

The Phenology of Sitona (Coleoptera, Curculionidae) in Israel  
by

Venezia Melamed-Madjar

A b s t r a c t

A survey, covering the years 1956-1963, is given on the regional distribution and phenology of 4 of the 12 species of Sitona found to occur on winter legumes in Israel. Host preference differs from species to species, as well as abundance in the course of several years; maxima of occurrence are also different in different species.

I n t r o d u c t i o n

This paper presents the results of a six-year study on Sitona species in Israel. The purpose of the study was to survey and identify the Sitona species common here, their respective hosts, and geographic distribution, to point out the most numerous and possibly injurious species, and to obtain more information on the phenology and fluctuation of their populations.

A list of the Sitona species occurring in Israel is included in the "Prodromus Faunae Palaestinae" by Bodenheimer (4). That list includes two species which were not found by us, namely S. svriacus Strl. and S. villosus All. On the other hand, it does not include species found in this survey, including a very common species such as S. lividipes Fahrs.

The species found in our survey

are:

S. lineatus L.

S. lividipes Fahrs.

S. hispidulus F.

S. crinitus Hbst.

S. limosus Rossi.

S. concavirostris Hch.

S. cylindricollis Fahrs.

S. gressorius F.

S. ocellatus Kust.

S. stierlini Rett.

S. lividipes v. hipponensis Desbrs. S.

intermedius Kust,

The first five species were most prevalent, occurring throughout the season and some even assuming the role of a pest. Four of these will be discussed at greater length, while the fifth - S. limosus - being limited to an area from which we had too few records, will not be dealt with.

Two species, S. concavirostris and S. cylindricollis, were less prevalent than the previously mentioned ones.

A list of species which occur only casually, with their respective hosts and localities, is given below:

<u>S. gressorius</u> F.	Beit-Dagan, Clover XII 57(2), XII 59(1), I 62(1) Bnei Reem, Clover I 63(1);
<u>S. ocellatus</u> Kust.	Beit-Dagan, Clover XII 56(1) Beer Tuvia, Clover, XII 62(1), III 62(1);
<u>S. stierlini</u> Rett.	Gilat, Alfalfa, IV 62(1) Beit-Dagan, Alfalfa, XII 58(2);
<u>S. lividipes</u> v. <u>hipponensis</u> Desbrs.	Beit Dagan, Alfalfa, III 59(1)
<u>S. intermedius</u> Kust.	Acre, Alfalfa, V 57(1).

#### Survey Methods

Biweekly visits were made to several different localities in Israel. Fields of various legumes were surveyed by making sweeps with an insect net over the crop. The beetles from 100 such sweeps were collected, identified, counted, and recorded.

The survey was made in the following localities on the respective crops

Malha	Upper Galilee	Clover, alfalfa, vetch
Tantura	Coast-Carmel region	Clover, alfalfa, vetch
Beit-Dagan	Coastal plain(south)	Clover, alfalfa, vetch
Bnei Reem	Coastal plain (south)	Clover, alfalfa, vetch, broad bean
Beer Tuvia	Coastal plain (south)	Clover, alfalfa, vetch, broad bean
Gilat	Negev (northern)	Clover, alfalfa, vetch, broad bean

#### Results

##### Distribution and host selection

The Sitona species are not evenly distributed throughout the country. It seems that the amount of precipitation at the various localities is a dominant factor in this respect.

Fig. 1 presents the amount of precipitation at Lod (in the coastal plain) and Gilat (in the northern Negev).

As can be seen from Table 1, Gilat, which has little rain (200-300 mm annually) was only slightly populated by four of the species; S. lineatus and S. cylindricollis were never collected there. S. lineatus was more numerous in the coastal plain region, but less so along the Carmel coast or in Upper Galilee, whereas S. cylindricollis was most numerous in Upper Galilee. S. lividipes was most numerous in the coastal plain while S. hispidulus was most numerous in the Carmel coast. S. crinitus seems to be the most adaptable species, being distributed over all the localities (except Gilat) in fair numbers.

