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Elevation of Attraction Efficiency of Jackson Trap on Peach Fruit Fly, *Bactrocera zonata* (Saunders)

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ABSTRACT

The Peach Fruit Fly (PFF), *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) is an important agricultural pest in Egypt. Monitoring and control of this species is relating to collecting data of traps catching. The efficiency of traps attraction has an important role to reach the real population density of PFF. Present study was carried out in the field on Jackson trap provided with the sex attractant, Methyl eugenol, to evaluate the effects of color and height of the trap as well as position of the trap in the main cardinal directions of the tree on attraction of male PFF, expressed as male flies captured per trap per day (CTD). Results of the comparison between yellow and white colors of card Jackson traps revealed that white trap color (4.67 CTD) was preferred than the yellow one (3.63 CTD) for peach fruit fly attraction. The suitable height for hanging traps on the tree was 1.5 m, followed by 1.0, 2.5 and 2.0 m heights, respectively. On the other hand, the best position of trap on the tree was West direction (3.33 CTD) of the tree, followed by North (3.20 CTD), East (1.90 CTD) and South directions (1.60 CTD), respectively.

Key words: Peach fruit fly, *Bactrocera zonata,* trap color, height and position

INTRODUCTION

Peach Fruit Fly (PFF), *Bactrocera zonata* (Saunders) (Diptera: Tephritidae), is one of most insect pests threatening the agriculture economy. It attacks a wide range of hosts over 50 cultivated and wild plant species as; guava, mango peach, apricot, fig and citrus (EPPO, 2010).

The existence of PFF in Egypt (CDFA, 2012) is threatening the export of fruit and vegetables. Because of the appropriate environmental conditions and availability of their hosts it had spread in Egypt where it was recorded in different locations such as Alexandria (El-Minshawy *et al*., 1999), Kalubia (Hashem *et al*., 2001), El-Beheira (Draz *et al*., 2002), on the mainland, the whole Nile Delta region, Nile Valley and Kharga and Dakla oases; on the Sinai peninsula, Ras El Sudr, El Tur and Nuweiba in South Sinai Governorate, captures all along the North Sinai Governorate from El Qantara (North-West) to Rafah (North-East) Governorates (EPPO/OEPP, 2005).

Lure traps are modern method for detecting and evaluating the population dynamics and survey flies (Hashem *et al*., 2001). However, monitoring the changes in population density of PFF by Jackson trap provided with sex attractant Methyl Eugenol (Draz *et al*., 2002). Plastic gallon traps, 5 feet above the ground, were used for controlling PFF and *B. dorsalis* in guava trees in Pakistan (Marwat *et al*., 1992), while PFF traps were suspended at 1.8 m above the ground (Qureshi *et al*., 1992). Also, cylindrical plastic traps, 6 feet above the soil, were used to study density fluctuation of trapped fruit flies male of PFF, *Dacus zonatus* (Mahmood *et al*., 2002) and mineral water bottles baited with different lures, 1.5 m above ground level, were used to attract male flies of *Bactrocera tau* (Hasyim *et al*., 2007).

This study aims to evaluate the effects of trap color, height and position in the main cardinal directions of the tree in order to raise the attracting efficiency of Jackson traps used in detection-, delimiting- and monitoring-survey male PFF population.

MATERIALS AND METHODS

Present study was carried out during fruit season, 2010 at Shoubrakhit district, El-Beheira Governorate in an orchard of 5 feddans contains various host trees; mandarin, navel orange, fig, mango and grapefruit.

Card Jackson trap provided with cotton wick (5 cm long and 1 cm diameter) contains liquid Methyl Eugenol 98% manufactured by Sinoway international (JIANGSU) Co. LTD-China with Killing agent, Malathion, with a ratio 8:2 (v/v) and the cotton wick retained for one month at most. The traps were used in three different experiments. Traps were examined weekly and number of male flies captured/trap/day (CTD) was calculated and repeated for three replicates.

First experiment: The first experiment was planned to determine the preferable color of card Jackson traps for attracting PFF males. Yellow and white colors of Jackson traps were used. The traps were hanged at 1.5 m height of the trees.

Second experiment: The second experiment was planned to determine the suitable height of white Jackson trap on the tree. Four height levels were tested; 1.0, 1.5, 2.0 and 2.5 m heights above the ground.

