Integrated Pest Management in Groundnut

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Foreword

Groundnut besides being a major oilseed crop is an important food legume also. To meet the growing requirements of oil and to ensure nutritional security to a population of over one billion in our country – groundnut has to play a pivotal role. The crop is mostly cultivated in dry lands under low input management, where a number of diseases and pests take a heavy toll. It is, therefore, a serious challenge to the researchers to develop and refine crop production and protection technologies, which are not only economically viable but also eco-friendly.

The groundnut crop is affected by a number of insect pests and diseases, which damage the crop at different stages of crop. It is practically difficult for the resource-poor farmers to follow the different recommendations of plant protection meticulously to protect their crop. In view of this, development of Integrated Pest Management (IPM) strategy based on the research carried out by the National Research Centre for Groundnut (NRCG) and AICRP groundnut scientists is of great relevance in controlling key pests and diseases most effectively. This will certainly help to improve the productivity of groundnut in India.

I congratulate the authors for bringing out this bulletin, which is likely to be useful to the farmers, researchers, extension officials and NGOs associated with groundnut production in the country.

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Contents

1. Introduction

India is the largest producer of groundnut in the world. In India, groundnut is grown in an area of 7.6 million hectares with a production of 7.8 tones of pods per annum. However, the average productivity is only around 1,000 kg/ha. This low productivity is attributed to several constraints. Besides abiotic stresses, biotic factors like insect-pests, diseases and weeds have been recognized as the major factors limiting groundnut production. The groundnut crop suffers from a variety of insect-pests, pathogens (plate1) and weeds, and cause heavy losses to an extent of Rs. 2,380 million per annum. The relative economic importance of pests (insect-pests, diseases, weeds, birds, nematodes and rodents etc.) in different states varies due to the local environment and the production systems. For successful development and implementation of an IPM strategy to manage biotic stresses a few basic requirements are (i) Constant surveillance (ii) A variety of management options that are feasible, economically viable and easily adaptable by farmers, (iii) Optimum blending of management options, (iv) Systematic on-farm evaluation of the modules, (v) assessment and refinement of the IPM technology and finally (vi) Strategies to disseminate the technology effectively among farmers. While some pests are widely distributed and cause serious yield losses, some are endemic to certain pockets and some are economically not important. However, these situations are not static and hence there could be some shifts due to sudden changes in the climate and production systems. A continuous and vigorous pest surveillance is thus essential for timely prevention of sudden outbreaks of epidemics. For this purpose qualified personnel should periodically visit farmers' fields, study the symptoms and injury and evaluate the damage. Wherever necessary, advice should be given on suitable control measures and judicious use of pesticides. This exercise has proved highly successful in case of rice, cotton, wheat, and sugarcane in India. Such an effort needs to be extended to groundnut also since this activity is the key to the Integrated Pest Management Strategy.

