J. stored Prod. Res. Vol. 29, No. 1, pp. 49-52, 1993
Printed in Great Britain.

0022-474X/93 $6.00 + 0.00

RESISTANCE TO *CALLOSOBRUCHUS MACULATUS* F. (COL., BRUCHIDAE) IN SOME COWPEA VARIETIES FROM SENEGAL

DOGO SECK*
Institut Sénégalais de Recherches Agricoles (I.S.R.A.), BP 17 Station de Nioro du Rip, Sénégal

(Received for publication 18 August 1992)

Abstract—Seeds of 80 varieties from the Senegal cowpea breeding program collection were tested for bruchid resistance in a five replication study. Significant differences among the varieties were found in oviposition, progeny and bruchid emergence. The variety 58-57 which is that most grown in Senegal appeared highly susceptible. On the other hand, 6 varieties (59-12; 58-28; 66-50; 66-S; 58-16 Dl and 59-26) showed a high level of resistance. The basis of that resistance is under investigation so that the incidence of the cowpea weevil in Senegal can be reduced by selective breeding of cowpea varieties.

Key words-bruchid resistance, ***Vigna unguiculata, Callosobruchus maculatus,*** Senegal.

INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walp. is an important food crop in tropical countries, specially in West Africa where it is a cheap source of protein (Labeyrie, 1981).

This crop is prone to heavy damage by *Callosobruchus maculatus* F., the cowpea weevil. Initial infestation occurs in the field prior to harvest and from there the insects are carried to storehouses where the population can build up rapidly (Prevett, 1961; Huignard, 1985). Caswell (1973) estimated that in Nigeria alone, the dry weight loss due to *C. maculatus* exceeded 2900 tonnes each year. In Senegal, damage in terms of holed seeds can increase to 99% after 6 months of storage (Seck *et al.*, 1991). In addition, bruchid infestation affects seed quality and can reduce germination ability to less than 20% after 4 months (Seck, unpublished). The control of C. *maculatus* in developing countries relies heavily on the use of synthetic chemicals which cause, numerous environmental, social and financial side effects that are well documented (Huignard, 1985; Egwuatu, 1987). To reduce this dependence on chemicals and to assist farmers in reducing losses due to bruchids, efforts could be placed in developing alternative control methods, such as varietal resistance. The purpose of the present paper is to locate sources of resistance through an intensive screening of varieties collected and provided by the Senegal Cowpea breeding program.

MATERIALS AND METHODS

Eighty cowpea varieties the seeds of which were provided by ISRA (Institut Sénégalais de Recherches Agricoles) were evaluated in order to assess their resistance to *C. maculatus* F.

Parental insects were allowed to mate and lay eggs on each tested variety for 10 days. They were then removed and eggs laid on the boxes and on seeds were counted.

Bioassays for bruchid resistance were performed using 90 mm dia petri dishes. Ten healthy seeds of each variety were infested in five replications with 3 freshly emerged *C. maculatus* adults (1♂ + 29). Test insects were taken from laboratory cultures maintained for several generations on the Senegalese variety 58-57.

Experiments were conducted in constant conditions (30°C and 60% r.h.). About 25 days after infestation (DAI) when Fl adults started emerging, a daily count of bruchids emerged in each box was performed unti142 DAI. Based on the total adults emerged from each variety and the number of eggs laid on seeds, the percentage adult emergence was calculated. At the same time, the mean number of eggs per seed was calculated for each variety. An analysis of variance and Duncan's multiple range test were performed to rank the varieties according to their resistance to the pest.

*Present address: Unité de Zoologie générale et appliquée, Faculté des Sciences agronomiques B-5030 Gembloux, Belgique.

Table 1. Average percentage adult emergence of the cowpea seed beetle in 80 varieties from Senegal

