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不同色板和悬挂方式对柑橘木虱的诱集效果

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摘 要:【目的】筛选出对柑橘木虱引诱效果最好的色板以及最佳的诱虫方位、高度及间距,为柑橘木虱的绿色防控及科学防治提供理论依据。**【方法】**悬挂白色、红色、青色、绿色、灰色、黑色、黄色、紫色、蓝色、粉色共10种颜色的色板,对柑橘木虱的诱虫效果进行筛选,将筛选出效果较好的色板,进行悬挂方位、高度、间距试验。**【结果】**供试的10种颜色色板中,黄色诱虫效果最好,与其他颜色存在极显著差异($p < 0.01$)。将黄色色板进行悬挂方位、高度、间距试验,结果表明,南面方位、高150 cm处以及间距4~5 m为诱集柑橘木虱的最佳悬挂方式。**【结论】**生产实践中可利用黄板进行柑橘木虱的监测,同时为其防控提供一定的指导基础。

关键词: 柑橘木虱;色板;黄板;诱虫

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The effects of different colors and different hanging modes for trapping Asian citrus psyllid

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Abstract:【Objective】In the field of agriculture, the monitoring and control of color trapping techniques has been widely used in containing field crops, vegetables, fruit trees and flowers and other pests. In order to screen out the best color for attracting Asian citrus psyllid (*Diaphorina citri* Kuwayama), evaluations were done of 10 different color sticky cards and determining the best mode for hanging based on different directions, heights and spacing. And based on these results, provide a theoretical basis for the green prevention and scientific control of Asian citrus psyllid, which is a solution to pesticide abusing, pesticide residue, insecticide resistance and environmental pollution.【Methods】Use completely randomized block designs for each treatment. All the experiments were carried out in an orchard garden without management oversight and the orange trees which were growing well and with similar growth stages were chosen for testing. Screen out the best color and directions for attracting Asian citrus psyllid through hanging white, red, cyan, green, grey, black, yellow, purple, blue and pink sticky cards in east, south, west, and north directions to observe and record the number of Asian citrus psyllid detected on sticky cards on the 1, 3, 5, 7, 9, 12 days after hanging. Then use the one-way analysis of variance (ANOVA) to determine which attracted the most citrus psyllids based on the colors and directions. This was then followed by the post-hoc Duncan's test for individual group comparisons and obtaining the best colors and directions for the next experiments. Screen out the best heights for hanging through setting 50 cm, 100 cm, 150 cm, and 200 cm heights in the best colors and directions. Screen out

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the best spacing for hanging by setting 2 m, 3 m, 4 m, and 5 m different spacings between the sticky cards in the best colors, directions and heights from the former test. The observations, recordings and analysis modes of the various heights and spacing experiments are the same as the experiments of different colors and directions.【Results】By comparing the effects of attracting Asian citrus psyllid for the 10 different colors, we determined the best color was the yellow sticky card and the average attracting amount after 12 days reached 21.83 per sticky card, which showed a highly significant difference when compared with other colors ($p < 0.01$). This was followed by the blue color card, with the average number of insect trappings in 12 days being 12.92 per card, however there were no significant differences when compared to the other 8 colors. In all the 10 colors tested, the colors with the worst trapping effects were pink, black, purple, grey and white. The average number of traps in the 12 days of the east, south, west and north were 13.50, 28.00, 15.50 and 20.50 individuals per card, respectively. The trapping effect in the south was best, which increased significantly compared with the east and west ($p < 0.05$) and had no significant increases when compared with the north. We therefore used the yellow sticky card and the south direction for further height and spacing experiments. The height experiment result showed that when the hanging height was 150 cm, the number of Asian citrus psyllid were the most, which had an attracted mean of 36.75 individuals per card after 12 days and possessed significant differences when compared with heights of 100 cm and 50 cm ($p < 0.05$). This was followed by the height of 200 cm, which had an average of 24 individuals per card. So the height of 150 cm was the best in all treatments. The results of the different spacing showed that 2 m, 3 m, 4 m, 5 m were 18.00, 19.67, 32.33, 24.67 individuals per card after 12 days. And when the spacing between cards was 4 m, it possessed a significant difference when compared with 2 m ($p < 0.05$) and did not with 5 m and 3 m. Though the treatment with 4 m did not have the significant effect as shown with 5 m and 3 m, it was still more than the other treatments. So in practical production, it is better to set the spacing at 4-5 m to guarantee the best effect.【Conclusion】After the experiments with using different treatments and analyzing the data, we concluded that the best way to trap Asian citrus psyllid was hanging the yellow sticky cards in the south of the orange trees, at the height of about 150 cm and setting the spacing of the sticky cards at 4-5 m. Using color trapping as an energy saving, environmental protection and pollution-free physical means to control Asian citrus psyllid, has the important significance of reducing pesticide usage. At the same time, because of its simple operation, and low cost, it is easy to promote large-scale production practices in practical production. But in the process of spreading the pest attractant sticky cards, the interaction effects of target insects with color, height, azimuth and spacing should be taken into account in order to achieve the best control effect and at the most optimal cost.

