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A HEADCAGE TECHNIQUE TO SCREEN SORGHUM FOR RESISTANCE TO MIRID HEAD BUG, *EURYSTYLUS IMMACULATUS* ODH. IN WEST AFRICA*

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Abstract—A headcage technique to screen for resistance to sorghum head bug, *Eurystylus immaculatus* Odh. (Hemiptera: Miridae) was standardized for use in West Africa. Panicles infested at the half-anthesis to complete-anthesis stage had greater population build-up and suffered maximum grain damage, loss in grain mass, grain hardness and seed germination. Panicles with higher grain damage also showed greater severity of grain mould incidence. Maximum population build-up and grain damage was recorded in panicles infested with 20 pairs of adults. Panicles infested with 30–40 pairs of bugs generally showed a decrease in population build-up, possibly because of crowding. Head bug numbers decreased with a decrease in panicle size, while the extent of grain damage increased. To screen for resistance to head bugs, data should be recorded both on head bug numbers and grain damage. Fifty nymphs (third to fourth instar) or 40 bugs collected at random can also be used in the headcage to screen for resistance to head bugs.

Key Words: Head bug, *Eurystylus immaculatus*, sorghum, resistance screening, no-choice, headcage

Résumé—Une technique de la panicule encagée pour le criblage du sorgho pour la résistance à la punaise des panicules, *Eurystylus immaculatus* Odh., en Afrique de l'ouest: Une technique de panicule encagée, destinée au criblage pour la résistance à la punaise des panicules du sorgho, *Eurystylus immaculatus* Odh. (Hémiptère: Miridés), a été normalisée en Afrique de l'Ouest. Les panicules infestées entre les stades de demi-anthèse complète ont revélé une pullulation plus importante et ont subi les plus graves dégâts aux grains, ainsi que la perte importante du poids des grains, de la dureté et de la germination de semences. Les panicules avec des dégâts plus élevés aux grains ont aussi montré une intensité accrue de l'incidence de moisissure de grain. La pullulation et les dégâts aux grains atteignent le maximum sur les panicules infestées avec 20 paires d'adultes. Les panicules infestées de 30 à 40 paires de punaises ont généralement montré une diminution des populations des punaises, probablement à cause de l'encombrement. Le nombre de punaises diminue avec une réduction de la taille de la panicule, alors qu'il y a une augmentation de dégâts aux grains. L'enregistrement des données doit porter tant sur le nombre de punaises que sur les dégâts aux grains afin de permettre le criblage pour la résistance aux punaises. Cinquante nymphes (stade larvaire III–IV) ou 40 échantillons aléatoires de punaises peuvent également être utilisés pour le criblage pour la résistance aux punaise des panicules.

Mots Clés: Punaise des panicules, *Eurystylus immaculatus*, sorgho, criblage pour la résistance, choix unique, panicule encagée

