



Efficacy of certain compounds of plant extracts for controlling *Spodoptera littoralis* (Boisd), *Spodoptera exigua* (Hb) and *Herpetogramma hipponalis* (L.) on sweet potato plant

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Abstract

Chemical insecticides caused several problems to different organisms and environment, natural control is one the solution to reduce the use of pesticides. The effectiveness of some plant extracts was evaluated against some pests of the order Lepidoptera, *Spodoptera littoralis* (Boisd), *Spodoptera exigua* (Hb) and *Herpetogramma hipponalis* which feed on the leaves of the sweet potato plant compared to Agerin as biopesticide. Lantana (*Lantana camara*) and Rimth Saltbush (*Halexylon salicornicum*) methanol extracts were used as natural insecticides. Results obtained showed that Rimth extract was the most effective than Lantana extract after 24 hrs with LC₅₀ 9738.0 and 10798.0 ppm under laboratory conditions against the 2nd larval of *S. littoralis* and vice versa after 72 hrs with slightly different. Meanwhile, Rimth extract (LC₅₀ 8853.0 and 5667.0 ppm) was highly toxic than Lantana extract (LC₅₀ 9994.0 and 6160.0 ppm) against *S. exigua* after 24 and 72 hrs, respectively under laboratory conditions. Also, *H. hipponalis* affected by Rimth extract (LC₅₀ 7744.0 and 5169.0 ppm) more than Lantana extract (LC₅₀ 8342.0 and 5716.0 ppm) after 24 and 72 hrs, respectively. On another hand, the two extracts and agerine (biopesticide) were tested against 2nd and 4th instars of the three pests under field conditions on sweet potato plant. The reduction% of the two extracts on the 2nd star of the three insects was over 80% after one days of treatment. The reduction% was increase with increasing days until 5 days of treatment (94-97%) then slightly decrease after 7 days comparing with agerine. The reduction% incase 4th instar less than 2nd instar in all treatments. This study revealed that Some vegetative growth parameters and the chemical compositions of sweet potato plants have relationship with the efficacy of plant extracts against *S. littoralis*, *S. exigua* and *H. hipponalis*

Keywords: *Lantana camara*, *Halexylon salicornicum*, *Spodoptera littoralis*, *Spodoptera exigua*, *Herpetogramma hipponalis*, Agerin

Introduction

Sweet potato is one of the important root crops in Egypt and many other countries in the world especially the Eastern and Southern parts of the African continent (Tumwegamire *et al.*, 2004) [41]. Sweet potato requires low inputs and less management and is an important food security crop grown in many of the poorest regions of the world mainly by women for food and as a source of food and family cash income (Woolfe, 1992) [43]. Talekar (1982) [40] reported at least two hundred species of insects that feed on sweet potatoes both in field and storage worldwide. One of the most important pests that feed on the sweet potato crops is cotton leaf worms *Spodoptera littoralis*, *Spodoptera exigua* and *Herpetogramma hipponalis*. The genus *Spodoptera* (Lepidoptera: Noctuidae) contains about 31 species spread over six continents, many of which important agricultural pests worldwide, including beet armyworm *S. exigua* and *S. littoralis*. Their main hosts include field crops, grasses and vegetables, causing great losses to agricultural production (Meagher *et al.*, 2008 [26]; Nagoshi *et al.*, 2011 [30] and Pogue, 2002) [32].

The cotton leaf worm (CLW) is the destructive pest to about 112 host plants from different families in Egypt as well as in Mediterranean and Middle East countries (Kandil *et al.*, 2003 [22]; El-Sinary *et al.*, 2008 [13] and El-Zoghby *et al.*, 2011) [14]. The most effective control measure against leaf worm has been achieved by using chemical insecticides.

Over the past 40 years, the intensive use of broad spectrum insecticides against the leaf worm had led to the development of resistance to many of them (Smaghe *et al.*, 1999 [38]; Aydin and Gurkan, 2006 [7] and Rizk *et al.*, 2010) [35].

