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Section D: Citrus, Nuts, and Other Tree Fruits

OLIVE: *Olea europaea* L. cultivar Leccino (trials A, C, and E), Cellina di Nardò (trials B and D), Cerasola (trial E)

Evaluation of Efficacy of Different Insecticides Against *Philaenus spumarius* L., Vector of *Xylella fastidiosa* in Olive Orchards in Southern Italy, 2015–17

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Olive | *Olea europaea*

Meadow spittlebug | *Philaenus spumarius* L.

Philaenus spumarius L. has been identified as the main vector of *Xylella fastidiosa*, the bacterium causing a disease denoted as Olive Quick Decline Syndrome (OQDS) in Southern Italy. OQDS epidemics have been decimating olive orchards since 2013 and marks the first establishment and spread of this pathogen in the European territory. A major impediment to contain OQDS spread has been the lack of registered and approved pesticides for the control of *P. spumarius* on olive. From late 2017 to early 2018, only two commercial formulations of acetamiprid and delthametrin were officially registered in Italy. Hence, an urgent need exists to evaluate field efficacy of chemicals with different active ingredients, formulations, and modes of action to control the meadow spittlebug.

From 2015 to 2017, six different field trials (A, B, C, D, E, and F) were conducted using a randomized block with six replicates per treatment including the untreated check and neonicotinoids as reference products with known efficacy against other Auchenorrhyncha. Each replicate consisted of a single olive branch confined in a net cage where a fixed number of adult spittlebugs (collected by sweeping net) were introduced before and after the insecticide applications.

Applications were performed by spraying the entire canopy, using a water volume of 1,500 liter/ha, except for the treatments with Prev-AM in trial D (Table 4), for which this volume was also increased to 2,000 liter/ha. In addition, in trial F, the formulations containing dimethoate and imidacloprid were applied also by injections in the branches.

Adult spittlebugs were collected by a sweeping net and a fixed number introduced in the cages before and after the insecticide applications.

The efficacy and persistence of each application was determined by scoring spittlebug mortality at 3, 7, 10, and 15 DAT for the trials conducted in 2015, and up to 20 and 25 DAT in trials conducted in 2016 and 2017 (Tables 1–6). Statistical analyses were performed with the CoStat software program ver 6.204. Comparison among numeric data sets was conducted using the one-way ANOVA followed by Duncan's Multiple Range test. Statistical significance was accepted for P-values ≤ 0.05 α-level (Tables 1–6).

Under these experimental conditions, synthetic pyrethroids (Decis Jet [deltamethrin] and Karathe Zeon [*lambda*-cyhalothrin]) and neonicotinoids (Epik SL [acetamiprid], Confidor 200 O-Teq [imidacloprid], Actara 25 [thiamethoxan], and Luzindo WG [thiamethoxam mixed with clarantraniprole]) showed the highest mortality rates ranging from 76.7% to 100% at 3 DAT and persistence up to 15 DAT with mortality rates higher than 40% (Tables 2–6). Applications of organophosphorus insecticides (Perfektion or Rogor L40 [dimethoate], Reldan 22 [chlorpyrifos-methyl], and Dursban 75 WG [chlorpyrifos-ethyl]) had lower mortality rates than the neonicotinoids and pyrethroids, and in the case of Dursban 75 WG (chlorpyrifos-ethyl), results were inconsistent between the 2 yr of testing. Although initial mortality was recorded for Laser (spinosad) and Prev-AM (sweet orange essential oil) used at high volume of application, both showed poor or no persistence. No dead insects

were recorded for the following treatments: Movento 48 SC (spirotetramat), Teppeki (flonicamid), Plenum (pymetrozine), Applaud Plus (buprofenzin), Pyganic (natural pyrethrin), and Neemazal (azadirachtin).

Spray applications were more efficacious and rapid than injection. For example, at 3 DAT, mortality rates for imidachloprid were 98.3% vs 60%, respectively, and for dimethoate were 88.3% vs 55%, respectively. Conversely, formulations applied by injection showed slightly higher persistence at 20 DAT with Confidor 200 O-Teq (imidachloprid) mortality 75.8% vs 69.4%, for injection and spray; and for Perfektion (dimethoate) mortality at 20.7 vs 8.9, respectively (Table 6).

