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Evaluation of New Alternatives of Neonicotinoid Insecticides Against Sucking Pests of Okra

Suvarna Patil[1]*, RB Hirekurubar[2], R Raghunatha[3], BArunkumar[4] and LH Kukanoor[5]
Regional Horticulture Research and Extension Center
University of Horticultural Sciences, Dharwad, 580005, (Karnataka), India

ABSTRACT

A field experiment was conducted during 2023-24 at RHREC, Dharwad, Karnataka to study the bio-efficacy and effectiveness of new alternatives of neonocotinoid insecticide molecules. Among the treatments, Flupyridifurone 200 SL @ 2.5 ml/l and Flonicamid 50 WG @ 0.4g/l proved highly effective in managing leaf hopper population by registering lowest mean number of leaf hoppers per 3 leaves (1.71 and 2.53, respectively) on 10 days after treatment imposition with highest percent suppression in population over control (84.29 and 76.75, respectively). With respect to whiteflies, among the treatments, Flupyridifurone 200 SL @ 2.5 ml/l and Flonicamid 50 WG @ 0.4g/l proved highly effective in managing whiteflies population by registering lowest mean number of whiteflies per 3 leaves (1.53 and 1.74, respectively) on 10 days after treatment imposition with highest reduction in population in terms of percent over control (83.45 and 81.24, respectively). Further because of lower pest load in Flupyridifurone 200 SL @ 2.5 ml/l and Flonicamid 50 WG @ 0.4 g/l treatment, which led to lesser damage with higher mean economic yield (11.08 t/ha and 10.76 t/ha respectively). Overall, chemical management by Flupyridifurone 200 SL @ 2.5 ml/l also Flonicamid 50 WG @0.4 g/l were most effective against leafhopper and whiteflies management with highest cost: benefit ratio of 2.60 and 2.90 respectively. The outcomes suggested that the present neonicotinoid insecticide were effective alternatives over conventional insecticides in formulating improved pest management strategy against sucking pests in okra.

Keywords: Leaf Hopper, Neonicotinoids,Okra, Pest Management, Whiteflies.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is cultivated as green vegetable commonly round the year in India and worldwide (Manu *et al,* 2021; Joshi *et al,* 2025). Fruits or pods of okra are highly valuable being highly nutritious, rich in vitamins, calcium, potassium, several minerals also having high medicinal, industrial and export potential (Joshi *et al,* 2021). Globally, India leads in okra production, contributing approximately 62 per cent to the total output. Okra grown with an area of 5.09 lakh hectares, annual production 60.95 lakh metric tons, with a productivity of 12 metric tons per hectare (Anonymous, 2018; Joshi *et al,* 2020). Okra is susceptible highly to damage caused by insect pests, approximately 72 species of insect pests and mites are limiting the okra crop growth (Rao and Rajendra, 2002). Among the various insect pests, sucking pests like leafhopper and whitefly responsible for the major threat that limit the okra production. The okra fruit yield loss is 94.0 % by whiteflies and 54.04 % by aphids (Meenambigai *et al,* 2017). The whitefly noted as most notorious pest among top insect pests showing a pandemic distribution and infesting various important crops including vegetables, fiber crops, tubers and ornamentals (Abdel-Baky and Al-Deghairi, 2008). Whiteflies cause direct damage by sucking plant sap and it is also noted for the vector for deadly virus that is yellow vein mosaic. Due to whiteflies fast movement from plant to another plant, living habitat and its high reproductive potential make management of the pest is very difficult (Fouly *et al,* 2011). Farmers depend on conventional insecticides like organophosphate, synthetic pyrethroids and carbamates for sucking pest management (Patel *et al,* 1997). The frequent use of systemic insecticides resulted in the insecticide

Corresponding Author's Email - patil.suvarna02@gmail.com
1Regional Horticulture Research and Extension Center, University of Horticultural Sciences, Dharwad, 580005, (Karnataka), India
2Horticulture Research and Extension Centre, Hidakal Dam, Gokak, Belgaum, 591107, University of Horticultural Sciences, Bagalkot, (Karnataka), India
3,4College of Horticulture, Munirabad, Koppal, 583234, University of Horticultural Sciences Bagalkot, (Karnataka), India
5Research and Extension Cetre, University of Horticultural Sciences, Dharwad, 580005, (Karnataka), India

