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Efficacy of different insecticides against two spotted spider mites (*Tetranychus urticae* Acari: Tetranychidae) on cotton in ecological zone of Bahawalnagar.

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Abstract

A field experiment was conducted during summer seasons 2014 and 2015 to determine the efficacy of different insecticides against two spotted spider mites of cotton (*Tetranychus urticae*) at farmer's field of Adaptive Research station Bahawalnagar. Five different insecticides Spiromesifen 24SC @250ml/ha, Azcyclotin 25WP @250g/ha, Chlorpenpyre 360GL @250ml/ha, Hexythiazox 10WP @500ml/ha and Diafenthuran 500EC @500ml/ha were evaluated in a three replicated RCBD method including an unchecked. Before application of insecticides, the pre treatment observations were taken on spider mites, while post treatment observations were taken after 3rd, 5th and 7th days of application of insecticides. However, Spiromesifen 24SC (91.1%) showed its effectiveness up to 7th day of the spray. The mortality percentage of spider mites on cotton was observed in case of Chlorpenoyre 360GL as (84.3%), Azcyclotin 25WP (80.6%) and Diafenthuran 500EC (77%). This attained its effectiveness up to 7th day after application. Least controlled was observed when applied Hexythiazox 10WP (74.7%).

Introduction

Cotton (*Gossypium hirsutum* L.) is the white gold of Pakistan. It is the most important and economy dependent crop of Pakistan (Hakim et al. 2011). In textile manufacturing, it produces seeds with a potential multi product base such as hulls, oil, lint and food for animals (Ozyigit et al. 2007). It contributes a huge share in the foreign exchange earnings of the country and is important fiber crop (Ahmad et al. 2011). The insect pest infestation in cotton caused deterioration in lint quality and 10–40% losses in crop yield (Gahukar, 2006). In more arid environments such as California and Australia, greater than 90% yield losses have been observed from spider mites (Sadras and Wilson, 1997; Wilson, 1993; Wilson et al. 1987). The pest status of two spotted spider mite, *Tetranychus urticae (*Koch), in cotton has changed over the last decade historically, spider mites were considered a late season pest and pesticide applications were rarely needed during the pre flowering and early flowering stages of cotton development. The number of acres sprayed has more than doubled since 2005 (Williams, 2010). Spiders mites (*T. urticae*) infestations on cotton are often severe during hot and dry weather. Spider mite symptoms in cotton usually show on the leaf surface as a speckled appearance. As infestations become heavier, symptoms may turn leave red in color and result in defoliation of the plant. Damage in fields usually occurs in spots upon initial infestation and as populations increase, damage can become field wide. (Studebaker, 1997). *Bt* cotton varieties were introduced in Pakistan during 2005 to control lepidopteran insect pests on cotton. However, widespread adoption of *Bt* cotton has resulted in an increase in sap feeding insect pests like mites, mealy bugs and others (Malik and Hussain 2006). In 1998, about 350 bales were lost in Arkansas due to spider mite damage (Williams, 1999).

Spider mites are not killed by regular insecticides usually, so be sure to check the pesticide label to see if the designation "miticide" is present. Nonrestricted use miticides are: abamectin, bifenazate, hexythiazox and spiromesifen. If a miticide has been used correctly and the spider mite population has not been controlled within five to seven days, do not use the same miticide. The population of mite may be resistant to the miticide and you should select a miticide with a different mode of action (David, 2011).

