DOI: 10.13656/j.cnki.gxkx.1999.01.019
广西科学 Guangxi Sciences 1999, 6 (1): 65~ 68

Selectivity of CC Traps in Catching Green Leafhoppers and *Thrips*
不同颜色 CC诱捕器对叶蝉和蓟马的诱捕作用

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Abstract CC trap base colors of white, red, yellow, lime, green, dark green, blue and black, were evaluated for capturing leafhopper and *Thrips* species in a yardlong beans (*Vigna sesquipedalis* Wright) in Nanning, Guangxi, People's Republic of China. Blue-colored traps caught an average of 22.8 Chinese *Thrips*, *Haplothrips chinensis* Priesnes, pertrap perday, about twice as many were caught in CC traps with white trap bases. Numbers of *Thrips* caught in CC traps with other trap base colors ranged from 0.1 to 1.7 *Thrips* /trap/ day. CC traps caught about four green leafhoppers (*Empoasca* spp.) per trap per day and there was no differences among trap colors. In Rajirdisnogar, Andhra Pradesh, India, CC traps with white, yellow or green colored trap bases were evaluated in a peanut field. Traps with white bases averaged 39.8 chillie *Thrips* (*Scirtothrips dorsalis* Hood) per trap per day. More than 2 times the numbers caught in traps with yellow bases. Traps with green colored bases caught the least numbers of *Thrips*. Traps with white colored bases also caught significantly more melon *Thrips*, *Thrips palmi* Karny, (17.3 *Thrips* /trap/ day) compared to 11.0 in traps with yellow colored bases. We conclude that CC traps with blue or white colored bases may be used for monitoring *Thrips* populations in bean and peanut fields.

Key words silverleaf whitefly, *Empoasca*, *Thrips*, traps

摘要 在中国广西南宁,测定8种不同基座颜色的 CC诱捕器对豇豆 (*Vigna sesquipedalis* Wright)上的叶蝉、蓟马的诱捕作用。蓝色基座诱捕器对华简管蓟马 (*Haplothrips chinensis* Priesnes) 的诱集量为白色基座诱捕器的2倍 (22.8头/诱捕器·天),其他基座颜色诱捕器的诱捕量为 0.1~ 1.7头/诱捕器·天。CC诱捕器对叶蝉 (*Empoasca* spp.)的诱集量为4头/诱捕器·天,不同基座颜色诱捕器的诱集量差异不显著。在印度,测定白色、黄色和绿色基座诱捕器对花生上两种蓟马的诱捕作用。白色基座诱捕器对茶黄蓟马 (*Scirtothrips dorsalis* Hood)的诱集量为39.8头/诱捕器·天,为黄色基座诱捕器的2倍多。绿色基座诱捕器的诱集量最少。白色基座诱捕器对瓜蓟马 (*Thrips palmi* Karny)的诱捕量 (17.3头/诱捕器·天)也显著高于黄色基座诱捕器 (11.0头/诱捕器·天)。结论为:白色和蓝色基座诱捕器可用于监测豇豆、花生上蓟马的种群数量。

关键词 银叶粉虱 叶蝉 蓟马 诱捕器
中图法分类号 S 433.3

A new whitefly trap (CC trap) was recently developed for monitoring silverleaf whitefly, *Bemisia argentifolii* Bellows and Perring, populations in cotton and other field crops[1~3]. The design of the trap was based on silverleaf whitefly adult attraction to yellow color[4~8], movement of adults for feeding and oviposition to shaded underleaf surfaces[9], and orientation to light when leaving host leaves[10]. The trap consists of three components, a clear plastic trap top to admit light for adult orientation into the trap, a deflector plate to reduce the escape of trapped adults, and a yellow colored trap base with an opening for adults to enter[1]. The trap does not employ any sticky materials,

1998-10-16收稿。
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pheromones or bait. The trap has been adopted by the Imperial County, California, U. S. A. for monitoring whitefly populations since 1996[11]. Recent studies also indicate that the trap has potential for the study of whitefly activity in various crops[2].

