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# INSECT–HOST PLANT RELATIONSHIP: THE CASE OF *Eurytylus oldi* (Poppius) [Hemiptera: Miridae] AND *Sorghum bicolor* (L.) Moench

# [RELACIONES INSECTO-PLANTA HOSPEDERA: EL CASO DE *Eurytylus oldi* (Poppius) [Hemiptera: Miridae] Y *Sorghum bicolor* (L.) Moench]

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## SUMMARY

$F_4$ progenies from a cross between two sorghum lines (HRhb 94001 x Samsorg 3) were evaluated for two years under artificial head bug infestation (1998 and 1999) in a randomized block design replicated three times. Performance data were used to assess head bug-host plant interrelationships. The results indicated variability in the population and the characters were quantitatively inherited. Positive ($P<0.01$) correlations were obtained between grain yield, germination percent and 1000 grain weight. However, significant negative correlations were obtained between grain yield, number of head bug / 10 panicle, grain damage rating and floaters percent. The correlated responses, when selection was practiced for higher grain yield, shows that it is better to practice direct selection for crop improvement.

**Keywords:** Head bug – Sorghum, selection programs, *Eurytylus oldi.*.

## RESUMEN

Progenies $F_4$ provenientes de cruza de dos líneas de sorgo (HRhb 94001 x Samsorg 3) fueron evaluadas durante 2 años (1998 y 1999) bajo infestación artificial empleando un diseño de bloques al azar con tres replicas. El comportamiento productivo fue empleado para evaluar las relaciones insecto-planta hospedera. Los resultados indicaros que la variabilidad in la población y los caracteres fueron cuantitativamente heredados. Correlaciones positivas ($P<0.01$) fueron encontradas entre producción de grano, porcentaje de germinación y el peso de 1000 semillas. Sin embargo, correlaciones negativas ($P<0.05$) fueron obtenidas entre el peso del grano, número de insectos /10 panículas, daño del grano y porcentaje de semillas flotadoras. Las respuestas obtenidas indican que cuando la selección se efectuó para mayor producción de grano es mejor la práctica de selección directa para la mejora en los programas de selección de cultivos.

Palabras clave: sorgo, programas de selección, *Eurytylus oldi.*

## INTRODUCTION

In crop improvement, several characters are often handled together; these characters relate with each other, the environment(s) and other biological entity (organism). Correlation coefficient measures the degree of association either genetic or non-genetic between two or more characters. The presence and significance of genetic association between characters and subsequent selection for one character(s), will cause changes in other characters, therefore, a positive correlation between desired characters is favorable to breeders because it helps selection while negative correlation hinders recombinants in both characters. Thus, the change caused in character(s) by selecting one character is called correlated response (Fakorede and Obilana, 1979; Tuberosa, *et al.,* 1992 Echekwu, 2001).

The production and utilization of sorghum *(Sorghum bicolor* L. Moench) is on the decline principally due to climatic, socio-cultural, menace of diseases and insect pests. The most devastating insect pest in the sub-Saharan region is head bugs: *Eurystylus oldi* Poppius and it is the most economically important in the head bug family (Hemiptera: Miridae). Breeding sorghum for head bug resistance / tolerance depends on the Host: Pest interaction, Then, the favorable characters that confine resistance are taken into consideration when selection and subsequent crop improvement programs are desired. In the present study, phenotypic and genotypic correlations and their associated genetic changes were determined in sorghum under artificial head bug infestation.

## MATERIALS AND METHODS

Hand emasculation was used to obtained a cross between sorghum line HRhb 94001 (from India) and Samsorg 3 (from Nigeria) in the1995 growing season, the resulting $F_4$ progenies from this cross was analyzed at the Institute for Agricultural Research (IAR) Samaru ($11^0$11'N, $7^0$ 38'E) for two years (1998 and 1999) under artificial head bug infestation using randomized complete block design with three replications in each year.

Ten pairs of adult head bug were artificially infested on each sorghum panicle at half anthesis using the 'no choice' head cage method recommended by Sharma *et al.,* (1992). Plot size consisted of two rows or ridges, 5m long, 0.80m apart and 0.30m seedling distance. Seedlings were thinned and transplanted to two plants / stand at two weeks after sowing; 32kg / ha of $P_20_5$ as single superphosphate fertilizer was applied before riding and sowing. Split application of urea fertilizer was done: 32 kg / ha as basal and 30 kg / ha as top dressing three weeks after thinning. All other crop management procedures to raise a successful crop were done as recommended by IAR (1993).