The distribution of the six species in the various crops is presented in Table 2. 90% of the individuals of S. lineatus were collected on vetch and broad beans. Clover was the main host of S. lividipes and S. hispidulus. S. crinitus was less specific to one host, but was most abundant on clover and vetch, S. cylindricollis and S. concavirostris, which are less common in Israel, seem to favour alfalfa and vetch.

#### Sitona lineatus L.

This species is typical to the Palearctic region. The most northern countries where it has been found include Latvia (2) and Scandinavia (9). In recent years it was recorded from the Neartic region, e. g. Vancouver (5), and also from the San Juan Archipelago (22). Severe damage is recorded from Russia (18), Germany (1), Austria (15) and England (7). According to the literature, its main hosts are peas, beans and vetches. When these are not available the beetles may be found on clover and alfalfa (7). In Israel most of the individuals were collected on vetch and broad beans (Table 2).

The emergence of S. lineatus from its summer quarters is somewhat retarded in comparison with that of S. crinitus or S. hispidulus (Fig. 2). S. lineatus may appear in small numbers in December, as happened in 1957-58, or it may be delayed to January, as in 1961-62. The peak of the population appears in late January and February and there is no marked distinction between the two generations.

An outstanding feature in the phenology of this species in Israel is the fact that its population, which was quite large in 1956-57, gradually decreased in the following years 1957-1963 (Fig. 2).

Sitona lividipes Fahr.

S. lividipes is a Mediterranean species occurring in Sicily, Sardinia, Corsica, North Africa and Syria (22). In Israel this species is abundant on clover (Table 2).

Fig. 3. represents the fluctuation of the population during 1957-1963. There are two distinct peaks in the population, with a distinct low between them. The two peaks do not differ much from each other every year, except during 1957-58 and 1958-59, when the earlier generation was more numerous than the new one. As a rule, the beetles emerge in the autumn earlier than those of S. lineatus, the earliest appearing in November. Unlike S. lineatus, the population of S. lividipes was low during the first two years of this survey, and increased in the following years, except in 1961-62, when its population was low again.

Sitona hispidulus F.

This Palearctic species has been recorded from the Caucasus (22), Syria (22) and England (8). At the end of the last century it spread to America (21), and nowadays it is found on the entire northern continent, including Canada (6). Damage has been reported from Oregon (17), California (20), Illinois (3), Kansas (13) and Virginia (19). In America and England the species is found mainly on clover and alfalfa (3, 8). The present survey shows that its main host in Israel is clover; it was found occasionally on alfalfa, vetch, and broad beans. In Fig. 4 the density of the population during the six years of the survey is given for the coastal plain and for the Carmel coast. This species, like S. lividipes, also appeared early in November, except when the autumn rains were delayed, as happened in 1962-1963. Throughout the season of its occurrence the population was more or less equal, with no fluctuations, except at the end, in April and May, when the new generation matured and the number of the individuals in the field increased suddenly. This species is far more abundant on the Carmel coast than in the coastal plain. The difference in the population density during the first two years of the survey and the other four years is quite marked in this species.

Sitona crinitus Hbst.

The species is also Palearctic. It has been recorded from Russia (18), the Caucasus (27), Turkestan (27), Austria (15), Poland (10), Latvia (14) and England (8). According to reports in the literature, it was found on various leguminous crops, and in particular on vetch and peas. In Israel ,

the most preferred hosts were vetch and clover; broad beans and alfalfa were attacked to a lesser extent (Table 2). Fluctuation of the population (Fig. 5) is very much like that of Sitona hispidulus except that the old generation after aestivation was at times more conspicuous than that of S. hispidulus (Carmel coast 61-62);

Like the two species S. hispidulus and S. lividipes, the population of S. crinitus was lower during the first two years of the survey, and was more numerous during the spring seasons of the following four years. As with S. hispidulus, the spring generation of S. crinitus each year was more numerous than the population after aestivation.

### D i s c u s s i o n

All studies on the biology of Sitona species indicate that in the northern countries of their distribution the species hibernate, wake in spring, and are active throughout summer. In Israel, the winter climate is more suitable for activity; the summer is spent in diapause.