Key words: Asian citrus psyllid; Sticky cards; Yellow sticky cards; Trap

柑橘木虱（*Diaphorina citri* Kuwayama），属半翅目（Hemiptera），扁木虱科（Liviidae），是世界范围内主要的柑橘害虫，其寄主有柑、橙、橘、柠檬、柚、九里香等[1]。木虱成虫、若虫吸取寄主嫩梢汁液，严重时能够导致幼芽萎缩干枯，若虫排出的白色蜜露还会引起煤烟病，影响光合作用。柑橘木虱产生更严重的危害是传播黄龙病（Huanglongbing）[2]。柑橘黄龙病能够侵染柑橘属、枳属、金柑属和九里香等多种芸香科植物。染病树出现各种症状，包括叶片褪绿、小枝枯死、落果、畸形、小果，降低果实品质，最终导致果树的死亡[3]。柑橘木虱成虫取食病树后扩散造成黄龙病菌（*Candidatus* Liberobacter asiaticus）传播，对柑橘产业带来毁灭性威胁[4]。

柑橘木虱在我国主要分布于南方柑橘产区，如福建、广东、广西、海南4个省区，柑橘黄龙病和柑橘木虱在全省区范围内都有发生；浙江、江西、湖南、四川、贵州、云南、台湾为局部发生。重庆和湖北两地经调查未发现柑橘黄龙病以及柑橘木虱。但随着气

候变暖，其分布范围正逐渐向北蔓延[5]。

在世界范围内，控制柑橘木虱、种植无菌苗木和挖除感病苗木是控制柑橘黄龙病的3个关键手段[6-7]。由于化学农药防治见效快、操作简单，目前对于柑橘木虱和黄龙病的防治主要依靠最有效的化学杀虫剂[8]。但高毒高残留农药在生产上被长期大量不合理使用，不但对天敌有伤害、破坏了生态平衡，还会造成农药残留超标，影响果实品质。更加严峻的是，在美国佛罗里达州发现，柑橘木虱对一些杀虫剂的抗药性越来越明显[9]，因此新的柑橘木虱绿色防控技术研究与应用日益重要。

目前，在农业领域中，各种颜色的色板诱杀技术已广泛应用于大田作物、蔬菜、果树和花卉等害虫的监测与防治[10-12]。笔者观察并分析了不同颜色对于柑橘木虱成虫的诱捕效果，进而对色板诱虫的方位、高度、间距等进行比较探究，以期能为柑橘木虱的绿色防控提供一定的借鉴与指导。

1 材料和方法

1.1 供试材料

主要试验材料：白色、红色、青色、绿色、灰色、黑色、黄色、紫色、蓝色、粉色共10种颜色的粘虫板（河南佳多科工贸有限责任公司生产），规格为24 cm×20 cm，厚度为0.3~0.35 mm，基板双面涂胶。

