GROUNDNUT

Groundnut (*Arachis hypogaea* L.), is an important oil seed crop grown in India. The NEH region is a non-traditional area for groundnut production. The crop has been newly introduced for cultivation in NEH region and found successful as rainfed crop during *kharif* season. It has got very high yield potential. The crop is gaining popularity among farmers of NEH region due to its multiple benefit as food, feed, cover crop and for restoring soil fertility. By far the groundnut is found as most potential field crop for organic production in the North-eastern region due to its high yield potential, ability to grow in marginal soils with minimum input and management and less problem of pests and diseases. However, the yield of groundnut in farmers field is low, mainly due to lack of improved technology available with them. The adoption of appropriate package of practices can increase the productivity of groundnut substantially in the NEH region.

Climate and soil

Groundnut is grown throughout the tropics and its cultivated up to 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 during the flowering and pegging of the crop. 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 grows 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.

Land preparation

With the onset of rains in April-May, the field is given two ploughings to make the land weed free and the soil is pulverised well to obtain a good tilth. The third ploughing may be given just before sowing. In terraces and flat lands, raised beds of 10-15cm height should be prepared to avoid water logging problems.

Varieties

Cultivars suitable for cultivation in NEH regions are ICGS 76, ICGS 44, ICGV 86590, TKG 19A, OG52l and ICGS 11.

Seed selection and treatment

Healthy and well developed pods should be hand shelled or shelled with a suitable groundnut sheller about a fortnight before sowing. Remove small, shrivelled, damaged

and broken kernels and retain only bold seeds. Application of *Rhizobium* as seed treatment is beneficial in increasing nodulation and nitrogen fixation. Seed treatment with bioorganic RCHE 641 @ 30 ml/l is found effective for enhancing maize yield.

Seed rate and spacing

Use of optimum seed rate for the maintenance of optimum plant population is the key to success in groundnut cultivation. The seed rate and spacing depends upon the varieties. For the bunch type the spacing should be 30x10cm and for semi-spreading type 30x15cm. The quantity of seeds required per hectare with the above spacing's will be about 95-100 kg for semi-spreading varieties and 100-120 kg for the bunch varieties.

Liming

Application of lime @ 2 tonne/ha is necessary to achieve higher yield of groundnut. Lime should be incorporated into the soil at least 1-2 weeks before sowing of the crop as it takes some time to complete the soil reaction, which starts immediately after the application of lime into the soil. The lime requirement can be reduced to 500 kg/ha if applied in furrows. Application of lime reduces the harmful effect of Aluminium toxicity and increases pod yield of groundnut.

Sowing time

Groundnut is grown mostly as a rainfed *kharif* crop. The optimum time for sowing is from May to June with the onset of monsoon. In some areas, where the monsoon is delayed, it is sown as late in August or early September.

Sowing method

Sowing should be done in furrows at a row spacing of 30cm and plant to plant 10-15cm depending upon the variety.

Manures

Application of 10-15t/ha of well decomposed farmyard manure (FYM) about 15-20 days before sowing along with 150 kg neem cake and 150 kg rock-phosphate has been found optimum for attaining good yield. Integrated application of FYM 10t + vermicompost 5 t + Rockphosphate 150 kg and neem cake 150 kg/ha is recommended for better soil health and higher productivity.

Weed control

Weeds cause considerable reduction in yield. A reduction of 20 to 45% in yield due to weeds has been recorded. For controlling weeds, and also to keep the soil in a friable condition, the crop should generally receive one or two hand hoeing. First operation should be done 15-20 days after sowing and the second operation at 30-35 days after

sowing. Intercultural should not be done at peg initiation stage. Earthing up can be done in the case of bunch and semi-spreading types to facilitate the maximum penetration of the pegs into the soil. Weeding can also be done quickly and efficiently with a wheel hand-hoe, if the soil is light. It should be run before weeds make excessive growth.

Crop rotation

Cropping sequences being followed in NEH region are as follows:

- Groundnut – toria
- Maize + Groundnut (2:2) – toria
- Maize + Groundnut (2:2) – carrot
- Upland rice + Groundnut (4:2) – toria
- Upland rice + Groundnut (4:2) – Radish

Pest management

Important Insects Pests

1. **Leaf miner (*stomepteryx subsivell Aproraemid modicella*)**

   Symptoms - Young larvae initially mine into the leaflets, feed on the mesophyll and form small brown, blotches on the leaf. Later stages larvae web the leaflets together and feed on them, remaining within the folds. Severely attacked field looks "burnt" from a distance.