The time of awakening depends upon the species and its particular hosts. Thus, in Finland (12) and in Israel (16), S. lineatus awakens later than other species. According to Markkula and Roivainen (12) this is due to the fact that pea, its main host, begins to grow later than other leguminous plants. In other words, this seems to be a fixed synchronization between host and dependent. Climate also affects the date of emergence of the adults from their diapause quarters. An early rain may hasten their emergence at the beginning of the season.

In the figure which illustrates the fluctuations of the populations of the four most common species in Israel, two distinct peaks are observed only in that of S. lividipes. The first peak represents the generation which has aestivated, and the second peak that of the new generation. In the figures for S. hispidulus and S. crinitus the second peak is distinct, while that for the aestivated population is less so. Markkula and Koppa (11) also found a similar phenomenon with the species in Finland. They explain this by assuming that the new generation is more active and, therefore, more readily caught in the net than the members of the older generation.

It is evident from the figures presenting the fluctuations of the populations that all species discussed produce only one generation during the year, which emerges in April-May and enters diapause around June.

### S u m m a r y

During the years 1956-1963, an insect survey on winter legumes was conducted in Israel. Among the insects found, twelve species of Sitona were identified, of which the four most abundant were: S. lividipes Fahrs., S. hispidulus F., S. crinitus Hbst. and S. lineatus L. S. concavirostris Hch. and S. cylindricollis Fahrs. were found to a lesser extent. The distribution of these species varies from region to region in Israel.

The survey showed that the main hosts of S. lineatus were vetch and broad bean, that of S. lividipes and S. hispidulus was clover, those of S. crinitus were vetch and clover, and that of S. concavirostris and S. cylindricollis were alfalfa and vetch.

In Israel, beetles of the species Sitona are active in the winter and spend the warm months in diapause. The first to appear, early in the winter, were S. lividipes and S. hispidulus caught between the end of November and the beginning of December. S. lineatus appeared a month later and the peak of its population was at the beginning of February.

In the diagrams showing the fluctuations of the population of the four most abundant species, it is seen that S. lividipes had two definite peaks, the first with the appearance of the beetles at the beginning of the season and the second with the emergence of the new generation in April-May. The populations of the young beetles of S. hispidulus and S. crinitus in the spring were larger than those of the beetles which passed a summer diapause and appeared at the beginning of winter.

In the first year of the survey, S. lineatus was caught in very large numbers, but during the following years its population decreased greatly. The opposite was the case with S. hispidulus and S. crinitus, whose populations were low in the first two years and increased during the following years.

Table 1Distribution of species in the various zones

Species	Number of beetles caught in 100 observation at:					
	Upper Galilee	Carmel Coast	Beit Dagan	Beer Tuvia	Bnei Reem	Gilat
<i>S. lineatus</i>	1	8	247	128	569	0
<i>S. lividipes</i>	73	168	532	496	465	17
<i>S. hispidulus</i>	83	618	60	156	224	2
<i>S. crinitus</i>	229	584	353	467	565	34
<i>S. concavirostris</i>	146	78	23	29	19	0.7
<i>S. cylindricollis</i>	73	43	8	2	1	0

Table 2Abundance of beetles in the various crops

Species	Number of beetles caught in 100 observations on:			
	Clover	Alfalfa	Vetch	Broad Bean
<i>S. lineatus</i>	20	15	675	2060
<i>S. lividipes</i>	739	92	15	0
<i>S. hispidulus</i>	470	22	12	45
<i>S. crinitus</i>	627	157	681	213
<i>S. concavirostris</i>	26	57	76	0
<i>S. cylindricollis</i>	15	27	21	0