Third experiment: The third experiment aimed to evaluate the best direction of white Jackson trap position on the trees. Traps were placed at four main directions of the tree i.e., North, West, East and South directions at 1.5 m height from the ground, as followed by the adopted formula according to El-Dessouky *et al*. (1989):

$$H = \sqrt{F_1^2 + F_2^2 + 2 F_1 F_2 \cos\theta}$$

Where:
H = Expected average number of PFF males at the resultant directional preference
F_1, F_2= Average number of PFF males at the two favorable directions
Cos θ = Cosign of angle between these two favorable directions

The above mentioned experiments were planned as complete randomized design with three replicates. Comparisons of means are done according to LSD. test at 0.05 level of probability using CoStat-Software (1990).

RESULTS AND DISCUSSION

Data presented in Table 1 and Fig. 1 revealed that the white card Jackson trap was more efficiency for attracting male PFF (4.67 CTD) than yellow one (3.63 CTD). The general mean numbers of PFF males revealed that the white card Jackson traps were higher with 1.29-folds than yellow one, where it was about 56% of the total mean numbers of CTD for all tested trap colors. The statistical analysis showed significant difference between mean numbers of CTD in white color trap than yellow color traps. The presented data demonstrated that the insects may use

Table 1: Effect of Jackson trap color on attraction of male PFF, *B. zonata* (Saunders)

	Mean No. of captured males/trap/day (CTD)					
	Month					
Trap color	1st	2nd	3rd	4th	Total	Mean±SD
White	4.85±0.15	5.66±0.60	4.00±0.60	4.14±0.16	18.69	4.67±0.75[a]
Yellow	4.00±0.50	4.64±0.25	2.66±0.23	3.21±0.21	14.51	3.63±0.83[b]
Total	8.85±0.00	10.43±0.00	6.66±0.00	7.35±0.00	33.10	8.30±0.00
Mean±SD	4.43±0.57	5.17±0.62	3.33±0.83	3.67±0.53	16.60	4.15±0.94

Means followed by the same letter(s) are not significantly different according to $LSD_{0.05}$. $LSD_{0.05}$, for Color: 0.29

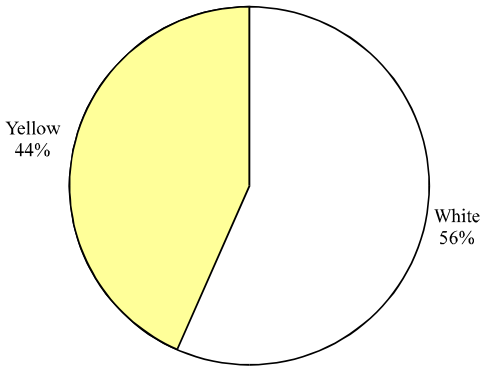

Fig. 1: Population density of mean numbers of PFF males, *B. zonata* and trap color

a particular color until find it's host fruit. However, present result supported the conclusion of Espiky *et al.* (2004) that the color can serve as a strong attractant using in a trap and most sticky traps use a color to target certain insects. Also, Al-Saoud *et al.* (2010) indicated that trap color has a significant effect on trap effectiveness. Nakagawa *et al.* (1978) found that black and yellow colors of diameter sphere were being the most attractive for male and female of Mediterranean Fruit Flies (MFF) of *Ceratitis capitata*, while white and grey colors were the least attractive. No significant differences were obtained between red spheres and yellow panels in performance for monitoring the Apple Maggot (AM) *Rhagoletis pomonella* Walsh (Brunner, 1987). Red spheres traps were not attractive to Utah AM populations and also recommended yellow panels for AM survey (Davis and Jones, 1986). On the other hand, Demirel and Yildirim (2008) mentioned that the yellow sticky color traps were significantly attractive for *Thrips tabaci* in 2006, while in 2007, the white sticky color traps were significantly attractive. So, Al-Saoud *et al.* (2010) indicated that the highest catch of red palm weevil, *Rhynchophorus ferrugineus* Olivier, was achieved in the red trap, followed by blue, green, orange, pink, yellow and white colors. Generally, it is concluded that the white color Jackson trap is more suitable for attraction of PFF males than yellow one. These results indicate that the attraction to color may differ not only between insect species but also between the insect orders.

