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Field studies to assess the efficiency of bio-extracts against the scourge of onion crops, *Thrips tabaci* Lindeman in Egypt

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ABSTRACT

Onion thrips (Thrips tabaci Lindeman) have become major pest invasive onion crops in Egypt. To propose an alternative to chemical control, the repellency or toxic effect of five plant extracts was evaluated against adult females thrips in the field. The materials used are: neem oil; neem leaves; Achook; lemon oil and garlic oil. The results indicated that all the extracts reduced the number of the tested insect pest and seed damage as well as increased seed yield by 2-3 times compared to the untreated control in the two seasons of investigation. Results of the present finding therefore suggest the alternative to chemical pesticides. It is safe for human; farm animals and environmentally friendly. The lemon oil and neem oil extracts showed superior efficiency in the management of the target pest in the field. Data also showed the increase % adult mortality after 72 h.. Achook powder had less effect on the % of adult mortality. The release of repellent or volatile masking substances into the air by associated plants may disrupt the olfactory orientation of onion thrips. In our studies, we revealed that the use of neem leaves and Achook affect on the response of onion thrips on flower volatiles. The main investigations which finding during and after treatments , suggest to cultivate onion crop in rows by alternative with other rows cultivate with another crop (example : 5 rows onion and other one by garlic) .

Keywords: plant extracts; repellence; *Thrips tabaci;* onion crops

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INTRODUCTION

Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), is the most important insect pest of onion, *Allium cepa* Linnaeus in Egypt and if uncontrolled, can reduce yield by as much as 85%, and about 60% in onion seeds. *Thrips tabaci* is a polyphagous species and a serious pest in field crops such as cotton; leek; strawberry and onion. Growers are currently limited to the registered organophosphate insecticides and fungicides for controlling different insects and diseases. In fields produce onion seeds, there is no program to control main enemy attack seeds. Both nymph and adult stages of thrips damage the tissue and destroy leaves by sucking the cell sap. Due to the attack of this pest, leaves curl up and in case of severe attack plants remain stunted at initial stage. Some growers complained of inadequate control at the time and suspect insecticide resistance but data generated in a previous study did not diagnose resistance. Chemical insecticides are costly, toxic to human and when used excessively may be harmful to the environment [1]. Hence the need for alternative control measures that exclude or minimise the use of synthetic insecticides in the management of onion pests. These botanicals are economical, environmentally safe, and less hazardous to humans and often less toxic to ecologically beneficial insects as well as the development of resistance by insect pests. Plant extracts contain many secondary metabolites, repellent; feeding deterrents and toxins, when have a role in defence against herbivores pests and pathogens. The release of repellent volatiles into the air by associated plants may disrupt the olfactory orientation of insect such as thrips. There is limited information the use of repellent against onion thrips. The use of repellent extracts, antifeedant and /or fumigant characteristics they

possess could be useful in developing integrating pest management strategies for thrips on onion [2]. To mitigate the hazards of chemical insecticides, the present study has been conducted to evaluate the efficacy of plant extract like: pure neem oil seeds (*Azerachita indica*), neem leaves powder ; Achook; garlic buble oil (*Allium sativum)* and lemon oil were screened against onion thrips [3]. The mixing of some botanical plant extracts could play a key role in the recommended program of for insect control [4]. More studies were carried out to assess the value of using insecticides of plant origin for controlling serious pests which attack important crops belonging to different orders [5-11].

MATERIALS AND METHODS

Field studies were conducted in 2015 and 2016 cropping seasons under semi dried conductions on the special farm in Menofyia governorate; the rain season usually began in December and latest till March. The experimental zone cultivate with onion in December 2014 in rows with distance about 40 cm. between each two hells and received all the agricultural practices normally (fertilization and irrigation) . Temperatures during the period varied from season to season 20-25℃ (2015) and 25-30℃ (2016). The soil type is clay -sand with organic matter content less than o.o4%. The field under for this study had an area of 1500 $m^{2.}$ The area divided into to 6 size plots. Each plot area except control divided into 5 replicates. The distance between each two plots is about two meters. The materials used include neem seed oil; neem leaves; Pakestanian commercial product (Achook , neem based) ; Lemon oil and garlic bulb oil. The plots were arranged in randomized complete block design.

