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Biology of *Hypera brunneipennis* (Boheman) (Coleoptera: Curculionidae) in the Central Province of Saudi Arabia

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Abstract. Six rearing sets of the Egyptian alfalfa weevil, *Hypera brunneipennis* (Boheman), were reared under normal climatic conditions, at the College of Agriculture, King Saud University, Riyadh, starting mid November, 1986. The incubation period and the durations of the larval and pupal stages ranged from 5-21, 10.5-33 and 5.7-27.8 days, respectively. Newly emerged adults fed extensively and went into aestivation by mid May. However, larvae which reached the adult stage before February gave a second generation; the spring generation, whereas the remaining adults went through aestivation and resumed activity late in Autumn. They started depositing eggs early in December. The preoviposition, oviposition, and postoviposition periods were recorded. The mean number of eggs laid per female in the spring and winter generations were 703 and 438 respectively.

Introduction

The Egyptian alfalfa weevil (EAW), *Hypera brunneipennis* (Boheman), is considered the most destructive and widely spread pest of alfalfa in Saudi Arabia [1,2]. Adults were observed in alfalfa fields in mid September, and larvae reached their peak numbers at about mid February but were absent from samples taken during mid May [3].

The biology of EAW was studied in Egypt under controlled conditions by Hammad *et al.* [4] who stated that this pest had only one generation per year.

Biological studies on a closely related species; the alfalfa weevil (AW), *Hypera postica* (Gyllenhal) [5-8] showed contradictory results concerning the number of annual generations. Greenhouse and laboratory studies carried out by Huggans and Blickenstaff [9], White *et al.* [10], and DeWitt and Armbrust [11] showed that photo-

period has a profound effect on the sexual development and aestivation of AW. Adults ensuing from larvae exposed to short-day photoperiods, 8:16 (L:D), did not aestivate, whereas those ensuing from larvae exposed to long-day photoperiods, 16:8 (L:D), did aestivate [11].

The purpose of this study was to study the biology of *H. brunneipennis* under uncontrolled field conditions in Riyadh, Central region of Saudi Arabia.

Materials and Methods

The present study was conducted at the College of Agriculture, King Saud University (KSU), Riyadh from November 1986 to May 1988, under uncontrolled climatic conditions prevailing in the field.

Adults of *H. brunneipennis* were collected, early in November 1986, from alfalfa fields at the Agricultural Experimental Research Station, KSU, at Deirab. These served as laboratory stock. They were sexually determined according to Pienkowski *et al.* [12], and separated into pairs, each in a Petri dish, 10 cm in diameter, with its bottom covered with filter paper. Alfalfa leaves were offered as food, and pieces of alfalfa stems as oviposition sites. Insects were then kept in a rearing cage, under natural climatic conditions.

Six rearing sets were made at monthly intervals starting November 1986. For each rearing set, about 400 newly laid eggs were collected from laboratory stocks, placed on filter paper in a Petri dish and then placed in the same rearing cage of adults. The percent of hatch and the duration of the incubation periods were recorded.

From each rearing set, 80 - 140 newly hatched larvae were isolated, each in a glass tube, 10×3 cm, covered with muslin. The rearing tubes were kept in a separate rearing cage, under the same conditions. Larvae were inspected, and food was changed daily. The durations of each larval instar, and the pupal stage were recorded.

Pairs of newly emerged adults of each rearing set were isolated, each in a Petri dish (10 cm), provided with alfalfa leaves and stems and kept in a rearing cage under the same conditions. The rearing wooden cage was 55 × 55 × 60 cm., with the upper end and two sides provided with clear glass, and the other two sides with muslin. Adults of the first rearing set and some of the second rearing set gave a second generation at about mid-April 1987. These adults were designated as parents of the spring generation. Each pair was kept on filter paper in a Petri dish and the preoviposition, oviposition, and postoviposition periods were determined.

The remaining adults went through aestivation and were transferred to the laboratory by mid May 1987 to avoid the effect of high temperature. They were then returned back to the field conditions on mid September. These adults were designated as parents of the winter generation. The duration of the preoviposition, oviposition, and postoviposition periods were also determined.

