PN-ABH-354

Assessment of a diallel cross for multiple foliar pest resistance in peanut (1)

W. F. ANDERSON, A. PATANOTHAI, J. C. WYNNE and R. W. GIBBONS (2)

Summary. — In most of the peanut-producing areas of the world, numerous diseases and insects are involved in yield reduction. A study was conducted to identify peanut (*Arachis hypogaea* L.) lines that are potentially useful as parents of multiple pest resistance breeding populations. The F_1, F_2 and F_3 progeny from a 10-parent diallel cross and the parents were assessed in three successive growing seasons at Khon Kaen, Thailand. Plants of the F_1 and F_3 generations were assessed for late leafspot [*Cercosporidium personatum* (Berk. & Curt.) Deighton] and rust (*Puccinia arachis* Speg.) resistance and the F_2 generation was screened for incidence of peanut stripe virus (PStV), tomato-spotted wilt virus (TSWV) and damage by leafminer (*Aproaerema modicella* Deventer and *Stomopteryx subseriella* Zeller). Screening was done in the field and greenhouse being facilitated by environments conducive to the different pests in different seasons. General combining ability was significant for all traits tested. Specific combining ability was significant for all traits except percentage of plants with peanut stripe virus and yield of F_3 plots. The two virginia-type parents NC Ac 2821 and ICGS 4 had the best general combining ability effects for the virus diseases. NC Ac 2821 also performed well for leafminer resistance. PI 341817 generally yielded hybrids with greater late leafspot and rust resistance, while ICGS 4 produced progeny with leafspot resistance and leaf retention.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is vulnerable to an array of foliar diseases and insects that may reduce yields or require great dependency on control chemicals. In developing countries, farmers may not have access to chemicals or are financially restricted from their use [10]. There is increasing worldwide concern about the environmental impact of pesticide use. Increasing partial or complete resistance through breeding efforts can be one of the most effective ways of reducing chemical dependency.

In many instances, breeding efforts consist of selecting parents, crossing and assessing subsequent material for improved resistance to only one disease. Materials are produced with resistance to a single disease or pest without consideration for resistance to other pests or deleterious effects to yield or seed quality. To address this problem, recent studies have involved investigation of resistance to multiple traits. Coffelt *et al.* [3] screened 45 peanut breeding lines and plant introductions to rust (*Puccinia arachis* Spegazzini), Cylindrocladium black rot (*Cylindrocladium crotalariae*), pod breakdown, early leafspot (*Cercospora arachidicola* Hori), and thrips (*Frankliniella* sp.) under natural field infestations. Multiple pest resistance was found in NC Ac 3033 and has been used in subsequent breeding programs [4, 5, 7].

The semi-tropical climate of Thailand not only allows for growth of multiple crops of peanut per year but also provides diverse environmental conditions conducive to development of different diseases or pests. Field screening for numerous diseases and pests over sequential seasons increases knowledge of resistance to different pests while facilitating advancement of populations toward homozygosity.

The objective of this study was to assess parents and hybrid progeny for resistance to foliar fungal diseases (late leafspot and rust) as well as for two virus diseases (peanut stripe virus and tomato spotted wilt virus) and an insect pest (leafminer) for the identification of crosses with potential multiple pest resistance.

MATERIALS AND METHODS

A 10-parent half-diallel cross was performed at the International Crops Research for the Semi-Arid Tropics (ICRISAT), Hyderabad, India. The parents were selected on the basis of resistance to late leafspot and rust (NC Ac 17090, PI 341817, PI 405132, TG3 × EC 76446), adaptation to Thailand growing conditions (Lampang, Tainan 9, Moket), high yields (ICGS-4), early maturity [ICGS(E)-5] and a high nitrogen fixation rate (NC Ac 2821).

F_1 Generation.

The F_1 material was planted on August 20, 1985 in single row plots (60 cm between rows) at Khon Kaen University, Thailand. Twenty seed were planted in each row. Single rows of the parents were also planted to constitute 55 different genotypes. Plants were spaced 20 cm within rows. Plants were sprayed with Azodrin (monocrotophos) and Daconil (chlorothalonil) every week for the first 6 weeks after planting, preventing insect damage and premature late leafspot, early leafspot, and peanut rust infection.

