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Directorate of Groundnut Research

MANUAL FOR
GROUNDNUT PEST SURVEILLANCE

National Initiative on Climate Resilient Agriculture

भाकृअनुप
ICAR

National Centre for Integrated Pest Management, New Delhi
Central Research Institute for Dryland Agriculture, Hyderabad
Directorate of Groundnut Research, Gujarat

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GROUNDNUT PEST SURVEILLANCE

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Implementation : Natural Resources Management Division
ICAR, New Delhi

Project Coordination : Central Research Institute for Dryland Agriculture
Hyderabad

Pest Surveillance Coordination : National Centre for Integrated Pest Management
New Delhi and Directorate of Groundnut Research
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Published by : ***Dr. O.M. Bambawale,*** Director
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Citation

NICRA team of Groundnut Pest Surveillance, 2011. *Manual for Groundnut Pest Surveillance*. Jointly published by National Centre for Integrated Pest Management, New Delhi, Central Research Institute for Dryland Agriculture, Hyderabad and Directorate of Groundnut Research, Gujarat. 29 pp.

Printed at

M/s Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase-I, New Delhi 110 028

Foreword

National Initiative on Climate Resilient Agriculture (NICRA) was launched during 2010-11 by Indian Council of Agricultural Research (ICAR). The mega project has three major objectives of strategic research, technology demonstrations and capacity building. Assessment of the impact of climate change simultaneous with formulation of adaptive strategies is the prime approach under strategic research across all sectors of agriculture, dairying and fisheries. Evolving climate resilient agricultural technologies that would increase farm production and productivity *vis-à-vis* continuous management of natural and manmade resources constitute an integral part of sustaining agriculture in the era of climate change.

Plant protection deserves prime importance in crop production because of the fact that potential yield of crops are limited by pest groups of various categories *viz.*, insects, diseases, weeds, nematodes and rodents. Since pests are biotic natural resources of the earth, their interdependent interactions amongst system variables are equally influenced by the factors of climate change. Climate effects on pests could be direct as well as crop mediated. NICRA recognized the importance of pest risks associated with climate change and provided a research platform across crops of rice, pigeon pea, ***groundnut***, tomato and mango during its first phase of implementation under eleventh plan. Assessment of the changing pest scenarios, mapping of vulnerable regions for pest risks, and to evolve curative and preventive pest management strategies towards climatic stress have been emphasized among many approaches to study the impact of climatic change on pests. The long term trend analysis of pests and their association with climate is important. Most often the available historical data sets on pests lack continuity and their holistic retrieval is cumbersome. Availability of information technological tools has made it possible to create centralized database of desired resources and associated activities with ease, in turn making scientific analyses and inferences more meaningful.

In case of studies relating to pest dynamics, it is essential to streamline methods of surveillance through carefully designed data recording formats relating to crops, pests, and production and protection practices in addition to weather. Implementation of pest surveillance across six different groundnut growing agro ecologies under NICRA offers *per se* heterogeneity of climate and would help to draw the underlying mechanism of the observed pest status. Analyses with weather would further aid in delineating climate effects on pests. Making pest surveillance operational through provision of pest scouts and data entry operators make it possible to capture quality data at field level guided by scientific staff.

Production of "***Manual for Groundnut Pest Surveillance***" has been a part of systematic attempt to give specific skills to the users to undertake sampling related to groundnut pests. I appreciate the team work of the groundnut plant protection specialists of the nation, and wish that the research outcome would be useful for the present and future of groundnut pest management.

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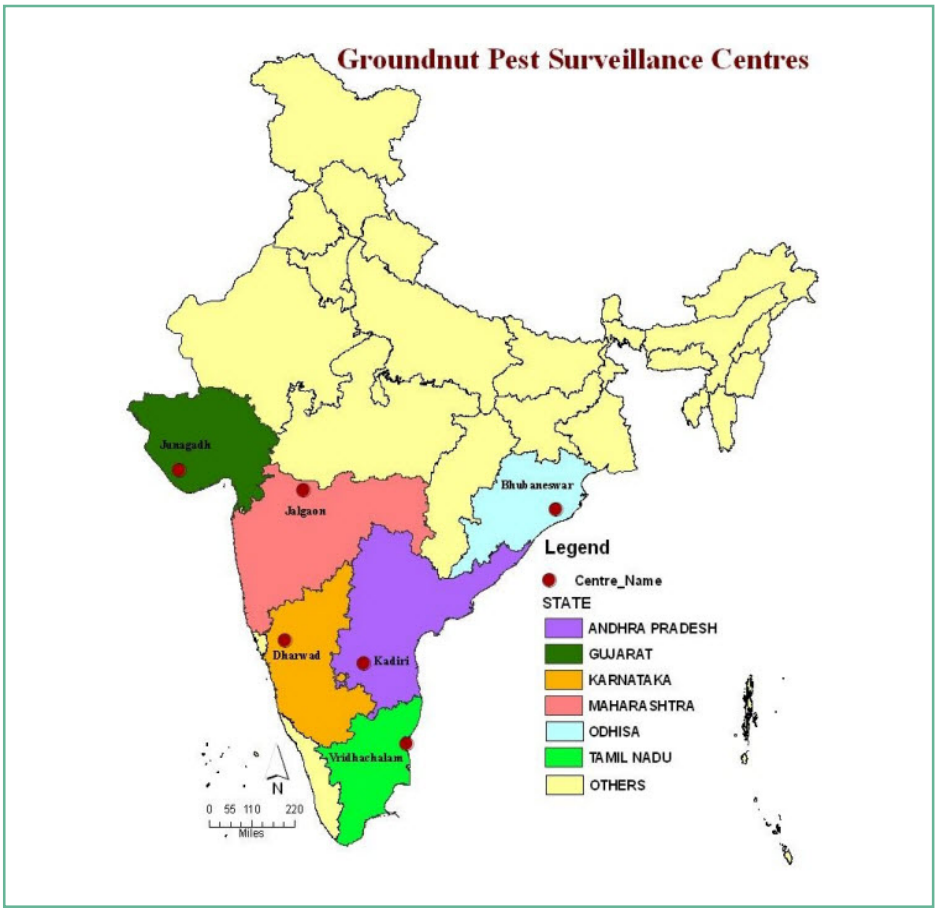
1. Introduction

