

# **Agronomy – Kharif Crops**

## **Sesame**

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## SESAME

**Botanical name:** *Sesamum indicum* L.

**Family:** Pedaliaceae

**Chromosome number:** 2n=26

Sesame, commonly known as til, is one of the important edible oilseeds cultivated in India. It is grown in the country since antiquity. Its seeds are rich in oil (50%) and protein (18-20%). Nearly 73% of the oil is used for edible purposes, where as 8.3% for hydrogenization and 4.2% for industrial purposes in the manufacture of paints, pharmaceuticals and insecticides. Sesame oil is also used in soap, cosmetic and skin care industries. The oil is very stable and does not turn rancid. It has anti-bacterial, anti-viral, anti-fungal and anti-oxidant properties. Since sesame seed oil is cholesterol free, it is also used in health food industries.

Seeds are used as fried and mixed with sugar and in several forms in sweet meats. White seeded sesame is extensively used in bakery products such as bread, bread sticks, cookies, candies, pasta, vegetables and curry dishes. Black seeded sesame has medicinal properties.

Sesame oil is an important cooking oil in south India. Lower grades of oil are used in soap making industries. The oil cake is an edible cake, rich in methionone, cysteine, arginine and tryptophan. It is used as cattle feed especially for milch animals. It is being used as a valuable ingredient upto 5% in well formulated poultry feed. It can also be used as a manure. Cake contains 6.0-6.2% N, 2.0-2.2% P<sub>2</sub>O<sub>5</sub> and 1.0-1.2% of potash.

### Origin and History

Sesame is presumed to have originated in Africa and later spread to West Asia to India, China and Japan. However, it is also believed that cultivated sesame originated in India. Sesame in wild form (black) was found in India as its use in religious function is mentioned in Sanskrit, and spread to Mesopotamia and then to Babylonia, Egypt, China, Greece etc.

The genus *Sesamum* consists of 35 recognized species (Total is over 60). Out of these, *S. indicum* L. is cultivated extensively. The other 6 partially cultivated species include *S. radiatum* (India, Africa, Sri Lanka), *S. angustifolium* (Congo, Mozambique, Uganda), *S. occidentale* (Africa, Sri Lanka, India), *S. calycinum* (Angola, Mozambique), *S. baumii* (Angola). All other species are wild and found in tropical African countries. Nine wild species have been found in peninsular India.

### Geographic distribution

Sesame is the crop of tropical and subtropical areas. It is grown on 6.5 mha, producing over 3 m tonnes of seed. India, Sudan, Myanmar, Medico and China account for 68% of world production (Table 1).

**Table 1. The major sesame producing countries of world**

Country	Area (m ha)	Production (m t)	Productivity (kg/ha)
India	1.85	0.68	368
Sudan	1.66	0.30	181
Myanmar	1.37	0.55	402
China	0.65	0.78	1083
Uganda	0.21	0.11	521
Nigeria	0.16	0.08	450
Tanzania	0.11	0.04	390
World	7.43	3.28	441

Source: FAO Year Book, 2004.

India accounts for the lion's share of 39% area, 27% production and 40 % export of sesame in the world. India exports sizeable quantity of sesame seeds (2.19 lakh tonnes in 2002) to Germany, Turkey, The Netherlands, USA, Greece, Hong Kong, Israel, China, UK, UAE, etc. to earn valuable foreign exchange. In India, its cultivation is mostly confined to Uttar Pradesh, Rajasthan, Madhya Pradesh, Andhra Pradesh, Orissa, Gujarat, Tamil Nadu and Karnataka (Table 2). In the east (West Bengal, Orissa, Assam and Andhra Pradesh) both red and black seeded sesame are grown, while in Gujarat and other western states, only white seeded sesame is grown.

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

State	Area (000, ha)	Production (000 t)	Productivity (kg/ha)
Andhra Prdaesh	161.0	43.0	267
Assam	14.5	8.0	552
Bihar	3.7	2.7	730
Chattisgarh	25.5	7.2	282
Gujarat	402.4	240.8	598
Himachal Pradesh	4.0	2.0	500
Jammu & Kashmir	6.3	2.8	444
Jharkand	9.0	2.0	222
Karnataka	58.0	25.0	431
Kerala	0.8	0.2	250
Madhya Pradesh	131.2	41.9	319
Maharashtra	123.0	38.0	309
Nagaland	4.0	3.0	750
Orissa	37.7	7.8	207
Punjab	10.6	3.6	340
Rajasthan	311.8	141.2	453
Tamil Nadu	118.0	61.5	521
Uttar Pradesh	174.7	23.2	133
West Bengal	163.3	143.0	876
<b>India</b>	<b>1774.0</b>	<b>803.0</b>	<b>453</b>

Source: Damodaran and Hegde, 2005

## Classification

Based on maturity period, sesame cultivars are classified as: *Early* (possess less number of flowers and branches) and *Late* (possess more number of flowers and branches) types. Based on seed coat colour, they are grouped into *white* and *black* seeded cultivars. Using the number of carpels in the capsules, sesame cultivars are classified as *Bicarpellatum* (two carpels) and *Quadricarpellatum* (four carpels in the capsule).