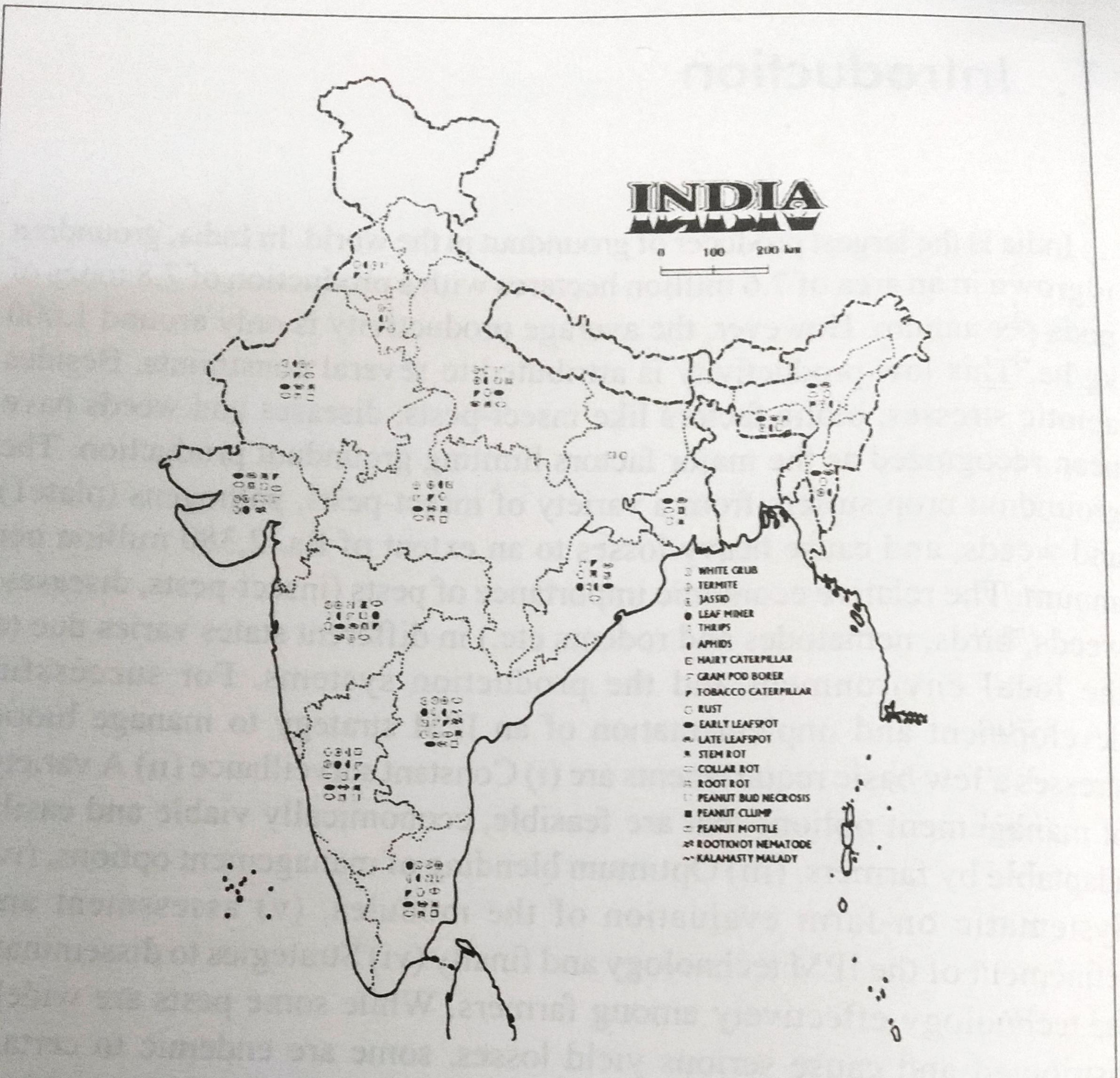

Fig. 1. Pest distribution pattern in India

In the case of pest control, the current approach of over kill through pesticides should be avoided. Though chemical pesticides have played an important role in increasing groundnut production, their indiscriminate use for the control of pests has led to several environmental problems such as development of resistance in pests to pesticides, pesticides residue and the destruction of beneficial parasites and predators of pests. Therefore, the strategy should aim at economically sound Integrated Pest Management (IPM). In IPM, a series of steps are followed to keep the population level of the pests below the economic threshold level and demands a judicious use of pesticides, disease free seeds of resistant/tolerant varieties, biological suppression of the pest population, usage of pheromones, timely spray of pesticides etc. to form part of the plant protection umbrella. Special attention should be given to those pests, which occur consistently and cause heavy losses, since growers will benefit economically by managing them. After a number of years of research on individual components for management of economically important pests, integrated pest management modules were configured. The basic criteria in choosing the components were, (i) Should be easily available, (ii) Economically viable, (iii) Easily adaptable by farmers and (iv) Mutually compatible. These modules were validated and refined at the NRCG and in real-farm situations. The details of this exercise are presented in this bulletin. Additionally, the information on period of occurrence and congenial climate for the development of major pests is also given. The scope of IPM, emerging insect-pest/disease scenario and scope of remote sensing technology are also indicated in this bulletin.

2. Holistic IPM developed in groundnut

A holistic IPM was developed in groundnut, based on six years of independent research on entomological, pathological and weeds management aspects, followed by three years of combined trials during rainy season. Through holistic IPM approach even under varied rainfall pattern, the productivity could be sustained. It not only sustained groundnut productivity but also the requirements for a farm family and his cattle, through other crops. The need based use of crude neem oil along with pesticides to the minimum, use of intercrops/trap crops such as pearlmillet, castor, soybean and pigeonpea increased the net profit and also acted as a security against the failure of groundnut crop due to some reason or the other (fig. 1).

Fig. 1. IPM module developed at NRCG (ICAR) Junagadh

Layout of different crops in the IPM module

B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	P	G	G	G	S	G	G	G	C	G	G	G	P	G	G	G	S	B
B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

C: Castor; P: Pegeonpea; G: Groundnut; S: Soybean/Cowpea; B: Bajra

The biotic stresses were managed more effectively, when the IPM package i.e. seed treatment with carbendazim + trap crops (pearlmillet and castor around the field and soybean and pigeonpea as intercrop) + (neem oil 2% + pheromone trap (for *Helicoverpa armigera, Spodoptera litura and Aproaererma modicella*) + 2% neem leaf extract spray (40 DAS), mancozeb 0.25% + carbendazim 0.05% (55 DAS), culture filtrate of *Penicillium islandicum*(70 DAS). For weed management, pre-emergence application of weedicide (flochloralin 1.5kg a.i./ha) + one interculturing (35 DAE) + one hand weeding (30 DAE) was followed. The IPM module along with pigeonpea, castor, pearlmillet and soybean contributed for higher CBR. Intercrop system always less likely to fail and more stable than mono-cropping. The higher CBR of 1 : 3.13 was obtained with a net return of Rs. 17,810/ha. Mixed crops always proved profitable in terms of net profit as well as catering to the other needs of the farm household.

2.1 Components used in the IPM module

1. Seed treatment

Carbendazim (Bavistin) 2g/kg of seeds for seed borne fungi.

2. Cultural practices

(a) Soil amendments such as castor cake or mustard cake or neem cake @ 500 kg/ha (preferably 15 days before sowing) for soil borne diseases like stem rot and collar rot.

