Observations on factors affecting attraction and oviposition preferences of millet head miner, *Heliocheilus albipunctella* De Joannis (Lepidoptera: Noctuidae) to pearl millet panicles

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Abstract. In laboratory studies to assess the oviposition preferences of *Heliocheilus albipunctella* de Joannis (Lepidoptera: Noctuidae) on five different panicle stages of pearl millet, 30% panicle extension proved to be the most attractive stage for female oviposition. In a choice test situation, females laid eggs only on whole millet panicles or filter papers impregnated with methanol extracts of millet panicles. These findings and other night field observation results suggest that volatiles may be responsible for host finding, while contact and plant nutrient composition may possibly be responsible for discriminative probing and oviposition site searching behaviour.

Introduction

The millet head miner, *Heliocheilus albipunctella* De Joannis (Lepidoptera: Noctuidae) is a serious insect pest of millet in the Sahelian zone of West Africa. Females lay 20-50 batches of about 300-400 eggs on millet heads (Bernardi *et al.,* 1989; Nwanze & Harris, 1992). Eggs normally hatch in 3-5 days and the developing larvae feed on floral glumes and flower stems thus causing yield decrease. ~

Even though millet panicles serve as oviposition sites for the head miner, the mechanisms underlying this choice remain unknown. This paper reports on laboratory experiments to investigate factors affecting host plant-head miner oviposition interactions.

Materials and Methods

Insects
Gravid female head miners were obtained from light traps (Robinson traps equipped with photosentivie cells with 125-W mercury vapour bulbs) located at International Crops Research lnstititute for the Semi-Arid Tropics (ICRISAT) Sahelian Center, Niger.

Panicle stages tests
The most suitable panicle stage for female egg oviposition was assessed using 5 stages, i.e., 30% panicle extension, 50% panicle extension, 100% panicle extension, flowering stage, and dough filling stage. Panicle stages were arranged evenly in paper containers (27 cm height, 25 cm diameter) covered with nylon gauze and 10 adult female *H. albipunctella* were allowed to oviposit in a choice test situation in the dark. Number of eggs laid on each panicle stage was counted the following morning. In all, 5 millet varieties were used and experiments were

replicated 3 times. Positions of millet panicles in the cageses were changed for each experiment.

Whole substrate tests
Four freshly detached sorghum panicles, millet panicles, millet leaves, and millet stems were used in a choice test experiment. Substrates were arranged in ca es as described above and 10 gravid female *H. albipunctella* were put in the cages between 6 and 7 pm. Cages were left in the dark for females to oviposit. The number of eggs on each substrate was counted the following morning. In all, 5 repetitions were carried out.

Methanol (MeOH) extracts tests
Fresh sorghum panicles, millet panicles, millet leaves, and millet stems (10 g each) were immersed in 100 ml of 80%-MeOH for 3 days in the dark. After removal of solid material, filter papers were soaked in the respective extracts. The MeOH was evaporated under vacuum (in a hood) and the resulting filter papers with extract only were fixed around around wooden rolling pins (length = 20 cm; diameter = 2 cm). The rolling pins were then set up in cages as described in the preceeding experiments. Ten gravid females were put in the cages between the hours of 6 and 7 pm. Cages were left overnight in the dark for females to oviposit. The number of eggs on each treatment was counted the following morning. In all, five repetitions were carried out. Control trials (i.e. filter paper dipped in MeOH only) were initially set up but later ignored because the methanol alone had no effect on female egg oviposition.

No-choice tests
In no choice tests, female insects were confined in cages with single treatments in a no-choice situation. Eggs laid on the various treatments were counted the next day.

Results

Female head miner egg oviposition in four millet varieties in a choice situation are presented in Table 1. Irrespective of variety studied, 30% panicle extension gave the highest mean percentage of eggs, followed in order by 50 % panicle head extension, full extension, flowering stage, and dough filling age. Almost no eggs were laid at all on flowering and dough filling stage panicles. However, in a no-choice situation (Table 2) some eggs were laid even though far lower than for 30% panicle stage. At 30% panicle extension, millet variety chalakh generally recorded the highest number of eggs, followed by ICMV IS 89305.

