Ovipositional Preference and Larval Establishment of the Indian Meal Moth and Almond Moth on Selected Peanut Genotypes[1]

R. K. Kashyap[2] and W. V. Campbell*[3]

ABSTRACT

Thirty-nine selected peanut (*Arachis hypogaea* L.) genotypes from a diverse germplasm collection with known resistance and susceptibility to preharvest insects were tested in the laboratory for postharvest resistance to the Indian meal moth, *Plodia interpunctella* (Hubner), and the almond moth *Cadra cautella* (Walker). After the initial test the number of genotypes was reduced to 20 to reduce duplication of pedigree and omit some of the genotypes with intermediate resistance. Additional data were collected from the 20 genotypes on ovipositional preference and larval establishment on shelled and unshelled (farmers stock) peanuts.

Genotypes with resistance to moth species included NC 6, GP-NC 343 X NC 5, PI 467307, NC 7 X NC 10247, GP-NC 343 X NC 17367 and breeding line 10-P10-B1-B1-B1-B1-B2. Resistance to preharvest and postharvest insect complexes suggest some common chemicals may be present in the green crop and the harvested seed that elicit ovipositional response.

Key Words: *Arachis hypogaea* L., *Plodia interpunctella* (Hubner), *Cadra cautella* (Walker), genotype resistance to insects, cross resistance, ovipositional preference, larval establishment.

The Indian meal moth *Plodia interpunctella* (Hubner) (Lepidoptera: Pyralidae) and the almond moth *Cadra cautella* (Walker) (Lepidoptera: Pyralidae) attack a wide variety of stored products throughout the world and are the two most important pests of stored, farmers stock peanuts in the southeastern United States (10).

Seeds of different cultivars of rice *Oryza sativa* Linn. (7 and 11), maize *Zea mays* Linn. (11) and sorghum *Sorghum vulgare* Pears. (12) were reported to show differential reaction to insect pests under stored conditions.Mbata (9) also reported differences in susceptibility of Nigerian peanut (*Arachis hypogaea* L.) cultivars to *P. interpunctella*.

Peanut genotypes were reported resistant to a complex of preharvest insects and mites (4 and 6). Our objective was to identify genotypes with insect resistance to storage pests.

Selected genotypes from a diverse collection of peanut germplasm with known preharvest insect resistance were tested for ovipositional preference, larval establishment, weight gain and damage by *P. interpunctella* and *C. cautella* on shelled and unshelled (farmers stock) peanuts.

Materials and Methods

The insects for the colonies were obtained from the USDA Stored Product Insects Laboratory, Savannah, Georgia. From this starter colony, insects were reared on moth medium (1) at 27± 1 C and 60± 5% RH with 12 hr light-dark cycle.

Genotypes used in the experiment were selected from a diverse collection of germplasm representing spanish, bunch and virginia market-types. Color of the shelled kernels varied from brick red to Indian pink (2). Analysis of variance (ANOVA) was conducted on all data and then subjected to Duncan's (8) multiple range test. Where appropriate square root and arc sine transformations were used.

The first experiment was conducted in May and June, 1988 and consisted of 39 genotypes with known resistance or susceptibility to preharvest insects. Plastic cups measuring 6.5 cm diameter and 3.7 cm deep were half-filled with shelled kernels. Cups were arranged in a randomized complete block design and replicated four times. The experiment was enclosed in a cage made of polyethylene stretched over a wooden frame that measured 2.5 m long, 0.8 m wide, and 0.5 m high. Four, uncapped 1 liter mason jars, each containing at least 100 pupae of *P. interpunctella* and *C. cautella*, were placed in the center of the cage, and moths were allowed to emerge and disperse within the cage. When most moths died, oviposition was considered complete and each cup was covered with a plastic lid containing a 2.5 cm square opening covered with organdy cloth for ventilation. Live larvae were counted approximately two weeks after placing lids on the cups. When larvae pupated, feeding damage to the kernels by the pest complex was estimated as percent consumed.

