CONTROL OF THE POTATO TUBER MOTH, *PHTHORIMAEA OPERCULELLA* ZELLER (LEPIDOPTERA GELECHIIDAE) AT STORAGE

RAMADAN M.FARRAG

Plant Protection Research Institute, Agricultural Research Station, Sabahia, Alexandria.

(Manuscript received 3 June, 1997)

Abstract

The effect of Dipel 2 X, caffeine and sumithion 3% D,60 days after treatment on infestation of potato tubers with *Phthorimaea operculella* was studied. Treatments with the afore-mentioned materials at concentrations of 0.1, 0.2 and 0.3% decreased infestation. At 0.3%, the percentage of infestation on tubers dropped to approximately 10% for caffeine treatment, while treatment with Dipel 2X or sumithion resulted in zero infestation compared to 100% infestation in the control after 60 days. Treatments decreased the numbers of tunnel exits on infested tubers after 60 days to 0, 0 and 2 with 0.3% Dipel 2X, sumithion and caffeine compared to 226.67 tunnel exits/1 kg. of tubers in the control.

INTRODUCTION

The potato tuber moth, *Phthorimaea operculella* Zeller is a serious insect pest of solanaceous crops in the field and store. The incidence of resistance to conventional insecticides has increased through the repeated pesticide use, leading to higher control cost and harmful effects on environment. Different means of control against *Ph. operculella* were studied (Mansour, 1984/1985; Hamdy and Salem 1986; Haydar and El-Sherif 1987; El-Sheikh et al. 1988; Kashyap et al. 1992; Horne 1993; Farrag et al., 1994).

The objective of this study is to investigate the effect of the bacterial inesticide Dipel 2X (*Bacillus thuringiensis* var. *Kurstaki*), caffeine (methylxanthine, MX) and the chemical insecticide sumithion 3% D against the infestation of potato tubers with *Ph.operculella* in store.

MATERIALS AND METHODS

Three compounds were evaluated; anhydrous caffeine (methylxanthine, MX), Dipel 2X 32,000 i.u./mg WP (*Bacillus thuringiensis* var. *Kurstaki*) and Sumithion 3% D (fenitrothion).

Fresh potato tubers (var. Sponta) obtained from the summer plantation were cleaned to remove surface pesticides and dust, then dried in the open for 14 days.Thereafater, tubers infested with *Ph.operculella* were mixed with dried ones to induce new infestations noted with the tunnel exits containing fresh excretions on tuber surface. Twenty eight days later, one kilogram of medium size tubers of nearly similar size, containing nearly equal numbers of infested tubers were used for each replicate. Three replicates were used for every treatment. Tubers were dusted with the specified material, then placed into a clean glass jar (4L.) lined at the bottom with filter papers to help absorb moisture and allow successful pupation. The rates of the tested materials were 0.1, 0.2 and 0.3%, w/w, i.e. 1,2 and 3Kg of insecticide/ton of tubers, respectively. Infestation on tubers was determined by examining them before treatment, 15, 30, 45 and 60 days after treatment. Infestation locations on tuber surfaces were marked, and the percentages of infestation were calculated. Also, the total numbers of tunnel exits on the surfaces of infested tubers were counted for each treatment. Tubers showing rot infection symptoms were removed regularly. Jars were covered with muslin and incubated at 26±2°C and 70±5 RH. Data were subjected to ANOVA and means were compared according to LSD test at 0.05 level (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Table 1 shows the effect of treatment with different rates of caffeine, Dipel 2X and sumithion on the percentages of tuber infestation with Ph.operculella 15, 30, 45 and 60 days after treatment. After 15 days, at a rate of 0.1% caffeine, Dipel 2X and sumithion showed 29, 11 and 63% infestation compared to 64% in the control. At the rate of 0.3% tuber infestation decreased to approximately 9, 9 and 14% with caffeine, Dipel 2X and sumithion, respectively.

