SYNERGISM AMONG SOME INSECTICIDES AND ERGOSTEROL BIOSYNTHESIS INHIBITING FUNGICIDES AGAINST *PECTINOPHORA GOSSYPIELLA* (SAUND.)

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Abstract

The toxicity of organophosphorus insecticide chlorpyrifos, pyrethroid insecticide cypermethrin, insect growth regulators, chlorfluazuron and biocide as a natural products spinosad increased when mixed with the ergosterol biosynthesis inhibiting (EBI) fungicides to newly hatched larvae of *Pectinophora gossypiella*. This study was carried out by feeding newly hatched larvae on artificial diet treated with different concentrations of the tested compounds either alone or in mixtures with EBI fungicide or IGR. Interestingly, these fungicides did not kill the larvae up to 100 ppm, moreover 20 ppm of each EBI fungicide with concentrations of the insecticides increased the toxicity of these insecticides. Also, all data indicated that the calculated LC_{50} of the insecticides alone were higher than the insecticides and fungicides or IGR. For instance, chlorpyrephos at 6.25 ppm caused 90.0 % larval mortality and 100.0 % larval mortality when mixed with 20 ppm of each fungicides or 3 ppm when mixed with IGR. The LC_{50} of chlorpyrifos alone were higher than that of chlorpyrifos when mixed with EBI fungicides and chlorfluazuron as IGR. For example, chlorpyrifos had LC_{50} equal 2.89 ppm, but 0.88, 0.48, 0.26, 0.26, and 0.13 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol and chlorfluazuron respectively. Also, the insecticidal action increased by 3.2, 6.02, 14.45, 11.11, 22.23 folds when mixed with the latter fungicides or the insect growth regulators. Cypermethrin at 25 and 12.5 ppm resulted in 81.66 and 78.33 % larval mortality when used alone, while these concentrations caused 100.0% larval mortality when 20 ppm of each fungicide or 3 ppm of IGR added to these concentrations. The LC_{50} values decreased when cypermethrin mixed with EBI fungicides or IGR, the LC_{50} were 1.95, 0.85, 1.01, 0.65 and 1.5 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol and chlorfluazuron compared with 3.01 ppm when cypermethrin used alone. Also, the insecticidal action increased by 1.54, 3.45, 2.98, 4.63, and 2.01 folds when mixed with the mentioned fungicides or the IGR respectively. Chlorfluazuron at 6.5 ppm caused 86.66 % larval mortality after 72 hr post treatment but the same concentration caused 100 % larval mortality after 48 hr from treatments when mixed with the latter EBI fungicides. LC_{50} values were 0.61, 0.11, 0.36 and 0.29 ppm respectively, compared with 1.01 ppm when used alone, insecticidal action increased by 6.01, 9.18, 2.85 and 3.48 folds respectively. Spinosad at 7.5 ppm caused 85.0 % larval mortality but the same concentration induced 100.0 % larval mortality when mixed with imazalil and fenarimol as EBI fungicides or chlorfluazuron as IGR and caused 95.08 and 98.33 when mixed

with both difenoconazol and tetraconazol as EBI fungicides. LC_{50} values were decreased to 0.51, 0.41, 0.76, 0.61 and 0.56 ppm when was mixed with difenoconazol, tetraconazol, imazalil, fenarimol and chlorfluazuron respectively, compared with 1.54 ppm when used alone, insecticidal action was increased by 3.08, 3.21, 1.97, 2.56, and 2.75 folds respectively. These results suggested that EBI fungicides and the IGRs enhanced the insecticidal activity of chlorpyrifos, cypermethrin and spinosad against the pink bollworm *P. gossypiella.*

