Adult *Sitona crinitus H. (Coleoptera: Curculionidae)* feeding preference on some legume species

Préférence alimentaire des adultes de *Sitona crinitus* H. (Coleoptera: Curculionidae) sur quelques espèces des légumineuses

EL DAMIR M.[1], EL BOUHSSINI M.[2], AL SALTI M. N.[3] & ABD EL MONEIM A. M.[2]

[1] Adam's Pest Control, Inc. 922 Highway 55, Medina, Minnesota, USA.
[2] International Center for Agricultural Research in the Dry Areas, Rabat, Morocco.
[3] Plant Protection Department, College of Agriculture, Aleppo University, Syria.

ABSTRACT

We determined the feeding preference under artificial infestation in plastic house conditions of *Sitona crinitus* Herbst on several legumes: *Vicia sativa, V. ervilia, V. faba, Lens culinaris* (small Syrian local " ILL: 4401"), *Medicago polymorpha, Trifolium angustifolium, Cicer arietinum,* and three *Lathyrus* species: *Lathyrus sativus, L. ochrus* and *L. cicera*. Beginning with the least-preferred leguminous food and feed crops, the order of feeding preference by *Sitona* was: *V. sativa, L. culinaris, V. ervilia, T. sativum, M. sativa, L. cicera, L. Sativus, L. ochrus.* No significant differences in preference were found between *V. sativa, L. culinaris, V. ervilia* and *T. sativum*. However, there were significant differences in feeding preference (P<0.05) between these species and *Lathyrus* spp. *Cicer arietinum* and *Vicia faba* were not hosts of *S. crinitus*. The genotypes of *L. ochrus* were less preferred than those of the other two *Lathyrus* species; the selection # 549 was the least preferred among *L. ochrus* genotypes. This nonprefernce may be related to the high level of the neurotoxin 3-(N-Oxalyl)-L-2, 3 diominopropionic acid (ß-ODAP) content of *L. ochrus*.

Key words: *ß-ODAP,* Lathyrus*, Legumes*, *preference,* Sitona crinitus*.*

RESUME

Nous avons déterminé la préférence alimentaire sous infestation artificielle dans des conditions de serre de *Sitona crinitus* Herbst sur plusieurs légumineuses: *Vicia sativa, V. ervilia, V. faba, Lens culinaris* (petit local syrien "ILL: 4401"), *Medicago polymorpha, Trifolium angustifolium, Cicer arietinum* et trois espèces de *Lathyrus*: *Lathyrus sativus, L. ochrus* et *L. cicera.* En commençant par les légumineuses alimentaires et cultures fourragères les moins préférées, l'ordre de préférence alimentaire par S*itona* a été: C. *sativa, L. culinaris, V. ervilia, T. sativum, M. sativa, L. cicera, L. Sativus, L. ochrus.* Aucune différence significative de préférence n'a été trouvé entre *C. sativa, L. culinaris, V. ervilia* et *T. sativum*. Cependant, il y avait des différences significatives dans la préférence alimentaire (P < 0,05) entre ces espèces et *Lathyrus* spp. *Cicer arietinum* et *Vicia faba* ne semblent pas être des plantes hôtes de *S. crinitus*. Les génotypes de *L. ochrus* ont été moins préférés que ceux des deux autres espèces de *Lathyrus*; la sélection # 549 a été la moins préférée parmi les génotypes de *L. ochrus* Cette nonprefernce peut être liée au niveau élevé de la neurotoxine 3-(N-Oxalyl)-L-2, de l'acide 3 diominopropionic (ß-ODAP) de *L. ochrus*.

Mots clés: ß-ODAP, *Lathyrus*, préférence, légumineuses, *Sitona crinitus*

INTRODUCTION

The lentil leaf weevil, *Sitona crinitus* Herbst, is the main insect pest of lentil in West Asia and North Africa (Hariri, 1981; Solh & al., 1986). Among *Sitona* species infesting lentils in northern Syria, *S. crinitus* is the most abundant (Tahhan and Hariri, 1982a). It comprises > 95% of the *Sitona* species on lentil, and is found throughout Syria (ICARDA, 1993). Adult feeding on the edges of the leaflets causes severe damage to seedlings. The most severe damage, however, is caused by the larvae feeding in the nodules, which affects the ability of the plant to fix atmospheric nitrogen (Hariri, 1981). Infestation of leaflets may be >90% and the larvae may destroy most of the nodules (Cardona, 1983; Tahhan and Hariri, 1982b). At high infestation level (93.5% nodule damage), the insect caused 17.7 and 14.1% losses in straw and grain yields, respectively (ICARDA, 1983).