The traps of white Jackson were hanged at 1.0, 1.5, 2.0 and 2.5 m heights above the ground. The results in Table 2 and Fig. 2 indicated that the traps were varied in their attractability for PFF males with trap heights. The general mean of numbers of CTD elucidated that the traps hanged at 1.5 m height were more attracted than the other trap heights; 5.17, 4.46, 3.66 and 3.31 CTD

Table 2: Effect of Jackson trap heights on attraction male PFF, *B. zonata* (Saunders)

	Mean No. of captured males/trap/day (CTD)					
	Height (m)					
Month No.	2.5	2.0	1.5	1.0	Total	Mean±SD
1	4.22±0.22	4.00±0.50	5.72±0.75	4.85±0.15	18.8±0.00	4.75±0.81
2	3.20±0.20	2.65±0.35	4.57±0.22	4.13±0.13	14.55±0.0	3.64±0.81
3	3.57±0.51	3.00±0.20	5.21±0.21	4.40±0.40	16.48±0.0	4.45±0.92
Total	10.99±0.00	9.95±.0.00	15.58±0.00	13.39±0.00	49.83±0.0	12.46±0.00
Mean±SD	16.16±0.00	3.66±0.53^{c}	3.21±0.68^{d}	5.17±0.14^{a}	4.46±0.68^{b}	4.15±0.93

Means followed by the same letter(s) are not significantly different according to $LSD_{.0.05}$, $LSD_{.0.05}$, for Height: 0.36

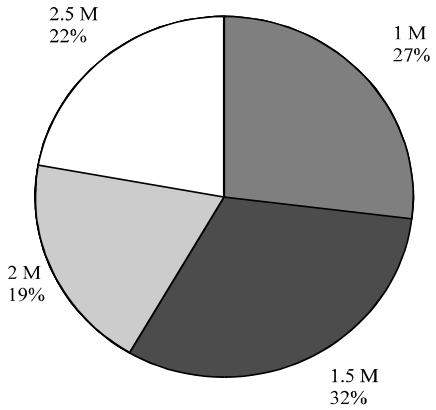

Fig. 2: Relationship between mean numbers of PFF males, *B. zonata* Jackson trap heights

for traps hanged at 1.5, 1.0, 2.5 and 2.0 m heights above the ground, respectively, during population activity period of PFF males, where it was about 32% of the total mean numbers of CTD at all trap heights. Our results indicated that there were highly significant differences in the mean numbers of CTD between the all tested trap heights. However, the trap position within the tree canopy is critical for maximizing trap efficiency (Drummond *et al*., 1984). The present results agree with Marwat *et al*. (1992) who suspended the PFF traps at 5 feet above the ground. Gencsoylu *et al*. (2006) hanged 1.5-2 m height above the ground for traps of MFF, also El-Messoussi *et al*. (2007) hanged traps of MFF at 1-2 m height. As a similar to these results, Qureshi *et al*. (1992) mentioned that the traps of PFF were suspended at 1.8 m above the ground at random on fruit trees. On the other hand, Siddiqui *et al*. (2003) noted that significantly highest numbers captured of PFF were achieved in hanged traps at 10 feet height, followed by 8, 6, 2 and 4 feet. Furthermore, a significantly highest captured flies of *Rhagoletis cingulata* (Loew) were achieved in unbaited Pherocon traps hung at 4.6 m within cherry trees than other one at 2.1 or at 1.2 m (Pelz-Stelinski *et al*., 2006).

However, it is concluded that the suitable trap height differs from one insect order to another one. Such conclusion support the results of Malik *et al*. (2002), who revealed that a significant difference was observed among all tested trap heights and maximum number of coddling moths (*Cydia pomenella* L.) were captured through the trap hanged at 4 m from the ground.

Generally 1.5 m height is the best position for hanging traps for more attraction of PFF males.

