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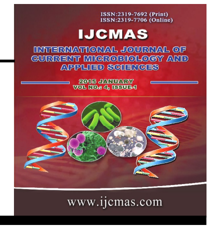

Original Research Article

Assessing the role of exposure time of chemical and botanical insecticides on the mortality and knockdown effect of western flower thrips, *Frankliniella occidentalis* Pergande

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A B S T R A C T

Keywords

Cypermethrin, Fipronil, Insecticide, LT50, Western flower thrips, KT50

Western flower thrips, *Frankliniella occidentalis* Pergande (Thysanoptera: Thripidae), is a major pest of many greenhouse vegetables, fruits and horticultural crops all over the world. Chemical control is the main strategy to control the thrips population because of the low damage threshold on crops susceptible to TSWV. Knowledge about effective insecticides for *F. occidentalis* is necessary, in order to provide information important for pesticide resistance management. In this study, diazinon (EC 60%), cypermethrin (EC 40%), fipronil (EC 2.5%), imidacloprid (SC 35%) and oxymatrine (kingbo AS 0.6%) was used to assessing role of exposure time of these insecticides on the mortality. The reaction of the thrips tested was recorded once every 2 hours until the last thrips killed. Findings from this study showed that LT_{50} for cypermethrin, fipronil, oxymatrine, imidacloprid and diazinon were 5.78, 8.33, 14.41, 15.42 and 15.49 for hour, respectively. Also, amounts of KT_{50} for cypermethrin, imidacloprid, fipronil and diazinon assessed 5.93, 7.68, 8.59 and 12.18 for hour, respectively. Oxymatrine had no knockdown effect.

Introduction

Western flower thrips *Frankliniella occidentalis* Pergande (Thysanoptera: Thripidae), was first detected in Iran in 2004 (Jalili Moghadam and Azmayeshfard, 2004). It is a major pest of greenhouse crops all over the world. Western flower thrips damage is due to feeding and laying that transmit the Tospoviruses TSWV (Tomato spotted wilt virus) and INSV (Impatiens necrotic spot virus) (Pearsall, 2002).

Therefore, damage threshold on host crops is low and leads to the reliance of the farmers to insecticides for controlling western flower thrips (Jensen, 2000; Herron and James, 2005; Contreras *et al*., 2001). Almost all life stages of *F. occidentalis* are protected from pesticide applications. Eggs are sets inside leaf tissue, adult feeds within flowers or new buds, and prepupal and pupal stages are located in soil or leaf litter (Dagh and Tunc, 2008). Management of *F. occidentalis* by insecticides is effective when the population density is low. When populations reach high levels is needed to increment of insecticides application (Cloyd, 2009). Therefore, they are difficult to control effectively with insecticides and resistance has reported in organophosphates, carbamates, pyrethroids (Immaraju *et al*., 1992; Bielza, 2008). Thus, the objective of the present study was evaluation the effectiveness of some conventional insecticides include diazinon, cypermethrin, imidacloprid, fiproniland oxymatrine by estimate the time mortality and knockdown effect for each pesticide under laboratory conditions.

Material and Methods

Western flower thrips was collected from a cucumber greenhouse in Varamin, Iran, in 2010 and has been reared in the laboratory without the pressure of insecticide (Figure 1). In the laboratory, we maintained all stages of the life cycle on young green bean pods (*Phasaeolous vulgaris*), at standard conditions of the temperature and relative humidity, 25±1°C, 65±5% and a photoperiod of 16h light. Plastic containers were used as the rearing container (with 20 cm length and 5 cm width). Kleenex was placed on the bottom as a shelter for thrips pupae.

Green bean pods were washed with water and liquid detergent to reduce the insecticide residues. Adult thrips were introduced into the rearing container with two fresh green bean pods (Figure 2). After one day, adult thrips knocked off the green bean pods and the green bean pods with thrips eggs were transferred to another container. All the rearing containers were held in a growing room at 25˚C and under 16: 8 light: dark photoperiod. Green bean pods were replaced daily. According to Martin and Workman (2003), the filter-paper dipping method was used in the current research. The filter-papers with 4 cm diameter and sections of green bean pod with 2 cm length were dipped for 10 sec in insecticide solutions. The treated filter-papers and sections of green bean pod dried in air under laboratory condition. Then, they were put into a Petri-dish and 20 adult thrips were introduced into the Petri-dish (Figure 3).

After covering with para-film, Petri-dishes were kept at 25 ± 1˚C under a photoperiod of 16:8 L:D. For each insecticide, concentrations was prepared and used to calculate LC_{50} values. Per concentration, three replicates and per each replicate 20 adults were performed. To determine the time of mortality and knockdown effect according to Martin and Workman (2003), was used the LC_{80} concentration to evaluation the reaction of 80% population. Time of mortality and knockdown effect were counted and recorded every hour as long as all test thrips were dead. The total mortality and knockdown effect for each treatment was corrected according to Abbott's formula based on the control mortality (<15%). The data was analyzed using the SAS-probit analysis.