Research on host-plant resistance against *S. crinitus* produced only limited results (Tahhan & Hariri 1983; El Bouhssini & al., 2008). The objectives of this study were to determine the feeding preference of *S. crinitus* among ten legume species under artificial infestation in greenhouse conditions. We also evaluated the least preferred legume accessions for resistance to *Sitona* spp. under plastic house and field conditions.

MATERIALS AND METHODS

Feeding preference assessment

Ten food and feed legume species (Table 1) were sown (three seeds of each one) in pots (15 by 16 cm) containing a mixture of 1 sand: 2 soil: 4 peat moss in a randomized complete block design with 10 replicate pots. Pots kept in a plastic house at 20±2 °C and 16: 8h (Light:Dark) photoperiod and a relative humidity of 65±5%. *S. crinitus* adults were collected from the field and starved for 48 h prior to their use. The seedlings were thinned to one seedling of each of the ten legume species per pot and infested with 12 weevils, then covered by well-aerated plastic cages (15 cm dia × 30 cm height). Cages had a fine mesh covering on the upper surface and four screened ventilation holes on the sides. They were pushed 2 cm into the soil to prevent weevils from escaping. After 3 days, the cages were removed and the number of notches in the leaves counted.

Screening under plastic house conditions

Genotypes that showed the least amount of leaflet damage (Table 2) were chosen to evaluate feeding preference of *S. crinitus* adults under artificial infestation in the plastic house. This experiment was conducted similarly to the preference test, except that seedlings were visually assessed for percentage of notched leaves.

Screening under field conditions

The experiment was done in 1999 and 2000 seasons under natural infestation in the field at Tel Hadya, the experimental station of the International Center for Agricultural Research in the Dry Areas (ICARDA). Seeds of each genotype (Table 2) were sown into 2-m rows, 0.45-m spacing, and 24 seeds/row using a randomized complete block design with four replicates. A visual damage score (1-9) was used to assess the percentage of leaves damaged in mid-February. This score was:1, no damage; 2, 1-10% leaflets damaged; 3, 11-20%; 4, 21-30%; 5, 31-40%; 6, 41-50%; 7, 51-70%; 8, 71-90%; 9, more than 90% leaflets damaged. Nodule damage was assessed from samples taken at flowering-time (mid-April). Five plants were randomly selected from each plot, uprooted with soil to recover most of the root system, which was then washed in the laboratory. Then number of total and damaged nodules in each plant was counted.

Non-host plant confirmation

In this experiment, seeds of each legume species that showed no feeding damage were sown individually in a plastic house in pots containing the soil mixture previously described. Later one young leaf from each species was placed on moist filter paper in a plastic container (5 cm dia × 2.5 cm height) with a fine canvas mesh covering the holes in the lid. Five weevils of *S. crinitus* were placed in each container and kept in a rearing room at 22±2°C, 60±5%RH, and 16: 8h (Light:Dark) photoperiod. There were five replicates for each weevil per plant species. Leaf damage was assessed after 24, 48, 72, and 96 h.

Neurotoxin ß- ODAP determination

The neurotoxin ß- ODAP was determined spectrophotometrically using the Φ-phthaldehyde fluorescent dye as modified by Briggs & al. (1983).

Data analysis

The data were analyzed using GenStat Ed. 14 (Payne & al. 2011). The variability in percentage of the number of notches, percentage of notched leaves, leaflet damage score and percentage of nodule damage were analyzed with ANOVA and with the Duncan's Multiple Range Test (5%).

RESULTS

In feeding preference experiments (Table 1), *Vicia sativa* L. was significantly (*P<0.05*) more damaged than *Medicago polymorpha* L., *Lathyrus sativus* L., *L. ochrus* (L.) DC. and *L. cicera* L. The *Lens culinaris* L. (ILL: 4401) was the next most severely damaged species, followed by *Vicia ervilia* and *Trifolium angustifolium*. *L. ochrus* was the least damaged species, and *S. crinitus* adults didn't feed on chickpea and faba bean leaves.

Table 1. Mean number of notches of legume seedling leaves damaged by *S. crinitus* adults under artificial infestation in plastic house conditions, Tel Hadya (ICARDA).

