Ber. Ohara Inst. landw. Biol., Okayama Univ. 19 : 137-144 (1987)

PROBING BEHAVIOUR OF THE APHID, *SCHIZAPHIS GRAMINUM* (RONDANI) , *RHOPALOSIPHUM MAIDIS* (FITCH) AND *LONGIUNGUIS SACCHARI* (ZEHNTNER) ON RESISTANT AND SUSCEPTIBLE SORGHUM PLANTS

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INTRODUCTION

Indole alkaloids are present in various species of Graminae, Leguminosae and other plant families (Culvenor 1973). Several plant secondary metabolites are thought to protect plants against aphids, *Schizaphis graminum* (Rondani) (Argandona et al. 1981) and *Rhopalosiphum maidis* (Fitch) (Longe et al. 1977).

Certain hybrids of sorghum have been monitored for their potential resistance to the aphid, *S. graminum* (Teetes et al. 1975 and Depew and Witt 1979). The resistance of sorghum to the aphid, *S. graminum* has been associated to the dgree of methylation of intercellular pectin (Dreyer and Campbell 1984).

Furthermore, Campbell et al. (1982) reported that the resistance in sorghum to *S. graminum* can be the result of any one of a combination of antibiosis, antixenosis or tolerance depending on the variety. However, some reports have suggested that gramine and related indole alkaloids present in many plant families are responsible for their toxicity to ruminants and aphids (Gallagher et al. 1964 and Corcuera 1984). Some barley cultivars lacking gramine have been reported to be the most susceptible to aphid, *Rhopalosiphum padi* (Linné) and that gramine incorporated in artificial diet decreased survival, amount of food ingested and reproduction of aphids (Zúñiga and Corcuera 1986).

McLean and Kinsey (1967) introduced a technique of electronically monitoring the probing behaviour of aphids. Distinctive sequences in wave forms corresponding to voltage fluctuations recorded from aphids feeding on plants were associated with probing, salivation and or ingestion in specific plant tissues. In some studies, the aphid, *S. graminum* probing on the resistant lines of sorghum showed a significantly reduced imbibition of phloem sap; increased number of sparate probes and increased duration of non probing as compared to the aphids fed on susceptible varieties

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Received June 16, 1987
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(Campbell et al. 1982).

In this paper the probing behaviour of three aphids, *S. graminum*, *R. maidis* and *L. sacchari* on susceptible and resistant varieties of sorghum is discussed.

MATERIAL AND METHODS

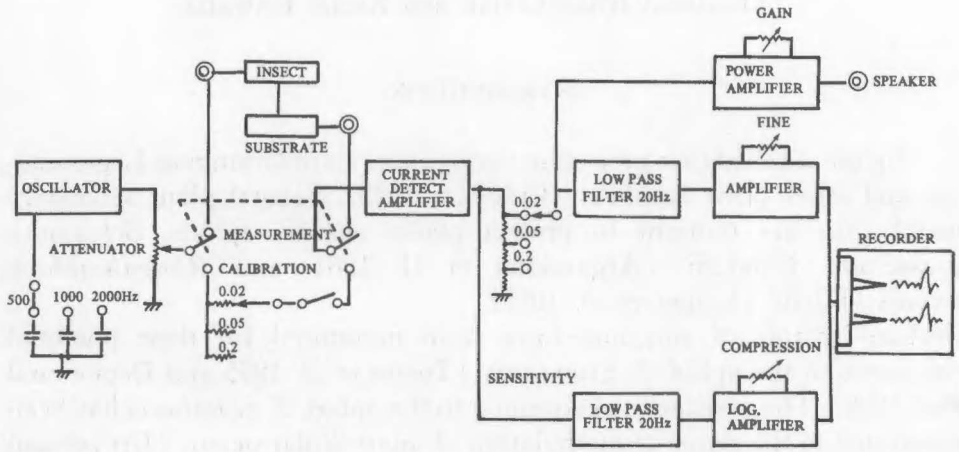

FIG. 1. Schematic diagram of aphid probing activity measurement system.

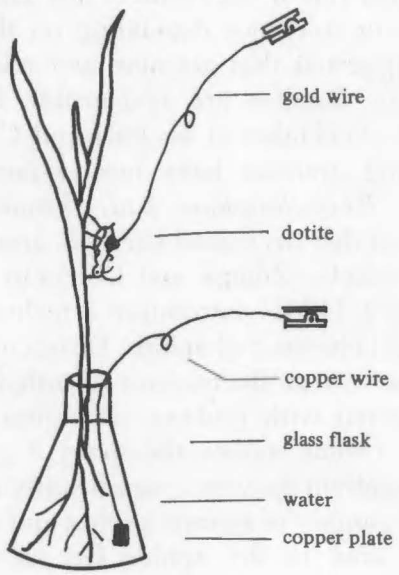

FIG. 2. Feeding apparatus of aphid.

