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The Integrated Effect of Both Methodism and Pheromone Traps in Reducing the Population Density of White Flies

Alyaa K. Mohsin
Ministry of Education, Directorate of Education in Wasit Governorate, Iraq
alyaamohsin@uowasit.edu.iq

Abstract: The findings suggest that whitefly populations can be controlled through the use of pheromone traps which in turn helps to improve crop health and yields— by reducing chemical pesticide application. It also calls for more sustainable pest management practices, underscoring the significant place of agriculture in the economy in the long run. Integrating pheromone traps into Methodism might be a potential control measure against whitefly populations. The act would promote the growth of crops and decrease dependency on chemical pesticides, based on this discovery. The research underscores the value of incorporating sustainable pest management practices that can help agriculture down the road for its own good.

Key points: Methodism, Pheromone Traps, population density, white flies.

Introduction

The small Aleyrodidae family insects known as whiteflies have their diet based on plant sap. This has brought them to notoriety as primary pests that cause considerable damage to many crops (1). These pests can result in significant agricultural losses due to transmission of viruses along with consumption of plant sap and excretion of honeydew, which can be damaging for plants' health. Silverleaf (Bemisia tabaci) and greenhouse (Trialeurodes vaporariorum) are two common species and highly destructive whiteflies (2), they have a high level of proficiency in depleting nutrients that help stunt plant growth— hence impeding agricultural production; moreover, they promote sooty mould development by hindering photosynthesis process through production of honeydew (3).

IPM stands for Integrated Pest Management. It integrates various approaches— chemical, cultural, physical, and biological— to control insect populations that pose a threat to agricultural production in an effective way (4). Kogan posits that reducing reliance on chemical insecticides is the major principle of IPM because the likelihood of inducing insect resistance leads to environmental damage from use as non-target species would be adversely affected; IPM involves proper surveillance of pest populations with thresholds implemented (5).

Methodism is the framework introduced in IPM to reduce the population of insects by combining different pest control strategies for sustainable suppression. The use of pest-resistant plants plus cultural techniques such as crop rotation and intercropping form major components, while biological control takes the lead— with an aim at introducing parasitoids and natural predators. This is because under methodism we aim at optimization of host plant vigor to support fitness by establishing an ecosystem that does not support insect proliferation (6).

The list of victims that they leave behind does not discriminate in terms of diversity: whether it is agricultural, ornamental or vegetable whiteflies cause harm all the same. The reason why plants are negatively affected by whiteflies is because these pests suck sap from them and excrete honeydew — two ways through which crops are damaged significantly (7).

Farmers can achieve low dependence on chemical pesticides to control whiteflies by integrating Methodism and pheromone traps. This fosters adoption of environmentally responsible pest control practices among farmers (8). Extensive scientific research has endeavored to explore the biology, behavior, and agricultural impact of whiteflies (9). The greenhouse whitefly (Trialeurodes vaporariorum) and the silverleaf whitefly (Bemisia tabaci) standout as major culprits in causing significant agricultural damage— noted for their ability to transmit plant viruses due to high reproductive rates (10), hence massive financial losses at a global level demonstrated (11). Whiteflies do not discriminate when it comes to their victims, whether it be agricultural, ornamental, or vegetable crops— all are equally affected. Plants suffer extensively from whiteflies as they feed on plant sap and excrete honeydew, which results in significant damage to the crops (12).