INTRODUCTION

Cotton growers in Egypt have experienced severe economic losses from cotton pests due to reduced yield, low lint quality and increased costs of insecticides (Amin and Gergis 2006). Insect- pests are considered one of the important factors that influence cotton production and cause economical damage to the crop yield. Pink bollworm *Pectinophora gossypiella* (Saund) and the spiny bollworm *Earias insulana* (Boisd) are the most serious cotton pests in Egypt (Hussein *et al.*_(002). They caused annually the greatest yield losses from the cultivated area.(Haque1991;.El-Naggar1998). Ergosterol biosynthesis inhibiting EBI fungicides is widely used in controlling pathogenic fungus. This group of fungicides inhibits fungi by blocking the cytochrome P-450 dependent demethylation at the C-14 position and thus inhibiting biosynthesis of the principal fungal sterol ergosterol (Ragsdal and Sislar 1991). These group of fungicides have been identified as potent synergists of pyrethroid insecticides in the honey bee. (Colin and Belzunces 1992). For example, 9-16 folds enhanced toxicity was recorded for the pyrethroid insecticides lambadacyalothrin when combined with the EBI fungicides prochloraz and propiconazol respectively, (Pilling and Jepson 1994). The mechanism of this synergism has been studied by (Plling *et al.*1995) reported that prochloraz delayed the metabolism, detoxication, excretion of lambadacyalothrin by inhibiting microsomal oxidation, effectively enhancing the toxicity of pyrethroids to the honey bee. Schmuck *et al.* (2003) found that slight synergistic effect of the thiacloprid to cyprodinil fungicide was observed with honey bee while a significant enhancement was found with EBI fungicides prochloraz and tebuconazol. The insect growth regulator is acting as chitin synthesis inhibitor in insects which confers a remarkable specification with low toxicity to mammals, birds and fish (Flint and Smith 1977). Also, the mixtures between these compounds and traditional insecticides increase the efficiency of these insecticides (Abdel-Sattar and EL-Guindy1988). Also, Raslan (2003) found that all mixtures of 25 ml Spinosad with Consult, Atabron and Dursban at their half- recommended rates per feddan resulted in increasing their activity against the 3rd instars larvae of cotton leaf worm *S. littoralis.* Also, Helalia *et al* (2006) found that the toxicity of the biocides was greatly enhanced

when used at low rates of conventional insecticides such as pyrethroids and some organophosphorus compounds in combination with *B. thuringiensis* proved to be suitable to control the cotton leafworm *Spodoptera littoralis*. Abd-EL-Mageed *et al* (2006), reported that spinosad gave moderately initial and residual effect when tested alone whereas the most pronounced initial effect was achieved when spinosad was mixed with methoxyfenozide. Also, they reported that the highest residual activity was noticed when spinosad was mixed with chlorpyrifos. Toru Arakawa (2008) found that Polyoxin AL a fungicide that inhibits chitin synthesis, showed a synergistic effect with benzoylphenylurea insect growth regulators in killing *Spodoptera litura* larvae.

Based on these studies, the present work was conducted to evaluate the synergism among some EBI fungicides, insect growth regulators and both organophosphorus, pyrethroids insecticides and one natural product spinosad against the pink bollworm *P.gossypiella*..

MATERIALs AND METHODS

1-INSECTS

Eggs of pink bollworm *Pictinophora gossypiella (*Saund.) were obtained from colony maintained in the laboratory of Bollworm Department Plant Protection Institute Agric. Res. Cent. These insects were not previously exposed to any insecticide. The newly hatched larvae were reared on artificial diet for maintaining mass cultures of the tested insects according to Abdel-Hafeze *et al.* (1982). The larvae were transferred to glass vials (2x7.5cm) containing 3 gm. artificial diet and incubated at 27°C±1 °C and 80-85 % R.H to obtain mass culture of insects and new egg for subsequent studies.

2-CHEMICALS

The following insecticides, fungicides were employed:-.

1- INSECTICIDES

1-1- Dursban (chlorpyrifos 48 % E.C) as OP insecticide

1-2 –Polytrin (cypermethrin 20 %E.C) as pyrethroids insecticide

1-3-Atabron (chlorfluazuron 5 % E.C) as insect growth regulator

1-4-Spintor (Spinosad 24 % E.C) as natural product

2 -FUNGICIDES

2- 1- Score (difenoconazol, 25 % E.C)

2 - 2 - Domark (tetraconazole, 12.5 % E. C)

2 -3 - Fungaflor (imazalil 70 % E.C)

2 - 4 - Rubigan (fenarimol 12 % E.C)