In India, groundnut (*Arachis hypogea*) is cultivated during *Kharif, Rabi* and summer seasons under various cropping systems. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan, and Maharashtra are the major groundnut growing States constituting and contributing around 80% of area and production, respectively. The States of Madhya Pradesh and Odhisa also cultivate groundnut. Area under groundnut crop in India is over 6.16 million hectares with an annual production of 7.17 million tonnes. The national average yield of *Rabi* groundnut is higher (1600kg/ha) over *Kharif* (1000kg/ha). Rainfed groundnut cultivation coupled with attack by a variety of insect pests and diseases are the major reasons for lower productivity. As the crop and its pests are sensitive to extreme weather events, the crop productivity is determined by the interplay of weather and pests in a given season.

Climate change is expected to trigger the changes in diversity and abundance of arthropods, geographical and temporal distribution of insect pests, insect biotypes, herbivore plant interactions, activity and abundance of natural enemies and efficacy of crop protection technologies which in turn will have a major bearing on food and nutritional security. In the context of climate change, we expect both the crop in terms of phenology and physiology and the pests in their occurrence and abundance likely to change. Study of impact of climate change on groundnut crop-pest interactions requires carefully collected data on long term basis. While already available historical data could form an approach for partial study of climate change impacts, formulation and implementation of a robust research strategy combining the present scenario of cropping patterns, cultivars, and production and protection practices across heterogeneous locations over time would yield improved and holistic understanding. Considering the importance of the groundnut grown across Indian cropping systems as an edible oilseed and its associated role in food and livelihood security, "National Initiative on Climate Resilient Agriculture (NICRA)" provided thrust to improve the productivity level of the groundnut crop through assessment of the changing pest dynamics in relation to climate, and through development of forewarning models.

A plan to study groundnut pest dynamics in multiple locations over seasons along with other system components including weather was formulated to be implemented through surveillance integrating geographical, field, crop, agronomical and pest management practices. During the eleventh plan, six research centers (refer map) located across six States representing dominant groundnut growing climatic zones have been included under NICRA for pest surveillance. Pre requisite for such surveillance is to devise a plan followed



by design of data recording formats suiting to the purpose. The consultative group meeting of the participating researchers of groundnut under NICRA finalized the structural plan of pest surveillance to be carried out in groundnut fields at the research/experimental station of the identified centre, and at villages in the farmers' fields.

This manual presents the procedures to be followed towards selection of fields for surveillance at the experimental/research stations, and at villages besides the methods to be adopted for recording the observation of pests using the data recording formats.

2. Surveillance plan and procedures

Two groundnut fields each at the experimental station and in ten selected villages of the region are to be fixed for pest surveillance. Fixed fields are those grown with groundnut, that once selected would be continuously monitored year round on weekly basis for pests and diseases using the specified data sheet formats. In addition, a random survey covering eight

fields at the rate of one per village among villages other than the ten selected villages for fixed surveillance has also to be done once a week. The schedule of surveillance is given as **Annexure I.**

2.1. Selection of fixed fields

Experimental / research station

Two groundnut fields -one **unprotected** field without any plant protection measures (designated as **Fixed 1**) and the other **protected** with need based plant protection practices (designated as **Fixed 2**) are to be used for weekly observations. Area of each selected field should be near to one acre.

Fields of farmers

Ten groundnut fields @ two fields per village at ten villages representative of the agro ecology of the identified region in the same and neighbouring district, distributed randomly should be selected. In each village, two fields grown with groundnut of near to one acre each are to be fixed (designated as **Fixed 1** and **Fixed 2**) for weekly observations. Assigning fields of farmers as **Fixed 1** and **Fixed 2** should be made at the time of field and village selection and same should be maintained all through the surveillance period. In case of field destruction due to any reason, almost similar field nearby in the same village has to be used for continuing pest surveillance. Care should be taken to select farmers growing common groundnut varieties of the region.

