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Short paper

Comparison of trapped western flower thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae) to yellow and blue sticky traps in three different heights on two greenhouse rose cultivars

Mohammad Khavanad[1], Kambiz Minaei[1*] and Hadi Atashi[2]

1. Department of Plant Protection, College of Agriculture, Shiraz University, Shiraz, Iran.
2. Department of Animal Science, College of Agriculture, Shiraz University, Shiraz, Iran.

Abstract: Western flower thrips, *Frankliniella occidentalis* (Pergande), an important pest in rose greenhouses, has several generations per year, and in addition to direct feeding damage to rose flowers it also transmits tospoviruses. Because of resistance to insecticides, alternative strategies are needed to manage this pest, including trapping. In this study, trapping by sticky traps of two different colours (blue and yellow) was experimented at three different heights (at canopy level, and 20cm above and below canopy level) on two rose cultivars (Red one and Avalanche). The numbers of trapped thrips were counted after five days. The number on the blue sticky traps, regardless of their height of placement and type of cultivar, was significantly higher than that on the yellow traps. Number of thrips on blue traps at 20cm above the canopy was significantly higher than on blue traps at the other levels in both cultivars. In contrast, the number of thrips that were trapped in yellow sticky tarps in various heights as well as cultivars was not significantly different.

Keywords: *Frankliniella occidentalis,* Rose, Colour sticky trap, Height, Greenhouse

Introduction

The western flower thrips (WFT), *Frankliniella occidentalis* (Pergande) is one of the most devastating pests of ornamental plants in greenhouses. WFT was described originally from California in 1895, the horticultural trade has progressively since the 1970's distributed this thrips around the world (Kirk and Terry, 2003; Sampson, 2018). This pest damages plants in two ways-by direct feeding on flowers, fruit, and other plant parts, and by transmission to plants of tospovirus diseases (Yudin *et al*., 1986; Lewis, 1997). The insect has a broad host range of more than 500 species in 50 plant families, including many crops and ornamental plants (Zhang *et al*., 2007). The pest can create brown streaks on the petals, silver lines in the branches and leaves, and deformed buds, flowers and leaves (Reitz, 2009). The development of resistance to chemical insecticides has justified the development of other pest control methods (Jensen, 2000). Traditionally in greenhouses, yellow traps are used as they are attractive to a wide range of herbivorous insects (Wu et al, 2018). However, various species prefer different colours and colour alone can attract some thrips species (Gillespie and and Vernon, 1990). Several studies have demonstrated that blue sticky coloured traps for trapping WFT is superior in relation to other colours (Brødsgaard, 1989; Broughton and Harrison, 2012). In contrast,

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* **Corresponding author**, e-mail: kminaei@shirazu.ac.ir
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Childers and Brecht (1996) in the absence of blue color trap showed that a white coloured trap was superior to yellow, red, or orange in attracting *Frankliniella bispinosa* (Morgan). An effect of cultivar differences was demonstrated by Bergh and Le Blanc (1997), with significantly different numbers of WFT on various cultivars of miniature roses. Similarly with greenhouse cucumber, the number of captured WFT was related to the height of sticky traps (Gillespie and Vernon, 1990). The use of trapping systems for monitoring and controlling western flower thrips populations is one of the conventional methods for the management of this pest in greenhouses (Tommasini and Maini, 1995). Moreover, using this method, the pest is detected early and this is very important for its management (Pinto *et al*., 2013). Various colored traps as well as trap heights play an important role in the attraction of thrips (Gillespei and Vernon, 1990). In this study, the effect of three different trap heights, two different trap colours and two rose cultivars on the number of trapped western flower thrips was investigated.

Materials and Methods

This study was conducted in a greenhouse of the Plant Protection Department, Shiraz University, Shiraz, southern Iran. Initially, rose flowers infested by WFT were collected.