The number of genotypes was reduced to 20 by eliminating some of the multiple pedigree entries and some genotypes that were intermediate in resistance. Tests consisting of 20 genotypes were conducted between September and December, 1988. Cages were reduced in size to 1.2 m long, 0.8 m wide and 0.5 m high. Genotypes were tested for ovipositional preference and larval establishment for each moth species separately. Tests were conducted at 27± 1 C with a 12 hr light-dark cycle.

Unshelled Peanuts

Plastic cups measuring 7.5 cm in diameter and 4.3 cm high were half filled with unshelled peanuts. Cups were arranged in a randomized complete block design and replicated three times. Forty pairs of newly emerged *P. interpunctella* and *C. cautella* moths were introduced into separate cages and allowed to oviposit on peanuts for 4 days. Cups were then covered with a plastic lid. A multifocus lens (2.5 magnification) was used to count eggs.

Shelled Peanuts

Shelled peanuts were tested for moth ovipositional preference and larval survival in a cage containing cups measuring 6.5 cm in diameter and 3.7 cm deep that were half filled with peanut kernels. Cups were arranged in a randomized complete block design and replicated four times. Two jars containing several hundred newly emerged *P. interpunctella* adults were placed in the cage and the lids were removed to allow the moths to escape. *C. cautella* were tested separately as described for *P. interpuctella*. Eggs of both species were counted with the aid of multifocus lens one week after moth release, then lids were placed on cups to prevent larvae from migrating. After two weeks larvae were counted.

Larval survival of each moth species was determined for the 20 genotypes. Sound, shelled kernels (20 gm) were placed in 6.5 cm diameter cups and infested with 10 newly hatched larvae. The cups were arranged in a randomized complete block design with four replications. Larval survival and weight of survivors was recorded 25 days after initiation of the experiment.

In another experiment, 10 genotypes representing low and high ovipositional preference ratings in prior tests were selected to determine ovipositional preference on shelled, shelled splits and unshelled peanuts. Genotypes were arranged in a split plot design with four replications. Genotype was the main plot. The Indian meal moth and almond moth were tested separately using the same methods previously described for ovipositional preference.

Results and Discussion

Among the 39 genotypes tested the genotypes with the highest infestation were (IC-74) Florigiant, (F_4-3) NC 7 X NC 302 (F_4-7) SK 38 X GP-NC 343, (IC-35) Manipintar X

[1]Paper No. 12153 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, N.C. 27695-7643. This research was partially supported by a grant from FAO, Rome and USAID, Peanut CRSP under Grant No. DAN-4048-G-SS-2065-00 and the Ministry of Agriculture, Government of India and Haryana Agricultural University, Hisar.

[2]Visiting Scientist, Department of Entomology, Haryana Agricultural University, Hisar 125004, India.

[3]Professor of Entomology, N.C. State University, Raleigh, N.C. 27695-7613.

*Corresponding author.

(Robut 33-1 X NC 2232), and (IGT-34) NC 18017 X NC 18018. Genotypes with significantly lower infestation were (IC-21, 18 and 13) Robut 33-1 X NC 2214, (IGT-8) GP-NC 343 X 17367, (IGT-27 and 28) GP-NC 343 X NC 5, (F_4-17 and IGT-31) NC 6, (IC-75) GP-NC 343, (IC 51) J11 X (M 13 X NC 2232), (IGT-13) 10-P10-B1-B1-B1-B1-B2, (IGT-19) F X [Var. 2750 X PI 259747] F_2-B2-B1, (IGT-1) Early Bunch X NC 18016, and (IC 63) NC 1107 X (NC 2232 X NC 2214). Genotypes with the highest damage included the entries listed with the highest infestation except for IC-35. Another entry with high feeding damage was (F_4-28) Tainan No. 9 X NC 10247. The entries with the lowest infestation were also among the entries with the lowest feeding damage. In addition other entries with low feeding damage include (IC 67) (NC 2232 X NC 2214) X TG 17, and (IC-62) NC 1107 X (NC 2232 X NC 2214) (Table 1). Genotypes with few larvae and low damage from *P. interpunctella* and *C. cautella* complex also exhibit resistance to a complex of preharvest field pests (3).