At day 49, the third expanded leaf from lateral stems of nine randomly chosen plants from each of the hybrid and parent genotypes was detached and used in two separate tests in the greenhouse. A modification of the detached leaf procedure [9] was used for each of the tests.

Four replications of detached leaves were arranged in a randomized complete block design (RCBD) and inoculated with conidia of late leafspot collected from infected leaves in a field used as a leafspot nursery in Khon Kaen, Thailand. Five other replications were arranged in a separate RCBD and inoculated with early leafspot conidia collected from leaves of another disease nursery. Collection and inoculations were performed after leaves had recovered turgor in the moist sand medium. Conidia were suspended in water and misted over the detached leaves using a hand sprayer. Inoculated leaves were allowed to incubate in trays of sand immersed in 2 cm of water. A cloth mesh was suspended

(1) Paper No. 12457 of the journal series of the North Carolina Agricultural Research Service, Raleigh, NC 27695-7643 (U.S.A.). This publication was supported in part by the Peanut CRSP, USAID grant number DAN-4048-C-SS-2065-00. Recommendations do not represent an official position or policy of USAID.

(2) Research Assistant, Crop Science, North Carolina State University, Raleigh, NC 27695; Groundnut Improvement Project Leader, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand; Professor, Crop Science, North Carolina State University, Raleigh, NC 27695; and Executive Director, West African Programs and Director, ICRISAT Sahelian Center, Niamey, Republic of Niger.

approximately 10 cm above inoculation trays. Edges of the cloth were submerged in the water reservoir to retain high humidity conducive to leafspot development. Once disease symptoms had developed, lesion number, lesion size, latent period (days to 50 % sporulation), and sporulation rating (1 = no spores to 5 = very profuse sporulation) were recorded.

Disease progression for F_1s and parents was also recorded in the field. At 50 days after planting (DAP), five healthy plants and one stripe virus-infected plant from each genotype were chosen at random, and the third expanded leaf from the main stem of each plant was tagged using brightly colored yarn. Lesions of late leafspot, early leafspot, and rust were counted on each tagged leaf at 5-day intervals starting after 10 days from tagging. Average lesion size and sporulation rating (1-5) were recorded at 20 days from tagging leaves on the main stem. Early leafspot was distinguished from late leafspot lesions by lighter brown appearance and sporulation on the upper leaf surface. Few early leafspot lesions were observed, thus only late leafspot was considered in the results. Days required for defoliation of the tagged leaves were also monitored. The F_1 and parent plants were harvested on December 10, 1985.

An analysis of variance was performed and means were calculated for all traits. Data collected from leaves with virus symptoms were compared with data from healthy leaves by orthogonal contrasts to determine whether stripe virus symptoms had any effect on development of the fungal diseases.

F_2 Generation.

Seed of the F_2 and parental lines were planted in a randomized complete block design with eight replications on January 10, 1986. Single row plots were spaced 60 cm apart with 25 seed (20 cm spacing) per row. The field was irrigated when necessary to prevent drought and sprayed with Daconil and Metasystox (oxydemetonmethyl) alternatively to control insects during the first 5 weeks.

Ten weeks after planting, a visual rating (1 = no damage ; 9 = 100 % foliar infestation) was used to estimate leafminer damage. At 12 weeks counts were made of plants showing peanut stripe virus (PStV) and tomato spotted wilt virus (TSWV) symptoms. Peanut stripe was identified by its striped light and dark green appearance on terminal leaves of the plant [12]. Random samples of diseased plants were tested using the enzyme-linked immunosorbent assay (ELISA) technique and confirmed the existence of PStV. Tomato spotted wilt virus-infected plants exhibited bud necrosis on lateral stems [16]. PStV and TSWV incidence was then assessed as a percentage based on the total number of plants per plot. On May 10, 1986, a single-seed descent procedure was initiated on all plots to advance to subsequent generations and for further assessment. Plots were then bulk-harvested and dried. Fruit yields were recorded and standardized to a per-plant basis.