   Management

   Cultural - Stray planting of cowpea or soybean as trap crop. Crop rotation with non-leguminous crop is advised in case of severe recurring problem. Crop rotation of groundnut with soybean and other leguminous crops should be avoided. Use resistant/tolerant varieties. Collect and destroy egg masses and early instars larvae. Install pheromone trap @ 5/ha for mass trapping.

   Control Measures - Spray neem based formulation @ 5%. Release *Trichogramma Chilonis* @ 50000/ha twice (7-10 days interval) Conserve the natural bio control population of spiders, long horned grasshoppers, praying mantis, robar fly, ants, green lace wing, damsel flies/dragon flies, flower bugs, shield bugs, lady bird beetles, ground beetle, predatory cricket, earwig, braconids, trichogrammatids, NPV, green muscular fungus. Intercropping groundnut with *Pennisetum glacum* enhanced the parasitoid *Goniozus spp*. on leaf miner. Mulching with rice straw causes reduction in leaf miner incidence and increase in percentage parasitism.

2. **Red hairy caterpillar (*Amsacta moori* and *A. albistriga*)**

Symptoms - The larvae are light brown color and turns reddish as they grow and are haired and are up to 5 cm long. Caterpillars cause defoliation of the crop as they are voracious feeders and often migrate from one field to another devastating whatever crops come their way. After about 30-40 days of feeding the larvae burrow into soil, usually in the undisturbed soil of field or non-cropped areas and pupate.

Management

Cultural - Deep summer ploughing. After the kharif crop, the field should be ploughed to expose the pupae to predatory birds. Early sowing is done to escape insect pest damage. Inter crop one row of castor for every 5 or 6 rows of groundnut. Crop rotation with sorghum/pearl millet or maize should be followed. Vegetative traps utilising Jatropa (wild castor) or Ipomoea prevent the migration of the grown up larvae. Irrigate once to avoid prolonged mid-season drought to prevent pre-harvest infestation. Install of 12 light traps/ha or bonfire in endemic areas. Erection of light traps soon after the monsoon for 20-45 days and collecting and killing of adult moths are found very effective. Collection and destruction of egg masses in the fields around light trap areas. Install 10-12 bird perches/ha. Two hand or mechanical weeding at 15-20 days after sowing. Conserve dominant predators like Coccinella sp. and *Minochilus sexmaculata* and parasitoids like Chelonus spp. Conserve the bio control population of spiders, long horned grasshoppers, praying mantis, robar fly, ants, green lace wing, damsel flies/dragon flies, flower bugs, shield bugs, lady bird beetles, ground beetle, predatory cricket, earwig, braconids, trichogrammatids, NPV, green musccardine fungus. Inter cropping with pigeon pea, mung bean and soybean provides increase in population of spiders. Population of coccinellids is higher on groundnut with maize, mung bean and soybean and Chrysoperla spp. is higher with maize and soybean intercrops

Control Measures - Spray A-NPV (2X 10^5 PIB/l) and *Bacillus thuringiensis* (Bt). Release of *Bracon hebetor* @ 5000/ha. two times at 7-10 days interval. Use 5% neem seed kernel extract on need basis.

3. **White grubs ((*Holotrichia consanguinea, Holotrichia serrata*)**

Symptoms - Both adults and larvae are damaging stage. The larvae feeds roots and damage pods. Grubs feed on fine rootlets, resulting in pale, wilted plants dying in patches.

Management

Cultural - Deep ploughing in summer. Always use well decomposed organic manure it attracts the adult beetles. Partial or complete lopping of host plants and retaining of a few most preferred host trees in the area for congregation of white grub adults. Crop rotation with sorghum/pearl millet or maize. Early sowing to avoid damage due to insect pest. Standing crops of fodder, sugarcane etc. are also protected. Install light traps with the onset of rains. Collection and destruction of white grub adults from host trees around the field. Conserve braconids, dragon flies, trichogrammatids, NPV, green muscardine fungus

Control Measures – Application of *Metarhizium anisopliae* @ 5kg/ha mixed with compost. Application of aqueous suspension of EPN *Steinernema carpocapsae* with a dosage of 40-50 lakh Infective juveniles/5 l water. Application of EPN *Heterorahbdtis* sp @ 50 lah IJ/5 lit of water is also effectively control the pest. Continuous application of EPN builds the native population and helps in managing the pest below ETL.

