Improving Techniques for Screening against the Millet Head Miner, a Major Pest of Pearl Millet in the Sahel.

Refining the Egg Infestation Technique.

Lack of efficient artificial infestation technique hinders effective screening for resistance against millet head miner (MHM), *Heliocheilus albipunctella* (De Joannis), a major insect pest in resource poor Sahelian region. Recently Youm *et al.* (1998) reported that use of MHM eggs is more effective than using larvae for artificial infestation technique, though the refinement of the technique was suggested. Collaborative field studies were therefore conducted at ICRISAT Niamey as a follow up to ascertain the optimum number of MHM eggs per panicle to cause at least a damage rating of 7 in a susceptible millet genotype. Furthermore, varieties were infested to assess their reaction to different levels of egg infestation using a rating scale. Some varieties were also assessed for reaction to head miner under natural infestation.

In one experiment the susceptible variety 3/4HK-B78, was subjected to six (6) levels of infestation including 20, 25, 30, 35, 40 and 45 eggs per panicle. In a second experiment, three (3) composites that were previously reported susceptible following infestation with 40 eggs were infested with 30 and 35 eggs. In both experiments, the design and infestation technique are similar to those described by Youm *et al*. (1998).

In all experiments the 40 eggs produced significantly higher scores of damage rating than any other infestation level (Tables I and 2). The ***larval production index*** (LPI) values indicate the proportion of eggs that developed to full-grown larvae or pupae out of the number of eggs infested per panicle. In respect to this variable, the difference between treatment levels was not significantly different in experiments (Tables 1 and 3). However the 40 eggs infestation level constantly scored the highest values.

Results of present studies and those reported by Youm *et al.* (1998) tally in general with the conclusion that use of 40 eggs per panicle is an efficient artificial screening technique for resistance against millet head miner. The fact that infestation level above 40 eggs, say 45 eggs, did not produced higher damage rating an LPI values in these particular experiments should be reviewed further, though the effect of larval crowding and competition on panicle could be considered. Furthermore, since full-grown larvae after feeding and causing damage to panicles tend to cut through the cages to go into soil for pupal diapause, it is suggested that larval movement be monitored from late instars to account for all full grown larvae and the improved LPI.

Varietal Trials to Screen for Resistance/Tolerance to Millet Head Miner

Resistant or tolerant millet is particularly important for farmers in Sahelian West Africa where the use of pesticides to control head miner on pearl millet is not economically profitable. Screening trials were therefore conducted at ICRISAT-Niamey in 1999 to identify resistant or tolerant genotypes, which can be incorporated in an IPM program.

In one trial, eighteen (18) genotypes from ICRISAT-Patancheru were infested artificially with 30 eggs/panicle. These genotypes belong to three different Parents including EC87, EC91 and HHVB. The genotypes were planted on-station in a randomized block design with four (4) replications. The materials and technique of infestation used were similar to those described by Youm *et al*. (1998).

In a second trial, twenty (20) genotypes from ICRISAT-Sadoré were screened under natural infestation (in the absence of sufficient artificial infesting material). In this trial the genotypes were planted on farmers' fields in a randomized-block design with four (4) replications. No fertilizer was applied and planting and weeding carried out as farmers do. At maturity panicles from eight (8) hills per plot were randomly cut and rated for head miner damage. Similarly samples of panicles with head miner damage from surrounding local variety were taken for control purposes.

Results of Trial 1 are presented in Tables 4 and 5. Results of Table 4 show that the genotypes did not differ significantly in terms of damage rating although the LPI values display significant differences. There were also no significant differences between parent genotype as shown in Table 5. Youm *et al.* (1998) screened these genotypes using 40 eggs/panicle and found significant differences between genotypes and their parents for both damage rating and LPI. Lack of significance in the present study could therefore, be attributed to the unsuitability of the 30 eggs/panicle infestation level. This is an additional confirmation that the 40 egg/panicle is an efficient level for MHM screening.

Results of trial two are presented in Table 6. The genotypes differed significantly in their behavior to MHM natural infestation. It is the landrace Local Sadoré that scored the lowest damage rating (1.66) probably due to its adaptation to the environment. Among the 20 genotypes, the newly created ICMV IS 99004 performed well with a low damage rating of 2.22. The highest damage rating (4.27) was scored by the genotype ICMV IS 88305. A common problem in screening under natural conditions is the fact that insect infestation is not always optimum and uniform. This may lead to inconsistent results when the trial is further repeated. To get reliable results, it is better to try these genotypes under artificial conditions using 40 eggs/panicle.

Main conclusions and recommendations

Studies reported here, as a follow up to 1998 studies, show that the technique of artificial infestation with 40 eggs/panicle was effective for screening against the millet head miner. It is therefore recommended that all future screening for resistance to the millet head miner be done under artificial conditions using eggs. Once reliable sources of resistance are found, and a resistant variety developed, on-farm testing can be undertaken in "hot spots". LPI can be a good indicator of varietal resistance/tolerance, along the damage rating. It is recommended that close monitoring of larvae and recording of full-grown larvae be done systematically so that LPI measure can be also used in addition to the damage rating.

Table 1. Mean (±SE) damage rating and larvae production index (LPI) per panicle of treatments in Trial 1 in 1999.