Table 3 shows female egg oviposition on different substrates and their respective MeOH extracts. In all cases, millet panicles or their extracts were preferred for egg laying. However, the number of eggs laid on filter paper impregnated with MeOH extract of millet panicles was lower than for intact millet panicles. In no-choice situations, no eggs were laid on whole plant or MeOH extracts of sorghum panicles, millet leaves, and millet stems (Table 3). This suggests the absence of oviposition preference signals in sorghum panicles, millet leaves, and millet stems.

Discussion

Egg oviposition by the millet head miner has not been studied at all. Generally, it is understood that there is a complex interaction between insects and host plants concerning procedures to identify hosts for feeding, mating, and oviposition (Brattsen & Ahmed, 1986; Metcalf & Metcalf, 1992; Hirano *et al.,* 1994; Owusu *et al.,* 1996) Preference of young panicles as oviposition sites suggests the possible presence of chemicals mediating oviposition in millet panicles, which are most attractive at 30% panicle extension and declining with panicle age.

We have observed in the field that on a night of moderate breeze, females invade millet fields more than during a night of still air (especially after rain), or very strong wind. These observations suggest that anemotaxis may compliment spectral reflectance, and millet panicle volatiles, as agents possibly responsible for host finding, while contact chemoreception and probably plant nutrient composition may be responsible for discriminative probing and oviposition site searching behaviour. After landing on millet panicles, females can spend as long as 15-20 minutes probing concurrently .with the ovipositor before deciding to lay their eggs. In some cases, they fly away to other panicles after such long periods of probing without laying. Reasons attributable to the latter case are difficult to find. Nevertheless, we suspect deposition of some chemicals by females after oviposition, which may deter other females from ovipositing on the same panicle.

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Table 1. Choice test responses of millet panicle stages to female head miner oviposition (3 replicates)

Variety	Mean % total eggs ± SE				
	30% ext	50% ext	100% ext	flowering	dough filling
3/4HK	57.2±2.48	30.3±1.26	12.5±3.73	0.0	0.0
MBH110	70.7±8.94	22.8±11.85	5.8±2.18	0.75	0.0
ICMV IS 89305	75.7±0.83	16.3±2.68	7.4±1.31	0.0	0.0
Chalakh	85.8±0.71	13.9±1.08	0.4	0.0	0.0

Table 2. No-choice test responses of millet panicle stages to female head miner oviposition (3 replicates)

Variety	Mean total eggs ± SE				
	30% ext	50% ext	100% ext	flowering	dough filling
3/4HK	46.0.2±8.52	21.0±2.94	10.3±1.25	3.3±1.70	3.0±1.41
MBH110	60.7±9.39	27.0±4.32	12.3±3.09	5.7±2.06	4.0±2.16
ICMV IS 89305	61.3±12.82	26.7±6.24	14.7±3.68	4.0±2.45	5.3±2.06
Chalakh	74.0±7.48	25.7±4.64	17.3±2.86	3.3±1.25	3.0±0.82

Table 3. Numbers of eggs (mean ± SE) deposited by *H. albipunctella* female moths on whole plant substrates or filter paper impregnated with methanol extract in choice (5 replicates) or no-choice (4 replicates) tests.

	Choice Test		No-Choice Test	
	plant	filter paper	plant	filter paper
Sorghum panicles	0.2 ± 0.18	0.0	0.0	0.0
Millet panicles	44.4 ± 7.38	5.4 ± 0.92	32.0 ± 2.9	16.8 ± 1.9
Millet leaves	0.2 ± 0.18	0.0	0.0	0.0
Millet stems	0.4 ± 0.36	0.0	0.5 ± 0.5	0.5 ± 0.5