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EVALUATION OF SOME ALTERNATIVE CARRIERS TO WHEAT BRAN ON THE FOURTH NYMPHAL INSTAR OF *EUPREPOCNEMIS PLORANS PLORANS* AND *HETERACRIS ANNULOSA*

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Abstract

Studies were carried out to evaluate some alternative carriers to wheat bran and the preferred carriers in the presence of green food plant, berseem, *Trifolium alexandrinum* and maize, *Zea mays* on the grasshoppers, *Euprepocnemis plorans plorans* and *Heteracris annulosa*.

The carriers used in the study were wheat bran, corn hull, bean hay, groundnut husts, berseem hay, wheat hay, rice husks and saw-dust.

No significant differences were observed between the four preferential carriers, i.e. wheat bran, bean hay, corn hull and groundnut husks. The descending order of the consumed amount of the carriers in gm. per gm. b.wt. of *E. plorans* : Wheat bran> bean hay>corn hull> groundnut husks> berseem hay> rice husks>wheat hay = saw dust.

Concerning *H. annulosa,* carriers could be arranged descendingly as follows : corn hull> wheat bran> bean hay> groundnut husks> berseem hay> wheat hay> rice husks> saw-dust. However, the grasshopper, *H. annulosa.* consumed less amounts of the carriers than the other one.

The grasshoppers ate the preferential carriers in the presence of the green plant berseem, *T. alexandrinum* with non significant differences in the case of *E. plorans.* But, with the grasshopper *H. annulosa*, significant differences were existed.

In the presence of the green food plant maize, similar results were recorded, but higher amounts were consumed from the carrier and the green plant berseem than from maize. Concerning *H. annulosa*, the contrary existed, since the insects consumed higher amounts of carriers in the presence of maize than in the presence of berseem, except in the case of groundnut husks, the nymphs ate approximately equal amounts.

INTRODUCTION

The grasshoppers caused great damage to clover, maize, leguminous, cereals, cotton and sugar-cane crops (Nakhla, 1957).

The most important economic species of grasshoppers in Egypt are the berseem grasshopper, *Euprepocnemis plorans plorans* Charpenter, *Heteracris annulosa* Walker and *Aiolopus strepens* Latr. (Metaweh, 1993).

In 1927, the farmers of El-Dakhla and El-Kharga oases reported to the ministry of agriculture that great numbers of grasshoppers had invaded their fields and caused serious damage. The berseem grasshopper *E. plorans plorans* caused at least 95% damage in the cultivated fields of lower Egypt (Nakhla, 1957). In 1986 and 1988, the farmers of El-frafra oases in the New Vally and the newly reclaimed areas in the south west of Alexandria, respectively, reported complaints on the serious damage especially in maize crop by *E. plorans plorans* (El-Garhy et al., 1988).

Poisoned baits are considered the standard method for controlling grasshoppers in Egypt. They are still regarded as the easiest, most economic and efficient method for grasshopper control (El-Sayed et al., 1988). Wheat bran nowadays is expensive, so the search for cheaper carriers becomes urgent.

Therefore, this work deals with evaluation of some alternative carriers to wheat bran on the fourth instar nymphs of the grasshopper *E. plorans plorans* and *H. annulosa* in the absence or in the presence of green food.

MATERIALS AND METHODS

1. Rearing procedure: The insects were reared in laboratory according to the technique of Hassanein (1975)

2. Evaluating the acceptance of carriers for the 4th nymphal instar of grasshoppers: The fourth nymphal instar of the grasshoppers, *E. plorans plorans* and *H. annulosa* were used. Many carriers were tested as a substitute to wheat bran. The carriers were corn hull, groundnut husks, bean hay, rice husks, wheat hay, berseem hay and saw-dust. Particles of bait carriers should pass through a 2 ml to > 500 micron. The nymphs were starved for 24 hrs. before the start of each test. Fourth instar nymphs of 3-5 days after their third moult were used. Each nymph was placed in a glass tube of (diameter 2.5 cm and length 20 cm), with the end covered with cheese cloth held on by rubber bands (Barnes, 1955). Half gram of each carrier was placed in each glass-tube. Preliminary tests showed that each insect of the fourth instar ate less