1.2 试验设计

试验在江西省赣州市柑橘科学研究所基地内失管橘园进行（赣州市蓉江区114°86′42″E，25°7′42″N，海拔为118~120 m），橘园内为树龄25 a（年）柑橘树，品种为‘纽荷尔脐橙’，高度为2~2.2 m。

不同颜色粘虫板及方位诱虫效果试验，试验共设10个颜色处理，采用完全随机区组试验设计，选择长势较好的橘树，每处理将同一颜色粘板按东、西、南、北4个方位挂于橘树上，每处理设3个重复，于悬挂后1、3、5、7、9、12 d观察粘板上的柑橘木虱成虫数量并记录。

不同高度粘板诱虫试验，采用完全随机区组试验设计，设置50、100、150、200 cm 4个高度于橘树引诱的较好方位悬挂，每处理设4个重复，于悬挂后1、3、5、7、9、12 d观察粘板上的柑橘木虱成虫数量并记录。

不同间距粘板诱虫试验，采用完全随机区组试验设计，设置2、3、4、5 m挂板间距于不同的小区中，每处理设3个重复，于悬挂后1、3、5、7、9、12 d观察粘板上的柑橘木虱成虫数量并记录。

1.3 数据处理

采用SPSS 18.0数据处理软件进行统计分析，采用Duncan’s新复极差法进行多重比较。

2 结果与分析

2.1 不同色板对柑橘木虱的诱集效果

试验结果（表1）表明，柑橘木虱成虫对白色、红色、青色、绿色、灰色、黑色、黄色、紫色、蓝色、粉色10种颜色色板的趋性各不相同，其中，黄色色板对柑橘木虱的诱集效果最好，12 d诱集的虫量均值达到了21.83头，且诱集效果与其他9种颜色的色板存在显著性差异（$p < 0.05$）；其次是蓝色色板，12 d诱虫量均值为12.92头；绿色、红色和青色色板的效果略差于蓝色，但无显著性差异；10种颜色中，诱集效果最差的是粉色、黑色、紫色、灰色和白色。因此，进一步的色板悬挂高度及间距试验使用黄色作为试验色板。

表1 不同色板对柑橘木虱的诱集效果

Table 1 Trapping effect of different color sticky cards for monitoring citrus psyllid

颜色 Color	12板总虫数 Total number of insects on 12 cards			平均虫数/（头•板$^{-1}$） Average number of insects/ (No. •card^{-1})
	3 d	7 d	12 d	
黄色 Yellow	53	186	262	21.83±3.27 aA
蓝色 Blue	29	92	155	12.92±1.37 bB
绿色 Green	21	65	113	9.42±1.16 bcBC
红色 Red	22	60	112	9.33±1.08 bcBC
青色 Cyan	22	66	100	8.33±1.23 bcBC
粉色 Pink	30	74	95	7.92±0.93 cBC
黑色 Black	27	71	94	7.83±1.61 cBC
紫色 Purple	25	55	77	6.42±1.08 cBC
灰色 Grey	18	50	75	6.25±1.04 cBC
白色 White	17	40	67	5.58±0.44 cC

注：平均虫数为12 d内3个重复诱捕虫量的平均数（表2、3、4同）。不同小写字母表示在0.05水平差异显著，不同大写字母表示在0.01水平差异显著。下同。

Note:Average number of insects represents the mean number of three replicates attracting individuals in 12 days（the same as in the following table 2，3 and 4）. Different small letters indicate significant difference at 0.05 level，different capital letters indicate significant difference at 0.01 level. The same below.

