Scaling-up of Improved Groundnut Varieties through Established Seed System in Various Cropping Systems of Smallholder Farmers in Odisha

Cultural Management Practices of Groundnut

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Introduction

Groundnut (*Arachis hypogaea*) is a self-pollinated, allotetraploid (2n=4x=40) with a genome size of 2891 Mbp, and was most likely domesticated and cultivated in the valleys of Paraguay. It is an annual herbaceous plant growing 30 to 50 cm (1.0 to 1.6 ft) tall. The leaves are opposite, pinnate with four leaflets (two opposite pairs; no terminal leaflet), each leaflet 1 to 7 cm (⅜ to 2¾ inch) long and 1 to 3 cm (⅜ to 1 inch) broad. Groundnut are known by many other local names such as peanut, earthnut, goober peas, monkey nut, pygmy nut and pignut. Despite its name and appearance, groundnut is not a nut, but rather a species in the legume or "bean" family. Groundnuts are rich in essential nutrients which are potential to provide health benefits. Groundnut gives 570 calories per 100 g serving and are an excellent source of several B vitamins; vitamin E; dietary minerals, such as manganese (95% DV), magnesium (52% DV), phosphorous (48% DV); and dietary fiber (right table). They also contain about 25% protein per 100 g serving, a higher proportion than in many tree nuts.

Groundnut is grown on nearly 23.95 million ha worldwide with the total production of 36.45 million tons and an average yield of 1520 kg/ha in 2009 (FAOSTAT 2011). China, India, Nigeria, USA and Myanmar are the major groundnut growing countries. However, the low groundnut productivity in many developing countries remains a cause of concern to the scientific community and policy makers. Good crop agronomy is crucial in harnessing the full potential of the crop in addition to appropriate variety and quality seed in order to facilitate a synergistic effect on crop productivity. This farmer-friendly booklet provides information on improved cultural practices in groundnut cultivation which will empower smallholder farmer to make his/her own decision on various components of integrated crop management technology. Although generalized agronomic recommendations are often made, they need to be customized to meet the requirements of specific fields and be compatible with the socio-economic conditions under which smallholder farmers function. Information on harvest and post-harvest operations will help ensure that smallholder farmers produce high quality groundnuts fetching them a higher price in the market.

Cropping Season

Groundnut can be grown in both rainy (*kharif*) and post-rainy (*rabi*/summer/spring) seasons. The optimum air temperature for growth and development of groundnut is between 25°C and 30°C. Moreover, groundnut yield in the rainy season is lower than in the post-rainy season due to cloudy weather and the presence of diseases and insect pests.

Selection of Field and Land Preparation

Groundnut after groundnut in the same field is not advisable as it leads to build-up of diseases and insect pests in the soil. Groundnut should be rotated with a well-fertilized cereal crop. Ideal groundnut soil is well drained, light color with sand, loamy sand or sandy loam texture and pH ranging between 6.0 and 6.3. Maintaining soil pH is important as it affects the availability of nutrients to plants. In case the pH is <5, lime (Ca CO3) in appropriate form and quantity should be mixed thoroughly into the soil before land preparation or at the time of land preparation so as to bring it into the optimal range. The rate of application of lime depends upon the type of lime, soil type and depth of application. As a general recommendation, it would require 1.5 t/ha of lime to raise the soil pH from 5.0 to 6.5.

Ridges

Flat beds

The field should be cleared of all stubble and plant residues of the previous crop. Un-decomposed plant residues promote growth of disease causing soil borne fungi. For land preparation, ploughing to a depth of 15-20 cm (very deep ploughing should be avoided) and several passes of the harrow to obtain a fine texture are required. Groundnut can be sown on flat beds or ridges or raised beds separated by furrows. Sowing on raised beds with 0.4-0.8% slope allows easy drainage of excess water, avoids compaction of seed beds and facilitates field operations as all movements are restricted to furrows.

Selection of Variety

Improved, trade-preferred cultivar recommended for the location and cropping season should be selected for sowing. It should also have resistance/ tolerance to diseases and insect pests prevailing in the locality. Some varieties may do well only in a specific growing season.


Rajasthan


Karnataka


Gujarat


Maharashtra

Quality of Seed

Certified seed purchased from a reliable source or owner saved seed, which is pure (true to type), graded (medium-size), undamaged, fully developed and healthy (free from discoloration and fungal infection) with germination above 90% should be used. Germination test on seeds should be carried out one week before sowing and the seed rate should be adjusted accordingly. Gap filling after 8-10 days of sowing does not help much.