F_3 Generation.

One complete population of single seed descent from F_1-derived lines and parental material harvested from the previous season were planted during the rainy season (July 16, 1986). Seed spacings and pesticide treatments were similar to the previous tests. Plots were randomized with four replications. Visual ratings for leafspot incidence and defoliation were performed on a per-plot basis at 10-day intervals starting 65 days after planting using the ICRISAT disease rating scale (1 = no disease and 9 = complete defoliation).

Means were computed for all traits. Simple correlations between all traits were calculated using entry means. General (GCA) and specific combining ability (SCA) were estimated using the diallel analysis of Griffing [6] for F_1, F_2 and F_3 generations using the model :

$$y_{ijk} = \mu + b_k + g_i + g_j + s_{ij} + \varepsilon_{ijk}$$

where Y_{ijk} is the observation of a hybrid from the cross of the i^{th} and j^{th} parents in the k^{th} replication, μ is the population mean, b_k is the effect of the k^{th} replicate, g_i and g_j are the general combining ability effects, s_{ij} is the specific combining ability of the j^{th} cross and ε_{ijk} is the experimental error associated with the Y_{ijk} observation.

General combining ability effects were obtained and compared to self mean effects.

RESULTS

From the F_1 assessment, symptoms of stripe virus had no effect on development of lesions of late leafspot and rust or on time to defoliation. Mean squares for selfs, GCA, SCA, and selfs versus cross contrast were all highly significant for traits measured in the field. General combining ability was significant for all disease components of both leafspots measured by use of detached leaf techniques. Specific combining ability was significant for only spore production and lesion size of both diseases.

Parents, GCA and SCA were significant for leafminer damage and tomato spotted wilt damage from F_2 assessments. Only selfs and GCA were significant for peanut stripe virus. GCA was significant for yield ; however, there were no significant differences between selfs.

Significant mean squares were also observed for selfs and GCA in the F_3 diallel analysis for all rating dates. SCA was significant for three of the four dates. Unlike the F_1 data, there was no significant orthogonal contrast between selfs and crosses. It should be noted that the percentage of late leafspot lesions observed increased from an average of 35 % at the first rating to 70-75 % at the last rating. The presence of early leafspot in the rainy season of 1986 was a much greater factor than in the F_1 field experiment in the previous year. By day 95 after planting, most susceptible genotypes had ratings of 9, resulting in lower mean squares.

Correlation coefficients between the ICRISAT ratings at the four 10-day intervals were all high and positive ($r = 0.75$-0.93). Moderate correlation (0.25-0.64) existed between traits evaluated in greenhouse and field for late leafspot. Leafspot and rust lesion counts from the field in the F_1 generation were correlated (Table I). This was due in large part to the selection of parents that have either combined resistance or susceptibility to leafspot and rust. Though both rust and late leafspot were correlated to defoliation, late leafspot number was more closely related to premature defoliation. Leafspot number and defoliation in F_1 were only moderately correlated with leafspot ratings in the F_3 generation. Correlation coefficients among disease components of early and late leafspot were moderate except for lesion number with other components (Tables II and III).

The utility of calculating GCA effects from different mating designs has been documented [7, 8, 9]. General combining ability and self effects from this study (Tables IV-VIII) indicate that parents may perform better or worse in crosses than the pure line evaluation would indicate. ICGS 4 consistently performed better for late leafspot resistance

TABLE I. — **Product moment correlation coefficients of multiple traits measured over three generations using cross and parental means of peanut grown in Thailand**

	F_1			F_2			F_3	
							ICRISAT[b]	
	Rust	Defo-liation	Leaf-miner	PStV	TSWV	Yield	D75	D85
Late leafspot	.69	– .78	NS[a]	NS	.44	NS	.48	.44
Rust		– .59	NS	NS	NS	NS	NS	NS
Defoliation			NS	NS	NS	NS	– .31	NS
Leafminer				NS	.34	NS	.41	.36
PStV					NS	– .35	.33	.41
TSWV						– .32	.59	.60
Yield							– .27	– .35
ICRISAT D75[b]								.90

[a]Not significant at the p = 0.05 significance level.
[b]Visual leafspot disease rating using the ICRISAT scale at 75 DAP (D75) and 85 DAP (D85).