Multiple applications of broad spectrum insecticides are needed every year to minimize yield losses from this insect. Because of widespread resistance, high rates of organophosphates or neonicotinoids applied in a tank mix with pyrethroids are the most common treatments to control cotton pests. These applications disrupt beneficial arthropod populations and create an ideal environment for rapid population increases of secondary pests such as two spotted spider mite. The impact of two spotted spider mites on yields of cotton is with current transgenic varieties (Furr and Pfrimmer, 1968). Acaricides should be applied when 30 to 50% of plants are infested and populations are increasing. No information exists about when to terminate acaricide applications during the cotton growing season. Spider mite infestation timings, plant productivity increased as time of infestation after planting increased (Wilson et al. 1987). Up to a 45% yield loss was observed for infestations initiated at the three leaf stage of cotton development when those infestations persisted for four weeks (Smith, 2010). Several factors might have contributed to the increase in the importance of spider mite as a season long pest. Insecticide, fungicide, and nematicide seed treatments replaced the use of aldicarb. The neonicotinoids, imidacloprid and thiamethoxam used as the insecticidal component of these seed treatments has been shown to increase mite densities compared to aldicarb (Troxclair, 2007). Chemical control measures include petroleum spray, oils and soap sprays (JainHua, 2003). So use of chemicals is an essential part of integrated pest management in crop protection measures (Mohyuddin et al. 1997). Neonicotinoids are among the most effective insecticides for the control of sucking insect pests. The insecticide, imidacloprid was the first insecticide of this class released in 1991 (Elbert et al. 2008) and is effective against a number of insect pests. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012). Neonicotinoids insecticides like diafenthiuron, acetamiprid, imidacloprid and thiamethoxam managed the development of resistance to *B. tabaci*, *A. devastans*, *T. urticae* and other sucking insect pests against conventional insecticides in different parts of USA and Israel on different crops (Palumbo et al. 2001). Due to reduced use of insecticides the incidence of mealy bug, mites and dusky cotton bugs is higher these days, however as reported by Rajanikantha (2004).

Keeping in view the economic importance and pest status of mites and environmental hazards, this study was conducted to evaluate and screen out the most effective selective insecticide for management of two spotted spider mites on cotton crop.

Materials and Methods

The experiment was conducted at farmer's field of Adaptive Research station Bahawalnagar during 2014 and 2015 against two spotted spider mites (*Tetranychus urticae* Acari: Tetranychidae) on cotton to test the efficacy of five insecticides viz. Spiromesifen 24SC @250ml/ha, Azcyclotin 25WP @250g/ha, Chlorpenpyre 360GL @250ml/ha, Hexythiazox 10WP @500ml/ha and Diafenthuran 500EC @500ml/ha on cotton variety, MNH-886. The experiment was laid out in Randomized Complete Block Design (RCBD). The insecticides used in the present experiment were obtained from the local market and were sprayed at field recommended doses when the population of pest reached the Economic Threshold Level (ETL). The ETL for the mites was considered as on appearance/attack. There were 6 treatments including control, having 3 repeats. The plot size was kept as 20 ft x 60 ft. The plant inspection method was used for sampling the pest population. The field recommended doses of the insecticides as presented in Table 1 were sprayed with hand operated knapsack sprayer having 20 liters capacity fitted with hollow cone nozzle. The control plot remained un sprayed. The sprayer was calibrated using simple water by calculating the amount of water required for spraying on a unit area prior to experiment. All agronomic practices like irrigation, fertilizer applications etc. were kept uniform throughout the experiment on all plots. Pest data was recoded from 12 randomly selected plant leaves. To study the efficacy of different insecticides as mentioned in (Table 1), population of two spotted spider mites was recorded by the same method a day before spray and 3rd, 5th and 7th days after treatment. Crop was kept free from weeds. Mortality of pest was calculated with following formula:

$$\text{Percent mortality} = \frac{A-B}{A} \times 100$$

Where A = population of cotton mites in control plot

B = post treatment population of cotton mites in each treatment

Data were analyzed statistically with M-stat package and means were compared by DMR test at 5 percent probability level.

Results and Discussion

Insecticides (Table 1) were sprayed in recommended doses when the population of cotton mites reached economic threshold level (ETL). Insecticides were dissolved in water to prepare insecticide solutions on vol. / vol. and Wt. / Vol. basis. The crop was sprayed in the morning before 10 a. m. The population of insect pests was recorded 3rd, 5th and 7th days after application of insecticides. The data on pest population were analyzed by using Fisher's analysis of variance

technique and LSD test at 0.05 probability level was employed to compare the differences among the treatments mean (Steel *at al*., 1997). The effectiveness of various insecticides was considered to be an indirect reflection of pest population in various treatments i.e. lower population of insect pests would represent higher toxicity and vice versa.

Table 1. Different insecticides used against two spotted spider mite, *Tetranychus urticae (*Koch) with respective doses per hectare.

