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GENETIC EXPRESSION OF *Eurystylus oldi* (POPPIUS) RESISTANCE IN TWO SORGHUM CROSSES.

[EXPRESION GENETICA DE RESISTENCIA A *Eurystylus oldi* (POPPIUS) EN DOS CRUZAMIENTOS DE SORGO]

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SUMMARY

The parents and six generations (P_1, P_2, F_1, F_1 reciprocal, F_2 and F_3) for two sorghum crosses were evaluated under artificial head bug (*Eurystylus oldi*) infestation to obtain genetic information on resistance. Highly significant heterosis was detected for percent floaters. Heterosis for grain damage rating and germination percentage varied between the crosses. Non-additive (dominant and epistatic) gene effects were more important in the inheritance of resistance to *E. oldi* in both crosses for the three resistance traits. No cytoplasmic effects were detected. Thus, nuclear genes confer resistance to *E. oldi*. Recurrent selection methods could be used to accumulate alleles for *E. oldi* resistance.

Key words: Resistance, heterosis, *Eurystylus oldi*, additive, dominance, epistasis, reciprocal effect.

RESUMEN

Se evaluaron dos variedades parentales de sorgo y seis generaciones (P_1, P_2, F_1, F_1 recíproco, F_2 y F_3) para obtener información genética sobre resistencia a una infestación artificial de *E. oldi.* Se encontró una heterosis significativa para la proporción de semillas flotantes. La heterosis para daño en el grano y germinación varió entre los cruzamientos. Los efecto no aditivos (dominancia y epistasis) fueron más importantes en la transmisión hereditaria de la resistencia a *E. oldi*. No se encontraron efectos citoplásmicos. La resistencia es asi contenida en genes nucleares. La selección recurrente puede ser empleada para acumular alelos para resistencia a *E. oldi.*

Palabras clave: Resistencia, heterosis, *Eurystylus oldi*, aditividad, dominancia, epístasis.

INTRODUCTION

Mirid head bugs are important pests of sorghum in Asia and Africa. Four insect general of head bug (*Calocoris, Campylomma, Creontiades* and *Eurystylus*) are known to attack sorghum. *Eurystylus oldi* (Poppius) (Hemiptera: Miridae) has gain attention in recent years as an economic pest of sorghum, that causes severe yield losses wherever they are found (Nwanze, 1985; Sharma, 1985). Yield losses of up to 86% have been attributed to *E. oldi* damage, principally due to its feeding and oviposition activities on the sorghum panicle and other tender parts of the plant.

Due to high cost of insecticides, rigour of biological and other cultural control measures, the most effective strategy of protecting sorghum from *E. oldi* is through the use of genetic resistance. A number of sorghum genotypes have been screened and observed to be resistant to *E. oldi* in India (Sharma *et al.*, 1992), and in West and central Africa (Ajayi and Tabo, 1995; Ajayi, 1996; Showemimo and Alabi, 2001). Resistance to *E. oldi* has been reported to be governed by recessive gene and resistance is related to endosperm characteristics (Ratnadass *et al.*, 1995). But non-additive gene action and low narrow sense heritability have also been reported to control the resistance traits (Showemimo, 1998; Showemimo, *et al.,* 2000).

The objective of the study was to determine inheritance of resistance and reciprocal effects between F_1 combinations of crosses. Results of genetic expression of resistance to *E. oldi* in two sorghum crosses are reported.

MATERIAL AND METHODS

Plant material

The plant material consisted of six generations: parents (P_1 and P_2), F_1, F_1 reciprocal, F_2 and F_3 of each of the two crosses of resistant genotype; HRhb 94007 and HRhb 94008 with a high yielding but susceptible genotype; HRhb 94005S (Showemimo, 1998). These resistant genotypes were crossed to a high yielding but susceptible genotype (HRhb 94005S) by hand emasculation to produce F_1 plants and reciprocals. The test material was evaluated at the Institute for Agricultural Research field, Samaru using artificial infestation technique described by Sharma *et al*, (1992). The experiment was planted in 5m long rows with inter and intra of 0.75m inter and 0.25m intra row spacing and replicated three times. The parents, F_1 and F_1 reciprocal generations were planted in two row plots, while F_2 and F_3 generations were planted in four row plots. Infestation was done at the soft dough stage with ten pairs of adult *E. oldi.* Each plant was evaluated for grain damage rating, percent floaters and germination percentage according to the procedures of Sharma *et al.* (1992).

Statistical analysis

The data was subjected to analysis of variance to test the significance of differences between treatments means. Duncan's Multiple Range Test (DMRT) was used in mean separation (Gomez and Gomez, 1984). Gene effects for each crosses was obtained following the procedures outlined by Hayman (1958). Joint scaling test was used as described by Rowe and Alexander (1980). Reciprocal effects were estimated by comparing the F_1 and F_1 reciprocal hybrids.