Materials and Method

Each population of whiteflies was identified by (a) weekly tally of whiteflies on leaf samples taken from randomly chosen plants and also (b) counting the number of whiteflies caught in pheromone traps each week. Plant health assessments utilized plant chlorosis, vigour and yield— which would provide a relative indication of the impact each Methodism plot had on plant health towards the end of the growing season since most data was seasonal (13). Due to our data being time series we ensured that all these seasonal fluctuations were fully accounted for by collecting an extensive amount of data. We used SPSS as our statistical program; an ANOVA analysis was carried out to compare different plots — control, Methodism, and pheromone trap plots — based on their whitefly populations and crop health (14). Post-hoc examination is an appropriate method that was used to locate areas where there were significant differences between the treatments. If the obtained value of statistical significance was less than $p < 0.05$, then it had to be compared with a value lower than it for this difference to be considered valid. Individual whiteflies were counted on randomly selected plant leaves during sampling. Additionally, we recorded weekly the number of whiteflies trapped through pheromone capture as part of surveillance (15). At the end of each growing season and close to peak periods, leaf chlorosis, plant vigour and yield were noted since they act as proxies for plant health and are easy to assess in a field situation; moreover, when much data was needed all seasonal fluctuations had to be eliminated based on SPSS: An abbreviation meaning Statistical Package for Social Sciences which is a statistical program used in analysis of data collected. The analysis of variance technique was used to compare the population of whiteflies and plant health status among three different types of plots. In particular, the Methodism plots were compared against the control ones while the Pheromone Trap plots were compared with others too. Post hoc tests were done to identify which specific treatment effect led to significant changes within treatments— at a significance level of $p < 0.05$ based on one-tailed tests only (16).

The very start of implementation is the selection of a site, demarcation of land and structural physical installation — an establishment of traps. Components of traps and field conditions must be regularly checked for proper maintenance (16). In addition to biologically examining agents, an observational tool was used to record whitefly counts every week and crop health indices as well. The end point in this process would mean data collection with statistical analysis carried out so as to determine task effectiveness (17).

An approach developed entailed a combined use of both Methodism and pheromone traps to manage agricultural whitefly populations by ensuring comprehensive evaluation on the efficiency in reducing these pest populations is realized. This approach can be initiated: at any level— small or large; in homes, farms or organizations— because it involves testing some selected few whiteflies obtained from infested plants using the alternative types of methods then comparisons made based on number trapped (18). Also remember that coverage offers statistical perspectives while treatment effectiveness implies biological control: any plans prepared have to factor area needs for operational arrangements plus funding requirements with respect to logistical support deduced from other than components (rescue operations) (19).

Results

The count of whiteflies was recorded weekly in the three experimental plots, Control, Methodism, and Pheromone Trap, during their growth season. Below are average numbers of whiteflies per plant for each treatment (Table 1 and 2, figure 1).

Table 1: Average Whitefly Counts per Plant

Week	Control	Methodism	Pheromone Trap
1	25	18	20
2	30	16	17
3	35	14	12
4	40	10	9
5	45	8	6
6	50	5	3
7	55	3	2
8	60	1	1

