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Control of Some Leaf Miners on Some Legume Plants by Freezing and High Temperatures

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ABSTRACT

The legume plants as infested with different leaf miners which cause considerable damage in both quantity and quality of the grains. Some of the species are great of economic importance as *Liriomyza trifolii* (Burgess) known as the primary pest on broad bean, *Vicia faba* L. and *Liriomyza congesta* (Backer) known as the primary pest on common bean *Phaselus vulgaris* L..The use of high temperature is a well-known technique to control stored product pests. High and low temperature has an effect on increasing susceptibility of all life stages and species. There was a significant decrease in the exposure time estimated to achieve target levels of mortality in nearly all cases with each increase and decrease in temperature.

The control of insect by freezing, egg and pupal stages were most susceptible but larval and adult stages were more tolerant to temperature for *L. trifolii.* While *L. congesta* adult stage was most susceptible than other different stages and required time less than *L. trifolii* to obtain mortality 100% for all different stages.

The control of insect by higher temperature over 40 °C up to 60°C also considered good method for control of all different stages of *L. congest* and *L. trifolii* and as temperature increase time required to reach 100 % mortality was decreased .However, *L. trifolii* was more heat tolerant *L. congesta.* High temperature up to 60°C has little side effect, while 70°C cause great side effect on seed germination.

KEYWORDS

Leaf Miner Insects Legum Plants Temperature.

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INTRODUCTION

Leaf miners have spread rapidly throughout vegetable crops and are considered one of the primary causes of yield losses.

Mortality rate of insects depended on species of insect and also on its stage. On the other hand, mortality rate reached 100 % in period up to 7 days by freezing (-15 and -10°C) for all stages of each insect and also mortality reached 100 % in time up to 6 hours by high temperature (50, 60 and 70°C) for all stages of each insect.

As a result of the climatic changes that happened in Egypt and its reflection on insect behavior and biology, also the continual development of modern method of insect control as an alternative to chemical controland from this come the idea of work.

The main insect pests infesting legume plants, cause serious damage to the plant and yield, at temperature that ate not instantly lethal, insects die through heat stress and dehydration heat can also make insects more susceptible to other methods of treatment **Civelek, *et al.* (2003)** and **El-Sayed *et al.* (2007)**

The present work was carried out to evaluate the effect of some ecological factors such as the temperature degree, relative humidity for insect control.

MATERIALS AND METHODS

Effect of freezing and high temperatures on mortality of insects:

Freezing

Each treatment contain one hundred of the developmental stages eggs, larvae, pupae and adults of the two tested insect species were exposed to two low temperature degrees (-10°C and -15°C) in deep-freezers. Mortality rate was determined after 1, 3, 5 and 7 days, three replicates were used for each treatment.

High temperature

Three degrees of high temperature as 50, 60 and 70°C were tested against the developmental stages (eggs, larvae and pupae) and adults of the tested insect species. The periods of insect exposure to the two tested temperature degrees were 2, 4 and 6 hours. Three replicates were used for each treatment. Each contained one hundred of samestage.

Effect of freezing and high temperature on broad bean grains

Germination

These tests were carried out in laboratory to evaluate the effect of grains exposure to high and low temperatures on germination ratio after 7 days from planting and its chlorophyll contents after 10 days from planting. Three samples of 20 seeds were placed separately on a surface of a ‘layer of cotton wool placed in Petri dish (6x1 cm). Cotton wool layers were wetted thoroughly with a tap water every day, according to **Awadalla (2006).**

Germination of seeds was determined after one week of plantation by counting the viable seeds and the germination percentages were calculated for each sample.

Chlorophyll content:

Chlorophyll content of the seedlings leaves in grains of the same previous treatments was recorded after 10 days of plantation and estimatedaccording to **Witham *et al.* (1971).**

Statistical analysis

The data were statistically analyzed by using the SAS program by Duncan grouping according to **SASInstitute (1985).**

RESULTS AND DISCUSSION

Effect of freezing and high temperatures on mortality of insects:

Freezing

Results presented in Table (1) showed the effect of two freezing temperature -10 and -15°C as a safe control method against differentstages of *L. trifolii* and *L. congest*. Results showed that at -10°C the mortality rates of the differentdevelopmental stages of *L. trifolii* reached 100% after 3 days foreggs, 7 days for other stages except the pupae which reached 100% mortality after 5 days. This indicated that the egg stage was the most susceptible followed by pupal stage then larvae and adults.