TABLE II. — **Product moment correlation coefficients for disease parameters of early leafspot from F_1 detached leaf evaluation[a] performed on peanut crosses and parents in Thailand**

	Lesion number	Lesion size	Sporulation rating	Latent period
Lesion size	NS[b]			
Sporulation rating	NS	.68		
Latent period[c]	NS	– .56	– .68	
Necrotic area	.42	.59	.65	–.53

[a]Calculated using genotypic means (n = 55).
[b]Nonsignificant at the 0.05 probability level; all others are significant at this level.
[c]Longer latent periods indicate greater resistance.

TABLE III. — **Product moment correlation coefficients for disease parameters of late leafspot from F_1 detached leaf evaluations[a] on peanut crosses and parents in Thailand**

	Detached leaf		
	Lesion number	Lesion size	Sporulation rating
Lesion size	NS[b]		
Sporulation rating	NS	.43	
Latent period[c]	– .37	– .33	– .59

[a]Calculated using genotypic means (n = 55).
[b]Nonsignificant at the 0.05 probability level; all others significant at this level.
[c]Longer latent periods indicate greater resistance.

than would have been expected from the self data. At the same time, PI 405132 performed worse than expected. Parental performance and self performance were similar for rust resistance (Table IV) but rankings were slightly different, with NC Ac 17090 performing the best when crossed with other parents. PI 341817 unquestionably produced progeny with the best resistance to early leafspot from the greenhouse evaluation (Table V).

TABLE IV. — **General combining ability and self effects for traits from F_1 field diallel analysis of peanut performed in Thailand**

Parent	Lesions				Days to defoliation[b]	
	Late leafspot[a]		Rust[a]			
	GCA	Self	GCA	Self	GCA	Self
Lampang	15.8	34.9	19.2	23.9	– 1.3	– 6.0
NC Ac 17090	– 3.6	– 18.7	– 66.7	– 81.4	0.4	– 1.2
Tainan 9	41.8	113.6	32.3	134.6	– 0.8	– 3.9
Moket	58.2	122.3	68.1	139.6	– 1.5	– 5.7
NC 2821	– 15.2	.13.3	5.2	3.3	– 0.4	– 3.5
PI 341817	– 36.6	– 60.4	– 41.5	– 110.9	1.4	4.8
ICGS 4	– 71.8	– 37.7	32.1	3.6	1.6	– 0.2
PI 405132	– 0.6	– 153.5	– 18.7	– 119.7	0.6	9.5
ICGS(E)-5	45.4	119.3	68.8	101.1	– 0.4	– 1.8
(TG3 × EC 76446)	– 33.2	– 132.7	– 46.9	94.4	0.5	8.0
$\bar{x}$	234	169	201	138	26	29
σ	8.6	24.1	10.3	28.7	0.4	1.0

[a]Negative values indicate greater resistance.
[b]Positive values indicate greater resistance.

NC Ac 2821 was the parent with the best GCA effects for reducing leafminer damage, PStV and TSWV incidence (Table VII). ICGS 4 was the best combiner for yield in the F_2 generation.

From the F_3 ICRISAT leafspot ratings, NC Ac 2821 had the most favorable GCA effects (Table VIII). ICGS 4 was the only other parent with consistently high negative effects, indicating progeny with resistance. The lower rating of these genotypes may have been influenced by the greater leaf canopy of the virginia growth habit. The homozygous parents (NC Ac 2821 and ICGS 4) and progeny possessed virginia growth habit and appeared resistant. Often a closer examination is required to detect defoliation and/or large number of leafspot lesions in the canopy interior.

