Academic Journal of Plant Sciences 4 (1): 26-29, 2011
ISSN 1995-8986

Importance and Management of Head Bug (*Eurystylus oldi* Poppius) of Sorghum in Nigeria

[1]F.A. Showemimo, [1]S.O. Alabi, [2]P.E. Olurunju and [3]O. Ajayi

[1]Department of Plant Science, Institute for Agricultural Research (IAR),
P.M.B. 1044, Ahmadu Bello University, Samaru, Zaria, Nigeria
[2]Agricultural Research Council, South Africa
[3]Africa Rice Centre, Ibadan, Nigeria

Abstract: Head bug; *Eurystylus oldi* Poppius (Hemiptera: Miridae) is an endemic insect pest of sorghum (*Sorghum bicolor* (L.) Moench) in Nigeria. Their life span is completed between 15 to 25 days; adult longitivity is between 20 to 25 days. Feeding and oviposition activities in developing panicles lead to both quantitative and qualitative grain loss and severe infestation can lead to entire crop failure. Seven sorghum cultivars (HRhb 97004, 97009, 97015, 97021, 97027, Samsorg-14 and Malisor 84-7) were evaluated for three years under artificial infestation using head cages and natural infestation. Grain weight and yield losses increased with increase in number of head bugs. Infestation by 10 pairs of head bug for a period of 20 days reduced grain weight by 28% and yield by 19% for all the years of evaluation. HRhb 97015, HRhb 97027 and HRhb 97004 had the least percent injury for both grain weight and grain yield. Thus, they posses some level of resistance. These cultivars should be included in integrated pest management programs that include suitable sowing date, use of safe insecticides and biopesticides.

Key words: Sorghum · Panicle pest · Injury · Control · Integration

INTRODUCTION

The presence of mirid head bugs of sorghum belonging to four genera (*Calocoris, Campylomma, Creontiades* and *Eurystylus*) in Nigeria was first reported by [1, 2]. Not much was known about their activities, until recently when surveys revealed that their infestation was widespread throughout the derived savanna, southern and northern guinea savanna, sudan and sahel savannas of Nigeria, causing severe damage to sorghum panicles. Thus, leading to economic hardship of resource-poor sorghum farmers in these agro-ecological zones. *Eurystylus oldi* Poppius is the most predominant and accounts for about 80% of total head hug population in West and Central Africa. In a recent survey in northern Nigeria, over 80% of the farmers' fields visited were infested by *E. oldi* and over 60% of panicles sampled had *E. oldi* on them [3, 4].

Head bug feeding and oviposition activities cause deterioration of the grain quality by rendering the grain soft and starchy, thus, unfit for food preparation. It also leads to higher incidence of grain mould caused by a complex of several fungi species from the genera; *Fusarium* and *Curvularia* [5]. Although little information is available on head bugs and their activities on sorghum in Nigeria, however, studies in neighbouring West African countries such as Niger, Senegal and Mali on head bug had been reported elsewhere [3, 6]. The objectives of these studies were to report the results of experiments conducted on the bionomics of *E. oldi*, damage potential on grain yield and yield component and management strategies for the control of *E. oldi* in sorghum.

MATERIALS AND METHODS

The sorghum cultivars used in this experiment were five sorghum hybrids; HRhb 97004, 97009, 97015, 97021, 97027 developed by Institute for Agricultural Research (IAR), Samaru, Nigeria, one commercial sorghum variety developed by the same Institute; Samsorg-14 and Malisor 84-7 (an internationally known *E. oldi* resistant variety

Corresponding Author: F.A. Showemimo, Department of Plant Science, Institute for Agricultural Research (IAR), P.M.B.1044, Ahmadu Bello University, Samaru, Zaria, Nigeria. Tel: +234-8034507782,

from Mali). The experimental design was randomized block design with three replications. Each plot was 5 m per row, 0.7 m between row and 0.30 m within plant stands. The seven cultivars were sown at IAR research farm in Samaru (11° 11' N; 07° 38' E at 686 m above sea level). Split application of compound fertilizer NPK (20: 10: 10) was done with 64 Kg N/ha, 30 Kg P/ha and 30 Kg K/ha. Half of N and all of P and K were applied as basal at harrowing, while the second application of N was done four weeks later. Weeding was done manually as the need arises. All other cultural and management practices to raise a successful crop were observed according to IAR [7].

