EFFICIENCY OF PROTECTIVE BARRIER APPROACH FOR CONTROLLING MOVEMENT OF LARGE INSTAR LARVEA OF THE COTTON LEAFWORM, *SPODOPTERA LITTORALIS* (BOISD.)

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Abstract

A protective barrier approach was suggested as to avoid the movement of large instar larvae of the cotton leafworm from one crop to another specially at harvesting time. Chemicals of different groups were used for this study: inorganic salts group (calcium sulfate gypsum and sodium chloride) alkaline group (calcium hydroxide slaked lime and sodium hydroxide), acidic group (sulfuric acid), oils (tar oil), sulfur (agriculture sulfur) and conventional insecticide (malathion 1% DP). Sodium chloride, sodium hydroxide ,sulfuric acid and tar oil were prepared as dust powder contained 7.5 % a.i. diluted with talc powder, while the other powders were used as it is without dilution. The protective barrier was made by spreading of each material powder in a circle shape on plastic sheet. Then, ten larvae of each instar larvae fourth, fifth and sixth were transferred to the central zone of the barrier. Fresh castor bean leaves were put out the barrier as attractive and feeding material to larvae. Number of escaped larvae, dead and alive larvae inside or outside the barrier after 24hrs exposure were counted. To study the latent effect on the alive larvae, of each treatment, they were collected and fed with fresh castor leave bean until to pupation stage, percent of larval mortality , pupation and moth emergency were calculated .The efficiency of barrier for protecting crops against larval attacks was determined by calculating the consumed food by the rest alive larvae during 48hrs exposure for each treatment compared with untreated .To clarify the residual activity of the tested barriers, the same procedure was carried out after 3 and 7 days of barrier spreading.

Results obtained indicated that malathion 1% DP achieved the highest activity since all passed and unpassed larvae through the barrier were killed and did not cause any damage, Moreover, malathion showed the same effect up to 3 and 7 days of spreading the chemical barrier. The other tested materials had a weak effect on passing and killing larvae within 24 hrs. exposure but their latent effects on larval mortalities, pupation and moth emergency percent were increased. They showed moderate effects on larval feeding, specially with the locally formulated material.

Finally, it could be recommended the application of malathion 1% Dp as a protective barrier for controlling movement of large instar larvae of the cotton leafworm. The other materials prepared as dust powder could be applied with higher active ingredient contents (>7.5%).

INTRODUCTION

Usually, large instar larvae of the cotton leafworm move after harvesting time especially from clover and cotton fields to adjacent ones and cause great damage on attacked plants. In 1998, at El-Behera governorate, larvae of this insect were moved from cotton fields to adjacent clover seedlings and destroyed large area. At this period, efforts were concentrated on spraying clover seedlings with oil (Badr *et al.*, 1999 and Hindy *et al.*, 1999) .

In 2007, at Kafer El-Zayaat villages, Gharbia governorate, larvae of the cotton leafworm were moved after harvesting clover to adjacent vegetable crops. Also, larvae walked through village roads and entered. to farmer houses. Accordingly, Farmers Faced this problem by spraying all attacked crops, roads and houses by conventional pesticides. Also, slaked lime as a barrier was used for stop movement of larvae. The method of using protecting barriers for controlling land snails (Toit *et al.,* 1992, Dawson *et al.*, 1996 and Iskandr 2002) by spreading the toxicant material prepared as dust powder around field border to prevent land snail access was suggested in this research as a solution of this problem as it considered easy in application , economic and cause no pollution for field crops.

The aim of this investigation was to determine the efficiency of some locally prepared chemicals either as diluted dust powder or used without dilution. In addition, one of conventional insecticide namely malathion 1% dry powder was used as protecting barrier for stop the cotton leafworm larvae movement to adjacent fields. The following criterion were considered:

- The effect of barriers on larvae movement.
- Initial, latent and developmental effects of this method on larvae.
- Effect of treatments on damage caused by larvae.

MATERIALS AND METHODS

Materials

Local experimental chemicals used in this study are belongs to different functional groups : inorganic salts (calcium sulfate (gypsum) & sodium chloride), alkalines (calcium hydroxide (slaked lime) & sodium hydroxide) , acidic compound (sulfuric acid) and tar oil , agricultural sulfur. Talc powder was used as diluent .