Also, the continuous and unwise use of insecticides to control agricultural pests usually lead to adverse effects on beneficial insects, fish and wildlife, hazards to man and animals by environmental pollution, residues in foods (Osman and Mahmoud, 2009 [31] and Ehab, 2012) [11]. Previous researchers demonstrated that plants were considered one of the richest sources which could be used as pest control agents. They attended to use plant extracts as toxicants, repellents, synergists, growth regulators and Antifeedant for cotton leafworm (Mohamed and El-Gengaihi, 1998 [29]; Arivudainambi, 2001 [5]; El-Kholy and Shaheen, 2004 [12]; El-Sinary *et al.*, 2008 [13]; Ragaei and Sabry, 2011; El-Zoghby *et al.*, 2011) [14]. *Halexylon salicornicum*, family Chenopodiaceae contains mainly alkaloids such as Anabasine, Piperidine, Betine, Aldotripiperidine, Haloxine (Sandberg 1972 [36]; Michel *et al.*, 1967) [27], Haloxylene A and B (Ferheen *et al.* 2005) [15]. Anabasine compound has an insecticidal activity against *Pieris rapae* (Zammit *et al.*, 2014) [45].

Phytochemical analysis of *L. camara* leaves indicated that the plant contained alkaloids, glycosides, tannins, steroids, flavonoids, coumarins, carbohydrates, saponins,

anthraquinone glycosides, hydroxy anthraquinones, proteins, phytosteroids and triterpenoids (Ganatra and Gurubaxani, 2016^[17]; Venkatachalam *et al.*, 2011^[42]; Al-Snafi, 2019)^[3]. Five major constituents were identified from volatile oils of *L. camara* ([3, 7, 11-trimethyl-1,6,10-dodecatriene, zingiberene, β -caryophyllene, α -humulene and γ -curcumene) by GC/MS analysis (Kurade *et al.*, 2010)^[25]. The water and acetone extracts of *Lantana camara* were tested against *S. littoralis* by Yacoub (2013)^[44] under lab. conditions. Insecticidal and antifeedant activities of some wild plant extracts were studied by Abd El-Aziz and Ezz El-Din (2007)^[2] to control *S. littoralis*. This study aimed to evaluate the toxic effect of some plant extracts against *S. littoralis*, *S. exigua* and *H. hipponalis* larval instar under laboratory and field condition.

Materials and methods

Plant Materials

Haloxylon salicornicum Rimth Saltbush plant family Amaranthaceae was collected from the Kilo 100, International Coastal Road, Alexandria-Morsa Matrouh (31.041233°N-28.438963°E) in April 2020. *Lantana camara* family Verbenaceae was collected from Mansoura University garden (31.041189°N -31.361730 °E). The plants were identified by prof. Dr. Ibrahim Mashaly, Botany department, faculty of Science, Mansoura University (Boulos, 2000)^[8].

Rearing the culture of *S. littoralis*, *S. exigua* and *H. hipponalis* larvae in laboratory

Spodoptera littoralis, *S. exigua* and *H. hipponalis* larvae were collected from sweet potato fields free from insecticides and reared in laboratory for several generations without any insecticidal pressure. The culture was reared under laboratory conditions at 25± 2° C and 60±5%RH.

Plants Extraction

The dried aerial parts of *H. salicornicum* (1 kg) and *L. camara* (1 kg) were grinded and extracted with methanol (2L × 3). The methanol extract was concentrated by rotary evaporator to obtained MeOH extracts.

Bioassay experiment

The toxicity of two extracts was evaluated by spray-bioassay method as natural pesticides against *S. littoralis*, *S. exigua* and *H. hipponalis* larvae under laboratory conditions. Five serial concentrations of each extract were prepared. Ten 2nd instar larvae of each insect were transferred to each jar (10D×20H cm). Pieces of potato leaves were used to feed larvae. Two ml of each concentrate were sprayed on larvae on each treatment. Only water was used for control group. Number of live larvae was recorded after one and three days. Mortality percentages were calculated and corrected by Abbott (1925)^[1]. LC₅₀, confidence limits and slope values were calculated as described by Finney (1971)^[16]. Also, toxicity index was calculated as described by Sun (1950)^[39].