Eggs/panicle (n)	Damage rating[1]	LPI (%)[1]
20 (6)	2.16±0.65c	14.16a
25 (8)	5.50±0.73b	23.50a
30 (8)	4.50±0.90bc	13.33a
35 (7)	3.71±0.9 1 bc	13.46a
40 (5)	8.60±0.24a	35.00a
45 (5)	5.40±0.67b	15.55a

[1] Means with the same letter are not significantly different at 5% level.

Table 2. Mean (±SE) damage rating of genotypes in Trial 2 in 1999.

	30 Eggs/panicle		35 Eggs/panicle		40 Eggs/panicle[2]	
Entry	Rating[1]	n	Rating[1]	n	Rating[1]	n
EC87-PVCI	3.00±0.84b	11	3.83±1.49b	6	7.07±0.52a	14
EC91-PVC4	2.70±0.83c	10	4.84±1.01b	13	7.92±0.28a	13
EC91 -Original	4.73±0.69b	15	5.30±0.76b	10	7.14±0.64a	14
Average	3.47		4.65		7.37	

[1] Means in the same row and followed by the same letter are not significantly different at 5%.
[2] Infestation of 1998.

Table 3. Mean (±SE) Larvae production index (LPI) in of the genotypes in Trial 2 in 1999

	30 Eggs/panicle		35 Eggs/panicle		40 eggs/panicle[2]	
Entry[1]	LPI (%)[1]	n	LPI (%)[1]	n	LPI (%)[1]	n
EC87-PVCI	16.36±6.91ab	11	5.71±3.90b	6	29.64±6.69a	14
EC91-PVC4	1.00±1.0oc	10	13.84±6.42b	13	50.70±5.10a	13
EC91-Original	29.33±7.13a	15	18.85±6.68a	10	31.14±0.64a	14
Average	15.56		12.80		37.16	

[1] Means in the same row and followed by the same letter are not significantly different at 5%.
[2] Infestation of 1998.

Table 4. Mean (±SE) damage rating and larvae production index (LPI) of the genotype following infestation with 30 eggs/panicle in 1999.

Genotypes	Damage rating[1]	LPI (%)[1]
EC91-PVC-5	5.66±0.79a	36.66±8.92a
EC91-PVC-2	5.85±1.28a	38.57±12.78ba
EC87-PVC-5	6.66±0.78a	31.85±7.99bac
EC91 -Original	4.92±0.73a	29.48±7.63bdac
EC91-PVC-1	5.80±1.20a	22.00±9.80bdac
EC91-PCV-3	5.71±1.30a	18.09±7.15ebdac
EC87-PVC-4	4.23±0.77a	21.53±6.9lebdac
HH-VBC-PVC-3	5.87±1.02a	17.91±7.31 ebdac
EC87-Original	3.88±1.19a	21.48±10.33ebdac
EC87-PCV-1	2.83±0.78a	17.22±0.78ebdac
HH-VBC-PVC-5	4.37±1.13a	10.83±1.13ebdac
EC87-PCV-2	3.10±0.94a	14.66±8.49ebdac
HH-VBC-PCV-4	3.42±1.02a	9.52±4.62ebdac
HH-VBC-PCV-2	4.00±1.91a	6.66±3.84ebdc
HH-VBC-Original	4.25±1.97a	5.00±3.96edc
HH-VBC-PCV-1	2.66±1.02a	8.14±7.35ed
EC87-PCV-3	4.20±0.96a	6.33±0.96ed
EC91-PCV-4	2.70±0.83a	9.52±4.62e

[1] Means in the same column followed by the same letters are not significantly different at 5%.

Table 5. Mean (±SE) damage and larvae production index of the parent genotype following infestation with 30 eggs/ panicle in 1999.

Genotype	Damage rating[1]	LPI (%)[1]
EC87	4.37±0.43a	19.01±3.52a
EC91	4.530.37a	22.80±3.30a
HHVB	4.070.49a	10.41±2.59a

[1] Means in the same column followed by the same letter are not significantly different at 5%.

Table 6. Millet head miner (MHM) **damage rating of the genotypes under natural infestation.'**

Entry	Damage rating[1]
ICMV IS 88305	4.27±1.16a
HKP-GMS	4.23±1.02ba
ICMH 9808	4.09±0.65ba
ICMV IS 99006	3.93±0.37bac
Gueriniari-2	3.62±0.76bdac
ICMV IS 99003	3.57±0.53bdac
ICMV IS 99005	3.55±0.69bdac
ICMV IS 99007	3.54±0.68bdac
SOSANK	3.53±0.50bdac
ANKOUTESS-98	3.34±0.64ebdac
ICMV IS 99002	3.31±0.17ebdac
ICMV IS 90309	3.29±0.41ebdac
ICMV IS 99009	3.27±0.42ebdac
ICMV IS 99001	3.24±0.67ebdac
ICMH 9807	3.15±0.45ebdac
ICMV IS 89305	3.02±0.46ebdac
ICMH 9809	2.94±0.65ebdc
ICMV IS 92326	2.75±0. 10edfc
CIVT-GMS	2.59±0.19edf
ICMV IS 99004	2.22±0.40ef
Local Sadoré	1.66±0.19f

[1] Means followed by the same letter are not significantly different at 5%.

Fig 1. *H. albipunctella* eggs mounted, 40 per pinned sticky label.

Fig 2. Egg carrying label pinned onto panicle