2.2 不同方位黄色色板对柑橘木虱的诱捕效果

试验结果（表2）表明，东、南、西、北4个方位12 d

表2　不同方位黄色色板对柑橘木虱的诱捕效果

Table 2　Trapping effect of yellow sticky cards in different directions for monitoring citrus psyllid

方位 Direction	总虫数 Total number of insects			平均虫数/(头•板$^{-1}$) Average number of insects/(No.•card^{-1})
	3 d	7 d	12 d	
南 South	26	91	112	28.00±5.28 aA
北 North	15	44	82	20.50±2.60 abAB
西 West	8	26	62	15.50±1.44 bAB
东 East	4	25	54	13.50±0.96 bB

平均诱虫数分别是13.50、28.00、15.50和20.50头•板$^{-1}$，以南面方位的诱捕效果最好，诱捕的柑橘木虱数量最多。南面方位与北面方位没有显著差异，与西、东方位之间存在显著差异（$p < 0.05$），北、西、东3个方位之间没有显著差异。

2.3　不同悬挂高度黄色色板对柑橘木虱的诱捕效果

试验结果（表3）表明，在色板悬挂高度为150 cm左右时，诱集的柑橘木虱数量最多，12 d均值为36.75头，与100 cm和50 cm存在显著差异（$p < 0.05$）；其次是200 cm，均值为24.00头。即色板悬挂高度高于150 cm时，对木虱的诱集效果最好，与高度低于150 cm之间存在显著差异（$p < 0.05$），随着悬挂高度降低，诱虫量逐渐减少。

表3　不同悬挂高度黄色色板对柑橘木虱的诱捕效果

Table 3　Trapping effect of yellow sticky cards in different heights for monitoring citrus psyllid

高度 Height/cm	总虫数 Total number of insects			平均虫数/(头·板$^{-1}$) Average number of insects/(No.•card^{-1})
	3 d	7 d	12 d	
150	44	105	147	36.75±7.85 aA
200	23	52	96	24.00±1.47 abAB
100	12	45	67	16.75±1.65 bcB
50	5	21	38	9.50±1.55 cB

2.4　不同间距黄色色板对柑橘木虱的诱捕效果

试验结果（表4）表明，当色板间距为4 m时，每板诱集的柑橘木虱数量最多，为32.33头，但仅与间距2 m的诱虫量之间存在显著差异（$p < 0.05$），与间距5 m、3 m不存在显著差异。间距4 m、5 m、3 m诱虫量较多，虽然诱虫量差异不显著，但间距4 m的诱虫数量多于其他2项。故实际生产上采取间距为4~5 m效果较好。

表4　不同间距黄色色板对柑橘木虱的诱捕效果

Table 4　Trapping effect of yellow sticky cards in different spacings for monitoring citrus psyllid

间距 Spacing/m	总虫数 Total number of insects			平均虫数/(头•板$^{-1}$) Average number of insects/(No. •card^{-1})
	3 d	7 d	12 d	
4	15	35	97	32.33±3.84 aA
5	7	32	74	24.67±2.40 abA
3	9	26	59	19.67±4.33 abA
2	11	28	54	18.00±5.13 bA

3　讨　论

昆虫的视觉感受器可以感受光波的刺激，在中枢神经系统内产生视觉反应，从而对光、颜色等其他外界刺激产生趋性[13-14]，农业生产上，通常利用昆虫的趋性对其种群发生动态进行监测与防治[15-17]。笔者筛选了不同颜色色板对柑橘木虱的诱集效果，在白色、红色、青色、绿色、灰色、黑色、黄色、紫色、蓝色、粉色10种颜色的色板中，黄色对柑橘木虱的诱捕效果最好，诱虫数量与其他颜色有显著性差异。已有研究证实，视觉因素在柑橘木虱寻找寄主活动中具有重要作用[18-20]。不同颜色色板诱杀柑橘木虱的研究表明，黄色效果最好，该结果与色板的反射率值有密切关系：在可见光谱中的黄色波长区域（560~590 nm），黄板的反射率达到一个最高峰[20-21]，对诱虫有较好的效果。

柑橘木虱具有较强的趋光性，在有光源处，柑橘木虱的诱集率明显高于无光源的场所，表明光源会影响柑橘木虱的飞行行为[19, 22]。同时有研究表明，诱捕器挂于橘树的南面与东面诱集柑橘木虱成虫的效果较好；橘树顶部与中部诱集的效果较好[23]。经分析，橘园南面方位光照强度较好，柑橘木虱趋向于橘树的南面方位，因此不同方位诱捕柑橘木虱试验结果中，南面方位诱捕效果优于其他方位。同时，橘树顶部与中部是橘树抽梢的主要部位，木虱仅产卵于新出嫩芽[24]，因此木虱的趋性较大，与悬挂高度150~200 cm相符，因此诱捕效果也优于其他高度。