2.2. General information for fixed fields

The geographical, cropping system and agronomical details relating to each of the groundnut fixed fields designated as **Fixed 1** and **Fixed 2** (both at experimental station and farmers' fields) should be collected using **Proforma 1 (Annexure II)** once in the beginning of the season.

2.3. Specific guidelines for observations in fixed fields

The recording of observations on insect pests and diseases in the selected fields should be initiated with the sowing of the crop and continued till the end of the season(s) and throughout the project period.

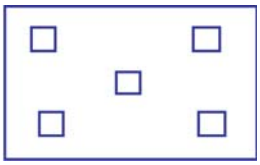
Fill in the details of State, district, taluka/block, village or location name of the field being sampled along with the designated field type (Fixed 1 (unprotected) or Fixed 2 (protected) in case of experimental station) and appropriate field number as Fixed 1 and Fixed 2 in the **Page 1 of Proforma 2 (Annexure III)**.

For crop stage, tick mark appropriate terms relating to stage of the crop during each period of surveillance *viz.*,vegetative/first flowering/pegs+pod

setting/seed setting and development/maturity.

For crop health, tick mark appropriate term as to excellent or good or poor based on the status of groundnut field relating to crop growth and development during each surveillance.

In each selected field, select five spots randomly such that four are from four corners and one from the center of the field (refer figure). Five feet distance alongside of boundary of the field in all directions should be left out as buffer space during observations.



The spot selection for pest observations during each weekly visit should be random and it is not the fixed spots in a groundnut field that would be sampled continuously.

At each spot select 10 plants adjacent to each other for observations relating to all and whole plant observations or else follow the sampling method given in the data sheet itself (as ready reference) or as mentioned below in respect of insects and diseases.

2.4. Pest observations (Proforma 2)

2.4.1. Insect pests

Aphids (*Aphis craccivora*)

Identification keys

- Infested plants have colonies of nymphs and adults of aphids.
- Nymphs are usually dark brown.
- Adults are winged or wingless with colour ranging from green or greenish brown to greenish black.
- Aphid infested plants are stunted in growth with distorted foliage and stem.
- Sooty mould on foliage and ant associations are also common.

Aphids on leaves

Aphids on shoot

Sampling method

Number of plants infested: Count the number of aphid infested plants out of 10 plants in the selected spot and record.

Severity of infestation: Assess the severity of infestation by selecting one of the maximum infested plants among the 10 observed plants in the spot on a 0-3 scale based on the approximate number of aphids present on the plant.

Scale of aphid severity

Scale	Number of aphids
0	Nil
1	1-25
2	26-50
3	>50

Thrips (*Scirtothrips dorsalis, Thrips palmi*)

Identification keys

- Thrips are smaller insects found in folded leaflets and flowers.
- Adults are soft bodied and have highly fringed wings.
- White patches on lower surface of the leaves, and distortion of young leaflets are the symptoms due to feeding by thrips.
- Severe infestations cause stunted plant growth.

Adult thrips

Symptoms of thrips damage

Sampling method

Number of insects: Count the number of nymphs and adults present in top three open leaves of one plant in the selected spot.

Number of plants with feeding patches: Count the number of thrip infested plants out of 10 plants of a spot showing whitish or greenish yellow patches or dark brown patches on upper surface and dark brown necrotic patches on lower leaf surface.

Jassids (*Empoasca kerri, Bachlucha spp*)

Identification keys

- Nymphs and adults are yellowish green.
- Whitening of veins and presence of chlorotic patches at the tips of leaflets and necrotic leaftips with typical 'V' shape are the symptoms of jassid damage.
- Crop presents yellow and scorched appearance known as 'hopper burn' under severe infestation by jassids.

Jassid adults

Jassid damage
(yellowing and 'V' shaped necrosis at leaf tip)

Sampling method

Number of insects: Count the number of nymphs present in top three open leaves of any one plant in each selected spot.

Number of plants with yellowing: Count the number of plants showing yellowing on leaf tips with typical V shaped mark/ severe yellowing/"hopper burn" out of the 10 plants of each selected spot and record.

Leaf miner (*Aproaerema modicella*)

Identification keys

- Larvae are seen within mines on leaflets.
- Full grown larvae are green with dark head and thorax.
- Infestation is detected by the presence of mines that are small brown blotches on the leaf.
- Mines vary in size depending on the stage of larvae
- At severe infestation entire leaflet becomes brown, shriveled and dried up.

Larvae of leaf miner

Plant damage due to leaf miner

Sampling method

Number of insects: Count the number of live larvae on one plant in a spot.

Number of infested plants: Count the numberof leaf miner infested (plants with mined leaves) in a spot and record.

Spodoptera (*Spodoptera litura*)

Identification keys

Eggs and gregarious larvae

- The eggs are laid in cluster of several hundreds on the upper surface of leaves.
- Egg masses appear golden brown as they are covered with the scales of moth.
- Young larvae are light green and larvae feed gregariously on the leaf surface.