*On the basis of chromosome number, sesame species are classified into the following three groups.*

Group	Chromosome number	Species
I	2n=26	<i>Sesamum indicum</i> , <i>S. alatum</i> , <i>S. malabaricum</i> , <i>S. mulayanum</i> , <i>S. schenckii</i>
II	2n=32	<i>S. prostratum</i> , <i>S. laciniatum</i> , <i>S. angolense</i> , <i>S. angustifolium</i>
III	2n=64	<i>S. radiatum</i> , <i>S. occidentale</i>

## Botanical Description

It is a herbaceous annual, growing to a height of 0.5-2.0 m.

**Root:** The root system is poorly developed in early maturing varieties. The tap root bears only a few secondary and tertiary roots. Late-maturing varieties have a well developed deep root system that bears a large number of secondary and tertiary roots near the soil surface.

**Stem:** The stem is erect, normally square in section. The upper part of the stem is particularly covered with short hair. Stem colour can range from light green to almost purple, but the most common is darkish-green shade. Some varieties have profuse branching and give the plant a bushy appearance. Some of the varieties do not produce branches.

**Leaves:** The leaves are alternate and opposite. Generally the lower leaves tend to be broader while the upper ones are narrow. The leaf size may vary from 3.0 to 17.0 cm in length and 1.0 to 7.0 cm in width.

**Inflorescence:** The inflorescence is a raceme and the fruit is a capsule. The flowers arise in the axils of the leaves and on the upper portion of the branches and stem. They are mostly self fertilized.



**Sesamum indicum L.**  
Image processed by Thomas Schoepke  
[www.plant-pictures.de](http://www.plant-pictures.de)





## Climatic Requirements

It is a short day plant of tropics and subtropics with an annual rainfall of 400-600 mm. It grows in the plains and hilly regions up to an elevation of 1,300 m. It is sensitive to both low (<20°C) as well as high temperature (>40°C), the optimum being 27-33°C. At temperatures below 10°C, germination and seedling growth is inhibited. It is susceptible to both frost and waterlogging. Heavy rains during crop growth are conducive for fungal diseases. Sesame is susceptible to hail damage at all stages of growth. The crop can withstand drought after establishment.

In northern India, it is grown as rainfed *khariif* crop. In central and western regions comprising parts of Madhya Pradesh, Andhra Pradesh, Gujarat and Maharashtra, it is grown during September-January. Sesame has also gained popularity as a summer crop (January-May) after potato or late rice in West Bengal, Bihar and Orissa. However, in south India, the crop is taken in all the 3 seasons.

## Varieties and hybrids

Sesame is highly sensitive to seasonal variations in terms of day length and temperature. Therefore, varieties recommended for commercial cultivation are location and season-specific. The improved varieties recommended for different parts of the country (semi-*rabi*, *rabi* and summer seasons), are presented in Table 3. The characteristics of important varieties are given in Table 4.

**Table 3. Sesame varieties recommended for various states of India**

State	Varieties
<b>Andhra Pradesh</b>	Gauri, Madhavi, Rajeshwasri, Swetha til, Gautam, Varaha, RT-54, RT-103, JTS-1, Chandana (JCS-94), Nirmala (OS-Sel-164), Pragati
<b>Tamil Nadu</b>	Co-1, KRR-1, KRR-2, Paiyur-1, VRI-1, VRISV-1, TSS-6, TMV-1, TMV-2, TMV-3, TMV-4, TMV-5, TMV-6, Rama, Nirmala
<b>Karnataka</b>	DS-1, E-8, KDSC-1, TMV-3, Rama, JTS-1, Pragati (MT-75)
<b>Maharashtra</b>	AKT-4, MRUG-1, N-128, N-8, Phule til-1, T-85, Tapi, TC-25, RG-54, RT-103, JLT-26 (Padma), JTS-8, Pragati
<b>Kerala</b>	Kayamkulam-1, Kayamkulam-2, Soma, Surya, Thilak, Trilthara, Tilottama, Nirmala
<b>Orissa</b>	Kalika, Kanaka, Usha (OMT-11-6-5), Uma (OMT-11-6-3), Vinayak, TKG-55, TKG-22, TKG-21, RT-125, Prachi (ORM-17), Nirmala
<b>West Bengal</b>	B-67, Krishna, Uma, TKG-21, TKG-55, RT-125, Rama, Punjab til-1
<b>Assam</b>	Uma, SP-1181, ST-1683, TRS-1, TKG-21, TKG-22, TKG-55, RT-125, Rama
<b>Bihar</b>	B-67, Krishna, Usha, Uma, TKG-21, TKG-22, TKG-55, RT-125,