Cultural Practices

Manure and fertilizers

Groundnut responds to residual soil fertility better than the direct application of fertilizers. The crop(s) preceding groundnut should be well fertilized to build up soil fertility particularly for phosphorus (P) and potassium (K). Application of fertilizers and their dose should be based on the nutrient status of the soil as determined by the soil test and the targeted yield. However, general recommendations for groundnut are as follows:

Manure

Farm yard manure (FYM) or Compost: 10-12 t/ha; 25-30 days before sowing

Introducing green manure in crop rotation also helps to increase the organic matter content of the soil and improve its structure.

Macronutrients

Nitrogen (N), P and K: 8-20 N, 16-80 P_2O_5, 0-75 K_2O kg/ha; as basal application

Calcium (Ca): 200-400 kg/ha of gypsum at the peak flowering stage as side placement. Calcium is essential for good seed development.

Micronutrients

Many fields are deficient in micronutrients – boron, zinc and sulphur. If soil test shows deficiency of these micronutrients, remedial measures should be taken as follows:

Boron (B): Apply 3-4 kg/ha borax to the soil at the time of land preparation. The residual effect of borax should last several seasons. Alternately, 0.1% borax can be sprayed on the crop early in the season to ensure boron uptake before flowering.

Zinc (Zn): Apply 10-20 kg/ha zinc sulphate to the soil once in three years at the time of land preparation.

Sulphur (S): Application of gypsum provides adequate sulphur to the crop. Sulphur deficiency is most likely on very sandy soils, which possess little anion exchange capacity.

Iron (Fe): In many calcareous soils, groundnut plants show iron deficiency symptoms (interveinal chlorosis in young leaves followed by full chlorosis (whitish yellow) of entire leaves). Iron chlorosis can be alleviated by applying ferrous sulphate @ 10 kg/ha to the soil or spraying the affected crop with 0.5% ferrous sulphate + 0.2% urea solution. If required, the spray treatment could be repeated at 10-14 days interval.

Zinc deficiency

Sulphur deficiency

Iron deficiency

Seed treatments

Rhizobium inoculation: Rhizobium inoculation could be beneficial in newly cleared fields, rice fallows, fields with eroded soils and low fertility. Seeds should be treated just before sowing with Rhizobium culture.

For soil borne diseases: Seeds should be treated with captan (1.5 g) + thiram (1.5 g), carbendazim (2.0 g) or mancozeb (3.0 g) per kg of seed or other locally recommended fungicide(s). Seed treatment with *Trichoderma viride* or *T. harzianum* @ 4-5 g/kg seed also helps in managing seed and soil borne diseases.

For soil insect pests: In white grub and termite endemic areas, seed should be treated with chlorpyriphos 20 EC @ 12.5 ml/kg seed.

For sucking insect pests: Seed treatment with imidacloprid (17.8 SC) @ 2 ml/kg seed gives protection against sucking insect pests (thrips, jassids and aphids) and leaf miner at early stages of plant growth.

Seed dormancy: Virginia varieties have postharvest seed dormancy, which may last for 5-6 months. If such varieties are to be sown immediately after harvest, the seeds should be thinly spread over a tarpaulin or plastic sheet and sprayed thoroughly with etherel 39 EC @ 5 ml/L water and air dried just before sowing.

Seed treatment with fungicide/insecticide gives protection up to 30 days after sowing. It should be carried out one or two days prior to sowing. Seeds should be treated first with liquid chemicals and after drying with powder/dust chemicals. If the *Rhizobium* strain is not compatible with fungicide/ insecticide, the culture can be applied in sowing rows following slurry method.

Spacing, sowing depth and seed rate

Spacing: Row to row 30–45 cm and plant to plant within a row 10–15 cm or as recommended for the location; one seed/hill.

A closer spacing for Spanish/Valencia (bunch) cultivars and a wider spacing for Virginia (semi-spreading or spreading) cultivars are recommended.

Sowing depth: 5 cm

Optimum plant population: 330,000 plants/ha for Spanish/Valencia cultivars and 148,000 plants/ha for Virginia cultivars.

Seed rate: The seed rate will vary depending on seed weight, germination % and row to row and seed to seed spacing adopted. Normally, it may range from 100 kg to 160 kg/ha.