Solitary larvae

- The late instar larvae are solitary and are dark green to brown having prominent black spots on the thorax.

Infested plants

- Scraping of the chlorophyll from the leaves is seen due to feeding by gregarious larvae.
- Defoliation of plant(s) occurs under heavy infestation when solitary larvae are seen.
- Under severe infestation by *Spodoptera*, only petioles and branches of plants are left.

Egg mass of *Spodoptera*

Larvae of *Spodoptera*

Sampling method

Egg mass and gregarious larvae: Count the number of egg masses as well as gregarious larvae together on all 10 plants in a spot and record.

Solitary larvae: Count the number of solitary larvae on all 10 plants in a spot (Look at the base of the plants and aslo on soil surface, while recording solitary larvae).

Number of infested plants: Count the number of damaged plants per spot out of 10 plants on which infestation and damage due to *Spodoptera are* seen.

Red hairy caterpillar (*Amsacta albistriga; A. moorei*)

Identification keys

- Larvae have a red head with reddish brown dense hairs on the body.
- Anterior and posterior parts of the body of the caterpillar may have black bands encircling a red band.
- Caterpillars are voracious feeders and cause defoliation of the crop.
- Much of foliage damage is done during night time.

Red hairy caterpillar

Defoliation due to red hairy caterpillar

Sampling method

Count number of red hairy caterpillar larvae on all the 10 plants in each selected spot and record.

Semilooper

Identification keys

- The newly hatched caterpillar is yellowish green with light brown head.
- The fully grown larva is dull grayish brown and larvae are slender.
- Larva has prominent looping movements.

Sampling method

Count number of semilooper larvae on all the 10 plants in each selected spot and record.

Helicoverpa armigera

Identification keys

- The larvae are dark greenish to brown in colour.
- Young larvae are small and found feeding on tender leaflets.
- Grown up larvae feed on flower and foliage, and defoliate the plants.

***H. armigera* larva (Green)**

***H. armigera* larva (Brown)**

Sampling method

Count number of *H. armigera* larvae on all the 10 plants in each selected spot and record.

2.4.2. Beneficials

Coccinellids

Identification keys

- Grubs are slender and with well-developed thoracic leg.
- Pupae are fixed to plant surfaces with exposed appendages.

- Adults are brightly coloured with yellow, orange, or scarlet elytra.
- Small black spots on their fore wings are common.
- Legs, head and antennae of adults are black in colour.
- Some species have forewings that are entirely, black, grey or brown.

Grub and pupae of coccinellids

Adult coccinellid beetle

Sampling method

Count the number all immature stages (grubs and pupae) plus adults present on one plant per spot and record.

Spiders

Identification keys

- Spiders have eight legs and two body parts - a head region (cephalothorax) and an abdomen.
- They lack wings and antennae.
- Nymphs resemble adults.
- Spiders may be web spinners, jumping type and varied in colour and size.

Spiders

Sampling method

Count the number of all stages of spiders across species present on one plant per spot and record.

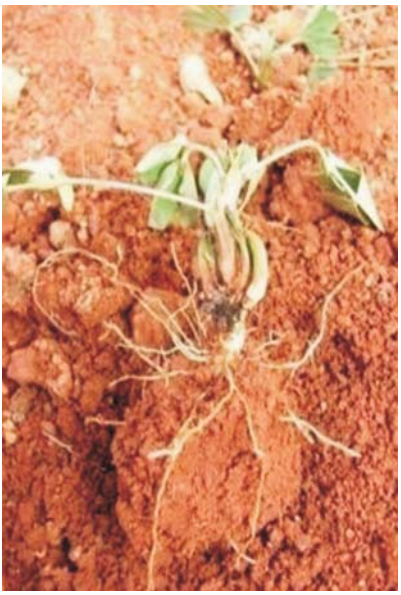
2.4.3. Diseases

Collar rot (*Aspergillus niger*)

Identification keys

- Circular light brown lesions are seen on the cotyledons upon seedling emergence.
- The hypocotyl tissues of stem region upon seedling emergence show water soaked and light brown discoloration.
- Seedlings collapse and die due to rotting of the hypocotyls.
- The collar region becomes shredded due to growth of fungus and black colour becomes visible.

Seedling with collar rot



Collapse of plant due to collar rot

Sampling method

Count the number of collar rot infected plants out of 10 plants in a spot and record.

Stem rot (*Sclerotium rolfsii*)

Identification keys

- Infection takes place on the stem just above the soil surface or at the foot of the plant.
- Initially deep brown lesions appear around the main stem at the soil level.

- They occur on the stem below the soil surface under dry conditions or above the ground in wet weather.
- The lesions become covered with white radiating mycelium that encircles the affected portion of the stem.
- The sclerotia of the size and colour of mustard seeds appear on the infected area as the disease develops.
- The distinct rot occurs beneath the fungal weft leading to wilt like symptoms characterized by yellowing and browning of the foliage, with drooping are obvious.
- The entire plant or one or two branches may be killed.