Aphids : The apterous virginoparous adults of the aphids, *S. graminum* *R. maidis* and *L. sacchari* were collected from naturally infested barley and maize crops and maintained at 20℃ in a 16L8D photoperiod regime in a nylon net cage in the laboratory.

Probing behaviour : The electronic system used for monitoring the probing behaviour of *S. graminum*, *R. maidis* and *L. sacchari* was similar to that described earlier (McLean and Kinsey 1967, McLean and Weight 1968 and Kono et al. 1982).

Fig. 1. shows the circuit as a block diagram and Fig. 2. shows a more detailed aphid feeding apparatus. Before their probing behaviour was monitored, the aphids were tethered to a 15 μum gold wire starved for 30 min and placed individually on susceptible (Redlan B) or resistant (PE 954-177) varieties of sorghum.

The probing behaviour was recorded for 60 min in all treatments at room temperature (26±2℃). The parameters of aphid probing behaviour tested between resistant and susceptible varieties of sorghum were the total number of probes, duration of salivation and duration of ingestion noted during a one hour feeding period. The data was analysed by Dankans multiple range test on a Hewlet Packard 9845A Computer.

TABLE 1 Probing behaviour of *S. graminum* on susceptible and resistant sorghum plants during 60 min.

Sorghum plant	No. aphids	Mean no. probes ± S. D.	Mean salivation ± S. D.	Mean ingestion ± S. D.
Susceptible	10	3.0 ± 1.6	8.6 ± 5.1	44.6 ± 5.4
Resistant	10	6.8 ± 3.1**	14.3 ± 7.4**	33.0 ± 10.7**

**Significant at 1 % level.

TABLE 2 Probing behaviour of *R. maidis* on susceptible and resistant sorghum plants during 60 min.

Sorghum plant	No. aphids	Mean no. probes ± S. D.	Mean salivation ± S. D.	Mean ingestion ± S. D.
Susceptible	11	2.1 ± 1.0	2.3 ± 0.7	51.5 ± 7.6
Resistant	11	6.1 ± 2.7**	13.1 ± 4.21**	32.9 ± 5.4**

**Significant at 1 % level.

TABLE 3 Probing behaviour of *L. sacchari* on susceptible and resistant sorghum plants during 60 min.

Sorghum plant	No. aphids	Mean no. probes ± S. D.	Mean salivation ± S. D.	Mean ingestion ± S. D.
Susceptible	6	2.0 ± 1.3	3.2 ± 2.5	54.8 ± 7.5
Resistant	6	5.3 ± 3.8**	15.1 ± 9.0**	25.4 ± 8.1**

**Significant at 1 % level.

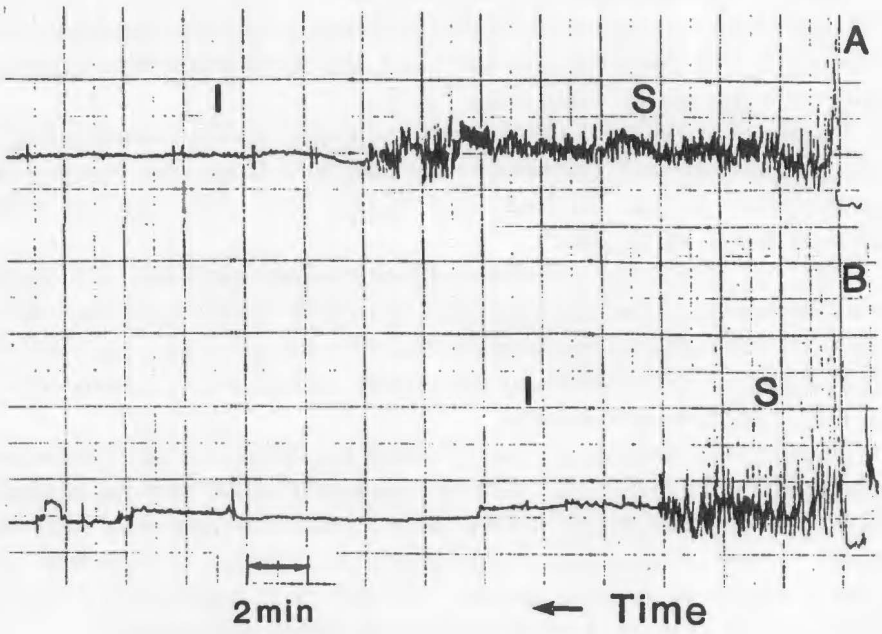

FIG. 3. Waveforms recorded when *S. graminum* probed into resistant (A) and susceptible (B) sorghum seedling. S : salivation, I : ingestion

