J. Plant Prot. and Path., Mansoura Univ., Vol.9 (7): 441 - 445, 2018

Side Effects of Seven Fungicides on Egyptian Cotton Leaf Worm Infesting Tomato Plants

Rahouma, A. K.[1] and R. M. A. El-Kholy[2]
[1]Plant Prot. Res. Inst., Agric. Res. Center, Dokki, Giza, Egypt
[2]Plant Prot. Dept., Fac. of Agric. Al-Azhar University,

ABSTRACT

The side effects of seven commercial fungicides used on tomato plants to control early blight disease on Egyptian cotton leafworm (ECLW) were studied. In greenhouse, the fungicides were sprayed on tomato plants at the same rate of the recommended rate by MoA for controlling early blight disease. Feeding rate, survival, larval and pupal growth and development to adult stage were recorded under laboratory conditions. Also, the effect of these fungicides on first generation was evaluated. The data clearly indicated that all these treatments significantly reduced the feeding of 4th instar larvae when fed for 24h on treated leaves with the tested fungicides. Also, reduced larval weight and increased larval duration (days). Also, reduced pupation % and pupal weight (mg) and increased pupal duration. No effect on fecundity but these fungicides reduced the number of eggs per female. These treatments reduced the longevity of male and female and finally these fungicides affect the first generation of this insect. These fungicides exhibited antifeeding properties and affect the growth and development of this insect.

Keywords:ECLW- fungicides, side effects, Biological aspects, *Spodoptera littoralis*, toxicity, Tomato.

INTRODUCTION

The Egyptian cotton leafworm *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) is one of the most serious and destructive polyphagous agricultural pest of different field crops with in its tropical and subtropical range (Carter, 1984). This insect can attack numerous economically important crops and causes considerable feeding damage on pepper, eggplant, tomato, lettuce and other field and vegetable crops throughout the season in Asia, Africa and Europe (Bayoumi *et al.*, 1998; Pineda *et al.*, 2007) and in Egypt (El-Sheikh, 2015 and Metayi *et al.*, 2015).

Many fungicides were used on tomato plants to control early blight disease and these may interact with the Egyptian cotton leafworm (ECLW). Therefore, it is essential to know the role of fungicides on the developmental profile of *S. littoralis* insect. Such observations will help to understand the shifts in insect population on a tomato crop influenced by these fungicides. Information on this interesting area of pest management is scanty. Previous reports indicated that the fungicides have side effects on *S. littoralis* insect pest. (Abd El-Aziz, Shadia and Mohamed, 2002; El-Kholy, 2005 and El-Sisi *et al.*, 2016), *S.exigua* (Adamsk: and Ziemmichi, 2004) and *S.litura* (Srivastava *et al.*, 2017).

Accordingly, keeping the things of view, the present study was evaluated to explore the possible effect of seven commercial fungicides (commonly used on tomato plants to control early blight disease) on some biological aspects of the Egyptian cotton leaf worm (ECLW).

MATERIALS AND METHODS

The seven commercial fungicides chosen in the present study are recommended for the control of early blight disease on tomato plants according to Ministry of Agric., Plant Prot. Res. Inst., Reclamation, 2017. Some information on these fungicides is listed in Table (1).

