – 500 030
31	SAGAR SHAKTI	H	2006	SP 19 X SM 35	Tolerant to wilt, <i>Alternaria</i> blight. leaf hoppers, Jassids and white fly Yield (kg/ha) – 2000 Days to maturity – 100-115 Oil content - 49	All India	Sagar Laxmi seeds, Hyderabad
32	GCH 7 (SHB- 758)	H	2007	SKP -84 X SKI- 215	Tolerant to white fly, jassids and thrips and resistant to nematode-wilt complex Yield (kg/ha) – 3000-3500 Days to maturity – 110 -210 Oil content – 49	Irrigated areas of Gujarat	Castor Breeder Main Castor & Mustard Res. Stn. S.D. Agricultural University Sardar Krishinagar,-385 506, Gujarat
33	Jwala (48-1)	V	2007	High oil Mutant x Mauthners Dwarf	Resistant to wilt, capsule borer and tolerant to jassid and <i>Botrytis</i> Yield (kg/ha) – 1100-1500 Days to maturity – 110-120 Oil content (%) –	All India	Castor Breeder Directorate of Oilseeds Research, Rajendranagar,Hyderabad – 500 030

					48		
34	YRCH-1	H	2010	DPC9 X TMV 5	Yield (kg/ha) – 1800 Days to maturity – 120-115 Oil content (%) – 49	Tamil Nadu	Castor Breeder Tapioca & Castor Res. Station TNAU, Puthiragoundanpalayam Yethapur – 636 119 Attur (Tq), Salem Dist. Tamil Nadu
35	K-8501 (chandraprabha)	V	2010	KALPI-6 X BHAGYA	Yield (kg/ha) – 1800-2000 Days to maturity – 225-235 Oil content (%) – 53.8 Resistant / tolerant to Capsule borer & castor semilooper	Rainfed areas of UP	CHANDRA SHEKHAR AZAD UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, KANPUR-2
36	DCS-107	V	2011	DCH-177 x JI- 133	Resistant to wilt and tolerant to leaf hopper Yield (kg/ha) – 1500-1700 Days to maturity – 100-135 Oil content (%) – 49	All India	DOR, Hyderabad
37	JI-273(GC-3)	V	2012	F7 T (JP-65 X JI-88) X 48-1	Yield (kg/ha) – 2340 Days to maturity – Oil content (%) – 49.6 Resistant to wilt, tolerant to Macrophomina	Irrigated areas of Gujarat	Castor Breeder Oilseeds Research Station Junagadh Agril. University Junagadh-362001, Gujarat

					root rot		
38	DSP-222	V	2012	D 12X D 117	Yield (kg/ha) – 2600-3000 Days to maturity – 121-148 Oil content (%) – 48.4 Resistant to wilt	Irrigated areas of Gujarat, Rajasthan, UP, Haryana	DANTIWADA SEED PVT. LTD. 211/SAKAR - V, B/H : NATRAJ CINEMA, ASHRAM ROAD, AHMADABAD, GUJARAT

#### F) Crop Cycle

State	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Gujarat										
Andhra Pradesh										
Rajasthan										



**Sowing**



**Growth**



**Harvesting**

#### G) Production Techniques:

To increase the production of Castor seeds, the following techniques are very useful.

##### Land Requirement:

Land to be used for seed production shall be free of volunteer plants. In addition the field should be well- drained and soil well aerated.

##### Isolation Requirements:

Castor is an often cross- pollinated crop. Cross-pollination by wind varies from 5 to 36 percent according to the prevailing climatic conditions. For pure seed production, the seed field



must be isolated from other variety fields and of same variety not conforming to varietal purity requirements of certification at least by three hundred meters for foundation seed class, and one hundred and fifty meters for certified seed class.