Field applications using different materials were start at the beginning of bloom (April 2015 and 2016) stage just two days before the opening of flowers. Weekly during April month, spraying applications started from 10.0 am. to 12.p.m. The knapsack sprayer (20 lit. capacity) was used. The spraying applications period continued till the black seeds observed by necked eye inside flowers (about one month). The thrips pest sampling was taken from 7.00 am. to 9.00 am. weekly. The onion thrips was sampled by random picking of five flower/plot (flower contain about 600 to 700 small flowers). The flowers were placed in glass jars (250 $cm^{3)}$ and then transfer to laboratory where dissected directly at the same day and the number of thrips individuals (alive or died) was recorded. During the experimental period, the number of thrips in each material used and the number of death flowers were recorded. One day before spraying applications, the number of thrips individuals were recorded in randomize sample collected flowers. After 24 h.; 48 h.; and 72 h. from spraying time the samples were collected and inspect in the laboratory . Mature seeds (black seeds) yield was recorded from each plot (5 plants /plot), the seeds weight and recorded. Another 15 plants were randomly inspected by necked eye per plot for signs of phytotoxicity two days after each spraying just before the next spray. Starch powder was used and add to all treatments as sticker , also tween droplets were add as emulsifier (3 droplets/lit.) . All data were analyzed using analysis of variance (ANOVA) and treatment means were separated by Student Newman Keuls test at 5% (SAS institute, 1989). Percentage corrected mortality was determined using Abbot Formula (1925).

$$\% \text{ corrected mortality} = \frac{\text{observed mortality - counted mortality x 100}}{\text{100-\% control mortality}}$$

Preparation of tested materials:

1- Neem oil (the tree grow in Egypt)

Neem seeds were collected from wild neem trees and then dried in sun shine for about 15 days . After dehulling oil extraction was carried out from dried seeds kernels by hydraulic press and soxhault apparatus using n-hexane as a solvent [12]. The 4% solution was prepared in ethanol which was just for the treatment.

2- Neem leaf powder

One kg. of fresh leaves were plucked from neem trees. The leaves were dried in a oven at 75 ^{0}c for the period of 3-4 days. The dried leaves were ground separately into a fine powder. The leaf powders were sieved into a particle size of 150 µl with a standard sieve and 50 g powder of each was weighed into one litre round bottom flask before a 400 ml. ethanol was added into it. The mixtures were thoroughly shaken with mechanical shaker for one day and allowed to settle overnight and later decanted and the solutions were then filtered and evaporated in a rotary film evaporator to get the solute [13].

3- Lemon oil (commercial product in market, 5 gm per litre +2 droplets tween + 1 gm. starch).

4- Achook (commercial insecticides, Pakistainian product). Achook is a neem (*Azadirachta indica)* based insect antifeedant/repellent containing 2800 ppm neem compounds , the recommended dose is 5 gm per liter.

5- Garlic bulbs oil, (in the market)

The experimental zone was sprayed four times at an interval of one week . The first spray was carried out on 1st April in both seasons (2015 & 2016) when the thrips reached the economic threshold level. One day Before treatment the number of thrips were recorded in flowers . After treatment or spraying the plots 24 h. ; 48h. and 72h. the plants inspected to determine the effect of materials used . Percent corrected mortality was determined using Abbot Formula (1925).

