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Attraction of Color Cups and Plant Compounds to *Thrips* Species on Organic Napa Cabbage

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Abstract: The thrips species, *Thrips tabaci* Lindeman and *Frankliniella occidentalis* (Pengande) (Thysanoptera: Thripidae), are the most common pests on agricultural crops in Colorado. The yellow cup baited with crushed freeze-dried canola pod extract caught significantly higher numbers of thrips species than baited with ground mustard seed in the first trial. The blue cup baited with mustard oil caught the highest number of thrips species at second trial. In addition, blue cup baited with canola and mustard oil caught three and four times much higher numbers of thrips species than yellow cup baited with raw canola and mustard oil in third trial. This study also appears to be the first showing that secondary host plant compound can increase captures of thrips species at the organic farm.

Key words: *Thrips* sp. (Thysanoptera: Thripidae) color cups, plant compounds, organic napa cabbage

INTRODUCTION

The thrips species, *Thrips tabaci* Lindeman and *Frankliniella occidentalis* (Pengande) (Thysanoptera: Thripidae), are the most common pests on the cultivated plants in Colorado (Cranshaw, 1998; Kirk and Terry, 2003). They are minute, slender-bodies insects with rasping-sucking mouthparts (Olkowski *et al*., 1991) and both nymphs and adults are plant feeder, attacking flower, leaves, fruits and twigs and destroyed plant cells during feeding (Borror *et al*., 1989; Olkowski *et al*., 1991). Therefore, they are one of the most important pest species on the agricultural crops (Borror *et al*., 1989; Olkowski *et al*., 1991).

The sticky color trap and secondary plant compound are commonly used to monitor insect species on the cultivated crops. The color trap attractiveness and capture rates of thrips depend on species (Kirk, 1984) and trap color (Cho *et al*., 1995). Therefore, the sticky blue cup traps caught the more *T. tabaci* than the white plastic cup traps (Liu and Chu, 2004). In addition, the western flower thrips, *F. occidentalis*, were attracted to blue sticky card traps compared with yellow or white sticky card traps (Chen *et al*., 2004).

Plants produce range of secondary compounds that affect various receiving species of insect attractants, arrestants, excitants and feeding stimulants (Wiseman, 1985). Plants of Brassicaceae are characteristically recognized by the distinctive compound of glucosinolates (Feeny, 1977; Finch, 1980; Aliabadi and Whitman, 2001) that were attracted on various insect species (Pivnick *et al*., 1991; Pinvick, 1993; Murchie *et al*., 1997; Bradburne and Mithen, 2000; Demirel and Cranshaw, 2006). However, there were no previous reports about their attraction of the thrips species.

The purpose of this study was conducted to identify color traps and plant compounds that might be used for optimal thrips species capture at organic farm.

MATERIALS AND METHODS

Three trials were conducted during 2000 within an organic napa cabbage field at the Grant Family Farms (GFF) in Waverly, CO (USA). Trials were concurrently conducted from 1 to 7 August.

A 266 mL golden yellow and blue dark drinking plastic cups were used as traps. The golden yellow drinking plastic cups were used in the first trial. Treatments consisted of raw canola oil (1 mL), raw mustard oil (1 mL), water check (10 mL) as a control, a ground mustard seed (1 mg) (Frontier of Natural Products, Fort Collins, CO) and an extract of crushed canola seed pods (1 mL) was prepared. This was done by crushing fresh pods and then concentrating the juice by freeze-drying. The dark blue drinking plastic cups were used the second trial in which consisting of those treatments; a combination of raw canola and mustard oil (0.5+0.5 mL/cup), raw canola oil (1 mL), raw mustard oil (1 mL), ground mustard seed (1 mg) and water check (10 mL) as untreated control. A golden yellow and dark blue drinking plastic cups were used in the third trial containing raw canola (1 mL) and mustard oil (1 mL) as a treatment. The golden yellow and blue cups were placed on a 38×38 cm wooden stake cross, the cups separated by 9 cm along the horizontal. Stakes containing the cups were separated by 11 m spacing. The test treatments were poured into the base of the cup and the inner rim of the cup was coated with Tanglefoot^{R}. All plot designs were randomized completed design with four replications. Upon collection each color cup and transferred to the lab for counts of the caught thrips species. All data were analyzed by analysis of variance (ANOVA) with using the SAS software and means were separated using the Least Significant Difference (LSD) Multiple Comparison Tests (SAS Institute, 1990).

