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RESEARCH PAPER

A study of efficacy of solomon 300 OD (betacyfluthrin 90 + imidacloprid 210 OD) on psylla (*Diaphorina citri* Kuwayana) in kinnow

Roop Singh Meena[1], Harjindra Singh*, Pradeep Kumar[1] **and** Bhupender Singh[1]
Krishi Vigyan Kendra, Padampur, Srigangangar (Rajasthan) India
(Email: jindra.ento@gmail.com)

Abstract : The study trial was conducted on kinnow 2 trees per treatment/ replicationat Agricultural Research Station, Sriganganagar during 2016-2017. Eight treatments including control were evaluated and each treatment was replicated three times and using RBD. Observations were also taken on number of leaves and infested leaves per twigs from 5 randomly selected twigs. The first application of each treatment was made at Economic threshold level using a water volume of 10 liters per treatment and second application was imposed on a need basis at an interval.The population of pysllaper 20 leaves were made from a tree before as well as 3, 7, 10 and 15 days after each spray and one day before spray to work out leaf and twig infestation using formula and observed the combination of both @ 7.0 ml / 10 lit was best for the control of pyslla and on at par in comparision to other treatments. The yield of fruit was recorded after harvesting the kinnow.

Key Words : Efficacy of solomon 300 od, Psylla, Kinnow

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INTRODUCTION

Kinnow produces good tasty (good blend of sugars/ acid ratio), yield of orange coloured, and very juicy in Sri-ganganagar and Hanumangarh agro-ecological conditions. It grows through-out Northern India and in other citrus growing state. It has grown in the agro-ecological conditions in Sri-ganganagar (Rajasthan) India. Kinnow was developed through hybridization between King mandarin x Willow leaf orange produced by H.B. Frost in 1915 and released in 1935 was introduced by Dr. J.C. Bakhshi at Abohar research station during 1954. Kinnow belongs to family Rutaceae and sub-family Aurantioedae. The area under kinnow cultivation in India is about 67000 hectares which produce 412000 Metric ton (2018-19). Kinnow contribute 6.23 per cent share of India from Sriganganagar and Hanumangarh district of Rajasthan. Kinnow has rich source of vitamins and have highly nutritional value. 85 g of fruits per capita per day according to the Indian council of medical Research has recommended balance diet but availability is only 48 g as compared to UK, Australia and Philippines where more

***Author for correspondence:**
[1]Agricultural Research Station, Srigangangar (Rajasthan) India

use of fruit per capita per day than recommendation. The kinnow is affected by several insect pests in the field out of them one is *Citrus psyllahere* only discussed about efficacy of the combined (Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)) insecticides with pyslla studied.

The active period of psyllaon young flush during spring till autumn but the more serious damage is done during flowering and fruit set stage in March-April. The egg of psyllidshave bright yellow and deposited on unopened leaf buds. Early instar nymphs are green or dull orange and late instar nymphs are bright yellowish orange. The adult is 3-4 mm long, mottled brown in colour, with transparent wings. The damage is caused by nymph and adult by sucking the cell sap. The psyllasuck plant sap from the leaves, tender shoots and flowers causing curling of leaves, defoliation and drying of twigs and reduce the vigour of the plants. Severely infested foliage turns pale green then brown and curled the shed down. Nymphs secrete whitish crystalline honey dew which attracts the growth of fungus, adversely affecting the photosynthesis. This insect also transmits the citrus greening disease. In case of severe attack the leaf buds, flower buds and leaves may wilt and die. So keeping in view solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) combination with different doses against white fly was tested to control of psylla in kinnow.

