Groundnut Pest Research at ICRISAT

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Initially research was concentrated on those particular pest problems which were of immediate concern at the ICRISAT Center. Simultaneously, information was collected on the most important pest problems of the crop in the Semi-Arid Tropics (SAT). This paper briefly reviews the progress made since groundnut pest research started at ICRISAT in late 1977.

Identification of Pest Problems

Groundnut Pests at ICRISAT

At ICRISAT the insect fauna from groundnuts was collected from 10x10 meter sized plots of three cultivars with erect bunch (cv TMV-2), spreading bunch (cv Robut 33-1), and runner (cv M-13) growth habits replicated three times in pesticide-free and pesticide-affected areas. Over 70 insect and other pests of groundnuts were collected.

The seasonal abundance of the various insects was also studied in plots of the groundnut cv TMV-2 raised at several locations on both Alfisols and Vertisols on the ICRISAT farm. The crops were sown monthly from June through February, individual plots being sited at least 400 m away from other groundnuts. Information on the abundance of insects in relation to locations, soil types, pesticide-free or affected areas, seasons, and years was recorded.

Termites and wlreworms were most abundant in Alfisols while earwigs and millipedes were more abundant in Vertisols. In Vertisols leaf miner was more prevalent in some locations than others. Thrips injury was more pronounced windward than leeward locations. Barriers across the prevailing winds affected thrips distribution; smaller numbers of thrips were observed on the plants in the vicinity of field bunds to the leeward side. Some insects became more abundant in drought years; *Caliothrips indicus,* leaf miner, *Aproaerema modicella,* and aphid *Aphis craccivora* were more abu ndant in th e drought year of 1979 th an in the good rainfall year of 1978. In normal years, insects such as thrips *(Scirtothrips dorsalis* and *Frankliniella schultzei)* were abundant in both rainy and postrainy seasons, *Spodoptera litura* and *Aproaerema modicella* in the postrainy season, *Aphis craccivora* in the summer season, and *Empoasca kerri* in the rainy season. *Heliothis armigera* was an important flower feeder in both rainy and postrainy seasons. (Fig. 1).

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Groundnut Pests in India

In India insect pests are major constraints on yields, being particularly important in the states of Andhra Pradesh, Tamil Nadu, Punjab, Rajasthan, Gujarat and Maharashtra. About two decades ago, only a few insects were regarded as important pests (Rai 1976) but the situation has changed considerably. Insects like *Spodoptera litura, Frankliniella schultzei, Scirtothrips dorsalis* and *Empoasca kerri* which were not considered important pests then, are now so recognized (Table 1).

Insects such as leaf miner have been spreading and considerable damage by this insect was reported for thefirsttimefrom Gujarat and from the Dhuliadistrict of Maharashtra in 1978. White grubs *(Lachnosterna consanguinea)* have compelled many farmers to abandon groundnut cultivation in sandy soils of Gujarat, Rajasthan, Uttar Pradesh, and Punjab.

Groundnut Pests in SAT

On the world scene, over 300 species of insect pests have been recorded from groundnuts but only a few are important worldwide and a few others in restricted regions (Table 2). Some are important as vectors of viral diseases (Table 3). Insects are important as quality reducers and