Conventional insecticide, namely malathion 1% dry powder produced by Kafr El-Zayat Co. for Pesticides and Chemicals Egypt, was tested.

Methods

Calcium sulfate (gypsum), calcium hydroxide and agricultural sulfur powders used directly for preparing protective barriers, while sodium chloride, sodium hydroxide, sulfuric acid and tar oil were prepared as a dust powder 7.5% a.i. using talc powder as diluent according the following method

1- preparation of experimental material as dustable powder 7.5%

Materials were prepared as dust powders by using dray mix method (Furmidge, 1972). 7.5g of each material was mixed thoroughly with 92.5g talc powder and sieved through 75 micron sieve twice for complete homogeneous mixing.

2- Determination the barrier efficiency of the tested materials against larvae

Tested dust powders were spread as a circle shape (26 cm diameter with 5 cm wide) on plastic sheet. The amount of each material required for making the strips of protecting barrier were calculated. To study the efficiency of barrier , ten larvae of each instar (fourth, fifth, sixth) were transferred to each plastic sheet inside the barrier. Fresh castor bean leaves were put out the barrier as attractant and feeding material to larvae. The same experiment was repeated after 3 and 7 days of spreading the chemical barrier to clarify the residual effect against larvae .

The following effects were studied and recorded:

a- Movement of larvae: the numbers of escaped larvae of each instar larvae were recorded after 24hrs. from the beganning the experiment according to Sakovich,1996. Also, numbers of dead and alive larvae inside or outside the barrier were counted.

b- Latent and developmental effects on alive larvae: Alive larvae of each treatment was collected and transferred to glass jar provided with fresh castor bean leaves till pupation.

c- Toxicity effect: It was determined by recording the numbers of dead larvae into two days intervals up to pupal stage .

d- Pupation and moth emergance percentages: They were estimated according to El-Sisi and Farrag, 1989.

3- Damage effects: The consumed amounts of leaves by larvae through 24 hrs were recorded. The weights of leaves before and after feeding period 24 hrs. compared with untreated ones were recorded. The protection efficiency was calculated according to El-Sherbiny *et al .,* (1994) equation:

$$\% \text{ Protection} = \frac{\text{consumed wt. control} - \text{consumed wt. treatment}}{\text{consumed wt. control}} \times 100$$

RESULTS AND DISCUSSION

Efficiency of chemical barrier on larval movement

Results in Table (1) indicated that the most economic and effective amount required for barrier efficiency was achieved with malathion 1% DP, followed by calcium sulfate. while Also, data showed that the most effective of the protective barrier was occurred as a result of contamination of larvae with powders during trying of escape. It caused death on passed and unpassed larvae. Malathion 1% DP was the most effective material since it caused the highest mortalities for passed and unpassed larvae while the other treatment did not achieve suitable percentage mortalities or did not prevent passing of larvae through the barrier. It could be mentioned that the residual activities of all tested chemicals after 3 and 7 days were the same as initial.

Latent and developmental effects on larvae

Data in Table (2) indicated that malathion was achieved the highest toxicity against larvae followed by sulfuric acid, tar oil, sodium hydroxide and calcium sulfate. The tested chemical barriers were decreased both % pupation and moth emergence , malathion achieved complete inhibition on pupation and moth emergence, followed by sodium chloride, sodium hydroxide, tar oil, sulfuric acid, calcium sulfate and sulfur. The same effects were recorded after 3 and 7 days.

Such effects of tested inorganic salts are agree with the findings of El-Sisi and Farrag, 1989 and Abdel-wahab and El-Sisi, 2001 while the effects of acidic and alkaline materials are agree with Abu-Lila *et al.*, 1999. The effects of volatile materials (tar oil and sulfuric acid) are agree with El-Sisi and Mahgoub,1999.