***S. rolfsii* infection on stems**

Field view of *S. rolfsii* infested plants

Sampling method

Count the number of stem rot infected plants out of 10 plants in a spot and record.

Dry root rot (*Macrophomina phaseolina*)

- Initially symptoms appear as water soaked lesions on the stem just above the soil surface.
- Marginal zonate and irregular spots characterize the symptoms of the leaf infection.
- Minute spots are also quite common and expand into bigger wavy spots on leaves.
- Gradually the lesions become dark and spread girdling the stem.
- The affected plants show wilting, followed by defoliation.
- The infected stem portion is shredded and becomes black and sooty in appearance with the development of sclerotia.The plant turns brown and subsequently dies.
- Usually rotting of stem is associated with rotting of roots.
- Rotting of pegs and pods is also seen.
- The dead lesions are covered with abundant minute black sclerotia giving a charcoal or ashy appearance.

Root rot damage

Sampling method

Count the number of stem rot infected plants out of 10 plants in a spot and record.

Peanut bud necrosis disease (PBND)

Identification keys

- Young quadrifoliates have mild chlorotic spots that turn into necrotic and chlorotic rings.
- Necrosis of the terminal bud is the characteristic symptom that occurs on crop.
- The secondary symptoms are stunting, auxiliary shoot proliferation and malformation of leaflets with severe leaf deformity.
- Necrosis of the terminal and auxiliary buds are typical.
- If plants are infected early, they are stunted and bushy.
- If plants older than one month are infected, the symptoms may be restricted to a few branches or to the apical parts of the plants.

Necrosis of terminal bud

Sampling method

Count the number of PBND infected plants out of 10 plants in a spot and record.

Peanut stem necrosis disease (PSND)

Identification keys

- Large necrotic lesions are seen on young quadrifoliates.
- These necrotic lesions coalesce and cover the entire leaflet leading to complete necrosis of young quadrifoliates.
- These symptoms will be followed by necrosis of the entire stem located below the necrosed quadrifoliates.
- If plants are affected less than one month at an age of the entire plant is often necrosed.
- In the case of older plants one or more branches will show necrosis.
- These plants are stunted but do not show any auxiliary shoot proliferation.

Necrotic lesions on leaves

Field view of PSND infested plants

Sampling method

Count the number of PSND infected plants out of 10 plants in a spot and record.

Peanut mottle virus (PMV)

Identification keys

- The symptoms appear on young leaves as irregular dark green islands.
- Older leaves show mild mottle symptoms visible in transmitted light.
- Some genotypes show characteristic interveinal depression and upward rolling of leaflet margins.

Mottle virus symptom on leaf

Sampling method

Count the number of peanut mottle virus infected plants out of 10 plants in a spot and record.

Peanut clump virus (PCV)

Identification keys

- Clump virus occurs in patches in the field.
- Young leaves show mosaic mottling and chlorotic ring symptoms.
- Older leaflets are darker green with faint mottling.
- Early infected plants are conspicuous in the field because they are severely stunted and dark green.

Stunted and dark green PCV infected plant

Sampling method

Count the number of peanut clump virus infected plants out of 10 plants in a spot and record.

Early leaf spot (*Cercospora arachidicola*)

Identification keys

- Early leaf spot symptoms first appear on the upper surface of lower leaves of the plants about 10-18 days after emergence as pale areas.
- Spots develop to become yellow; necrosis occurs from the centre of the lesion and later on, the entire spot become necrotic.
- Spots are circular to irregular characterized by a yellow halo of variable width.
- At maturity the spots turn reddish-brown to black and lower surface of the spot is orange in color.

Circular to irregular spots with yellow halo

Early leaf spot infested plants

Late leaf spot (*Phaeoisariopsis personata*)

Identification keys

- Late leaf spot symptoms appear after 28 to 35 days of emergence or at the time of harvest at the lower leaf surface.
- Shape of spot tends to remain distinctly round, and yellow halos are seen only around mature spots.
- Spots are almost black on both surfaces, but lower surface of the spot is distinctly carbon black.
- Conidiophores are always found confined to the lower leaf surface and these are usually in the plainly visible concentric circles.

Carbon black spots of late leaf spot

Late leaf spot infested plants

Rust (*Puccinia arachidis*)

Identification keys

- Orange red-chestnut brown uredo pustules are seen on the lower surface of leaflets initially.
- Later on pustules are also seen on upper surface of leaf and other aerial parts.
- The uredo pustules are either isolated or in groups.
- Reddish brown mass of spores become visible on surface of the leaves that turn dark brown and coalesce to cover larger areas.
- The leaflets curl and drop off resulting in defoliation.

Rust on upper leaf surface

Rust pustules on lower leaf surface

Alternaria leaf spot (*Alternaria alternata, A. arachidis & A. tenuissima*)

Identification keys

- Lesions are small, chlorotic, water soaked and spread over the surface of the leaf.
- Lesions are brown in colour, and irregular in shape surrounded by yellowish halos.
- Light to dark brown blighting of apical portion of leaflets are seen.

