

BIOEFFICIENCY OF BERMUDA GRASS, *CYNODON DACTYLON* (L.) ON THE FEEDING ACTIVITY OF *SCHISTOCERCA GREGARIA* (FORSK.) (ORTHOPTERA, ACRIDIDAE)

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Abstract

The effects of Bermuda grass, *Cynodon dactylone* (L.) on approximate digestibility (AD), consumption index (CI), efficiency of conversion of ingested food (ECI) and digested food (ECD) into body substances as well as growth rate of the last nymphal instars of *Schistocerca gregaria* (Forsk.) were studied in the laboratory. The obtained results revealed that, feeding 4th instar nymphs on the contaminated clover, *Trifolium alexandrinum* with leaves and roots extracts of bermuda grass in methanol, acetone and ethoxyethanol significantly reduced AD, ECI and ECD. The reductions in these parameters were expressed as remarkable reduction in the body weight of the treated 4th instar nymphs. The same treatments were conducted against the 5th instar nymphs and resulted in significant increasing in AD and CI, but ECI and ECD were decreased in comparison to the control. The decreasing in ECI and ECD was reflected as a reduction in the growth rate of the treated 5th instar nymphs. It seems that, 5th instar nymphs were more sensitive than 4th one to the juvenilizing action of Bermuda grass because the increasing in AD and CI and the decreasing in ECI and ECD in the treated 5th instar nymphs with the extracts of Bermuda grass are considered as a juvenilizing effect of this grass, which coincide with many other studies on plant extracts against insect pests. It is may refer to that Bermuda grass may include some effective compounds enable it to resist the desert locust plague.

INTRODUCTION

Recently, bioassais of plant extracts against insects attracted much attention to develop environmentally acceptable alternative controlling methods against insects. Mordue (2004) supported the previous studies on this approach, when he stated that azadirachtin, the most effective isolated compound of the Neem tree, *Azadirachta indica* (Family, Meliaceae) exhibited strong antifeedant, repellent and growth regulator actions for a wide variety of phytophagous insects. In this direction, Jogar *et al.* (2006) found that, the treated pharate pupae of *Tenebrio molitor* with *Ledum palustre* plant extract transformed into extra-pupal instars, which is a symptom of its juvenilizing effect. El-gammal *et al.* (2008) obtained the same intermediate insects (adultoied) after feeding the 5th instar nymphs of *Schistocerca gregaria* on treated

clover with some plant extracts of Bermuda grass, *Cynodon dactylon* (L.). Also, Akhtar *et al.* (2008) stated that bioactivities of some plant extracts belonging to the family Maliceae proved to be strong growth inhibitors and contact toxins.

Therefore, the present work aims to reveal the reasons of which the Bermuda grass, *Cynodon dactylon* was argued to resist the infestations of the desert locust, *Schistocerca gregaria* in some area during the last plague 2004-2005 in Egypt.

MATERIALS AND METHODS

A- Insects used

Newly moulted 4th and 5th instar nymphs, *Schistocerca gregaria* (Forsk.) were segregated from gregarious colony of locust and grasshoppers Research Department and Kept in wooden – framed cages cube of 30 cm side under the crowded conditions as mentioned by Hunter-Jones (1961). These nymphs were fed on treated leaves of clover, *Trifolium alexandrinum* with some extracts from Bermuda grass, *Cynodon dactylon*. Unconsumed food, dead locusts and faeces were removed daily.

B- Plant extracts preparation

After one month of Bermuda grass, *C. dactylon* planting in experimental plots of clay soil, the grass was picked up, and allowed to dry in shadow under room temperature for 10 days. Air dried leaves and roots were separately grounded by house hold grinder. One hundred gram of each were soaked in 200 ml of the solvents, methanol, acetone and ethoxyethanol for 48 hr, with continuous stirring. Filtration was conducted after soaking through fine gauze to get the supernatant of each extract for testing against 4th and 5th instar nymphs of *S. gregaria*.

C- Treatments with plant extracts

Populations of 45 and 30 nymphs of 4th and 5th instars were fed in 3 replications on treated leaves of clover with leaves and root extracts of Bermuda grass in methanol, acetone and ethoxyethanol for 6 days. The nymphs, were normally fed on untreated clover along the remained period to the next moult. The untreated 4th and 5th instar nymphs were daily fed on untreated leaves of clover.

