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EFFICACY OF CERTAIN INSECTICIDES AGAINST OLIVE PSYLLID *EUPHYLLURA STRAMINEA* (LOGINOVA)

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ABSTRACT

A field study was conducted to assess the effectiveness of six insecticides (with different modes of action) viz, imidacloprid, spirotetramat, sulfoxaflor, buprofezin, pyriproxyfen, and mineral oil, against the olive psyllid *Euphyllura straminea* (Loginova) *(*Homoptera*:* Aphalaridae*)* on olive trees (*Olea europea* L.) in Giza Governorate during the 2022 season. The results indicated that all tested insecticidesa significantly reduced the olive psyllids (both nymph and adult stages). Particularly, imidacloprid, sulfoxaflor, and spirotetramat were superior in reducing nymphs (91.37, 89.80, and 89.34% reduction, respectively). Mineral oil was the least effective (only 81.39% reduction). The same order of efficiency was observed with the adults, except for spirotetramat. Buprofezin and pyriproxyfen as insect growth regulators (IGR) displayed good efficacy.

Key words: Olive, insecticides, *Euphyllura straminea*, olive psyllid, IGR, buprofezin, pyriproxyfen, mineral oil, spirotetramat, sulfoxaflor, imidacloprid, insect growth regulator

In Egypt, olive trees are often affected by different insect pests that cause significant damage to both the quality and quantity of fruits. One of the pests is *Euphyllura straminea* (Loginova), which causes serious damage. Yield loss due to sap-sucking insect pests is estimated to be 37%. Both adults and nymphs of *E. straminea* suck plant sap, resulting in yellowing and wilting leaves, shedding leaves, and significant damage from seedling to fruiting stages. Severe infestations can reduce growth rates and productivity. In addition, they produce honeydew, which promotes the growth of sooty mold, decreasing photosynthesis and weakening plant vitality (Oliveira et al., 2001; Wade et al., 2020). Also, the presence of *E. straminea* nymphs is indicated by whitish cottony masses on olive twigs. Infested twigs may dry and die, flowers and young fruits may fall, and a significant reduction in fruit yield can be expected (Katroju et al., 2014; Essam et al., 2022). Therefore, chemical treatment with insecticides is a suitable strategy to prevent the spread and reduce its impact when infestations are already established. The main chemical control strategy for *E. straminea* has focused on using conventional insecticides such as organophosphates, neonicotinoids, and mineral oils (Hassan, 2003; Rasha et al., 2015). However, there are serious concerns regarding the development of resistance and their negative impact on the environment and beneficial insects, such as natural enemies and bees (Serrão et al., 2022). Thus, it has become urgent to search for new alternative insecticides that have different modes of action and are environmentally safe. Hence, this study aimed to evaluate the efficacy of some insecticides belonging to different chemical groups that have different modes of action viz., sulfoxaflor (a sulfoximine group) and spirotetramat (a tetramic acid derivative, ketoenole chemical class) as well as two of insect growth regulators (IGR) including buprofezin and pyriproxyfen, in addition to a mineral oil comparing with imidacloprid.

MATERIALS AND METHODS

The study was conducted in a selected olive orchard located in the village of Mansouriya (11° 26′ N, 75° 53′ E), Giza Governorate, Egypt from April to June 2022. The olive orchard was planted with the Tuffahy cultivar, and the trees were approximately 18 years old, ranging from 5 to 9 m in height. Twenty-one olive trees of the same age, height, and similar vigour, with relatively homogeneous infestation levels were selected to evaluate the efficacy of various insecticides. The experiment was designed using a randomized complete block design (RCBD) with seven treatments. Each treatment was replicated three times, with one tree as replicate. The treatments included six commercial insecticides viz, spirotetramat (Movento 10%SC) @40 ml/ 100 ℓ, sulfoxaflor (Transform 50%WG) @ 25g/ 100 ℓ, imidacloprid (Imidachem35%SC) @ 75 ml/ 100 ℓ, buprofezin (Apruant 40%SC) @35 ml/

100 ℓ, pyriproxyfen (Provy10%EC) @ 50 ml/ 100 ℓ and mineral oil (K- Z oil 95%EC) @ 2500 ml/ 100 ℓ in addition to an unsprayed treatment served as a control. The tested insecticides were applied at the recommended rate according to the Ministry of Agriculture recommendations. Spray application was conducted on May 3, 2022, using a motor sprayer (20 liters tank) with a pressure of 100 pounds/ inch^2.

Pre-spraying samples were randomly collected in the early morning from each replicate before spraying. A total of 10 twigs (15-20 cm long) were collected to represent all directions of each tree (Youssef et al., 2011). Post-spraying samples were collected using the same method at two-, four, and six-week intervals. The samples were preserved in plastic bags and transferred to the Department of Plant Protection Laboratory, Faculty of Agriculture, Cairo, Egypt, at Al-Azhar University, for further inspection. Leaves, buds, and inflorescences were carefully examined under a stereomicroscope for nymphs and adults. Immature and adult stages were sorted, counted, and recorded. To evaluate the efficiency of the tested insecticides, % reduction in immature and adult stages was determined according to Henderson and Tilton (1955). The data were subjected to ANOVA, and significant differences were calculated using Duncan's (1955) multiple range test ($p > 0.05$), using the Costat program (1988).