Sowing method

The use of seed drill (bullock-drawn or tractor-mounted) is recommended as it results in faster sowing, quicker emergence and uniform plant stand. There should be enough moisture in the soil before sowing to ensure quick and uniform germination. In case of dry sowing, irrigation should be provided soon after, preferably with sprinklers. Flood irrigation should be avoided.

Intercultivation and weed management

It is essential to keep groundnut fields weed free for up to 45 days after crop emergence. Even at later stages it is desirable not to have weeds in the field as they interfere with harvesting. Application of pre-emergence herbicides such as pendimethalin @ 1.0 -1.5 kg a.i./ha as spray or fluchloralin @ 1.0 -1.5 kg a.i./ha as pre-plant soil incorporation followed by 1-2 hand weeding, as and when needed, effectively reduces weed competition. The last hand weeding can be done along with gypsum application so as to incorporate it in the soil. The plant should not be disturbed once the pegs enter the soil.

Interculture in a rainfed crop helps to reduce weeds and also encourages infiltration of rainwater.

Many farmers practice earthing up (mounting soil around the plant), which is not recommendable, to allow pegs from higher nodes to enter the soil. This practice may promote growth of stem rot causing fungus *(Sclerotium rolfsii*). It also deteriorates the quality of earlier set mature pods while waiting for the later set pods to mature.

Water management

Rainfed crop: Proper arrangements for drainage should be made so that excess rain water does not stagnate in the field. If supplementary irrigation is available, it should be given at critical stages such as flowering, pegging and pod and seed development.

Irrigated crop: Except for crops grown on residual moisture, *rabi*/summer/spring season crops are fully irrigated. Generally, 600-650 mm water is sufficient to raise a full groundnut crop. A 2-3 week moisture stress soon after crop emergence followed by regular irrigation, often helps in inducing profuse flowering and uniform pod maturity. At pegging and pod and seed development stages, light but frequent irrigation is required. Excessive irrigation at later stages of crop growth may promote pod and seed diseases at maturity. The preferred method of irrigation is sprinkler irrigation. Flood irrigation, often practiced in flat sowing in south Asia, is not a good method of irrigation as it wastes water, results in over watering and trampling of plants in the field by workers engaged in irrigation.

Plant Protection

There are a number of disease/insect pest management measures, including use of resistant cultivars, cultural, chemical and biological. Growing resistant/tolerant cultivars is the most economic and efficient measure. In case the level of resistance in a preferred cultivar is not high enough, other approaches should be combined to obtain better protection against diseases and insect pests.

For high volume sprayers, 450-500 L and for low volume sprayers 225-250 L water is required to cover 1 ha. While using chemicals, protective clothing should be worn and proper care should be taken to dispose empty bottles/ cartons of chemicals in a safe manner.

Diseases

Rust and early- and late-leaf spots

If both rust and leaf spots occur together, chlorothalonil 75 WP @ 750 g a.i./ ha should be sprayed on the crop. If only leaf spots appear, use carbendazim 50 WP @ 250 g a.i./ha or mancozeb 50 WP @ 500 g a.i./ha. If only rust is seen, use calixin 80 EC @ 250 ml a.i./ha. For effective control, fungicides should be applied immediately after the appearance of symptoms. Further applications should be made at 10-15 days interval until 2-3 weeks before harvest. A close monitoring of the crop can help to reduce the number of sprays to the minimum.

Rust

Early leaf spots

Late leaf spots

Collar rot/stem rot

These diseases can be managed by treating seeds with seed dressing fungicides or *T. viride* or *T. harzianum* (Please see 'Seed treatments') or soil application of *T. viride* or *T. harzianum* @ 2.5 kg (incorporated in 50 kg FYM or castor cake) per ha at the time of sowing.

Aflatoxin

Aflatoxin, a carcigenic toxin, is produced in groundnut seed by *Aspergillus* group of fungi. The fungus can infect the pods in the field when they are

developing, during harvesting and curing and in storage. End-of-season drought influences pods to fungal infection. It is essential to minimize aflatoxin contamination of the produce as it affects human and livestock health and restricts the international trade of the commodity. The following precautions can be taken to minimize aflatoxin contamination: growing tolerant varieties, applying *Trichoderma viride* @ 1 kg (mixed with 50 kg FYM) per ha to the soil at the time of sowing and gypsum at peak flowering, light but frequent irrigation (if available) during pod and seed development stages, avoiding mechanical damage to pods during weeding, harvesting, curing, threshing and storage, control of soil insects, harvesting at optimum maturity (in case of severe drought, the crop should be harvested early), drying the pods to <8% moisture content, removal of immature, discolored and damaged pods from the produce, not mixing the gleanings (leftover pods collected from the soil) with main produce and protection from storage insect pests. Immature pods should be removed from the haulms before feeding them to livestock.