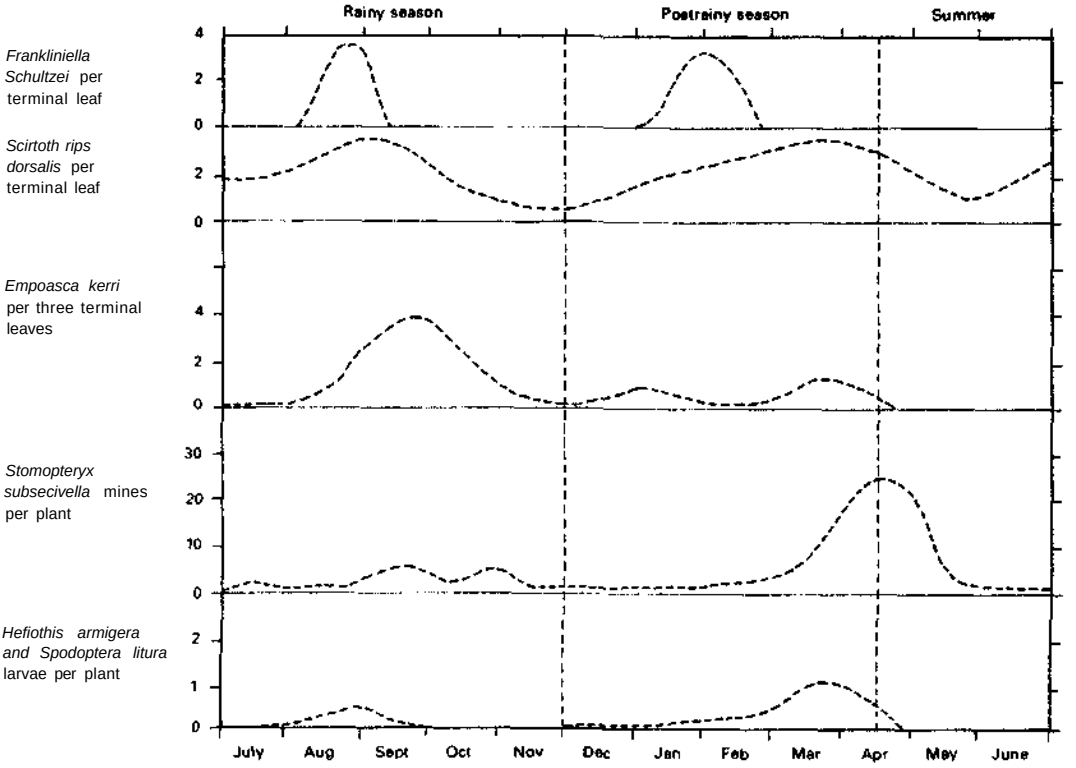

Figure 7. Major pests of groundnut at ICRISAT and their seasonal distribution.

Table 1. Major pasts of groundnut in India.

Year 1968[a]	Year 1979[b]
1. *Aphis craccivora*	1. *Lachnosterna consangumea*
2. *Aproaerema modicella {Stomopteryx subsecivella)*	2. *Aphis craccivora*
3. *Amsacta spp*	3. *Aproaerema modicella [Stomopteryx subsecivella)*
4. *Microtermes sp* and *Odontotermes sp*	4. *Amsacta albistriga*
	5. *Heliothis armigera*
	6. *Spodopetera litura*
	7. *Frankliniella schultzei*
	8. *Scirtothrips dorsalis*
	9. *Empoasca kerri*
	10. *Odontotermes obesus*
	11. Pod scarifying termites

a. Rai, B. K. 1976. Pests of oilseed crops In India and their control. Indian Council of Agricultural Research, New Delhi.
b. From field trips, literature, and correspondence.

there are many storage pests against which strict quarantine is in vogue, e.g., *Caryedon serratus, Trogoderma granarium.* The literature on groundnut insects from Commonwealth countries has been reviewed by Feakin (1973), for the USA by Bass and Arant (1973), and brief review of world pests by McDonald and Raheja (1980).

Studies on the Thrips Vectors of Bud Necrosis Disease

Thrips-borne bud necrosis disease caused by tomato spotted wilt virus is an important disease in India (Table 4) and ICRISAT (Table 5). A higher incidence was observed in the rainy season than in the postrainy season. A major epiphytotic occurred in 1979 when the infection level in unsprayed crops reached 80-95%. In the subsequent postrainy season less than 30% infection was recorded in unsprayed plots. Infection levels were lowest in crops sown in September and October and from February - May.

Table 2. Major Arthropod pesta of groundnut.[a]

	Regions where serious			
	Asia	Africa	Americas*	Australia
Sucking pests	*Aphis craccivora* *Empoasca kerri* *Scirtothrips dorsalis* *Frankliniella schulaei* *Caliothrips indicus*	*Aphis craccivora* *Empoasca dolichi* *Empoasca facialis*	*Empoasca fabae* *Ennoethrips flavens* *Frankliniella fusca*	*Austrasca* sp *Paraplobia* sp
Foliage feeders	*Spodoptera litura* *Heliothis armigera* *Aproaerema modicella* *Amsacta* spp	*Spodoptera littoralis*	*Spodoptera fungiperda* *Heliothis zea* *Feltia subterranea* *Anticarsia gemmatilis*	*Spodoptera litura* *Heliothis armigera*
Root feeders	*Lachnosterna* sp *Odontotermes* sp	*Hilda petruelis* *Microtermes* thoracalus		*Rhopaea magnicornis* *Heteronyx* sp
Pod feeders	*Microtermes* sp *Etiella zinckenella* *Elasmolomus sordidus*	*Microtermes* sp *Elasmolomus sordidus* *Peridontopyge* sp. *Caryedon serratus*	*Diabrotica undecim-punctata* *Pangeas bilineatus*	

a. Feakin, S. D. 1973. Pest control in groundnut, PANS Manual No. 2. COPR, London.
b. Mainly from Bass, M. H. and Aran!, F. S. 1973. Pages 383-428 *In* Peanuts-culture and uses.