3-TOXICITY TESTS

The toxicity of the insecticides applied separately or mixed with various fungicides and one insect growth regulators was tested on the newly hatched larvae of *Pectinophpra gossypiella.* This test was carried out using artificial diet to determine the LC_{50} values of the tested compounds alone or in mixtures with both fungicide or insect growth regulator. Serial concentrations with water of the test compound in water were prepared 6.25, 3.12, 1.56, 0.78, 0.39, 0.195 and 0.09 ppm for chlorpyrifos and 25,12.5, 6.25, 3.12, 1.56, 0.78, 0.39, for cyprmethrin and 6.50, 3.25, 1.62, 0.812, 0.406, 0.203 0. 101ppm for chlorfluazuron and 7.5, 3.75,1.87, 0.93,0.46, 0.23, 0.11 ppm for spinosad used alone or in mixtures with 20 ppm of fungicides or 3 ppm of insect growth regulator added to the first concentration then diluted gradually until seven concentrations. The diet was put into glass tubes (2_X7.5 cm) approximately 3g. diet / tube. Three replicates being used per concentration, each containing 20 glass tube. Tubes containing diet were treated with 0.05 ml of each concentration from each compounds. For the check treatments the diet was treated with 0.05 ml distilled water. All tubes were exposed to air current for 30 min to insure absorption of the compound on the diet surface. Single newly hatched larva was transferred carefully to each tube using fine hair brush, and the tubes were plugged with cotton and kept at 27°C ± 1 °C and 80-85 % R.H. Inspection of larval mortality was recorded 24 hrs after chlorpyrifos, pyrethroids and spinosad treatment, but chlorfluazuron treatment alone was recorded at 72 hrs or where in mixtures with fungicides or insecticides was recorded at 48 hrs. Corrected mortality percent was obtained using check treatment and Abbott's formula Abbott's (1925). Calculation of LC_{50} values were subjected to probit analysis Finney (1971) and were expressed as concentration that gives 50 % mortality. The synergistic action calculated according to Sun and Johnson (1960) as following:

$$\text{synergistic ratio} = \frac{LC_{50} \text{ of the insecticides alone}}{\text{mixture of the insecticides } LC_{50}}$$

RESULTS AND DiSCUSSION

Results in Table (1) show the, toxicity and synergistic action of the tested compound used alone or in mixtures with EBI fungicides or IGR at different concentrations to the newly hatched larvae of *P. gossypiella.* The present data proved that LC_{50} of chlorpyrifos, cypermethrin, chlorfluazuron and spinosad were 2.89, 3.01, 1.01 and 1.54 ppm when used alone respectively. Data in the same table indicate that the LC_{50} values, were decreased when these compounds were mixed with EBI

fungicides or IGR. The LC_{50} values were 0.88, 0.48, 0.26, 0.26 and 0.13 ppm when chlorpyrifos was combined with difenoconazol, tetraconazole, imazalil, fenarimol as EBI fungicide and chlorfluazuron as IGR respectively, compared with 2.89 ppm when used alone. This indicate that insecticidal action increased by 3.2, 6.02, 14.45, 11.11 and 22.23 folds respectively. Also these values decreased when cypermethrin was mixed with both EBI fungicides and IGR. These values were 1.95,0.85, 1.01, 0.65 and 1.5 ppm respectively, compared with 3.01 ppm when cypermethrin was used alone. The insecticidal action increased by 1.54, 3.54, 2.98, 4.63 and 2.01 folds respectively. These values were decreased when chlorfluazuron was combined with EBI fungicides however these values were 0.61, 0.11, 0.36 and 0.29 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol respectively, compared with 1.01 ppm when this compound was used alone. The toxicity of this compound increased by 6.01, 9.18, 2.85 and 3.48 folds respectively. Also the same data indicated that the decrease in the LC_{50} values were obtained when the spinosad was mixed with EBI) fungicides or IGR and these values were 0.51, 0.41, 0.78, 0.61 and 0.56 ppm when mixed with difenoconazol, tetraconazol, imazalil, fenarimol and the IGRs chlorfluazuron respectively, compared with 1.54 ppm for Spinosad when used alone. The insecticidal action increased by 3.08, 3.21, 1.97, 2.56 and 2.75 folds respectively. Mixtures of EBI fungicides or IGR with different concentrations of organophosphorus insecticides (Chlorpyrifos) or pyrethroids insecticides (Cypermethrin) or natural product (Spinosad) enhanced the toxicity of these insecticides. Interestingly, the fungicides at different concentrations did not cause larval ortality.