Intercropping:

**Table No.11**

**Remunerative Intercropping Systems with Castor**

<b>Intercropping System</b>	<b>Row Proportion</b>	<b>Recommended States</b>
Castor + Pigeon pea	1:1	Gujarat, Andhra Pradesh
Castor + Cowpea	1:2	Gujarat, Andhra Pradesh
Castor + Urd bean	1:2	Gujarat, Andhra Pradesh
Castor + Mung bean	1:2	Gujarat, Andhra Pradesh
Castor + Cluster (vegetable)	1:1	Andhra Pradesh
Castor + Groundnut	1:5 or 1:7	Andhra Pradesh, Tamilnadu, Karnataka
Castor + Groundnut (Bunch)	1:3	Gujarat
Castor + Soybean	1:1	Bihar

**H) A Brief on Cultural Practices:**

Preparation of Land:

Castor is a deep-rooted crop. Therefore, deep ploughing has been found very useful. One deep ploughing followed by two to three harrowing is sufficient to bring the field to the desired tilth.

Time of Sowing:

The sowing time in most of the states is June to July. In Bihar (Rabi Crop) castor sown in September to October. In Gujarat, planting is done in August to September and in Karnataka it is sown in April.

Source of Seed:

If it is for farmers, seeds from authorized dealers else obtain nucleus / breeder's foundation seed for planting from source approved by a seed certification agency.

Method of Sowing:

The crop is planted in rows either by drill, or behind the plough in furrows. The depth of seedling is 7.5 to 10 cm.

Spacing:

Row to Row – 90 cm (annual varieties)

Plant to Plant – 45 to 90 cm.

Seed Rate:

11 to 18 kg per ha, varies upon spacing, seed size and method of sowing. For rainfed crops, a seed rate up-to 33 to 44 kg is also practiced.

Fertilization:

The crop responds well to organic manures. The rate of fertilizer application varies considerably in different states and ranges from 20 kg to 80-100 kg per hectare for nitrogen-10 to 40 kg Phosphorous and 10 to 40 kg Potash.

Irrigation:

The number of irrigations required varies with the rain. Usually two to three irrigations during the entire crop season may be required. Adequate moisture in soil at the time of flowering is necessary.

Interculture:

The castor field must be kept weed-free for the first sixty days after planting. Two to three weeding / hoeing are sufficient to keep the field clean. Application of 2-4-D or trifluralin (3 to 4 kg per ha) is also recommended for controlling annual dicot weeds.

Nipping:

Nipping of auxiliary buds of all the branches gives increased seed yields, besides reduction in maturity period and uniform maturity.

Plant Protection:

The major diseases in India are fusarium wilt and Botrytis, Phytophthora and cercospora are minor diseases. For control of *Fusarium wilt* Seed treatment with carbendazim (slurry 2g/Kg or seed soak 1g/l for 12 hrs)/ Tricho-derma viride 10g/kg and soil application 2.5 kg/ha incubated in 125 kg FYM, avoid continuous cultivation. And for control of Botrytis ricini

treatment with prophylactic spray with carbendazim or thiophanate methyl 1 g/l and one more spray soon after disease appearance. Prophylactic spray with *T.viride* + *Pseudomonas fluorescens* 3 g/l, remove infected spikes/capsules & destroy. For control of semilooper, spray 0.35 percent thiodan or 0.03 percent Dimecron, for castor capsule borer, spray thiodan (1200 ml per ha) and for caterpillar, dust 5 percent BHC dust or spray 0.04 percent Malathion solution.

#### Harvesting and Threshing:

The capsules are ready for picking in November. The picking continues until April, because the capsules mature unevenly due to sequential development of racemes. The fruits should be gathered when they start turning light yellow and placed in piles to dry in the sun until they blacken. Later the seeds are beaten out with sticks, winnowed and screened to remove husks, dry skins and soil pebbles. Before storage, the seed must be dried to eight percent moisture content.

#### Seed Yield:

8-10 q/ha. High yielding varieties if managed well may give 15-20 q/ha seed yield under irrigated condition.

### **Conclusion**

Owing to the advancements in the agricultural field, different types of methods are used for cultivation so that the yield is high. The farmers are now following newer methods of cultivation which are far better and help in fulfilling the demand of the local as well as the international markets. Thus, India now produces a variety of castor seeds that are highly popular in the international market.

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