D- Criteria studied

1. Growth rate

The treated and untreated nymphs were weighed daily to estimate their growth rate, according to the following equation of Waldbauer (1968):

$$\text{Mean} = \frac{\text{initial weight} + \text{final weight}}{2}$$

2. Feeding activity

Feeding activities of treated and untreated 4th and 5th instar were evaluated daily by measuring the faeces, food eaten and locust weights. The various indices of consumption and utilization of food were calculated on dry-weight basis according to the methods of Waldbauer (1968):

$$\text{- Approximate digestibility (A.D.)} = \frac{\text{Food digested (D)}}{\text{Food ingested (F)}} \times 100$$

$$\text{- Consumption index (C.I.)} = \frac{F}{TA}$$

F = fresh or dry wt. of food ingested.

T = Duration of feeding period in days.

A = Mean fresh or dry wt. of insect during feeding period.

$$\text{- Efficiency of conversion of ingested food to body weight matter: (E.C.I.)} = \frac{\text{Dry weight gained}}{F - \text{Dry wt. of faeces}} \times 100$$

$$\text{- Wherease, Dry weight gained} = \frac{\text{Initial wt.} - \text{final wt.}}{2}$$

RESULTS AND DISCUSSION

To realize the efficiency of Bermuda grass, *Cynodon dactylon*, on food consumption, food utilization and growth of the last two nymphal instars of *Schistocerca gregaria*, newly moulted 4th and 5th instar nymphs allowed to feed on treated leaves of clover with different extracts from this grass for 6 days. These extracts were in methanol, acetone and ethoxyethanol. Food consumption, food utilization and growth rates of the treated nymphs were estimated as, approximate digestibility (A.D.), consumption index (C.I), efficiency of conversion of ingested food to body substances (ECI) and efficiency of conversion of digested food to body substances (ECD) according to Waldbauer (1968). The obtained results were :

1. Effects of Bermuda grass on feeding activity of 4th instar nymphs

Table (1) shows that, the extracts of both leaves and roots of Bermuda grass in methanol and acetone significantly reduced A.D. of the treated 4th instar nymphs in

comparison to the untreated control. The percentages of A.D. were, 87.93, 88.64, and 88.35 after treatment with the extracts of leaves and roots in methanol and only roots in acetone, respectively compared with 91.22% in the untreated control. Consumption index (CI) did not exhibit any differences than the control one. E.C.I values were strongly affected by these treatment, they were 13.59, 9.87 and 3.26% for each previous extracts, respectively compared with 24.47% in the control. E.C.D. also, was greatly declined by these extracts, its percentages were, 13.59, 11.29 and 10.38% after treatment with the same extracts, respectively compared with 26.75% in the untreated control.

These suppressions in conversion of the food ingested and food digested to body substances in the treated 4th instar nymphs of *S. gregaria* resulted in reduction in the growth rate of these treated nymphs (Fig. 1). The growth rates were obviously affected by acetone roots extract followed by methanol roots extract and methanol leaves extracts.

2. Effects of Bermuda grass on feeding activity of 5th instar nymphs

Table (2) indicates that, approximate digestibility (A.D) of the treated 5th instar nymphs, *S. gregaria* was significantly increased compared with the untreated control. They ranged from 85.52% in the treated 5th instar nymphs with the extract of Bermuda grass roots in acetone to 95.64% in the treated 5th instar nymphs with roots extract in ethoxyethanol compared with 81.66% in the untreated control ones. The consumption index (C.I.) was also increased compared with the control. The values of C.I were ranged from 0.21 after feeding the 5th instar nymphs on contaminated clover with the extract of Bermuda grass leaves in ethoxyethanol to 0.39 in the treated 5th instar nymphs with its roots extract in methanol compared with 0.23 in the untreated control nymphs.

Also, Table (2) shows that, the conversion of ingested and digested food to body substances (E.C.I and E.C.D) was significantly decreased than untreated control 5th instar nymphs. The percentages of E.C.I. ranged from 4.05 in the treated 5th instar nymphs with the contaminated clover with the extract of Bermuda grass roots in acetone to 15.37% after treatment with its leaves extract in ethoxyethanol, compared with 22.63% in the untreated 5th instar nymphs. Moreover, table 2 indicates that, the percentages of E.C.D. were also, decreased by treatment of the 5th instar nymphs, *S. gregaria* with the tested extracts of Bermuda grass. The maximum decreasing value was obtained after feeding the 5th instar nymphs on the contaminated clover with acetone extract of Bermuda grass roots, it was 4.88%, whereas the lower decrease was obtained after feeding on the contaminated clover with the extract of Bermuda

leaves in ethoxyethanol (16.84%), compared with 29.00% in the control nymphs. So, the deficiencies in the conversion of both ingested and digested food to body substances in the treated 5th instar nymphs, *S. gregaria* with the indicated extracts of Bermuda grass (Table 2) were expressed in obvious decreases in their body weights (Fig. 2).