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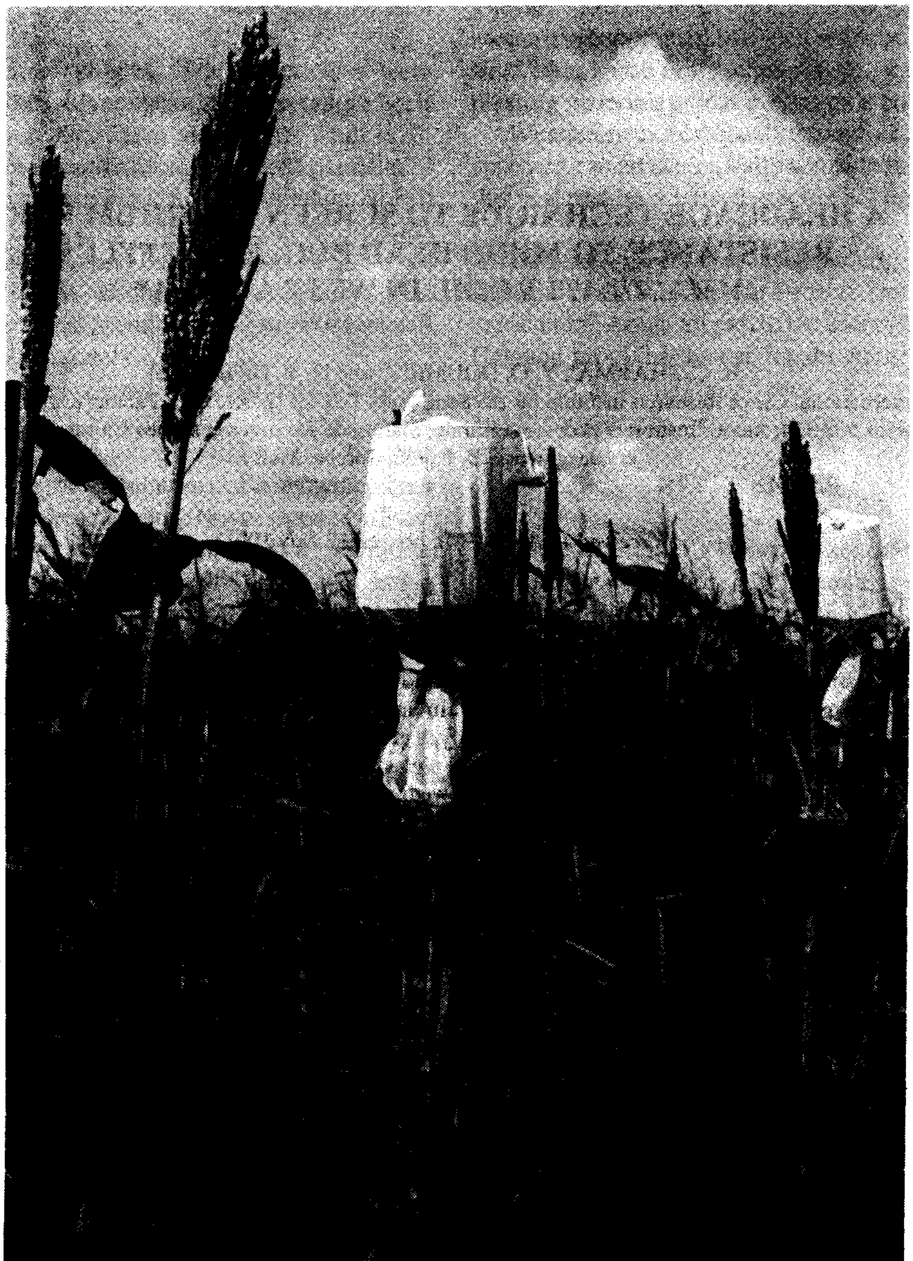

Fig. 1. Headcage technique standardized to screen for resistance to head bugs.

INTRODUCTION

Sorghum, *Sorghum bicolor* (L.) Moench is the most important cereal crop in parts of West Africa. Grain yields on farmer's fields are generally low due to erratic rainfall, insect pests, birds and diseases (Nwanze, 1985). Over 100 species of insects have been reported as serious pests of sorghum, of which sorghum midge (*Contarinia sorghicola* Coq.), head bugs (*Eurystylus immaculatus* Odh., *Campylomma* spp., *Creontiades pallidus* Ramb. and *Taylorilygus vosseleri* Popp.), stem borer (*Busseola fusca* Fuller), head caterpillars (*Helicoverpa armigera* Hb., *Pyroderces* spp. and *Eublema gayneri* Roths.), and grasshoppers and locusts are the most important (Nwanze, 1985; Sharma, 1985).

Reports of head bug damage in sorghum are quite common in West Africa (Steck et al., 1989; McFarlane, 1989; Doumbia and Bonzi, 1985). In a series of collections from Nigeria, Niger, Mali and Burkina Faso, *E. immaculatus* Odh. was found to be the predominant species in the region. Earlier papers on *Erystylus marginatus* Odh. and *E. rufocunealis* Odh. are in fact based on *E. immaculatus* Odh. Grain damage by mirid head bugs is becoming the most important limiting factor for increasing the crop production through newly developed high yielding cultivars (Sharma, 1985; Doumbia and Bonzi, 1985). The traditionally grown *Guinense* landraces are relatively less susceptible to the head bugs. Also, these landraces flower during October, when head bug populations begin to decline. To increase sorghum production to meet the ever increasing demand for this cereal, the high yielding varieties need to be less susceptible to head bugs to avoid losses in grain yield and quality.

Head bug populations vary over space and time. Cultivars flowering at the beginning or end of the cropping season escape head bug damage, while those flowering in the mid-season are exposed to high head bug density. This situation makes it difficult to have meaningful screening under natural conditions. Keeping this in view, an effort was made to standardize the headcage technique (Sharma et al., 1988; Sharma and Lopez, 1989) to screen for resistance to *E. immaculatus* using uniform head bug pressure under no-choice conditions.

MATERIALS AND METHODS

The headcage technique was standardized in relation to most susceptible stage of the panicle for head bug damage, number of bugs required for each infestation, and the effect of panicle size, stage of insect, and the method of insect collection for infestation on population build-up and grain damage.