Field experiment

The objective of this experiment was to evaluate LC₉₀ concentration of each plant extract compared to the

recommended bio pesticide in the field. The experiment was conducted at the farm of Agriculture Research Center at Baramoon, Dakahlia governorate during 2022 successive summer season on Sweet potato, *Ipomoea batatas* (L.). The sweet potato variety was Abees and the variety was cultivated on 21th of April 2022 in an area of about quarter feddan. The plot was divided into four treatments, each treatment having three replicates. Spraying was carried out at vegetative stage and directed to the plants using a small hand pressure sprayer at the morning hours, Split-plot distributions in a randomized. Reduction percentage was evaluated according to Hendrson and Tilton formula, (1955)^[20] after 1, 3, 5 and 7 days from spraying for *S. littoralis* by assigned treatments according to the formula

$$\text{Reduction (\% mortality)} = \frac{[(Cb \times Ta) - 1]}{Ca \times Tb} \times 100$$

Where

Cb= number of alive pest individuals in control before treatment.

Ca= number of alive pest individuals in control after treatment.

Ta= number of alive pest individuals after treatment.

Tb= number of alive pest individuals before treatment.

Analysis of Plant Components

Vegetative growth parameters

Five plants were randomly picked up from each plot, 100 days after planting to measure, plant length, canopy dry weight / plant and leaf area/plant (according to the method of Koller (1972)^[24]

Yield and its components

At harvest, 135 days from planting, all tuber roots plants of each plot were digged up, classified into two categories, i.e., marketable and non- marketable roots then weighted to determine the total yield per feddan (tons). Marketable roots have a diameter of 3.5 to 6.5 cm, while non-marketable roots have a diameter of less than 3.5 cm or more than 6.5 cm according to the method described by Grang (1963)^[19].

Chemical constituents

Samples of cured sweet potato tuber roots were taken to determine total nitrogen (%), phosphorus (%) and potassium (%) following methods described by A.O.A.C. (1990), Jhon (1970) and Brown and Lilleland (1946)^[9], respectively.

Organic composition

Total carbohydrate contents were determined according to the method of Michel *et al.* (1956)^[28] and total sugars (%) according to the method of Dubois *et al.* (1956)^[10].

Results and discussion

Toxicity Effect of the treated plant extracts on *S. littoralis*, *S. exigua* and *H. hipponalis* under laboratory conditions

Data in Table (1) obtained showed that Rimth extract was the most effective than Lantana extract after 24 hrs with LC₅₀ values 9738.0 and 10798.0 ppm under laboratory conditions against the 2nd larval of *S. littoralis*. While, after 72 hrs of treatment Lantana extract became more toxic with slightly different. The mortality percentage increased with increasing the concentration of both extracts.

Table 1: Insecticidal activity of secondary metabolites of some wild plant against 2nd instar larvae cotton leaf worm (*Spodoptera littoralis*) under laboratory conditions