After 60 days, Dipel 2X was more effective than caffeine or sumithion. Infestation recorded 29, 4 and 7% with 0.2% concentration for caffeine, Dipel 2X and sumithion, respectively. At 0.3%, infestation droppped to 10% with caffeine compared to zero for Dipel 2X and sumithion, and 100% for the control.

Table 1 further indicates that the grand means of infestation were approximately 90, 33, 10 and 31% for the control, caffeine, Dipel 2X and sumithion, respectively. Differences between treatments were statistically significant and Dipel 2X was the most effective, Table 2.

Table 1. Effect of caffeine, Dipel 2X and sumithion on infestation.

Treatment	Rate (%)	% Infestation before treatment	% Infestation (day after treatment)				
			15	30	45	60	Grand mean
Control		8.28	64.07	94.84	100.00	100.00	89.73 A
Caffeine	0.1	8.76a	28.90a	65.00a	96.30a	100.00a	
	0.2	9.39a	9.39b	9.01b	30.00b	29.17b	
	0.3	9.40a	9.40b	6.05b	4.55c	9.52c	
	$\overline{X}$	9.18	15.90	26.69	43.62	46.23	33.11B
Dipel 2X	0.1	8.33a	11.11a	22.49a	21.57a	14.07a	
	0.2	9.70a	9.70a	7.50b	7.87b	3.70b	
	0.3	8.93a	8.93a	3.03b	3.70b	0.00b	
	$\overline{X}$	8.99	9.91	11.01	11.05	5.92	9.47 C
Sumithion	0.1	10.07a	63.07a	70.47a	57.00a	86.11a	
	0.2	10.66a	15.13b	17.04b	17.04b	7.20b	
	0.3	9.58a	14.29b	14.29b	14.29b	0.00c	
	$\overline{X}$	10.10	30.83	33.93	29.44	31.10	31.33 C

Means followed by the same letter (vertically) are insignificantly different at 0.05 level.

Table 2. Effect of caffeine, Dipel 2X and sumithion on % infestation at different intervals after treatment .

Treatment	% Infestation before treatment	Means % infestation (days after treatment)			
		15	30	45	60
Control	8.28 a	64.07 a	94.84 a	100.00 a	100.00 a
Caffeine	9.18 a	15.90 b	26.69 b	43.62 b	46.23 b
Dipel 2X	8.99 a	9.91 b	11.01c	11.05 c	5.92 c
Sumithion	10.10 a	30.83 a	33.93 b	29.44 d	31.10 d

Means followed by the same letter (vertically) are insignificantly different at 0.05 level.

Table 3 refers that treatment with caffeine, Dipel 2X and sumithion decreased the numbers of tunnel exits on infested tubers in comparison to control during 15-60 days after treatment. After 15 days, the mean number of holes was 28.9, 3 and 13 for tubers treated with 0.1% caffeine, Dipel 2X and sumithion, respectively. At 0.2%, these means were 11.67, 2.33 and 6.67, while at 0.3% they were 5.33, 1 and 4, respectively. Tables 3 and 4 show significant differences among the treatments and bring to light the pronounced effect of Dipel 2X against *Ph.operculella* infestation on potato tubers during storage.

Previous results seem to agree with findings of Farrag et al. (1994), who stated that the microbial insecticides, Bactospeine and Delfin, as well as the chemical insecticide Marshal showed biological effects on *Ph.operculella*, depending on concentration, application method and period after treatment. Hannay (1953) mentioned that the insecticidal action of *B.thuringiensis* is ascribed to protein crystals produced by the bacteria. Massoud and Moustafa (1993) stated that the microbial treatments cause inhibition and/or delayig effect on DNA synthesis. Nathanson (1984) stated that natural and synthetic methylxanthines (caffeine, theophylline and theobromine) inhibit insect feeding through the inhibition of phosphodiesterase activity and increase of intracellular cyclic adenosine monophosphate.

The afore-mentioned results and discussion indicate the possible role of microbial insecticides, natural products and their synthetic analogues as well as chemical insecticides as components to be included in the IPM programmes developed for the protection of stored potato tubers from *Ph.operculella* infestations. Dipel 2X and caffeine may have the advantage of being environmentally safe and non-toxic to mammals. Therefore, Dipel 2X and caffeine may be recommended as alternatives for organic chemical insecticides against *Ph.operculella* in stores.

