

OILSEED CROPS



GROUNDNUT

ECONOMIC IMPORTANCE. The oil content of the seed varies from 44 to 50 per cent, depending on the varieties and agronomic conditions. Groundnut oil is an edible oil. It finds extensive use as a cooking medium both as refined oil and Vanaspati Ghee. It is also used in soap making, and manufacturing cosmetics and lubricants, olein stearin and their salts. Kernels are also eaten raw, roasted or sweetened. They are rich in protein and vitamins A, B and some members of B₂ group. Their calorific value is 349 per 100 grammes. The H.P.S. type of groundnut kernels are exported to foreign countries. The residual oilcake contains 7 to 8 per cent of N, 1.5 per cent of P₂O₅ and 1.2 per cent of K₂O and is used as a fertilizer. It is an important protein supplement in cattle and poultry rations. It is also consumed as confectionary product. The cake can be used for manufacturing artificial fibre. The haulms (plant stalks) are fed (green, dried or silaged) to livestock. Groundnut shell is used as fuel for manufacturing coarse boards, cork substitutes etc. Groundnut is also of value as rotation crop. Being a legume with root nodules, it can synthesise atmospheric nitrogen and therefore improve soil fertility.

DISTRIBUTION, AREA AND PRODUCTION

The major groundnut-producing countries of the world are India, China, Nigeria, Senegal, Sudan, Burma and the USA. Out of the total area of 18.9 million hectares and the total production of 17.8 million tonnes in the world, these countries account for 69% of the area and 70% of the production. India occupies the position, both in regard to the area and the production, in the world. About 7.5 million hectares is put under it annually and the production is about 6 million tonnes. 70% of the area and 75% of the production are concentrated in the four states of Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka. Andhra Pradesh, Tamil Nadu, Karnataka and Orissa have irrigated area forms about 6% of the total groundnut area in India.

CLIMATE AND SOIL. Groundnut is grown throughout the tropics and its cultivation is extended to the subtropical countries lying between 45 degrees N and 35 degrees S and upto an altitude of 1000 metres. The crop can be grown successfully in places receiving a minimum rainfall of 1,250 mm. The rainfall should be well distributed well during the flowering and pegging of the crop. The total amount required for presowing operations (preparatory cultivation) is 100 mm; for sowing, it is 150 mm and for flowering and pod development an evenly distributed rainfall of 400-500 mm is required. The groundnut crop, however, cannot stand frost, long and severe draught or water stagnation.

Groundnut is grown on wide variety of soil types. However, the crop does best on sandy loam and loamy soils and in the black soils with good drainage. Heavy and stiff clays are unsuitable for groundnut cultivation as the pod development is hampered in these soils.

SEASON. Groundnut is raised mostly as a rainfed kharif crop, being sown from May to June, Depending on the monsoon rains. In some areas or where the monsoon is delayed, it is sown as late as August or early September. As an irrigated crop it is grown to limited between January and March and between May and July.

YIELD. Under rainfed conditions, the average yield of semi-spreading and spreading varieties is 1200-1400 kg of unshelled pods per hectare and that of bunch types is 800-1,000 kg. The crops grown with supplemental irrigations produce 3,000 kg more of pods per hectare. The pods yield 70 to 75 per cent of kernels by weight. The yield of haulms is usually two to two-and-half times that of pods.

RAPSEED AND MUSTARD Under the names rapeseed and mustard, several oilseeds belonging to the cruciferae are grown in India.

1. Brown mustard, commonly called rai (raya or laha)--*Brassica juncea* (L.) Czern. & Coss
2. Sarson
 - o Yellow sarson--*B. campestris* L. var. *sarson* Prain
 - o Brown sarson--*B. campestris* L. var. *dichotoma* Watt
3. Toria (lahi or Maghi Labi)--*B. campestris* L. var. *toria* Duth.
4. Taramira or tara (*eruca sativa* Mill.)

In trade, sarson, toria and Taramira are known as rapeseed, and rai as mustard.