The epiphytotics of the disease were associated with an abundance of the major vector *Frankliniella schultzei.* Investigations over the last three years have given some useful information:

1. The major vector, *Frankliniella schultzei* is a polyphagous thrips species. Populations of these thrips are lowest during summer months when they survive mainly in flowers of wild plants, cultivated summer crops, and ornamentals. *Cassia* sp, *Ageratum conyzoides, Tridax* sp, *Tribulus* sp, and *Calltropis* sp are some of the important weeds that harbor *F. schultzei* while greengram, black gram, and cowpea are important crop hosts, and marigold and chrysanthemums are important ornamentals. The thrips migrate to the crops which are sown early or to the weeds particularly *Cassia* sp and *Ageratum* sp that emerge soon after the first few monsoon showers. The populations build up on these hosts.

2. Migrations to groundnuts take place throughout the season but the large scale migrations occur in August and January. The thrips are carried on the prevailing winds and mainly at dusk. The disease infection is associated with immigrant thrips and secondary spread is not important Crops sown early largely escape from the disease (Fig. 2). The number of immigrant thrips is independent of the number of plants per unit area. A

higher plant stand results in a proportional decrease in the percentage of infected plants.

3. Early infection can lead to a total yield loss. Infection during flowering and pegging stages results in substantial reduction in the numbers of flowers produced, the duration of

Table 3. Insect vactors of virus/mycoplasma diseases of groundnut.[a]

Diseases	Vectors	Regions
Rosette	*Aphis craccivora*	African continent
Peanut spotted wilt*	*Thrips tabaci*	Brazil, South Africa and Australia
Bud necrosis[b]	*Frankliniella*[c] *schultzei*	India
Yellow spot	*Scirtothrips dorsalis*[c]	India
Peanut mottle	*Aphis craccivora*	USA, China, Malaysia
Peanut stunt	*Aphis craccivora*	USA
Witches' broom	*Orosius* sp	Indonesia, Java
Rugose leaf curl	Not known	Australia
Marginal chlorosis	Not known	Papua New Guinea

a. Feakin, S. D. 1973. Pest control in groundnut, PANSManual No. 2. pp.197 - Centre for Overseas Pest Research, London.
b. Caused by tomato spotted wilt virus.
c. Amin, unpublished.

Table 4. Bud necrosis disease incidence on groundnut crops in India."

States	Region	Percent disease incidence	Year
Andhra Pradesh	Hyderabad	50-60	1978
		50-90	1979
	Coastal	0-5	1978
	Central	0-20	1979
Karnataka	Eastern	0-2	1978
	Southern	0-2	1978
Maharashtra	Eastern	0-5	1977
		0-5	1978
		0-5	1979
	Western	0-5	1977
		20-50	1980
Punjab		2-10	1977
Uttar Pradesh	Western	10-25	1978
		40-50	1979
		0-5	1980
Tamil Nadu	Western	15-20	1978
Gujarat	Saurashtra	0-10	1977
		0-5	1979
		0-5	1980
	North Eastern	0-5	1977
		20-60	1980

a. Estimates from field trips of Groundnut Program scientists of ICRISAT.