Effects on food consumption

Results in Table (3) showed the leaf consumption caused by the rest alive larvae in relation to the tested barriers during the experiment. The calculated % protection efficiency clearly indicated that malathion was achieved complete protection for crop up to 7days of barrier application but the following remarks could be considered on the other barrier treatments:

- Talc when used alone showed slight protection, but when talc was as diluent in sodium chloride, sodium hydroxide, sulfuric acid and tar oil formulations it proved more efficiency.
- Chemical barriers used directly without dilution [calcium sulfate (gypsum), calcium hydroxide (slaked lime), sulfur and talc] showed different performances. Calcium hydroxide showed the highest protection, followed by talc and calcium sulfate while sulfur gave the least effects .
- Tar oil and sulfuric acid formulations showed the highest initial kill which decreased gradually up to 7days of treatment as a result of their volatility from diluent material.

- Initial kill of sodium chloride and sodium hydroxide dusts were less than tar oil and sulfuric acid preparation. They gave the same performance up to 7days of application.

According to mean % protection, it could be said that malathion showed complete protection up to 7days of application, followed by tar oil DP, sodium chloride DP, sodium hydroxide and calcium hydroxide which gave mean % protection more than 40% while talc, calcium sulfate and agricultural sulfur showed the least effect.

The mode of action of the tested chemicals could be explained as follows: malathion works as nervous toxicant since it act an inhibitor to acetylcholine esterase enzyme (O'Brien, 1967), the toxic effect of inorganic salts may be due to loss a part of insect water content as a result of osmotic force (Steward, 1958) the toxic effect of acidic material (sulfuric acid) and alkaline materials (sodium hydroxide and calcium hydroxide) is due to impairment of cuticle layer of the pest (Abo-lila, 1999).

Generally, it could be recommended to apply malathion 1% DP barrier for controlling the movement of larval stage of the cotton leafworm. The other matrieals are not suitable therefore other formulation contained high concentrations more than 7.5% of (sodium chloride, sodium hydroxide, sulfuric acid and tar oil) should be prepared and tested as protective barriers against larvae of cotton leafworm.

Table 1. Effects of chemical barriers on the numbers of passed & unpassed , dead & alive larvae of *S. littoralis* inside and outside the barrier.

Treatment		Calcium sulphate				Sodium chloride				calcium hydroxide				Sodium hydroxide				Sulphoric acid				Sulfur				Tar oil				Talc				Malathion				Untreated			
		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed		passed		unpassed	
		A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D
Zero time	4th instar	6	3	0	1	9	1	0	0	10	0	0	0	8	2	0	0	5	2	0	3	5	1	0	4	10	0	0	0	10	0	0	0	2	5	2	1	10	0	0	0
	5th instar	8	0	0	2	8	2	0	0	10	0	0	0	10	0	0	0	9	1	0	0	10	0	0	0	9	1	0	0	10	0	0	0	0	5	1	4	10	0	0	0
	6th instar	6	0	0	4	6	4	0	0	7	3	0	0	10	0	0	0	10	0	0	0	9	1	0	0	5	5	0	0	10	0	0	0	0	6	0	4	10	0	0	0
	Total	20	3	0	7	23	7	0	0	27	3	0	0	28	2	0	0	24	3	0	2	24	2	0	4	24	6	0	0	30	0	0	0	2	16	3	9	30	0	0	0
After 3 days	4th instar	8	0	0	2	8	2	0	0	9	1	0	0	10	0	0	0	6	0	0	4	7	0	3	0	8	0	0	2	7	3	0	0	0	3	0	5	10	0	0	0
	5th instar	10	0	0	0	10	0	0	0	9	1	0	0	10	0	0	0	8	0	0	2	9	0	1	0	8	0	0	2	10	0	0	0	0	9	0	1	10	0	0	0
	6th instar	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0	9	0	0	1	10	0	0	0	10	0	0	0	10	0	0	0	0	6	0	4	10	0	0	0
	Total	28	0	0	2	28	2	0	0	28	2	0	0	30	0	0	0	23	0	0	7	26	0	4	0	26	0	0	4	27	3	0	0	0	18	0	10	30	0	0	0
After 7 days	4th instar	10	0	0	0	10	0	0	0	9	0	1	0	9	1	0	0	9	1	0	0	10	0	0	0	8	2	0	0	9	1	0	0	0	4	0	6	10	0	0	0
	5th instar	10	0	0	0	9	1	0	0	10	0	0	0	9	1	0	0	10	0	0	0	10	0	0	0	10	0	0	0	9	1	0	0	0	4	0	6	10	0	0	0
	6th instar	10	0	0	0	10	0	0	0	9	0	1	0	9	1	0	0	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0	0	9	0	1	10	0	0	0
	Total	30	0	0	0	29	1	0	0	28	0	2	0	27	3	0	0	29	1	0	0	30	0	0	0	28	2	0	0	28	2	0	0	0	17	0	13	30	0	0	0
Weight (g) of each material		23.59				31.95				22.26				36.52				31.82				27.38				39.86				27.20				9.70				0.00			