MATERIAL AND METHODS

The study was conducted on kinnow 2 trees per treatment/ replicationat Agricultural Research Station, Sriganganagar during 2016 and 2017. Eight treatments including control were evaluated and each treatment was replicated three times and using RBD. All the agronomic practices were followed as per the recommended package of practices. The first application was made on (23 and 26 February 2016 and 2017, respectively) when insect pest population reaches at ETL using 10 liters of water per treatment. Second application (14 and 18 March 2016 and 2017, respectively) was imposed on a need basis at an interval. The population of psylla per 20 leaves were made from a tree before spray and as well as 3, 7, 10 and 15 days after spray. Observation were also taken on number of leaves and infested leaves per twigs form 5 randomly selected twigs one days before spray and 3, 7, 10 and 15 days after spray to work out leaf infestation. The infestation percentage of leaves was calculated by using below mentioned formula.

$$\text{Percentage of infestation leaves} = 100\left(\frac{X_1 - X_2}{X_1}\right)$$

where,

$X_{1=}$ Number of leaves

$X_{2=}$ Number of healthy leaves.

The data obtained from field experiments in a Randomized Block Design were statistically analyzed after converting it into count data into square root and percentage data into arc sin transformed values.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Citrus psylla:

During the study on data was taken of psylla in the kinnow orchard and observed that Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) @ 7.0 ml/ 10 litter of waterwas recorded significantly less psylla population 4.67, 9.33, 16.50 and 39.17 and 5.67, 8.83, 15.17 and 36.17Psylla/20 leaveson 3rd, 7th, 10th and 14th days after Ist and IInd spray, respectively during 2016 while 4.17, 7.67, 12.17 and 29.83 and 3.83, 7.67, 12.33 and 31.33 Psylla/20 leaves on 3rd, 7th, 10th and 14th days after Ist and IInd spray, respectively during 2017 followed by at the dose with 5.0 ml/10 litter of water observed that 6.83, 11.67, 19.00 and 40.67 and 7.67, 11.17, 17.50 and 37.67 Psylla/20 leaves during 2016 while with same dose it was 5.67, 9.83, 14.17 and 31.67 and 5.83, 10.67, 15.17 and 32.67 Psylla/20 leaves during 2017 over the control (50.67, 53.83, 56.17 and 60.17 and 49.50, 52.50, 53.33 and 55.17 Psylla/20 leaves) on 3rd, 7th, 10th and 14th days after 1st and 2nd spray, respectively during 2016 while the data was 37.67, 40.83, 43.67 and 45.83 and 42.33, 44.67, 46.33 and 48.17 Psylla /20 leaves on 3rd, 7th, 10th and 14th days after 1st and 2nd spray, respectively during 2017. Therefore, when this insecticides used @ 7.0 ml/ 10 litter of water then observed maximum mean per cent reduction of psylla (69.74 and 69.45 %) after 1st and 2nd spray, respectively during 2016 similarly 69.29 and 70.52 per cent after 1st and 2nd spray, respectively during 2017 followed by solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) @ 5.0 ml/ 10 litter of water (65.87 and 65.56%) after 1st and 2nd spray, respectively during 2016 and 64.72 and 65.41 per cent after 1st and 2nd spray, respectively during 2017. It is observed that

solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) @ 3.0 ml/ 10 litter of water 58.17 and 57.19 per cent mean psylla population after 1st and 2nd spray, respectively during 2016 and 56.72 and 57.22 per cent mean psylla population after 1st and 2nd spray, respectively during 2017 and wit Imidacloprid 200 SL (imidacloprid 17.8% w/w SL) @ 7.50 ml/10 litter of water 55.93 and 55.85 per cent after 1st and 2nd spray, respectively during 2016 and 54.80 and 55.82 per cent after 1st and 2nd spray, respectively during 2017. It was at par with solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) @ 7.0 ml/ 10 litter of water both the years. The rest of treatments *viz.*, Imidacloprid 200 SL (imidacloprid 17.8% w/w SL) @ 5.0 ml, Quinalphos 25% EC@ 28.0 ml and Betacyfluthrin 25 SC (Betacyfluthrin 2.45% w/w SC) @ 25.50 ml/10 litter of water also reduced the mean psylla population during 2016 and 2017 and it was (51.82 and 50.80) and (50.49 and 50.65) per cent after 1st and 2nd spray mean population during 2016 and 2017, respectively, (47.83 and 46.51) and (45.87 and 46.16) and (46.50 and 45.57) and (44.69 and 45.11) per cent, respectively (Table 1a and 1b).