Varieties	% adult emergence		Varieties	% adult emergence	
66-67	79.21	A	**66-76**	30.56	A-H
58-57	76.11	AB	59-13	30.27	A-H
58-79 T	70.49	A-C	58-191	29.09	A-H
66-65	67.37	A-D	**58-74-D_1-B_1**	29.98	A-H
58-79-D_2-B_1	63.92	A-E	58-39	28.57	A-H
58-29	62.20	A-F	66-47	28.13	A-H
58-12	50.04	A-G	**58-74-D_1-C_2**	27.63	A-H
66-14	58.12	A-G	58-95-D,	27.22	A-H
66-41	56.46	A-G	66-73	21.05	A-H
66-53	55.88	A-G	**58-81**	27.03	A-H
66-69	55.78	A-G	**66-2**	26.61	A-H
66-48	55.04	A-H	59-30	26.56	A-H
66-61	53.22	A-H	58-3	25.15	A-H
59-24 T	51.42	A-H	66-21	25.15	A-H
66-36	SO.73	A-H	66-64	24.64	A-H
58-161	50.43	A-H	58-95-D,	24.50	A-H
66-1	50.40	A-H	58-20	24.04	B-H
66-38	48.96	A-H	58-43	23.05	B-H
66-57	48.16	A-H	59-20 B	20.93	C-G
66-72	47.87	A-H	5X-51	20.82	C-H
58-52	43.95	A-H	**66-22**	20.40	C-H
66-40	43.41	A-H	**58-**154	20.18	C-H
63-6	42.87	A-H	**58-95-D_2-B_2**	19.68	C-H
66-42	41.99	A-H	58-16 T	19.56	C-H
58-44	40.78	A-H	58-80	18.67	C-H
66-66	40.12	A-H	**58-**162	18.46	C-H
58-74-D_1-C_1	39.94	A-H	59-21	17.75	C-H
58-74	38.88	A-H	**66-27**	17.24	C-H
58-24	38.55	A-H	59-25	16.18	C-H
58-4	36.64	A-H	66-49	15.69	A-H
66-77	36.25	A-H	58-30	15.37	C-H
58-19	36.05	A-H	77-70	13.33	D-H
58-47	35.79	A-H	58-2	10.53	E-H
58-41	34.54	A-H	**58-79-D_2-A_2**	10.29	E-H
58-47	33.69	A-H	58-16-D,	9.08	E-H
58-79-D_2-A_1	33.16	A-H	*66-5*	7.06	F-H
58-32	32.36	A-H	**66-50**	6.78	GH
58-151	31.14	A-H	58-28	6.55	GH
58-58	31.00	A-H	59-12	6.01	GH
5X-146	30.77	A-H	59-26	0.00	H

Within a column, means followed by the same letters are not significantly different at the 5% level.

RESULTS AND DISCUSSION

Percentage adult emergence (Table 1) ranged from 79.2% in the variety 66-67 to 0% for 59-26. Analysis of variance indicated significant differences between varieties at $P = 0.05$. Of 80 varieties tested, only 6 of them (59-26, 59-12, 58-28, 66-50, 66-5 and 58-16-D1) scored less than 10%.

Mean number of eggs laid per seed (Table 2) ranged from 7.38 in the variety 58-57 to 0.16 eggs per seed for variety 66-5. The comparison of this parameter with the percentage of adult emergence shows that except for the variety 59-12 (6.08 eggs per seed), the other 5 varieties which permitted less than 10% adult emergence also had a low number of eggs per seed, ranging from 0.16 in variety 66-5 to 1.20 in variety 66-50, that is to say 46 to 6 times less than the most sensitive variety 58-57.

Adult progeny (Table 3) ranged from 54 in the variety 58-57 to 0 in 59-26. Once again data revealed the same tendency as that observed for adult emergence and the number of eggs per seed.

Emergence patterns (Table 4) show that resistant variety 58-16D1 was characterized by a delayed adult emergence in contrast to the :most sensitive one that showed an extremely rapid emergence with most of the insects emerging during the first five days following the beginning of F1 emergence. Similar observations have also been made by Singh et *al.* (1985) on three resistant cowpea lines (TVu 2027, TVu 11952 and TVu 11953) compared to the very susceptible Nigerian variety "Ife Brown".

Our present results on the testing of a part of the Senegalese cowpea gene pool indicate that the following varieties: 59-12; 58-28; 66-50; 66-5; 58-16-D1; 59-26 have resistance to attack by C. *maculatus.* They also demonstrate the high sensitivity of 58-57 which is the most cultivated variety

Table 2. Number of eggs laid by *Callosobruchus maculatus* females on seeds of 80 cowpea varieties from Senegal