Greenhouse pot experiments were conducted at the Fac. of Agric. (Cairo). Al-Azhar Univ., during summer season of 2017. Tomato seeds *Lycopersicun esculentum* (cv. Tomato N 23) were planted in nursery, then, one month old tomato seedlings were Translocated to pots 20 cm in diameter and irrigated when needed. After 45 days, the treatments were arranged in a randomized complete block design (RCBD) with 5 replicates for each treatment. The tomato plants were sprayed with 2 liter hand sprayer in aqueous solutions of the tested fungicides at the same rates of field. The treated and untreated leaves were collected after one hour from spraying and left to dry for 30 min at laboratory and weighed before use in the experiments. The susceptible strain was obtained from Plant Protection Research Institute (PPRE). Agriculture Research Center (ARC). Dokki, Giza, This strain were reared in laboratories for many generations according to a method described by El-Defrawi *et al.*, (1964) and was not previously exposed to any pesticides. Neonated fourth instar larvae (one day old) with an average 22± 2 mg wee starved for 3hr before use. Ten replicates (each contains 10 larvae) were used in each treatment. The larvae were fed on treated leaves of castor bean, *Ricimus communis* L., for 24hr, and then, on fresh untreated leaves throughout the larval instar. The feces and dead larvae were discarded. The uneaten leaves and larval mortality was observed daily, uneaten leaves and new fresh leaves were weighted daily after taking the natural loss of moisture in consideration (control 2).

At the end of larval stage, the consumed fresh leaves were corrected according to a method described by Ghanema, Hoda (2002) as follow:

Corrected weight of the consumed leaves = Cb / Ca x Ta.

Where:

Cb = Initial weight of castor bean leaves before larval exposure.
Ca = Final weight (after exposure to natural dryness for 24 hrs.) of leaves without larvae
Ta= Final weight of treated leaves after feeding the larvae for 24 hrs.

Daily weight (fresh basis) of consumed treated leaves/larva= A – B/C.

Where:

A= Initial fresh weight of treated leaves before feeding the larvae.
B= Corrected fresh weight of treated leaves after feeding the larvae.
C= Number of survived larvae.

Also, the following parameters were calculated at the end of larval instar as follow:

- Mean weight of consumed leaves larva^{-1} (gm).
- **Feeding ratio (Wada and Manukata, 1968) = b / a x 100.**

Where:

a= Amount of fresh weight of leaves consumed in the control.

b= Amount of fresh weight of leaves consumed in the treatment

- Antifeedant index % (AFI) according to Pavela *et al.* (2008) as follow:

$$AFI=\{(C-T)/(C+T)\} \times 100.$$

Where:

C= Weight of leaves consumed in the control.
T= Weight of leaves consumed in the treatment.
- The larval weight (mg).
- The larval duration (days).
- The larval mortality %.

Also, at pupal stage, the pupation %, pupal mortality% and pupal duration (days) were recorded. At the adult stage, the adult emergence % was calculated.

Pairs of 2 males and 2 females resulted from each treatment of any fungicides were placed in glass jar (2 liter) containing *Nerium oleander* L., leaves as a site of egg laying. The jars were provided with pads of cotton soaked with a 15 % sugar solution and covered with muslin. Pads of cotton were replaced daily when needed. Five replicates were used in each treatment beside the control. The effect of these fungicides on adults was recorded as follow:

- Reproductive parameters (fecundity and fertility).

Where:

Fecundity= Number of deposited eggs female^{-1} .
Fertility= Egg hatchability %.

- Sterility % (Toppozada *et al.*, 1966) as follow:

$$= 100 - \{(a \times b / A \times B) \times 100\}.$$

Where:

a= Number of eggs laid female^{-1} in the treatment.
b= Percent of hatchability in the treatment.
A= Number of eggs laid female-1 in the control.
B= Percent of hatchability in the control.

Percentages of mortality were corrected when needed according to Abbott's formula (Abbott, 1925). The latent effects on the first generation were also recorded as mortality %.

Statistical analysis:

Statistical analysis was conducted by ANOVA and compared by L.S.D. test at 5% and 1% of probability in all experiments (Duncan, 1955).

Table 1. Some characteristic of the used fungicides.

Trade names	Concentrations and formulation	Common Names	Rate of application 100L. Water
Aromil plus	50% WP	Copper oxychloride + metalaxyl	150 gm
Captan EZ	50% WP	Captan	250 gm
Dragostar	25% EC	Difenocenazole	200 cm^3
Manco	80% WP	Mancozeb (78% maneb +2 % Ion zincion)	250 gm
No-Blight	50% WP	Thiram	200 gm
Oxyplus	47.89% WP	Copper oxychloride	250 gm
Tazolen	72% WP	Mancozeb + metalaxyl	250 gm

According to the Recommendations by Agricultural Pesticide Committee (APC), Ministry of Agriculture and Land Reclamation (2017).