To begin the experiment, a population of the pest was collected by collecting pest infestations for breeding and reproduction in the laboratory. In order to fosterage and multiply the population of the pest, samples of rose plants were collected from the garden of the College of Agriculture, Shiraz University, and transferred to the laboratory in plastic containers covered with 120 mesh net. In the laboratory, in order to obtain the same aged thrips, several pairs of both sexes were reared in incubator conditions set at 25 ± 2 °C, 65 ± 5% R. H, and a photoperiod of 16: 8 (L: D) h. (Degraaf and Wood, 2009). Sticky traps were obtained from Russell IPM Ltd, United Kingdom. The experiment was carried out as a 2 × 2 × 3 factorial experiment in a completely randomized design with 4 replications per each treatment. For each treatment, 180 adults were released and 4 sticky card traps (24.8 × 9.8cm) traps were used. For each replication, 45 adults were released and after 5 days, the number of trapped thrips were counted and expressed as percentage [(No. of trapped thrips/(No. of total thrips = 45) × 100]. Two greenhouse roses' cultivars (Red one and Avalanche) and sticky traps of two different colors (blue or yellow) were used. Each stage was performed for yellow and blue traps separately and one trap was used for each replication.The sticky traps were placed at three different heights (20cm above the canopy, at canopy level and 20cm below the canopy). Statistical analyses were conducted using PROC GLM in SAS software (SAS 1999). The mean of treatments were compared at significant level of 0.05. The assumptions of homogeneity of treatment residual variance and normality of residuals were investigated using Bartlett test and Shapiro-Wilk test, respectively (SAS 1999).

Results and Discussion

The main effects of height, cultivar and trap colour on number of trapped thrips

Effect of height location of traps, rose cultivar and colour of sticky trap on captured thrips is shown in Table 1. There were significant differences in the number of WFT on the traps at various heights ($P < 0.0001$), cultivars ($P < 0.0004$) and trap colours ($P < 0.0001$). The number on the blue sticky trap was higher than that on the yellow trap, and the number trapped at 20cm above the canopy was also higher. Several studies have demonstrated that blue sticky colored trap is superior to other colors for trapping WFT (Brødsgaard, 1989; Broughton and Harrison, 2012; Tang et al, 2016). In contrast, Childers and Brecht (1996) in the absence of blue color trap showed that a white colored trap was superior to yellow, red, or orange in attracting *F. bispinosa*. An effect of cultivar differences was demonstrated by Bergh and Le Blanc (1997), with significantly

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different numbers of WFT on various cultivars of miniature roses. Similarly with greenhouse cucumber, the number of captured WFT was related to the height of sticky traps (Gillespie and Vernon, 1990).

Table 1 The density (SE) of the trapped thrips for three heights of trap places, two rose cultivars and two trap colours.

Factors	Treatments	Density (SE) of trapped thrips (%)[1]
Heights of trap places	H1	47.08 (0.61)a
	H2	40.00 (0.61)b
	H3	36.25 (0.61)c
Rose cultivars	Red one	39.72 (0.50)b
	Avalanch	42.50 (0.50)a
Trap colours	Blue	45.65 (0.50)a
	Yellow	36.57 (0.50)b

H1: 20cm above the canopy, H2: canopy level, H3: 20cm below the canopy.
[1] Means with different letter are significantly different ($P < 0.05$) (Adjusted for multiple comparisons using Tukey's test).

The interaction effects of height, cultivar and trap colour on captured thrips

Despite the significant effect of height, cultivar and trap colour on catching of WFT, their interactions are complicated. The greatest number of thrips trapped was at height 1 (20cm above) with blue trap, but no interaction was found with the two cultivars. The only exception was when the blue trap was located 20cm below canopy level, when the catch was higher in Avalanche than in Red one. Interestingly the results show that when yellow traps were used, then height of trap as well as cultivars had no effect on the number of trapped thrips. According to Table 2, the least effective were the yellow traps, with the number of thrips on such traps not significantly different at various heights and cultivars. Moreover, the attraction of WFT to both traps (blue and yellow) at two levels was not significantly different in the two rose cultivars used (Red one and Avalanche). Our study show the importance of trap colours and their placement relative to the plant canopy in order to effectively manage WFT in glasshouse.