RESULTS

Field applications of extracts commenced with the period of onset of flowers of onion plants. The results of the investigation showed the neem oil and lemon oil have high insecticidal potentials and significantly (P< 0.01) reduced the incidence of thrips onion damage compared to untreated check. The application of neem oil; lemon oil and garlic oil considerably represented the priority. This is evident on the population of the target pest on onion. Similarly, the application of other tested materials also reduced significantly the damage of these post-flowering period, but it differed significantly lower from that of neem extracts. Thus, although all the treated plots had significant control of thrips and while Achook powder was less effective than others. Control plots differed from the treated plots and had the highest level of infestations of pest through the two seasons. The application of garlic oil ;lemon oil and neem oil extracts significantly reduced the incidence of these post -flowering pests of onion throughout the experimental period . However, it differed significantly higher than the used neem leaf and Achook powder . The neem oil and lemon oil extracts showed superior efficiency in the management of the target pest in the field. The untreated plots (control) differed from the treated plots and had the highest level of infestations. Table (1) showed that lemon oil extracts controlled thrips adults and the % of adult mortality increased as follow: 51.2% in 24 h.; 55.2% in 48 h. ; 63.7% in 72 h. with average of 56.7% . In second spray, it controlled thrips population as follow: 46.2% in 24 h.; 50.7% in 48 h. and 55.4% in 72 h., while the least effect observed on data recorded from plots treated with Achook powder. The percentage of adult mortality in all treatments ranged between 313% to 56.7% through the experimental period (four weeks) (Table 1, season 2015). (Table 2 , season 2016) showed that the observed data is similarly with that obtained and recorded in 2015 season, with some exception due to the fluctuation conditions (temperatures and wind orientation). From the data recorded in Table (2), the percentage of adult mortality increased for all applications within three days after application. Table (1) showed that the average percentage of adult mortality ranged between 35.8% to 56.7% ; 22.5% to 50.8% ; 31.2% to 47.2% and 31.3% to 43.9% in 1^{st} ;2^{nd} ;3^{rd} and 4^{th} spray in 2015 season, respectively. On the other hand , the observation on Table (2) data revealed that there are some factors effect on the population fluctuations of thrips individuals such as the main crop cultivated in the area near the onion crop field (experimental zone). The data indicated that the percentage of adult mortality increased compared with data in table (1). In 1^{st} ;2^{nd} ;3^{rd} and 4^{th} spray during season 2016 (Table 2) the average % of adult mortality ranged between 39.4 to 60.7 ; 37.3 to 53.4 ; 28.8 to 52.3 and 32.2 to 47.9% respectively. On the other hand, the aqueous extracts of neem leaf and Achook was inferior degree to the other extracts on most of the parameters tested. Throughout the experiments period, the incidences of these insects were more sever during the 2015 farming season than the 2016 season.

The results on seed yield (Table 3) showed significant relationship between the incidence of the pest and plant extracts applications which effect on yield quantity and quality. The untreated control plots recorded the highest number of damaged flowers and least total seeds yield and were significantly inferior to the other extracts applied. Lemon oil extracts is the most important botanical extracts for controlling onion thrips. The yield amount is 155.6 kg/ feddan ; 150.9 kg/feddan ; 143.3 kg/feddan ; 121.4 kg/feddan and 65.1 kg/feddan recorded in plots treated with lemon oil; neem oil; garlic oil; neem leaf powder and Achook powder respectively (Table 3). In 2016 season, the yield seeds ranged between 74.5 to 163.1 kg/feddan (Table 3). The data in Table (3) shows that there is no significant differentiation between the two seasons. However, plots treated with neem oil; garlic oil and lemon oil were found to be superior over than other extracts by producing higher yield (Table 3). The untreated control plots recorded the highest number of damaged seeds and least yield quantity.

DISCUSSION

The results showed that the application of insecticides of plant origin on onion crops at bloom stage significantly (P< 0.05) reduced the adult populations of *Thrips tabaci* Lindeman when compared with untreated plots, which suggesting the importance of technology in the management of pests. The use of botanical extracts (crude or extracts) for the controlling or avoid crops have been recorded as one of the oldest methods highly success methods [14]. The high effect of the treated materials could be attributed to insecticidal properties they contain that are lethal to a wide range of insects including thrips [15]. Concerning the high effect of neem oil or lemon oil may be attributed to its genetic property that posses better insecticidal properties that enhanced its performance. The use of Achook powder for controlling onion thrips , which less effect on the thrips adults may be due to the less release of volatile oils . These results suggest that odour is the main stimulus for upwind flight to the cue and after landing on the visual cue thrips continue searching for the odour source by walking. [16]. reported that due to over use of chemicals , botanicals are used as alternative technique for the control of sucking insects . The aqueous neem oil or other derivates is applied in all the world which cause mortality at nymph ; adult stage and eggs . Some researches [17] , which indicated that combining two or more plant extracts in botanical formulations is more potent that when only one plant materials is used. Further studies are required to ascertain their optimum levels and spraying schedules for optimum onion seed yield.