(b) Intercropping of groundnut with pegionpea/ pearlmillet/sorghum (3 : 1) depending upon the locally recommended intercrops for foliar fungal diseases

(c) Use of trap crop such as cowpea/soybean/castor as border crop against sucking/defoliating insect-pests.

(d) One hand weeding after the application of pre-emergence weedicide.

3. Biological control

(i) Use of commercially available preparations of *Trichoderma* spp. for the control of stem rot and seed rots as seed treatment @ 4 g/kg seed or soil application @ 25 to 62.5 kg/ha.

(ii) Application of Bt (*B. thuringensis* @ 300–500 g/ha) against *Spodoptera* and *Helicoverpa* (between 45–60 days)

4. Pheromone traps

Install pheromone traps at a distance of 100 m all around for monitoring of the populations of *Spodoptera* @ 2/ha, *Helicoverpa* @ 2/ha and @ 5/ha for leafminer.

5. Need based application of pesticides

(i) Foliar spray of crude neem oil @ 2% in teepol (for both foliar fungal diseases and sucking pests)

(ii) Foliar spray of fungicides (0.05% carbedazim + mancozeb 0.2%) at 45 and 60 DAS against early and late leaf spots and rust

(iii) Use of flochloralin @ 1.5kg a.i./ha as pre-emergence weedicide.

This holistic IPM module was tested under farmers' conditions for evaluation and refinement under the project Technology Assessment and Refinement through Institution Village Linkage Programme (TAR-IVLP) during *kharif* seasons of 1999–2001. The modules were amended from time to time to suit the needs of farmers.

For instance, though at the NRCG level castor was found to be a good border crop, it was not feasible at farmers' level and hence it was reintroduced as an intercrop after every three rows of groundnut. This has been successfully adopted by the farmers.

This IPM technology gave control of major insect-pests ranging from 24–46% and diseases from 28–48% with an average increase in yield by 19%, and highest gross monetary return of Rs 52,000/ha as against farmers' practice of Rs 36,099/ha. Considering the added advantages, farmers have now realized the importance of the IPM package.