ORIGIN. *Brassica juncea* L. (rai) was originally introduced from China into north-eastern India. From where it has extended into Afghanistan via the Punjab. Eastern Afghanistan, together with the adjoining north-western India is one of the independent centres of brown sarson (*Brassica campestris* var. *brown sarson*). Yellow

sarson (*B. campestris* var. yellow sarson) is commonly grown in the eastern parts of India where it shows much diversity of forms. Taramira is a relatively recent introduction into India. It is believed to be a native of southern Europe and North Africa.

ECONOMIC IMPORTANCE. Rapeseed and mustard yield the most important edible oil content of the seeds of different ranges from 30 to 48 per cent. In the case of white mustard, the oil content ranges from 25 to 33 per cent. The oil obtained is the main cooking medium in Northern India and can not be replaced by any other edible oil. The seed and oil are used as a condiment in the preparation of pickles and for flavouring curries and vegetables. The oilcake is mostly used as cattle feed. The leaves of young plants are used as a green vegetable. The use of mustard oil for industrial purposes is rather limited on account of its high cost.

CLIMATE AND SOIL. The rapeseed and mustard crops are of the tropical as well as of the temperate zones and require relatively cool temperatures for satisfactory growth. In India, they are grown in the rabi season from September-October to February-March. The rapeseed and mustard crops grow well in areas having 25 to 40 cm of rainfall. Sarson and toria are preferred in low-rainfall areas, whereas raya and toria are grown in medium and high-rainfall areas respectively.

The rapeseed and mustard thrive best in light to heavy loams. Raya may be grown on all types of soil, but toria does best in loam to heavy loam. Sarson is suited to light-loam soil and taramira is mostly grown on very light soils.

CULTIVATION. A fine seed-bed is required to ensure good germination. In irrigated areas, the first ploughing is done with a medium sized soil-turning plough, followed by two to four ploughings with a desi plough or a cultivator. Sohaga (Planking) is given after every ploughing.

In rainfed areas, one to two ploughings with a desi plough or a cultivator, each followed by planking, may be given. Toria, in particular, requires a fairly moist seed-bed for good germination, but excessive moisture should be avoided. The rate in the case of mixed cropping depends on the proportion of the rapeseed to the main crop.

When sown pure, 5 kg of seed per ha is used for all rapeseeds and mustard. When sown mixed with other crops, the time of sowing rapeseed and mustard is governed by the sowing of the main crop. The first half of September is best for sowing toria (if wheat is to follow, it should be sown by the end of August), 25th September to 15th October for sarson, 30th September to 15th October for raya, and tarantira is sown throughout October. The seed from healthy and desirable plants, grown in isolation in the case of self-sterile form, should be used. Whenever moisture in the field is inadequate, the seed is mixed with moist soil and kept overnight. For distributing evenly, the seed is usually mixed with sand before sowing.

In mixed cropping rapeseed and mustard are sown in rows 1.8 to 2.4 metres apart across the main crop. The pure crop of rapeseed or mustard is sown at a depth of 4 to 5 cm in lines, 30 cm apart, with a drill, or with a (tube) attached to the plough. Thinning is done three weeks after sowing to maintain a plant-to-plant distance of 10 to 15 cm.

One hoeing in the case of toria in the third week after sowing and 1-2 hoeings in the case of sarson and raya are adequate. Forty kg of W per ha is optimum for all rapeseed and mustard crops in rainfed areas. Under irrigated conditions doses of 40 and 80 kg of W per ha are considered optimum for toria, sarson and rapeseed respectively. For tarantira, 20 kg of W per ha is ancient. All the fertilizers should be drilled before sowing. Among the Brassicaceae, raya is most responsive to irrigation, followed by yellow sarson. Two irrigations, one at flowering and the other at pod formation, result in the maximum yield in the case of toria, sarson and raya. Its flowering is most economical, if there is water scarcity. Tarantira is not irrigated.

Harvesting is done as soon as the crop begins to turn yellow. Tma, which takes 75 to 90 days to mature, is the earliest crop to be harvested. Harvesting is done with hand-sickler. Threshing is done by beating with a wooden stick the seed bearing part of the plants, taken in convenient bundles or by trampling them under the feet. Winnowing is done with by slowly dropping the threshed produce from a basket held shoulder-high. The seed after being dried in the sun is stored in gunny bags or bins.