TABLE V. — General combining ability effects, self effects, and means of disease parameters of early leafspot from detached leaf evaluation of F_1s and parents of peanut

Parent	Lesion size (mm²)		Sporulation rating (1-5)		Latent period* (days)	
	GCA	Self	GCA	Self	GCA	Self
Lampang	0.33	1.06	0.18	0.58	− 0.10	− 0.70
NC Ac 17090	− 0.04	− 0.44	− 0.12	− 0.12	− 0.01	0.70
Tainan 9	0.16	0.86	− 0.02	0.58	− 0.76	− 1.30
Moket	0.02	0.76	0.04	0.48	− 1.70	− 0.30
NC Ac 2821	0.07	− 0.54	0.22	0.08	− 0.45	− 1.10
PI 341817	− 0.45	− 1.04	− 0.44	− 0.82	2.02	2.90
ICGS 4	− 0.29	− 0.24	0.29	0.38	− 0.01	− 1.50
PI 405132	− 0.06	− 1.04	− 0.24	− 1.22	0.19	1.10
ICGS(E)-5	0.36	1.16	0.19	0.88	0.09	− 0.90
(TG3 × EC 76446)	− 0.10	− 0.54	− 0.09	− 0.82	0.72	1.10
$\bar{x}$	1.92	2.14	3.43	3.49	25.45	25.50
σ	0.16	0.46	0.13	0.36	0.51	1.45

*Positive values indicate greater resistance.

TABLE VI. — General combining ability effects, self effects, and means of disease parameters of late leafspot from detached leaf evaluation of F_1s and parents of peanut

Parent	Lesion size (mm²)		Sporulation rating (1-5)		Latent period* (days)	
	GCA	Self	GCA	Self	GCA	Self
Lampang	0.42	0.60	− 0.03	− 0.26	0.72	− 1.05
NC Ac 17090	0.07	0.60	− 0.14	− 0.76	− 0.59	0.20
Tainan 9	0.19	1.47	0.10	0.11	− 0.77	− 0.80
Moket	− 0.03	0.22	− 0.07	0.49	0.16	− 1.30
NC Ac 2821	− 0.25	− 0.77	0.13	0.61	− 0.18	− 0.80
PI 341817	− 0.14	− 1.02	− 0.35	− 0.51	0.66	1.95
ICGS 4	− 0.73	− 1.15	− 0.14	0.11	0.44	− 1.30
PI 405132	0.02	− 1.27	− 0.17	− 0.89	0.51	3.70
ICGS(E)-5	0.17	2.22	0.41	1.11	− 0.56	− 2.55
(TG3 × EC 76446)	0.27	− 0.90	0.26	− 0.01	− 0.40	1.95
$\bar{x}$	2.30	2.39	3.01	2.93	20.85	21.90
σ	0.16	0.44	0.09	0.26	0.32	0.90

*Positive values indicate greater resistance.

DISCUSSION

It has been reported that early generation testing has limited usefulness for quantitative traits such as yield [2, 8, 13] and leafspot resistance [8]. Information based on hybrid means (F_1) or subsequent generations is primarily used for the selection of crosses between parents with good general combining ability. If crosses can be tested for multiple traits in early generation, then segregating germplasm will be identified with the greatest potential of producing lines with numerous favorable traits. The growing of F_1 progeny in the field under conducive environmental conditions is imperative to obtain sufficient F_2 material for effective testing, and to retain a large base population of segregating material. During the growth of F_1s in this study, irrigation, good soil fertility, and early applications of insecticides and fungicides provided a favorable environment for sufficient production of F_2 seed for further evaluation. If the single seed descent technique is used through selfing generations, then nonfatal disease, pest or qualitative screening can be performed on the population without concern with reduced genetic variation.

A genotype is considered a good combiner if it produces progeny with superior average performance. In selecting parents based on GCA or SCA effects, the breeder is determining the cross with the best hybrid (F_1) combination of genes or with the greatest proportion of segregating plants (F_2) with desirable traits. Thus, in principle, within these crosses there should be a high probability of finding favorable individual plants. This cannot be verified without deter-

TABLE VII. — General combining ability and self effects for traits from F_2 diallel analysis of peanut crosses and parents performed in Thailand