Legume species	Number of notches
Vicia sativa selection # 2541-2560	45.7a
Lens culinris (small Syrian local " ILL: 4401	40a
V. ervilia selection # 2542-2563	37.9 ab
Trifolium angustifolium	26.7 abc
Medicago polymorpha	24 bc
L. cicera selection # 495	16.5cd
L. Sativus selection # 533	14.9 cd
L. ochrus selection # 762	1.1d
Vicia fabae (ILB 1811)	0 d
Cicer arietinum (FLIP82-150)	0 d
LSD (5 %)	14.6

Means followed by same letter are not significantly different (Duncan's Multiple Range Test, P<0.05).

The mean percentage of leaflets damaged under artificial infestation in a plastic house, and leaflet damage scores, and percentage of nodule damage under natural infestation in the field are presented in Table 2. *L. ochrus* genotypes were significantly ($P<0.05$) less infested with *S. crinitus* than the *L. cicera* genoptyes under artificial infestation in a plastic house and natural infestation in the field conditions.

L. ochrus genotype, selection #549, had a lower leaflet damage than *L. cicera* and the other *L. ochrus* genotypes in the plastic house and field conditions. But, there were no significant differences between this genotype and the other two *Lathyrus* spp. genotypes in terms of nodule damage (Table 2).

Table 2. Assessment of *S. crinitus* feeding on *Lathyrus ochrus* and *L. cicera* accessions under artificial and natural infestations, Tel Hadya (ICARDA).

Lathyrus sp.	Selection #	Plastic house	Field		β- ODAP(%)
		Notched leaflets (%)	Visual Damage Score	Nodule Damage (%)	
L .ochrus	537	18.5ab	3b	13.3ab	5.6a
L .ochrus	540	20.9ab	2.31a	15.13ab	5.5a
L .ochrus	547	18.8ab	2.33a	12.88a	5.6a
L .ochrus	549	13.98a	1.87a	12.13a	5.7a
L .ochrus	550	23.59b	2.24a	19.75d	5.7a
L .ochrus	762	16.50ab	2.12a	15.63bc	6.0a
L. cicera	88	66.33d	2.80b	16.12bc	1.4b
L. cicera	487	50.4c	3b	18.00bcd	1.2b
L. cicera	488	54.05c	3b	24.00e	1.12b
L. cicera	489	70.24d	2.82b	18.75c	1.48b
LSD (5%)		7.89	0.84	3.39	1.33b

Means followed by same letter are not significantly different (Duncan’s Multiple Range Test, $P<0.05$).

DISCUSSION

Our study showed that *L. ochrus* was the least preferred to *S. crinitus* feeding. This result points out that this nonprefernce could be related to the neurotoxin (ß-ODAP) content of *L. ochrus*. The percentage of this neurotoxin was higher in *L. ochrus* than in *L. cicera* (Table 2). The same results were also obtained by Alitor & al., (1994); the least percentage of ß -ODAP was found in *L. cicera* with 1.28 g/kg seed, whereas it was about 4-5 times higher in *L. ochrus* and *L. sativus.* Nonpreference of Crown vetch *Coronilla varia* L. and *Lotus* species to *S. hispidulus*, particularly *L. pedunculatus*, from a range of legume seedlings in the cotyledon stage was related to levels of phytoallexins and other antifeedant compounds present in these legume seedlings with intraspecific, cultivar differences being detectable in some instances (Barratt & Byers, 1992). Crown vetch (*C. varia*) is known to contain 3-nitropropionic acid, which may provide protection to plants from many phytophagous insects (Byers & *al*., 1996). *S. lineatus* avoids feeding on several species of lupine with high alkaloid content (Cantot & Papineau, 1983). Our study also indicated that chickpea and fababean were non-host plants of *S. crinitus*. These results contradict what was reported by Hariri 1981 who showed that chickpea is a host of *S. crinitus* in Europe, North Africa and South West Asia. A study by Melamed 1966 indicated some feeding by *S. crinitus* on faba bean leaves; however, this was much less than on other host legume species.

CONCLUSION

S. crinitus showed a distinct feeding preference when subjected to a range of legume seedlings. *V. sativa* was the most preferred species, followed by lentil (small Syrian local " ILL: 4401"). *L. ochrus* genotypes were the least preferred by *S. crinitus.* This nonprefernce seems to be related to the high level of the neurotoxin (ß-ODAP) content of *L. ochrus*. Both chickpea and faba bean seem to be non- host plants of *S. crinitus*.

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