不同的色板间距对诱虫量和控制效果有明显的差异[25]，设置的不同色板间距表明在橘园内每隔4~5 m悬挂黄板对于柑橘木虱具有较好的引诱作用及防效。本试验中，在设置的不同间距中，4 m处优于5 m、3 m、2 m处，设置的最大间距不一定是诱虫效果最好间距，这与其他粘板试验结果相似[26-27]。有研

究指出，黄板防治害虫时，其有效作用距离很有限，例如在田间对于假眼小绿叶蝉的控制距离可能仅有2 m左右[28]。昆虫通过视觉和嗅觉因素同时作用定位寻找寄主植物[29]，在较近距离时，植物的光谱信息（尤其是色彩和强度）是激发植食性昆虫接触植物的首要因素[30-31]。昆虫仅仅具有视觉刺激，而视觉作用范围较为有限，因此超过一定距离，色板的引诱效果变差，对其区域的木虱可能起不到诱集效果。

针对柑橘木虱，在柑橘3—4月春梢期前将黄板以间距4~5 m悬挂于长势较好、即将抽梢的橘树的中上部，以达到对木虱较好的诱捕效果。本研究可为柑橘木虱绿色防控提供科学依据。

4 结 论

色板诱捕作为一种绿色环保无污染的物理防治手段，不仅对减少农药的使用具有重要意义，同时因其操作简便，成本低廉，更易于在大面积生产实践中推广。但在诱虫板推广过程中，应充分考虑目标昆虫与色板颜色、悬挂高度、方位、间距等因素的互作效应，以达到最好的综合防治效果。

参考文献 References：

[1] CAPOOR S P，RAO D G，VISWANATH S M. *Diaphorina citri* Kuway. A vector of the greening disease of *Citrus* in India[J]. Indian Journal of Agricultural Science，1967，4: 572-576.

[2] 张宏宇，李红叶 . 图说柑橘病虫害防治关键技术[M]. 北京: 中国农业出版社，2012: 54.
ZHANG Hongyu，LI Hongye. Pictures of citrus diseases and pests and key control techniques [M]. Beijing: China Agriculture Press，2012: 54.

[3] GOTTWALD T R，GRAÇA J V D，BASSANEZI R B. *Citrus* Huanglongbing: the pathogen and its impact[J]. Plant Health Progress，2007，9: 906-910.

[4] BOVÉ J M. Huanglongbing: a destructive，newly-emerging，century-old disease of citrus [J]. Journal of Plant Pathology，2006，88(1): 7-37.

[5] 王晓亮，李潇楠，冯晓东，吴立峰. 柑橘黄龙病与柑橘木虱在我国发生情况调查[J]. 植物检疫，2016，30(2): 44.
WANG Xiaoliang，LI Xiaonan，FENG Xiaodong，WU Lifeng. *Citrus* Huanglongbing and citrus psylla occurrence in China[J]. Plant Quarantine，2016，30(2): 44.

[6] QURESHI J A，STANSLY P A. Integrated approaches for managing the Asian citrus psyllid *Diaphorina citri* (Homoptera: Psyllidae) in Florida[J]. Proceedings of the Florida State Horticultural Society，2007，120: 110-115.

[7] BELASQUE J，BASSANEZI R B，YAMAMOTO P T，AYRES A J，TACHIBANA A，VIOLANTE A R，TANK JR A，GIORGI F D I，TERSI F E A，MENEZES G M，DRAGONE J，JANK JR R H ，BOVÉ J M. Lessons from Huanglongbing management in São Paulo State，Brazil[J]. Journal of Plant Pathology，2010，92(2): 285-302.