Table 2 The density (SE) of trapped thrips for interaction effects of heights of trap, two cultivars and two trap colours.

Heights of trap places	Trap colours	Cultivars	Density (SE) of trapped thrips (%)[1]
H1	Blue	Red one	55.00 (1.22)^{a}
		Avalanche	56.67 (1.22)^{a}
	Yellow	Red one	37.78 (1.22)^{cde}
		Avalanche	38.89 (1.22)^{cde}
H2	Blue	Red one	41.67 (1.22)^{bc}
		Avalanche	45.56 (1.22)^{b}
	Yellow	Red one	35.00 (1.22)^{ed}
		Avalanche	37.78 (1.22)^{cde}
H3	Blue	Red one	34.45 (1.22)^{e}
		Avalanche	40.56 (1.22)^{cbd}
	Yellow	Red one	34.44 (1.22)^{e}
		Avalanche	35.56 (1.22)^{de}

H1: 20cm above the canopy, H2: canopy level, H3: 20cm below the canopy.
[1] Means with different letter are significantly different ($P < 0.05$) (Adjusted for multiple comparisons using Tukey's test).

Conclusions

In conclusion the best recommended colour of sticky trap for WFT control is blue when used at 20cm above the canopy. This is in parallel with what we have at canopy level although the rate of thrips catching is lower. However, if for various reasons we have to use the trap at 20cm below the canopy then there would be no difference between blue and yellow colour.

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مقایسه تریپس غربی گل به تله افتاده (*Frankliniela occidentalis* (Thysanoptera: Thripidae به تله‌های چسپنده زرد و آبی در سه ارتفاع مختلف روی دو رقم گل رز گلخانه‌ای

محمد خاوند[1]، کامبیز مینایی[1*] و هادی آتشی[2]

۱- بخش گیاه‌پزشکی، دانشکده کشاورزی، دانشگاه شیراز، شیراز.
۲- بخش علوم دامی، دانشکده کشاورزی، دانشگاه شیراز، شیراز.
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چکیده: تریپس غربی گل، *Frankliniella occidentalis* (Pergande) یکی از آفات مهم گلخانه‌های رز به‌حساب می‌آید که دارای چندین نسل در سال است. این حشره علاوه بر خسارت مستقیم به گل‌های رز توسپو ویروس‌ها را نیز منتقل می‌کند. به‌دلیل مقاومت این حشره به حشره‌کش‌ها، رهیافت‌های جایگزین برای مدیریت آفت شامل به تله انداختن آنان ضروری است. در این پژوهش تله‌های چسبنده با دو رنگ مختلف (آبی و زرد) در سه سطح مختلف پوشش گیاهی (هم سطح پوشش گیاهی، ۲۰ سانتی‌متر بالاتر و ۲۰ سانتی‌متر پایین‌تر از سطح گیاه) با دو رقم رز (رد وان و آوالانژ) آزمایش شد. تعداد تریپس‌های به تله افتاده پس از پنج روز شمارش شدند. درصد تریپس‌ها در تله‌های آبی قرار داده شده در سطح ۲۰ سانتی‌متری بالای پوشش گیاهی از تله‌های آبی قرار داده شده در دیگر سطح‌ها به‌طور معنی‌داری در هر دو رقم بیش‌تر بود. برعکس، درصد تریپس‌های شمارش شده در تله‌های چسبنده زرد در سطح‌های مختلف پوشش گیاهی و رقم‌های گوناگون تفاوت معنی‌داری نداشتند.

واژگان کلیدی: *Frankliniella occidentalis*، رز، تله‌های چسپنده رنگی، ارتفاع، گلخانه

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