RESULTS AND DISCUSSION

The results in Table (2) showed that, the effect of seven commercial fungicides on food consumption of fourth instar larvae of *Spodoptera littoralis* when fed on treated leaves for 24 h and then on untreated leaves until the end of larval instar. The data clearly indicated that all fungicides significantly reduced the mean weight of consumed leaves larva^{-1} (gm) at the end of larval instar in comparison with untreated treatment. Tazolen fungicide significantly gave the highest effect in comparison with other fungicide and no significant differences was found between the other fungicides. The Tazolen fungicide gave 8.72% reduction in food consumption, while the other fungicides gave reduction% ranged between 3.47 to 5.72% in comparison with the untreated treatment.

Table 2. Food consumption by *Spodoptera littoralis* larvae after feeding of 4th instar for 24hrs. on fungicides treated leaves (at the end of larval instar).

Treatments	Rate 100L. Water	Mean weight of consumed leaves larva (gm) ± SE	Feeding Ratio %	AFI (%)¨
Aromil plus 50% WP	150 gm	02.43 ± 0.014 b	90.67	04.89
Captan EZ 50% WP	250 gm	02.47 ± 0.046 b	92.16	04.08
Dragostar 25% EC	200 cm^3	02.42 ± 0.028 b	90.30	04.90
Manco 80% WP	250 gm	02.39 ± 0.040 b	89.18	05.72
No-Blight 50% WP	200 gm	02.50 ±0.044 b	93.28	03.47
Oxyplus 47.89% WP	250 gm	02.39 ±0.058 b	89.18	05.72
Tazolen 92% WP	250 gm	02.25 ±0.035 c	83.95	08.72
Untreated	-	02.68 ±0.050 a	100.00	00.00

Means with the same letter are not significantly different.
˙ SE = Standard error.
¨ AFI = Antifeeding index.
L.S.D. for Treatments 5% = 0.12 & 1% = 0.16

The results in Table (3) indicated that the effect of fungicides on mean larval weight (mg) and mean larval duration (days) at the end of larval instar and the effect of the tested compounds on larval mortality %. The data clearly indicated that all treatments significantly decreased the larval weight in comparison with the untreated treatment. Tazolen fungicide significantly reduced the larval weight in comparison with other fungicides, followed by Dragostar, Manco and Oxyplus, respectively. These fungicides gave larval weight by 1421.4, 1432.4, 1449.6 and 1458.6 for Tazolen, Dragostar, Manco and Oxyplus, respectively. Also, they observed no significant differences between Aromil plus, Captan EZ and No. Blight in this respect. They gave 1472.0, 1473.4 and 1469.2 mg, respectively. The mean larval weight in untreated treatment was 1534.0 mg. Also, the effect of the tested fungicides on larval duration (days) was also listed in Table (3). The obtained results indicated.

That all treatments significantly increased the larval duration in comparison with the untreated control. The Tazolen fungicide increased the larval duration significantly in comparison with other treatments. The Tazolen fungicide gave 12.57 days followed by Manco and Oxyplus (they gave 12.28 for each). Dragostar gave 12.25, No-Blight gave 11.89 while Aromil plus and Captan EZ gaves 11.94 and 11.97 days, respectively. The treatments also affected the larval mortality. The Tazolen fungicides gave the highest effect (23%) followed by Oxyplus (21%) and Manco (21%). Other fungicides ranged between 15% to (19%) in larval morality.