Table 3. Effect of caffeine, Dipel 2X and sumithion on the numbers of tunnel exits on infested tubers.

Treatment	Rate (%)	Mean no.of tunnel before treatment	Mean no. of tunnel exits (days after treatment)				
			15	30	45	60	Grand mean
Control		7.33	64.07	144.67	190.67	226.67	156.52 A
Caffeine	0.1	6.67a	28.90a	78.33a	88.67a	55.33a	
	0.2	7.00a	11.67b	4.00b	4.33b	7.67b	
	0.3	7.67a	5.33c	3.00b	2.33c	2.00c	
	$\overline{X}$	7.11	15.30	28.44	31.78	21.67	24.30 B
Dipel 2X	0.1	6.67a	3.00a	5.00a	1.67a	1.00a	
	0.2	6.67a	2.33ab	0.67b	0.67ab	0.33ab	
	0.3	7.00a	1.00b	0.33b	0.33b	0.00b	
	$\overline{X}$	6.78	2.11	2.00	0.89	0.44	1.36 C
Sumithion	0.1	6.67a	13.00a	24.33a	34.33a	86.33a	
	0.2	7.00a	6.67b	5.67b	2.33b	1.67b	
	0.3	7.00a	4.00c	3.00c	1.00b	0.00c	
	$\overline{X}$	6.89	7.89	11.00	12.55	29.33	15.20 C

Means followed by the same letter (vertically) are insignificantly different at 0.05 level.

Table 4. Effect of caffeine, Dipel 2X and sumithion on % infestation at different intervals after treatment .

Treatment	Mean no.of tunnel exits before treatment	Means no. of tunnel exits (days after treatment)			
		15	30	45	60
Control	7.33 a	64.07 a	144.67 a	190.67 a	226.67 a
Caffeine	7.11 a	15.30 b	28.44 b	31.78 b	21.67 b
Dipel 2X	6.78 a	2.11 c	2.00 c	0.89 c	0.44 c
Sumithion	6.89 a	7.89 d	11.00 b	12.55 d	29.33 b

Means followed by the same letter (vertically) are insignificantly different at 0.05 level.

REFERENCES

1 . El-Sheikh, F.M., L.M. Abd El-Naby and R.M. Farrag. 1988. Effect of two insect growth regulators on pupae of the potato tuber, *Phthorimaea operculella* (Zeller) in laboratory. Boll. Lab. Ent. Agr. Filippo Silvestri, 45: 9-14.

2 . Farrag, R.M., L.M. Abd El-Naby and N.I. Noussier. 1994. Effects of microbial and chemical insecticides on certain biological aspects of the potato tuber moth *Phthorimaea operculella* Zeller. Alex. Sci. Exch., 15 (1): 127-137.

3 . Hamdy, M.K. and S.A. Salem. 1986. The possible use of the juvenoid methoprene as a control agent against the tuber moth *Phthorimaea operculella* Zeller (Lepidoptera : Gelechiidae). Bull. ent. Soc. Egypt, Econ. Ser., 15: 59-64.

4 . Hannay, C.L. 1953. Crystalline inclusions in aerobic spore-forming bacteria. Nature, 172:1004.

5 . Haydar, M.F. and L.S. El-Sherif. 1987. Microbial control of the potato tuber, *Phthorimaea operculella* (Zeller) in the field. Bull. ent. Soc. Egypt, Econ. Ser., 16 : 127-132.

6 . Horne, P.A. 1993. Sampling for the potato moth (*Phthorimaea operculella*) and its parasitoids. Aust. J. Exp. Agric., 33 (1): 91-96.

7. Kashyap, N.P., R.M. Bhagat; D.C. Sharma and S.M. Suri. 1992. Efficacy of some useful plant leaves for the control of potato tuber moth, *Phthorimaea operculella* Zell. in stores. J. Entomol. Res. (New Delhi), 16 (3): 223-227.