Chlorpyrifos toxicity

The results in Table (2) indicate that chlorpyrifos alone at 0.09 ppm did not cause any mortality but by increasing the concentration of this compound the larval mortality was increased. Chlorpyrifos at 0.195 ppm caused 3.33 % mortality but at 0.39 ppm caused 5 % larval mortality, moreover 68.33% larval mortality was achieved when the larvae were fed on artificial diet treated with 3.12 ppm. The insecticides caused 90 % larval mortality when the artificial diet were treated with 6.25 ppm. Mortality assessment 24 hrs post treatment of co-application of chlorpyrifos with EBI fungicides or IGR, revealed increasing insecticides toxicity for these treatments as well as chlorpyrifos–IGR mixtures. Chlorpyrifos at 0.09 ppm did not cause any mortality to larvae as mentioned above while this concentration caused 36.66, 31.66, 36.66, 35.59 and 41.66 % larval mortality when it was mixed with difenoconazol, tetraconazol, imazalil, fenarimol, and the IGR(chlorfluazuron0), respectively. Also, chlorpyrifos alone at 0.39 ppm caused 5 % larval mortality while this concentration induced 49.15, 48.33, 61.66, 66.10 and 78.33% larval mortality

when mixed with difenoconazol, tetraconazol, imazalil, fenarimol, as EBI fungicides and chlorfluazuron as IGR, respectively. These results showed that chlorpyrifos at 3.12 ppm caused 68.33 % larval mortality when used alone however, this concentration caused 93.22, 81.66, 95.55, 89.83 and 100% larval mortality when was mixed with difenoconazol, tetraconazol, imazalil, fenarimol, as EBI fungicides and chlorfluazuron as IGR respectively. Interestingly, chlorpyrifos at 6.25 ppm when used alone resulted in 90 % larval mortality, but when was mixed with both EBI fungicides or IGR caused 100% larval mortality.

Toxicity of cypermethrin

Toxicity of cypermethrin to the newly hatched larvae of *P. gossypiella* shown in Table (3) indicate that the lowest concentrations 0.39 ppm, caused 13.33% larval mortality but, increasing the concentration resulted in great increment of cypermethrin toxicity. Cypermethrin at high concentration 25 ppm caused 81.66% larval mortality when used alone. Concerning cypermethrin-EBI fungicides or IGR mixtures shown in this table clearly indicate that the cypermethrin toxicity to larvae increased by adding the fungicides or IGR. For example 0.78 ppm of cypermethrin caused 16.66 % larval mortality when used alone but cypermethrin-fungicides-IGR mixtures at the same concentration caused 43.11, 49.15, 39.65, 50.84, and 28.81% larval mortality when was mixed with difenoconazol, tetraconazol, imazalil, fenarimol, and the IGR respectively. All high concentrations such as 25, 12.5 ppm caused 81.66 and 78.33 % larval mortality when were used alone, but when were mixed with EBI fungicides or insect growth regulator, caused 100% larval mortality. Generally both EBI fungicides or IGR greatly increased the insecticidal action of cypermethrin in all the tested concentrations.

Toxicity of chlorfluazuron

Data in Table (4) show the effect of chlorfluazuron alone or mixed with EBI fungicide on *P. gossypiella* larvae. The mortality percent of the newly hatched larvae *P. gossypiella* at higher concentration (6.5 ppm) of chlorfluazuron alone was 86.66 % after 72 hrs. These mortality percent increased to 100 % after mixing with EBI after 48 hr. The low concentration (0.101 ppm) of chlorfluazuron alone caused 10.0 % mortality after 72 hr compared with 30.0, 48.33, 20.33 and 25.33 % mortality after mixing with EBIs after 48 hr. These results clearly indicate that EBIs fungicide accelerated and increased the activity of chlorfluazuron against *P. gossypiella* larvae. The insect growth regulators is acting as chitin synthesis inhibitor in insects which confers a remarkable specification with low toxicity to mammals, birds and fish

Toxicity of Spinosad

Data in Table (5) indicate that spinosad at 0.11 ppm caused 8.33 % larval mortality but increasing the concentration gradually resulted in great increment of mortality. Spinosad at 1.87 and 3.75 ppm caused 53.3 and 75% larval mortality, however 7.5 ppm gave 85 % larval mortality.