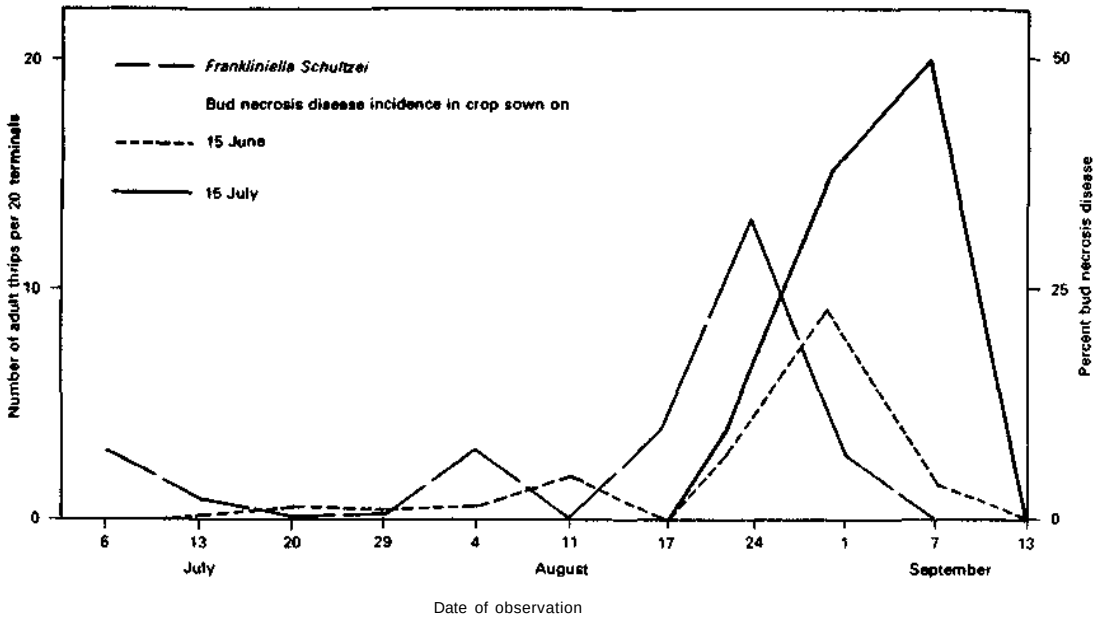

Figure 2. Effect of sowing dates on bud necrosis disease incidence, rainy season 1979.

Table 5. Incidence of bud necrosis disease on groundnut at ICRISAT Center.[a]

Year	Season	Percent disease incidence
1977	Rainy	50-60
	Postrainy	45-56
1978	Rainy	60-80
	Postrainy	45-55
1979	Rainy	90-100
	Postrainy	20-30
1980	Rainy	80-90

a. Figures for unprotected plots.

Table 6. Bud necrosis disease incidence in standard cultivars during different seasons in unsprayed plots.

Season	Percent disease Incidence		
	TMV-2	Robut 33-1	M-13
Rainy 1978[s]	86.8	33.6	60.6
Postrainy 1978*	48.5	28.2	37.0
Rainy 1979*	100.0	50.2	57.1
Postrainy 1979[c]	34.4	20.5	27.8
Rainy 1980[b]	93.8	35.3	40.8

a. Nonreplicated plots
b. 3 replications
c. 4 replications

the flowering period, peg length, and pod growth. Infection in the late stages reduces yield but to a lesser extent than does early infection.

4. Some cultivars appear less susceptible than others to field infection by the disease. Robut 33-1 is one such cultivar; it has a high yield potential and is commercially acceptable (Table 6).

5. Insecticides are generally not effective in reducing the disease incidence, unless applied twice a week throughout the season. Insecticide applications during thrips immigration, requiring 3-4 sprays, is as effective as 12 sprays applied at weekly intervals through the cropping season.

Based on the above findings, a combination of cultural and insecticidal methods was recommended to reduce damage from the disease. This consisted of: (1) early sowing (about 6 weeks before mass immigration of thrips), (2) higher plant density, (3) use of less susceptible cultivars, and (4) use of insecticides during

thrips immigration. When all these practices are followed, substantial reductions in disease are obtained (Table 7).

Screening Germplasm for Pest Resistance

Four insects which are important worldwide and also occur at ICRISAT were selected for screening. The general screening procedure and objectives are given in Figure 3. The insects were thrips *(Frankliniella schultzei),* jassids *(Empoasca kerri),* and termites which caused pod scarification. Screening against aphids *Aphis craccivora* was done in the glasshouse because populations of aphids were not high enough in the field, except during June and the early part of July.

Thrips

Frankliniella schultzei infestation resulted in a scarring of foliage and distortion of leaf margins. An injury rating scale of 1-9 was used in initial trials (1 = no injury; 9 = distortion of margins). Promising lines were advanced and selections were made by visual scoring. The lower susceptibility of some of these lines and wild Arachis sp was confirmed in the laboratory by studying the fecundity of thrips (Tables 8a, 8b). Some of the promising lines have been sent to the USA and Brazil for further testing where *Frankliniella fusca* and *Enneothrips flavens* are important thrips pests.