At 50% dough stage (soft dough), 0 (control), 2, 5, 7 and 10 pairs of adult *E. oldi* were caged on the panicle of the cultivars as described by Sharma *et al.* [6] each for 10, 15, 20 and 25 days. This was done for three cropping seasons (1999, 2000 and 2001). Monitoring of *E. oldi* on the sorghum plots that had not received insecticidal spray treatment was done to record the bionomics and extent of insect damage. The sorghum cultivars evaluated under control (C), natural infestation (NI) and artificial infestation (AI) were used to assess host-plant resistance importance in a pest management program as described by Sharma *et al.* [6].

Data were obtained for number of head bug per 20 panicles, grain damage rating, 1000 grain weight and grain yield. Percent reduction and percent injury were computed to obtain the extent of sorghum damage and to identify resistant/tolerant and susceptible cultivar(s) as described by Blum, [8] and Sharma *et al.* [6].

RESULTS AND DISCUSSION

Bionomics: The population dynamics at different days of evaluation and rate (pairs) of head bug infestation in 1999 are presented in Table 1. A direct association was recorded; the more the pairs of head bug introduced, the more their rate of multiplication, irrespective of the period of evaluation during a specific cropping season. For each of the head bug pairs there was over 100% increase from between the 10 – 15th and 15 – 20th day of infestation. However, there was less than 10% head bug increase between 20-25th day of infestation. The rapid increase in population of *E. oldi* in this study shows that several generations of *E. oldi* could be completed on the same crop in a single cropping season with an observed peak of infestation occurring between late September and October. This was supported by earlier report [9] that adult longevity was about 25.3 days for males and 21.7 days for females. The less than 10% population difference between 20th and 25th day of infestation was due to the grains getting to hard dough stage and some of the plant parts were no longer tender so *E. oldi* could no longer feed on them as alternative source of feeding. Therefore, the crop on reaching maturity was no longer fresh thus; it did not support their feeding and oviposition activities. Furthermore, their life cycle was completed between 15 to 25 days.

Extent of Damage: Damage on sorghum plant by *E. oldi* is caused by both feeding and oviposition activities in developing sorghum grains. The head bug (adult and nymphs) feed mainly by sucking sap from the developing grains and occasionally tender parts of the sorghum panicle. It was observed that, the damaged grains showed distinct reddish-brown coloration as a result of feeding punctures and at times grains became tanned in the case of severe feeding. Early infestation could lead to entire crop failure.

The oviposition activities which include egg laying, hatching, nymph molting and other developmental stages disturbs grain filling process, thereby, leaving unacceptable color on the grains. Similar observations had been reported [10, 9]. In 1999 and 2000, the effect of artificial infestation on the commercial sorghum variety (Samsorg-14) at Samaru revealed a general increase in grain damage rating as the number of caged adults *E. oldi* increased from 2 to 10 pairs per panicle for each period of evaluation (Table 2). There was a general decrease in

Table 1: Population dynamics of *E. oldi* at different days and rate of infestation on Samsorg-14 at Samaru

No. of *E. Oldi* (pairs)	10th day	15th day	20th day	25th day
2	8	31	47	50
5	17	50	121	123
7	32	79	208	210
10	59	166	439	441
20	86	219	803	803

Table 2: Effects of artificial infestation of *E. oldi* on sorghum (Samsorg-14) at Samaru, 1999 and 2000.

No. of adult	10 days			15 days			20 days		
E. oldi/plant (pairs)	GDR	1000-grain wt (g)	Yield/ panicle (g)	GDR	1000-grain wt (g)	Yield/ panicle (g)	GDR	1000-grain wt (g)	Yield/ panicle (g)
0	0	23.6(0)*	66.8(0)	0	21.4(0)	66.1(0)	0	20.7(0)	66.1(0)
2	1.7	21.8(8)	64.7(3)	2.0	19.8(8)	64.2(3)	2.0	19.2(7)	64.0(3)
5	2.9	20.0(15)	63.0(6)	3.1	18.0(16)	62.1(6)	4.2	17.9(15)	61.3(7)
7	5.1	18.4(22)	58.9(12)	5.9	16.7(22)	55.8(16)	6.7	15.5(26)	53.8(17)
10	5.6	17.9(24)	57.4(14)	6.2	16.1(25)	55.0(17)	6.9	14.9(28)	53.4(19)
Mean	3.1	20.3(14)	62.2(7)	3.44	18.6(15)	60.6(8)	4.0	17.6(15)	59.7(9)
SE(±)	0.56	1.62	2.11	0.37	0.89	1.02	0.33	1.65	3.04

GDR = Grain damage rating (1 = grains with few feeding punctures and 9 = undeveloped or shriveled grains).
*Numbers in parentheses are % reduction for the given parameters.