Concerning spinosad and EBI fungicide and IGR mixtures shown in the same table clearly indicate that the spinosad toxicity to larvae was increased by adding the fungicide or IGR to spinosad concentrations. For instance 0.11 ppm of Spinosad caused 8.33 % larval mortality, but the same concentration when mixed with EBI fungicides, i.e., difenoconazol, tetraconazol, imazalil, fenarimol, or IGR chlorfluazuron, caused 16.66, 36.66, 33.33, 23.33, and 43.3 % larval mortality respectively. Indeed, spinosad alone at 1.87 and 3.75 ppm caused 53.3 and 75 % larval mortality but caused 78.33 and 91.66% 86.66 and 93.33 % larval mortality when these concentrations were mixed with, difenoconazol, and tetraconazol respectively. Interestingly, the spinosad alone at 7.5 ppm induced 85 % larval mortality, this concentration caused 100 % larval mortality when was mixed with both imazalil, fenarimol as EBI fungicides and chlorfluazuron as IGR respectively. Also, the same concentration gave 98.33 and 95.08 % larval mortality when was mixed with tetraconazol and difenoconazol, respectively as EBI fungicide.

DISCUSSION

Mixtures of EBI fungicides or IGR with different concentrations of organophosphorus insecticides (Chlorpyrifos) or pyrethroids insecticides (Cypermethrin) or natural product (Spinosad) enhanced the toxicity of these insecticides. Interestingly, the fungicides at different concentrations did not cause larval mortality. This effect was also reported by (Schmuck *et al.,* 2003) and (Pilling *et al.*,1995). They found that the EBI fungicides did not have toxic effect to honey bee. It is known that these fungicides inhibit cytochrom P450 monooxygenase system which prevent the biosynthesis ergosterol in fungi. Since, monooxygenase are also involved in the metabolism of organophosphorus, and pyrethroid insecticides (Littele *et al.*,1989 and Johnston *et al* 1989).Thus fungicides may delay the toxification, of insecticides by inhibiting monooxygenase system in the insects, and enhanced their toxic action against larvae. Moreover, it has been reported that fungicides that did not inhibit the biosynthesis of ergosterol in fungi did not enhance the toxicity of thiacloprid to honey bee (Schmuck *et al.*,2003). These results also, agree with the previous studies (Colin and Belzunnces 1992). They reported that the fungicides have been identified as synergists of pyrethroids insecticides in the honey bee. (Plling and Jepson 1994). Found that the toxicity of pyrethroid were enhanced from 9-16 folds when combined

with EBI fungicides Prochloraz and Propiconazol to honey bee. The insect growth regulators ar acting as chitin synthesis inhibitor in insects which confers a remarkable specification with low toxicity to mammals, birds and fish (Flint and Smith 1977). Also, the mixtures between these compounds (IGRs) and traditional insecticides increase the efficiency of these insecticides (Abdel-Sattar,1988). Also, (Raslan 2003) found that all mixtures of 25 ml Spinosad with Consult, Atabron and Dursban at their half-recommended rates per feddan resulted in increasing their activity against the 3rd instars larvae of cotton leaf worm. Also, (Helalia *et al.* 2006) found that the toxicity of the biocides was greatly enhanced when using low rates of conventional insecticides such as pyrethroids and some organophosphorus compounds in combination with *B. thuringiensis* proved to be suitable to control the cotton leaf worm *S. littoralis* Abd-EL-Mageed *et al* (2006) reported that spinosad gave moderately initial and residual effect when tested alone whereas the most pronounced initial effect was achieved when spinosad was mixed with methoxyfenozide. Also, they reported that the highest residual activity was noticed when spinosad was mixed with chlorpyrifos. Toru Arakawa (2008) found that Polyoxin AL a fungicide that inhibits chitin synthesis, showed a synergistic effect with benzoylphenylurea insect growth regulators in killing *Spodoptera litura* larvae.

As mentioned before it could be used as mixtures of these fungicides or IGR with the insecticides to increase the insecticidal activity at low concentrations.