The result of the study pointed out that the bio-efficacy and phyto-toxicity data and results during two consecutive seasons *i.e.* 2016 and 2017 it can be concluded that solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)@ 3.0, 5.0 and 7.0 ml/ha were found best and on par with each other in respect to psylla control also increasing the fruit yield. However, result observed by Vaishali *et al.* (2018) on cashew against effective for management of tea mosquito bug and thrips and also recorded the highest yield and is no phytotoxic effect observed with solomon 300 OD (1.5ml/10 lit) tested against cashew and tea mosquito bug and thrpis similar Patil *et al.* (2018) evaluated that the solomon 300 OD @ 400 ml/ha was found to be the most superior in reducing aphid population with higher grain yield of wheat. At this concentration, it did not show any symptom of phyto-toxicity on wheat similar results also present by others.

Table 1a : Bio-efficacy of solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) against Psylla, *Diaphorina citri* Kuwayana, 2016 (first spray)

Sr. No.	Treatments	Dose (ml/10 lit. water)	Psylla/20 leaves						Mean per cent reduction
			B.S.	3 DAS	7 DAS	10 DAS	14 DAS	Mean	
1.	Control	-	48.33 (6.99*)	50.67 (7.15*)	53.83 (7.37*)	56.17 (7.53*)	60.17 (7.79*)	55.04 (7.45*)	0.00
2.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	3.00	49.17 (7.04)	9.67 (3.18)	15.33 (3.98)	23.33 (4.88)	47.00 (6.87)	23.42 (4.66)	58.17 (49.65)
3.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	5.00	51.17 (7.19)	6.83 (2.71)	11.67 (3.49)	19.00 (4.41)	40.67 (6.41)	19.46 (4.24)	65.87 (54.94)
4.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	7.00	50.67 (7.15)	4.67 (2.27)	9.33 (3.13)	16.50 (4.12)	39.17 (6.28)	17.25 (3.91)	69.74 (57.71)
5.	Betacyfluthrin 25 SC (Betacyfluthrin 2.45% w/w SC)	25.50	51.33 (7.20)	11.33 (3.44)	20.00 (4.52)	34.33 (5.89)	56.17 (7.53)	30.63 (5.37)	46.50 (41.90)
6.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	7.50	48.67 (7.00)	9.83 (3.21)	14.67 (3.89)	25.67 (5.11)	50.50 (7.14)	25.08 (4.83)	55.93 (48.27)
7.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	5.00	50.33 (7.12)	11.17 (3.41)	17.00 (4.18)	28.83 (5.41)	52.83 (7.30)	27.92 (5.14)	51.82 (45.52)
8.	Quinalphos 25 % EC	28.00	47.67 (6.92)	12.50 (3.57)	19.33 (4.43)	31.50 (5.64)	55.33 (7.47)	28.54 (5.12)	47.83 (42.80)
	C.V. %		5.59	7.89	6.02	5.18	5.32	5.28	5.31
	S.E. (±)		0.32	0.23	0.21	0.23	0.31	0.27	2.18
	C.D. (P=0.05)		0.98	0.71	0.65	0.68	0.93	0.54	6.62

*Figures in parentheses are square root transformed values; B.S.- Before spray; DAS – Days after spray

Table 1b : Bio-efficacy of Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) against Psylla, *Diaphorina citri* Kuwayana, 2016 (Second spray)