Several other insects are also attracted to yellow color, e g. bumblebees *Bombus* spp. [12], corn flea beetle, *Chaetocnema publicaria* Melshimer[13], leaf miner, *Liriomyza sastivae* Blanchard[14], and aphids, *Aphis* spp., *Diglyphus begini* Ashmead, and western flower *Thrips*, *Frankliniella occidentalis* Pergrande[7, 15]. Gaum and Giliomee[16] reported that while greenhouse whitefly, *Trialeurodes vaporariorum* Westwood, responded more positively to yellow colored traps with peak reflectance at 600 nm, western flower *Thrips*, *Frankliniella occidentalis* Pergande, showed a greater phototactic response to bright blue sticky traps with a peak reflectance at 460 nm. Numerous other reports also indicate that *Thrips* are attracted to blue as well as white[17~24]. Vernon and Gillespie[25] found that yellow traps placed in front of violet or blue backgrounds caught significantly more *Thrips* than traps with yellow background.

The objectives of this study were to explore the potential use of CC traps with different colored trap bases for catching *Thrips* and other insects.

1 Materials and methods

1.1 Experiment 1

The experiment was conducted in a 0.05 hm^2 yardlong beans, *Vigna sesquipedalis* Wright, field in Nanning, Guangxi, Peoples' Republic of China. Seeds were sowed on 26 July 1997 at three seeds per hill spaced 30 cm in a row. There were 32 rows in the field with rows 50 cm apart. The trap study was initiated when trellised plants were about 180 cm high. The experimental design was a randomized complete block with two replicates. Each plot was four rows wide and 5 m long. Eight trap color bases, white, red, blue, yellow, lime, green, dark green and black, were compared. Traps were hung on horizontal trellises. Traps were placed in the middle of plots between plant rows and 30 cm below the top of plants. Traps were exposed for 24 h each on 27 sampling dates from 29 September to 27 October 1997. Insects caught with each CC trap were killed by suffocation in water, separated for different species and counted.

1.2 Experiment 2

The experiment was conducted in a 0.15 hm^2 peanut, *Arachis hypogaea* L., field in Rajirdisnogar, Andhra Pradesh, India. The cultivar 'CV JL24' was planted on 21 June 1997. The trap study was initiated when the *Thrips* activity was expected to be the highest during the season. The experiment was conducted in a completely randomized design with six replicates. Traps with three trap base colors, white, yellow and green were compared. Each trap was hanged on a bamboo stake placed 10~ 15 cm above the crop canopy. Traps were retrieved after 16 h exposures on each weekly sampling. The study was conducted for eight weeks from July to August, 1997. Only live *Thrips* were counted after each trap retrieval.

2 Results and Discussion

Blue base colored CC trap caught 22.8 *Thrips* / trap· day, significantly more than traps with all other trap base colors (Table 1). Traps with white colored bases caught significantly more *Thrips* (12.2 *Thrips* / trap· day) than traps with any of the other trap colored bases except blue. Catches with red, lime, green, dark green, yellow and black colored trap bases ranged from 0.1 to 1.7 *Thrips* /trap· day. CC traps also caught on an average of 4.6 leafhoppers/trap· day over all colors, with a range from 3.6 to 5.7/trap· day. Differences among the eight colored trap bases were not statistically significant. A few leafminers and aphids (0.4 and 0.1/trap· day, respectively) were also caught in the CC traps.

In India, traps with white colored trap bases caught 39.8 chillie *Thrips* (*Scirtothrips dorsalis*) / trap· day compared to 15.9 and 4.4 for yellow and green traps, respectively (Table 2). Traps with white colored trap bases also caught significantly more melon *Thrips* (*Thrip palmi* Karny, 17.3 *Thrips* /trap· day) compared to 11.0 for traps with yellow colored bases.

Thrips can cause economic losses by feeding on foliage and fruits and reducing (cucumber) yields, fruit size, and total numbers of fruit[26]. Different species attack many greenhouse and field crops including ornamental and vegetables[25], and tree fruits[20]. Some thrip species are also vectors of viruses[24]. The two most frequently used techniques for monitoring *Thrips* density are sampling plants or plant parts and attracting them to traps using visual and/or olfactory stimuli. Results of this study on yardlong bean agree with others that blue is probably the most suitable color to attract adult *Thrips*[17~18, 21]. White colored sticky traps are also used for trapping western flower *Thrips*, in preference to other colored sticky traps[18, 20, 24, 27]. However, Cho et al.[15] reported that yellow sticky traps caught significantly more western flower *Thrips* than white or blue sticky traps in a staked tomato field study. A significant correlation was found between numbers of *Thrips* caught with

colored sticky traps and numbers of *Thrips* found in tomato flowers. Using colors of various hues and brightness in a cotton field, Matteson and Terry[23] indicated highly significant correlations for thrip preference to light reflectance in blue-violet range. However no significant correlations for preference to brightness in the visible, green-yellow, or ultraviolet range were noticed.