Results and Discussion

Findings from this study showed that cypermethrin has the lowest LT_{50} and KT_{50} values among all tested insecticides (LT_{50} = 5.78 hours; KT_{50}= 5.93 hours). LT_{50} for fipronil, oxymatrine, imidacloprid were estimated 8.33, 14.41, 15.42 hours and KT_{50} were equal with 7.68, 8.59 hours. Oxymatrine had no knockdown effect on thrips. Also, diazinon had highest LT_{50} and KT_{50} values (LT_{50}= 15.49 hours; KT_{50}= 12.18 hours) (Tables 1 and 2; Figures 4 and 5). Cypermethrin-related mortality was started in 4 hours after bioassay until in 6 to 10 hours reached to maximum level. 100% mortality was recorded in 28 hours. Start of mortality, highest mortality and the time required for 100% mortality for diazinon was observed in 2,14- 20 and 26 hours, respectively. The start of knockdown effect for cypermethrin and diazinon was recorded in 4 and 2 hours until in 12 and 6 hours reached to maximum. The high values of LT_{50} for diazinon and imidacloprid can to justify their low efficiency inthe chemical control of western flower thrips.

The existence of knockdown effect in insecticides has the one advantage that poisoned insects loses their own water body and dies under the sunlight. Although a quick knockdown effect causes that thrips does not get lethal dose fully (Zhai and Robinson, 1994). Thus, due to the lack of the sufficient contact with insecticide, after a short time, the percentage of mortality is reduced. Also, the existence of knockdown effect may be induces the knockdown resistance (Jensen, 2000). The lack of knockdown effect in oxymatrine can be a good point. Oxymatrine is a botanical insecticide and long-term exposure to this compound largely stops the population growth, not causing quick mortality (Mondal and Parween, 2000). So, this can reduce the risk of resistance to oxymatrine. The percentage of mortality is dependent on insecticide and exposure time.

Table.1 Comparison of lethal times (LT_{50}) and confidence limits of five insecticides against adult of western flower thrips

Insecticide	The number of insect	Slope ± SE	Intercept ± SE	LT_{50} (CL95%) hours
Cypermethrin	180	2.94 ± 0.56	-2.24 ± 0.53	5.78 (4.23-6.94)
Fipronil	180	5.61 ± 1.28	-5.16 ± 1.27	8.33 (6.87-9.43)
Oxymatrine or matrine	180	3.36 ± 0.67	-3.90 ± 0.84	14.41 (10.45-18.90)
Imidacloprid	180	3.34 ± 0.42	-3.97 ± 0.53	15.42 (13.54-17.23)
Diazinon	180	5.42 ± 0.89	-6.45 ± 1.08	15.49 (13.88-17.11)

Table.2 Comparison of knockdown times (KT50) and confidence limits of five insecticides against adult of western flower thrips

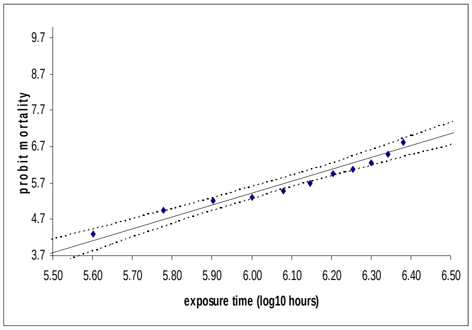
Insecticide	The number of insect	Slope ± SE	Intercept ± SE	KT_{50} (CL95%) hours
Cypermethrin	180	0.14 ± 0.02	-0.86 ± 0.28	5.93 (3.22-7.52)
Imidacloprid	180	0.20 ± 0.40	-1.32 ± 0.39	7.68 (5.71-8.75)
Fipronil	180	0.25 ± 0.05	-2.17 ± 0.58	8.59 (6.81-9.78)
Diazinon	180	5.01 ± 1.50	-5.33 ± 1.56	12.18 (9.93-14.43)
Oxymatrine or matrine	180	-	-	-

Fig.1 Adults of western flower thrips on Cucumber

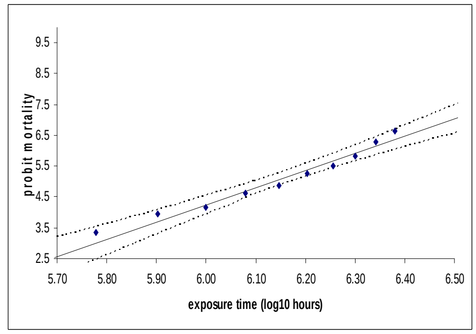
Fig.2 Breeding *Frankliniella occidentalis* on original food

Fig.3 An example of a prepared Petri dish for experiments

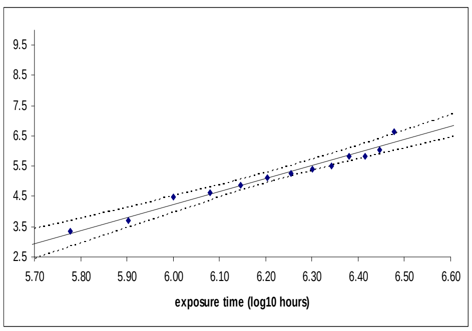
Fig.4 Time-probit mortality lines of response to adult strain of western flower thrips