State	Varieties
	Kanke white
<b>Uttar Pradesh</b>	T-12, T-13, T-4, T-78, TKG-21, TKG-22, TKG-55, Shekhar (SH-446), RT-46, RT-125, JTS-8, Pragati
<b>Rajasthan</b>	T-13, TC-25, RT-46, RT-127, Pratap (C 50), JTS-8, Pragati
<b>Punjab</b>	TC-289, TC-25, RT-46, Punjab til-1
<b>Haryana</b>	RT-46, Haryana til-1, Pragati
<b>Gujarat</b>	RT-54, RT-103, Purva-1, Purba-1, Gujarat til-1, Gujarat til-2, JTS-8, Pragati
<b>Madhya Pradesh</b>	TKG-55, TKG-22, TKG-21, RT-125, N-32, Kanchan til (JT-7), JTS-8
<b>HP, J &amp; K</b>	RT-46, TC-25, Punjab til-1

### Hybrids:

Sesame hybrids have been evolved in China to exploit heterosis at commercial scale for the first time, with two hand-emasculated hybrids, having a yield potential of 3 t/ha. In India, All India Coordinated Research Project (AICRP) on Sesame and Niger (ICAR) at Jawaharlal Nehru Krishi Viswavidyala, Jabalpur (M.P.) has evolved some hybrids. Seven experimental hybrids AHY.Til-5, AHY.Til-12, RTH-1, AHYT-13, RHT-3, TKG-HY-5 and TKG-HY-4 exhibited superiority of 31.0 to 44.3% in seed yield and 13.0 to 48.0% in oil yield over TKG-22, the national check variety. The cost of hybrid seed (Rs 350-1000/kg) is, however, a deterrent for its wide adoption. Evolution of CMS based hybrids will solve this problem, and efforts in this direction are underway.

### Soils

The crop prefers well-drained light to medium textured soils with good water holding capacity and moderate fertility. Under irrigated conditions, the crop can be grown successfully in medium-textured soils. Very sandy alkaline and acidic soils are not suitable for its cultivation. The crop can grow in soils with 5.0-8.0 pH with neutral soils being ideal.

### Land preparation

Seeds of sesame are very small; hence require fine seed bed preparation for proper germination of the seeds. The fine tilth can be obtained by one deep ploughing in summer followed by 1-2 cross harrowings and planking. The land should be levelled to avoid damage associated with waterlogging. For the *rabi* crop, the land preparation involves 2-3 harrowings followed by planking.

### Seed and Sowing

#### Seed rate and spacing

The seed rate varies from 5-6 kg/ha in broadcast sowing 2.5-3.0 kg/ha in line sowing. Treat the seed before sowing with cerasan or agrosan GN @ 2 g/kg of seed. Seed treatment with

carbendazim (0.01%) + thiram (0.4%) or *Trichoderma viridi* (0.4%) or *Trichoderma* (0.4%) or cowdung ash (0.4%) may reduce the incidence of *Macrophomina* stem/root rot disease. The most commonly adopted spacing is 30 cm x 15 cm in *kharif*. A wider spacing (45 cm x 10/15 cm) is adopted in Gujarat, Maharashtra and *rabi* season. In Tamil Nadu, square planting of 22.5 x 22.5 cm in *kharif* and 30 cm x 30 cm in *rabi*/summer has been recommended. The depth of sowing should be shallow i.e.between 2-5 cm. The seed being small must be mixed with sand, soil or manure increase quantity for even distribution.

Thinning is carried out to plant to plant spacing and also for efficient use of inputs especially fertility and water. First thinning should be done at 2 weeks after sowing and the final thinning a week later.