At -15°C, the time required to attain a complete mortality was slightly decreased than at -10°C. The egg stage was the most susceptible one. Mortality rate was 100% after 3days for egg stages, while it was after 5days for new larva, old larva, pupa and adult stages for *L. trifolii*.

On the other hand data given in table (1) revealed that in case of *L. congesta* complete mortality100 %at -10 °C were reached after 3, 3, 5, 3 and 1 days for egg, new larva, old larva, pupa and adult stage, respectively, at -15°C the complete mortality reached after 1, 1, 3, 3 and 1 days for egg, new larva,-old larva, pupa and adult stage, respectively. The adult stage was the most sensitive at both -10 and -15°C, where time required to kill 100% was 1 day for each.

According to the data in Table (1) it was clarified that different stages of *L. congest* were controlled in shorter time than these of *L. trifolii* which needed at least 7 days while *L. congest*needed 5 days.

High temperature

Three degrees of high temperature 50, 60 and 70°C were tested as a safe control method against all different stages of both *L. trifolii* and *L. congesta.*

The results obtained are given in Table (2) and revealed that the mortality rates of different stages *L. trifolii* increased as exposure periods of temperature increased. Mortality reached 100 % at 50 and 60°C after 6 hours for all stages of *L. trifolii* and after 4 hours at 70 °C for all stages.

To reach 100 % mortality in different stages of *L. congesta* was after 4 hours at 50°C and 60°C, while it was after 2 hours at 70°C of exposure period

Table (1) *Mortality percentage of L. trifolli and L. congest stages as induced by freezing.*

Stage	Time (days)	*L. trifolli*		*L. congest*	
		-10°C	-15°C	-10°C	-15°C
Egg	**1** **3**	54 100	61 100	65 100	100 --
New larva	**1** **3** **5** **7**	0 36 72 100	0 70 100 --	60 100 -- --	100 -- -- --
Old larva	**1** **3** **5** **7**	0 0 40 100	0 20 100 --	20 74 100 --	57 100 -- --
Pupa	**1** **3** **5**	0 62 100	0 73 100	33 100 --	40 100 --
Adult	**1** **3** **5** **7**	12 72 86 100	0 85 100 --	100 -- -- --	100 -- -- --

Table (2) *Mortality percentage of L. trifolli and L. congest stages as inducedby high temperature.*

Stage	Time (hours)	*L. trifolli*			*L. congest*		
		50°C	60°C	70°C	50°C	60°C	70°C
Egg	**2** **4** **6**	0 61 100	13 77 100	69 100 --	60 100 --	82 100 --	100 -- --
New larva	**2** **4** **6**	0 76 100	12 87 100	86 100 --	57 100 --	83 100 --	100 -- --
Old larva	**2** **4** **6**	0 70 100	11 83 100	66 100 --	57 100 --	81 100 --	100 -- --
Pupa	**2** **4** **6**	0 88 100	20 91 100	79 100 --	51 100 --	79 100 --	100 -- --
Adult	**2** **4** **6**	18 79 100	25 88 100	79 100 --	57 100 --	73 100 --	100 -- --

Effect of freezing and high temperature on grain of broad bean.

Germination test

Effect of freezing grains at -10 and -15°C for one week or exposure to 50°C and 60°C for 6 hours and 70°C for 2 hours on germination test of broad bean grains is presented in Table (3).

Data showed that insect control by freezing and high temperature had no huge side effect on bean germination where germination ratios at -10°C and -15°C were 81.7 and 70% respectively, while abnormal form ratios were 11.7 and 1 1.7 %, respectively compared to 91.7% germination ratios and 6.7% abnormal form ratios for control. The lowest germinated grain was recorded at -15 °C as 70 % and abnormal forms ratio as 11.7%, respectively.

Also high temperature up to 60°C had a little side effect on germination test while insect control by 70°C has great side effect on germination ratio of broad bean grains. On the other hand, for the high temperature, the greatest germinated grains was at 50°C and registered 65% and its abnormal forms ratio was 11.7% while at 60°C they were 53.3 and 23.3% while at 70°C they recorded 1.7 and 6.7% compared to 91.7 and 6.7%, respectively for germination ratios and abnormal forms ratios per control, respectively.