Table 3: Genotypic performance under *E. oldi* infestation at Samaru for two seasons (2000 and 2001).

	Grain damage rating			1000-grain weight (g)				Grain yield (t/ha)			
Genotype	*C	NI	AI	C	NI	AI	%I	C	NI	AI	%I
HRhb 97004	0	4.0	3.2	21.1	18.7	19.1	10.5	2.2	2.3	1.9	15.8
HRhb 97009	0	4.5	5.6	19.8	14.9	15.3	29.4	1.6	1.4	1.3	30.0
HRhb 97015	0	2.0	2.5	28.3	27.9	26.3	7.6	2.7	2.5	2.5	8.0
HRhb 97021	0	6.3	6.9	27.5	22.4	20.1	36.8	2.0	1.8	1.5	33.3
HRhb 97027	0	3.1	2.8	26.7	26.0	24.6	8.5	2.3	2.1	2.1	9. 5
Malisor 84-7 (check)	0	1.9	2.4	20.5	19.9	19.0	7.9	1.7	1.6	1.5	13.3
Mean	0	3.6	3.9	24.0	21.6	20.7	16.8	2.1	2.0	1.8	18.3
LSD (0.05)		0.41	0.83	3.85	4.11	4.18		0.33	0.31	0.35	

* - C = Control, NI = Natural infestation, AI = Artificial infestation and %I = percent injury

1000-grain weight and grain yield per panicle for the separate period of evaluation as the number of head bug increases. The least percent reduction for grain yield was 3% when two pairs of adult head bugs were introduced into the head cages for the period of evaluations (10, 15 and 20th days) while the highest was 19% when 10 pairs of head bugs were released into caged sorghum panicle for 20 days. The highest 1000-grain yield reduction was 28% when 10 pairs of head bugs were released into caged sorghum panicle for 20 days (Table 2).

In 2000 and 2001, six sorghum cultivars were evaluated under control, natural and artificial infestation. HRhb 97015 had the least damaged grains rating under natural and artificial infestation (2.0 and 2.5), the most damaged grains under natural and artificial infestation (6.3 and 6.9) was cultivar HRhb 97021 (Table 3). The percent injury (or susceptibility of cultivars) caused by headbug for grain weight and grain yield are also presented in Table 3. HRhb 97015 had the least percent injury for both grain weight and grain yield (7.6 and 8%) followed by HRhb 97027 (8.5 and 9.5%) and HRhb 97004 (10.5 and 15.8%). The non-infested (control = caged panicle without headbugs) were free from any damage symptoms.

Head Bug Management: In the context of pest management, the insect pest, host plant and environment(s) are always in association. All suitable techniques and methods such as cultural practices, host plant resistance, insecticides, biological control and legislation in a compatible manner are employed to keep the pest population at levels below those causing economic injury [11].

Cultural practices such as sowing date, tillage and fertilizer management had been suggested for headbug management but they conflict with socio-economic values and traditions of the areas of study. The use of biological control or natural enemies require information on species composition, distribution and efficiencies, however, it is known that existing natural enemies do not appear to be effective in regulating the abundance of the specific insect [11]. Chemical or insecticide and biopesticides (e.g. neem extract) control methods have attracted the attention of government and non-governmental organization as regards 'safe-environment'. The problem of cost of procurement, proper application and mismanagement has continued to be a threat to human and animal health.

The management of headbug through host plant resistance is the most economic, durable and long-term control measure. The effects of resistant genotypes on insect pests population are continuous, cumulative and affordable to farmers. Therefore, the sorghum cultivars that have been identified in this study (HRhb 97015, HRhb 97027 and HRhb 97004) in Table 3 with some level of resistance to headbug should be included in an integrated pest management program.