Parent	Leafminer rating* (1-9)		Peanut stripe virus* (%)		TSMV* (%)		Yield (g/plant)	
	GCA	Self	GCA	Self	GCA	Self	GCA	Self
Lampang	0.55	0.41	1.1	– 0.7	– 1.5	0.5	– 1.0	– 2.8
NC Ac 17090	– 0.19	– 0.32	1.5	1.9	1.8	– 0.9	– 0.4	– 4.2
Tainan 9	0.28	– 0.09	– 1.2	4.3	0.6	2.3	1.1	4.3
Moket	0.34	– 0.23	0.6	0.8	2.0	7.1	1.3	4.9
NC 2821	– 0.56	– 0.21	– 4.9	– 8.6	– 4.6	– 8.0	– 0.5	5.6
PI 341817	– 0.08	1.04	– 2.6	– 7.0	1.9	– 4.0	– 1.0	– 2.6
ICGS 4	– 0.03	0.41	– 3.7	– 18.0	– 3.6	– 9.4	2.2	4.0
PI 405132	– 0.37	– 1.09	5.4	16.3	0.5	4.5	– 0.3	– 3.6
ICGS(E)-5	0.30	1.04	2.4	– 4.3	5.7	17.2	– 1.3	– 1.8
(TG3 × EC 76446)	– 0.25	– 0.96	1.5	15.3	– 2.7	– 10.2	– 0.2	– 4.0
$\bar{x}$	6.80	6.93	27.5	25.2	11.4	10.5	17.8	20.8
σ	0.15	0.42	1.7	5.0	1.3	3.7	0.7	2.0

*Negative values indicate greater resistance.
*,**Correlation coefficient significant at the 0.05 and 0.01 probability levels, respectively.

TABLE VIII. — General combining ability and self effects for traits from F_3 diallel analysis of peanut crosses and parents performed in Thailand

Parent	ICRISAT visual rating scale (1-9)*					
	Day 65		Day 75		Day 85	
	GCA	Self	GCA	Self	GCA	Self
Lampang	0.21	1.22	0.13	0.90	0.08	0.85
NC Ac 17090	0.33	– 0.02	0.44	– 0.10	0.39	0.35
Tainan 9	0.33	0.72	0.26	0.15	0.33	0.60
Moket	0.33	1.47	0.22	1.40	0.36	1.10
NC 2821	– 0.98	– 1.52	– 1.02	– 2.10	– 1.01	– 2.15
PI 341817	– 0.01	– 0.02	0.04	0.65	– 0.04	0.35
ICGS 4	– 0.51	– 1.52	– 0.71	– 1.85	– 0.76	– 1.90
PI 405132	0.08	– 0.02	0.10	0.15	0.11	0.10
ICGS(E)-5	0.24	0.72	0.41	0.65	0.55	1.10
(TG3 × EC 76446)	– 0.01	– 1.02	0.13	0.15	– 0.01	– 0.40
$\bar{x}$	5.29	5.02	6.49	6.97	7.96	7.90
σ	0.15	0.43	0.12	0.35	0.10	0.29

*Negative values indicate greater resistance.
**Correlation coefficient significant at the 0.01 probability level.

mining and comparing heritabilities of the crosses. Problems in interpretation of results from combining ability studies may arise when the desirable genes are recessive in nature and will be masked in the F_1 generation. Thus, analysis of the hybrids may only indicate which recessive resistance genes are in common among parents, or uncover parents with resistance genes that are not recessive. In either case, selection and further evaluation of individual families within these crosses is warranted.

It is interesting to note that two of the best parents for reduced peanut stripe virus and tomato spotted wilt virus (NC Ac 2821 and ICGS 4) were the two parents with virginia growth habit. Aquino [1] tested eight genotypes representing valencia, virginia, and spanish botanical groups for symptom development and peanut stripe virus accumulation. He discovered that virginia peanut expressed less severe symptoms and had lower virus titer than either valencia or spanish peanut. This would indicate that there may be some genetic or physiological connection between growth habit and severity of the diseases.

No clear conclusions can be made on the best yielding parents in this study due to possible confounding effects of virus and leafminer incidence on yield (Table I). Also, the diallel analysis indicates that replication mean squares were 40-fold greater than self or GCA mean squares, indicating great environmental variation. Due to lack of early generation material, effective yield trials may not be possible and may be limited in usefulness [8, 13]. Incorporation of resistance in early generations and testing families within crosses in later generations for yield is more practical.