Jassids

The major jassid pests of worldwide impor-

Table 7. Effect of various cultural practices and insecticldal regimes on the incidence of bud necrosis disease.

Sowing date	Plant density (000/ha, approx)	Cultivar	Basis for insecticide* treatment	Percent disease incidence
Early (15 June)	120	Robut 33-1 (T)	Thrips invasion*	28.5
			Weekly schedule	23.9
		TMV-2(S)	Thrips invasion	57.2
			Weekly schedule	60.4
	80	Robut 33-1(T)	Thrips invasion	36.1
			Weekly schedule	32.1
		TMV-2(S)	Thrips invasion	83.5
			Weekly schedule	81.3
Normal (15 July)	120	Robut 33-KT)	Thrips invasion	48.0
			Weekly schedule	59.8
		TMV-2(S)	Thrips invasion	92.5
			Weekly schedule	94.2
	80	Robut 33-KT)	Thrips invasion	51.1
			Weekly schedule	49.9
		TMV-2(S)	Thrips invasion	92.8
			Weekly schedule	94.8

T. Cultivar with tolerance to virus
S - Cultivar susceptible to virus
a. Dimetheate 400 ml/ha
b. Based on thrips catches In suction trap.

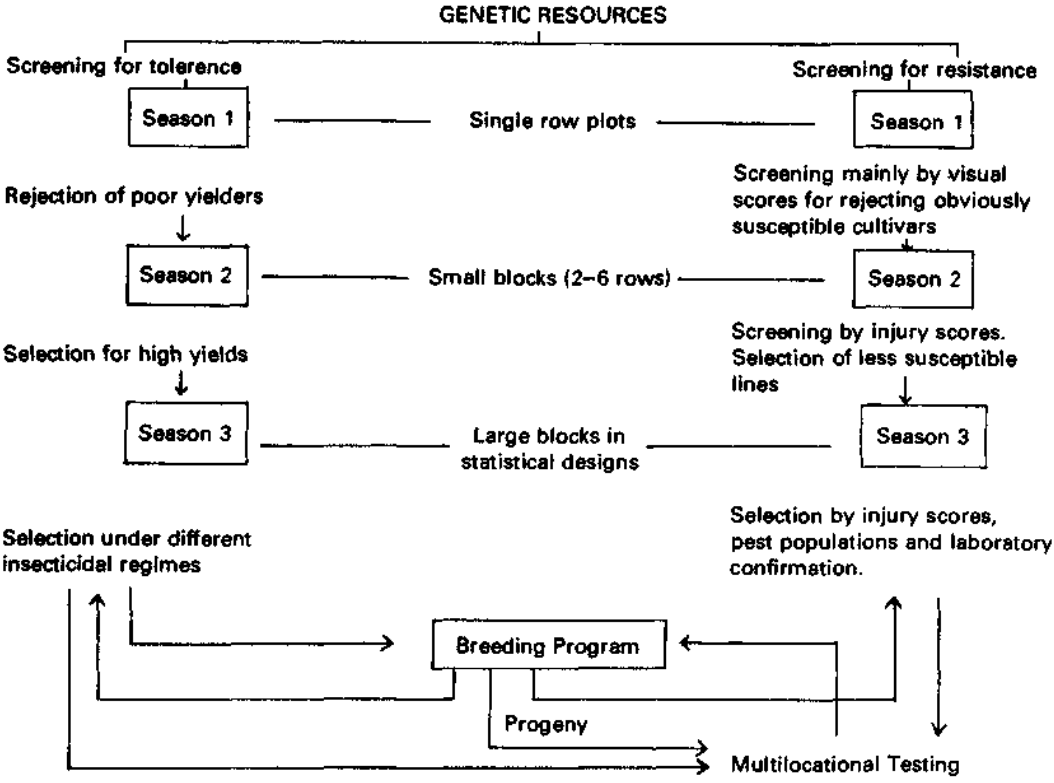

Figure 3. Basic scheme for identification and utilization of multiple pest resistanceltolerance.

Table 8a. Fecundity of *Franklinlella achultzai* on some cultivars of groundnut.