RESULTS AND DISCUSSION

Table 1 illustrates the efficacy of the tested insecticides on the nymph and adult stages of *E. straminea*. The pre-and post-spraying counts of nymphs and adult stages as well as the effectiveness of the insecticides with their reduction % on nymphs and adult populations, were recorded after the 2nd, 4th, and 6th week, respectively. The obtained results showed that all the tested insecticides significantly reduced the number of nymphs and adults. Additionally, the effectiveness on the nymph and adults increased with time. Significantly, imidacloprid, sulfoxaflor, and spirotetramat showed the highest efficiency (Table 1). On the other hand, the lowest reduction of *E. straminea*

Table 1. Efficacy of insecticides against *E. straminea* on olive (Giza Governorate, May-June 2022)

Treatments	Pre-spraying count	Post spraying counts						Mean of % reductions
	3/ 5/ 2021	Two weeks		Four weeks		Six weeks		
	Nymph	Count	% Reduction	Count	% Reduction	Count	% Reduction	
Nymphs								
Spirotetramat	63.10	9.10	85.53*	5.90	90.51	4.80	91.98	89.34^{ab}
Imidacloprid	52.00	5.50	89.39	4.20	91.80	3.50	92.90	91.37^{a}
Buprofezin	42.10	7.40	82.37	6.70	83.85	4.80	87.98	84.73^{bc}
Sulfoxaflor	40.20	5.60	86.03	3.80	90.41	3.50	90.82	89.08^{ab}
pyriproxyfen	46.10	8.40	81.72	6.70	85.25	5.20	88.11	85.03^{bc}
Mineral oil	60.20	19.90	79.38	17.80	81.34	15.20	83.44	81.39^{c}
Untreated	98.30	96.50		95.40		91.80		
LSD								4.84
Adults								
Spirotetramat	1.80	0.70	58.68	0.50	58.94	0.30	71.67	63.09^{c}
Imidacloprid	1.20	0.10	91.15	0.00	100.00	0.00	100.00	97.05^{a}
Buprofezin	1.90	0.80	55.26	0.30	76.66	0.20	82.11	71.34^{c}
Sulfoxaflor	1.40	0.20	84.82	0.00	100.00	0.00	100.00	94.94^{ab}
pyriproxyfen	1.80	0.60	64.58	0.20	83.57	0.10	90.56	79.57^{abc}
Mineral oil	1.60	0.70	78.13	0.50	78.26	0.40	80.00	78.80^{bc}
Untreated	3.40	3.20		2.30		2.00		16.90
LSD								

*% reductions transformed to arc-sine values; Means in a column followed by the same small letter not significant ($p<0.05$, DMRT)

nymphs was observed with mineral oil (81.39%). The remaining insecticides (pyriproxyfen and buprofezin) showed strong reductions in nymphs (85.03% and 84.73%, respectively). The same trend of results was observed in the adult stage except that the treatment with spirotetramat and buprofezin caused the lowest reduction (63.09 and 71.37%, respectively). Indeed, the results showed that spirotetramat was more effective on nymphs than in the adult stage (Table 1).

It was observed that all insecticides were effective in controlling *E. straminea* on olive trees. Particularly, imidacloprid and sulfoxaflor showed higher efficiency. These results agree with those of Youssef et al. (2011), on imidacloprid, pyriproxyfen, and miscible mineral oil. Similarly, Rasha et al. (2015) found that treatment with imidacloprid and mineral oil as single or mixture treatments reduced the population in the west-north coast of Egypt. In another study, the most effective treatment was thiacloprid followed by imidacloprid when evaluated against the pear psylla (*Psylla pyricola*) on pear (Nissar et al., 2017). Katsuya et al. (2010) reported high psyllid mortality (>80%) with imidacloprid 10 days after treatment on citrus psylla (*Diaphorina citri*). Gatineau et al. (2010) found that imidacloprid reduced adult psyllid *E. straminea* populations by over 90%. Mohamed et al. (2021) found that with mineral oil, buprofezin, and spirotetramat (92, 90, and 89% reduction, respectively) reductions were observed in *Planococcus ficus* infested grapes in Egypt.

It is known that imidacloprid is designed to be effective by contact or ingestion. It is a systemic insecticide that moves quickly through the tissues of the plant after application. It acts on post-synaptic nicotinic acetylcholine receptors, which are located only in the central nervous system (CNS) in insects. Imidacloprid binds to the nicotinic receptor, causing spontaneous discharge that prevents the cell from transmitting more impulses. The binding of imidacloprid to the receptor is irreversible (Leicht, 1993). Sulfoxaflor is a new insecticide that belongs to the sulfoximine chemical group with a unique mode of action. It acts as an agonist at insect nicotinic acetylcholine receptors (nAChRs) and functions differently from other insecticides that act at nAChRs (Watson et al., 2011). Spirotetramat is a new systemic insecticide belonging to the ketoenol family that works against a wide range of sucking pests, and it acts as an inhibitor of lipid biosynthesis (Nauen et al., 2008). Buprofezin is a chitin biosynthesis inhibitor that prevents cuticle formation and functions through contact action. Pyriproxyfen is a juvenile hormone mimic that influences balance, embryogenesis, metamorphosis, and adult formation (Horowitz et al., 2020), and has translaminar activity. Generally, the higher activity obtained by imidacloprid and sulfoxaflor compared to other treatments may be due to their mode of action as agonists at insect nicotinic acetylcholine receptors (nAChRs). Finally, we concluded that all the tested insecticides showed high efficacy against the olive psyllid, *E. straminea*. Among the tested insecticides, the most effective treatment was imidacloprid, followed by sulfoxaflor. The tested IGRs and mineral oil showed good efficiency, with the added advantage of being safe for natural enemies and the environment, making them possible alternatives to chemical insecticides.

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AUTHOR CONTRIBUTION STATEMENT

M K H planned, designed, and performed methods. H M R analyzed data, wrote and revised the original manuscript. S S E and M M M M collected and examined the samples.

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CONFLICT OF INTEREST

No conflict of interest.

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