Table 3. Effect of feeding of *Spodoptera littoralis* 4th instar larvae for 24 hrs. on fungicides treated leaves on larval instar (at the end of larval instar)

Treatments	Rate 100L. Water	Mean larval weight gm ± SE	Mean larval duration days ± SE	Larval mortality %
Aromil plus 50% WP	150 gm	1472.0 ± 11.47 b	11.94 ± 0.07 c d e	15.00
Captan EZ 50% WP	250 gm	1473.4 ± 10.605 b	11.97 ± 0.07 b c d	15.00
Dragostar 25% EC	200 cm^3	1432.4 ± 8.13 c d	12.25 ± 0.06 b c	16.00
Manco 80% WP	250 gm	1449.6 ± 14.82 b c d	12.28 ± 0.07 a b	21.00
No-Blight 50% WP	200 gm	1469.2 ± 12.87 b	11.89 ± 0.06 d e	19.00
Oxyplus 47.89% WP	250 gm	1458.6 ± 8.79 b c	12.28 ±0.07 a b	21.00
Tazolen 92% WP	250 gm	1421.4 ± 4.39 d	12.57 ± 0.17 a	23.00
Untreated	-	1534.0± 6.628 a	11.65 ± 0.21 e	00.00

Means with the same letter are not significantly different.
*** SE = Standard error.**
L.S.D. for Treatments at 5% = 29.43 and 0.32 at 1% = 39.56 and 0.43

The data presented in Table (4) cleared that, the effect of feeding of *Spodoptera littoralis* 4th instar larvae for 24h. on seven commercial fungicides treated leaves on pupal stage. These data indicated that all the tested fungicides reduced the pupation % in comparison with the untreated treatment. All seven fungicides significantly reduced pupal weigh (mg) in comparison with the control.

Tazolen fungicide significantly reduced the pupal weight in comparison with other treatments and gave 369.94 mg, followed by No-Blight, Oxyplus and Manco gave 382.98, 388.36 and 389.44 mg, respectively. No significant differences was found between Aromil plus, Captan EZ and Dragostar, which gave 407.36, 407.34 and 404.46 mg, respectively. Also, the all fungicides treatments significantly increased pupal duration (days) in comparison with the untreated treatment. Manco and Tazolen fungicides significantly increased the pupal duration in comparison with other treatments followed by No-Blight and Oxyplus, respectively. No significant differences was found between Captan EZ, Aromil plus and Dragster fungicides. Tazolen fungicides gave 7.79%, pupal mortality followed by Oxyplus (05.06%), No-Blight(4.94%), Dragostar(4.76%), Manco(03.80%), Captan EZ(03.53%) and Aromil plus(03.53%), respectively (Table, 4).

Table 4. Effect of feeding of *Spodoptera littoralis* 4th in star larvae for 24 hrs. on fungicides treated leaves on pupal stage.

Treatments	Rate 100L. Water	Pupation %	Mean pupal weight mg ± SE	Mean pupal duration days ± SE	Pupal mortality %
Aromil plus 50% wp	150 gm	85.00	407.36± 1.48 b	10.02± 0.27 b c	03.53
Captan EZ 50% WP	250 gm	85.00	407.34± 1.46 b	09.97± 0.08 b c	03.53
Dragostar 25% EC	200 cm^3	84.00	404.46± 0.82 b	10.22± 0.12 b c	04.76
Manco 80% WP	250 gm	79.00	389.44± 2.81 c	11.02± 0.10 a	03.80
No-Blight 50% WP	200 gm	81.00	382.98 ± 1.34 c	10.46± 0. 29 b	04.94
Oxyplus 47.89% WP	250 gm	79.00	388.36± 2. 38 c	10.48± 0.27 b	05.06
Tazolen 92% WP	250 gm	77.00	369.94± 4.44 d	11.26± 0.11 a	07.79
Untreated	-	100.00	418.76± 1.46 a	09.93± 0.06 c	00.00

Means with the same letter are not significantly different.
*** SE = Standard error.**
L.S.D. for Treatments at 5% = 6.62 and 0.51 at 1% = 8.89 and 0.68