Effect of panicle development and infestation levels on head bug numbers and grain damage

During the 1985 rainy season, an experiment was conducted on sorghum variety Malisor 84-7 at Sotuba, Mali, to determine the most susceptible stage of the panicle, and the optimum head bug density required to screen for resistance under headcage. Three panicle development stages (complete-anthesis, milk and dough stage) and four head bug densities (5, 10, 20 and 40 pairs of bugs/panicle) were tested in a split plot design. There were three replications. Panicles covered with muslin cloth bags at anthesis (to avoid bug damage) served as uninfested control.

Head bugs were collected from the field in muslin cloth bags when the sorghum panicles were at the dough stage. At this stage sorghum panicles have a large number of newly moulted adults. The bugs were brought to the laboratory and kept in a refrigerator for 3–5 min to inactivate them. The inactivated bugs were placed on the table and collected in pairs of 5, 10, 20 and 40 in 200 ml plastic bottles using an aspirator. Panicles at the complete-anthesis, milk and dough stages (i.e., 6, 12, and 18 days after anthesis) were infested with 5, 10, 20 and 40 pairs of head bugs per panicle under headcage (Fig. 1). There were five replications. Head bug numbers in the infested panicles were counted 20 days after infestation. At maturity, the panicles were harvested and data were recorded on grain damage (scored on a 1–5 scale where 1 = grain with a few feeding punctures and 5 = grain completely shrivelled), grain mould incidence (1 = < 10% moulded grain and 5 = > 40% moulded grain), proportion of light grain separated in sodium nitrate solution of a specific density of 1.31 (Hallgren and Murty, 1983), grain hardness (1 = grain hard and corneous and 5 = grain soft and chalky), and 1000 grain mass of the light and heavy grain. Seeds were also subjected to a germination test by putting 100 randomly selected grains between the folds of a moist filter paper in a Petri dish. The number of seeds germinated was recorded after 72 hr.

During the 1986 season, the experiments were conducted on sorghum variety SPV 35 at Kamboinse, Burkina Faso. In the first experiment, five panicles

Table 1. Head bug population build-up in sorghum panicles infested at the complete-anthesis, milk and dough stages with four levels of infestation (cv Malisor 84-7, 1985 rainy season, Sotuba, Mali)

Stage of panicle at infestation	Days after panicle emergence	No. of head bugs/panicle (20 days after infestation)				
		5 pairs	10 pairs	20 pairs	40 pairs	Mean
Complete-anthesis	6	186 (13.6)*	204 (14.3)	307 (17.4)	170 (12.7)	217 (14.5)
Milk stage	12	11 (3.2)	94 (9.5)	107 (10.0)	114 (10.6)	82 (8.3)
Dough stage	18	13 (3.6)	21(4.5)	56 (5.5)	72 (8.5)	41(5.5)
Mean		70 (6.8)	106 (9.4)	157 (11.0)	119 (10.6)	

S.E. for stage of panicle at infestation ± (0.61)
S.E. for level of head bug infestation ± (1.47)

*Figures in parenthesis are square root values.

were infested at the half-anthesis, complete-anthesis, milk and dough stages with 20 pairs of bugs per panicle. There were five replications in a randomized block design. Head bug numbers were counted 20 days after infestation. Data on grain damage and 1000 mass were recorded after harvest as described earlier.

In the second experiment, panicles of SPV 35 were infested with 10, 15 and 20 pairs of head bugs per panicle at the complete-anthesis stage. There were five replications in a randomized block design. Five panicles were kept as uninfested control. Head bug numbers in the infested panicles were counted 20 days after infestation. Panicles were rated for head bug damage at maturity. Data were also recorded on 1000 grain mass.

During the 1988 rainy season, head bug population build-up and grain damage were studied on S 34 at Sotuba, Mali. Ten panicles at the complete-anthesis stage were infested each with 0, 10, 20, 30 and 40 pairs of head bugs per panicle. There were 10 replications in a randomized block design. Head bug numbers were counted 20 days after infestation. Data on grain damage, 1000 grain mass and seed germination were recorded after harvest as described before.

Effect of panicle size on population build-up and grain damage

The effect of panicle size on head bug population build-up and grain damage was studied under headcage. Such effects have earlier been observed for *Calocoris angustatus* Leth. (Sharma, 1985). Five, 10, or 20 primary branches were retained in the mid portion of each panicle. The extra branches were cut off with scissors. Panicles with all branches intact served as a control. Each panicle was infested with 10 pairs of head bugs/panicle at the complete-anthesis stage. Five panicles were kept as uninfested control. There were five replications in a randomized block

Table 2. Head bug damage and grain mould incidence in sorghum panicles infested at three stages of panicle development (cv Malisor 84-7, 1985 rainy season, Sotuba, Mali)