[8] HALBERT S E，MANJUNATH K L. Asian citrus psyllids (Sternorrhyncha: Psyllidae) and greening disease of citrus: a literature review and assessment of risk in Florida[J]. Florida Entomologist，2004，87(3):330-353.

[9] TIWARI S，MANN R S，ROGERS M E，STELINSKI L L. Insecticide resistance in field populations of Asian citrus psyllid in Florida[J]. Pest Management Science，2011，67(10): 1258.

[10] RODRIGUEZ-SAONA C R，BYERS J A，SCHIFFHAUER D. Effect of trap color and height on captures of blunt-nosed and sharp-nosed leafhoppers (Hemiptera: Cicadellidae) and non-target arthropods in cranberry bogs[J]. Crop Protection，2012，40(5): 132-144.

[11] FRANCESE J A，RIETZ M L，MASTRO V C. Optimization of multifunnel traps for emerald ash borer (Coleoptera: Buprestidae): influence of size，trap coating，and color[J]. Journal of Economic Entomology，2013，106(6): 2415-2423.

[12] POLAND T M，MCCULLOUGH D G. Comparison of trap types and colors for capturing emerald ash borer adults at different population densities[J]. Environmental Entomology，2014，43(1): 157.

[13] 孙晓玲，蔡晓明，王国昌，高宇，王德强，陈宗懋 . 茶园中广翅蜡蝉成虫对不同颜色的趋向选择[J]. 茶叶科学，2011，31(2): 95-99.
SUN Xiaoling，CAI Xiaoming，WANG Guochang，GAO Yu，WANG Deqiang，CHEN Zongmao. Tendency to different colors by ricaniidae insects in tea garden [J]. Journal of Tea Science，2011，31(2): 95-99.

[14] 王政，孟倩倩，钟国华 . 植食性昆虫取食行为过程及机制研究[J]. 环境昆虫学报，2014，36(4): 612-619.
WANG Zheng，MENG Qianqian，ZHONG Guohua. Study on the feeding behavior process and mechanism of phytophagous insect[J]. Journal of Environmental Entomology，2014，36(4): 612-619.

[15] 傅建炜，徐敦明，吴玮，尤民生 . 不同蔬菜害虫对色彩的趋性差异[J]. 昆虫知识，2005，42(5): 532-533.
FU Jianwei，XU Dunming，WU Wei，YOU Minsheng. Preference of different vegetable insect pests to color[J]. Chinese Bulletin of Entomology，2005，42(5): 532-533.

[16] 陈尚文，罗基同，杨秀好，吴耀军，覃崇贵，梁一萍，常明山. 黄色粘板对桉树枝瘿姬小蜂成虫的引诱及在监测中的应用[J]. 广西林业科学，2009，38(4): 199-203.
CHEN Shangwen，LUO Jitong，YANG Xiuhao，WU Yaojun，QIN Chonggui，LIANG Yiping，CHANG Mingshan. Yellow sticky board luring adults of eucalyptus gall wasp (*Leptocybe invasa* Fisher et La Salle) and the application in monitoring[J].

Guangxi Forestry Science，2009，38(4): 199-203.

[17] 夏西亚，付步礼，邱海燕，唐良德，李强，刘奎 . 黄胸蓟马对颜色的趋性反应[J]. 应用昆虫学报，2017，54(2): 230-236.
XIA Xiya，FU Buli，QIU Haiyan，TANG Liangde，LI Qiang，LIU Kui. Preference of *Thrips hawaiiensis* for different colors [J]. Chinese Journal of Applied Entomology，2017，54(2): 230-236.

[18] WENNINGER E J，STELINSKI L L，HALL D G. Roles of olfactory cues，visual cues，and mating status in orientation of *Diaphorina citri* Kuwayama（Hemiptera: Psyllidae）to four different host plants[J]. Environmental Entomology，2009，38（1）: 225-234.

[19] SÉTAMOU M，SANCHEZ A，PATT J M，NELSON S D,JIFON J，LOUZADA E S. Diurnal patterns of flight activity and effects of light on host finding behavior of the Asian citrus psyllid[J]. Journal of Insect Behavior，2012，25(3): 264-276.