SESAMUM

GEOGRAPHIC ORIGIN. Sesamum (*Sesamum indicum* L.), also known as sesame, til and gingerly, is an important and ancient oil-yielding crop. Africa is considered to be the primary centre of origin of this crop because of the presence of its diverse wild species in that continent. India is the secondary centre of origin and another secondary centre is Japan.

ECONOMIC IMPORTANCE. The sesamum seed is a rich source of edible oil. Its oil content generally varies from 46 to 52 per cent. Its grains may be eaten fried, mixed with sugar or in the form of sweetmeats. Sesamum oil is used as a cooking-oil in southern India. It is also used for anointing the body, for manufacturing perfumed oils and for medicinal purposes. Sesamum-cake is a rich source of protein, carbohydrates and mineral nutrients, such as calcium and phosphorus. The cake is edible and is eaten avidly by working classes. It is also a valuable and nutritious feed for milch cattle.

CLIMATE AND SOIL. Sesamum grows in the plains and at elevations up to 1,200 m. It cannot stand frost, continuous heavy rain or prolonged drought. It is grown in sandy-loam to heavy black soils. Most of the crop is confined to lighter soils and its cultivation in heavy soils is limited to certain regions. The pH of sesamum growing soils ranges from 5.5 to 8.2. The sesamum growing soils are shallow to medium in Andhra Pradesh, Orissa, Andhra Pradesh and Tamil Nadu and are deep in Rajasthan, Gujarat and Maharashtra.

MIXED CRPOPPING. sesamum is grown both as pure and mixed with other crops, whereas the semi-rabi and summer crops are taken as pure. The common component crops are red-gram (arhar) in Andhra Pradesh, bajra and red-gram in Gujarat, red-gram and jowar in Madhya Pradesh. cotton, groundnut and red-gram in Maharashtra, and black-gram, green-gram and horse-gram in Orissa.

CULTIVATION. In India, seasmum is grown in three seasons, viz. kharif, semi-rabi and summer. The kharif crop occupies over 70 per cent of the area, whereas the semi-rabi and summer crops occupy 20 per cent and 10 per cent area respectively. The kharif sesamum is sown in June-July with the onset of the monsoon and is harvested in December-January. The kharif and semi-rabi crops are entirely rainfed, whereas summer crop is grown under irrigation. The yield of the kharif crop is poor, whereas those of the semi-rabi and summer crops are high, as they are grown in rich soils and under better management. The preparatory cultivation for the kharif crop is usually not thorough. For the semi-rabi and summer crops, the land is ploughed and harrowed repeatedly to secure a clean and fine seedbed. Except in Maharashtra and Gujarat, where line-sowing is practised, in all other states it is sown broadcast. The recommended spacings for the line-sown crop in different regions, however, range from 25 to 35 cm between the rows and 10 to 20 cm between the plants in the row. The seed being small, it is often mixed with sand to ensure its even distribution and the drill is operated rather shallow to avoid deep sowing. After sowing, the seed is covered lightly with a brush harrow. The seed-rate varies from 3 to 5 kg per hectare. The seed should be treated with Captan or Thiram at the rate of 3 g per kg of seed to control seed-borne diseases.

The rainfed crop is weeded and hoed once or twice and the irrigated crop is weeded often. Wherever the weed control with mechanical means is a problem, chemical weed control with pre-emergence application of Lasso at the rate of 3 litres/ha is recommended. The crop is generally recommended for different regions as 25-30 kg of W, 20-30 kg of P₂O₅ and 0-20 kg of K₂O per hectare. The crop is harvested when the leaves, stems and capsules begin to turn yellow and the lower leaves start shedding. To prevent the shedding of grains, the crop should not be allowed to become a drip in the field. The ripe plants are cut, carried to the threshing-yard, stacked for a week in the sun with the cut-ends downwards and well shaken or beaten to take out the grains from the dry capsules. Winnowing and cleaning completes the process.