In conclusion, all the plant extracts of Bermuda grass exhibited a strong reduction in feeding activity parameters of the treated 4th and 5th instar nymphs, *S. gregaria*, but the last instar was more sensitive than the other. These observations may be explained the resistance of Bermuda grass to the infestations of the desert locust, *S. gregaria* during its last plague in Egypt, 2004-2005. The obtained decrease in the most effective parameters (ECI and ECD) of the treated nymphs on growth coincide with El-gammal *et al.* (2008) who stated that, the treated 5th instar nymphs, *S. gregaria* were transformed into intermediate features of 5th instar and adult stage after feeding on some selected extracts of Bermuda grass, *C. dactylon*. These symptoms are consider as a juvenilizing effects of this grass in *S. gregaria*. Thus, the inhibition effects of Bermuda grass extracts on *S. gregaria* feeding parameters, E.C.I and E.C.D as well as their growth rate may be attributed largely to some bioactive compounds in these extracts caused high level of juvenile hormone (JH) in the haemolymph of the treated last two nymphal instars of *S. gregaria*, specially the 5th instar nymphs which were more sensitive than the 4th one. Moreover, it was observed in the present study that, A.D. was higher in the treated 5th instar nymphs, *S. gregaria* after feeding on tested extracts of the Bermuda grass, *C. dactylon*. All these findings could be explained by the results of Beenackers *et al.* (1974) who stated that, the approximate digestibility (A.D) of the 5th instar nymphs, *Locusta migratoria* was somewhat higher after implantation of corpora allata (the source of JH) and lower after allatectomy, the ECI was greater in normally developing nymphs than in adults. Implantation lowered this efficiency of conversion in developing nymphs. Peter and Ananthakrishnan (1993) found that, azadirachtin-coated leaves had reduced body weight of *Cyrtacanthacris tatarica* (Orthoptera: Acrididae) and showed little variation in A.D, ECD and ECI compared with injected larvae. Also, Bhergava *et al.* (2005) studied the effects of plant products on food utilization of *Carcyra caphalonica* and observed that, AD, ECI ECD were decreased and the weight gained by the larvae were reduced when fed on treated food with different plant extracts of, *Pongamia glabra*, *Vitex negundo*, *Azadirachta indica*, *alophyllum inophyllum*, *Swietenia mahagoni* and *Brassica Juncea*. More recent study was carried out by Nathan et al (2007) supported all the previous findings when they evaluated the toxicity and physiological effect of the botanical insecticide Dysoxylum triterpenes against the rice leaffolder

Cnaphalocrocis medinalis. They found that, food consumption, digestion, relative consumption rate, ECI, ECD and relative growth rate values declined significantly but AD of the treated larvae was significantly higher as a result of treatment.

Generally, the findings of the present study coincide with many other studies about the biological and physiological effects of plant extracts and botanical insecticides against insects which revealed that the *Bermuda grass C. dactylon* (L.) may includes many active principles for further study to isolate its active components in the future to prepare botanical insecticides for insect pests like *S. gregaria*.

Table 1. food consumption and food utilization by gregarious 4th instar nymphs, *Schistocerca gregaria* as affected with some plant extracts from Bermuda grass, *Cynodon dactylon* L.

Plant extracts used:	A.D. ± s.d.	C.I. ± s.d	E.C.I. ± s.d	E.C.D. ± s.d
Leaves in methanol :	87.93±1.14	0.41±0.11	13.59±0.65	13.59±0.72
Roots in methanol :	88.64±3.24	0.50±0.09	9.87±0.75	11.29±0.66
Roots in Acetone :	88.35±2.71	0.40±0.06	3.26±0.27	10.38±0.32
Untreated control :	91.22±1.20	0.40±0.14	24.47±1.21	26.75±1.90
L.S.D. :	2.27	0.03	1.52	1.86

- Populations of 45 nymphs (males and females) were fed on treated leaves of clover, *Trifolium alexandrinum* with each indicated extracts.
- A.D. = Approximate digestibility, C.I = consumption index, E.C.I. = Efficiency of conversion of ingested food to body substances, and E.C.D. = efficiency of conversion of digested food to body substances.

Table 2. effects of some plant extracts from Bermuda grass, *Cynodon dactylon* L. on food consumption and food utilization by 5th instar nymphs, *Schistocerca gregaria*.