Stage of panicle at infestation	Days after panicle emergence	Damage rating after releasing				
		5 pairs	10 pairs	20 pairs	40 pairs	Mean
Complete-anthesis	6	2.3 (2.5)*	2.8 (2.5)	2.8 (2.5)	4.5 (4.5)	3.1 (3.0)
Milk stage	12	1.3 (2.5)	2.3 (2.0)	2.8 (2.8)	3.3 (4.0)	2.4 (2.8)
Dough stage	12	1.0 (1.0)	2.5 (1.8)	3.3 (1.5)	3.3 (3.0)	2.5 (1.8)
Mean		1.5 (2.0)	2.5 (2.1)	3.0 (2.3)	3.7 (3.8)	–
S.E. for stage of panicle at infestation		± 0.16 (0.29)				
S.E. for level of head bug infestation		± 0.29(0.16)				

*Figures in parenthesis are grain mould damage ratings.

Table 3. Effect of head bug damage on grain mass and per cent germination in panicles of Malisor 84-7 infested at different stages of panicle development (1985 rainy season, Sotuba, Mali)

Stage of panicle at infestation	Grain mass/panicle (g)					% Light grain				
	5 pairs	10 pairs	20 pairs	40 pairs	Mean	5 pairs	10 pairs	20 pairs	40 pairs	Mean
Complete-anthesis	48.0	55.2	49.4	44.4	49.3	54	68	9	36	42
Milk stage	57.4	73.5	51.0	50.7	58.4	17	5	17	32	18
Dough stage	67.1	44.5	52.1	47.7	52.9	31	10	11	17	17
Mean	57.5	57.7	50.8	47.6	–	34	28	12	28	–
S.E. for stage of panicle at infestation					±5.9					± 6.8
S.E. for level of head bug infestation					± 8.3					± 6.2

Table 4. Effect of head bug damage on 1000 grain mass in panicles of Malisor 84-7 infested at different stages of panicle development (1985 rainy season, Sotuba, Mali)

	1000 grain mass (g)									
	Heavy grain					Light grain				
Stage of panicle at infestation	5 pairs	10 pairs	20 pairs	40 pairs	Mean	5 pairs	10 pairs	20 pairs	40 pairs	Mean
Complete-anthesis	21.5	23.0	25.0	22.5	23.0	19.0	19.5	10.5	20.9	17.5
Milk stage	23.5	27.5	29.0	21.0	25.3	17.7	18.0	23.5	18.3	19.4
Dough stage	27.0	23.0	22.5	26.0	24.6	22.0	15.0	17.5	18.0	18.1
Mean	24.0	24.0	25.5	23.2	24.3	19.6	17.5	17.2	19.1	18.3
S.E. for stage of panicle at infestation					± 1.42					± 1.12
S.E. for level of head bug infestation					± 1.51					± 1.94

Table 5. Grain hardness ratings of heavy and light grain in panicles of Malisor 84-7 infested with head bugs at different stages of panicle development (1985 rainy season, Sotuba, Mali)

	Heavy grain					Light grain				
Stage of panicle at infestation	5 pairs	10 pairs	20 pairs	40 pairs	Mean	5 pairs	10 pairs	20 pairs	40 pairs	Mean
Complete-anthesis	3.5	3.0	2.8	3.5	3.2	4.0	4.0	5.0	3.3	4.0
Milk stage	2.3	2.5	2.8	2.8	2.6	3.5	4.5	4.8	4.3	4.3
Dough stage	2.8	2.8	2.5	2.8	2.7	3.3	4.0	3.0	3.8	3.5
Mean	2.9	2.8	2.7	3.0	–	3.6	4.2	4.3	3.8	–
S.E. for stage of panicle at infestation					± 0.16					± 0.26
S.E. for level of head bug infestation					± 0.10					± 0.30

design. Data were recorded on head bug numbers (20 days after infestation) and grain damage (1–5 scale), and 1000 grain mass after harvest.

Use of nymphs to screen for resistance to head bugs

To overcome the problem of availability of adequate adults, sex identification and collection of adult bugs, an experiment was conducted with various levels of nymphal infestation on S 34 at the complete-anthesis stage at Sotuba, Mali. Nymphs (third to fourth instar) were collected from panicles at the dough stage with aspirators in 200 ml plastic bottles. Five panicles each were infested with 25, 50, 100 and 200 nymphs/panicle under headcage. Five uninfested panicles served as a control. Head bug numbers were counted 20 days after infestation, and data on grain damage, 1000 grain mass and seed germination were recorded after harvest as described earlier.