Cultivar	No. eggs/female
NC Acc 2243	4.0
NC Acc 2232	4.8
NC Acc 2214	8.5
TMV-2	15.0

Table 8b. Fecundity of *Franklinlalla schulttml* on different *Arachis* species.

Species	No. eggs laid by 10 females in 24 hours
A. chacoense	0
A. glabrata	0
A duranensls	4
A. hypogaea (cv TMV-2)	44

tance belong to the genus *Empoasca.* In India and at ICRISAT, *Empoasca kerri* is the dominant species. Jassid injury results in tip yellowing and tip burn. Initial evaluations were done on the basis of the number of leaflets showing injury in 100 randomly collected leaflets, and subsequent evaluations by counting the number of jassid nymphs on three terminal leaves of 10 plants of individual accessions. Some promising lines with resistance to jassids are given in Table 9.

Recently, it has been observed *that Empoasca kerri* nymphs and adults cause irreversible wilting in seedlings. Further laboratory screening trials are planned.

Aphids

In preliminary glasshouse trials, five potted plants of each accession were subjected to high aphid attack by placing them near aphid-infested

Table 9. Some promising germplasm against *Empoasca karri.*

Cultivar	Growth habit	Average no of jassid nymphs[a]	Range*	Susceptibility
NC Acc 2214	Runner	2	0-5	R
" 2232	"	3	2-6	R
" 2243	"	5	3-13	R
" 2240	"	5	1-8	R
" 2242	"	5	3-10	R
" 343	"	13	9-20	MR
M-13	"	19	10-43	S
NC Acc 2462	Spreading bunch	15	10-19	MR
" 2477	" "	14	10-17	MR
Robut 33-1	" "	39	17-41	S
NC Acc 2663	Erect bunch	17	12-25	MR
" 2888	" "	15	9-20	MR
" 406	" "	14	5-19	MR
" 489	" "	15	11-18	MR
TMV-2	" "	31	15-57	S

a. Nymphs were counted from three terminal leaves each from ten plants. Average for three replications.
b. Number of nymphs per ten plants.
B = Resistant, MR - Moderately resistant, and S = Susceptible.

plants. The accessions showing more than 25 aphids per plant were rejected. The same procedure was applied to wild relatives of *Arachis.* One accession and several wild species that showed promise were tested in the laboratory. The results are shown in Table 10.

Termites

At ICRISAT, pod scarifying termites (species not identified) occur in pesticide-free Alfisols. A one-hectare plot where the termite population was high was set aside for screening. Termite build-up was encouraged by avoiding the use of pesticides and deep cultivation, and by supplying bamboo pegs for food during off seasons. The distribution of termites was studied by distributing bamboo pegs throughout the plot. Many pegs were attacked indicating a fairly uniform distribution of termites. The scarification of pods was studied in pods attached to plants as well as in detached pods. The

Table 10. Number of progeny produced by *Aphis cracclvora* on the detached shoots of two cultivars of *Arachis hypogaaa* and *Arachis chacoansa.*

Cultivars/ wild species	No. of trials	Total no. of adults used	Total no. of nymphs produced	Nymphs/ female
A. chacoense[a]	9	92	30	0.3
A. hypogaea:				
NC Acc 2214(8)	4	54	61	1.1
NC Acc 2214(7)	15	143	319	3.2
TMV-2[b]	10	94	1308	14.0

a. Resistant check
b. Susceptible check

technique of testing detached pods has been further improved by baiting the pods with a cowdung slurry which attracts termites. Such pods are buried near the bamboo pegs that have been attacked by termites. Some cultivars had much less termite damage than others. A few lines that showed very low damage for two seasons are being further tested.

References

BASS, M. H., and ARANT, F. S. 1973. Peanuts — culture and uses. Pages 383-428 American Peanut Research Education Association. Stone Printing Co., Virginia, USA.

FEAKIN, S. D. (ed.) 1973. Pest control in groundnuts. PANS Manual No. 2, Centre for the Overseas Pest Research, London.

MCDONALD, D., and RAHEJA, A. K. 1980. Advances in legume science. (Summerfield and Bunting eds.)./n The Proceedings of the International Legume Conference, Kew, England, 31 July-4 August 1978.

RAI, B. K. 1976. Pests of oilseed crops in India and their control. Indian Council of Agricultural Research, New Delhi.