Unshelled Peanuts

When the almond moth (ALM) was exposed to unshelled peanuts, oviposition was not significantly different among the 20 genotypes. However, differences were found with Indian meal moth (IMM). Significantly more eggs were laid on Manipintar X (Robut 33-1 X NC 2232), SK 38 X GP-NC 343 and J11 X (M-13 X NC 2232) than on 10-P10-B1-B1-B1-B1-B2, NC 18017 X NC 18018, and NC 7 X NC 10247 (Table 2).

Shelled Peanuts

Shelled genotypes differed significantly in almond moth oviposition and larval establishment. Oviposition and larval establishment was high for selections from the cross of J11 X (M-13 X NC 2232), Manipintar X (Robut 33-1 X NC 2232), and SK 38 X GP-NC 343. Oviposition and larval establishment was low for GP-NC 343 X NC 5 and NC 7 X NC 10247 (Table 3). Oviposition was also low for PI 467307, NC 6, NC 18017 X NC 18018, and NC 7 X NC 302. NC 6 exhibited resistance to ALM oviposition but ALM larval establishment on this genotype was high.

The Indian meal moth showed significant preference among genotypes for oviposition. SK 38 X GP-NC 343 received the highest number of IMM eggs and the highest infestation of larvae. In general larval establishment did not correlate well with oviposition. Other genotypes with high egg counts include F X [Var. 2750 X PI 259747] F_2-B2-B1, Manipintar X (Robut 33-1 X NC 2232), and NC 1107 X (NC 2232 X NC 2214).

Lowest number of eggs were laid on NC 6, 10-P10-B1-B1-B1-B1-B2, PI 467307, GP-NC 343 X NC 17367, GP-NC 343 X NC 5, NC 7 X NC 10247, NC 18017 X NC 18018, and NC 7 X NC 302 (Table 4). Genotypes with the lowest infestation of IMM larvae were 10-P10-B1-B1-B1-B1-B2, GP-NC 343 X NC 17367, NC 7 X NC 10247, Robut 33-1 X NC 2214, and GP-NC 343 X NC 5.

Table 1. Differences among peanut genotypes in Indian meal moth and almond moth larval establishment and larval damage to kernels. Raleigh, N.C. 1988.