Table 1. Toxicity and synergistic effect of the tested compounds used alone or in mixtures with (EBI) fungicide or IGR at different concentrations to the newly hatched larvae of *P. gossypiella as* indicated by LC_{50} and fold of synergism

Compounds	Insecticides only (LC_{50} ppm)	Insecticides + difenoconazol	fold	Insecticides + tetraconazol	fold	Insecticides + imazalil	fold	Insecticides + fenarimol	fold	Insecticides + chlorfluazuron	fold
chlorpyrifos	2.89	0.88	3.2	0.48	6.02	0.26	14.45	0.26	11.11	0.13	22.23
cypermethrin	3.01	1.95	1.54	0.85	3.54	1.01	2.98	0.65	4.63	1.5	2.01
chlorfluazuron	1.01	0.61	6.01	0.11	9.18	0.36	2.85	0.29	3.48	-	-
spinosad	1.54	0.51	3.08	0.41	3.2	0.76	1.97	0.61	2.56	0.56	2.75

Table 2. Larval mortality percent of the newly hatched larvae of *P. gossypiella* as affected by feeding on artificial diet treated with chlorpyrifos separately, in mixtures with EBI fungicides or IGR at different concentration in laboratory bioassay

Concentration (ppm)	Larval mortality (%)					
	Chlorpyrifos only	Chlorpyrifos + difenoconazol	Chlorpyrifos + tetraconazol	Chlorpyrifos + Imazalil	Chlorpyrifos + Fenarimol	Chlorpyrifos + Chlorfluazuron
6.25	90.0	100.0	100.0	100.0	100.0	100.0
3.12	68.33	93.22	81.66	95.55	89.83	100.0
1.56	16.66	79.66	75.0	88.33	86.44	91.66
0.78	11.66	66.10	63.33	80.0	77.96	88.33
0.39	5.0	49.15	48.33	61.66	66.10	78.33
0.195	3.33	37.28	38.33	46.66	49.15	63.33
0.09	0.0	36.66	31.66	36.66	35.59	41.66
Control	3.55	8.66	4.55	2.33	3.66	5.66

Table 3. Larval mortality percent of the newly hatched larvae of *P. gossypiella* as affected by feeding on artificial diet treated with cypermethrin separately, in mixtures with EBI fungicide or IGR at different concentrations in laboratory bioassay

Concentration (ppm)	Larval mortality (%)					
	Cypermethrin only	Cypermethrin + Difenoconazol	Cypermethrin + Tetraconazol	Cypermethrin + Imazalil	Cypermethrin + Fenarimol	Cypermethrin + Chlorfluazuron
25	81.61	100.0	100.0	100.0	100.0	100.0
12.5	78.33	100.0	100.0	100.0	100.0	93.22
6.25	75.0	98.27	89.83	87.92	96.55	86.44
3.12	48.33	91.13	88.83	60.34	86.66	61.01
1.56	33.33	72.41	77.96	51.72	53.22	47.45
0.78	16.66	43.11	49.15	39.65	50.84	28.81
0.39	13.33	36.22	41.66	27.58	22.41	11.86
Control	7.55	4.55	2.66	6.66	3.33	4.66

Table 4. Larval mortality percent of the newly hatched larvae of P. gossypiella as affected by feeding on artificial diet treated with chlorfluazuron separately, in mixtures with EBI fungicides at different concentrations in laboratory bioassay

Concentration (ppm)	Larval mortality(%)				
	Chlorfluazuron only	Chlorfluazuron + Difenoconazol	Chlorfluazuron + Tetraconazol	Chlorfluazuron + Imazalil	Chlorfluazuron + Fenarimol
6.5	86.66	100.0	100.0	100.0	100.0
3.25	81.66	100.0	100.0	91.89	91.66
1.62	53.33	90.0	93.33	88.33	88.33
0.812	40.0	76.66	90.0	75.0	80.0
0.406	21.66	48.33	76.66	58.33	68.33
0.203	15.66	45.0	55.0	26.66	31.66
0.101	10.0	30.0	48.33	20.33	25.33
Control	6.33	8.66	6.66	5,55	5.66

Table 5. Larval mortality percent of the newly hatched of *P. gossypiella* as affected by feeding on artificial diet treated with Spinosad separately, in mixtures with EBI fungicides or insect growth regulators at different concentrations in laboratory bioassay

Concentration (ppm)	Larval mortality(%)					
	Spinosad Only	Spinosad + Difenoconazol	Spinosad + Tetraconazol	Spinosad + Imazalil	Spinosad + Fenarimol	Spinosad + Chlorfluazuron
7.5	85.0	95..08	98.33	100.0	100.0	100.0
3.75	75.0	91.66	93.33	98.33	91.66	98.66
1.87	53.33	78.33	86.66	93.33	88.33	86.66
0.93	33.33	61.66	65.0	75.0	68.33	68.66
0.46	15.0	48.33	58.33	58.33	51.66	61.66
0.23	11.66	36.66	46.66	48.33	31.66	48.33
0.11	8.33	16.66	36.66	33.33	23.33	43.33
Control	4.55	3.33	6.66	3.66	3.46	5.55