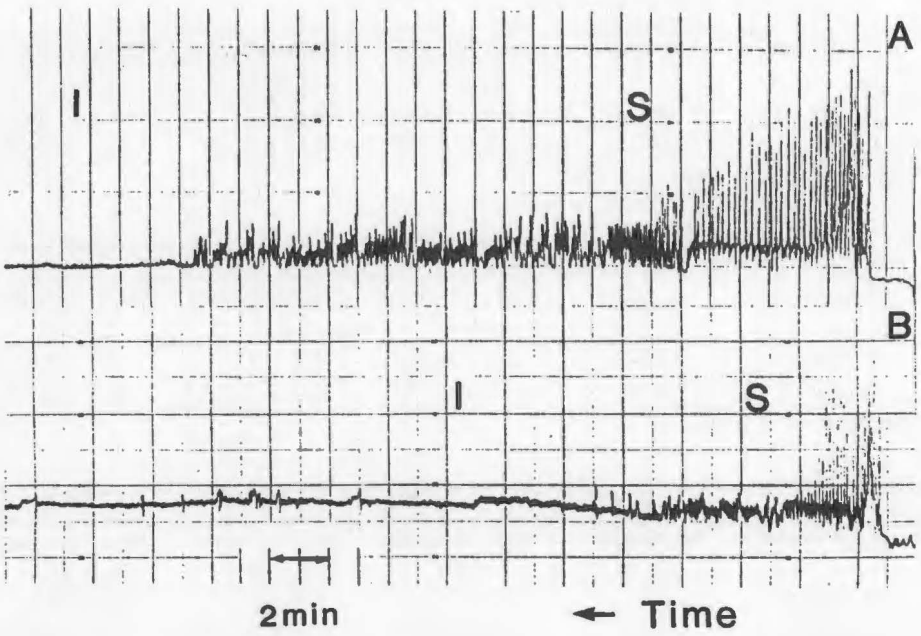

FIG. 4. Waveforms recorded when *R. maidis* probed into resistant (A) and susceptible (B) sorghum seedling. S : salivation, I : ingestion.

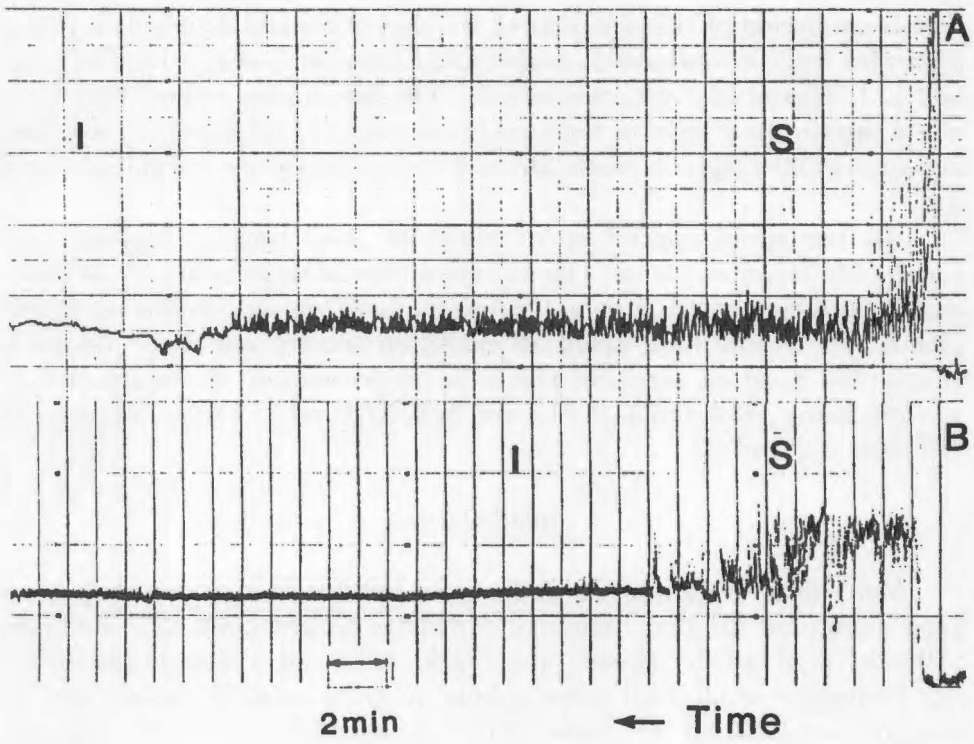

FIG. 5. Waveforms recorded when *L. sacchari* prpobed into resistant (A) and susceptible (B) sorghum seedling. S : salivation. I : ingestion.