LINSEED

GEOGRAPHIC ORIGIN. Linseed (*Linum uaitdissimum* L.) belongs to the family Linaceae and the genus *Linum* which has 100 species. It has been grown from ancient times for fibre (flax) and for its seed which is rich in oil. The oldest regions of cultivated flax are reported to be in Asia and on the Mediterranean coast.

ECONOMIC IMPORTANCE. Linseed occupies a greater importance among oilseeds; owing to its various uses and special qualities. In India, it is grown mainly for seeds, used for extracting oil. The oil content of the seed varies from 33 to 47 per cent. Linseed oil is an excellent drying oil used in manufacturing paint and varnishes, oilcloth, waterproof fabrics and linoleum and as an edible oil in some areas. Linseed-cake is a very good manure and animal feed. Linseed straw produces fibre of good quality. Linseed is used in making paper and plastics.

AREA AND DISTRIBUTION. Linseed is extensively grown in the countries of the temperate zone as well as in those of the tropical zone. The major linseed-growing countries are Argentina, the USSR, India, the USA, Canada, Pakistan and Australia. India accounts for about 1.9 million hectares, with a seed production of 4.98 lakhs of tonnes and occupies the third rank among the linseed-producing countries. Australia and Canada have the highest productivity of about 7 quintals per hectare, whereas India averages 255 kg per ha. This yield is the lowest in the world.

In India, Madhya Pradesh leads in yield and acreage, followed by Uttar Pradesh and Maharashtra, Bihar, Rajasthan, Karnataka and West Bengal also grow linseed in large areas. Madhya Pradesh and Uttar Pradesh together contribute to the national linseed production to the extent of about 70 per cent.

CLIMATE AND SOIL. Linseed is grown in the range of latitudes between the 10th and 65th parallels, both north and south. Its cultivation is confined to low elevations, but it can be successfully grown up to 770 metres. Areas with the annual rainfall ranging from 45-75 cm are best suited for its cultivation. The seed crop does well under moderate cold, but the fibre crop grows best in cool moist climates. In India, the crop is grown in the rabi season from September-October to February-March.

Linseed can be grown on different kinds of soils, except the sandy and badly drained heavy clays or clay loams. It does well on the deep clayey black soils of central and peninsular India and on the alluvium loams of the Indo-Gangetic plains.

CULTIVATION. Fields of linseed are prepared as for other crops. Frequent ploughings are given to retain moisture and to check weeds in the field during the rainy season and a fine weed-free seedbed is prepared for sowing. BHC 10% or Aldrin or Chlordane 5% dust at the rate of 26-30 kg per ha is mixed within soil during the last ploughing before sowing to protect the seedlings against white-ants and the early damage from cutworms.

The main season for sowing linseed is October to November, depending upon the cessation of the rains. The crop is grown either broadcast or is drilled in lines 20 to 30 cm apart: In the case of broadcasting, which includes uterasowing also, the seed-rate is kept at 40 kg per ha. For line-sowing, the seed-rate varies from 20 to 510 kg per ha, depending upon the seed size. Thin sowing gives a good number of tillers, but for fibre and weed, thick sowing is desirable.

The application of fertilizers and irrigation increases the yield of the crop. Under rainfed conditions, the fertilizer dose including 30 kg of N and 15 kg of P per ha is given. If irrigation is available, two to three irrigations are sufficient. Under irrigated conditions, the linseed crop requires 60 kg of K and 30 kg of P per ha.

The deep placement of fertilizer at sowing in the case of the rainfed crop gives better results. Under irrigated conditions, nitrogen is applied in two splits, half the dose as basal and the other half at the first irrigation, 40 to 50 days after sowing. The utera crop is fertilized at the rate of 10 kg of N per ha applied at the time of sowing. The rainfed crop generally requires no interculture. When the crop is irrigated, one weeding becomes essential.

YIELD. The average yield of a pure crop varies from 210 to 450 kg per ha of seed under rainfed cultivation. The crop in northern India generally gives higher yield than in central and peninsular India. The irrigated crop may yield 1,200 to 1,500 kg per ha.