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الفعل التنشيطي بين بعض المبيدات الحشرية والمبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات ضد دودة اللوز القرنفلية

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في تجربة معملية تم تغذية الفقس الحديث لدودة اللوز القرنفلية علي بيئة غذائية صناعية معاملة سطحيا بتركيزات مختلفة من كلا من مبيد الدرسبان من المبيدات الفسفورية العضوية ومبيد السيبرميثرين من البيريثرويدات المصنعة ومركب الاتابرون من منظمات النمو الحشرية وكذلك مركب الاسبينوساد من المركبات الحيوية المستخلصة من البكتريا حيث استعملت هذة المركبات إما منفردة أو في مخاليط مع بعض المبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات وذلك لتحديد قيم آل LC_{50} لهذة المركبات منفردة أو في مخا لبط لمعرفة مدي زيادة فاعليتها علي الحشرة موضع الدراسة ودلت النتائج علي أن قيم أل LC_{50} لهذة المبيدات منفردة كانت عالية عنها في حالة استعمالها في مخاليط فمثلا كانت قيمة أل LC_{50} لمبيد الدرسبان عندما استعمل منفردا ٢,٨٩جزء في المليون انخفضت هذة القيمة إلي٠,٨٨ – ٠,٤٨ – ٠,٢٦ ٠,٢٦-- – ٠,١٣ جزء في المليون عندما تم خلطها مع difenoconazol- tetraconazol- imazalil- fenarimol من المبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات وكذلك مع مركب chlorfluazuron من منظمات النمو الحشرية علي الترتيب وهذا يدل علي أن سمية هذا المركب ذادت بمقدار ٣,٢- ٦,٠٢ – ١٤,٤٥- ١١,١١- ٢٢,٢٣ضعف علي التوالي كذلك كانت قيمة أل LC_{50} لمركب السيبرميثرين عندما استخدم بمفردة هي ٣,٠١جزء في المليون انخفضت هذة القيمة إلـي ٠,٨٥-١,٩٥- ١,٠١- ٠,٦٥- ١,٥ جزء في المليون عندما تم خلطها مع difenoconazol- tetraconazol- imazalil- fenarimol من المبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات وكذلك مع مركب chlorfluazuron من منظمات النمو الحشرية علي الترتيب وهذا يدل علي أن سمية هذا المركب ذادت بمقدار ١,٥٤ – ٣,٥٤ – ٢,٩٨- ٤,٦٣- ٢,٠١ ضعف علي التوالي كذلك كانت قيمة LC_{50} لمركب الاتابرون عندما استخدم منفردا هي ١,٠١جزء في المليون انخفضت هذة القيمة إلي ٠,٦١- ٠,١١ – ٠,٣٦- ٠,٢٩ جزء في المليون عندما تم خلطها مع difenoconazol- tetraconazol- imazalil- fenarimol من المبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات علي الترتيب وهذا يدل علـي أن سمية هذا المركب ذادت بمقدار ٦,٠١- ٩,١٨- ٢,٨٥- ٣,٤٨ ضعف علي التوالي كذلك كانت قيمة أل LC_{50} لمركب الاسبينوساد هي ١,٥٤جزء في المليون عندما استخدم بمفردة انخفضت هذة القيمة إلي ٠,٥١- ٠,٤١- ٠,٧٦- ٠,٥٦-٠,٦١ جزء في المليون عندما تم خلط هذا لمركب مع difenoconazol - tetraconazol- imazalil- fenarimol من المبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات وكذلك مع مركب chlorfluazuron من منظمات النمو الحشرية علي الترتيب وهذا يدل علي أن سمية هذا المركب ذادت بمقدار٣,٠٨- ٣,٢- ١,٩٧- ٢,٥٦- ٢,٧٥ ضعف علي التوالي وعلي هذا نقترح استخدام مخاليط هذة المبيدات الحشرية مع المبيدات الفطرية المثبطة لتخليق الايرجسترول في الفطريات أو مع منظمات النمو الحشرية لزيادة فاعلية هذة المبيدات علي دودة اللوز القرنفلية مما يؤدي إلي تقليل معدل استخدام هذة المبيدات .