than $^1/_2$ gm of a carrier. The nymphs were weighed and exposed to the carrier for 24 hrs. (10 replicates/carrier), one insect in a single tube for each. Two replicates were used as a control without insects for evaluating the carrier loss of humidity. Nymphs with carriers were kept in an incubator for 24 hours at 32 C° with a fluorescent lamp of 16 Watt as a source of light. The remaining of the carriers after 24 hrs. were removed and weighed after the faeces were separated. The amount of the eaten carrier was divided on the insect weight in the same tube to determine the amount eaten per gram of the insect. Analysis of variance was done to verify the differences between carriers as compared with wheat bran.

3. Evaluating the food preference between carriers and green plants: Experiments were performed to test the ability of the insects to eat the carrier in the presence of the green plant or not. The previous technique was used except for adding the green plant. Half gram of berseem, *Trifolium alexandrinum* or of maize, *Zea mays* leaves was placed in the second end of the test tube, and a $^1/_2$ gm of the tested carrier in the first end, while the insect was placed between them and let it to be free to eat each of them. Two test tubes for each green plant were used as a control without insect to determine the loss of humidity. After 24 hrs., the remaining of the green plants were weighed as well as the carriers and the control. The weight of eaten green material was adjusted according to the control of the green plant. The same adjustment was done to the carriers. For simplification, the consumed amount of carrier was transformed to percentage value based on the consumed amount of the green plant and considered here to be acceptability percent.

$$\text{Acceptability \%} = \frac{\text{Average wt. of eaten carrier}}{\text{Average wt. of eaten green food}} \times 100$$

RESULTS AND DISCUSSION

1. Food Preference to Certain Carriers

1.1. Acceptance of some carriers by the 4th nymphal instar of the grasshoppers, *E. plorans plorans and H. annulosa*: The preference to certain alternative carriers were evaluated in the laboratory by the *4th* nymphal instar of both grasshoppers. The carriers were wheat bran, corn hull, bean hay, groundnut husks,

berseem hay, wheat hay, rice husks and saw-dust. The summarized results are shown in Table 1. The results recorded after 24 hrs. post treatment revealed that in case of the grasshopper, *E. plorans plorans,* the most preferable carrier was wheat bran and the lowest preferable one was wheat hay and saw-dust. However, no significant differences were observed between the four preferential carriers wheat bran, bean hay, corn hull and groundnut husks. The preferability for carriers could be descendingly ordered, according to the consumed amounts of the carriers (gm/gm.b.wt.), as follows: wheat bran > bean hay > corn hull > groundnut husks > berseem hay > rice husks > wheat hay = saw-dust.

Concerning the *H. annulosa,* the most attractive one was corn hull, while the lowest one was saw-dust. The alternative carriers could be descendingly ordered as follows: corn hull > wheat bran > bean hay > groundnut husks > wheat hay > rice husks > berseem hay > saw-dust.

Finally, for comparing the two tested grasshoppers. *E. plorans plorans* and *H. annulosa,* it was observed that there were differences in food preference between them. As for, *E plorans plorans* no significant differences were found among the first four preferable carriers (wheat bran, bean hay, corn hull and groundnut husks). In case of, *H. annulosa,* there were substantial differences among the first four acceptable carriers.

Moreover, the nymphs of the grasshopper *E. plorans plorans* ate larger amounts of the carrier than the other one.

Our results agree with that obtained by Ford and Larrimer (1921) who mentioned that saw-dust was less attractive to grasshoppers than wheat bran and Uvarov (1928) who stated that wheat bran is the best known carrier to the grasshoppers of family Acrididae. Berezhkov (1923) obtained good results in case of chaff of wheat and oat which is cheaper than bran and mixed them with wheat bran in baits to grasshoppers. Also, the results of Nurein and Amare Beine (1981) go in line with our results. They used groundnut husks as carrier in baits and proved to be good carrier to locust.