Sr. No.	Treatments	Dose (ml/10 lit. water)	Psylla/20 leaves						Mean per cent reduction
			B.S.	3 DAS	7 DAS	10 DAS	14 DAS	Mean	
1.	Control	-	46.83 (6.87*)	49.50 (7.07*)	52.50 (7.28*)	53.33 (7.34*)	55.17 (7.46*)	52.88 (7.30*)	0.00
2.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	3.00	47.00 (6.87)	10.83 (3.36)	15.50 (4.00)	22.00 (4.73)	43.33 (6.61)	22.46 (4.60)	57.19 (49.08)
3.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	5.00	40.67 (6.41)	7.67 (2.84)	11.17 (3.42)	17.50 (4.24)	37.67 (6.15)	18.08 (4.09)	65.56 (54.58)
4.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	7.00	43.83 (6.66)	5.67 (2.43)	8.83 (3.05)	15.17 (3.96)	36.17 (6.05)	16.29 (3.85)	69.45 (57.51)
5.	Betacyfluthrin 25 SC (Betacyfluthrin 2.45% w/w SC)	25.50	49.50 (7.06)	10.67 (3.33)	21.17 (4.63)	33.67 (5.84)	51.27 (7.19)	29.65 (5.32)	45.57 (41.48)
6.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	7.50	47.17 (6.90)	9.83 (3.20)	15.00 (3.94)	24.00 (4.95)	45.83 (6.81)	23.21 (48.32)	55.85 (48.32)
7.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	5.00	48.83 (7.02)	11.17 (3.41)	18.00 (4.30)	28.00 (5.34)	48.17 (6.98)	25.79 (45.02)	50.80 (45.02)
8.	Quinalphos 25 % EC	28.00	50.00 (7.10)	12.00 (3.50)	20.83 (4.62)	31.67 (5.65)	50.00 (7.11)	27.88 (42.19)	46.51 (42.19)
	CV %		5.33	7.61	5.85	5.29	5.15	5.54	5.87
	S.E. (±)		0.30	0.23	0.21	0.22	0.28	0.24	2.31
	C.D. (P=0.05)		0.90	0.69	0.63	0.68	0.86	0.48	6.92

*Figures in parentheses are square root transformed values; B.S.- Before spray; DAS – Days after spray

Table 1c : Bio-efficacy of solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) against Psylla, *Diaphorina citri* Kuwayana, 2017 (first spray)

Sr. No.	Treatments	Dose (ml/10 lit. water)	Psylla/20 leaves						Mean per cent reduction
			B.S.	3 DAS	7 DAS	10 DAS	14 DAS	Mean	
1.	Control	-	35.17 (5.97*)	37.67 (6.18*)	40.83 (6.43*)	43.67 (6.65*)	45.83 (6.81*)	42.46 (6.55*)	0.00
2.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	3.00	33.33 (5.81)	8.17 (2.94)	12.83 (3.65)	17.83 (4.27)	36.33 (6.06)	19.00 (4.27)	56.72 (48.77)
3.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	5.00	37.67 (6.15)	5.67 (2.45)	9.83 (3.21)	14.17 (3.81)	31.67 (5.63)	14.67 (3.63)	64.72 (53.97)
4.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	7.00	36.17 (6.05)	4.17 (2.15)	7.67 (2.86)	12.17 (351)	29.83 (5.51)	13.42 (3.50)	69.29 (57.40)
5.	Betacyfluthrin 25 SC (Betacyfluthrin 2.45% w/w SC)	25.50	34.60 (5.91)	8.83 (3.04)	16.83 (4.16)	27.67 (5.31)	42.67 (6.57)	23.54 (4.69)	44.69 (40.88)
6.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	7.50	35.83 (6.03)	7.83 (2.88)	12.33 (3.58)	19.83 (4.51)	38.67 (6.26)	19.58 (4.29)	54.80 (47.59)
7.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	5.00	34.83 (5.93)	8.67 (3.02)	14.50 (3.87)	22.67 (4.81)	40.17 (6.38)	21.33 (4.49)	50.49 (44.81)
8.	Quinalphos 25 % EC	28.00	33.67 (5.84)	9.67 (3.17)	16.67 (4.12)	25.83 (5.13)	41.67 (6.49)	23.29 (4.71)	45.87 (41.77)
	C.V. %		5.77	8.32	6.13	6.56	5.58	5.64	6.72
	S.E. (±)		0.28	0.22	0.20	0.25	0.28	0.22	2.47
	C.D. (P=0.05)		0.85	0.67	0.60	0.76	0.85	0.65	7.41