The results presented in Table (5) revealed that, the effect of fungicide treatments on fecundity (eggs $female^{-1}$). No significant differences were found between these treatments and untreated control. Manco followed by Tazolen and Oxyplus gave the lowest eggs $female^{-1}$, which gave 803.28, 817.92 and 821.22 eggs $female^{-1}$, respectively, other treatments ranged between 830.42 to 869.16 eggs $female^{-1}$. The untreated control gave 900.30 eggs $female^{-1}$. These fungicides reduced hatchability % in comparison with the untreated control. The hatchability % in these fungicides were 86.13%, 87.12, 88.23, 89.13, 89.65, 90.43 and 92.25% in Tazolen, Manco, Oxyplus, Dragostar, No-Blight, Captan EZ and Aromil plus, respectively. The same trend was also observed in the case of sterility%.

The data in Table (6) demonstrated the effect of the tested fungicides on longevity of adults and reduction% in longivity. The data clearly indicated that all the tested fungicides significantly reduced the longevity of male (days) in comparison with the untreated treatment. Tazolen and Manco significantly more effective than other fungicides and they gave 10.73 and 10.81 days, respectively. Oxyplus gave 11.07, Aromil plus gave 11.52, No. Blight gave 11.53, Captan EZ gave 11.64 Dragostar gave 11.76, while untreated control gave 12.18 (days). On females, longevity was also reduced significantly in all treatments in comparison with untreated treatments, Tazolen and Oxyplus were the most effective in reducing the female longevity(days) followed by Manco and No-Bloight. No significant differences was found between Aromil plus, Captan EZ and Dragostar fungicides. The reduction % in male longevity were 11.90, 11, 25, 9.11, 5.42, 5.34, 4.43 and 3.45% for Tazolen, Manco, Oxyplus, Aromil plus, No-Blight, Captan EZ and Dragostar, respectively. The reduction in female longevity were 10.49, 10.32, 8.43, 5.93, 4.90, 4.64 and 3.61% for Tazolen, Oxyplus, Manco, No. Blight, Captan EZ, Dragostar and Aromil plus, respectively.

Table 5. Effect of feeding of *Spodoptera littoralis* 4th instar larvae for 24 hrs. on fungicides treated leaves on adult stage.

Treatments	Rate 100 L. Water	Adult emergence%	Fecundity egg /female	Fertility hatchability %	Sterility %
Aromil plus 50% wp	150 gm	96.47	869.16± 20.19 a	92.25	07.22
Captan EZ 50% WP	250 gm	96.47	830.42± 6.76 a	90.43	15.06
Dragostar 25% EC	200 cm^3	95.24	844.36± 11.66 a	89.13	14.88
Manco 80% WP	250 gm	96.20	803.28± 9.25a	87.12	20.48
No-Blight 50% WP	200 gm	95.06	833.10± 7.80 a	89.65	15.52
Oxyplus 47.89% WP	250 gm	94.94	821.22± 7.13 a	88.23	18.05
Tazolen 92% WP	250 gm	92.21	817.92± 16.14 a	86.13	20.32
Untreated	-	100.00	900.30± 23.20 a	98.20	00.00

Means with the same letter are not significantly different.
˙ SE = Standard error.
L.S.D. for Treatments at 5% = 130.85 at 1% = 175.91

Table 6. Effect of feeding of *Spodoptera littoralis* 4th instar larvae for 24 hrs. on fungicides treated leaves on longevity of adults.