[20] DAVIDG H，MAMOUDOU S，RUSSELLF M. A comparison of sticky traps for monitoring Asian citrus psyllid（*Diaphorina citri* Kuwayama）[J]. Crop Protection，2010，29（11）: 1341-1346.

[21] SÉTAMOU M，SANCHEZ A，SALDAÑA R R，PATT J M，SUMMY R. Visual responses of adult Asian citrus psyllid（Hemiptera: Liviidae）to colored sticky traps on citrus trees[J]. Journal of Insect Behavior，2014，27(4): 540-553.

[22] HALL D G. An assessment of yellow sticky card traps as indicators of the abundance of adult *Diaphorina citri*（Hemiptera: Psyllidae）in citrus[J]. Journal of Economic Entomology，2009，102(1): 446.

[23] 李云明 . 柑橘木虱信息素复合诱捕器监测柑橘木虱成虫效果试验[J]. 基层农技推广，2016(2): 21-22.
LI Yunming. Citrus psyllid pheromone trap monitoring of citrus psylla composite effect test[J]. Primary Agricultural Technology Extension，2016(2): 21-22.

[24] LIU Y H，TSAI J H. Effects of temperature on biology and life table parameters of the Asian citrus psyllid，*Diaphorina citri* Kuwayama（Homoptera: Psyllidae）[J]. Annals of Applied Biology，2015,137(3): 201-206.

[25] 陈丹，张以和，热孜万古力，米日古丽，杨媚，潘卫萍，马德英 . 黄板诱杀对设施蔬菜烟粉虱控制作用研究[J]. 新疆农业科学，2012，49(2): 255-260.
CHEN Dan，ZHANG Yihe，REZIWANGULI，MIRIGULI，YANG Mei，PAN Weiping，MA Deying. Control effects of yellow sticky trap（YST）to *Bemisia tabaci* in the greenhouses in Turpan area[J]. Xinjiang Agricultural Sciences，2012，49（2）: 255-260.

[26] 于法辉，夏长秀，李春玲，张宏宇 . 不同色板对柑橘园蓟马的诱集效果及蓝板的诱捕效果[J]. 应用昆虫学报，2010，47(5): 945-949.
YU Fahui，XIA Changxiu，LI Chunling，ZHANG Hongyu. The attractiveness of different colors to thrips in citrus orchards and the trapping effect of blue sticky[J]. Chinese Bulletin of Entomology，2010，47(5): 945-949.

[27] 张怀江，巫鹏翔，刘小侠，仇贵生，王克有，张青文 . 不同颜色色板对梨瘿蚊的诱集效果[J]. 中国南方果树，2015，44(4): 93-95.
ZHANG Huaijiang，WU Pengxiang，LIU Xiaoxia，QIU Guisheng，WANG Keyou，ZHANG Qingwen. The trapping effect of different color swatches of pear gall midge[J]. South China Fruits，2015，44(4): 93-95.

[28] 徐秀秀 . 茶树挥发物对假眼小绿叶蝉的引诱作用及影响因子研究[D]. 北京: 中国农业科学院，2015 .
XU Xiuxiu. Attraction of tea plant volatiles to *Empoasca vitis* and influencing factors[D]. Beijing: Chinese Academy of Agricultural Sciences，2015.

[29] BERNAYS E A，CHAPMAN R E. Behavior: the process of host-plant selection by phytophagous insects[M]. US: Springer，1994: 95-165.

[30] KENNEDY J S，BOOTH C O，KERSHAW W J S. Host finding by aphids in the field[J]. Annals of Applied Biology，1961，49（1）: 1-21.

[31] VAISHAMPAYAN S M，WALDBAUER G P，KOGAN M. Visual and olfactory responses in orientation to plants by the greenhouse whitefly，trialeurodes vaporariorum（Homoptera: Aleyrodidae）[J]. Entomologia Experimentalis Et Applicata，1975，18（4）: 412-422.