8. Mansour, S.A. 1984-1985. Toxicity of some insecticides to the larvae of potato tuber moth, *Phthorimaea operculella* (Zell.) in laboratory. Bull. ent. Soc. Egypt, Econ. Ser., 14: 57-61.

9. Massoud, M.A. and Y. Moustafa. 1993. Spermatocidal and spermatogensis inhibiting effect of *Bacillus thuringiensis* Berliner on: 1-The gonad-cells of *Spodoptera littoralis* (Boisd.). Com. in Sci. and Dev. Res., 44: 23-46.

10. Nathanson, J.A. 1984. Caffeine and related methylxanthines: possible naturally occurring pesticides. Science, 226: 184-187.

11. Steel, R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics. A: Biometrical approach, 2nd ed. McGraw-Hill Book Co., New York.

مكافحة فراشة درنات البطاطس أثناء التخزين

رمضان محمد سليمان فراج

معهد بحوث وقاية النباتات ، مركز البحوث الزراعية، الصبحية ، الإسكندرية.

إستهدف هذا البحث مكافحة الإصابة بفراشة درنات البطاطس (*Phthorimaea operculella*) من عائلة Gelechiidae ورتبة حرشفية الأجنحة والتى تصيب درنات البطاطس أثناء التخزين. قيم تأثير كل من مركب ميثايل زانثينات (كافيين) والمبيد البكتيرى (دايبل X٢) ومبيد فوسفورى عضوى (سومثيون ٣٪ مسحوق تعفير) على النسبة المئوية لإصابة الدرنات المخزنة بالآفة وعدد فتحات الأنفاق الناتجة عن الإصابة وبعد ١٥ ، ٣٠، ٤٥ ، ٦٠ يوما من المعاملة. أجريت الدراسة بتعفير أوزان ثابتة من درنات البطاطس المصابة بالمواد الثلاثة المختبرة بمعدلات ٠,١ ، ٠,٢ ، ٠,٣ ٪ (مكافئ ١، ٢، ٣ كجم من المبيد لكل ١ طن من الدرنات على التوالى) ثم حسبت النسبة المئوية للدرنات المصابة، وعدد فتحات الأنفاق قبل المعاملة وبعدها بـ ١٥، ٣٠، ٤٥ ، ٦٠ يوماً.

وأظهرت النتائج فعالية المواد المختبرة ضد فراشة درنات البطاطس وأدت المعاملات إلى تقليل نسبة إصابة الدرنات عنها فى المقارنة غير المعاملة. ووجد أن فعالية مادة دايبل X٢ أقوى نسبياً من فعالية كل من الكافيين والسومثيون. كما تزايدت الفعالية لجميع المواد المختبرة بزيادة التركيز المستخدم حيث كانت النسبة المئوية للإصابة بعد ٦٠ يوماً من المعاملة ١٠٠ ، ١٤ ، ٨٦ عند التركيز ٠,١ ٪ للكافيين ، ودايبل X٢ ، وسومثيون على التوالى، بينما كانت نسبة الإصابة عند تركيز ٠,٣٪ حوالى ١٠٪ فى حالة الكافيين، وصفر ٪ لكل من الدايبل X٢ والسومثيون مقارنة بـ ١٠٠٪ فى حالة الدرنات غير المعاملة. وأدت المعاملات إلى خفض عدد الأنفاق على سطح الدرنات المصابة، حيث وصلت الأعداد إلى ٢٢٦,٦٧ فى المقارنة مقابل ٢٪ عند التركيز ٣٪ للكافيين، وأنعدمت الأنفاق عند تركيز ٣٪ لكل من دايبل X٢ وسومثيون بعد ٦٠ يوماً من المعاملة. وأوضحت النتائج فعالية دايبل X٢ والكافيين فى مكافحة فراشة درنات البطاطس أثناء التخزين مع إنخفاض سميتهما للثدييات وسلامة إستخدامها بيئياً.