4. **Jassids (*Empoasca kerri, Bachlucha* spp)**

Symptoms - Both nymphs and adults suck sap from central surface of leaves, inject toxins resulting in whitening of veins and chlorotic patches especially at the tips of leaflets, in a typical 'V' shape. Heavily attacked crop looks yellow and gives a scorched appearance known as 'hopper burn'

Management

Cultural - Timely sowing of the crop and field sanitation. Grow tolerant varieties like Girnar 1

Crop rotation with non-host crop. Intercropping with pearl millet. Avoid groundnut-castor inter crop, it increases the infestation. Irrigate once to avoid prolonged mid-season drought to prevent pre-harvest. Conserve bio agents like praying mantis, long horned grass hoppers, dragon flies spiders, green muscardine fungus.

Control Measures – Foliar spray of soft soap and 7 days interval 2-3 times, Foliar spray of soft soap and neem oil (3%) also help n management of jassids.

5. **Aphids (*Aphis craccivora*)**

Symptoms - Nymphs and adults suck sap from tender growing shoots, flowers, causing stunting and distortion of the foliage and stems. They excrete honeydew on which sooty molds flow forming a black coating. Aphids are also known to transmit peanut stripe virus and groundnut rosette virus complex

Management

Cultural - Timely sowing of the crop. Varieties which are densely hairy and with stiff leaves are resistant to pest attack (like Girnar 1). Handpicking and destruction of various insect stages and the affected plant parts.

Biological - Augment the release of *Cheilonenes sexmaculata* @ 1250/ha. Conserve bio agents like flower bugs (anthocorids), lady bird beetles (coccinellids), praying mantis, hover flies (syrphids), green lace wing (chrysopids), long horned grass hoppers and spiders

Control measures – Foliar spray of soft soap 2-3 times at 7 days interval. Foliar spray of soft soap and neem (3%). Apply NSKE 5% (neem seed kernel extract) to control sucking pests.

Important Diseases

6. **Tikka (*Cercospora arachidicola* and *Cercospora personata*)**

Symptoms - The first visible symptoms appear on the leaflets of lower leaves as dark spots which at a later stage, are surrounded by yellow rings. The spots are circular. Mature spots are dark-brown to almost black, particularly on the upper surface of the leaflets. Whereas, on the lower surface they are lighter in colour. The spots are few on the leaf petioles and stem. The shedding of leaves is a characteristic feature of the disease.

Management

Cultural - Burning of previous year's diseased plant debris will, to a great extent, reduce the source of primary infection. Two to four years' crop rotation often cuts down the rate of infection

Avoid late sowing to reduce infection rate

Control measures - Seed treatment with *Trichoderma viride* and *Pseudomonas fluorescens* effectively control the problem. Seed treatment with garlic-cinnamon - clove extract is also very effective. Secondary infection can be controlled by sulphur spray. Copper oxychloride @ 0.3% also effectively checks its spread

7. **Early leaf spot (ELS) by *Cercospora arachidicola and* Late leaf spot (LLS) by *Phaeoisariposis personata***

Symptoms - Brown lesions (spots), usually surrounded by a yellow colour on the upper side of leaves, are the most common symptom of early leaf spot. Dark brown lesions (spots), usually on the underside of affected leaves, are the most common symptom of late leaf spot.

Photo – Early leaf spot (left) and late leaf spot (right)

Management

Cultural - Plant improved groundnut varieties. Use correct planting density (50 cm x 30 cm or 50 cm x 40 cm). Mix crops of groundnut with maize or sorghum. Remove weeds at 3 and 6 weeks after planting. Plough and harrow to cover crop residues with soil after harvest and to destroy fungus in the soil. Rotate groundnut crop with cowpea and maize. Remove heavily infected plants to prevent spread of the fungus. Remove infected leaves to prevent further spread of the fungus. Destroy diseased debris and avoid excessive irrigation

Control measures - Spray copper fungicides such as copper oxychloride (0.3%)