- The blighted leaves curl inward and become brittle.
- Veins and veinlets adjacent to the lesions become necrotic.

Blight at apical portion of leaves

Alternaria infested plants

Sampling method for foliar diseases (Early, late and Alternaria leaf spots and rust)

1. Disease severity rating (1-9 scale) will be noted for early and late leaf spots, rust and *Alternaria* leafspot.
2. Three plants in a spot out of 10 plants should be checked for the severity of the disease.
3. The observed scale of severity should be recorded for the plants 1, 2 and 3 in each spot.

Disease severity rating for leaf spots and rust

Rating	Description of severity
1	No disease
2	1-5 % leaf area of lower leaves affected
3	6-10 % leaf area of lower and middle leaves affected
4	11-20 % leaf area of lower and middle leaves affected
5	21-30% leaf area of all lower and middle leaves affected
6	31-40% leaf area of all lower and middle leaves affected
7	41-60% leaf area of lower and middle leaves affected
8	61-80% damage to lower and middle leaves
9	81-100% leaf area affected, almost all leaves withered and bare stem seen

Pictorial representation of disease severity rating for leaf spots and rust

(0%) 1

(1-5%) 2

(6-10%) 3

(11-20%) 4

(21-30%) 5

(31-40%) 6

(41-60%) 7

(61-80%) 8

(81-100%) 9

2.5 Additional details to be recorded for fixed fields

2.5.1 Pheromone trap catches

- Pheromone traps for two insects *viz.*, *Helicoverpa armigera* and *Spodoptera litura* @ 2/ fixed field have to be installed from the start of the season.
- Species specific lures have to be used with the traps. Install the traps with lures randomly in the selected field each separated by a distance of 25m from the other traps.
- Fix the traps to the supporting pole at a height of one foot above the plant canopy.
- Use a cotton swab dipped in diclorvos inside the polythene bag to kill the insects getting trapped (take care that the insecticide does not come in contact with funnel at any one time).
- If insecticide is not used, see to that the live moths are killed before counting/emptying.
- Change of lures should be made once a month.
- Emptying of the moths from collecting container/bag should be made after counting and recording. Ensuring the presence of traps and readiness to replace in case of breakage/missing events should be followed meticulously. Therefore after initial installation of traps with lures, surveillance team or member should carry few traps and lures during each week of surveillance for attending to missing traps immediately.
- Since both the species are polyphagous year round deployment of the traps and monitoring are recommended.

Identification keys of male moths caught in traps

S. litura: Moths are stout, dark brown with greyish-brown forewings patterned with wavy white markings. Hind wings are opaque or semi-hyaline white with dark brown marginal line.

H. armigera: The adult moths have greenish grey forewings with light darker transverse bands in distal third. Hind wings are pale grey with a darker marginal band having small brown marking at base.

Male moth *S. litura*

Male moth *H. armigera*

Observation method

During each week of surveillance the total number of moths/trap/ week in respect of *S. litura* and *H. armigera* traps should be counted and recorded.

2.5.2 Plant protection sprays

During each time of visit to the fixed fields *ie.*, once in a week, the plant protection operations taken up against insects, diseases, weeds, and use of any biorationals or biopesticides including bioagents, botanicals and microbials along with their names and dosages should be collected from the farmer and entered in the table of **Page 3 of Proforma 2 (Annexure III)**.

2.5.3 Fertilizer management

During each time of visit to the fixed fields *i.e.*, once in a week the details on application of green manure, farm yard manure (FYM), nutrient spray (micronutrient or hormonal) and general pattern of fertilizer use as to overuse or optimal and deficit use should be recorded in the table of **Page 3 of Proforma 2 (Annexure III)**.

2.5.4 Weather events of the week

Details of weather that is prevailing during the week of surveillance in respect of the farm/village should be stated in an objective pattern of YES or NO. If any other weather pattern prevails other than those mentioned in the table,it can be written against'Any other remarks' as a short phrase in the table of **Page 3 of Proforma 2 (Annexure III)**.

2.5.5 End season record of yield and price

One time and final recording of the yield obtained in respect of each fixed field and the prevailing market or sale price of the groundnut as commodity should be collected at /after harvest and noted in **Page 3 of Proforma 2 (Annexure III)**.

2.6 Random field survey

2.6.1 Field selection for random survey

During the survey fields located in the villages having large area under groundnut, will be selected randomly. Around 7-8 km distance can be maintained between two villages for survey and in each village the observation is to be made in one groundnut field using the same data sheet as per the guidelines given earlier for fixed fields. The survey is to be conducted once in a week (Friday) by scientist along with project staff in the area/villages not covered by scouts by hiring vehicle.