| Treatments | Conc. (ppm) | Insecticidal activity after 24 hours of treatment | | | | | Insecticidal activity after 72 hours of treatment | | | | | | |
|------------------------|-------------|---|------------------------|------------------------|--------------|--|---|------|------------------------|------------------------|--------------|--------------------|------------------------------------|
| | | M.% | LC ₅₀ (ppm) | LC ₉₀ (ppm) | Slope ± S.E. | Toxicity Index (%) at LC ₅₀ | LC ₅₀ /LC ₉₀ | M.% | LC ₅₀ (ppm) | LC ₉₀ (ppm) | Slope ± S.E. | Toxicity Index (%) | LC ₅₀ /LC ₉₀ |
| <i>H. salicornicum</i> | 2500 | 12.5 | 9738.0 | 36283 | 2.24±0.44 | 100 | 0.268 | 20 | 6380 | 21085 | 2.47±0.42 | 99.04 | 0.302 |
| | 5000 | 22.5 | | | | | | 35 | | | | | |
| | 7500 | 35 | | | | | | 50 | | | | | |
| | 10000 | 47.5 | | | | | | 67.5 | | | | | |
| | 12500 | 67.5 | | | | | | 82.5 | | | | | |
| <i>L. camara</i> | 2500 | 10 | 10798 | 41500 | 2.19±0.44 | 90.18 | 0.260 | 25 | 6319 | 26582 | 2.05±0.40 | 100 | 0.237 |
| | 5000 | 22.5 | | | | | | 37.5 | | | | | |
| | 7500 | 32.5 | | | | | | 47.5 | | | | | |
| | 10000 | 42.5 | | | | | | 65 | | | | | |
| | 12500 | 62.5 | | | | | | 80 | | | | | |

Date in Table (2) illustrated the toxicity effect of the treated plant extracts on *S. exigua* after one and three days from treatment. Rimth extract (LC₅₀ 8853.0 and 5667.0 ppm) was highly toxic than Lantana extract (LC₅₀ 9994.0 and 6160.0

ppm) against *S. exigua* after 24 and 72 hrs, respectively under laboratory conditions. Also, mortality% increased with increasing the concentration of Rimth and Lantana extracts.

Table 2: Insecticidal activity of secondary metabolites of some wild plant against small cotton leaf worm (*Spodoptera exigua*) under laboratory conditions

| Treatment | Conc. (ppm) | Insecticidal activity after 24 hours of treatment | | | | | Insecticidal activity after 72 hours of treatment | | | | | | |
|------------------------|-------------|---|------------------------|------------------------|--------------|--|---|------|------------------------|------------------------|--------------|--------------------|------------------------------------|
| | | M.% | LC ₅₀ (ppm) | LC ₉₀ (ppm) | Slope ± S.E. | Toxicity Index (%) at LC ₅₀ | LC ₅₀ /LC ₉₀ | M.% | LC ₅₀ (ppm) | LC ₉₀ (ppm) | Slope ± S.E. | Toxicity Index (%) | LC ₅₀ /LC ₉₀ |
| <i>H. salicornicum</i> | 2500 | 15 | 8853 | 35645 | 2.12±0.42 | 100 | 0.248 | 27.5 | 5667 | 21202 | 2.24±0.40 | 100 | 0.267 |
| | 5000 | 27.5 | | | | | | 37.5 | | | | | |
| | 7500 | 40 | | | | | | 55 | | | | | |
| | 10000 | 50 | | | | | | 67.5 | | | | | |
| | 12500 | 70 | | | | | | 87.5 | | | | | |
| <i>L. camara</i> | 2500 | 12.5 | 9994 | 41852 | 2.06±0.43 | 88.58 | 0.238 | 27.5 | 6160 | 26179 | 2.04±0.39 | 91.99 | 0.235 |
| | 5000 | 25 | | | | | | 35 | | | | | |
| | 7500 | 37.5 | | | | | | 50 | | | | | |
| | 10000 | 47.5 | | | | | | 65 | | | | | |
| | 12500 | 62.5 | | | | | | 82.5 | | | | | |

Also, *H. hipponalis* affected by Rimth extract with LC₅₀ values 7744.0 and 5169.0 ppm more than Lantana extract with LC₅₀ values 8342.0 and 5716.0 ppm after 24 and 72 hrs, respectively (Table 3).