Dialy thermohygrographic records of temperature and relative humidity were maintained.

Data were analyzed using the Duncan analysis, at P=0.05 level with a program from the Statistical Analysis System (SAS) [13].

Results and Discussion

Temperature and humidity are moderate during winter in this area. The maximum and minimum temperatures recorded, during the persent study, were 44°C, and 12°C, during mid April and late November, respectively.

Since the temperature was moderate during winter, female adults in this area did not cease egg production unlike those in cooler areas where female adults cease egg laying in this season [14]. As a result of the continuous production of eggs, larvae of this pest attain a very high population level early in February [3] and thus cause severe damage to the alfalfa crop.

The incubation period of eggs was negatively correlated with temperature (r=0.85). The longest incubation period was 21.0 days, for the mid-December rearing set, at a mean outdoor temperature of 13°C. The shortest incubation period was 5 days, for the mid-April rearing set, at a mean outdoor temperature of 41°C (Table 1). The percent of hatch ranged betweem 44-66% with no significant difference between rearing sets, and no correlation with the mean temperature. Larval development was also negatively correlated with the mean temperature (r=0.87). The longest period was 33 days, for the mid-November rearing set, at a mean temperature of 16°C. It decreased significantly as the season advanced (Table 1) being only 10.5 days, in the mid-April rearing set, at a mean outside temperature of 30.6°C.

Larvae passed through four instars in all rearing sets (Table 2). The duration of each instar tended to be shorter with the steady increase of both temperature and day length. Larval mortality ranged from 16% to 56%. The highest mortality rate occured at extreme temperatures, mid December and mid-April rearing sets, and among larvae of the first instar.

Similar to the egg and larval stages, pupal development was also negatively correlated with temperature (r=0.82). It gradually decreased as the temperature

Table 1. Mean duration (in days) of the different developmental stages of *H. brunneipennis* throughout the year 1986-1987

Date rearing set started	Means ± S.E Egg	Larval	Pupal	Life cycle (egg-adult)
15 Nov. 1986	11.3 ± 0.34 C	33.0 ± 0.94 A n=124	27.8 ± 0.66 A n=23	72.3 ± 0.96 A n=20
15 Dec. 1986	21.0 ± 0.04 A	27.2 ± 0.22 B n= 80	15.7 ± 0.17 B n=23	64.0 ± 0.23 B n=23
15 Jan. 1987	16.4 ± 0.06 B	18.3 ± 0.15 C n= 85	12.1 ± 0.14 C n=58	46.9 ± 0.20 C n=56
15 Feb. 1987	10.7 ± 0.07 D	15.8 ± 0.21 D n= 94	9.5 ± 0.31 D n=56	36.0 ± 0.41 D n=41
15 Mar. 1987	10.8 ± 0.12 D	15.6 ± 0.12 D n= 80	5.7 ± 0.12 E n=39	32.3 ± 0.21 E n=29
15 Apr. 1987	5.0 ± 0.08 E	10.5 ± 0.24 E n= 86	-- n=16	--

Means with the same letter are not significantly different at P=0.05, Duncan's multiple range test.
n=number used.

Table 2. Larval instar durations (in days) for *H. brunneipennis* and day length in hours

Date rearing set started	Length of larval instars (days) 1st	2nd	3rd	4rth	Total	Day length mean (h)
15 Nov. 1986	7.5	7.4	9.0	9.2	33.0 A	10:41
15 Dec. 1986	7.3	8.3	6.7	5.0	27.3 B	10:53
15 Jan. 1987	4.8	4.7	5.4	3.4	18.3 C	11:20
15 Feb. 1987	3.6	4.0	3.7	4.3	15.8 D	11:50
15 Mar. 1987	4.5	4.5	3.7	3.0	15.6 E	12:34
15 Apr. 1987	3.0	2.8	2.0	2.8	10.5 E	13:00

Means with the same letter are not significantly different at P=0.05, Duncan's multiple range test.
n=number used.

increased (Table 1). The pupal mortality rate was less than 15% in the first three rearing sets. It increased gradually afterwards reaching a maximum, (100 %) for the mid-April rearing set. This high percentage of mortality may probably be due to the extremely high temperature attained during this period of the year which could not be tolerated by the pupae.