Peanut bud necrosis disease (PBND) and peanut stem necrosis disease (PSND)

Seed treatment with imidacloprid provides initial protection for 30 days after sowing through control of thrips vectors. Field sanitation, removal of weed hosts and cultural practices such as timely sowing, optimum plant population and intercropping and border cropping with fast growing tall cereal crops offer best solution to contain these diseases.

Insect pests

Tobacco caterpillar (*Spodoptera*), Gram pod borer (*Helicoverpa*) and Red hairy caterpillar (*Amsacta*)

These defoliators inflict economic losses only when the foliage damage exceeds 25%.

Tobacco caterpillar

Gram pod borer

Red hairy caterpil-lar

Integrated pest management (IPM): Includes growing of resistant/tolerant cultivar, growing of trap crop such as sunflower and castor bean on borders or in groundnut field (1 plant 20/m), destroying of egg masses on trap crops and groundnut plants by hand, encouraging larvae predation by birds by providing perches in the field (10-15/ha) and application of nuclear polyhedrosis virus (NPV) @ 250 LE/ha, obtained from a reliable source and neem seed kernel extract @ extract obtained from 10 kg neem seed powder/ha.

Chemical control: Chemical control should be followed as a last resort when there is absolute necessity. Apply endosulfan @ 350 mL a.i./ha, or monocrotophos @ 300 mL a.i./ha or fenvalerate @ 100 mL a.i./ha or indoxacarb @ 70 mL a.i./ha or spinosad @ 45 mL a.i./haif defoliation exceeds 25%, or if one or more larvae per plant is observed during the first 50 days after seedling emergence (DAE).

For red hairy caterpillars, digging a 15-20 cm deep trench all around the field and placing *Ipomea* or some other plant twigs in them can restrict the migrating caterpillars to the trench, where they could be destroyed manually or by spraying fenvalerate @ 1 ml/L water. Alternately, a short barricade of polythene fence (10 cm high) across the migrating route can prevent their entry into the field and they can be collected manually and destroyed.

Groundnut leaf miner

Chemical control is recommended if 5 or more active larvae/plant are found up to 30 DAE, 10 larvae/plant between 30-50 DAE, or 15 larvae/plant at 51 DAE or later. Apply dimethoate @ 200-250 ml a.i./ha or monochrotophos @ 150-200 ml a.i./ha or imidacloprid @ 25 ml a.i./ha.

Aphids, Thrips and Jassids

For aphids, apply dimethoate @ 200-250 ml a.i./ha when all the terminal buds in a young plant are infested. Only when five thrips per terminal leaf (folded) are observed before 20 DAE, apply imidacloprid @ 25 ml a.i./ha or dimethoate @ 200-250 ml a.i./ha. If 10% of the total leaves show hopper burn ('V' shaped yellowing at the leaf tip), imidacloprid @ 25 ml a.i./ha or dimethoate @ 100-200 ml a.i./ha should be sprayed for control of jassids.

Aphids

Thrips

Jassid

White grub

Apply thimet 10 G or carbofuran 3 G @ 1 kg a.i./ha in seed furrows just before sowing or treat seeds with chlorpyriphos 20 EC @ 12.5 ml/kg seed.

Termites

Seed treatment with chlorpyriphos provides protection up to 30 days after sowing. Chemical control in rainfed crop at later stages is difficult and

expensive. However, some cultural practices such as destroying the termite mounds in the vicinity of the field, removal of plant residues and debris from the field and timely harvest can help to minimize the damage.

Harvest and Postharvest Operations

Harvest at maturity

Optimum harvest time is determined by uprooting a few representative plants from different spots in the field around the expected time of maturity and checking the inner side of the pod shell, which shows black color when mature. When 75-80% pods in case of Spanish/ Valencia cultivars and 70-75% pods in case of Virginia cultivars show internal pericarp darkening, the crop is ready for harvest. If sprouting of seeds is observed in Spanish/Valencia cultivars (due to rains at harvest time in cultivars lacking fresh seed dormancy), the crop should be harvested as soon as the conditions permit without waiting for 75-80% of pods to mature. Over maturity or delay in harvesting can result in greater pod loss in the soil and deterioration in pod quality.