Table (1). Efficacy of some botanical extracts against onion thrips (2015)

Plant extracts	Dose	Adult mortality (%)															
		First spray				Second spray				Third spray				Fourth spray			
		24 h.	48 h.	72 h.	Average	24 h.	48 h.	72 h.	Average	24 h.	48 h.	72 h.	Average	24 h.	48 h.	72 h.	Average
Lemon oil	6.5%	51.2	55.2	63.7	56.7	46.2	50.7	55.4	50.8	45.7	46.3	49.7	47.2	48.7	44.4	44.5	43.9
Neem oil	6.5%	46.4	48.1	65.1	53.2	44.1	45.0	55.1	48.0	41.1	42.0	52.1	45.1	40.1	40.0	49.2	43.1
Garlic oil	6.5%	33.1	36.1	38.2	35.8	33.1	33.2	34.4	33.6	31.3	30.8	31.4	31.2	34.2	30.3	29.4	31.3
Neem leaf	6.5%	42.0	44.7	48.1	44.9	40.1	42.0	44.0	42.0	40.7	40.3	43.5	41.5	42.8	49.1	40.3	44.1
Achook	5gm/lit.	46.2	50.3	54.2	50.2	45.1	48.0	49.0	47.4	43.3	44.1	48.6	44.3	40.2	42.3	44.3	42.3
Control		309.7				440.1				460				511.2			
S.E.		4.4	8.3	5.2		5.3	6.7	4.2		4.9	5.5	7.1		4.0	6.8	8.7	
F.		7.1	5.6	4.9		6.6	7.1	6.2		5.5	4.9	7.5		6.8	7.3	8.1	
P.		0.007	0.11	0.24		o.o8	0.34	o.oo9		0.04	o.o2	o.o1		o.oo7	o.o1	o.o42	

Table (2). Efficacy of some botanical extracts against onion thrips (2016

Plant extracts	Dose	Adult mortality (%)															
		First spray				Second spray				Third spray				Fourth spray			
		24 h.	48 h.	72 h.	Average	24 h.	48 h.	72 h.	Average	24 h.	48 h.	72 h.	Average	24 h.	48 h.	72 h.	Average
Lemon oil	6.5%	55.1	56.8	70.1	60.7	48.6	51.4	60.2	53.4	46.1	48.2	45.3	46.5	50.7	46.1	45.2	47.3
Neem oil	6.5%	43.2	46.1	64.3	57.2	47.3	48.1	57.8	51.1	44.8	42.0	62.1	52.3	49.6	40.2	50.9	47.9
Garlic oil	6.5%	35.6	40.2	42.3	39.4	35.7	34.9	41.2	37.3	31.9	31.2	33.4	28.8	35.2	30.1	31.2	32.2
Neem leaf	6.5%	40.3	40.6	65.0	41.7	44.5	48.1	44.2	45.6	43.8	51.2	48.3	43.8	44.3	52.2	43.1	45.9
Achook	5gm/lit.	47.9	50.9	54.3	51.0	47.2	52.1	53.2	50.8	45.1	49.0	42.9	44.0	45.1	49.1	45.7	45.3
Control		420.8				590.7				618.3				311.8			
S.E.		5.2	7.7	4.3		4.2	5.0	3.1		4.1	5.2	6.1		5.2	5.3	6.1	
F.		5.1	5.4	5.2		4.2	6.2	6.1		3.8	4.4	4.7		5.1	7.2	7.4	
P.		o.01	0.03	0.034		0.04	0.09	0.06		0.05	0.02	0.11		0.006	0.015	0.044	

Table (3). Effect of the plant extracts on yield (2015 & 2016)

Treatments	Yield kg/Fed.	
	2015	2016
Lemon oil	155.6±4.9	16309±5.5
Neem oil	150.9±4.1	157.8±6.7
Garlic oil	143.3±5.2	149.9±7.2
Neem leaf	121.4±4.3	136.9±5.0
Achook	105.0±3.3	119.9±4.1
Control	65.1±7.1	74.8±5.6

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