*Figures in parentheses are square root transformed values; B.S.- Before spray; DAS – Days after spray

Table 1d : Bio-efficacy of solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD) against Psylla, *Diaphorina citri* Kuwayana, 2017 (Second spray)

Sr. No.	Treatments	Dose (ml/10 lit. water)	Psylla/20 leaves						Mean per cent reduction
			B.S.	3 DAS	7 DAS	10 DAS	14 DAS	Mean	
1.	Control	-	41.83 (6.50*)	42.33 (6.54*)	44.67 (6.72*)	46.33 (6.84*)	48.17 (6.98*)	45.29 (6.76*)	0.00
2.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	3.00	38.33 (6.22)	8.67 (3.01)	13.83 (3.79)	18.67 (4.37)	38.00 (6.19)	20.50 (4.45)	57.22 (49.04)
3.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	5.00	37.67 (6.17)	5.83 (2.51)	10.67 (3.34)	15.17 (3.96)	32.67 (5.74)	16.38 (3.94)	65.41 (54.50)
4.	Solomon 300 OD (Betacyfluthrin 90 + Imidacloprid 210 OD)	7.00	38.17 (6.22)	3.83 (2.05)	7.67 (2.84)	12.33 (3.58)	31.33 (5.62)	13.33 (3.41)	70.52 (58.29)
5.	Betacyfluthrin 25 SC (Betacyfluthrin 2.45% w/w SC)	25.50	42.67 (6.56)	9.67 (3.18)	18.00 (4.28)	29.67 (5.48)	44.67 (6.72)	25.08 (4.85)	45.11 (41.18)
6.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	7.50	38.67 (6.26)	8.17 (2.94)	13.17 (3.70)	20.67 (4.60)	40.00 (6.36)	20.83 (4.45)	55.82 (48.27)
7.	Imidacloprid 200 SL (imidacloprid 17.8% w/w SL)	5.00	40.17 (6.38)	9.50 (3.16)	16.00 (4.06)	23.67 (4.91)	42.33 (6.54)	22.50 (4.61)	50.65 (44.89)
8.	Quinalphos 25 % EC	28.00	41.67 (6.49)	10.83 (3.36)	17.67 (4.26)	27.67 (5.30)	43.67 (6.65)	24.88 (4.88)	46.16 (41.95)
	CV %		5.29	8.36	5.55	5.08	5.42	5.49	6.53
	S.Em (±)		0.27	0.23	0.19	0.20	0.28	0.25	2.37
	CD at 5%		0.83	0.69	0.56	0.61	0.85	0.76	7.11

*Figures in parentheses are square root transformed values; B.S.- Before spray; DAS – Days after spray

Conclusion:

Solomon 300 OD, a mixture of beta-cyfluthrin 90 % and imidacloprid 210 per cent is effective than individual compound. Solomon contains Imidacloprid (systemic) and Beta- Cyfluthrin (contact) in an innovative oil dispersion which gives quick knockdown and anti-feeding effects. Thus, It is a broad segment insecticide for sucking and biting pests. The oil dispersions based on O-TEQ formulation (patent protected) ensures better rain fastness, penetration activity and optimized retention. Beta-Cyfluthrin (3A) is an insecticide of synthetic pyrethroid group. Beta-Cyfluthrin is acting by contact and ingestion. It acts on the insects' nervous system as sodium channel blocker. In the pest, rapid excitation and impairment of co-ordination are the first visible symptoms of intoxication, followed by knockdown and death. Imidacloprid (4A) is antagonist to the nicotinic acetyl choline receptor in the central nervous system. It disturbs the proper signal transmission system leading to excitation of nerve cell. Consequently a disorder of the nervous system occurs leading finally to the death of the treated insect. The product was found to be safe to crop.

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