RESULTS

Table 1. 2. 3, and, Fig. 3, 4, 5 show the data demonstrating the differential probing behaviour elicited by the aphids, *S. graminum R. maidis* and *L. sacchari* in response to the susceptible and resistant varieties of sorghum. All the aphid species showed a similar response to sorghum plants. The resistant sorghum was deterrent to all aphid species.

The results of the electronic monitoring of all aphid species show that the mean number of various kinds of probes made by *S. graminum, R. maidis* and *L. sacchari* on susceptible and resistant sorghum plants were 3.0 and 6.8, 2.1 and 6.1, 2.0 and 5.3, respectively (Tables 1, 2 and 3). The mean number of probes per hour of recording made by three aphid species was significantly higher in the resistant sorghum than in the susceptible sorghum.

The aphids on resistant sorghum plants behaved as on non-favoured host plants with a tendency to show state of restlessness. The duration of

salivation for the three aphids was also increased on resistant sorghum. The mean period of salivation noted on susceptible and resistant sorghum plants for the *S. graminum*, *R. maidis* and *L. sacchari* being; 8.6 and 14.3, 2.3 and 13.1, 3.2 and 15.1 min, respectively. The data analysis show that there was a significant difference between the duration of salivation on resistant and susceptible sorghum plants for the three aphid species (Tables 1.2 and 3).

All the aphid species spent much of their time in ingestion on susceptible sorghum plants. The ingestion time of three aphid species was significantly lower on resistant sorghum than on susceptible sorghum plants. The mean time spent in ingestion during one hour on both susceptible resistant sorghum plants by *S. graminum*, *R. maidis* and *L. sacchari* being ; 44.6 and 33.0, 51.5 and 32.9, 54.8 and 25.4 min, respectively (Tables 1,2 and 3).

DISCUSSION

Many lines of germplasm and certain hybrids of sorghum crop have been monitored for their potential resistance to greenbug, *S. graminum* (Weibel et al. 1972, Schuster and Starks 1973 and Teetes et al. 1975).

In present studies all three aphids, *S. graminum*, *R. maidis* and *L. sacchari* were found to show deterrent behaviour towards resistant sorghum plants.

For example, all aphids probed and salivated more on resistant sorghum than on susceptible sorghum. However, the ingestion period of all aphid species was significantly reduced on resistant plants as compared to susceptible plants (Tables 1, 2 and 3).

The differences in the number of probes, mean duration of salivation and mean duration of ingestion for the three aphid species on both resistant and susceptible sorghum plants are similar to the responses observed for other species of aphids feeding on resistant host plants (Haniotakis and Lange 1974, Nielson and Don 1974, Kennedy et al. 1978, Nault and Styler 1972 and McLean and Kinsey 1968).

Campbell et al. (1982) found that that the reduction of phloem ingestion by aphids feeding on resistant varieties of host plants is a result of the lack or low amounts of a phago stimulant or the presence of a feeding deterrent. Similarly, Fisk (1980) reported that lower production of honey dew, increased branching of salivary sheaths and reduced frequency of stylets terminating in phloem by *R. maidis* was moderately correlated with increased concentrations of phenolic acids in different varieties of sorghum. Moreover, the increased resistance of barley, wheat and rye to the aphid *Metopolophium dirhodum* Walker was associated with higher concentra-

tions of hydroxamic acids in plant extracts (Argandoña et al. 1981). It has also been observed that gramine and related indole alkaloids present in Gramineae, Leguminosae and other plant families are responsible for their toxicity to ruminants and aphids (Saxton 1965, Gallagher et al. 1964 and Corcuera 1984).

The above results suggest that some plant metabolites possibly the indole alkaloids present in sorghum plants are responsible for the resistance of sorghum plants to aphids.

ACKNOWLEDGMENTS

We wish to thank the Matsumae International Foundation Japan for providing financial support to M. K, Lohar for the above research. Both authors are indebted to Dr. S. Ono, Chugoku Agriculture Experiment Station for supplying the sorghum seed, Dr. H. Tsumuki for correction of the manuscript and Mr. T. Enomoto for his help in statistical analysis of the data.

SUMMARY

Three species of aphids,the greenbug *Schizaphis graminum* (Rondani), the corn aphid. *Rhopalosiphum maidis* (Fitch) and the sugar cane aphid, *Longiumguiso sacchari* (Zehntner) showed significantly different probing behaviour when fed on susceptible and resistant sorghum plants. Electronic monitoring of the aphids probing behaviour showed that all aphid species probing on resistant sorghum showed a significantly decreased rate of ingestion, increased rate of salivation and increased number of probes as compared to the aphids fed on susceptible sorghum plants. The results suggest that some plant chemical compounds possibly the indole alkaloids are responsible for the resistance of sorghum plants to aphids.

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