2.6.2 Guidelines for pest observations

All relevant details of random survey *viz.*, date of survey, GPS coordinates, village name and area of the field sampled should be recorded and the pest observations are to be carried out as per the **Proforma 2 (pages 1- 2) (Annexure III).** Eight individual data sheets (**Proforma 2**) should be used for the eight fields across eight villages during random survey. Additional details such as trap catches, plant protection sprays, fertilizer management, and weather events of the week need not be done for fields of random survey. The general information relating to **Proforma I** need not be collected for random fields.

2.7 Record of meteorological information

Daily records of weather data from the observatory of the research station or any other nearest location should be collected using the **Proforma 3 (Annexure IV).** Their upload can be once a week.

2.8 General instructions

Depending on the agro climatic zone the species of insects/diseases vary. There could be occurrence of additional species of the same group of insect or altogether a new species so far. Therefore the hitherto unrecorded species needs to be collected and preserved for identification. Preservation of insects has to be done in 70% ethyl alcohol in screw capped glass vials. Identification and reporting can be done at institution level directly or through crop coordinators of NICRA. Description of some of the insects and diseases of importance that are of varying significance to groundnut production but not listed in data sheet should be maintained for reference and reporting separately.

In case of closed holidays, the surveillance should be adjusted so as to cover the fixed field and random surveys on the subsequent days, and the same flexibility applies to upload of data also. Ensure quality data collection by adhering to datasheet and guidelines.

Only presence of pests on the crop need sampling and recording of their counts/severity *etc.*, and the columns of pests not present should be filled with zero.

In case of non-recording of observations in any of the fixed fields during any of the weeks, the same should be reported as not recorded with reasons. Since it is research data all out efforts should be taken not to miss the data collection for any one week during crop season.

Each farmer whose field has been selected can be given a diary for record keeping on the intercultural operations, plant protection sprays, fertilizer application, weather events, yield and market price of groundnut at harvest.

By visiting the fixed fields in villages on fixed days in a week for surveillance, farmer too can be made to be an effective partner of the programme. Their contact details including postal address and phone numbers (land line and mobile, whichever is available) must be maintained for feedback and impact assessment in future.

Annexure I

Schedule for Surveillance

Day	Schedule of surveillance for pest scouts and data entry operator (DEO)	No. of fields
Monday	Two fixed fields (Fixed1- Unprotected and Fixed 2-Protected) at research station; Documentation of historical data of the center	2
Tuesday	Two fixed fields/village at two villages (four fields) by one scout (Total of four villages and 8 fields / two scouts); DEO to enter the data collected on previous day + documentation of historical data	8 in 4 villages
Wednesday	Two fixed fields/village at two villages (four fields) by one scout (Total of four villages and 8 fields / two scouts); DEO to enter the data collected on previous day + documentation of historical data	8 in 4 villages
Thursday	Two fixed fields/village at One village (Two fields) by one scout (Total of TWO villages and 4 fields / two scouts); DEO to enter the data collected on previous day + documentation of historical data	4 in two villages
Friday	Random field survey across eight villages (@one field/village) by scientist and surveillance team; look for new/emerging pests for reporting in addition to using prescribed data sheet	8 in 8 villages
Saturday	Checking data/Upload of pest and weather data	-

(*Each field of near to 1 acre size*)

NICRA REAL TIME PEST SURVEILLANCE (GROUNDNUT)

Annexure II

(Proforma 1)

Data Sheet for General Information of Fixed fields of Surveillance

General Information for fixed fields to be filled only once in the beginning of the season)

Geographic Details

Agro climatic zone	State	District	Tehsil/Block	Experimental Station/ Village Name	Latitude	Longitude

Cropping system details of the region

Major Cropping Systems of region	Growing condition (Irrigated/Rainfed)	Growing season (Kharif/Summer)	Normal Sowing time		New crops of the region (during last five years)
			Kharif	Summer	

Agronomic details of the Field

Field	Name of the Farmer	Previous Crop	Sole/ intercrop	Name of Cultivar		Seed rate (kg/ha)	Date of sowing	Seed treatment (Y/N)			Spacing (cm)	
				Variety	Hybrid			Insecticide	Fungicide	*Trichoderma*	Plant to plant	Row to row
Fixed 1												
Fixed 2												

Field	Approx. Area (acres)	Soil type	Deep Summer Ploughing (Yes/No)	Soil applications (Yes/No)				General Soil health (Excellent /Good)/Poor	Crops in the adjacent fields	Source of irrigation (Canal/Well) /Tubewell	Method of irrigation (Flooding/Sprinkler)
				FYM	Neem Cake	Trichoderma	Others				
Fixed 1											
Fixed 2											

Postal address and phone number of farmer of fixed field 1 :

Postal address and phone number of farmer of fixed field 2 :

Annexure III

Data Sheet for Pest Observations in Fixed and Random Fields

NICRA REAL TIME PEST SURVEILLANCE (GROUNDNUT)

Proforma 2

State		Distict		Tehsil	

Experimental Station	
Location	
Field type/no.	Unprotected (Fixed 1)/ Protected (Fixed 2)

Fixed fields farmers	
Village name:	
Field no.	Fixed 1 / Fixed 2

Random Survey	Village name	Latitude	Longitude	Altitude	field area (ac)

Date of observation		General crop health	Excellent/Good/Poor

Stage of crop:	Vegetative/ first flowering/ Pegs+pod setting/ seed setting & development/ maturity

Spot no. (10 plants/ spot)	**Insect Pests**							
	Aphids		**Thrips**		**Jassids**		**Leaf miner**	
	No. of plants infested	Severity of infestation	Nos.	No. of plants with feeding patches	Nos.	No. of plants with yellowing	No. of larvae	No. of infested plants
1.								
2.								
3.								
4.								
5.								