The percentage of oil in the seeds varies from 37 to 43, but the commercial extraction in expellers of rotaries gives about 33 per cent from small seeds and 34 to 36 per cent from hold seeds. Crushed in village ghanis, the seeds yield only 25 to 30 per cent of oil.



CASTOR

GEOGRAPHIC ORIGIN. According to the available literature, castor (*Ricinus communis* L.) is indigenous to Eastern Africa and most probably originated in Ethiopia.

ECONOMIC IMPORTANCE. It is generally grown for its oil-yielding seeds. The oil content of the seeds varies from 35-58 per cent in different varieties, the average being about 47 per cent. Castor-oil is being used widely for various purposes. It is used as a lubricant in high-speed engines and aeroplanes, in the manufacture of soaps, transparent paper, printing-inks, varnishes, linoleum and plasticizers. It is also used for medicinal and lighting purposes. The cake is used as a manure and plant stalks as fuel or as thatching material or for preparing paper-pulp. In the silk-producing areas, leaves are fed to the silkworms.

YIELD. The average yield of rainfed castor varies from 200 to 500 kg per hectare, that of the mixed crop from 100 to 200 kg and of the irrigated crop from 500 to 800 kg. In eleven years (from 1964-65 to 1974-75), the average total yield of castor in India has risen to 350 kg per ha.



SAFFLOWER

The three centres of origin, as suggested by Vavilov for safflower (*Carthamus tinctorius* L.), are India, Afghanistan and Ethiopia. Decandole was of the opinion that Arabia was the most

probable centre of origin.

ECONOMIC IMPORTANCE. The crop is now cultivated, primarily for its seeds which yield oil, though at one time it used to be grown for the extraction of a dye also. The seeds are edible and are eaten after roasting. Their oil content varies from 24 to 36 per cent, depending on the variety, soil, climate and other conditions. The cold-pressed oil is golden yellow and is used for culinary purposes, or for making soap. The oil obtained by dry hot distillation is black and sticky and is used only for greasing well ropes and leather goods exposed to water. Safflower oil has also good drying properties and is, therefore, used in the manufacture of paints, varnishes and linoleum. It can be mixed with white paint without any after-yellowing effects. The cake, particularly from decorticated seed, is used as a concentrated cattle feed, and that from undecorticated seed is sometimes used as a manure.

CLIMATE AND SOIL. The crop is grown during rabi primarily as a rainfed crop, but in some areas it is raised under irrigation. At all stages of growth of the crop, excessive rainfall or humidity increases damage from fungal diseases. Water-logging due to poor drainage or prolonged rains even for relatively short periods can cause substantial fall in seed-yield. Being drought-resistant, it is cultivated on all types of soil, including sandy soil, but it thrives best on water-retentive black soils and alluvial loams. The crop is fairly resistant to saline condition.

CULTIVATION. Safflower is grown mostly as a mixture with wheat, barley, gram and rabi jowar, three rows of safflower being planted after every nine, 12 or more rows of the main crop. Sometimes, it is sown as border rows surrounding the crops of wheat, rabi, jowar, etc., because being spiny, it protects the main crop against cattle trespass. As a pure crop, it is rotated with wheat, gram and rabi jowar. Occasionally, it is grown as a second crop after any quick-maturing kharif crop, e.g. green-gram (moong), black-gram (mash), groundnut, coriander, etc.

The number of ploughings should be as few as possible and be aimed at preserving the maximum amount of soil moisture. One or two ploughings with a country plough will be sufficient to remove the weeds and break the clods. Sowing is generally done in September and October. The seed-rate adopted varies from 5 to 12 kg per hectare, depending upon the soil fertility and the nature of the crop (pure or mixed). When grown in strips, a row spacing of 45 cm is adopted. Plants too close tend to have thinner stems or wear a superficial root-system, with a reduced number of flowers. In general, the pure crop is given one or two weedings, combined with hoeing on the 20th and the 45th day after sowing. The application of 20-40 kg of N per hectare results in a substantial increase in yield. The mixed crop shares the preparatory tillage, manuring and cultivation given to the main crop. When the plants have developed the central flowering head, they are topped to promote branching, flowering and seed production.