Plate 1. Leafminer adult

Plate 2. Leafminer damaged leaves with larva

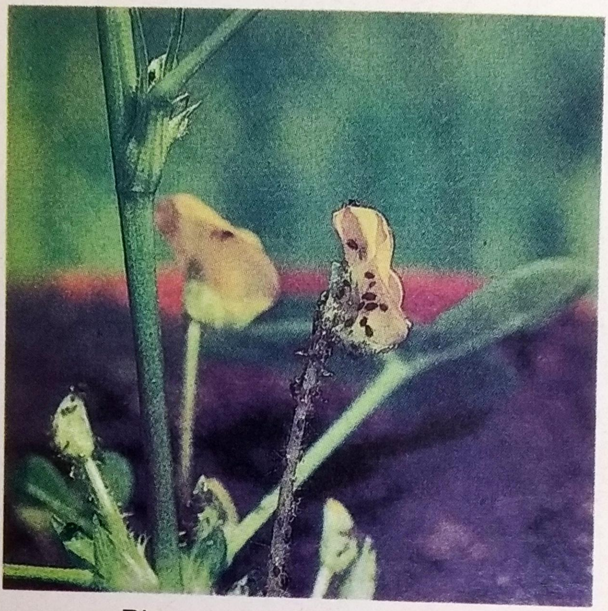

Plate 3. Aphids on flower

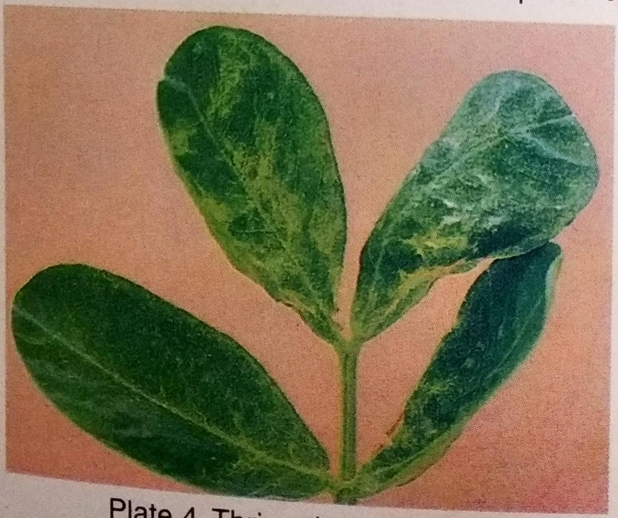

Plate 4. Thrips damaged leaf

Plate 5. Adult jassid

Plate 6. Jassid damaged plants

Plate 7. Tobacco caterpillar

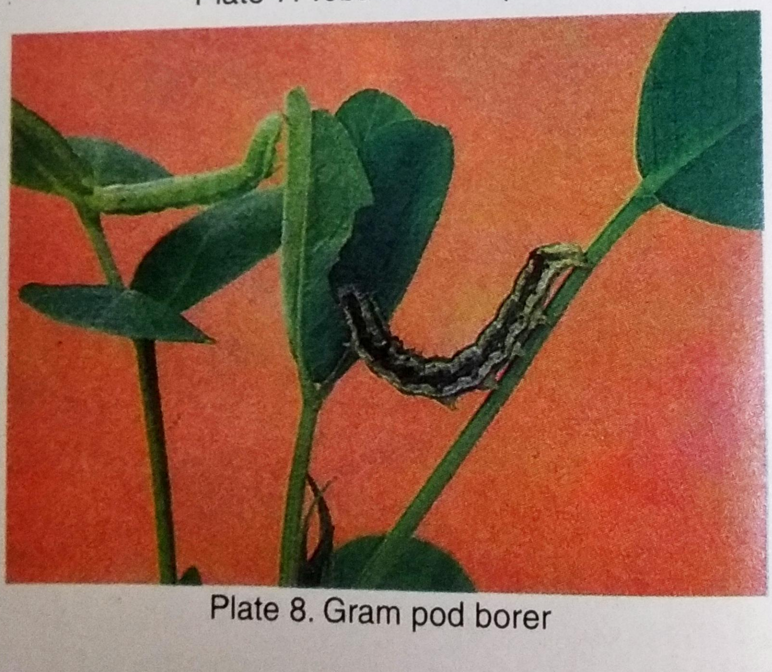

Plate 8. Gram pod borer

Plate 9. Red hairy caterpillar

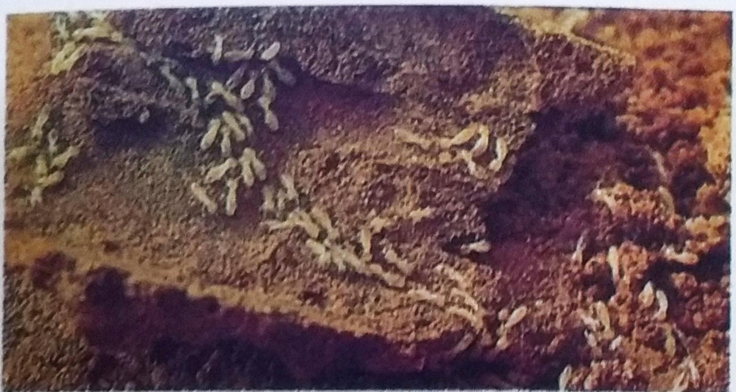

Plate 10. Termites

Plate 11. Termite damaged stem

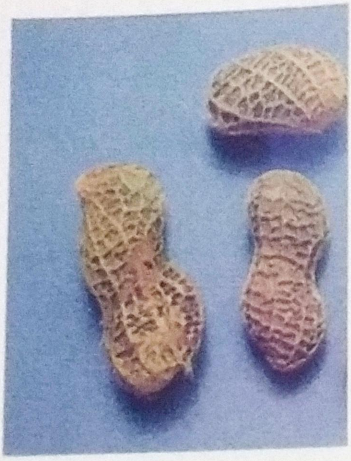

Plate 12. Termite scarified pods

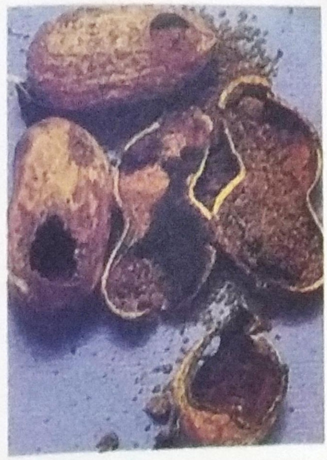