Entry	Pedigree	Avg. no. larvae[1]	Avg. % damage[1]
IC-74	Florigiant	246.5a	23.0a
F_4-3	NC 7 X NC 302	199.7ab	19.5ab
F_4-7	SK 38 X GP-NC 343	187.7a-c	17.2a-c
IC-35	Manipintar X (Robut 33-1 X NC 2232)	168.2a-d	5.0f-i
IGT-34	NC 18017 X NC 18018	156.0b-e	13.2b-e
IC-67	(NC 2232 X NC 2214) X TG 17	150.2b-f	2.7hi
F_4-52	Florigiant	141.0b-g	9.5d-h
F_4-51	NC 302	137.2b-h	6.2e-i
F_4-49	GP-NC 343	135.5b-h	5.5f-i
IC-71	(Goldins X Faizpur 1-5) X NC 2232	135.5b-i	5.5f-i
IGT-32	GP-NC 343	127.5b-i	3.5hi
F_4-42	UPLPN4 X NC 10247	127.0b-j	8.2d-i
IGT-29	GP-NC 343 X NC 5	124.2c-k	5.2f-i
IC-62	NC 1107 X (NC 2232 X NC 2214)	123.5c-k	1.7hi
F_4-28	Tainan No. 9 X NC 10247	123.5c-k	14.2b-d
IGT-76	Florigiant	119.0c-k	12.2c-f
F_4-1	NC 7 X GP-NC 343	118.7c-k	4.5f-i
IC-41	X 52-X-X-3-B X (M 13 X NC 2214)	113.2c-l	5.2f-i
IC-34	Manipintar X (Robut 33-1 X NC 2232)	110.7d-l	4.0g-i
IGT-42	NC 6 X NC 3033	104.0d-m	5.7f-i
IGT-26	GP-NC 343 X NC 17367	102.0e-m	3.0hi
IGT-123	NC 7	99.5e-m	5.2f-i
F_4-5	NC 7 X NC 10247	98.5e-m	11.7c-g
IC-73	NC6	93.2e-m	4.0g-i
IGT-113	PI 467307	92.0e-m	4.5f-i
IC-63	NC 1107 X (NC 2232 X NC 2214)	90.7f-m	1.0i
IC-13	Robut 33-1 X NC 2214	89.7f-m	2.7hi
IGT-1	Early Bunch X NC 18016	89.5f-m	4.5f-i
IGT-19	F X [Var. 2750 X PI 259747] F_2-B2-B1	88.2f-m	4.0g-i
IGT-27	GP-NC 343 X NC 5	86.2f-m	3.7g-i
IGT-13	10-P10-B1-B1-B1-B1-B2	83.2g-m	4.5f-i
IC-51	J 11 X (M-13 X NC 2232)	82.5g-m	2.7hi
IGT-31	NC 6	81.2g-m	3.2hi
IC-18	Robut 33-1 X NC 2214	75.7i-m	2.2hi
IC-75	GP-NC 343	73.7i-m	3.0hi
F_4-17	NC 6	69.5k-m	3.0hi
IGT-28	GP-NC 343 X NC 5	67.2k-m	3.0hi
IGT-8	GP-NC 343 X NC 17367	61.0lm	3.0hi
IC-21	Robut 33-1 X NC 2214	56.7m	2.0hi

[1] Means followed by the same letter are not significantly different ($P < 0.05$) by Duncan's (1951) multiple range test.

Table 2. Ovipositional preference of Indian meal moth on some unshelled peanut genotypes.

Entry	Pedigree	Average number of eggs/cup[1]
IC-35	Manipintar X (Robut 33-1 X NC 2232)	230.0a
F_4-7	SK 38 X GP-NC 343	206.3a
IC-51	J 11 X (M-13 X NC 2232)	204.7a
IGT-28	GP-NC 343 X NC 5	199.3ab
F_4-3	NC 7 X NC 302	198.7a-c
IC-75	GP-NC 343	189.3a-c
IGT-8	GP-NC 343 X NC 17367	188.3a-c
IC-21	Robut 33-1 X NC 2214	187.7a-c
IGT-113	PI 467307	187.7a-c
F_4-17	NC 6	186.3a-c
IC-74	Florigiant	177.0a-c
IC-18	Robut 33-1 X NC 2214	167.7a-c
IC-67	(NC 2232 X NC 2214) X TG 17	167.3a-c
IGT-27	GP-NC 343 X NC 5	163.7a-c
IGT-1	Early Bunch X NC 18016	154.0a-c
IGT-19	F X [Var. 2750 X PI 259747] F_2-B2-B1	149.0a-c
IC-63	NC 1107 X (NC 2232 X NC 2214)	141.0a-c
F_4-5	NC 7 X NC 10247	119.7bc
IGT-34	NC 18017 X NC 18018	117.0bc
IGT-13	10-P10-B1-B1-B1-B1-B2	116.7c

[1] Means within a column followed by the same lettter are not significantly different ($P < 0.05$) Duncan's (1951) multiple range test.

Table 3. Ovipositional preference and larval establishment of almond moth on some shelled peanut genotypes.