Data were recorded on ten randomly selected plants per plot on: number of head bugs / 10 panicle, grain damage rating, floaters percent, germination percent, 1000-grain weight and grain yield as recommended by Sharma (1997). The combined data for two years were analyzed since no yearly significant differences were detected by analysis of variance. Heritability phenotypic, genotypic correlations and correlated responses (using genotypic correlations) were estimated (Gomez and Gomez, 1984; Steel and Torrie, 1980; Fakorede and Obilana, 1979).

## RESULTS AND DISCUSSION

Yearly significant differences were not detected by analysis of variance (data not presented), thus mean data of character performance, correlations and correlated responses are presented. Mean grain yield of 1.6 t/ha, 1000 grain weight of 19.8 g and grain damage rating of 3.8 were obtained for the $F_4$ population across two years of evaluation under artificial head bug infestation. The low grain yield, 1000 grain weight, germination percent and high floaters percent are mainly due to the head bug feeding activity as evidenced by the high grain damage rating and number of head bugs / 10 panicles. However, there are variability within the $F_4$ population as seen by the character ranges and coefficient of variations (Table 1). The highest phenotypic and genotypic coefficient of variation was for 1000 grain weight (27.5% and 26.2%) followed by No. of head bugs / 10 panicles and grain yield. 1000 grain weight, grain damage rating and number of head bugs / 10 panicles had the highest broad sense heritability estimates of 70.7%, 66.1% and 56.4% respectively. The inherent variability in the population in association with head bug gives opportunity for selection based on character performance. The character with high heritability estimate indicates quantitative inheritance nature of the character, thus, the character can easily be exploited in a crop improvement program. Generally the phenotypic coefficient of variations are larger in magnitude than genotypic coefficient of variations and the difference between them for each character is less than 2%, thus, minimal influence of environments on the characters' interaction with head bugs. Similar findings were reported by Balikai (1995) on sorghum-aphids association; Jeewad (1993) on sorghum-shoot fly interaction and Showemimo (1998).

The estimates of phenotypic, genotypic correlations and their correlated responses among the six characters are presented in Table 2. As a general observation, in most instances the genotypic correlation is higher in magnitude than the phenotypic correlation, thus, reference will mostly be made to the more important genotypic correlations.

Table 1. Mean values, heritability (H%), ranges and coefficient of variation for six characters of sorghum under artificial *E. oldi* infestation**.**

| Character | Mean | SE± | Range | H | Coefficient of Variation | |
|---|---|---|---|---|---|---|
| | | | | | PCV | GCV |
| No. of headbugs/10 panicles | 595 | 14.71 | 132-861 | 56.4 | 17.5 | 16.4 |
| Grain damage rating | 3.8 | 0.23 | 1.3-7.2 | 66.1 | 13.7 | 11.9 |
| Floaters percent (%) | 69.7 | 4.16 | 52.6-98.7 | 40.7 | 6.6 | 6.1 |
| Germination percent (%) | 72.4 | 3.1 | 51.1-90.3 | 50.3 | 13.1 | 12.6 |
| 1000 grain weight (g) | 19.8 | 0.87 | 8.9-21.6 | 70.7 | 27.5 | 26.2 |
| Grain yield (t/ha) | 1.6 | 0.09 | 0.5-2.4 | 51.2 | 15.3 | 14.1 |

PCV= Phenotypic coefficient of variation, GCV= Genotypic coefficient of variation, H= Broad sense heritability percent.

Table 2. Phenotypic (lower left), genotypic (upper right) correlations and expected correlated response of six characters of sorghum under artificial *E. oldi* infestation

| Character | Headbugs / 5 panicles | Grain damage rating | Floater percentage | Germination percentage | 1000 grain weight | Grain yield |
|---|---|---|---|---|---|---|
| No. of headbugs /10 panicles | 1.00 | 0.371** | 0.264** | -0.259 | -0.122 | -0.511** |
| Grain damage Rating | 0.329** | 1.00 | 0.571** | -0.395** | -0.614** | -0.521** |
| Floaters percent | 0.184 | 0.553** | 1.00 | -0.784** | -0.763** | -0.692** |
| Germination percent | -0.253* | -0.350** | -0.728** | 1.00 | 0.245* | 0.358** |
| 1000 grain weight | -0.061 | -0.852** | -0.744** | 0.261* | 1.00 | 0.497 |
| Grain yield | -0.486** | -0.482** | -0.647** | 0.437** | 0.511** | 1.00 |
| Correlated response | -0.346 | -0.217 | -0.021 | 0.059 | 0.266 | - |

*, ** Significant at P<0.05 and 0.01, respectively.