HARVESTING AND YIELD. The crop matures in 4 or 5 months after sowing. The ripe plants are either cut or pulled out, stacked for a few days to dry, threshed by cutting with sticks, and the resulting material is winnowed to obtain clean seeds. The average yield of the pure crop is 400-500 kg of seed per hectare, whereas that of a mixed crop is about 100 kg.



SUNFLOWER

ORIGIN AND DISTRIBUTION. The cultivated sunflower (*Helianthus annuus* L.) is a native of southern United States and Mexico, from where it was taken to Spain before the middle of the sixteenth century. In the nineteenth century, the cultivation of sunflower as an oilseed crop began in the Soviet Union and the majority of the present day varieties grown all-over the world trace back their origin to the USSR. The major sunflower-producing countries of the world are the Soviet Union, Argentina, Bulgaria, Rumania, Turkey and South America. Sunflower, as an oilseed crop, was introduced into India in 1969 and, according to the estimates of the trade and the Vanaspati Manufacturers Association, 3,88,000 hectares of sunflower was grown in India during 1975-76.

ECONOMIC IMPORTANCE. Sunflower is mainly grown for its oil. The oil is used for culinary purposes, in preparation of vanaspati and in the manufacture of soaps and cosmetics. It is especially recommended for heart patients. Its cake is rich in protein and is used as a cattle and poultry feed.

CLIMATIC AND SOIL REQUIREMENTS

Sunflower is a day neutral plant can be grown successfully in different seasons under varying conditions of day length, provided the temperature is favourable. Sunflower, basically a temperature plant, can also be grown commercially in tropical or sub-tropical conditions. It grows best with clear sky and occasionally rain shower during early stages. This crop requires a cool climate during germination and seedling growth and warm non-cloudy weather and high temperature during flowering to maturity. Sunflower can tolerate

temperature range of 8 to 30°C but the temperature below 16°C and above 40°C reduces yield and oil content. High temperature affects pollination and fertilization, thus care should be taken to adjust the sowing date in such a way that flowering does not coincide with high temperature. The optimum temperature for best performance under controlled conditions is 27-28 °C. Sunflower can be planted successfully when soil temperature exceeds 10°C, though germination begins at 3-5°C. Young plants (1 or 2 pairs of leaves) can withstand frost to -6°C. However, plants are frost sensitive from 6-8 leaf stage until flowering finishes. Late frost does not destroy the whole plant but destroys the fruiting head, leading to increased branching, resulting in small heads with many empty fruits. During flowering temperature should be between 18-20°C. Good yields are obtained where the ruling temperature is 18-22°C showing that generally speaking the crop needs a warm climate. Average minimum temperature below 17°C between flowering and maturity is necessary to ensure best oil quality. The crop is grown from 45°S to 55°N but greater production is between 20-50°S. The crop can be cultivated up to an altitude of 2500m but highest yield of oil is obtained below 1500m. Sunflower cannot tolerate frost and requires a frost free period of 120 days. It is resistant to drought but requires continuous availability of soil moisture for the best performance.

Sunflower can thrive on a wide range of soils such as sandy loam, black soil and alluvial soil, but it performs better on sandy loam soil than on clay soil under similar management. However, good drainage is more important than soil type. Thus, fertile, well drained, medium textured soils having heavy water holding capacity are best suited for the cultivation of sunflower. Sunflower is highly susceptible to water logging. Avoid cultivation of sunflower on soils affected by salts and with poor drainage. The optimum pH requirement is 6.0 to 8.5.

PREPARATORY TILLAGE

Sunflower requires a fine seedbed, free of weeds and clods, for proper germination and good crop stand. To bury the residues or previous crop, ploughing with disc harrow followed by 2-3 cultivations and plankings may be required. Fields vacated by potato may not require much seedbed preparation. However, adequate soil moisture is essential for good germination.