Table 3: Insecticidal activity of secondary metabolites of some wild plant against *H. hipponalis* under laboratory conditions.

| Treat. | Conc. (ppm) | Insecticidal activity after 24 hours of treatment | | | | | Insecticidal activity after 72 hours of treatment | | | | | | |
|------------------------|-------------|---|------------------------|------------------------|--------------|--|---|------|------------------------|------------------------|--------------|--------------------|------------------------------------|
| | | M.% | LC ₅₀ (ppm) | LC ₉₀ (ppm) | Slope ± S.E. | Toxicity Index (%) at LC ₅₀ | LC ₅₀ /LC ₉₀ | M.% | LC ₅₀ (ppm) | LC ₉₀ (ppm) | Slope ± S.E. | Toxicity Index (%) | LC ₅₀ /LC ₉₀ |
| <i>H. salicornicum</i> | 2500 | 15 | 7744 | 27431 | 2.33±0.42 | 100 | 0.282 | 30 | 5169 | 19530 | 2.22±0.39 | 100 | 0.264 |
| | 5000 | 30 | | | | | | 42.5 | | | | | |
| | 7500 | 45 | | | | | | 57.5 | | | | | |
| | 10000 | 60 | | | | | | 70 | | | | | |
| | 12500 | 72.5 | | | | | | 90 | | | | | |
| <i>L. camara</i> | 2500 | 12.5 | 8342 | 29793 | 2.32±0.42 | 92.83 | 0.279 | 27.5 | 5716 | 23053 | 2.12±0.39 | 90.43 | 0.247 |
| | 5000 | 30 | | | | | | 40 | | | | | |
| | 7500 | 42.5 | | | | | | 52.5 | | | | | |
| | 10000 | 55 | | | | | | 67.5 | | | | | |
| | 12500 | 70 | | | | | | 85 | | | | | |

The acute toxicity of *H. salicornicum* extract against the three Lepidoptera insects may be due to the presence of alkaloid compounds like anabasine (Schep *et al.*, 2009) [37]. Anabasine alkaloid has an insecticidal activity against *Pieris rapae* (Zammit *et al.*, 2014) [45]. Also, anabasine has a role in inhibiting the acetylcholinesterase enzyme (Karadsheh *et al.*, 1991) [23]. Asad *et al.*, (2023) [6] used *L. camara* water extract against *S. exigua* which exhibited low mortality comparing with our results may be due to the different solvent extraction and method of treatment. *L. camara* water

and acetone extracts gave moderate toxicity against *S. littoralis* at different concentration (Yacoub, 2013) [44].

Toxicity Effect of the treated plant extracts and Agerin as a bio insecticide on *S. littoralis*, *S. exigua* and *H. hipponalis* under field conditions.

When treating the second instar larvae of *S. littoralis*, *S. exigua* and *H. hipponalis* with Rimth and Lantana extracts compared with Agerin as a bio insecticide, it became clear

through the study the efficiency of the plant extract Rimth and Lantan after the first day of treatment, compared to the effect of bio insecticide in *S. littoralis*, *S. exigua* and *H. hipponalis*. The efficiency of Rimth extract was highest than Lantana extract after one day of treatment on *S. littoralis* and *S. exigua*. Meanwhile, Lantana extract was more effective than Rimth after one day of treatment on *H. hipponalis*. Date in Table (4) indicated that mortality of the 2nd instar of *S. littoralis*, *S. exigua* and *H. hipponalis* increased with increasing days after one, three and five days in Lantana extract and bio insecticide (Agerin) while, mortality of the 2nd instar of *S. littoralis*, *S. exigua*, *H. hipponalis* treatment with Rimth extract decreased after three days of treatment. The obtained results in Table (4)

Table 4: Corrected mortality percentage of the second instar of *S. littoralis*, *S. exigua*, *H. hipponalis* treated with some plant extract under the field condition on sweet potato cultivar.