Another interesting result was the moderate but significantly positive correlation between leafminer, PStV, TSWV resistances in F_2 and the ICRISAT leafspot ratings in F_3 (Table I). Certain parents used in the diallel appear to produce progeny that have resistance to multiple diseases while other parents give general susceptibility.

Within approximately 15 months, three generations of hybridized material were grown and assessed for multiple resistance and yield potential. From this information and the progression of material to greater homozygosity by use of single seed descent, selections and further evaluation of useful crosses can be made with an improved chance of incorporating multiple resistances.

REFERENCES

[1] AQUINO V. M. (1987). — Biology of peanut stripe virus (PStV) on *Arachis hypogaea* L. Unpubl. M. S. Thesis, N. C. State Univ., Raleigh, 36 p.

[2] COFFELT T. A. and HAMMONS R. O. (1974). — Early generation yield trials of peanuts. *Peanut Sci.* 1, p. 3-6.

[3] COFFELT T. A., PORTER D. M., SMITH J. C. and GARREN K. H. (1977). — Reaction of 45 peanut (*Arachis hypogaea* L.) lines to 5 fungal and insect pathogens. *Proc. APRES*, 9, p. 33 (abstr.).

[4] GREEN C. C., BEUTE M. K. and WYNNE J. C. (1983). — A comparison of methods of evaluating resistance to *Cylindrocladium crotalariae* in peanut field tests. *Peanut Sci.*, 10, p. 66-69.

[5] GREEN C. C. and WYNNE J. C. (1986). — Diallel and generation means analyses for the components of resistance to *Cercospora arachidicola* in peanut. *Theor. Appl. Genet.*, 73, p. 228-235.

[6] GRIFFING B. (1956) — Concept of general and specific combining ability in relation to diallel crossing systems. *Aust. J. Biol. Sci.*, 9, p. 463-493.

[7] HADLEY B. A., BEUTE M. K. and LEONARD K. J. (1979). — Variability of *Cylindrocladium crotalariae* response to resistant host plant selection pressure in peanut. *Phytopathology*, 69, p. 1112-1114.

[8] IROUME R. N. and KNAUFT D. A. (1987). — Heritabilities and correlations for pod yield and leafspot resistance in peanut (*Arachis hypogaea* L.): Implications for early generation selection. *Peanut Sci.*, 14, p. 46-50.

[9] MELOUK H. A. and BANKS D. A. (1978). — A method of screening peanut genotypes for resistance to cercospora leafspot. *Peanut Sci.*, 5, p. 112-114.

[10] MC DONALD D. and REHEJA (1980). — Pests, diseases, resistance, and crop protection in groundnuts, p. 501-514. *In :* Summerfield and Bunting (eds.), *Advances in Legume Science*. Kew Botanical Gardens, Kew, England.

[11] SUBRAHMANYAM P., HAMMONS R. O., NIGAM S. N., MC DONALD D., GIBBONS R. W., FAN M.-Y. and YEH W.-L. (1983). — International cooperative screening for resistance of peanut to rust and late leaf spot. *Plant Dis.*, 67, p. 1108-1111.

[12] THAILAND COORDINATED GROUNDNUT IMPROVEMENT RESEARCH PROGRAM (1985). — *Compendium of Groundnut Diseases in Thailand*. Groundnut Pathology Working Group, Department of Agriculture, Faculty of Agriculture, Khon Kaen Univ. and Faculty of Agriculture, Kasetsart Univ.

[13] WYNNE J. C. (1976). — Evaluation of early generation testing in peanuts. *Peanut Sci.*, 3, p. 62-66.

RESUMÉ

Evaluation d'un croisement diallèle pour la résistance aux ravageurs foliaires multiples chez l'arachide.