1.2. Acceptance of preferential carriers of both grasshoppers, *E. plorans plorans and H. annulosa* in the presence of the green food

1.2.1. Acceptance of carriers in the presence of the green food berseem, *T. alexandrinum:* The most preferential carriers; wheat bran, bean bay, corn hull and groundnut husks were chosen and examined in presence of the green plant berseem, Table 2. Data presented revealed that in the case of the *4th* instar nymphs of *E. plorans plorans,* there was neither significant differences between the carriers nor between the green food. These results clearly indicated that the grasshopper *E. plorans plorans* can eat the carriers in the presence of the green plant berseem. As regard to the grasshopper, *H. annulosa,* data presented in Table 2 revealed that the consumed amount of green plant berseem was significantly different than the other amounts in case of groundnut husks as a carrier. On contrary, the amount of groundnut husks and bean hay recorded the lowest consumed amounts in presence of green plant berseem. While, no significant differences were observed between wheat bran and corn hull in presence of the green plant berseem. The descending order of consumed amounts of the carriers were: wheat bran>corn hull > groundnut husks > bean hay. However, the corresponding consumed amounts of the green food berseem were 0.49, 0.49, 0.27, 0.68 gm/gm body weight of the insect. Calculating the acceptability percent for each carrier indicated moderate amounts, i.e. from 49-73 gm per 100 gm of the green berseem plant, for *E. plorans plorans.* Contrary to this very low acceptability percent, i.e. from 6-22 gm per 100 gm of green berseem were consumed by *H. annulosa.*

1.2.2. Accceptance of carriers in the presence of the green food maize, *Zea mays:* The most preferential carriers were examined in presence of the green maize plant, for the two tested species of grasshoppers. Data tabulated in Table 3 revealed that in case of the *4th* instar nymphs of *E. plorans plorans*, the consumed amounts of the carriers could be arranged descendingly as follows: wheat bran (0.18 gm/gm b.wt.), corn hull (0.15 *gm/gm* b.wt.), groundnut husks (0.10 gm/gm b.wt) and bean hay (0.08 gm/gm b.wt.). The corresponding values of consumed green foods were 0.12, 0.13, 0.09 and 0.35 gm/gm b.wt. of insect, respectively. The acceptability factor indicated that the insect preferred wheat bran, corn hull and groundnut husks

more than the green maize plants. In case of the other species *(H. annulosa),* there was no significant differences observed between the consumed amounts of green foods in case of presence of each carriers. In conclusion, for controlling *E. plorans plorans* nymphs we can use any preferential carriers such as wheat bran, corn hull and groundnut husks, but not bean hay as poison baits in presence of green maize. For *H. annulosa,* it preferred more apparently corn hull, bean hay and wheat bran, but not groundnut husks in presence of green maize plants and can be used as poison baits with great success.

Jerome *et al.* (1980) tested the acceptance of wheat bran carbaryl bait in the field against grasshoppers. They found that the species differed markedly in their acceptance of the bait.

In an attempt to ánswer the question why do the grasshoppers eat different amounts from different plants or carriers ? Rowell (1963) stated that the meal size depend on the balance between the deterrent and phagostimulatory chemicals in the plants

Uvarov (1928) reported that *Schistocerca gregaria* as a polyphagous insect is known to feed on some 400 species of plants.

However, there are other plants that are not eaten at all and some can be eaten with great reluctance. It is worthy to mention that the two species of grasshoppers, *E. plorans plorans* and *H. annulosa* are also polyphagous insects.

Bernays and Chapman (1978) concluded that sucrose is a phagostimulant for Acrididae and the same is probably true for glucose and fructose. They observed that the amount of substrate eaten is proportional to concentration of the sucrose up to an optimum level. The same authors found that some amino acids and plant phospholipids have been shown to be phagostimulatory for several species.