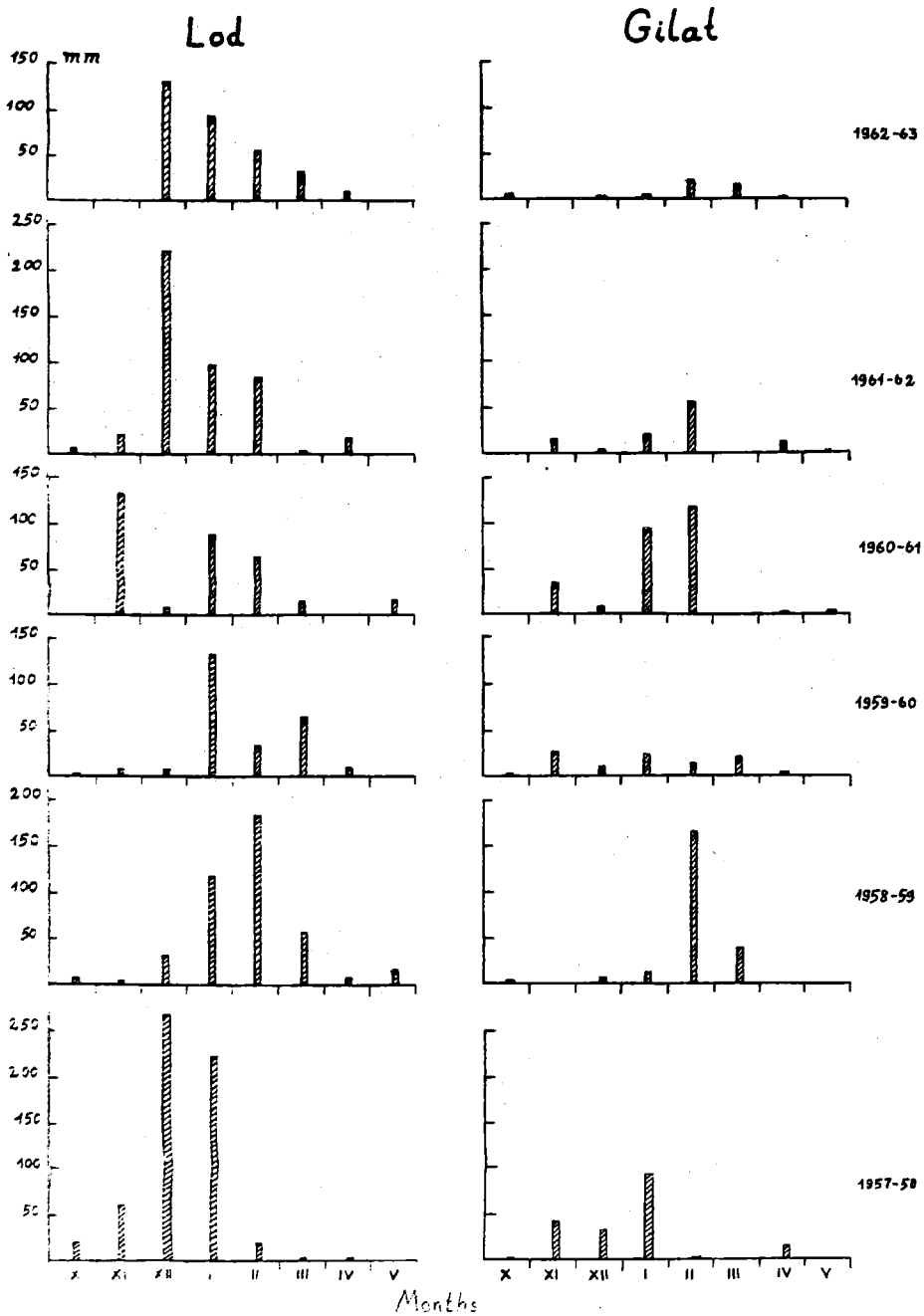


Fig. 1 . Precipitation in mm at Lod and Gilat 1957-1963



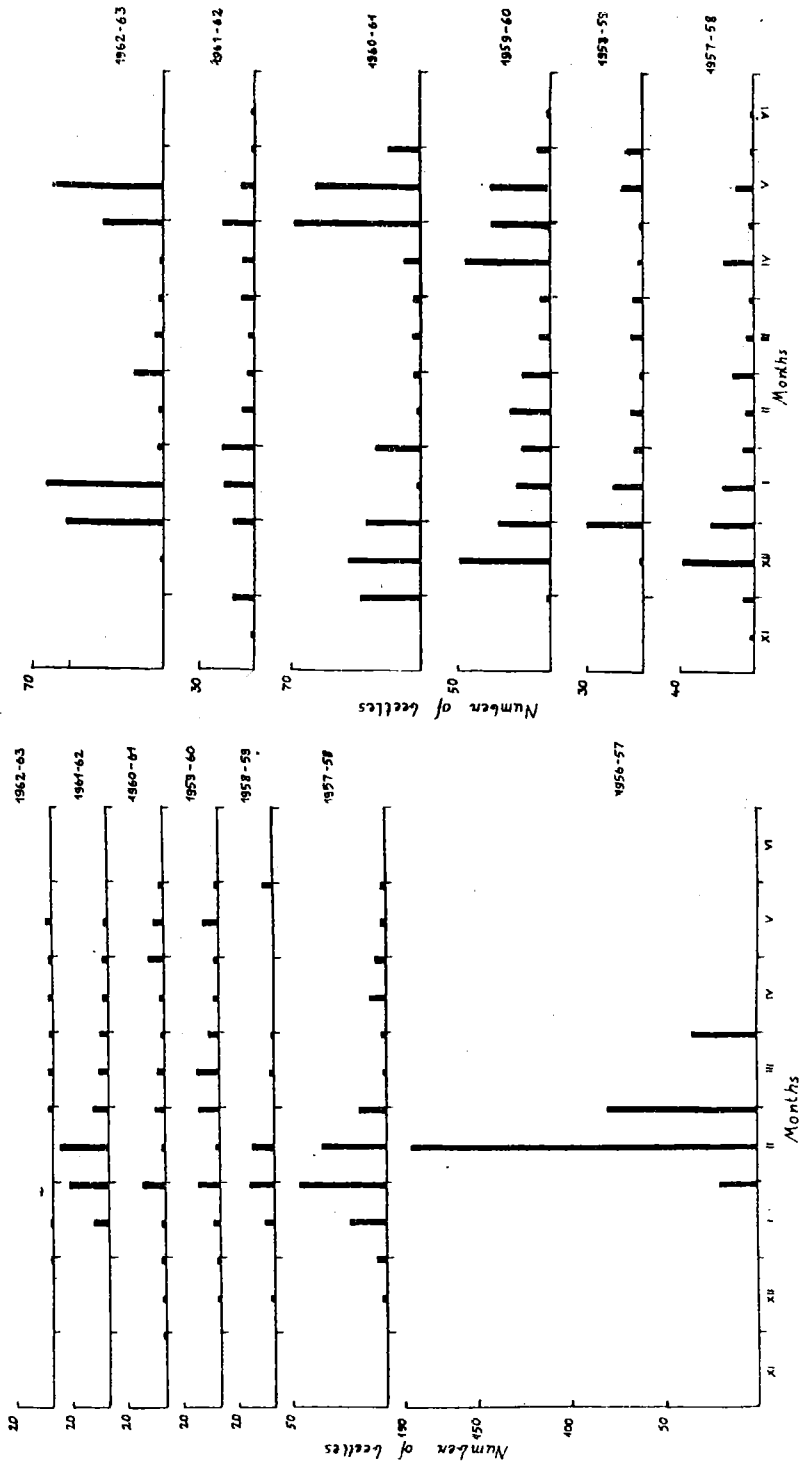