Treatments	Rate 100L. Water	Male longevity days ± SE	Reduction %	Female longevity days ± SE	Reduction %
Aromil plus 50% WP	150 gm	11.52 ± 0.26 b c	05.42	11.09 ± 0.11 a b	04.64
Captan EZ 50% WP	250 gm	11.64 ± 0.18 b	04.43	11.06 ± 0.06 a b	04.90
Dragostar 25% EC	200 cm^3	11.76 ± 0.12 a b	03.45	11.21 ± 0.32 a b	03.61
Manco 80% WP	250 gm	10.81 ± o.17 d	11.25	10.65 ± 0.26 b c	08.43
No-Blight 50% WP	200 gm	11.53 ± 0.15 b c	05.34	10.94 ± 0.06 b c	05.93
Oxyplus 47.89% WP	250 gm	11.07 ± 0.64 c d	09.11	10.43 ± 0.23 c	10.32
Tazolen 92% WP	250 gm	10.73 ± 0.10 d	11.90	10.41 ± 0.22 c	10.49
Untreated	-	12.18 ± 0.12 a	00.00	11.63 ±0.23 a	00.00

Means with the same letter are not significantly different.
˙ SE = Standard error.
L.S.D. for Treatments at 5% = 0.45 and 0.59 at 1% = 0.060 and 0.80

The results in Table (7) indicated that the effect of seven commercial fungicides on first generation of *S. littoralis* insect as larval, pupal and adult mortality%. These results clearly indicated that Tazolen fungicide was more effective on first generation and caused the highest mortality on larval, pupal and adult stage. Also, Oxyplus and Manco fungicides gave the highly effect followed by Dragostar, No-Blight, Aromil plus and finally Captan EZ. These data clearly indicated that these fungicides affected the population of this insect as latent effect and observed that on first generation.

From these data listed in this study, we concluded that the tested fungicides clearly observed antifeeding properties against the ECLW larvae and the reduction in weight of larvae at the end of larval stage may be due to reduction in fresh consumed leaves. Also, these treatments affect pupal and adult stage and caused considerable damage on this insect. These compounds may cause toxic effects on ECLW and the differences between these fungicides are probable to the differences in the composition and the rates of application.

These results were supported by many investigators. Chalfant (1977) mentioned that the Guazatine fungicide caused significant reduction in feeding of all insect species tested, except *N. viridula* and *A. germmatulis*. Abdel-Aziz, Shadia and Mohamed (2002) indicated that a wide variation in feeding response of *S.littoralis* larvae towards tested fungicides. They found that Euparen M was very effective followed by Galben Copper, Rizolex and Dithane M-45, respectively. Less feeding detterncy was observed with Topas loo and Topsin M treatments on pepper plants. They added that Sulphur M, Previcur, Ridomil plus and Dithane M-45 gave the higher larval mortality, respectively. They also found that Ridomil plus, Sulphur M and Galbin Copper gave the higher pupal mortality incomparis on with Sumi 8. Idinger (2002) found that reproduction rate of *Folsomia candida* Willem, 1902 (Collembola): was significantly reduced by Euparon M (Tolyfluanid) and copper oxychloride and this was more susceptible to Euparen M than to copper oxychloride. El-Kholy (2005) mentioned that the tested fungicides reduced the feeing ratio of *S. littoralis* larvae, weight of larvae and pupae, pupation % and adult emergence and also fecundity and fertility when 4th instar larvae of *S.littoralis* were fed on treated leaves with Micronised Sulphar, Dithane M45, Galbin Copper and Ridomil plus. Topas, Delcup and Rubigan were the least effective. El-Sisi *et al.* (2016) indicated that beside using fungicides, they showed that slightly initial and latent effects against second and fourth instar larvae of *S .littoralis* and high developmental effect against both pupae and moth stages enough to broke the insect life-cycle especially in case of Copper Sulphate and Copper Oxychloride against second instar larvae of this insect. Srivastava *et al.*, (2017) reported that Ridomil M and Mancozeb fungicides affect the growth and development of *S. littoralis* at higher concentrations. The larval duration was significantly prolonged. Also, pupation rate, adult emergence and longevity and fecundity was reduced by these fungicides.