		Avg. number/cup[1]	
Entry	Pedigree	Eggs	Larvae
IC-51	J 11 X (M-13 X NC 2232)	272.7a	118.2a
IC-63	NC 1107 X (NC 2232 X NC 2214)	269.5a	65.7b-g
IC-67	(NC 2232 X NC 2214) X TG 17	249.0ab	70.5b-f
IC-18	Robut 33-1 X NC 2214	248.2ab	98.0a-d
IC-35	Manipintar X (Robut 33-1 X NC 2232)	245.2ab	110.2ab
F_4-7	SK 38 X GP-NC 343	241.0a-c	124.7a
IGT-1	Early Bunch X NC 18016	218.7b-d	58.0d-g
IC-75	GP-NC 343	210.0b-e	86.2a-e
IC-74	Florigiant	198.2c-f	107.2a-c
IC-21	Robut 33-1 X NC 2214	181.0d-g	44.5e-g
IGT-19	F X [Var. 2750 X PI 259747] F_2-B2-B1	177.5d-g	98.0a-d
IGT-13	10-P10-B1-B1-B1-B1-B2	168.5e-h	92.7a-d
IGT-8	GP-NC 343 X NC 17367	161.0f-h	54.2d-g
IGT-27	GP-NC 343 X NC 5	146.5g-i	23.7g
F_4-3	NC 7 X NC 302	141.7g-j	79.0a-f
IGT-28	GP-NC 343 X NC 5	125.5h-j	34.7fg
IGT-34	NC18017 X NC 18018	122.7h-j	63.0c-g
F_4-17	NC 6	105.5ij	87.2a-e
F_4-5	NC 7 X NC 10247	98.5j	35.2fg
IGT-113	PI 467307	96.7j	67.1b-g

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) Duncan's (1951) multiple range test.

Table 4. Ovipositional preference and larval establishment of Indian meal moth on some shelled peanut genotypes.

		Avg. number/cup[1]	
Entry	Pedigree	Eggs	Larvae
F_4-7	SK 38 X GP-NC 343	346.7a	100.2a
IGT-19	F X [Var. 2750 X PI 259747] F_2-B2-B1	294.2ab	34.2g-i
IC-35	Manipintar X (Robut 33-1 X NC 2232)	267.0bc	64.2c-e
IC-63	NC 1107 X (NC 2232 X NC 2214)	264.0bc	48.0d-h
IC-75	GP-NC 343	262.5b-d	96.7ab
IC-18	Robut 33-1 X NC 2214	240.7b-e	73.7b-d
IGT-27	GP-NC 343 X NC 5	233.7b-f	17.7i
IGT-1	Early Bunch X NC 18016	233.2b-f	56.5c-g
IC-74	Florigiant	231.5b-f	39.2e-i
IC-21	Robut 33-1 X NC 2214	231.0b-f	27.7hi
IC-51	J 11 X (M 13 X NC 2232)	224.7b-f	69.2cd
IC-67	(NC 2232 X NC 2214) X TG 17	201.5c-g	37.7f-i
F_4-3	NC 7 X NC 302	193.2d-g	76.2bc
IGT-34	NC 18017 X NC 18018	191.5e-g	69.2cd
F_4-5	NC 7 X NC 10247	184.7e-g	24.5hi
IGT-28	GP-NC 343 X NC 5	179.0e-g	40.7e-i
IGT-8	GP-NC 343 X NC 17367	168.2fg	21.7i
IGT-113	PI 467307	154.0g	62.2c-f
IGT-13	10-P10-B1-B1-B1-B1-B2	149.5g	17.0i
F_4-17	NC 6	146.7g	62.5c-f

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) Duncan's (1951) multiple range test.

When newly emerged larvae of the Indian meal moth were transferred to selected shelled genotypes, larval survival was best on GP-NC 343 X NC 17367 and SK 38 X GP-NC 343. Genotypes did not significantly affect larval weight gain. Nearly half of the genotypes did not support larval survival.