Plate 13. Termite damaged pods

Plate 14. Whitegrub larva

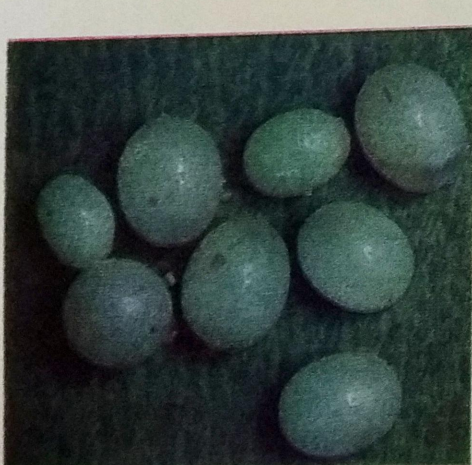

Plate 15. Whitegrub eggs

Plate 16. Adult of whitegrub

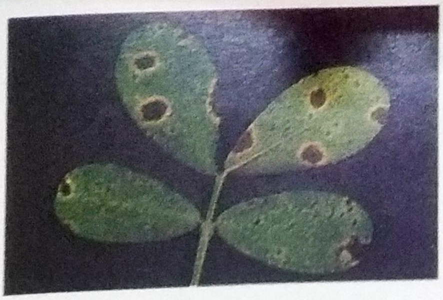

Plate 17. Early leaf spot

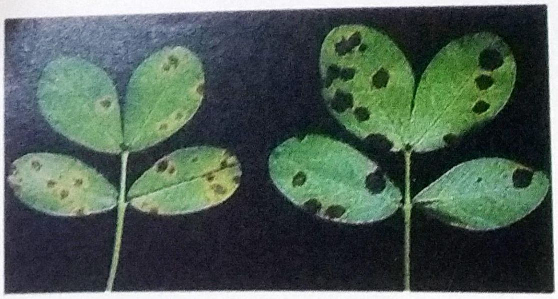

Plate 17a. Late leaf spot

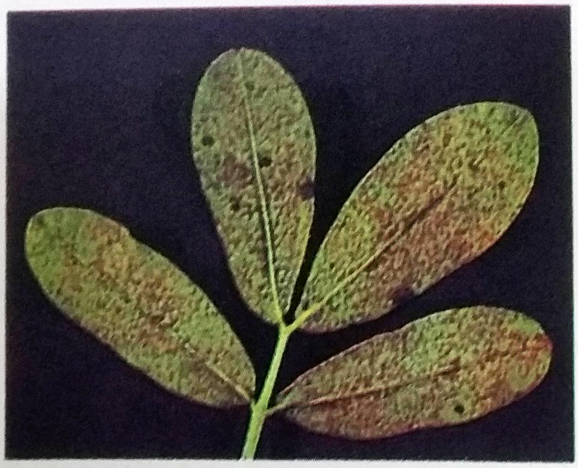

Plate 18. Rust

Plate 19. Collarrot

Plate 20. Stemrot

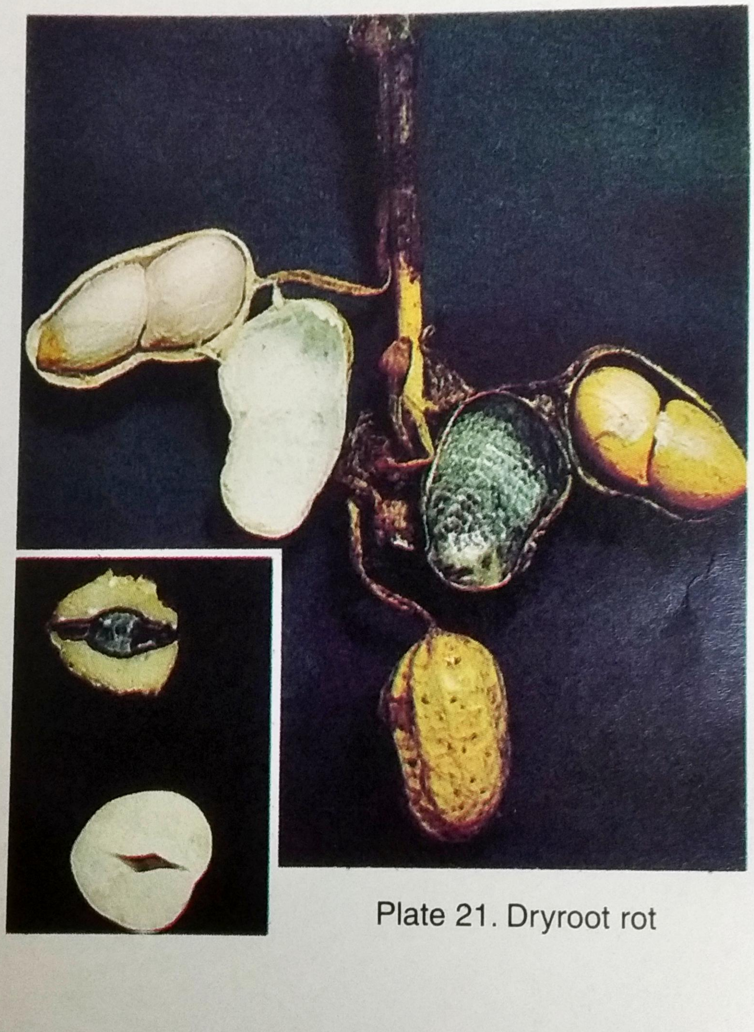

Plate 21. Dryroot rot

Plate 22. Peanut bud necrosis diseases

Plate 23. Peanut clump (Field view)

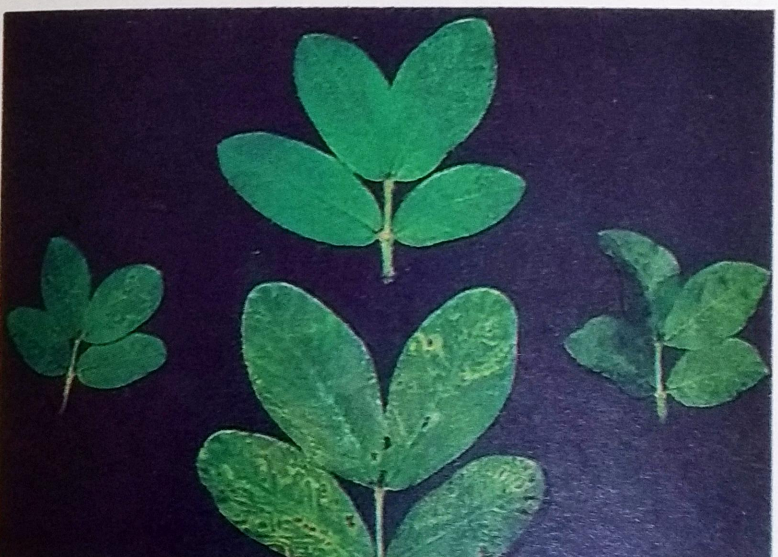

Plate 23a. Peanut clump (close view)