8. **Rust by *Puccina arachidis***

Symptoms - The characteristic orange-coloured pustules, the uredinia, appear first on the lower surfaces of the groundnut leaves. Uredinia then rupture to expose masses of reddish-brown urediniospores (Subrahmanyam and McDonald, 1983). Pustules may later appear on the upper surfaces of the leaflets opposite those on the lower surfaces of susceptible cultivars. In highly susceptible cultivars, secondary pustules may develop around the primary pustules. Pustules are usually circular, and range from 0.5 to 1.4 mm diameter. They may form on all aerial plant parts with the exception of flowers. Rust-damaged leaves become necrotic and dry up but remain attached to the plant. In the case of severe damage, plants have a burnt appearance.

Management

Cultural – Use disease free seeds. Use rust resistant cultivars. If feasible, times of sowing should be adjusted to avoid environmental conditions conducive to disease

build-up. Weeds should be controlled since a heavy growth of weeds may favour disease development through high humidity in the crop canopy

Control measures - Seed treatment with *Pseudomonas fluorescens* or seed treatment with garlic-clove-cinnamon extract. Foliar spray of Lime sulphur or sulphur dust effectively manages the disease

9. **Bacterial wilt (*Pseudomonas solanacearum*)**

Symptom - It is a minor disease. Infected plants appear unhealthy, chlorotic and wilt under water stress. Dark brown discolouration of xylem is seen. Grey slimy liquid ooze out of the vascular bundles**.** Infection of young plants can result in sudden wilting and death, but the leaves remain green. Infection of mature plants results in loss of turgidity, and leaves become light green, chlorotic, and curl at the tips. Eventually leaflets become brown but remain attached to the plant.

Management

Cultural - Crop rotation with cereal crops may reduce the incidence of a bacterial wilt. Use the seed produced in unaffected areas. Use wilt resistant variety. Prevent the disease being introduced into new areas by following plant quarantine regulations

10. **Stem rot (*Sclerotium rolfsii Saccardo*)**

Symptoms - Germinating seeds infected by groundnut stem rot are covered with masses of black spongy fungi. This causes rapid wilting of the entire plant or its branches. The development of white fungal threads can be seen on affected plant tissue, particularly on the stem. The base of the plant turns yellow and then wilts down. Mature plants may also be attacked. Lesions develop on the stem below the soil and spread upwards along the branches. The whole collar region becomes shredded and dark brown. Dried, dead branches can be easily detached from the disintegrated collar region.

Management

Apply deep covering of organic matter before planting. Carry out non-dirting cultivation by avoiding movement of soil up around the base of plants. Preventing accumulation of organic debris. Rotate the groundnut crop with wheat, corn and soybean

Control measures - Use seed treatment of *Trichoderma viride* @ 4 g/kg seed and soil application of *Trichoderma viride* @2.5 kg/ha, mixed with 50 kg farmyard

manure or with organic amendments such as castor cake or neem cake or mustard cake @ 500 kg/ ha

Harvesting and Storage

Harvesting should be done at the right time for obtaining higher yield of pods and oil. The bunch type varieties mature in about 110-115 days and the semi spreading varieties in 120-125 days. The prominent symptoms of maturity are the yellowing of leaves, the shedding of older leaves, the development of pink color of the testa and the dark tint inside the shell. The bunch and semi- spreading varieties are usually harvested by hand pulling when there is adequate moisture in a soil. The spreading types, on the other hand, are harvested by digging with a spade or local plough or with the help of a blade harrow. The pulled out plants are stacked for a few days for drying and detached the pods afterwards. Delay of harvest after maturity will result in stem rot and weakening of pegs, thus pods may be left in the soil.

The pods are cleaned and dried to a safe moisture content of not more than 5%. Damp nuts, if stored, will ferment and allow the development of poisonous moulds,. (*Aspergillus flavus*) in the Kernels, leading to contamination with aflatoxin--a health hazard both for human beings and livestock. It is desirable to store groundnut in gunny bags and stacked in a storeroom in tires comprising not more ten in each in such a way that the air keeps circulating over planks to avoid damage from dampness, rats, etc. The store rooms should be periodically inspected to ensure that there is no storage pest.

Yield

Under rainfed conditions, the average yield of semi-spreading and spreading varieties is 1500- 2000 kg of unshelled pods per hectare and that of bunch types is 1200-1500 kg.