Shelled peanuts were preferred to unshelled peanuts by Indian meal moth and almond moth. The IMM preferred shelled split to shelled whole kernels for oviposition. These differences were statistically significant. Almond moth oviposition was higher on the shelled split than on shelled whole kernels but the differences were not significant (Table 5).

Table 5. Comparison of Indian meal moth and almond moth oviposition on shelled and unshelled selected peanut genotypes. Raleigh, N.C. 1988.

Physical condition of peanut	Avg. no. eggs[1]	
	Almond Moth	Indian Meal Moth
Shelled Splits	128.4a	119.5a
Shelled	118.8ab	104.4b
Unshelled	91.4c	77.1c

[1] Average number of eggs from 10 genotypes.
Means followed by the same letter are not significantly different at ($P < 0.05$) by Duncan's (1951) multiple range test.

When data were combined for oviposition on shelled, shelled split and unshelled peanuts, the almond moth laid more eggs on GP-NC 343 X NC 5 than on PI 467307, GP-NC 343 X NC 17367, NC 6 or 10-P10-B1-B1-B1-B1-B2 (Table 6).

The Indian meal moth laid significantly more eggs on Florigiant than on 10-P10-B1-B1-B1-B1-B2, NC 7 X NC 10247, GP-NC 343 X NC 5 or NC 6 (Table 7). Preferential egg laying was reversed by the ALM and IMM for PI 467307 and GP-NC 343 X NC 5.

The effect of seed coat color did not provide consistent correlation between seed coat color or seed size and ovipositional preference. Other characteristics such as seed texture or hardness were not tested.

Larval survival on unshelled peanuts was poor for both ALM and IMM. Under natural storage conditions, however, there are sufficient cracked and broken pods to provide easy

Table 6. Variation in almond moth oviposition on selected peanut genotypes when data are combined for shelled peanuts, shelled splits and unshelled peanuts. Raleigh, N.C. 1988.

Entry	Pedigree	Avg. no. eggs[1]
IGT-27	GP-NC 343 X NC 5	136.2a
IC-74	Florigiant	125.9ab
IC-21	Robut 33-1 X NC 2214	123.7a-c
F_4-5	NC 7 X NC 10247	113.7a-c
F_4-7	SK 38 X GP-NC 343	111.0a-c
IGT-28	Tainan No. 9 X NC 10247	108.9a-c
IGT-8	GP-NC 343 X NC 17367	106.3bc
IGT-113	PI 467307	106.1bc
F_4-17	NC 6	100.4bc
IGT-13	10-P10-B1-B1-B1-B1-B2	96.4c

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) Duncan's (1951) multiple range test.

access to the kernels by young larvae to initiate an infestation. Based on personal observation large larvae are able to seek out pods and gain entry to feed on the kernels.

Cross resistance and susceptibility of genotypes to preharvest field pests were evident among genotypes exposed to ALM and IMM complex in the laboratory. Selected genotypes resistant to a complex of field pests (3 and Campbell, unpublished) that were also resistant to IMM and/or ALM oviposition and larval establishment include: (F_4-17) NC 6, (IGT-28) GP-NC 343 X NC 5, (F_4-5) NC 7 X 10247, (IGT-8) GP-NC 343 X NC 17367, (IGT-113) PI 467307, and (IGT-13) 10-P10-B1-B1-B1-B1-B2. Genotypes that exhibit susceptibility to a complex of field pests and are also susceptible to ALM and/or IMM oviposition and larval establishment include:(IC-74) Florigiant, (F_4-7) SK 38 X GP-NC 343 and (IC-35) Manipintar X (Robut 33-1 X NC 2232), (F_4-3) NC 7 X NC 302, and (IGT 34) NC 18017 X NC 18018.

Extensive data are available on the resistance of NC 6 cultivar and the susceptibility of the Florigiant cultivar to a complex of field pests (5). The addition of postharvest data as it relates to pest resistance and susceptibility suggests that chemicals, possibly volatiles, are common to the growing plant and the seed that may influence multiple pest ovipostion and pest establishment.