RESULTS AND DISCUSSION

The analysis of variance, though not shown indicated significant differences ($P < 0.05$) among the entries for all the three traits. High and positive heterosis was obtained for both crosses as measured by deviation of F_1 mean from the superior parent thus indicating dominance of resistance over susceptibility (Table 1). Highly significant heterosis was obtained for the entire resistance trait in the cross HRhb 94008 x HRhb 94005S, while only for floaters percentage in the cross HRhb 94007x HRhb 94005S. Significant difference (P= 0.05) was obtained for grain damage rating in the HRhb 94007x HRhb 94005S hybrid but measurement of heterosis for germination percentage in this cross was non-significant, thus suggesting relative importance of additive gene action.

The joint scaling tests and chi-square (data not shown) indicated satisfactory of fit. Thus, Table 2 show estimates of gene effects for resistance to *E. oldi* in two sorghum crosses using a five parameter model. The mean effect was highly significant. Additive gene effect (d) was highly significant in both crosses for floaters percentage and HRhb 94007 x HRhb 94005S for germination percentage. Dominance (h) and epistatic (i, l) gene effects were highly significant for all the resistance traits, except l = 1.60 for grain damage rating, and l = - 0.53 for germination percentage. Apparently, the dominance in all crosses comes from resistant parents. Additive gene effect was not significant in both crosses for grain damage rating and in HRhb 94008 x HRhb 94005S for germination percentage.

Table 1. F_1 heterosis (%) above superior – parent for resistance to *Eurystylus oldi* in two sorghum crosses.

Cross	Grain damage rating (1-9)	Floaters percentage (arcsine)	Germination percentage (arcsine)
HRhb 94007 x HRhb 94005S	6.30*	24.89**	2.03
HRhb 94008 x HRhb 94005S	54.80**	31.45**	29.35**

*, ** = Significant at 5% and 1% level of LSD respectively.

Table 2. Estimates of gene effects for resistance to *E. oldi* in two sorghum crosses

Cross	m	d	h	i	l
Grain Damage Rating					
HRhb 94007 x HRhb 94005S	1.80**	-1.75	-5.07**	-4.79**	1.60
HRhb 94008 x HRhb 94005S	2.20**	-1.35	4.13**	-2.32**	5.33**
Floaters Percentage					
HRhb 94007 x HRhb 94005S	86.90**	-15.55**	38.47**	13.12**	-118.13**
HRhb 94008 x HRhb 94005S	89.10**	-12.55**	-17.80**	-34.95**	12.00**
Germination Percentage					
HRhb 94007 x HRhb 94005S	97.67**	15.15**	0.87**	15.62**	-9.63**
HRhb 94008 x HRhb 94005S	91.33**	7.50	5.73**	-1.09**	-0.53

** T-test was significant at P=0.01. 't' value obtained by dividing the values of each estimate by its SE.
m = Mean effect, d = additive gene effect, h = dominance gene effect, i = additive x additive gene interaction, l = dominance x dominance gene interaction

These results suggest the preponderance of non-additive (dominance and epitasis) gene effects in the inheritance of resistance to *E. oldi* in sorghum, while both additive and non-additive gene effects were important for the expression of floaters percentage though non-additive gene effects are higher in magnitude than the additive gene effects. Non-additive gene action has also been reported to be more important in the inheritance of *E. oldi* resistance in sorghum by Ratnadass (1995); Showemimo *et al.* (2000).

No significant differences were detected between F_1 reciprocal crosses for any of the three resistance traits measured in all the crosses (Table 3). Thus, the studies suggested no indication of cytoplasmic or material effect in the conferment of resistance to *E. oldi*. However, nuclear genes determined the resistance.

CONCLUSION

Dominance gene effects seem predominant in the inheritance of resistance to *E. oldi,* no reciprocal effects were detected in F_1 hybrids, and positive and moderately high heterosis was obtained. Recurrent selection methods have been used to accumulate alleles for resistance to insect pest (Russel *et al.*, 1979; Guthrie and Russel, 1988; Showemimo, 1998).

Therefore, it is suggested that a modified recurrent selection method that includes yield be used to incorporate resistance. The high magnitude of heterosis for resistance (especially for grain damage rating), suggests possible commercial exploitation of F_1 hybrids of this cross.

Table 3. *E. oldi* resistance scores in two reciprocal crosses of sorghum

Cross[1]	Grain damage rating (1-9)	Floaters percentage (arc sine)	Germination percentage (arc sine)
Cross 1			
HRhb 94007 (P_1)	1.97bc[2]	60.70c	93.89a
HRhb 94005s (P_2)	4.85a	96.81a	68.57b
F_1 (P_1 x P_2)	2.08b	70.52b	95.13a
F_1 (P_2 x P_1)	2.11b	69.43b	94.00a
Cross 2			
HRhb 94008 (P_1)	2.00b	74.25b	89.65a
HRhb 94005s (P_2)	4.79a	95.11a	66.10b
F_1 (P_1 x P_2)	2.51b	71.24b	88.79a
F_1 (P_2 x P_1)	2.46b	70.96b	90.03a

[1] P_1 x P_2 mean P_1 is the female parent and P_2 is the male parent; P_2 x P_1 mean P_2 is the female parent and P_1 is the male parent in the reciprocal cross combination.
[2] Means following same letter in the column for a cross are statistically non significant by DMRT.

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