Fig. 2. Fluctuations of the population of *Sitona lineatus* 1956-1963

Fig. 3. Fluctuations of the population of *Sitona lividipes* 1957-1963

Fig. 4. Fluctuations of the population of *Stroma hispidulus* 1957-1963

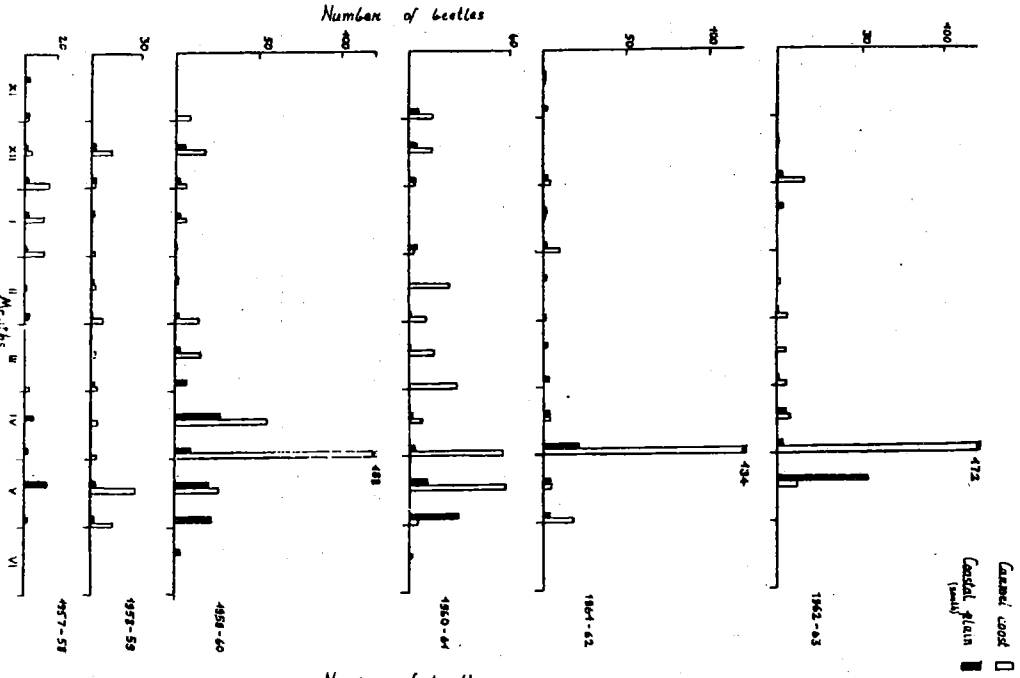
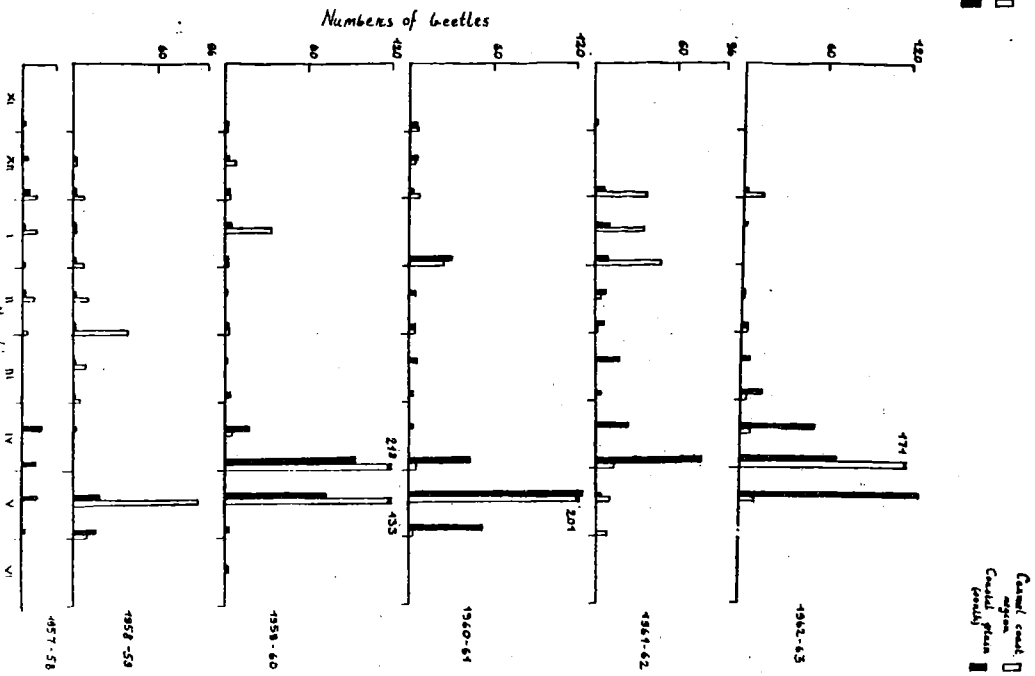