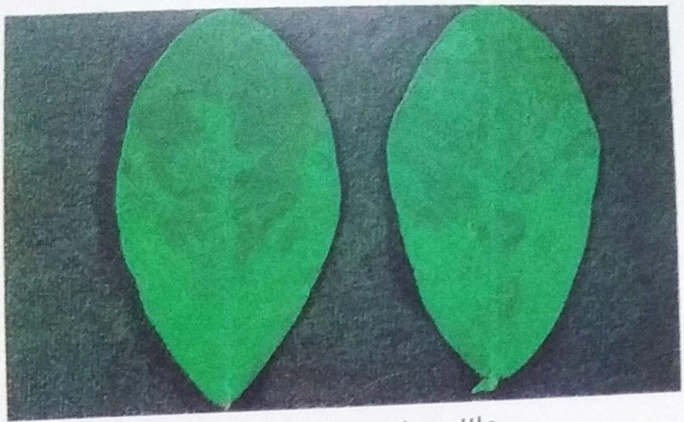

Plate 24. Peanut mottle

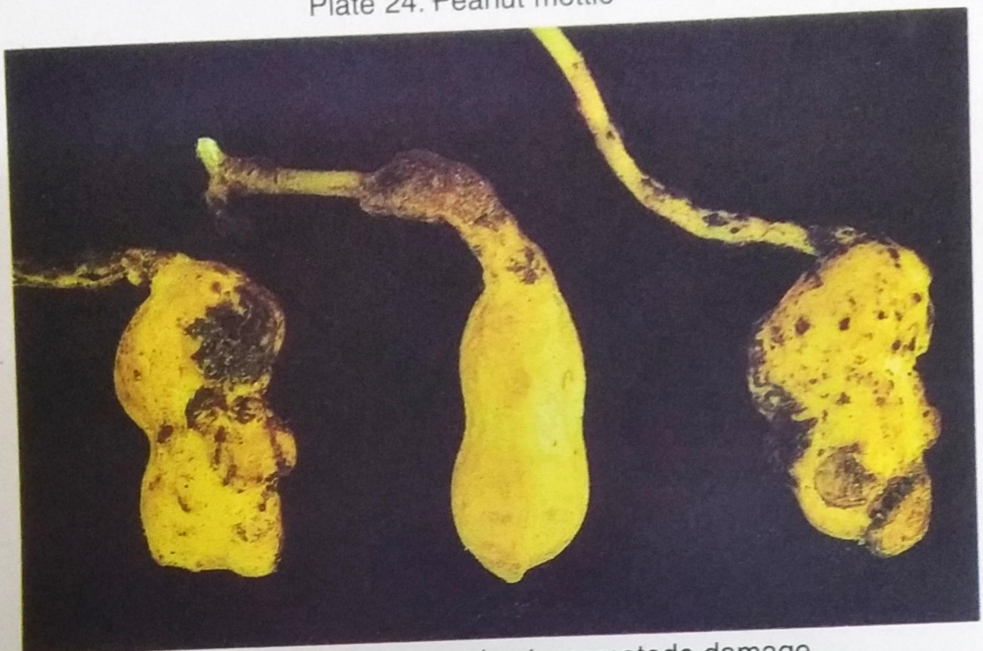

Plate 25. Pod and root knot - nematode damage

Plate 26. Pod and root lesion nematode damage

Plate 27. Kalahasti Malady

3. Plant Protection options available for groundnut farmers

3.1 Resistant/tolerant varieties

Following varieties resistant/ tolerant to various major insect-pests and diseases can be used.

Insect-pests/Diseases	Resistant/ Tolerant varieties
Sucking pests (aphids, jassids and thrips)	Girnar 1
Defoliators (tobacco caterpillar, Gram pod borer and leafminer	BG 2
Early leaf spot, late leaf spot and rust	ALR 1,ALR 2, ALR 3, Girnar 1, ICGV 86590, ICGV 87160, ICGV 86325, CSMG 84-1, OG-52-1, RSHY 1, DRG 12, DRG 17, TAG 24, BSR 1, VRI 5, CO 4
Aflaroot and Collar rot	J 11, JCG 88 and OG-52-1
Stem rot	OG-52-1, Dh 8, ICGV 86590
Peanut Bud Necrosis Disease(PBND)	ICGS 11, ICGS 44, ICG 37, Kadiri 3, ICGV 86325, K 134, DRG 12, R 8808, JCG 88, CSMG 884, Chandra

3.2 Cultural practices

- Deep burying of crop residues; destruction of crop debris by burning removal of volunteer groundnut plants (self-sown plants); early planting and wider row spacing (40–45 cm) for managing early leafspot, late leafspot, and rust.

- Against collar rot, avoid deep sowing (not more than 2 inches) and avoid injury to seedlings and deposition of soil particles on cotyledons during intercultural operations.
- Non-dirtying cultivation in combination with minimizing defoliation due to leaf spot; deep burial of surface organic matter and crop debris by ploughing it to a depth of 8–10 inches; early sowing and close planting to manage stem rot pathogen.
- Deep tillage for management of soil-borne insect-pests and pathogens.
- Soil amendment with castor cake/neem cake/mustard cake @ 500 kg/ha against termites and soil borne pathogens.
- Early sowing (first fortnight of June) for Peninsular and central India, late sowing (first fortnight of July) for northern India; and close spacing (20×10 cm/ 30×7.5 cm) to manage bud necrosis.