Head bug damage under headcage from 20 pairs vs. 40 bugs collected at random

Sex identification for infestation requires utmost attention and experience. The sex ratio of *Eurystylus* is close to 1:1 under natural conditions. We studied head bug damage in a relatively resistant (Malisor 84-7) and a susceptible (S 34) cultivar under headcage using 40 sexed (20 pairs) and unsexed (picked at random) bugs. Other experimental details were the same as described before.

Statistical analysis

Data on head bug numbers (converted to square root values), grain mass, seed germination and head bug damage were subjected to analysis of variance. Simple correlations between the parameters studied were also computed.

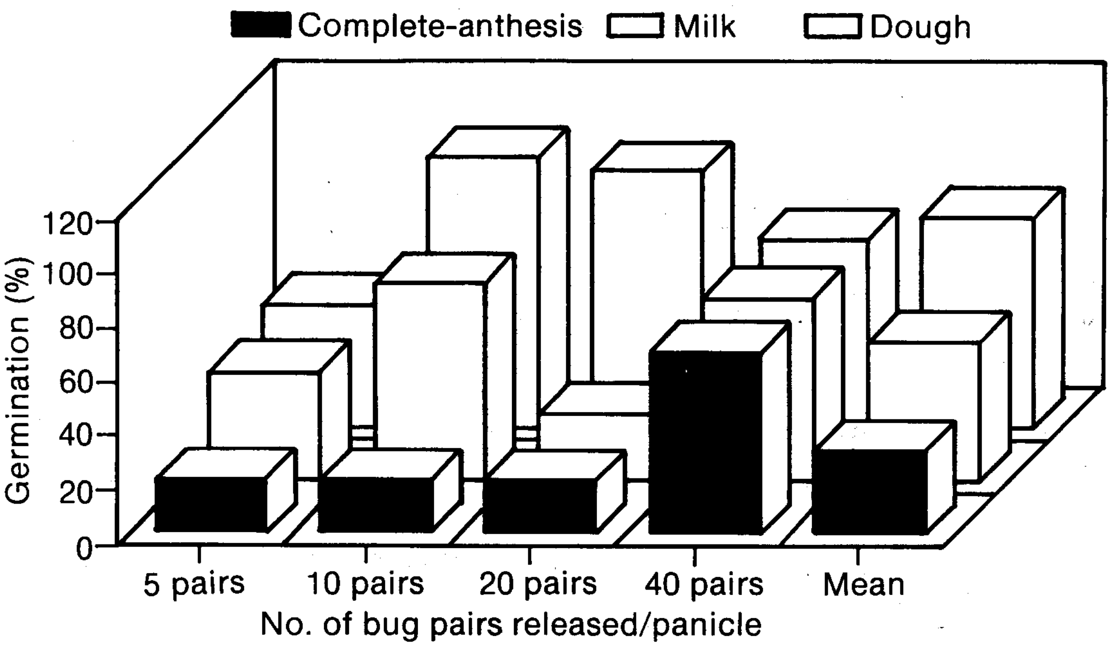

Fig. 2. Effect of head bug damage on 1% seed germination in panicles infested at three stages of development.

Table 6. Effect of head bug infestation (20 pairs/panicle) at different stages of panicle development on population build-up under the headcage (cv. SPV 35, 1986 rainy season, Kamboinse, Burkina Faso)

Stage of panicle development	No. of head bugs/ panicle (20 days after infestation)	Damage rating	1000 grain mass (g)
Half-anthesis	158 (12.4)*	4.3	18.0
Complete-anthesis	82 (9.0)	4.8	14.8
Milk stage	61 (7.6)	3.7	18.8
Dough stage	40 (6.3)	3.3	21.1
Uninfested control	–	–	20.2
S.E.	± (0.65)	± 0.24	± 1.08

*Figures in parentheses are square root values.

RESULTS AND DISCUSSION

Effects of stage of panicle development and infestation level on head bug numbers and grain damage

The greatest head bug numbers were recorded in panicles infested at the complete-anthesis stage followed by those infested at the milk stage in Malisor 84-7. There was no increase in bug numbers in panicles infested at the dough stage, possibly because of the inability of the bugs to lay eggs inside the hardened grain and/or difficulty in feeding by the nymphs on hard grain (Table 1). Panicles infested with 20 pairs of bugs per panicle had the maximum head bug numbers. Panicles infested with 40 pairs of bugs per panicle showed some decrease in head bug numbers. Such a decrease possibly resulted from intra-species competition for food and/or decreased egg laying because of crowding. Such effects of crowding have also been observed for *C. angustatus* (Sharma, 1985). Maximum grain damage was observed in panicles infested with 40 pairs followed

Table 7. Head bug population build-up under headcage in SPV 35 infested with different levels of head bug pairs at the complete-anthesis stage (1986 rainy season, Kamboinse, Burkina Faso)

No. of head bug pairs released/ panicle	No. of head bugs/ panicle (20 days after infestation)	Damage rating	1000 grain mass (g)
5	26 (5.4)*	1.9	17.9
10	77 (8.4)	3.3	18.5
15	127 (11.0)	4.2	19.6
20	124 (10.7)	4.4	16.8
Uninfested control	–	–	20.2
S.E.	± (0.43)	± 0.21	± 1.25

*Figures in parentheses are square root values.