Table (3) *Effect of different temperature on germination and chlorophyll content of broad bean grains.*

Parameter	-10°C	-15°C	50°C	60°C	70°C	Control
Germination ratio	81.7	70.0	65.0	53.3	1.7	91.7
Abnormal germination ratio	11.7	11.7	11.7	23.3	6.7	6.7
Chlorophyll (mg/gm dry weight)	17.1	16.5	19.4	17.8	--	17.9

The use of high temperature is a well-known technique to control stored product pests. For example, temperature above 40°C are lethal for most stored food pests **(Sallam, 2007).** Adult emergence of *Liriomyza* spp. can be totally suppressed after exposing their pupae to 45°C for 72 hours. However, low temperature treatment of grains may also provide a degree of control **(Sharma *et al.*, 1997).**

However, in the application of high temperature treatments for disinfestation, in which acute thermal stresses are applied heat shock protein may play a very important role thermal tolerance to a subsequent normally lethal heat treatment of 90 min at 45°C. this thermal tolerance decayed over time, but lasted 72h., beyond the time over which the originally induced were degraded (24h.),this was an excellent example of how pre-conditioning of an insect can confer thermal tolerance to a subsequent higher treatment, but this effect is not necessarily being related to heat shock proteins; other factors may participate in thermal tolerance **Mahroof (2003**).

The cuticle is also sensitive to temperature changes. The wax of the cuticle is important in protecting theinsects from its external environment and maintaining water balance. High temperatures can alter the wax complex to become more fluid and may lead to desiccation **(Hepburn, 1985).** The effects of high temperature on insect mortality in low humidity environments may be compounded with desiccation stress **(Beament, 1959).** However, a high temperature treatment in a highly saturated environment may lead to drowning, primarily due to the loss of circular protection of the spiracles leading to the treacheoles.

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مكافحة بعض صانعات الأنفاق على بعض النباتات البقولية باستخدام التجميد والحرارة المرتفعة

عفاف عبد الوهاب عباس[1]– حورية عبد الوهاب[2]– نعمة عبدالحميد[1]– سامية عبد الفتاح[2]– إيمان السعيد[1]

تصاب النباتات البقولية بالعديد من صانعات الأنفاق التي تسبب تدمير لكميه وجودة الحبوب . ويوجد بعض الأنواع من الحشرات صانعه الأنفاق ذو الأهمية الإقتصادية الكبيرة مثل ذبابه الفول البلدي ويعد العائل الرئيسي لها نبات الفول وأيضا ذبابة الفاصوليا والعائل الرئيسي لها نبات الفاصوليا. إستخدام درجات الحرارة من افضل طرق المكافحة علي أفات الحبوب المخزونة وذلك لأن درجات الحرارة العالية والمنخفضة لها تأثير علي زيادة حساسيه كل المراحل في دورة حياة الحشرات صانعة الأنفاق. والفرق المعنوي يختلف باختلاف وقت التعريض لدرجات الحرارة المختلفة حتي الوصول لنسبه موت ١٠٠٪ في كل المراحل . مكافحة الحشرات باستخدام التجميد لكل مراحل حياة الحشرة ولقد أوضحت النتائج أن مرحله البيض والعذراء كانت أكثر حساسية من اليرقة والطور البالغ فقد كانوا اكثر تحمل لدرجات الحرارة كما في ذبابة الفول البلدي بينما ذبابة الفاصوليا كانت مرحلة الطور البالغ اكثر تحمل عن بقية المراحل و قد تتطلب وقت اقل عن ذبابة الفول البلدي للحصول عل نسبة الموت ١٠٠٪ لكل مراحل الحياة . أوضحت مكافحة الحشرات باستخدام درجات الحرارة العالية ٦٠،٤٠ درجة مئوية أنها تعتبر من افضل طرق المقاومة لكل المراحل المختلفة في دورة حياة كل من ذبابة الفول البلدي وذبابة الفاصوليا ومع زيادة درجات الحرارة يتم الوصول لأعلي نسبة موت ١٠٠٪ ويقل وقت التعريض وبالرغم من أن ذبابة الفول البلدي أكثر تحمل من ذبابة الفاصوليا الي أن استخدام درجات الحرارة عند ٦٠ درجة مئوية يكون ذو تأثير أقل علي جودة الحبوب بينما عند استخدام ٧٠ درجة مئوية يكون ذو تأثير ضار ومدمر علي جودة وإنبات البذور .

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