Positive and significant correlations were observed between number of head bugs / 10 panicles and grain damage rating (P<0.01), and floaters percent (P<0.05) while negative but highly significant with grain yield (P<0.01). Thus, high number of head bugs in association with sorghum panicle leads to increase in grain damage, floaters percent and significant decrease in grain weight and grain yield. The association between grain damage due to head bug-sorghum relationship leads to significant decrease in germination percent, 1000-grain weight and grain yield, while an increase in floaters percent is observed (Table 2). The floaters percentage has negative but highly significant effect on germination percent (r=-0.784), 1000-grain weight (r=-0.763) and grain yield (r=-0.692). Grain yield was positive and highly significantly correlated with germination percent (r=0.358) and 1000-grain weight (r=0.497). Thus, improving grain yield with head bug resistance indirectly through high germination percent, 1000-grain weight and directly through low number of head bugs, grain damage rating and floaters percent is desirable.

The overall head bug – sorghum relationship between sorghum grain yield and the characters investigated in this study is presented as the correlated response in grain yield when selection is practiced for the various characters is given in Table 2. When number of head bugs / 10 panicle, grain damage rating and high floaters percent are selected for there is a decrease of 34.6%, 21.7% and 2.1% respectively on sorghum grain yield, while selecting for high germination percent and 1000 grain weight contributed with 5.9% and 26.6% of grain yield under artificial head bug infestation. Under this situation, it is profitable to practice direct selection for plant types in the $F_4$ population that harbor few numbers of head bugs, least damaged grains and floaters percent with high germination percent and grain weight, more so, these characters had been established to have moderate to high heritability (Sharma *et al.,* 1992; 1997; Toure *et al.,* 1992; Showemimo, 2001).

## CONCLUSION

The study on head bug–sorghum relationships has provided helpful information on the possibility of using the characters studied as selection parameters in crop improvement program.

## REFERENCES

Balikai, R.A. 1995. Ecological studies on sorghum aphid; *Melanaphis sacchari.* Animal progress report of sorghum Improvement Project. Bijapur, university of Agricultural Sciences 39 p.

Echekwu, C.A. 2001. Correlations and correlated responses in upland cotton *(Gossypium hirsutum* L.) Tropicultural, 19 (4) 210-213.

Fakorede, M.A.B., and Obilana, A.T. 1979. Predicted responses to recurrent selection in maize. Ife Journal of Agriculture. 1:36-44.

Gomez, K.A., and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research, with emphasis on rice. International Rice Research Institute, Los Banos, Philippines. Wiley and Sons. 546 pages.

IAR; 1993. Institute for Agricultural Research recommended crop management practices for crop based on research at IAR, Samaru Zaria: In IAR, desk diary.

Jeewad, A.S. 1993. Studies on the inheritance of resistance to shoot fly *(Antherigoona Soccata* Rondani) of sorghum. M.Sc. Thesis. Pradesh Agricultural University. 140 pages.

Sharma, H. C., Doumbia, Y.O., and Diorisso. N.Y. 1992. Screening sorghum for resistance to head bug *Eurystylus immaculatus* Odh. In

West Africa. Insect Science and it's Application 13: 417-427.

Sharma, H.C. 1997. Screening for resistance to sorghum head bugs. In: Plant resistances to insects in sorghum. Sharma, H.C, Faudar Singh, and Nwanze, K.F., (eds). Patancheru, Andhra Pradesh, India: International Crops Research Institute of the Semi-Arid tropics. Pp: 65-71

Showemimo, F.A. 1998. Host-Plant resistance and response to selection in sorghum *(Sorghum bicolor* L. Moench) to head bugs *(Eurystylus oldi* Poppius). Ph.D dissertation. Ahmadu Bello University Zaria, 65 p.

Showemimo, F.A. Alabi, S. O., Olorunju, P. E., and Ajayi, O. 2001. Breeding sorghum *(Sorghum bicolor* L. Moench) for resistance to sorghum head bug *(Eurystylus oldi* Poppius) in Nigeria Samaru Journal of Agricultural Research 17: 35-44.

Steel, R.G.D., and Torrie, J.H. 1980. Principles and procedures of statistics. McGraw-Hill Book Company, Inc. New York. 633 p.

Toure, A., Miller, F.R., Rooney, L.W., and Mc Donough, C. 1992. Grain filling rates in same sorghum genotypes. In: International Sorghum and Millet CSRP Conference, 8-12 July, Texas, U.S.A. P: 266

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