These data on efficacy of different chemicals and formulations to control *P. spumarius* showed that neonicotinoids performed better than the other products. In general, however, for the majority of the products tested, low persistence was recorded. These results suggest that newer formulations and chemicals are needed along with trials to determine proper timing and number of applications for effective management of this vector. Moreover, an integrated pest management approach is needed to manage spittlebug populations along with a sustainable strategy to reduce progression of OQDS in olive groves.

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Table 1

Treatment/formulation	Rate (g or ml/ha)	Mortality (%)—Trial A—2015			
		DAT_3	DAT_7	DAT_{10}	DAT_{15}
Untreated check	–	0 c	1.5 c	0 c	2.7 c
Epick SL	1,500	100 a	16.7 abc	10.5 a	17.9 ab
Confidor 200 O-Teq OD	1,125	87.2 ab	13.3 bc	8.8 ab	16.9 ab
Decis Jet EC	1,150	100 a	28.3 ab	4.3 abc	21.2 a
Karathe Zeon 1.5 CS	2,500	85 b	10.2 bc	0.7 c	16.1 ab
Trebon Up EC	500	84.4 b	34.2 a	3.1 abc	7.5 bc
Perfektion EC	2,250	6.7 c	0.9 c	2.3 bc	5.3 c
Plenum WP	800	0 c	1.3 c	0.6 c	4.7 c
Applaud Plus WP	2,000	2.8 c	1.7 c	1.1 bc	4.9 c
F value		110.83	3.62	2.28	4.22
Pr > *F*		<0.00001	0.0030	0.0407	0.0010

Mean values followed by the same letter, on the column, are not statistically different at the probability levels $P < 0.05$.

Table 2

Treatment/formulation	Rate (g or ml/ha)	Mortality (%)—Trial B—2015			
		DAT_3	DAT_7	DAT_{10}	DAT_{15}
Untreated check	–	0 e	0 d	0 d	5.6 cd
Epik SL	1,500	76.7 bc	81.5 a	35.4 ab	42 a
Confidor 200 O-Teq OD	1,125	86.7 ab	81.1 a	45.2 a	47 a
Decis Jet EC	1,150	98.3 a	72.1 a	15.5 cd	15.5 bcd
Karathe Zeon 1.5 CS	2,500	85 ab	81.7 a	32.1 ab	17 bc
Trebon Up EC	500	65 c	51.6 b	39 ab	24 b
Perfektion EC	2,250	25 d	36.4 c	22.7 bc	4.6 d
Rogor L 40 SL	2,000	20 d	36.8 c	13.3 cd	6.3 cd
Plenum WP	800	0 e	0 d	0 d	4.4 d
Applaud Plus WP	2,000	0 e	0 d	0 d	5.6 cd
Movento 48 SC	3,750	0 e	0 d	0 d	6.1 cd
F value		71.15	85.84	9.91	17.67
Pr > *F*		<0.00001	<0.00001	<0.00001	<0.00001

Mean values followed by the same letter, on the column, are not statistically different at the probability levels $P < 0.05$.

Table 3

Treatment/formulation	Rate (g or ml/ha)	Mortality (%) – Trial C - 2015			
		DAT_3	DAT_7	DAT_{10}	DAT_{15}
Untreated check	–	0 c	0 b	1.1 b	1.7 b
Confidor 200 O-Teq OD	1,125	86.7 a	88.3 a	68.9 a	64.7 a
Neemazal EC	3,000	18.3 b	0 b	0 b	3.5 b
Pyganic EC	3,750	23.3 b	5.6 b	0.6 b	3.8 b
Prev AM SL	8,000	23.3 b	1.8 b	3.6 b	0 b
F value		44.14	317.58	79.01	17.39
Pr > *F*		<0.00001	<0.00001	<0.00001	<0.00001

Mean values followed by the same letter, on the column, are not statistically different at the probability levels $P < 0.05$.