W. F. ANDERSON, A. PATANOTHAI, J. C. WYNNE et R. W. GIBBONS, *Oléagineux*, 1990, 45, N° 8/9, p. 373-378.

Dans la plupart des régions productrices d'arachide du monde, de nombreux maladies et insectes interviennent dans la réduction des rendements. Une étude a été conduite afin d'identifier des lignées d'arachide (*Arachis hypogaea* L.) pouvant éventuellement servir de géniteurs dans la sélection de populations résistantes aux multiples ravageurs. Les descendances F_1, F_2 et F_3 d'un croisement diallèle à 10 géniteurs et les géniteurs ont été évalués pendant trois campagnes successives à Khon Kaen, en Thaïlande. Les plantes des générations F_2 et F_3 ont été évaluées pour la résistance au late leafspot [*C. Personatum* (Berk. et Curt.) Deighton] et à la rouille [*Puccinia arachis* Speg.], et la génération F_2 a été criblée pour l'incidence de la striure de l'arachide (peanut stripe virus — PStV), de la maladie bronzée de la tomate (tomato-spotted wilt virus — TSWV) et pour les dégâts causés par les mineuses de feuilles (*Aproaerema modicella* Deventer et *Stomptery subsericella* Zeller). Le criblage a été effectué au champ et sous serre, facilité par des environnements favorables aux différents ravageurs selon la campagne. L'aptitude générale à la combinaison était significative pour tous les caractères testés. L'aptitude spécifique à la combinaison était significative pour tous les caractères sauf ceux du pourcentage de plantes présentant le virus de la striure de l'arachide et du rendement des parcelles F_2. Les deux géniteurs Virginia, NC Ac 2821 et ICGS 4, présentent des meilleurs effets d'aptitude générale à la combinaison pour les maladies virales. Le NC Ac 2821 a également un bon comportement vis-à-vis de la résistance aux mineuses de feuilles. Le PI 341817 donne généralement des hybrides plus résistants au late leafspot et à la rouille, tandis que les descendances du ICGS 4 sont résistants au leafspot et gardent mieux leurs feuilles.

RESUMEN

Evaluación de un cruzamiento dialelo para la resistencia a las plagas múltiples de las hojas en el maní.

W. F. ANDERSON, A. PATANOTHAI, J. C. WYNNE y R. W. GIBBONS, *Oléagineux*, 1990, 45, N° 8/9, p. 373-378.

En la mayoria de las regiones productoras de maní del mundo, muchas enfermedades e insectos desempeñan un papel en la disminución de los rendimientos. Se realizó un estudio encaminado a identificar líneas de maní (*Arachis hypogaea* L.) capaces de utilizarse como genitores en el mejoramiento de poblaciones resistentes a las plagas múltiples. Las descendencias F_1, F_2 y F_3 de un cruzamiento dialelo de 10 genitores y los propios genitores se evaluaron en Khon Kaen, Thailandia, en tres campañas seguidas. Las plantas de las generaciones F_2 y F_3 se evaluaron por la resistencia al late leaf spot [*C. personatum* (Berk. et Curt.) Deighton] y a la roya [*Puccinia arachis* Speg.], y la generación F_2 se sometió a un proceso de selección por la incidencia del estriado del maní (peanut stripe virus — PStV), de la enfermedad broncada del tomate (tomato-spotted wilt virus — TSWV) y por los daños causados por los barrenadores de las hojas (*Aproaerema modicella* Deventer y *Stomopteryx subsecivella* Zeller). El proceso de selección se realizó en el campo y en invernadero, y fue facilitado por entornos favorables a las diversas plagas según la campaña. La habilidad combinatoria general era significativa para todos los caracteres probados. La habilidad combinatoria especifica era significativa para todos los caracteres, salvo para el porcentaje de plantas que evidencian el virus del estriado del maní, y el rendimiento de las parcelas F_2. Los dos genitores Virginia, NC Ac 2821 e ICGS 4 muestran efectos de habilidad combinatoria general más favorables para las enfermedades virales. El NC Ac 2821 también tiene un buen comportamiento frente a la resistencia a las minadoras de hojas. El PI 341817 suele dar híbridos mas resistentes al late leaf spot y a la roya, mientras las descendencias de ICGS 4 resisten al leaf spot y conservan mejor sus hojas.

6