Fig. 5. Fluctuations of the population of *Stroma crinitus* 1957-1963



## REFERENCES

1. Anderson, K. T., (1931). Der linierte Graueruessler oder Blattrandkäfer Sitona lineata L. Monogr. Pflanzenschutz. No. 6, Berlin.
2. Anonymous, (1924). Report of the Institute of Plant Protection for 1923-24. Latvian Central Agric. Soc., Riga.
3. Bigger, J. H., (1930). Notes on the life history of the clover root Curculio, Sitona hispidula Fab., in central Illinois. J. econ. Ent. 23 (2):334-342.
4. Bodenheimer, F.S. (1937). Prodrömus Faunae Palestinae . Mem. Institute d'Egypte, Cairo.
5. Downes, W., (1938). The occurrence of Sitona lineatus L. in British Columbia. Canad. Ent: 70 (1) :22.
6. Hudson, H. F., (1926). Egg studies of clover leaf Curculio, Sitona hispidulus Fab. 56th Ann. Rep. Ent. Soc., Ontario, Toronto.
7. Jackson, S. J. (1920). Bionomics of weevils of the genus Sitones injurious to leguminous crops in Britian. Ann. appl. Biol. 7(2-3): 269-298.
8. ——— (1922). Bionomics of weevils of the genus Sitona injurious to leguminous crops in Britain. II Sitona hispidula, F.S. sulcifrons, Thun, and S. crinita, Herbst. Ann appl. Biol. 9(2):93-115.
9. Kemner, N. A. (1917). Artviveln (Sitona lineatus L.) - Central-anstalten fuer Jordbruksforsod, Flygblad No. 63; Entomologiska Avdelningen, No. 16, Stockholm.
10. Kracucki, A. (1926). Weevils (Sitonini) in S. E. Poland. Shrorby i Szkoduiki Roslin 1 (1):11-18.
11. Markkula, M. and Koppa, P. (1960). The composition of the Sitona (Col., Curculionidae) population on grassland legumes and some other leguminous plants. Ann. Ent. Fenn. 26:246-263.
12. Markkula, M. and Roivainen, S. (1961). The effect of temperature, food-plant and starvation on the oviposition of some Sitona (Col., Curculionidae) species. Ann. Ent. Fenn. 27: 30-45.
13. Marshall, G. E. and Wilbur, D. A. (1934). The clover root curculio (Sitona hispidula Fab.) in Kansas. J. econ. Ent. 27:807-814.

14. Ozols, E. (1933). Pea Pests. Lauksaimn. Menesr. J. Agric. 3:130-137.
15. Ripper, W. (1937). Schaden und Bekaempfung der Blattrandkaefer (Vorlaeufige Mitteilung). Neuheiten Pflsch. 30 (2):55-58.
16. Rivnay, E. and Melamed, V. (1959). A survey of the Sitona spp. on the leguminous fodder crops in Israel. Prelim. Rept. Agric. Res. Sta., Rehovot, Israel. No. 265 (Hebrew).
17. Rockwood, L. P. (1926). Alfalfa and clover insects in the North Pacific Region. Columbia Port Digest 4 (4):8-9.
18. Ulashkevich, M. J. (1935). Nodule weevils of the species Sitona lineata L. and Sitona crinita Hbst. Vinnitz'ika obl. s. - g. dosl. sta. No. 23. Kiev.
19. Underhill, G. W., Turner, E. C. and Henderson, R. G. (1955). Control of the clover root Curculio on alfalfa with notes on life history and habits J. econ. Ent. 48(2): 184-187.
20. Van Dyke, E. C. (1917). A newly introduced clover beetle, Sitones hispidulus, Germ. - Mthy. Bull. Calif. St. Comm. VI (6): 248-249, Sacramento.
21. Webster, F. M. (1915). Alfalfa attacked by the clover root Curculio. Fmrs. Bull. U.S. Dept. Agric. No. 649.
22. Winkler, A. (1924-1932). Catalogus Coleopterorum Regionis Palaearcticae, pp. 1484-1488, Wien.