Drying and curing

Inverted windrows

Lift the plants, and invert them with the pods uppermost in windrows for about 2-3 days. Pick the pods (preferably by thresher) and spread them out in a thin layer to sun-dry for a further 3-4 days. The seeds in well-dried pods should have less than 10% moisture content. In the post-rainy season, when temperatures at the time of harvesting are high, the

harvested plants should be assembled in circular heaps with pods facing inside so as to avoid their direct exposure to the sun. The pods should be shade-dried to maintain seed viability.

Circular heaps

Storage

It is important to remove all damaged, discolored, rotted, immature and sprouted pods, other plant materials and soil from the produce before storage. Under unfavorable conditions, groundnut seed loses viability quickly.

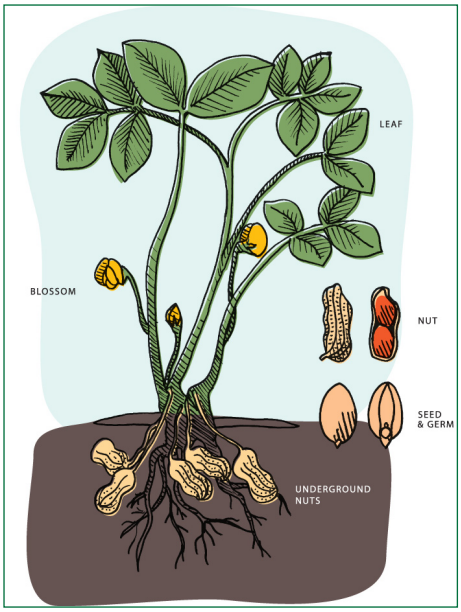
Commercial produce

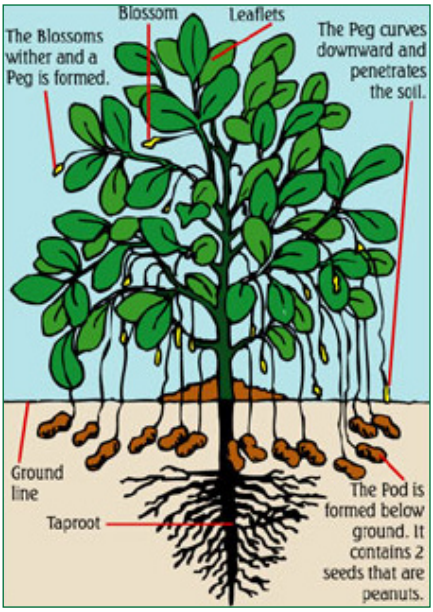
Well cleaned, dried, mature pods free from plant debris, soil and other inert materials should be stored in gunny bags in a well-ventilated rodent free room for marketing. The bags should be placed on wooden planks and should not be stacked very high. If longer storage is needed for marketing reasons, proper care should be taken to avoid storage insect pest infestation. Only safe chemicals, if needed, should be used.

Seed purpose

Only sound, mature, clean and well filled pods from 'true to type' plants should be selected for seed purpose. Well-dried pods with about 5% moisture content should be stored to avoid fungal and insect pests attack in storage. The pods should be stored in polythene-lined gunny bags or in some other safe storage structure in a well-ventilated and rodent free room, which is not in general use and out of bounds to children. The bags should be placed on wooden planks (not more than five in a stack) and away from walls to avoid damage from dampness and should be protected from storage pests by dusting the bags with 5% lindane or 5% malathion dust. In case of pest outbreak in storage, the bags should be fumigated with celphos (tablets) @ 3 g/bag (40 kg bag) and under cover with polythene sheet for 4-5 days.

(Adapted in ICRISATs 'Improved Cultivation Practices for Groundnut)


LEAF
BLOSSOM
NUT
SEED
& GERM
UNDERGROUND
NUTS


Blossom
Leaflets
The Blossoms wither and a Peg is formed.
The Peg curves downward and penetrates the soil.
Ground line
Taproot
The Pod is formed below ground. It contains 2 seeds that are peanuts.

About ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

ICRISAT is a member of the CGIAR Consortium

The **International Crops Research Institute for the Semi-Arid Tropics** (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru, Telangana, India, with two regional hubs and five country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

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