Table 8. Head bug population build-up and grain damage in S 34 under different levels of infestation under headcage (1988 rainy season, Sotuba, Mali)

Infestation level	No. of head bugs/ panicle	Visual damage rating	Germination (%)	1000 grain mass (g)
10 pairs	93 (9.3)*	3.7	31(33.0)**	21.5
20 pairs	84 (9.0)	4.8	8 (9.1)	16.0
30 pairs	54 (7.2)	4.8	0 (1.3)	26.2
40 pairs	47 (6.7)	5.0	0 (1.3)	24.6
Uninfested control	–	–	90(70.5)	28.5
S.E.	± (0.69)	± 0.12	± (3.49)	± 2.18

*Figures in parentheses are square root values.
**Figures in parentheses are angular values.

by those infested with 20 pairs (Table 2). Maximum grain damage was recorded in panicles infested at the complete-anthesis stage. There were no differences in grain damage between the panicles infested at the milk and dough stages. Panicles suffering higher head bug damage also had a greater incidence of grain moulds (r = 0.70**). Panicles infested at the complete-anthesis stage suffered maximum grain mould incidence (Table 2). Thus, physical injury by insect feeding possibly predisposes the grain to mould incidence.

Grain mass per panicle was lowest in panicles infested at the complete-anthesis stage across infestation levels (Table 3). Panicles infested with 40 pairs of bugs had the least grain mass and did not differ significantly from those infested with 20 pairs. Proportion of light grain separated in the sodium nitrate solution (specific density 1.31) was maximum (42%) in panicles infested at the complete-anthesis stage. Grain mass of heavy and light grain was lowest in panicles infested at the complete-anthesis stage (Table 4). Differences in 1000 grain mass for heavy grain did not show any trend across infestation levels. Panicles infested with 10 and 20 pairs had lower grain mass than those infested with five pairs. Grain hardness was low in panicles infested at the complete-anthesis stage (Table 5). Across infestation levels, the differences in grain hardness were not much for the heavy grain, but the light grain showed low hardness in panicles infested with 10 and 20 pairs of bugs per panicle.

Seed germination was significantly affected by head bug damage and it was low in panicles infested at the complete-anthesis stage (Fig. 2). Also, the

Table 9. Head bug population build-up under headcage (infested with 10 pairs/panicle) in different sized panicles of SPV 35 (1986 rainy season, Kamboinse, Burkina Faso)

Panicle size	No. of nymphs per panicle	Damage rating	1000 grain mass (g)
5 primary branches	3 (1.5)*	4.5	21.6
10 primary branches	2 (1.3)	4.8	23.5
20 primary branches	45 (6.3)	3.3	22.7
Full panicle	113 (10.2)	3.7	15.0
Uninfested control	–	–	22.5
S.E.	± (0.88)	± 0.34	± 1.31

* Figures in parentheses are square root values

Table 10. Effect of different levels of nymphal infestation in S 34 on grain damage (Sotuba, Mali, 1988 rainy season)

No. of nymphs released/ panicle	No. of head bugs (20 days after infestation)	Survival (%)	Damage rating	Germination (%)	1000 grain mass (g)
25	46 (6.7)*	186	4.3	24 (28)**	20.3
50	44 (6.3)	88	4.6	45 (41)	22.3
100	54 (7.2)	54	5.0	0.1 (2)	12.0
200	134 (11.6)	67	5.0	0.1 (2)	3.2
Uninfested control	–	–	–	90(70)	32.0
S.E.	± (0.79)	± 0.23		± (4.2)	± 2.81

*Figures in parentheses are square root values.
**Figures in parentheses are angular values.

panicles infested with 20 pairs of bugs showed maximum decrease in seed germination. Per cent loss in grain mass was significantly correlated with the percentage of light grain (r = -0.57**) and grain hardness (r = 0.40**), indicating that these can be used as criteria for evaluating head bug damage.