Varieties	Mean number of eggs/seed		Varieties	Mean number of eggs/seed	
58-57	7.38	A	58-24	1.84	C-F
58-95-D,	7.34	A	58-146	1.82	C-F
66-40	6.96	AB	58-12	1.78	C-F
59-12	6.08	A-C	66-73	1.76	C-F
58-79-D_2-B_1	5.50	A-D	66-27	1.76	C-F
59-21	5.10	A-E	58-19	1.74	C-F
58-79 T	4.64	A-F	**58-161**	1.70	C-F
66-1	4.34	A-F	58-43	1.64	C-F
66-67	4.08	A-F	66-61	1.58	C-F
66-57	3.82	A-F	58-95-D,	1.48	D-F
59-20 B	3.74	A-F	58-162	1.48	D-F
66-3	3.68	A-F	58-47	1.46	D-F
58-16 T	3.64	A-F	58-74	1.32	D-F
66-41	3.54	A-F	66-2	1.28	D-F
66-38	3.52	A-F	58-39	1.28	D-F
66-66	3.48	A-F	58-29	1.22	D-F
66-21	3.46	A-F	66-50	1.20	D-F
58-81	3.46	A-F	58-32	1.16	D-F
58-52	3.10	A-F	66-64	1.16	D-F
66-69	2.92	B-F	59-24 T	1.10	D-F
66-72	2.88	B-F	66-65	1.10	D-F
66-14	2.86	B-F	66-76	1.08	D-F
58-4	2.74	B-F	58-77	0.98	D-F
58-3	2.70	B-F	66-47	0.90	E F
66-36	2.58	C-F	66-77	0.82	E F
59-30	2.56	C-F	58-151	0.80	E F
58-20	2.54	C-F	59-25	0.70	E F
58-154	2.42	C-F	58-58	0.66	E F
66-42	2.38	C-F	**58-41**	0.62	E F
58-74-D_1-C_2	2.36	C-F	58-28	0.62	E F
66-48	2.36	C-F	58-80	0.62	E F
59-13	2.30	C-F	**58-95-D_2-B_2**	0.62	E F
58-79-D_2-A_1	2.26	C-F	66-49	0.54	F
58-30	2.14	C-F	58-16-D,	0.52	F
58-74-D_1-B_1	2.08	C-F	**58-79-D_2-A_2**	0.52	F
66-22	2.04	C-F	58-191	0.46	F
58-74-D_1-C_1	1.98	C-F	66-70	0.26	F
58-44	1.94	C-F	59-26	0.20	F
66-57	1.88	C-F	58-2	0.18	F
58-51	1.86	C-F	66-5	0.16	F

Within a column, means followed by the same letters are not significantly different at the 5% level.

Table 3. Number of F, *Callosobruchus maculatus* adults from seeds of 80 cowpea varieties from Senegal

Varieties	Mean number of adults emerged		Varieties	Mean number of adults emerged	
58-57	54.00	A	**58-154**	9.40	C-G
58-95-D,	35.00	B	**66-2**	9.20	C-G
66-67	32.00	BC	58-51	9.20	C-G
58-79-T	30.40	B-D	58-39	9.20	C-G
66-1	26.00	B-E	58-44	9.20	C-G
66-40	25.80	B-E	**58-74-D_1-B_1**	9.00	C-G
66-66	25.00	B-F	66-22	9.00	C-G
58-79-D_2-B_1	24.00	B-G	58-16-T	8.80	C-G
66-53	23.20	B-G	59-20-B	8.80	C-G
66-14	22.00	B-G	**58-95-D_2**	8.60	C-G
66-41	21.10	B-G	66-76	8.40	C-G
66-36	21.20	B-G	59-21	8.40	C-G
66-69	19.00	B-G	58-32	8.00	C-G
63-6	18.80	B-G	59-13	7.80	C-G
66-61	16.20	B-G	59-30	7.20	C-G
66-42	16.20	B-G	58-3	7.00	C-G
66-38	15.60	B-G	**58-79-D_2-A_1**	6.80	C-G
58-30	15.60	B-G	66-47	8.80	C-G
66-21	15.40	B-G	59-12	6.40	C-G
66-57	15.40	B-G	**58-95-D_2-B_2**	6.20	E - G
66-48	15.20	B-G	58-77	6.20	E - G
66-72	15.20	B-G	58-151	6.20	E - G
58-161	14.60	B-G	66-64	5.60	E - G
58-19	14.40	B-G	58-58	5.00	E - G
58-81	14.20	B-G	58-80	4.80	E - G
58-12	14.00	B-G	66-77	4.20	E - G
58-74-D_1-C_1	14.00	B-G	58-191	3.80	E - G
58-74-D&	13.80	B-G	59-25	3.60	E - G
58-146	13.40	B-G	58-41	3.60	E - G
58-20	11.80	B-G	66-27	3.20	E - G
58-52	11.60	B-G	66-49	3.00	E - G
66-65	11.00	C-G	66-50	2.00	E - G
59-24-T	10.80	C-G	58-28	2.00	E - G
58-47-T	10.80	C-G	58-162	1.80	E - G
58-4	10.60	C-G	**58-79-D_2-A_2**	1.20	FG
58-29	10.40	C-G	58-2	1.00	FG
58-43	10.40	C-G	58-16-D,	1.00	FG
58-74	10.20	C-G	66-70	1.00	FG
58-24	10.00	C-G	66-5	0.60	G
66-73	9.80	C-G	59-26	0.00	G