SOWING TIME

Spring season is the best for getting higher and stable seed yield sunflower. Sunflower being a cross pollinated crop depends on honey bees for pollination and seed setting. Availability of honey bees is abundant during spring season due to favourable conditions. Planting during spring should be made after the soil temperature exceeds 10°C at 10cm depth at 8 a.m. Earlier planting at lower temperature increases time of flowering without much earliness. Best results are obtained when crop is sown in the first fortnight of January which produces higher seed yield than later planting. Sowing of short duration hybrids like GKSFH-2002, PSFH-67 and nsfh-592, however, can be extended up to second fortnight of January. Besides low yields, the late sowing may also face early monsoon rain at harvesting and threshing causing difficulty in its management.

WATER MANAGEMENT

Sunflower can withstand moderate drought because of its deep root system. However, it responds favourably to irrigation and its seed yield can be increased substantially by sustaining adequate moisture in soil by timely irrigations besides improvements in oil content. Sunflower is highly moisture sensitive plant and its broad leaves exhibit wilting with slight moisture deficiency.

First irrigation to sunflower should be applied a month after sowing and interval during the subsequent months be reduced to 2-3 weeks during March and 8-10 days during the hot months of April and May. Irrigation should be stopped about 12-14 days before harvest. Sunflower is a tall growing plant with heavy head, therefore, irrigation at flowering and thereafter should be given on clam days to avoid lodging. The incidence of Sclerotinia stem-rot is more under irrigated conditions especially where the soil drainage is poor. Excessive and frequent irrigations on fine textured soils should be avoided.

HARVESTING AND THRESHING

The crop is ready for harvesting when the back of flower heads turn lemon yellow or yellowish brown near the stalk and the discs start drying. At this stage the seeds give a blackish look and are fully ripe. The shedding of disc-flower residues from undamaged heads also indicates physiological maturity. Promptly harvesting seed after physiological maturity has many advantages; seed is least exposed to bird and rodent attack; the crop cycle is shorter resulting in more time to prepare for the next crop; reduces harvest seed losses; provides high quality seed and reduces exposures to bad weather. The harvested heads are mildly dried and threshed by beating or trampling with tractors or sunflower threshers. The sunflower threshers are more efficient and economical. After threshing the produce should be thoroughly dried before storing otherwise in storage it gets affected by fungus and decomposes.



NIGER GEOGRAPHIC ORIGIN. The Niger (*Guizotia abyssinica* L.F. Cass. crop is said to be indigenous to tropical Africa and more specifically to Ethiopia.

ECONOMIC IMPORTANCE. The crop is grown for its seed, used for extracting oil which is about 37 to 43 per cent of the seed weight. The oil is used for culinary purposes, for anointing the body, for manufacturing paints and soft soaps, for lighting and lubrication and for manufacturing cosmetics. The oilcake is a well-known cattle feed. The crop sheds a large quantity of dry leaves in the field and thereby adds organic matter to the soil.

CLIMATE AND SOIL. Niger is grown as a kharif crop under rainfed conditions. A moderate rainfall of 1,000-1,250 mm suits this crop and, as such, it is not cultivated in regions of heavy rainfall.

Light red soils and brownish loams with sufficient depth and good texture are considered suitable for this crop. It is often grown on poor soils of coarse texture. It can be grown on well-drained heavysoils.

CULTIVATION. Niger is grown either as a pure crop or is grown mixed with minor millets. Two to three ploughings are enough to prepare the land for sowing. The field is made weed-free and levelled by planking before sowing. The crop is sown from June to August, either behind a country-plough or with a four-coultered drill. A spacing of 30 cm between lines and that of 10-15 cm between plants in the line are generally adopted. A seed-rate of 7-8 kg per hectare is adequate to maintain a good crop-stand and a pure crop. About a fortnight after sowing, thinning is done to regulate spacing between plants. One or two hoeings are required for controlling weeds. In general, the Niger crop is not manured. But the application of 20 kg of N and 20 kg of P₂O₅ per hectare is recommended for obtaining higher yields of the crop. When sown as a mixed crop, Niger shares the manuring given to the main crop. The crop matures in November and December. The mature plants are cut with sickles at the base and heaped in the threshing-yard for a week. They are then spread in the sun to dry for two to three days, threshed by beating with sticks, and winnowed.

YIELD. The average yield of Niger is about 200 kg/ ha, but under favourable conditions and with best management practices it yields up to 600 kg.