From earlier studies, non-additive gene action and low narrow-sense heritability controls the factors of headbug resistance in sorghum [6, 12-15] It is well known that resistant genotypes slow down rate of insect pest population and also delays the time required for insect infestations to reach economic threshold levels, insect feeding on resistant plants may be less vigorous and can easily be killed by change in weather conditions and resistant cultivars are compatible with other control methods.

CONCLUSIONS

Eurystylus oldi (Poppius) is an endemic panicle pest of sorghum in Nigeria and their incidence and population dynamics are cause for concern. Their feeding and oviposition activities cause quantitative and qualitative losses and severe infestation can lead to total crop loss. Under artificial infestation grain weight and yield reduction increased as the number of headbugs per plant increased; 28 and 19% respectively when 10 pairs of adult *E. oldi* caged on sorghum panicle for 20 days. HRhb 97015, HRhb 97027 and HRhb 97002 are potential resistant/tolerant cultivars which could be included in an integrated pest management program such as, sowing date and use of neem extract thereby conserving natural enemies, preserving environmental quality and slows down development of insecticide resistant pest population.

ACKNOWLEDMENT

The authors appreciate the support of Mallam B. Bello, Prof. C.C. Nwasike, Prof. Jacob P. Voh, Director of IAR, Zaria and ICRISAT for funding the research.

REFERENCES

1. Anon, 1982. Icrisat Annual Report. Patancheru Andhra Pradesh 502 324, India, Icrisat Center, pp: 13-15.
2. McFarlane, J.H., 1989. The hemipterous insects and spiders of sorghum panicles in northern Nigeria. Insect Science and its Applicat., 10(3): 277-284.
3. Ajayi, O. and R. Tabo, 1995. Effect of crop management practices on Eurystylus immaculatus on sorghum. Pages 233-240 in panicle insect pests of sorghum and pearl millet, K.F. Nwanze and O. Youm, (eds.), Icrisat Sahelian. Center.
4. Ajayi, O., 1996. Report on survey of farmers' field for the head bug *E. oldi* in West Africa with emphasis on Nigeria. West and Central Africa Program. Entomology Annual Report, Icrisat, Nigeria.
5. Sharma, H.C. and V.F. Lopez, 1990. Biology and population dynamics of sorghum head bugs (Hemiptera: miridae). Crop Protection 9: 164-173.
6. Sharma, H.C., Y.O. Doumbia and N.Y. Diorisso, 1992. Screening sorghum for resistance to head bug in West Africa. Insect Science and its Applicat., 13: 417-427.
7. IAR, 1993. Institute for Agricultural Research recommended cultural and management practices for crops based on research at IAR, Samaru, Zaria. In IAR desk iary.
8. Blum, A., 1988. Plant breeding for stress environments. CRC Press Boca Raton, Florida, USA. pp: 223.
9. Ratnadass, A., Y.O. Doumbia and O. Ajayi, 1995. Bioecology of sorghum head bug and crop losses in West Africa. Pages 91-102 in panicle insect pest of sorghum and pearl millet, K.F. Nwanze and O. Youm, (eds.). ICRISAT Sahelian Center.
10. Gahukar, R.T., 1991. Recent development in sorghum entomology research. Agricultural. Zool. Rev., 4: 1-13.
11. Nwanze, K.F. and K.M. Harris, 1992. Insect pests of pearl millet in West Africa. Review of Agricultural Entomol., 80: 1134-1155.
12. Brader, L., 1979. Integrated pest control in the developing world. Annual Rev. Entomol., 24: 225-254.
13. Jeewad, A.S., 1993. Studies on the inheritance of resistance to shoot fly (*Antherigona soccata* Rondani) of sorghum. Unpublished M.Sc. Thesis, Pradesh Agricultural University, pp: 140.
14. Showemimo, F.A., S.O. Alabi, P.E. Olorunju and O. Ajayi, 2001. Breeding sorghum (*Sorghum bicolor* L. Moench) for resistance to head bug (*Eurystylus oldi* Poppius) in Nigeria. Samaru J. Agricultural Res., 17: 35-44.
15. Showemimo, F.A., 2004. Gene action for resistance in sorghum to head bug (*Eurystylus oldi* Poppius). J. Tropical Biosciences, 4:60-64.
16. Showemimo, F.A., 2007. Combining ability and pattern of inheritance for head bug resistance in sorghum. African Crop Science Proceed., 8: 699-702.