Table 4

Treatment/formulation	Rate (g or ml/ha)	Mortality (%)—Trial D—2016		
		DAT_3	DAT_7	DAT_{15}
Untreated check	–	7.5 c	0 a	5 ab
Confidor 200 O-Teq OD	1,125	85.8 a	8.3 a	3.3 ab
Neemazal EC	3,000	6.7 c	5 a	7.5 a
Pyganic EC	3,750	32.5 bc	6.7 a	5 ab
Prev-AM SL (application volume of 1,500 liter/ha)	8,000	30 bc	1.7 a	5.8 ab
Prev-AM SL (application volume of 2,000 liter/ha)	8,000	54.2 ab	8.3 a	3.3 ab
Decis Jet EC	1,150	82.5 a	13.3 a	0 b
F value		7.83	0.89	1.49
Pr > *F*		<0.00001	0.5118	0.2146

Mean values followed by the same letter, on the column, are not statistically different at the probability levels $P < 0.05$.

Table 5

Treatment/formulation	Rate (g or ml/ha)	Mortality (%)—Trial E—2016					
		DAT_3	DAT_7	DAT_{10}	DAT_{15}	DAT_{20}	DAT_{25}
Untreated check	–	20 b	4.6 d	4.9 d	5.2 d	5.8 b	12.1 a
Confidor 200 O-Teq OD	1,125	91.7 a	92.6 a	89.2 a	92.4 a	41.7 a	16.7 a
Movento 48 SC	3,750	26.7 b	7.4 d	1.4 d	4.7 d	5 b	11.5 a
Reldan 22 EC	4,500	66.7 a	46.2 c	18.4 c	15.3 c	4.8 b	7.6 a
Dursban 75 WG	1,050	81.7 a	66.7 b	41.9 b	32.9 b	7.5 b	18.6 a
Actara 25 WG	450	90 a	89.4 a	80.9 a	98.5 a	0 b	16.7 a
Luzindo WG	250	88.3 a	91 a	86.5 a	94.2 a	25 ab	16.7 a
Teppeki WG	140	43.3 b	12.5 d	3.9 d	1.1 d	7.2 b	12.6 a
Laser SC	450	80 a	31.2 c	10.3 cd	4 d	4.8 b	9.2 a
F value		12.83	40.51	149.35	232.79	2.38	0.14
Pr > *F*		<0.00001	<0.00001	<0.00001	<0.00001	0.0333	0.9966

Mean values followed by the same letter, on the column, are not statistically different at the probability levels $P < 0.05$.

Table 6

Treatment/formulation	Rate (g or ml/ha)	Mortality (%)—Trial F—2017					
		DAT_3	DAT_7	DAT_{10}	DAT_{15}	DAT_{20}	DAT_{25}
Untreated check	–	23.3 d	8.5 e	5.6 b	11.1 d	9.1 b	5.4 b
Confidor 200 O-Teq OD	1,125	98.3 a	65.8 ab	71.4 a	73.9 b	69.4 a	8.3 b
Confidor 200 O-Teq OD–Injection	1,125	60 c	76.9 a	67.5 a	80.2 b	75.8 a	16.7 ab
Movento 48 SC	3,750	15 d	10.8 e	7.6 b	15.1 cd	6.8 b	7.4 b
Reldan 22 EC	4,500	90 ab	36.1 cd	15.4 b	17.1 cd	9.8 b	1.3 b
Dursban 75 WG	1,050	70 bc	36 cd	20.8 b	14.6 cd	14.7 b	3.8 b
Actara 25 WG	450	96.7 a	80.3 a	70.6 a	86.4 ab	66.8 a	0 b
Luzindo WG	250	98.3 a	70.5 a	77.1 a	94.4 a	59.6 a	36.1 a
Teppeki WG	140	21.7 d	10.4 e	6.9 b	6.9 d	8.3 b	2.2 b
Laser SC	450	90 ab	51.1 bc	18.6 b	10.7 d	15.8 b	4.5 b
Perfektion EC	2,250	88.3 ab	21.2 de	10.7 b	4.4 d	8.9 b	5.5 b
Perfektion EC–Injection	2,250	55 c	36.7 cd	20.9 b	28.7 c	20.7 b	9.1 b
F value		18.87	24.94	23.94	57.32	19.41	17.17
Pr > *F*		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001

Mean values followed by the same letter, on the column, are not statistically different at the probability levels $P < 0.05$.