Table 3: Direction effect of Jackson trap on attraction male PFF, *B. zonata* (Saunders)

	Mean No. of captured males/trap/day (CTD)					
	Direction					
Week No.	N	W	E	S	Total	Mean±SD
1	0.90±0.08	1.14±0.57	1.35±0.64	0.64±0.50	4.03	1.00±0.50^{de}
2	7.65±0.93	8.41±2.99	7.14±2.86	5.21±0.64	28.40	7.10±2.20^{a}
3	7.14±0.00	5.64±2.93	1.49±0.07	1.56±0.85	15.83	3.96±2.90^{b}
4	4.42±0.85	5.06±2.78	1.71±0.75	1.56±0.28	12.69	3.19±2.02^{b}
5	2.06±0.35	2.57±1.00	1.90±0.83	1.56±0.85	8.09	2.03±0.77^{c}
6	1.78±0.93	2.00±1.00	0.99±0.28	1.35±0.78	6.12	1.53±0.66^{cd}
7	0.99±0.28	1.18±0.15	0.64±0.07	0.78±0.64	3.59	0.90±0.37^{de}
8	0.71±0.43	0.68±0.25	0.00±0.00	0.18±0.16	1.57	0.39±0.39^{e}
Total	25.70±0.00	26.68±0.00	15.22±0.00	12.84±0.00	80.30	
Mean±SD	3.20±2.75^{a}	3.34±3.03^{a}	1.90±2.30^{b}	1.60±0.56^{b}	10.04	2.51±2.55

Means followed by the same letter(s) are not significantly different according to $LSD_{0.05}$, $LSD_{0.05}$, for Direction: 0.66, $LSD_{0.05}$, for Inspection: 0.94, N: North., W: West, E: East, S: South

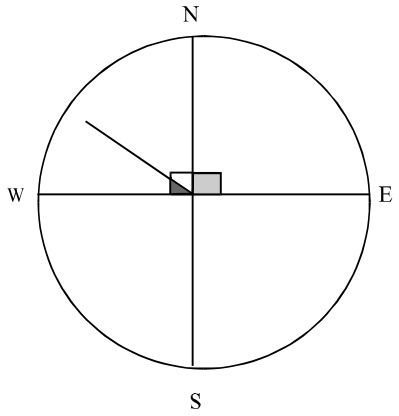

Fig. 3: Average preference direction of PFF males, *B. zonata,* at main cardinal directions

Appropriate placement of traps in the orchard and the tree both of them are important for trap efficiency. The best situation of traps baited with methyl eugenol suspended at main cardinal directions of tree; West, North, East and South directions were determined and presented in Table 3 and Fig. 3. The results showed that the PFF males were trapped in higher numbers by traps suspended at the West direction, followed by North, East and South directions; 3.33, 3.20, 1.90 and 1.60 CTD, respectively. The traps were suspended at West direction were higher catching with 1.04, 1.75, - and 2.08-folds than traps were suspended at North, East and South directions, respectively, where the percent of mean number of CTD at the East direction was 33% of total mean number of CTD, followed by 32% for North direction, it's clear that the PFF males prefer to concentrate on the West-North direction. So, the expected average number of PFF males at the resultant directional preference was 2.37 CTD. The statistical analysis showed there were significant differences in the mean numbers of CTD between West, North, East and South directions, respectively, while no significant difference in the mean numbers of CTD was found between West and North directions. The results is agree with Hashem *et al.* (2003) who found that

the West direction was the best position for placing Jackson traps at the four main directions and field center to receiving a highest significant number of PFF males, followed by North, Center, East and south directions, respectively. While, Calkins *et al.* (1984) detected the population activity of *Anastrepha suspensa* by using McPhail traps within the foliage in the northeast of each design, Draz *et al.* (1993) showed that the number of capture MFF was at North, West, East and South directions, respectively. On the other hand, Pelz-Stelinski *et al.* (2006) suspended traps of *R. cingulata* in the southwest direction of cherry trees. While, it was hanged at south-east direction for trapped of MFF (Gencsoylu *et al.*, 2006). El-Messoussi *et al.* (2007) conclude from these results that there is a difference between species in attraction to the different height levels of trap, which may extend to the same species. It's important to mention that there are important factors did not study in the present experiments. This fact may be supported by Qureshi *et al.* (1975) who found that the most PFF dispersed in south western and south direction when the wind was predominantly west-south-west. So, effect of insecticide of pheromone efficiency (Malik and Ali, 2002).

CONCLUSION

Overall, the results obtained here clearly show that for elevation efficiency of Jackson traps used for catching PFF males, it is recommended to use the white color trap, hanging about 1.5 m above ground, in the West or/North or West-North directions on the tree throughout summer season.

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