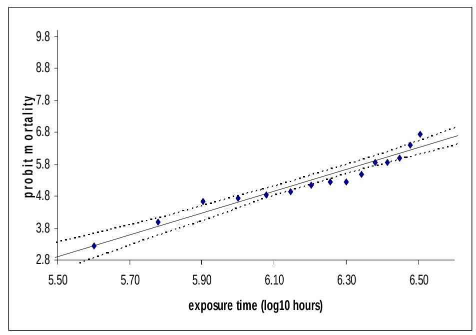
Time-probit mortality line of cypermethrin



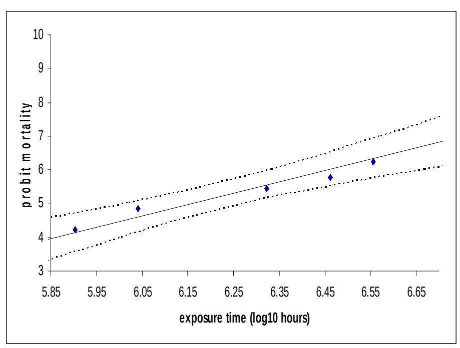
Time-probit mortality line of diazinon



Time-probit mortality line of fipronil

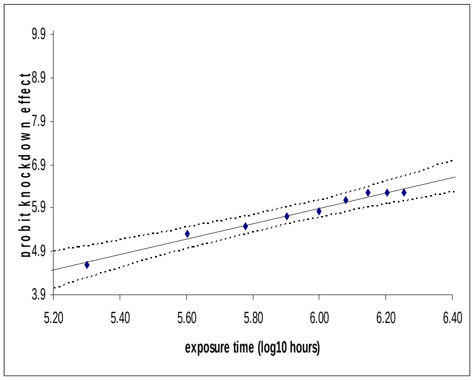


Time-probit mortality line of imidacloprid

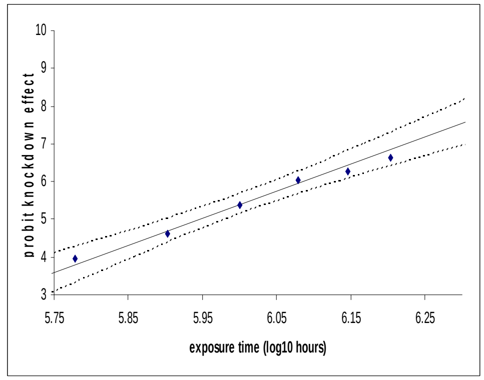


Time-probit mortality line of oxymatrine

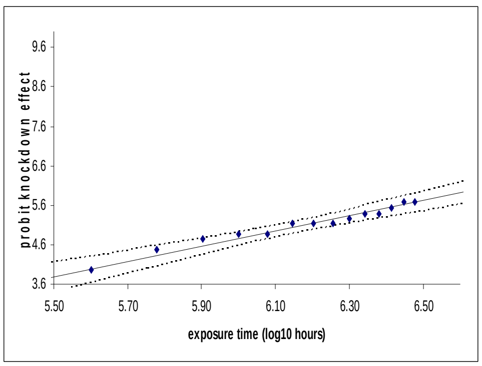
Fig.5 Time-probit knockdown effect lines of response to adult strain of western flower thrips



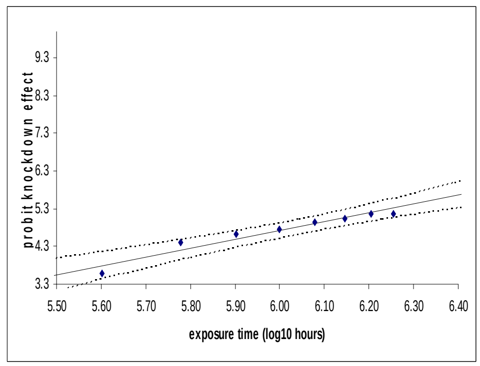
Time-probit knockdown effect line of cypermethrin



Time-probit knockdown effect line of diazinon



Time-probit knockdown effect line of fipronil



Time-probit knockdown effect line of imidacloprid

Decrease and increase in the exposure time, changes effectiveness of insecticides. It should be noted that changing in the amount of insecticide applied may be possible for the changes in effectiveness of exposure time or knockdown effects. This issue may be considerable in resistance to insecticides. Other researchers have conducted experiments about the efficiency of insecticides such as fipronil on *F. occidentalis* and all of which have demonstrated the usefulness of fipronil (Herron *et al*., 1996; Martin and Workman, 2005; Herron and James, 2005; Kay and Herron, 2010). But experiments on cypermethrin shows that this insecticide is ineffective for control (Herron and Cook, 2002; Dagh and Tunc, 2008). So it is suggested that fipronil suitable for control of western flower thrips.

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