| Insect pests | Treatments Conc. | Mortality after treatments % | | | | Total Mortality % |
|----------------------|------------------|------------------------------|--------|--------|-------|-------------------|
| | | One day | 3 days | 5 days | 7days | |
| <i>S. littoralis</i> | Rimth 2.1% | 89.20 | 97.02 | 97.35 | 95.12 | 94.67% |
| | Lantan 2.6% | 84.61 | 95.26 | 97.21 | 94.66 | 92.93% |
| | Agerin 6.5% WP | 92.90 | 97.84 | 100 | 100 | 97.68% |
| <i>S. exigua</i> | Rimth 2.1% | 85.09 | 98.30 | 96.92 | 96.39 | 94.17% |
| | Lantan 2.6% | 83.28 | 95.45 | 96.59 | 94.62 | 92.48% |
| | Agerin 6.5% WP | 94.38 | 100 | 100 | 100 | 98.59% |
| <i>H. hipponalis</i> | Rimth 2.1% | 88.01 | 96.58 | 94.11 | 92.05 | 92.68% |
| | Lantan 2.6% | 91.14 | 98.95 | 98.85 | 97.06 | 96.50% |
| | Agerin 6.5% WP | 91.29 | 100 | 100 | 100 | 97.82% |

The obtained results in Table (5) indicated that mortality of the fourth instar of *S. littoralis*, *S. exigua* and *H. hipponalis* increased with increasing days after one, three and five days in Rimth, Lantana extracts and bio insecticide (Agerin). Also the date in Table (5) showed that the total mortality percentage of the fourth instar larvae of *S. littoralis*

also illustrated that the total mortality percentage for the second instar larvae of *S. littoralis* for Rimth, Lantana and Agerin were 94.67, 92.93 and 97.63% respectively. Meanwhile, it was 94.17, 92.48 and 98.59% for the second instar larvae of *S. exigua*, while, it was 92.68, 96.50 and 97.82% for the second instar larvae of *H. hipponalis*. These results are in agreement with Ghoneim *et al.*, 2012^[18] and Redaet *et al.*, 2013^[34] proved that the *S. littoralis* could be affected by plant extracts and their active ingredients. (Yacoub, 2013)^[44] who mentioned that the lemongrass extract in water at 10% conc. on the 2nd larval instar and lantana extract in water at 10% conc. on 4th larval instar were the highest in efficacy as antifeedants.

treatment with Rimth, Lantana and Agerin were 91.3, 89.7 and 94.1% respectively. Meanwhile, it was 91.1, 90.1 and 94.7 % for the fourth instar larvae of *S. exigua*, while, it was 90.6, 93.1 and 94.4% for the fourth instar larvae of *H. hipponalis*.

Table 5: Corrected mortality percentage of the fourth instar of *S. littoralis*, *S. exigua*, *H. hipponalis* treated with some plant extract under the field condition on sweet potato cultivar.

| Insect pests | Treatments Conc. | Mortality after treatments % | | | | Total Mortality % |
|----------------------|------------------|------------------------------|--------|--------|--------|-------------------|
| | | One day | 3 days | 5 days | 7 days | |
| <i>S. littoralis</i> | Rimth 2.1% | 79.00 | 94.64 | 97.12 | 94.44 | 91.3% |
| | Lantan 2.6% | 77.33 | 91.84 | 96.94 | 93.00 | 89.7% |
| | Agerin 6.5% WP | 80.54 | 97.25 | 100 | 98.46 | 94.1% |
| <i>S. exigua</i> | Rimth 2.1% | 78.78 | 94.10 | 96.47 | 95.22 | 91.1% |
| | Lantan 2.6% | 75.40 | 93.51 | 95.77 | 95.83 | 90.1% |
| | Agerin 6.5% WP | 83.39 | 98.64 | 100 | 97.10 | 94.7% |
| <i>H. hipponalis</i> | Rimth 2.1% | 77.66 | 93.18 | 96.34 | 95.29 | 90.6% |
| | Lantan 2.6% | 82.19 | 96.14 | 98.03 | 96.03 | 93.1% |
| | Agerin 6.5% WP | 83.02 | 97.00 | 100 | 97.79 | 94.4% |

Leaflet Chemical Compositions of sweet potato plants and their relation with efficacy of some plant extracts against *S. littoralis*, *S. exigua*, *H. hipponalis*.