### Manures and Fertilizers

Sesame, in general, is grown on residual fertility, but also responds well to direct fertilization. The crop is given 10-20 t/ha of FYM incorporated into the soil at the time of ploughing. The crop invariably responds to N fertilizer. The response varies from 20 to 50 kg N/ha. Nitrogen is applied in 2 equal splits at sowing and flower initial stage (30-35 DAS). Hoeing of soil after top-dressing of N is essential for better response to fertilizer N. Under prolonged drought spells, 2-3% foliar spray of urea 30-35 days after sowing (DAS) gives promising results. Seed treatment with *Azospirillum* @ 600 g/ha along with application of 50% N is usually as effective as 100% N fertilizer. The *Azospirillum* inoculation is more promising under rainfed conditions.

Application of 20-40 kg P<sub>2</sub>O<sub>5</sub>/ha based on soil test value at the time of sowing has been found beneficial. Potassium fertilization is rare in this crop. In soils deficit in available K, application of moderate doses (10-30 kg/ha) of K<sub>2</sub>O is necessary. In Zn deficient soils, as in Madhya Pradesh, 25 kg ZnSO<sub>4</sub>/ha application once in 3 years is recommended. The recommended fertilizer doses for *rabi* and *zaid* sesame are given below.

### Recommended dose of fertilizers for different states

State	Condition	NPK (kg/ha)
Andhra Pradesh	Irrigated	40:40:20
Gujarat	Irrigated	25:25:0
Madhya Pradesh	Rainfed	30:30:0
Maharashtra	Rainfed	30:0:0
Orissa	Rainfed	30:20:0
Tamil Nadu	Rainfed	23:13:13
	Irrigated	25:23:23

## **Water management**

Sesame is mainly raised as a *khariif* rainfed crop. The crop is rarely irrigated, inspite of the fact that it is highly susceptible to moisture stress. Hence, during prolonged dry spells, a protective irrigation especially at flowering stage is essential for realizing economical yields.

The crop is raised under irrigation during both *rabi* and summer seasons. The water requirement of sesame varies from 400-600 mm. The critical stages of irrigation in sesame are 4-5 leaf stage, flowering and pod formation. Besides a pre-sowing irrigation, the crop requires irrigation at 12-15 days interval. *Rabi* crop requires 3-4 irrigations coinciding with critical growth phases, whereas summer crop requires 5-6 irrigations. Flooding and border strip are the two common methods of irrigation. The border strip method of irrigation is more efficient.

## **Weed Management**

The slow initial growth of sesame and intermittent rains provide conducive environment for weed growth. The critical period of crop-weed competition for sesame is 20-30 days after sowing. Therefore, the crop requires effective control of weeds during this period. This is achieved by 2 hand weedings at 15 and 35 days after sowing (DAS) in broadcast and line sown crop. In line sown crop, hoeings (both manual and mechanical) are possible. At times of labour scarcity and severe weed infestation use of pre-emergence herbicides pendimethalin @ 1 kg /ha, diuron @ 0.5 kg/ha and alachlor @ 2 kg/ha for weed control during initial periods is advised. The integration of herbicides with one hand weeding at 30-35 DAS provides more efficient control of weeds.

## **Cropping Systems**

*Khariif* sesame is usually grown both as pure and mixed crop. In north India, it is generally grown mixed with pigeonpea, sorghum, pearl millet, groundnut, cotton and maize crops. Intercropping with groundnut (2:4) and chickpea (3:3) results in higher total productivity in Tamil Nadu. In the eastern region it is normally sown after the potato crop.

Sesame intercropping with blackgram (1:3) shows least incidence of *Phytophthora* blight. Similarly, its intercropping with maize minimizes incidence of *Alternaria* leaf spot. Sesame + pigeonpea (3:1 row proportion) may reduce the incidence of phyllody. Inter or mixed cropping with mothbean or mungbean may minimize the *Macrophomina* stem or root rot incidence.

## **Harvesting and Threshing**

The crop is harvested when leaves and capsules turn yellow and defoliation starts. Harvesting at proper time is very important, as the delayed harvesting may result in shattering of capsules. After harvest, bundles are staked erect on the threshing floor for several days for drying, and thereafter threshed.

## **Yield**

The yield fluctuates widely (0.2-1.0 t/ha) depending upon the variety, method of cultivation and weather conditions. However, with the improved package of practices, it should be possible to obtain 0.8-1.0 tonnes of seed/ha. Oil to seeds crushed is 40% and cake to seeds crushed is 60%.