Barrier/repellant crops

- Pearlmillet against thrips, leafminer, peanut bud necrosis disease.
- Castor against tobacco caterpillar (*Spodoptera litura*) and semi-looper (*Achaea janata*).

Intercrops

- Soybean or cowpea as intercrops after 3–4 rows of groundnut to trap leafminer, thrips and jassids.
- Pearlmillet, sorghum, maize and pigeonpea to reduce early leafspot, late leafspot and rust. Pealmillet and maize also help in reducing bud necrosis disease.
- Mixed cropping with moth bean (*Phaseolus aconitifolius*) in alternate rows to manage stem rot.
- Crop rotation with cotton or wheat or maize or onion or garlic to reduce stem rot incidence.

3.3 Biological control/Biopesticides

- Pheromone traps @ 10 traps/ha for *Spodoptera* and *Helicoverpa* and 25 traps/ha for leafminer for mass trapping.
- Nuclear polyhedrosis virus for the management of *Spodoptera* and *Helicoverpa* @ 250 LE (6×10^9/LE /ha).
- Spray of aqueous neem leaf extract (2–5%) 3 times at 15 days interval for the management of leafspots and rust commencing from first obsrevation of symptoms or
- Spray of neem seed kernel extract (5%), or crude neem oil in teepol (2%) against defoliators, mites and foliar pathogens or
- Release of *Trichogramma chelonis* @ 50,000/ha, two times at 7–10 days interval followed by release of *Bracon hebetor* @ 5,000/ha two times at 7–10 days against leafminer and defoliators commencing from brood emergence in case of leafminer and 30 DAE against defoliators

3.4 Chemical Methods (Need based)

Table 1. Pesticides recommended against insect-pests and noninsect-pests

Leafminer	Carbosulfan 10 G at 4 kg a.i./ha OR Cartap (Padan 50 EC) at 1 kg a.i./ha
Tobacco caterpillar	Diazinon 300 g a.i./ha
American boll worm	Dichlorvos 350–500 g a.i./ha
Red hairy caterpillar	Dichlorvos 300–500 g a.i./ha or Dicrotophos 150-200 g a.i./ha
Sucking pests (leaf hopper, thrips, aphids)	Carbaryl 1.12 kg a.i./ha or dichlorvos 350 g to 500 g a.i./ha or malathion 1.12 kg a.i./ha or dimethoate at 200 to 250 ml a.i./ha or Phorate 1.12 kg a.i./ha
Termite and white grub	Soil application of phorate granules at 1.1 and 1.6 kg a.i./ or 5% diazinon granules at 25 kg/ha or carbofuran 3G at 10 kg/ha
Mites	Kelthane 500 ml

Table 2. Chemical control of diseases

Diseases	Spray schedule
1	2
Early leafspot, late leafspot, rust	Two sprays of mancozeb 0.2% at 35 and 70 days after germination and one spray of carbendazim 0.025% at 60 days after germination (ICBR 1 : 2.85) or Application of carbendazim 0.025% + tridemorph 0.04% five times at fortnightly intervals commencing 35 days after sowing during summer season or

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(concluded)

1	2
	Spray application of carbendazim 0.05% + mancozeb 0.2% at 2–3 weeks interval, 2 or 3 times starting from 4–5 weeks after planting (ICBR 1 : 14.8 to 1 : 24.4) or Foliar application of chlorothalonil (0.1%)
Collar rot	Seed treatment with carbendazim 1–2g/kg seed of mancozeb 2–3 g/kg seed or chlorothalonil/captafol 2 g/kg seed
Stem rot	Seed treatment with carbendazim 2g/kg seed or mancozeb 3g/kg seed
	Soil drenching with 0.2% carbendazim
PBND	Foliar application of dimethoate or quinalphos 0.02% (two spray) within 40 day of germination

3.5 Economic Threshold levels (ETL) for the insect-pests of groundnut

The following ETLs can be observed using sweepnets in the case of thrips and jassids, foliage damage in case leafminer, *Spodoptera litura* and other defoliators. Collect 20, 40 or 60 compound leaves from 25 m^2 area of groundnut crop if the damage is high, medium and low, respectively. If the population or damage crossed the ETLs, apply any one or two of the management strategies as required.

Table 3. The ETLs for important insect-pests

Insects	Economic Threshold Level	Remarks
Thrips	5 adults/terminal buds	Attains severe status only on young crop during rainy season when the crop is sown in cold weather
Jassids	5 to 10 adults per plant up to 30DAE	Can cause damage to crop at the seedling stages
Leafminer	5 mines/plant up to 30DAE 10 mines/plant up to 45DAE 15 mines/plant up to 50 DAE	Need to look for parasites. If 50% of the larvae are parasitized and the population is close to the threshold level then there is no need to spray
Spodoptera and other defoliators	20 to 25% defoliation up to 40 DAE	From 50DAE the crop can tolerate up to 50% defoliation without any economic loss

4. Information on development of major insect-pests and diseases

The period of occurrence and the congenial climate required for the development of the major insect-pests (Table 4) and diseases (Table 5) is give below.