Data presented in Table (6) show the vegetative growth and yield and its components measurements of sweet potato plant variety Abees after treated with some plant extract and bio insecticide against larval of *S. littoralis*, *S. exigua* and *H. hipponalis*. The data indicated there were significant correlation between vegetative measurements and treated Abees variety with Rimth, Lantana extracts and Agerin bio insecticide compared with control. Leaf area, vine length, total yield of tuber were highest in treatment treated with

Agerin bio insecticide it were 0.73, 139.1 and 9.42 respectively, whereas the lowest one was 0.65, 131.6 and 8.59 treated with Lantana extract. Rimth extract was more efficacy than Lantana extract compared with efficacy with Agerin bio insecticide in Leaf area, vine length, total yield of tuber. There is no difficult correlation between treatment treated with Rimth and Lantana extract in total yield of tuber roots and marketable yield, Also there is no difficult correlation between treatment treated Agerin bio insecticide and Rimth extract in non-marketable yield of sweet potato plant.

Table 6: Simple correlation coefficient values between efficacy of some plant extracts against *S.littoralis*, *S.exigua*, *H. hipponalis*, vegetative growth and yield and its components measurements of sweet potato plants.

| Treatments Conc. | Leaflet chemical composition of sweet potato | | | | |
|------------------|--|---------------------|-------------------------------|---------------------|-------------------------|
| | Leaf Area(m ²) | Vine Length(m) | Total yield of tuber roots(t) | Marketable yield(t) | Non marketable yield(t) |
| Rimth 2.1% | 0.68 ^b | 134.1 ^{ab} | 8.61 ^b | 7.63 ^b | 1.58 ^b |
| Lantan 2.6% | 0.65 ^c | 131.6 ^b | 8.59 ^b | 7.41 ^{bc} | 1.87 ^a |
| Agerin 6.5% WP | 0.73 ^a | 139.1 ^a | 9.42 ^a | 8.64 ^a | 1.46 ^b |
| Control | 0.46 ^d | 117.4 ^c | 8.16 ^b | 6.93 ^c | 1.91 ^a |

In the same column, means followed by the same letter are not significantly different at 5% level according to Duncan's multiple range test

Data presented in Table (7) show the chemical analysis of sweet potato variety Abees after treated with some plant extract and bio insecticide against larval of *S. littoralis*, *S. exigua* and *H. hipponalis*. The highest treatment in carbohydrates treated with Agerin bio insecticide followed

by treatment with Rimth extract then Lantana extract 69.49, 66.33 63.61 respectively. The highest treatment in total sugar was treated with Agerin (9.06), while the lowest one was treated with Lantana extract (8.0). The highest treatment in K %, N %, P% treated with Agerin bio insecticide followed by treatment with Rimth extract then Lantana extract.

Table 7: Simple correlation coefficient values between efficacy of some plant extracts against *S.littoralis*, *S.exigua*, *H. hipponalis* and some chemical components of sweet potato plants.

| Treatments Conc. | Leaflet chemical composition of sweet potato | | | | |
|------------------|--|--------------------|-------------------|----------------------|-------------------|
| | N% | P% | K% | Total carbohydrates% | Total sugar% |
| Rimth 2.1% | 1.39 ^b | 0.142 ^b | 1.69 ^b | 66.33 ^b | 8.39 ^b |
| Lantan 2.6% | 1.31 ^c | 0.140 ^b | 1.64 ^b | 63.61 ^c | 8.00 ^b |
| Agerin 6.5% WP | 1.41 ^a | 0.15 ^a | 1.74 ^a | 69.49 ^a | 9.06 ^a |
| Control | 1.20 ^d | 0.130 ^c | 1.47 ^c | 58.81 ^d | 7.48 ^c |

In the same column, means followed by the same letter are not significantly different at 5% level according to Duncan's multiple range test

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