During the 1986 season, the greatest number of bugs was recorded in panicles infested at the half-anthesis stage, followed by those infested at the complete-anthesis and milk stages (Table 6). Again, panicles infested at the dough stage did not record any increase in bug numbers. Grain damage and reduction in grain mass (1000 grain mass) was maximum in panicles infested at the complete-anthesis stage followed by those infested at half-anthesis. Panicles infested at the dough stage did not show any reduction in 1000 grain mass. Maximum head bug numbers were recorded in panicles infested with 15 and 20 pairs per panicle, resulting in a damage rating of greater than 4 (Table 7). However, panicles infested with 20 pairs suffered maximum loss in grain mass, indicating that 20 pairs per panicle forms an optimum infestation level to screen sorghums for resistance to head bugs. Steck et al. (1989) observed 19–62% losses in panicles infested with 20 pairs of bugs.

During the 1988 rainy season, the greatest bug numbers were recorded in panicles infested with 10 and 20 pairs/panicle (Table 8). Grain damage was significantly lower in panicles infested with 10 pairs as compared with those infested with 20 or 40 pairs. Seed germination was also significantly low in panicles infested with 10 or 40 pairs of bugs per panicle. Maximum reduction in 1000 grain mass was recorded in panicles infested with 20 pairs.

Half-anthesis to complete-anthesis stage (4–6 days after panicle emergence) is the optimum time to infest panicles for resistance screening under headcage. The females lay eggs inside the grain as soon as it is visible outside the glumes. In most cultivars having short- to medium-sized glumes, the grain is seen outside the glumes in 7–10 days. Thus, panicles infested 4–6 days after emergence at the half-anthesis to complete-anthesis stage give 2–3 days for copulation and acclimatization, and egg laying takes place in the soft milk grain. Also, the nymphs emerge in time (in 5 days) to be able to feed and develop on the milk grain and this results in maximum population build-up and grain damage. Population build-up and grain damage are lower in panicles infested at the milk and dough stages, because the grain at these stages is unfit for oviposition and feeding.

Maximum population build-up and grain damage were generally recorded with 20 pairs of bugs per panicle. A further increase in bug density often resulted in a decrease in head bug numbers across stages of panicle development and over seasons. Thus, 20 pairs of bugs form an optimum level to screen for resistance to head bugs under uniform insect pressure under headcage.

Effect of panicle size on population build-up and grain damage

Maximum head bug numbers were recorded in undisturbed panicles (with all branches intact),