A = alive D = dead

Table 2. latent and developmental effects of the tested materials on the rest alive larvae after 24 hrs. barrier expousre

Treatment		Calcium sulphate			Sodium chloride			calcium hydroxide			Sodium hydroxide			Sulphoric acid			Sulfur			Tar oil			Talc			Malathion			Untreated		
		% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar.	% pup.	% mo.	% lar	% pup.	% mo.
Zero time	4th instar	50	50	50	50	50	30	30	70	60	60	40	40	50	50	20	60	40	40	50	50	20	40	60	50	100	0	0	10	90	90
	5th instar	20	80	70	60	40	10	30	70	50	70	30	0	40	60	60	0	100	100	40	60	30	30	70	70	100	0	0	20	80	80
	6th instar	40	60	40	50	50	0	40	60	50	70	30	30	50	50	30	50	50	40	50	50	20	10	90	80	100	0	0	10	90	90
	mean	36.6	63.3	53.3	53.3	46.6	13.3	33.3	66.6	53.3	66.6	33.3	13.3	46.6	53.3	36.6	36.6	63.3	60	46.6	53.3	23.3	26.6	73.3	66.5	100	0	0	13.3	86.6	86.6
After 3days	4th instar	50	50	50	60	40	40	20	80	80	10	90	90	40	60	60	70	30	30	30	70	70	40	60	60	100	0	0	10	90	80
	5th instar	10	90	70	30	70	30	30	70	60	30	70	60	40	60	40	50	50	50	40	60	50	30	70	70	100	0	0	10	90	90
	6th instar	30	70	40	40	60	20	20	80	70	20	80	40	40	60	60	0	100	100	40	60	40	10	90	80	100	0	0	20	80	70
	mean	30	70	53.3	43.3	56.6	30	23.3	73.3	70	20	80	6303	40	60	53.3	40	60	60	36.6	63.3	53.3	26.6	73.3	70	100	0	0	13.3	86.6	80
After 7days	4th instar	40	60	60	30	70	30	20	80	70	60	40	10	40	60	60	60	40	30	20	80	80	20	80	80	100	0	0	10	90	90
	5th instar	70	30	30	20	80	50	20	80	60	30	70	30	50	50	50	20	80	80	30	70	60	20	80	80	100	0	0	10	90	80
	6th instar	40	60	40	20	80	30	20	80	70	30	70	50	60	40	20	10	90	80	50	50	50	10	90	80	100	0	0	10	90	80
	mean	50	50	43.3	23.3	76.6	36.6	20	80	66.6	40	60	30	50	50	43.3	30	70	63.3	33.3	66.6	63.3	16.6	83.3	80	100	0	0	10	90	83.3

lar. = larvae
pup. = pupae
mo. = moth

Table 3. Effect of different chemical barriers on food consumption (wt.) and percentage protection for larvae of the cotton leafworm.

Treatments	zero day		3 days		7days		Mean
	consumed (g)	% protection	consumed (g)	% protection	consumed (g)	% protection	% protection
Calcium sulfate	16.53	30.87	14.44	39.61	21.59	9.7	26.5
Sodium chlorid	10.78	45.09	12.94	45.88	13.54	43.37	44.78
Calcium hydroxid	11.98	49.89	15.22	36.34	14.79	38.14	41.46
Sodium hydroxid	13.66	42.87	13.48	43.62	13.24	44.63	43.71
Sulforic acid	10.84	54.66	12.38	48.22	17.56	26.56	43.15
Sulfur	18.39	23.09	21.75	9.03	21.46	10.25	14.12
Tar oil	8.52	64.37	13.98	41.53	15.55	34.96	46.95
Talc	15.89	33.54	15.7	34.34	17.75	25.76	31.21
Malathion	0	100	0	100	0	100	100
Untreated	23.91	0	23.91	0	23.91	0	0