The total life -cycle (period from egg to adult), was considerably decreased in the successive rearing sets, as the season advanced (Table 1). It ranged from 32.3 days, for the mid-April rearing set, to 72.3 days, for mid-November rearing set.

Newly emerged adults of all sets remained inactive for 1-2 days after which they fed vigorously for a period of 38-63 days, with an average of 53 days. Individuals that reached the adult stage before February produced a second generation; whereas, those that reached the adult stage after the first week of February entered into aestivation by mid May.

DeWitt and Armbrust [11] and Huggans and Blickenstaff [9] found that induction of aestivation in the AW is a photic response of larvae. Adults of EAW ensuing from larvae exposed to less than 11 h. day length (the first and second rearing sets, Table 2), had their sexual organs developed and gave the spring generation. Those emerging from larvae exposed to more than 11 h. day length had their sex organs not well developed and entered into aestivation.

Having a second generation in this environment is in contrast with some other work previously done on the same weevil [4-15] and thus, make this pest potentially more severe in this area.

Female adults of the spring generation started egg laying on March 27, 1987. The mean preoviposition, oviposition and postoviposition periods recorded were 53.4 and 27.4 and 13 days ranging from 38-63, 14-34 and 9-24 days respectively. The mean number of eggs laid per female was 703 (ranging from 540-1406).

The aestivated adults, characterized by a cessation of feeding, stopped movement and tended to aggregate in light- protected zones under filter paper durig summer and late autumn. They resumed activity early in November and started depositing eggs early in December. However, larvae were observed in the fields in the first week of November.

The mean preoviposition, oviposition and postoviposition periods of females of the winter generation were 198, 118 and 24 days, respectively. The mean number of eggs per female was 438 (Table 3).

The delay in egg- laying of females and the obvious reduction in the number of eggs per female of the winter generation may be attributed to the inconvenient rearing conditions in the laboratory compared with the field conditions.

Table 3. Preoviposition, oviposition, and postoviposition periods (in days) and number of eggs laid per female during spring and winter generation of *H. brunneipennis*.

Periods	Spring generation		Winter generation	
	mean	range	mean	range
Preoviposition	53.4 n=10	38 – 63	198 n=18	185 – 205
Oviposition	27.4	14 – 34	118	106 – 142
Postoviposition	13.0	9 – 24	24	14 – 34
Eggs/female	703	540 – 1406	438	280 – 668

n=number used

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دراسة بيولوجية عن سوسة ورق البرسيم (هيبرا برونيبنس) في المنطقة الوسطى من المملكة العربية السعودية

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ملخص البحث. أجريت هذه الدراسة تحت الظروف الطبيعية الخارجية في كلية الزراعة بجامعة الملك سعود بالرياض بمتابعة حياة سوسة ورق البرسيم في ست مجاميع متتالية، بدأت الأولى منها في منتصف نوفمبر ١٩٨٦م.

وقد تم تقدير طول فترة حضانة البيض، والطور اليرقي، وطور العذراء، وقد تراوحت هذه المدد بين ٥ ـ ٢١، ٥,١٠ ـ ٣٣، و٥,٧ ـ ٨,٢٧ يوم للأطوار السابق ذكرها على التوالي. وكانت الحشرات الكاملة في جميع الحالات شرهة التغذية. وقد أعطت الحشرات الكاملة التي خرجت قبل بداية شهر فبراير جيلاً آخر سمي بجيل الربيع. بينما دخلت الأفراد التي ظهرت بعد ذلك طور السكون الصيفي في منتصف شهر مايو واستمرت كذلك حتى خريف ١٩٨٦م، ثم عاودت نشاطها وأعطت جيلاً جديدًا في بداية شهر ديسمبر وسمي بجيل الشتاء. ولقد سجل طول فترة ما قبل وضع البيض، فترة الوضع وفترة ما بعد الوضع لكل من جيلي الربيع والشتاء. وكان متوسط عدد البيض الذي وضعته كل أنثى في جيلي الربيع والشتاء ٧٠٣ و٤٣٨ بيضة على التوالي.