Adams and Bernays (1978) found that proteins amino acids, sulphur compounds, monoterpenes, sesquiterpenes, triterpenoids, fatty acids, phenolics, phenolic glycosids, tannins, purines and miscellaneous N-compounds cyanogenic glycosides, alkaloids and inorganic salts at higher concentrations were all known to be deterrent with *S. gregaria.*

Lewis (1982), showed that the selection of food is affected by its water content and that of the insect. Evidence that specific olfactory responses may occur (Boppre *at al,* 1984). They showed that the grasshopper, *Zonocerus elegans* is attracted by pyrolizidine alkaloids. They found also, that this grasshopper is attracted by the odor of *Chromolaenta odorale* which is known to contain these alkaloids.

Heidron and Joern (1987), showed that *Ageneotettix deorum* ate larger meal on leaves that had higher nitrogen levels. By observing the chemical structure of the carriers, it was found that wheat bran and corn hull contained higher percentages of water content and carbohydrates than the other carriers. That explained the food preference of those carriers than the others. Rice husks contained high percentage of silica which had a deterrent effect. The reason for the very small meal in the case of sawdust is attributed to the presence of tannins.

Table 1. The consumed amounts of some carriers by the 4th nymphal instar of the grasshoppers, *E. plorans plorans* and *H. annulosa* after 24 hours post-treatment.

Carriers	*E. plorans*			*H. annulosa*		
	Average weight of the insect (gm)	Average weight of the eaten carriers (gm)	Average weight of the eaten carriers (gm/gm. b.wt.)	Average weight of the insect (gm)	Average weight of the eaten carriers (gm)	Average weight of the eaten carriers (gm/gm. b.wt.)
Wheat bran	0.205	0.059	0.30 a	0.220	0.019	0.079 b
Bean hay	0.194	0.041	0.21 ab	0.197	0.014	0.068 b
Corn hull	0.198	0.036	0.19 ab	0.230	0.025	0.113 a
Groundnut husks	0.213	0.034	0.16 ab	0.214	0.009	0.031 c
Berseem hay	0.241	0.029	0.12 b	0.154	0.008	0.006 c
Rice husks	0.174	0.018	0.11 b	0.162	0.003	0.018 c
Wheat hay	0.187	0.016	0.09 b	0.180	0.003	0.021 c
Saw-dust	0.207	0.016	0.09 b	0.173	0.0004	0.002 c
L. S. D. 5%			0.15			0.03

Table 2. The consumed amount of some carriers in the presence of green food berseem, *Trifolium alxrandrinum* by the *4th* nymphal instar of the grasshoppers, *E. plarans plorans* and *H. annulosa* after 24 hours post-treatment.

Carriers	Insect weight (gm)	Eaten carrier gm/insect	Eaten green food gm/insect	Eaten carrier gm/gm b.wt.	Eaten green food gm/gm b.wt	Acceptability % *
	E. plonrans plonrans					
Wheat bran	0.289	0.078	0.117	0.31 a	0.50 a	62
Corn hull	0.314	0.063	0.077	0.22 a	0.30 a	73
Bean hay	0.289	0.069	0.125	0.28 a	0.44 a	64
Groundnut husks	0.234	0.047	0.088	0.23 a	0.44 a	49
LSD				0.10	0.25	
	H. annulosa					
Wheat bran	0.260	0.026	0.12	0.110 a	0.49 b	22
Corn hull	0.15	0.009	0.088	0.074 ab	0.49 b	15
Bean hay	0.26	0.004	0.063	0.016 c	0.27 c	6
Groundnut husks	0.16	0.005	0.115	0.043 bc	0.68 a	6
LSD				0.044	0.17	

* Acceptability % = (Average wt. of eaten carrier /Average wt. of eaten green food) X 100

Table 3. The consumed amount of some carriers in the presence of green maize, *Zea mays* by the *4th* nymphal instar of the grasshoppers, *E. plorans plorans* and *H. annulosa* after 24 hours post treatment.