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كفاءة الحاجز الواقى للسيطرة على انتقال يرقات الاعمار الكبيرة لدودة ورق القطن(سبودبترا ليتورالس)

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اقترحت طريقة الحاجز الواقى كحل لمشكلة انتقال يرقات الاعمار الكبيرة لدودة ورق القطن من محصول لاخر خاصة أثناء فترة الحصاد . تم استخدام مواد كيميائية من مجموعات مختلفة لهذه الدراسة : مجموعة الاملاح غير العضوية (كبريتات الكالسيوم (الجبس) ، كلوريد الصوديوم) ، مجموعة المواد القلوية (هيدروكسيد الكالسيوم (الجير المطفي) ، هيدروكسيد الصوديوم)، المواد الحامضية (حمض الكبريتيك)، الزيوت(الزيت القطرانى)، الكبريت(الكبريت الزراعى)والمبيد التقليدى ملاثيون ١% مسحوق قابل للتعفير . تم تحضير كلوريد الصوديوم وكلوريد الكالسيوم وحمض الكبريتيك والزيت القطرانى على صورة مسحوق تعفير يحتوى على ٧,٥% مادة فعالة وذلك باستخدام التلك كمادة مخففة ، اما مساحيق بقية المواد استخدمت كما هى بدون تحضير . تم عمل الحاجز الواقى وذلك بنثر مسحوق المواد على شكل دائرة وذلك على سطح بلاستيك حيث تم وضع ١٠ يرقات من كل عمر من الاعمار الرابع والخامس والسادس فى وسط الحاجز وتم تقديم ورق خروع طازج خارج الحاجز كمادة جاذبة وغذاء لليرقات ، تم تسجيل اعداد اليرقات الموجودة داخل الحاجز وخارجه وكذلك الاعداد الميتة والحية داخل وخارج الحاجز بعد فترة ٢٤ ساعة من المعاملة .

ولدراسة التأثير المتأخر على اليرقات الحية تم جمع اليرقات الحية لكل معاملة وتغذيتها على ورق خروع وتغييره كل يومين حتى طور العذراء وتم تقديرالنسبة المئوية لموت اليرقات ، نسبة التعذير ، نسبة خروج الفراشات . كما تم دراسة تأثير الحاجز على حماية المحاصيل وذلك بتقدير الغذاء المستهلك بواسطة اليرقات الحية المتبقية من تجربة الحاجز مقارنة بالغير معامل ، كما تم دراسة مدى احتفاظ الحاجز بفعاليته بعد ٧،٣ أيام من المعاملة باعادة تكرار نفس التجربة السابقة.

أظهرت النتائج المتحصل عليها ان الملاثيون ١% مسحوق تعفير حقق اعلى فعالية حيث ماتت كل اليرقات التى عبرت والتى لم تعبر الحاجز علاوة على ذلك احتفظ الحاجز بفعاليته حتى بعد ٧ أيام من التطبيق بينما كان للمواد الاخرى تأثيرا ضعيفاعلى منع مرور وموت اليرقات من الحاجز خلال فترة ٢٤ ساعة تعرض بينماا كان لها تأثير ا متأخرا واضحا على موت اليرقات ونسبة التعذر وخروج الفراشات كما كان لها تأثيرا متوسطا على منع التغذية خاصة المواد المحضرة على صورة مساحيق تعفير .

و علي ذلك يمكن التوصية باستخدام الملاثيون ١% مسحوق تعفير كحاجز واقى لمكافحة انتقال يرقات الاعمار الكبيرة لدودة ورق القطن بينما يجب اجراء تجارب اخرى للمواد المحضرة على صورة مساحيق تعفير (كلوريد الصوديوم ، هيدروكسيد الصوديوم ، حمض الكبريتيك ، الزيت القطرانى) ولكن بتركيزات اعلى من ٧,٥% .