4.1 Insect-pests

Table 4. Conditions congenial for occurrence of insect-pests of groundnut

Insect-pests	Period of occurrence	Congenial climate
1	2	3
Leafminer (plate 1 & 2)	March–October	High temperature favours population build up
White grub (plate 14, 15 & 16)	August–October	Temperature coupled with humidity favours the survival of the grub
Thrips (plate 4)	March–October	Early drought favours the population build up
Jassid(plate 5 & 6)	March–October	Dry weather, bright sun shine and occasional rains favour the population
Aphids (plate 3)	July–September	Succulence in plants favour the population
Hairy caterpillars (plate 9)	June–October	Long drought period followed by rains favour the population

(*Contd . . .*)

(concluded)

1	2	3
Tobacco caterpillar (plate 7)	March–October	Hot and humid climate favours the population
Gram pod borer (plate 8)	March–October	High rain fall followed by drought for few days favours the population
Termites (plate 10, 11, 12 & 13)	September–October	Warm humid weather favours the population soil temperature above 30°C passively favours the population

4.2 Diseases

Table 5. Conditions congenial for development of diseases of groundnut

Diseases	Period of occurrence	Congenial Climate
1	2	3
Early leafspot and Late leafspot (plate 17)	10–28 days after emergence	Mean min. temp. : 18–23°C Mean Max. temp. : 31–35°C RH (%) : above 80% Mean monthly rainfall: at least 60 mm. Conidia show typical forenoon pattern of diurnal periodicity for the release with daily peaks recurring at 10h. For an epidemic : 90–93% RH with around 20°C temp. for 6–7 days. Temperature/RH index for each of five days for prediction.

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(contd . . .)

1	2	3
Rust (plate 18)	40–50 days after emergence	In summer (May–June) incubation period is 18 days. Continuous dry period, RH below 70% and high temperature > 26°C delays rust epidemic. In low altitude areas disease appears severely. For spore dissemination diurnal periodicity with peak occurrences around noon. Optimum temperature of 20°C, high humidity and moisture on the leaf surface favour infection.
Collar rot (plate 19)	Within 30–35 days after planting	High soil (30–35°C)- and air temperatures; soil moisture levels of 13–16%. In sandy and sandy loam soils more incidence. In Punjab July sown crop suffers more damage.
Stem rot (plate 20)	Through out the crop season	29–32°C during most of the day, and night temp. around 25°C, Soil moisture to the extent of 40–50% of water holding capacity
Dry root rot (plate 21) .	Mature plants are affected	26–35°C congenial. High incidence in shallow fields

(Contd . . .)

(concluded)

1	2	3
Peanut bud necrosis disease (plate 22)	30–40 days after planting	Vector thrips are mainly carried by the wind, temperature around 30°C and a wind speed of 10 km/hr favour migration of thrips. Major spread of disease in August and September in *kharif* sown crop and in December, January in *rabi* / Summer crop. High plant population reduces severity
Peanut clump (plate 23)	3–4 weeks after emergence	–
Peanut mottle (plate 24)	Young developing leaflets	29–32°C favour severe disease
Pod and root-knot (plate 25)	Through out crop season	–
Pod and root lesion (plate 26)	Through out crop season	–
Kalahasti malady (plate 27)	Through out crop season	–

5. Emerging insect-pests/ diseases problems

The likelihood of a drastic change in the pest system is unlikely unless a new devastating pest turns up. No specific problems with breakdown of resistance have cropped up so far and even clear races of the pests are yet to be found.

However, resurgence of some insect-pests such as thrips, *Spodoptera*, *Helicoverpa*, and bruchid beetle in some pockets and ultimately acquiring a national problem status are not unaware.

Similarly, occurrence of peanut bud necrosis in an epidemic form in Ananthpur district of Andhra Pradesh, spreading of stem rot and collar rot to vast areas, sporadic reports of bacterial wilt in Orissa and other areas, introduction of diseases of quarantine significance (peanut stripe virus etc.) need due attention while formulating the IPM modules.

6. Scope of remote sensing technology

In all the states where groundnut is largely cultivated basically as monocrop such as Saurashtra region of Gujarat, Ananthpur area of Andhra Pradesh, South Arcot district of Tamil Nadu, remote sensing techniques would be of immense value as the images gathered through satellites could be used for the forewarning of the epidemics of insect-pests and diseases. The techniques are also useful for the estimating losses due to biotic stresses.

7. Suggestions for implementation of IPM in groundnut

- Better understanding of the groundnut based production systems to understand the insect-pest/disease problems.
- Thorough survey and surveillance during crop seasons to monitor development of pests.
- Integration of individual feasible and economically viable components based on the knowledge base of the local situations into dynamic IPM modules
- Spatial and temporal large scale verification trials especially to demonstrate the economic viability and sustainability of the modules
- Regular feed back and refinement of the IPM modules
- Building awareness among the clientele
- Establishment of a strong formal network of researchers, extension workers and farmers.
- Periodic interactions among, ICAR, SAUs, Depts. of Agriculture, Ministry of Agriculture of Union and State Govts. NGOs, Private agencies and other organizations for monitoring and reviewing of strategies for effective implementation of IPM in diversified production systems in a synergistic approach.
- Human resource development through capacity building to upgrade the knowledge base of the field workers in diagnosis of pests for proper reporting and management.