RESULTS AND DISCUSSION

The golden yellow cup baited with crushed freeze-dried canola pod extract caught significantly higher numbers of thrips species than yellow cup baited with ground mustard seed in the first trial (Table 1). However, there were not many studies about attraction of secondary compounds, whereas many studies attraction of sticky color trap for thrips species. For example, yellow sticky color traps caught significantly more thrips than blue or white traps (Cho *et al*., 1995). In addition, the yellow sticky color trap was attractive to *Scirtothrips perseae* Nakahara on avocados (Hoddle *et al*., 2002). Moreover, the thrips species, basswood thrips, *Thrips calcaratus* Uzel, pear thrips, *Taeniothrips in-cortsequem* (Uzel) and native basswood thrips, *Neohydatothrips tiliae* (Hood), were also attractive to yellow sticky color traps (Rieske and Raffa, 2003). Furthermore, the most recent report by Demirel and Cranshaw (2006) indicated that the highest numbers of *T. tabaci* and *F. occidentalis* were caught the neon yellow sticky color traps comparing with yellow, blue, neon green, silver and orange sticky color traps at the brassica crops.

The blue cup baited with raw mustard oil caught significantly higher numbers of thrips species than baited with ground mustard seed and water check in the second trial (Table 1). Evaluation of the second trial also indicated that numbers of the thrips species were much higher than the first trials. In addition, the blue cup baited with canola and mustard oil caught significantly higher thrips species than yellow cup baited with canola and mustard oil in the third trial (Table 1). The blue sticky color traps were the most attractive trap base colors for western newer thrips, *F. occidentalis* (Pengande) adults (Chu *et al*., 2000). In addition, the blue sticky plastic cup traps caught the most onion thrips, *T. tabaci* Lindeman (Liu and Chu, 2004). Moreover, the western flower thrips, *F. occidentalis* (Pengande), were attracted to blue sticky card traps compared with yellow or white sticky card traps (Chen *et al*., 2004). However, the most recent report by Demirel and Cranshaw (2006) indicated that the blue sticky color traps was less attractive for *T. tabaci* and *F. occidentalis* than neon pink, neon yellow and neon orange on the brassica crops. On the other hand, the current study blue cup baited with canola oil caught interestingly three times much higher numbers of *T. tabaci* and *F. occidentalis* than yellow cup baited with canola oil. In addition, the blue cup baited with mustard oil caught four times much higher those species than yellow cup baited with mustard oil. Therefore, blue cup baited with mustard and canola oil were significantly attractive for thrips species and can be useful for monitor them on organic farm.

Table 1: Capture of thrips species in yellow and blue cup baited with plant compounds at the grant family farms, waverly, CO in 2000

	Insects captured (±SE) per four cups[y]	
Tested compound/trap	Cup color	*Thrips* sp.
Trial I		
Canola oil	Yellow	50.8±3.1ab
Mustard oil	Yellow	52.3±2.9ab
Crushed freeze-dried canola pods extract	Yellow	63.0±4.7a
Ground mustard seed	Yellow	38.0±2.7b
Water check	Yellow	44.3±10.6ab
Trial II		
Mustard oil+Canola oil	Blue	163.8±44.8ab
Canola oil	Blue	156.0±9.9ab
Mustard oil	Blue	220.8±38.3a
Ground mustard seed	Blue	136.5±7.1b
Water check	Blue	125.3±7.1b
Trial III		
Canola oil	Yellow	67.0±14.2b
Mustard oil	Yellow	53.0±9.4b
Canola oil	Blue	204.0±38.8a
Mustard oil	Blue	211.8±56.5a

[y] Means within a column not followed by the same letter(s) are significantly different ($p<0.05$) by LSD

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