Carriers	Insect weight (gm)	Eaten carrier gm/insect	Eaten green food gm/insect	Eaten carrier gm/gm b.wt.	Eaten green food gm/gm b.wt	Acceptab-ility % *
	E. plonrans plonrans					
Wheat bran	0.260	0.042	0.036	0.18 a	0.12 b	150
Corn hull	0.194	0.029	0.024	0.15 ab	0.13 b	115
Bean hay	0.248	0.022	0.084	0.08 b	0.35 a	22.9
Groundnut husks	0.246	0.021	0.029	0.10 ab	0.09 b	111
LSD				0.075	0.120	
	H. annulosa					
Wheat bran	0.189	0.049	0.036	0.23 a	0.23 a	100
Corn hull	0.2	0.051	0.011	0.23 a	0.05 a	460
Bean hay	0.18	0.016	0.006	0.10 ab	0.04 a	250
Groundnut husks	0.24	0.011	0.069	0.04 b	0.26 a	15.4
LSD				0.13	0.23	

* Acceptability % = (Average wt. of eaten carrier /Average wt. of eaten green food) X 100

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تقييم بعض المواد الحاملة البديله لرده القمح على العمر الرابع الحورى لنطاط البرسيم *إيوبريبوكنيمز بلورانس بلورانس* و نطاط البرسيم المتشابه *هيتراكريس انيولوزا*

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أجريت دراسات لتقيم كفاءه بعض المواد الحاملة البديله لرده القمح، كذلك التفضيل الغذائى لهذه المواد في وجود النبات الأخضر المفضل مثل البرسيم والذره الشاميه على العمر الرابع الحورى لنطاطى البرسيم العادى و المتشابه.

المواد الحامله التى أستخدمت في هذه الدراسه هى رده القمح و رده الذره و تبن الفول البلدى و قشر الفول السودانى و تبن البرسيم و تبن القمح وسرس الأرز و نشاره الخشب. لم يلاحظ فروق معنويه بين الأربعه مواد المفضله و هى رده القمح و رده الذره و تبن الفول البلدى و قشر الفول السودانى في حاله نطاط البرسيم. تم ترتيب هذه المواد حسب أفضليتها تنازليا مقدره بالجرام ماده مأكوله / جرام من وزن الحشره:- رده القمح > تبن الفول البلدى > رده الذره > قشر الفول السودانى > تبن البرسيم > سرس الأرز > تبن القمح > نشاره الخشب.

وفيما يتعلق بنطاط البرسيم المتشابه كان الترتيب التنازلى لهذه المواد حسب أفضليتها كالأتى :-

رده الذره >رده القمح > تبن الفول البلدى > قشر الفول السودانى > تبن القمح > سرس الأرز > تبن البرسيم > نشاره الخشب.

علما بأن نطاط البرسيم المتشابه يأكل كميات أقل من المواد الحاملة عن نطاط البرسيم.

تم دراسه قابليه تغذية الحشرات على المواد الحاملة التى فضلت من قبل في حاله وجود النبات الأخضر (البرسيم) وذلك لحساب متوسط المستهلك من تلك المواد الحاملة أو النبات الأخضر بالجرام / جرام من وزن الحشره و لقد وجد الآتى:-

حدث إقبال على تغذية هذه المواد في ظل وجود النبات الأخضر (البرسيم) حيث لم يلاحظ فروق معنوية و ذلك في حالة نطاط البرسيم العادى، بينما حدث نفس الإقبال و لكن كانت الكميات المستهلكة أقل في حالة حوريات نطاط البرسيم المتشابه.

و قد حدث نفس الإقبال على هذه المواد في حالة وجود النبات الأخضر (الذرة الشامية) مع ملاحظة أن المستهلك من تلك المواد أو النبات الأخضر كان أكثر في حالة (البرسيم) عنه في حالة الذرة بالنسبة لنطاط البرسيم العادى. أما في حاله نطاط البرسيم المتشابه حدث العكس حيث استهلكت الحشرات من تلك المواد في ظل وجود النبات الأخضر (الذره) أكثر منه في حاله البرسيم إلا في حاله قشر الفول السودانى فقد كانت الكميه المستهلكة متساويه تقريبا في الحالتين.