Table 7. Variation in Indian meal moth oviposition on selected peanut genotypes when data are combined for shelled peanuts, shelled splits and unshelled peanuts. Raleigh, N.C. 1988.

Entry	Pedigree	Avg. no. eggs[1]
IC-74	Florigiant	148.7a
IGT-113	PI 467307	115.7b
IC-21	Robut 33-1 X NC 2214	108.2bc
IGT-28	Tainan No. 9 X NC 10247	103.8b-d
IGT-8	GP-NC 343 X NC 17367	103.7b-d
F_4-7	SK 38 X GP-NC 343	89.3cd
IGT-13	10-P10-B1-B1-B1-B1-B2	87.7cd
F_4-5	NC 7 X NC 10247	87.2cd
IGT-27	GP-NC 343 X NC 5	84.2cd
F_4-17	NC 6	80.4d

[1] Means within a column followed by the same letter are not significantly different ($P < 0.05$) Duncan's (1951) multiple range test.

References Cited

1. Boles, H. P. and F. O. Marzke. 1966 Lepidoptera infesting stored products, pp. 259-70. *In.* C. N. Smith (ed.) Insect Colonization and Mass Production. Academic Press, Inc., New York.
2. British Colour Council. 1938-41. Horticultural colour chart. Compiled by Robert F. Wilson. London: Royal Horticultural Society. Vol. 1-4.
3. Campbell, W. V. 1989. Evaluating legumes for insect and mite resistance, pp. 85-100. *In.* H. T. Stalker and C. Chapman (eds.)

Scientific Management of Germplasm: Characterization, Evaluation and Enhancement. International Board for Plant Genetic Resources, Rome. 194 pp.
4. Campbell, W. V. and J. C. Wynne. 1980. Resistance of groundnuts to insects and mites. *In*. Proceedings International Workshop on Groundnuts, 13-17 October. ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) Patancheru, A. P. India: 149-157.
5. Campbell, W. V. and J. C. Wynne 1985. Influence of the insect-resistant peanut cultivar NC 6 on performance of soil insecticides. J. Econ. Entomol. 78 (1): 113-116.
6. Campbell, W. V., J. C. Wynne and H. T. Stalker. 1982. Screening groundnut for *Heliothis* resistance. International Crops Research Institute for the Semi-Arid Tropics. *In*. Proceedings International Workshop on *Heliothis* Management, 15-20 November. Patancheru, A. P., India: 267-276.
7. Cogburn, R. R. 1974. Domestic rice varieties; apparent resistance to rice weevils, lesser grain borers and Angoumois grain moth, *Sitotroga cerealella*. Ann. Entomol. Soc. Am. 63:930-931.
8. Duncan, D. B. 1951. A significance test for differences between ranked treatments in an analysis of variance. Va. J. Sci. 2:171-189.
9. Mbata, G. N. 1987. Studies on the susceptibility of groundnut varieties to infestation by *Plodia interpunctella* (Hubner) (Lepidoptera: Pyralidae). J. Stored Prod. Res. 23 (1): 57-63.
10. Redlinger, L. M. and R. Davis. 1982. Insect Control in postharvest peanuts. pp. 520-570. *In*. H. E. Pattee and C. T. Young (eds.), Peanut Science and Technology. Amer. Peanut Res. Educ. Soc. Yoakum, TX. 825 pp.
11. Russell, P. P. 1976. Resistance of commercial rice varieties to *Sitotroga cerealella* (Oliver) (Lepidoptera: Gelechiidae). J. Stored Prod. Res. 12, 105-110.
12. White, S. C. 1975. Laboratory studies of levels and causes of insect resistance in varieties of stored sorghum. M. S. Thesis, Kansas State University, Manhattan.

Accepted February 17, 1990