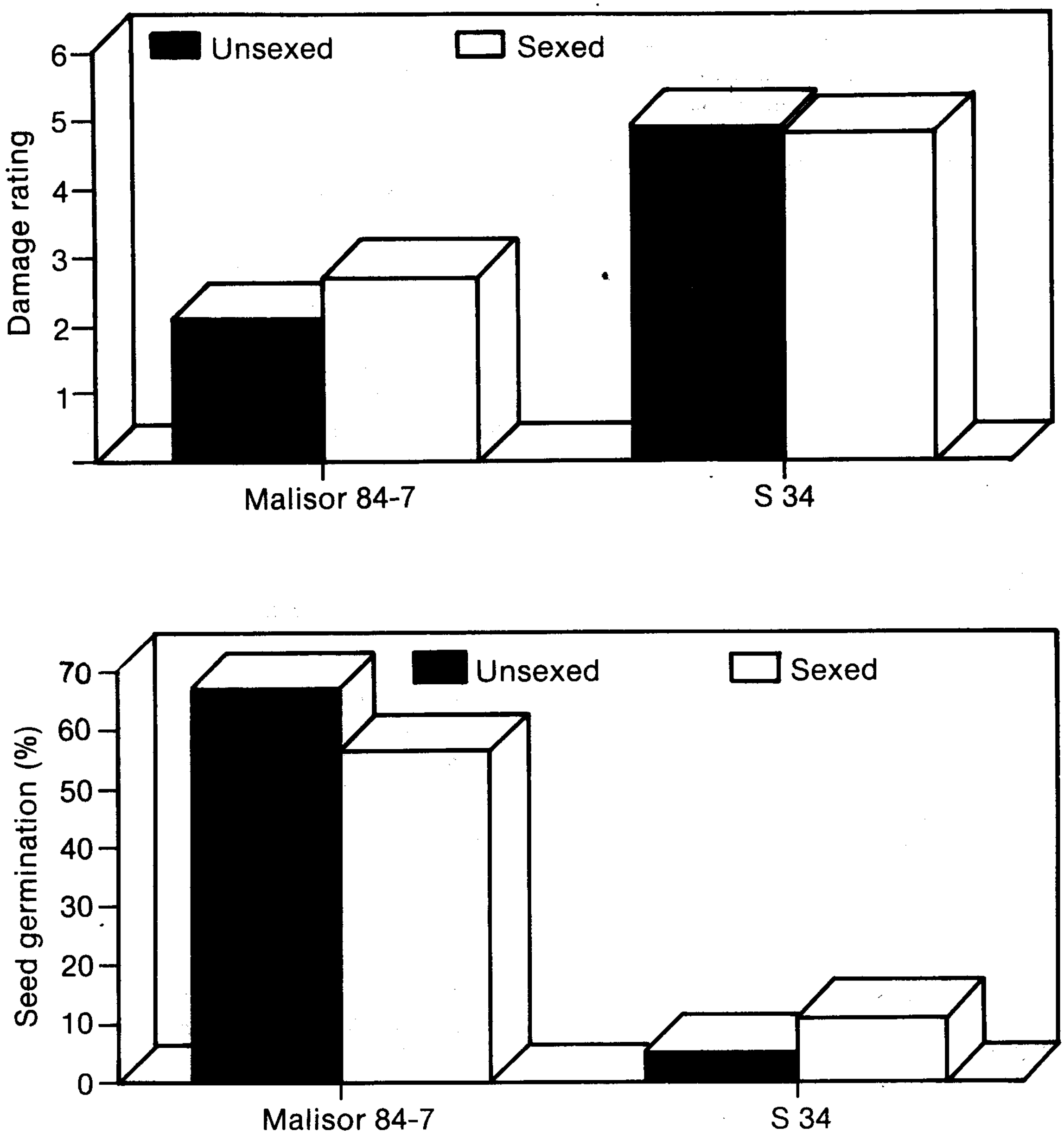

Fig. 3. Grain damage (a) and % seed germination (b) in Malisor 84-7 and S 34 from 20 pairs (S) vs. 40 bugs collected at random.

followed by those with 20 primary branches per panicle (Table 9). There was a progressive decrease in bug numbers in panicles with fewer branches. Grain damage decreased with an increase in panicle size, indicating that depletion of food possibly leads to lower population build-up in panicles having low number of grains per panicle. Maximum reduction in 1000 grain mass was recorded in normal panicles where the greatest population build-up was recorded. Thus, panicle size is an important factor in screening for head bug resistance. Sorghum genotypes have a wide variation in panicle size or amount of grain available for oviposition and feeding. Also, the panicle size is greatly influenced by the season and fertility status of the soil. Thus, it is important to maintain some degree of uniformity in panicle size in genotypes being tested under headcage. Excessive branches may be removed with scissors. Similar effects of panicle size on population build-up and grain damage have earlier been recorded for *C. angustatus* (Sharma, 1985).

Use of nymphs for resistance screening

Maximum bugs were recorded in panicles infested with 200 nymphs (Table 10). However, there was a significant decrease in survival of nymphs in panicles infested with 100 and 200 nymphs. Increase in bug numbers was only recorded in panicles infested with 25 nymphs per panicle. Grain damage rating was greater than 4.5 in panicles infested with 50–200 nymphs. Grain germination was significantly low (less than 45%) in panicles infested with 25–200 nymphs. Panicles infested with 100 nymphs suffered a complete loss in seed viability. Grain mass was also significantly low in panicles infested with 25–200 nymphs. Greater reduction was observed in panicles infested with 100 and 200 nymphs. Fifty nymphs/panicle resulted in a fairly high grain damage in the susceptible cultivar S 34. In situations where collecting adequate number of adults or sorting the bugs according to sexes is a problem, 50 nymphs can be used to screen for resistance to head bugs at the complete-anthesis stage.

Head bug damage under headcage from 20 pairs vs 40 bugs collected at random

Grain damage and reduction in seed germination were higher in panicles infested with 20 pairs compared with those infested with 40 bugs collected at random in Malisor 84-7 (Fig. 3a, b). However, such differences were not apparent in case of the susceptible cultivar, S 34. Reduction in 1000 grain mass was higher with 40 bugs collected at random for Malisor 84-7, but not in S 34. Therefore, resistance screening can also be carried out with 40 bugs collected at random, although it would be desirable to use 20 pairs per panicle as far as possible.

To identify reliable and stable sources of resistance to head bugs for use in a resistance breeding programme, sorghum genotypes can be tested using uniform insect pressure of 20 pairs of bugs per panicle at the complete-anthesis stage (i.e., about 6 days after panicle emergence). Forty bugs collected at random or 50 nymphs can also be used for resistance screening. Both population build-up and grain damage should be considered for selecting resistant genotypes. Grain mass, percentage of light grain, grain hardness and seed germination can also be used as criteria for evaluating head bug damage. This technique has been used to screen for resistance to head bugs in West Africa (Sharma et al., Unpublished data).

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