Leafhoppers are also important economic pests of field crops, in addition to their ability to vector viruses and phytoplasmas. Yellow sticky traps have been reported as the most effective sampling method for monitoring the alfalfa hopper, *Spissistilus festinus* Say, compared to white, green, orange, red, blue, magenta or black sticky traps[28]. Numbers of leafhoppers caught with CC traps did not show any significant preference among the eight colors tested in China (Table 1).

Table 1 Mean numbers of green leafhoppers and *Thrips* caught in CC traps in yardlong bean from September to October 1997 in Nanning, Guangxi, People's Republic of China

Trap base color	No./trap/day	
	Empoasca spp.	*Haplothrip chinensis*
White	4.4± 0.9 a†	12.2± 2.0 b
Red	4.8± 0.9 a	1.7± 0.6 c
Yellow	4.0± 1.3 a	0.3± 0.1 c
Lime	3.6± 0.6 a	0.6± 0.2 c
Green	4.6± 1.0 a	0.3± 0.1 c
Dark green	4.5± 0.7 a	0.2± 0.1 c
Blue	5.7± 0.8 a	22.8± 2.7 a
Black	4.8± 0.7 a	0.1± 0.1 c
F value, probability‡	1.27, NS	71.95, < 0.001

† Means and SEM in a column followed by different letters differ significantly (Student-Neuman-Keul's Multiple Range Test, $P < 0.05$).
‡ NS and < 0.001 denote not significant and significant at $P < 0.001$ level respectively.

Table 2 Mean numbers of *Thrips* caught in CC traps in peanut from July to August 1997 in Rajirdisnogar, Andhra Pradesh, India

Trap color	No./trap/day	
	Scirtothrips dorsalis	*Thrips palmi*
White	39.8± 5.0 a†	17.3± 0.9 a
Yellow	15.9± 1.0 b	11.0± 12.0 b
Green	4.4± 0.6 c	–
F value, probability‡	31.0, < 0.001	81.0, < 0.001

† Means and SEM in a column followed by different letters differ significantly (Student-Neuman-Keul's Multiple Range Test, $P < 0.05$).
‡ < 0.001 denote significant at $P < 0.001$ level.

Sampling tools are important in detecting, measuring, predicting insect occurrence or for formulating judicious application systems for chemical control. It is apparent that for *Thrips*, blue or white colored CC traps offer a better alternative than blue or white colored sticky traps as sampling tools.

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中国国际论文数排名首次进入世界前10名

中国作为世界上最大的发展中国家,在国际上的学术地位正在逐步提高。1995年世界各学科科学出版物统计结果表明,中国所占的世界份额比1990年提高了38%,是《世界科学报告》统计的世界12个国家和地区中增长最快的国家。1995年世界专利统计结果表明,中国在欧洲专利系统中的份额比1990年提高了52%,在美国专利系统中的份额提高了18%。1997年中国科技人员发表的国际论文总数达35 311篇,比1996年上升了28.1%,按论文数排序,中国首次进入世界前10名,位居美、日、英、德、法、加、意、俄之后排名第9位。若按SCI收录论文数比较,1997年中国16 883篇,比1996年增加了16.8%,位居美、英、日、德、法、加、意、俄、西班牙、澳、荷之后,世界排名第12位,居第三世界国家首位。按EI收录论文数比较,1997年中国12 638篇,比1996年增加了38.2%,居美、日、英之后,排世界第4位。另外,1997年SCI收录我国科技期刊数由1996年的5种增加到9种,EI收录我国科技期刊数由79种增加到90种,这反映我国科技期刊质量有所提高。

(摘自中国科学院1999年《科学发展报告》P188,题目为本刊按)