As concluded that, from these results, these fungicides can serve a practical tool reduce the S. *littoralis* populations in tomato fields and may assume a greater role in integrated program showed to the manage insect pests

and diseases. These fungicides also can affect the first generation as latent effect.

Table 7. Mortality percentages of the developmental stages of the first generation previously exposed the 4th instar larvae of *Spodoptera littoralis* to fungicides treated leaves.

Treatments	Rate 100gl. Water	Larval Mortality %	Pupal mortality %	Adult mortality %	Accumulative mortality %
Aromil plus 50% WP	150 gm	2.19	3.15	13.39	18.73
Captan EZ 50% WP	250 gm	2.23	2.19	11.37	15.79
Dragostar 25% EC	200 cm^3	2.32	3.52	14.22	20.06
Manco 80% WP	250 gm	3.11	4.65	19.25	27.01
No-Blight 50% WP	200 gm	2.68	3.47	13.66	19.81
Oxyplus 47.89% WP	250 gm	3.07	5.93	22.11	31.11
Tazolen 92% WP	250 gm	3.14	6.19	24.66	33.99

REFERENCES

Abbott, M. S. (1925). A method of computing the effectiveness of an insecticides. J. Econ. Entomol., 18: 265 – 267.

Abd El-Aziz, Shadia E. and A. N. Mohamed (2002). Non-target effects of some fungicides used on pepper *Capsicumfrutescens*L. cultivated in greenhouses on the developmental stages of Spodoptera littoralis (Boisd.). Bull. Ent. Soc. Egypt, Econ. Ser., 28: 67 – 79.

Adamski, Z. and K. Ziemnicki (2004). Side effects of mancozeb on *Spodoptera exigua* (Hübn.) larvae. J. Appl. Entomol., 128: 212 – 217.

Bayoumi, A. A., R. Balana-Fouce, A. K. Sobeiha and E. M. K. Hussein (1998). The biological activity of some chitin synthesis inhibitors against the cotton leafworm *Spodoptera littoralis* (Boisduval), (Lepidoptera: Noctuidae). Bol. Sanid Vegetal Plagas, 24: 499 – 506.

Carter, D. (1984). Pest Lepidoptera of Europe with special reference to the British isles. Junk publishers, Dordrecht, the Netherlands.

Chalfant, R. B., J. W. Todd, W. K. Taylor and B. Mullinix (1977). Laboratory studies on the antifeeding effect of a fungicide, Guazatine, on eleven species of phytophagous insects. J. Econ. Entomol., 70 (4): 513 – 517.

Duncan, D.B. (1955). Multipe range and multiple F test. Biometrics, 11:1-42.

El-Defrawi, M. E., A. Toppozada, N. Mansour and M. Zeid (1964). Toxicological studies on the Egyptian cotton leafworm, *Prodenia litura* L. Susceptibility of different larval instars to insecticides. J. Econ. Entomol., 57: 591 – 593.

El-Kholy, R. M. A. (2005). Nontarget effects of fungicides on some biological aspects of the cotton leafworm, *Spodoptera littoralis* (Boisd.). Al-Azhar J. Agric. Res., 42: 79 – 93.

El-Sheikh, E. A. (2015). Comparative toxicity and sublethal effects of emamectin benzoate, lufenuron and spinosad on *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae). Crop Prot., 67: 228 – 234.

El-Sisi, A. G., Abd-Allah, Amal, A. and Heikal, Gamila, A. (2016). Side effects of some recommended cupreous fungicides against cotton leafworm infested bean seedlings. Egypt. Acad. J. Biol. Sci., 8 (1): 127 – 131.

Ghanema, Hoda, A. E. (2002). Studies on the environmental toxicity of some insecticides among the cotton leafworm, *Spodoptera littoralis* (Boisd.). Ph. D. Thesis, Agric. College, Moshtohor, Zagazig Univ., 163 pp.