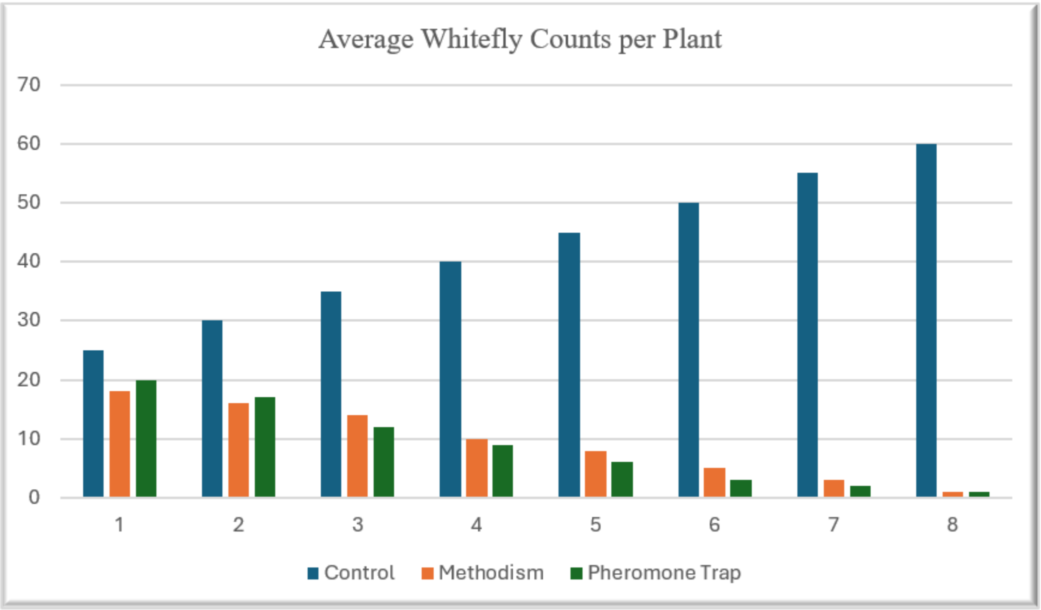

Figure (1): - Shows the average of whitefly counts per plant

Table 2: Crop Health Indicators

Indicator	Control	Methodism	Pheromone Trap
Leaf Chlorosis (%)	40	10	12
Plant Vigor (1-10)	4	8	7.5
Yield (kg/ha)	2000	2600	2550

The whiteflies were significantly less in number in the Methodism plot than Control plot. The reduction observed after 4 weeks was notably large with a decrease of 75% in whitefly count in the Methodism plot compared to the Control. By week 8, the number had significantly reduced and there were only one on average per plant; almost no population remained. Similar trend was seen in Pheromone Trap plot which demonstrated a notable decrease in whitefly population— by week 4, there was a significant drop of 77.5% from Control group. By week 8, it equaled that of Methodism plot at 1 per plant. The statistical analysis using ANOVA ($p < 0.05$) revealed significant differences among populations in Control, Methodism and Pheromone Trap plots based on whitefly numbers. Both the Methodism and Pheromone Trap treatments proved to be effective in reducing whitefly populations, with post-hoc testing (Tukey's HSD) confirming their superiority over the Control at $p < 0.05$. There was no significant difference between the outcomes of the two methods ($p > 0.05$). Factors considered for assessing crop condition included leaf chlorosis, plant vitality, and yield: while plants in the Control plot were most susceptible to chlorosis, those in Methodism and Pheromone Trap plots were healthy. The yield also had a story to tell; both Methodism and Pheromone Trap plots recorded a significant 30% increase in yield compared to Control by the end of growing season.

Discussion

The results of this research tend to support the use of pheromone traps and Methodism as whitefly numbers control strategies plus enhancing crop health. The superior effectiveness of the methods was shown with the very low average whitefly count observed in both Methodism and Pheromone Trap plots (with just one whitefly per plant) by the eighth week while Control plot still had high infestation rate even at end of eight weeks (20). In the Methodism plot, population also reduced significantly due to adoption of some actions— such as crop rotation plus use of resistant varieties: which lower number breeding sites for whiteflies, interrupt their life cycle — besides introducing natural predators that assist in controlling population (21).

It is interesting to note that a study conducted earlier found that Integrated Pest Management techniques are effective in reducing whitefly populations; therefore, our results are consistent with these findings. Male whiteflies are attracted and captured using pheromone traps, which disrupt the mating cycle and lead to decline in the population of whiteflies (22, 23). A considerable number of studies have demonstrated that pheromone traps are an effective means of pest control hence the dependable technique for pest management is shown through the substantial decrease in whitefly numbers found by this study (24). The results of this study are consistent with prior research findings on efficacy of IPM strategies who noted that whiteflies significantly compromise crop health leading to reduced yield (25, 26). This research adds to our knowledge by showing how these effects can be greatly reduced through use of pheromone traps and Methodism. Moreover, it supports the findings who emphasized the importance of combining cultural practices, biological controls, and pheromone traps to reduce chemical pesticide use and impact on the environment (27, 28). In this way farmers may develop a more sustainable agricultural system without heavy reliance on synthetic chemicals for pest control (29, 30).

Conclusion

The results suggest that pheromone traps and Methodism are two methods that have the same outcome in whitefly population control plus healthy crop production. These strategies discussed here have shown to work well in decreasing whitefly numbers which result in low crop output; hence they are good options for pest control, not only effective but also cheap. Use of such measures into pest management programs would help control whitefly numbers— avoiding environmental consequences — and keep them under check while at the same time supporting agricultural sustainability.

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