Plant extracts used:	A.D. ± s.d.	C.I. ± s.d	E.C.I. ± s.d	E.C.D. ± s.d
Leaves in methanol :	87.76+3.61	0.37+0.04	7.88+0.62	9.88+0.68
Roots in methanol :	87.16+4.95	0.39+0.03	7.21+0.44	8.08+0.49
Leaves in Acetone :	89.62+3.99	0.27+0.03	7.77+0.27	8.89+0.99
Roots in acetone :	85.52+5.24	0.28+0.08	4.05+0.31	4.88+0.40
Leaves in ethoxyethanol :	91.28+5.10	0.21+0.04	15.37+0.48	16.84+0.52
Roots in ethoxyethanol :	95.64+4.53	0.29+0.03	5.41+0.13	6.48+0.42
Untreated control :	81.66+6.20	0.23+0.03	22.63+1.27	29.00+1.88
L.S.D. :	4.03	0.04	1.38	2.01

- Thirty nymphs (males and females) were fed on treated leaves of the Egyptian clover, *Trifolium alexandrinum* with each indicated extracts.
- A.D. = Approximate digestibility, C.I = consumption index, E.C.I. and E.C.D are the efficiency of conversion of injected and digested food to body substances.

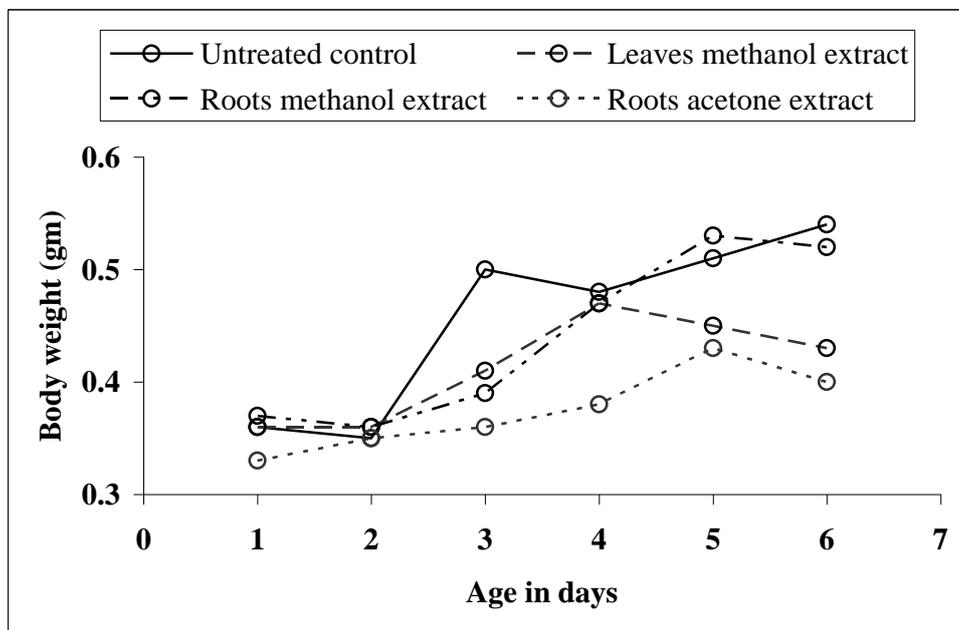


Fig. 1. Effects of different extracts from Bermuda grass, *Cynodon dactylone* on body weight of 4th instar nymphs, *Schistocerca gregaria* (Forsk.)