Spot no. (10 plants/ spot)	**Spodoptera**			**Other caterpillars**			**Beneficials**	
	Egg mass/greg arious	No. of solitary larvae	No. of infested plants	Red hairy cater pillar	Semi looper	*Helicoverpa*	Coccinellids	Spiders
1.								
2.								
3.								
4.								
5.								

Aphid	Approximate number of aphids in **one of the maximum infested plants** among 10 plants in the spot on 0-3 scale 0=Nil; 1 :1-25; 2 :26-50; 3 :>50)
Thrips	Number of nymphs and adults present in **top three opened leaves of one plant** in the spot; Out of 10 plants how many are showing whitish or greenish yellow patches or dark brown patches on upper surface of dark brown necrotic patches on lower leaf surface
Jassids	Number of nymphs present in **top three opened leaves on one plant** per spot; Number of plants showing yellowing on leaf tips with typical V shape mark/ servere yellowing/ "Hopper burn"
Leafminer	Number of **live larvae on one plant** in a spot
Spodoptera	Number of grown up larvae on **all 10 plants** in a spot (also count at the base of the and on soil surface) Number of damaged plants/spot
Other caterpillars	Live Larvae in respect of Red hairy caterpillar, semilooper, *Helicoverpa* should be recorded
Coccinellids	Number of **all immature stages** (grubs & pupa) and adults present **on one plant per** spot
Spiders	Number of immatures and adults together on **one plant** per spot

NICRA REAL TIME PEST SURVEILLANCE (GROUNDNUT)

Diseases							
Spot no. (10 plants/ spot)	**Number of diseased plants out of 10 plants in spot**						
	Seedling diseases			**Viral diases**			
	Collar rot	Stem rot	Dry root rot	PBND	PSND	Peanut mottle virus	Peanut clump virus
1.							
2.							
3.							
4.							
5.							
For diseases namely collar rot, stem rot, dry root rot, PBND, PSND, PMV & PCV Count the number of infected plants out of 10 plants in a spot							

Foliar diseases					
Name of the Disease	**Spot no.**	**Disease Severity (1-9 Scale) per spot**			Disease severity rating (1-9 scale) for all leaf spots and rust
		Plant 1	**Plant 2**	**Plant 3**	**Three plants in a spot out of 10 plants should be checked for the severity of the disease.**
Early leaf spot	**1**				1 = No disease 2 = 1-5% leaf area of lower leaves affected 3 = 6-10% leaf area of lower and middle leaves affected 4 = 11-20% leaf area of lower and middle leaves affected 5 = 21-30% leaf area of on all lower and middle leaves affected 6 = 31-40% leaf area of all lower and middle leaves affected 7 = 41-60% leaf area of lower and middle leaves affected 8 = 61-80% damage to lower and middle leaves 9 = 81-100% leaf area affected, almost all leaves withered, bare stem seen
	2				
	3				
	4				
	5				
Late leaf spot	**1**				
	2				
	3				
	4				
	5				
Rust	**1**				
	2				
	3				
	4				
	5				
Alternaria leaf spot	**1**				
	2				
	3				
	4				**The observed scale of severity should be entered for the plants 1, 2 & 3**
	5				

Record the following for **fixed fields only**

Trap	Pheromone trap catches (no. of moths/ trap)	
	S. litura	*H. armigera*
Trap 1		
Tarp 2		

Plant protection sprays	Name of chemical	No. of Applications
Against insects		
Against diseases		
Against Weeds		
Use of biorational		

Fertiliser Management	
Green manuring	Yes / No
FYM	Yes / No
Name of nutrient spray	
Type of Fertiliser use	Over use/ optimal/ deficit use

Unusual weather events of the week	
Unseasonal rains	Yes / No
Hail storms	Yes / No
High intensity rains	Yes / No
Prolonged dry spells	Yes / No
Floods	Yes / No
Temperature	High/ Normal/ Low
Any other Remarks	

One time observation at the end of season for fixed fields	
Yield / acre (kg)	Market price during season (Rs. / Quintal)

Proforma 3 *Annexure IV*

Data Sheet for Meteorological Observations

METEOROLOGICAL INFORMATION (based on the nearest location / research station)

Name of Location		Latitude		Longitude		Altitude	

Date	Max. Temp.	Min. Temp.	RH		Rainfall	Sun Shine	Wind velocity
			Morning	Evening			
	(^{0}C)	(^{0}C)	(%)		(mm)	(hrs.)	(km h^{-1})

NOTES