S. #	Insecticides with formulation	Dose (ml or gm/ha)
1	Spiromesifen 24SC	250
2	Azcyclotin 25WP	250
3	Chlorpenpyre 360GL	250
4	Hexythiazox 10WP	500
5	Diafenthuran 500EC	500

The population of cotton mites was significantly lower (P<0.05) in insecticides treated plots as showed in (Table 2). All tested insecticides in (Table 2) caused significant mortality in population of cotton mites even 7th days after spray. Spiromesifen 24SC was statistically highly effective with mortality in cotton mites population as 70.5 and 91.1% even 5th and 7th days of treatment during 2014 followed by Chlorpepyre 360GL that caused a mortality in population of cotton mites as 63.1 and 83.3. In case of Azcyclotin 25WP the mortality in population as 60.0 and 79.4% after 5th and 7th days of treatment. While in case of Hexythiazox 10WP and Diafenthuran 200EC a similar effect on the mortality of cotton mites was observed even after 5th and 7th days after treatment i.e (60.5 & 73.3) and (53.6 & 80.0) as described in table 3. Spiromesifen 24SC proved to be the best product even after 5th and 7th days after application of insecticides. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012). Non restricted miticides: abamectin, bifenazate, hexythiazox and spiromesifen are best for controlling sucking pests especially spider mites on cotton (David, 2011).

Table 2. Mean percent population mortality of cotton mites after application of different insecticides on cotton during 2014.

Treatments	Dose/ha (g,ml)	A.v pest population before spray	Post treatment average population/plant			Mortality (%)		
			3rd day	5th day	7th day	3rd day	5th day	7th day
Spiromesifen	250	16	7.6a	5.6a	1.6a	56.3	70.5	91.1
Azcyclotin	250	16	9.8bc	7.6bc	3.7c	43.6	60.0	79.4
Chlorpenpyre	250	15	8.9b	7.0b	3.0b	48.8	63.1	83.3
Hexythiazox	500	17	10.9d	7.5bc	4.8d	37.3	60.5	73.3
Diafenthuran	500	16	11.2d	8.8d	3.6c	35.6	53.6	80.0
Control		16	17.4e	19.0e	18.0e	-	-	-
LSD (0.05)			1.1	0.7	0.5			

Each value is a mean of three replications. Means sharing similar letters in columns are not significantly different by DMR test (P=0.05)

It is evident from the (Table 3) that insecticides were found to be effective in controlling population of cotton mites during 2015 under field conditions. All tested insecticides (Table 1) caused significant mortality in population of cotton mites even 7 days after spray. Spiromesifen 24Sc was statistically highly effective with mortality in cotton mites population as 75.3 and 91.2% even 5th and 7th days of treatment during 2015 followed by Chlorpepyre 360GL that caused a mortality in population of cotton mites as 68.7 and 85.3. In case of Azcyclotin 25WP the mortality in population as 64.8 and 81.9% after 5th and 7th days of treatment. While in case of Hexythiazox 10WP and Diafenthuran 500EC a similar effect on the mortality of cotton mites was observed even after 5th and 7th days after treatment i.e (58.5 & 76.1) and (58.5 & 74.0) as described in table 3. Spiromesifen 24SC proved to be the best product even after 5th and 7th days after application of insecticides. Theses results are similar as described by (Palumbo *et al.* 2001: Troxclair, 2007: JainHua, 2003: Mohyuddin *et al.* 1997 and Elbert et al., 2008).

Table 3. Mean percent population mortality of cotton mites after application of different insecticides on cotton during 2015.

Treatments	Dose/ha (g,ml)	A.v pest population before spray	Post treatment average population/plant			Mortality (%)		
			3rd day	5th day	7th day	3rd day	5th day	7th day
Spiromesifen	250	15	10a	6.3a	2.3a	54.5	75.3	91.2a
Azcyclotin	250	17	11.6c	9.0c	5.3c	47.2	64.8	81.9c
Chlorpenpyre	250	17	10.6b	8.0b	4.3b	51.8	68.7	85.3b
Hexythiazox	500	17	14.6d	10.6d	7.0d	33.6	58.5	76.1d
Diafenthuran	500	17	15.6e	10.6d	7.6d	29.0	58.5	74.0e
Control		15	22f	25.6e	29.3e	-	-	-
LSD (0.05)			0.6	1.0	0.9			

Each value is a mean of three replications. Means sharing similar letters in columns are not significantly different by DMR test (P=0.05)

Conclusion

It is concluded from the research trial that all the insecticides proved to be effective for controlling cotton mites but Spiromesifen 24SC @ 250ml/ha proved to be more effective against cotton mites followed by Chlorpepyre 360GL and Azcyclotin 25WP.

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