Idinger, J. (2002). Laboratory studies to direct effects of selected plant protection products on *Folsomia candida* Willem, 1902 (Collembola: Isotomidae) Zeitschrift für pflanzenkran-Kheiten und pflanzenschutz, 109: 512-529.

Metayi, Mervat, H.A., Ibrahiem, Moataza, A.M. and El-Deeb, Dalia, A. (2015). Toxicity and some biological effects of emamectin benzoate, novaluron and diflubenzuron against cotton leafworm. Alexandria Science exchange J. 36(4): 350-357.

Pavela, R., N. Vrchotova and B. Sera (2008). Growth inhibitory effect of extracts from *Reymoutria sp*. Plants against *Spodoptera littoralis* larvae. Agrociencia, 42: 573 – 584.

Pineda, S., M. Schneider, G. Smagghe, A. Martinez, P. D. Estal, E. Vinuela, J. Valle and F. Budia (2007). Lethal and sublethal effects of methoxyfenozide and spinosad on *Spodoptera littoralis* (Lepidoptera: Noctuidae). J. Econ. Entomol., 100: 773 – 780.

Srivastava, K., S. Sharma, D. Sharma and R. Kumar (2017). Effect of fungicides on growth and development of *Spodoptera litura*. Int. J. Life. Sci. Scientific Res., 3 (2): 905 – 908.

Toppozada, A. S. Abdallah and M. E. El-Defrawi (1966). Chemosterilization of larvae and adults of the Egyptian cotton leafworm *Prodenia litura,* by Apholate, Metepa, and Tepa. J. Econ. Entomol., 59: 1125 – 1128.

Wada, K. and K. Manukata (1968). Naturally occurring insect control chemicals. Isoboldine, a feeding inhibitor and cocculolidine, an insecticide in the leaves of *Cocculus trilobus* DC. J. Agric. Food Chem., 16: 471 – 474.

التأثيرات الجانبية لسبعة من مبيدات الفطريات على دودة ورق القطن المصرية التي تصيب نباتات الطماطم

علي كامل علي رحومة[١] و رمضان مصطفى عبده الخولي[٢]

[١] معهد بحوث وقاية النباتات - مركز البحوث الزراعية - دقى – جيزة – مصر

[٢] قسم وقاية النبات – كلية الزراعة – جامعة الأزهر بالقاهرة

تمت دراسة التأثيرات الجانبية لسبعة من مبيدات الفطريات المستخدمة في حقول الطماطم لمكافحة مرض الندوة المبكرة على حشرة دودة ورق القطن المصرية ، تم رش نباتات الطماطم بمبيدات الفطريات على المعدلات الموصي بها في الحقل طبقاً لتوصيات وزارة الزراعة لمكافحة مرض الندوة المبكرة على الطماطم. ثم دراسة معدل التغذية والموت ونمو وتطور اليرقات والعذاري والحشرات الكاملة, وكذلك تأثير هذه المعاملات على الجيل الأول الناتج من هذه المعاملات ، تمت تغذية يرقات العمر الرابع لمدة ٢٤ ساعة على الورق المعامل في المعمل ثم على أوراق غير معاملة حتى التعذير. دلت النتائج على أن هذه المركبات تنقص من معدل التغذية ووزن اليرقات ويزيد من العمر اليرقي (بالأيام) ولم يلاحظ فروق معنوية على عدد البيض الموضوع ولكنها تنقص من عدد البيض بصورة غير معنوية، كما لوحظ أن هذه المعاملات تنقص من طول عمر الفراشات الذكور والإناث وتؤثر بصورة كبيرة على الجيل الأول الناتج من هذه المعاملات ، وهذه المبيدات المستخدمة لها تأثير كمانع للتغذية وتؤثر على نمو وتطور الأعمار المختلفة للحشرة.

الكلمات المفتاحية : دودة ورق القطن المصرية - مبيدات الفطريات - التأثيرات الجانبية - العمليات الحيوية - الطماطم .