**Table 4. Suitable varieties of Sesame for different states**

Varieties	Maturity period (days)	Yield (q/ha)	Oil (%)	Other
<b>Uttar Pradesh</b>				
T4	98	7.00	52	White seed, suitable for Bundelkhand
T10	90	4.50	51	Early variety, white seeded
T12	88	8.00	52	White seeded
T13	90	8.00	46	Black seeded, suitable for whole Uttar Pradesh
RT46	80			White seeded. Also suitable for Punjab, Haryana, Himachal Pradesh and Jammu and Kashmir
RT25	75-80	6.00	50	
<b>Bihar</b>				
B 3-2	115	1.90	48	Black seeded
B 3-3	115	1.90	47	Black seeded
<b>Punjab and Haryana</b>				
T5	90	3.50	50	Black seeded
T22	100	3.50	46	Black seeded
Punjab Til 1	80	5.50	53	Seeds are bold and white in colour
TC289	95	5.00	53	Larger size seed
T 12-24	85	4.00	50	
<b>Madhya Pradesh</b>				
N32	95-100	7.70	53	Selection from local material of Chattarpur district of M.P., single stemmed, multicapsular, shining white seeds. <i>Semi-rabi</i> , <i>Sesamum</i> growing areas of MP, viz. Hoshangabad, Score, Raisen and Narsinghpur
JT7	85	7.00	53	Bold white seed, Erect
No.32	96	7.00	54	Erect, white shining seed
No. 41	120	5.00	54	Light brown seed, suitable for <i>kharif</i>
No. 128	100	6.50	50	Erect, light brown seed, suitable for Narmada valley area

Varieties	Maturity period (days)	Yield (q/ha)	Oil (%)	Other
Gwalior (G) 5	95	5.50	53	Erect, branch area less, bold white seed
Gwalior 35	95	4.75	52	
No. 8	90-100	6.00		A selection from local material of Nagpur. Semi-rabi, <i>Sesamum</i> growing areas of MP
<b>Rajasthan</b>				
Pratap (C50)	98	5.50	48	White seed, 6 leaves per node, 4-6 capsule
T13	90	8.00	50	White seeded, suitable for rainfed area
TC25	85	5.00	50	Bold white seed, 4-5 branch/plant
<b>Andhra Pradesh</b>				
Gauri	95-100	8.00	37	A selection of local material of Vishakhapatnam district. It is recommended for irrigated conditions in coastal districts of Andhra Pradesh in <i>rabi</i> /summer season
Madhavi	70-75	8.50	44	A selection from local material of Vishakhapatnam district. It is recommended for irrigated condition in coastal districts of Andhra Pradesh in <i>rabi</i> /summer season
Chandana (JCS 94)				High yielding, sandal wood coloured seed
<b>Orissa</b>				
Vinayak	-	-	-	Toerant to leaf spot
Kanak	78	6.00	47	Developed from the cross 'Vinayak x T4. Suitable for summer season in whole of Orissa
Kalila	82	6.00	48.7	Mutant of 'Vinayak'. Suitable for summer season in whole of Orissa
Prachi (ORM17)	-	-	-	Black seeded, pests and disease resistant varieties
<b>Maharashtra</b>				
hule Til 1	95	6.50	51	Selection from local material, with light brown, bold seeds. Whole of semi-rabi of the state
<b>Gujarat</b>				

Varieties	Maturity period (days)	Yield (q/ha)	Oil (%)	Other
Gujarat til 1	85-90	5.50	51	Selection from local material with light brown seeds
Purva 120	120	5.00	50	Multi-capsular, suitable for semi-rabi season, reddish seeds
Gujarat til 10	105	7.50	47.5	A black seeded variety suitable for <i>kharif</i>
<b>Tamil Nadu</b>				
TMV 4	85	6.50	52	Pure line selection from 'Sattur' variety. Profusely branched with brown seeds. Ideally suitable for summer irrigated season
TMV 2	80-85	4.00-6.00	52	Suitable for cold season
TMV3	-	5.00-10.00	50	Brownish-black seeded, resistant to wilt & shoot borer
TMV5 and TMV6	85-95	7.00	54	Tall growing, moderate branching, brownish black seeds. Drought tolerant. Suitable for Salem district
Co.1		7.30	-	Evolved from a cross (TMV3 x SI 1878) x SI 1878
<b>Kerala</b>				
Kayam Kulam 1	90-100	5.00	-	Local selection, branches, and is suitable for Onattukara region and similar areas for rice fallows
Thilothama (Kayam Kulam 2)	-	6.00	-	Evolved from cross between PT58-35 x Kayam Kulam 1. It performs well under low land rice fields and in uplands
<b>West Bengal</b>				
B67	100	6.00	50	Local selection for West Bengal. Seeds are black. Suitable for summer
Thilarani	80	6.80	51	Dark brown seeded, high yielding <i>rabi</i> variety
B9, N.10, B14				
<b>Assam</b>				
RT1	95-100	8.00	50	Suitable for summer season