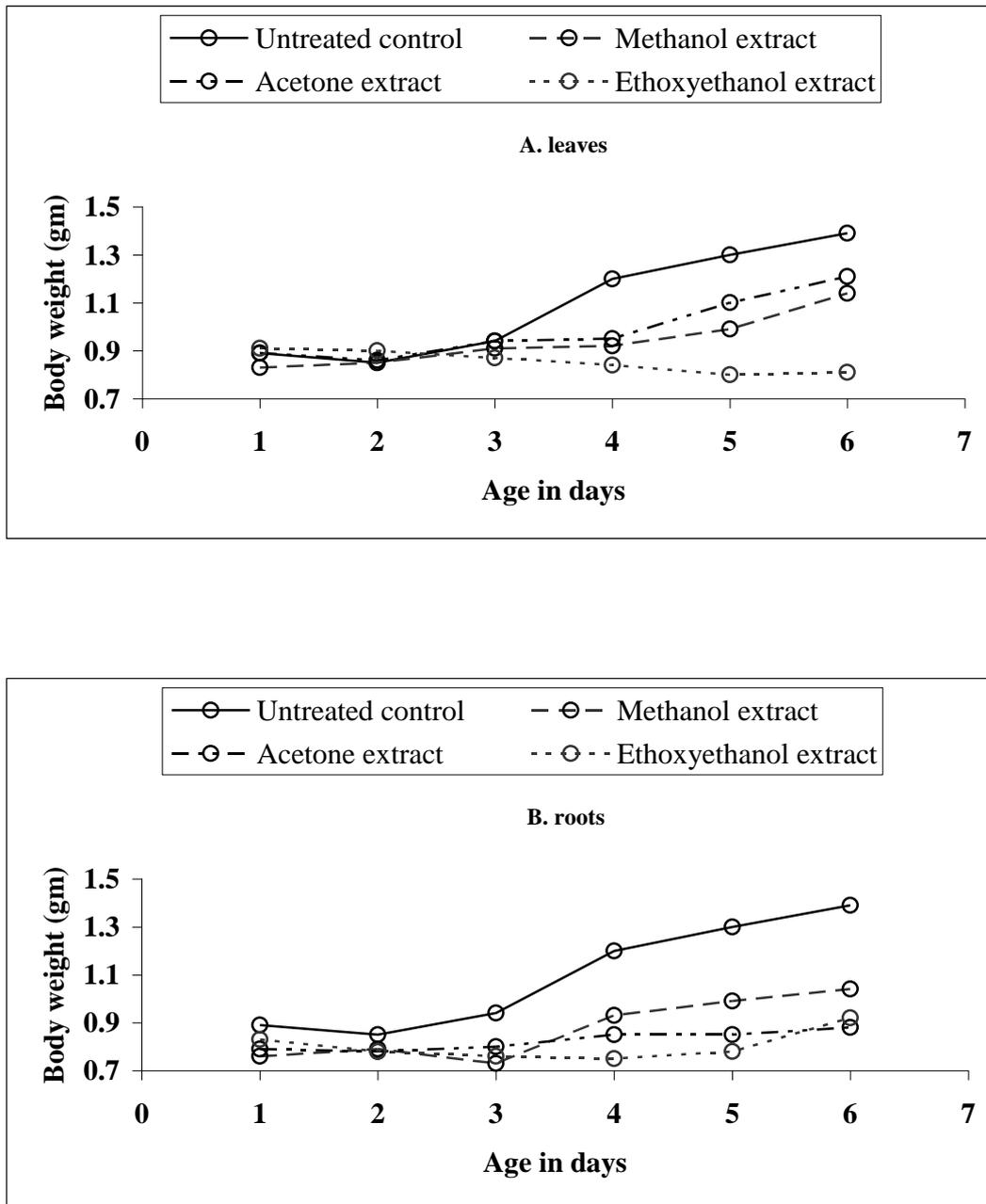


Fig. 2. Effects of different extracts from Bermuda grass, *Cynodon dactylone* on body weight of 5th instar nymphs, *Schistocerca gregaria* (Forsk.)

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الكفاءة الحيوية لنجيل البرمودا (سايونون داكليلون) على استهلاك الغذاء فى الجراد الصحراوى "شيسستوسيركا جريجاريا (مستقيمات الأجنحة : جراديات)

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تم دراسة تأثير النجيل من النوع برمودا على معدل الهضم (AD) واستهلاك الغذاء (CI) وكفاءة تحويل الغذاء المأكول (ECI) وكفاءة تحويل الغذاء المهضوم (ECD) إلى أنسجة الجسم فى الجراد الصحراوى وكذلك أوزان الحوريات فى المعمل. أوضحت النتائج المتحصل عليها أن تغذية حوريات العمر الرابع على أوراق البرسيم المعاملة بمستخلصات الميثانول والأسيتون والإيثوكس إيثانول من أوراق وجذور هذا النجيل أدى إلى خفض هذه المعدلات مما أدى الى انخفاض واضح فى أوزان هذه الحوريات.

كما أدت نفس المعاملات ضد حوريات العمر الخامس إلى زيادة معنوية فى (CI, AD) ولكن حدث انخفاض ملحوظ فى معدلات (ECI) والد (ECD) بالمقارنة بالكونترول. نتج عنه انخفاض واضح فى أوزان الحوريات المعاملة. من ذلك يبدو أن حوريات العمر الخامس كانت أكثر حساسية لهذه المعاملات عن حوريات العمر الرابع للتأثيرات الهرمونية لهذا النجيل لأن ارتفاع مستوى هرمون الشباب Juvenile hormone فى دم الحوريات يزيد من معدل الهضم (AD) ومعدل استهلاك الغذاء (CI) يقلل من معدلات تحول الغذاء المأكول (ECI) والمهضوم (ECD) إلى أنسجة حية بالجسم، وهذا ما حدث فى حوريات العمر الخامس بهذه الدراسة و يبدو أن نجيل البرمودا قد يحتوى على بعض المركبات المؤثرة والتي ساعدته على مقاومة غزوات الجراد الصحراوى.