Within a column, means followed by the same letters are not significantly different at the 5% level.

Table 4. Brucbid emergence pattern in a selected resistant and a susceptible varietv

Variety	Number of bruchids emerged (days post-infestation) 25	26	27	28	33	34	35	36	37	40	41	42	Total adults emerged
58-16-D,	0	0	0	0	0	3	0	0	0	0	2	0	5
58-57	17	18	25	28	44	9	5	32	6	21	2	10	217

Data are based on 50 seeds samples.

in Center and Northern center of Senegal and suggest the need to improve its resistance to the cowpea weevil.

From this point of view, the six cited varieties are potential sources of resistance to the cowpea weevil. Nevertheless, further studies have to be conducted on their morphological and biochemical characters. Nwanze *et al.* (1975, 1976), and Gatehouse *et al.* (1979) demonstrated the importance of such factors in the resistance *of V. unguiculata* varieties to C. *maculatus.*

Acknowledgements—Sincere thanks are due to N. Cisse for providing the varieties, B. Sidibe for his technical assistance and Miss A. Van Meensel who kindly typed the manuscript. I am grateful to Dr J.-L. Hemptinne, Pr. Ch. Gaspar and an anonymous referee for their valuable comments on the paper.

This work was supported in part by the Bean/Cowpea Collaborative Research Support Program (CRSP) under the ISRA Senegal/University of California-Riverside Project.

REFERENCES

Caswell G. H. (1973) The impact of infestation on commodities. ***Trop. stored Prod. Inf. 25, 19.***

Egwuatu R. I. (1987) Current status of conventional insecticides in the management of stored product insect pests in the tropics. *Insect* ***Sci. Applic. 8,*** 695–701.

Gatehouse A. M. R., Gatehouse J. A., Dobie P., Kilminster P. and Boulter D. (1979) Biochemical basis of insect resistance in ***Vignaf unguiculata. J. Sci. Food Agric. 30, 948-958.***

Huignard J. (1985) Importance des pertes dues aux insectes ravageurs des graines: problèmes posés par la conservation des légumineuses alimentaires, sources de protéines végétales. *Cah. Nutr. Diét., XX 3,* 193–199.

Labeyrie V. (1981) Vaincre la carence protéique par le développement des légumineuses alimentaires et la protection de leurs récoltes contre les bruches. ***Food Nutr. Bull. 3,*** 24–38.

Nwanze K. F. and Horber E. (1976) Seed coats of cowpeas affect oviposition and larval development of *Callosobruchus maculatus. Environ. Ent. 5,* 213-218.

Nwanze K. F., Horber E. and Pitts C. W. (1975) Evidence for ovipositional preference of *Callosobruchus maculatus* for cowpea varieties. *Environ. Ent. 4,* 409–412.

Prevett P. F. (1961) Field infestation of cowpea ***(Vigna unguiculata)*** pods by beetles of the families Bruchidae and Curculionidae in Northern Nigeria. ***Bull. Ent. Res. 52,*** 635–646.

Seck D., Sidibé B., Haubruge E., Hemptinne J.-L. and Gaspar Ch. (1991) La protection chimique des stocks de Niébé et de maïs contre les insectes au Sénégal. ***Med. Fac. Landbouww. Rijksuniv. Gent. 56/3b,*** 1225-1234.

Singh B. B., Singh S. R. and Adjadi 0. (1985) Bruchid resistance in cowpea. ***Crop Sci. 25, 736739.***