Treatment Details with dose followed in the experiment were as follows

Treatment	Dose (ml/L)
Flonicamid 50WG	0.2g/l
Flonicamid 50WG	0.3g/l
Flonicamid 50WG	0.4g/l
Flupyridifurone 200SL	1.5 ml/l
Flupyridifurone 200SL	2.0 ml/l
Flupyridifurone 200SL	2.5 ml/l
Imidacloprid17.8 SL	0.35ml/l
Untreated Control	-

resistance development in the insect pest and causes disturbance in the agroecology by disturbing the non-targets (Dittrich *et al,* 1990). So, the present study intended to evaluate the effectiveness of newer neonicotinoid molecules with novel mode of action to identify a viable option for sustainable management of okra sucking insect pest.

MATERIALS AND METHODS

The seeds of okra cv. Arka Anamika were sown by line sowing method during *Kharif* 2023-24 at the AICRP (Vegetable crops) experimental farm, Regional Horticultural Research and Extension Centre, Dharwad. After fifteen days of sowing, the thinning of seedling was carried out by maintaining the spacing of 60 cm x 40 cm and following standard agronomic practices. The layout of experiment was in a RBD (Randomized Block Design) with seven insecticidal treatments and an untreated check and all treatments replicated thrice. Two insecticidal sprays at fifteen days interval were imposed during growing season and five plants were tagged randomly in each plot for recording the insect population before and after treatment imposition. The survival insect population were observed and recorded from three leaves per plant (top, middle and bottom). The population of survival leafhopper, whitefly and coccinellid were recorded one day earlier to treatment imposition and three, five, seven and ten days after treatment imposition (DATI). The recorded data were subjected to suitable statistical analysis with the help of SAS 9.2 programme (Sandra and Ramon, 1987).

RESULTS AND DISCUSSION

Efficacy of new insecticides against leafhopper population

The data on the population of leafhoppers (Table 1) for 2023-24 revealed that the leafhopper started appearing from early August, but their population was meager. Hence, evaluation of these novel neonicotinoids was done at more than one month stage of the crop growth *i.e.* from August, when the pests started building up. Pre-count of leafhopper population was non-significant among the treatments. After 10 days of both sprays, all the seven neonicotinoids were statistically superior over the other treatment including control with respect to reduction in leafhopper population count. The average leafhopper population count after the first treatment imposition was lowest in the Flupyridifurone 200 SL @ 2.5ml/L treated plots (1.71) followed by Flonicamid 50 WG @ 0.4g/L (2.53) with per cent population reduction over control of 84.29 and 76.75 respectively. The present findings corroborate with Ghosal *et al* (2013) and Sujay Anand *et al* (2013) who also observed the superiority of newer neonicotinoids among different treatments tested. The next best treatments were Flupyridifurone 200 SL @ 2.0ml/L (2.86) and Flonicamid 50 WG @ 0.3g/L (3.04) which were in line with each other. This was in parallel with the findings of Raghuraman and Birah (2011) who found that the Imidacloprid @ 80 g ai/ha statistically suppressed leafhopper populations coupled with increase in yield. The superior yield was observed in imidacloprid (80 g a.i./ha) followed by its next lower dose of about 40 g a.i./ha and was superior in controlling leafhopper population in okra. The current findings were matching with findings of Begum and Patil (2016), who reported that imidacloprid (17.8 S L) was effective in reduction in leafhoppers and whiteflies population. Ahmad *et al* (2023) reported similar data, which supports our results, indicating that imidacloprid (17.8 SL) was effective in reducing the leafhoppers population and both of which are systemic neonicotinoids.

Efficacy of new insecticides against whitefly

The effect of insecticide treatments is presented in table 2. The data on the whiteflies population for 2023-24 revealed that the whiteflies started appearing from early August, but their population was meager. Hence, evaluation of these novel neonicotinoids were done at more than one month stage of the crop growth *i.e.* from August, when the pests started building up. Pre count of whiteflies population was non-significant among the treatments. After 10 days of both sprays, all the seven neonicotinoids were statistically superior over other treatments with respect to reduction in whiteflies population count. The average whiteflies population after the first treatment imposition was lowest in the Flupyridifurone 200 SL @ 2.5 ml/L treated plots (1.53)

Table 1: Number of leaf hoppers per 3 leaves after spray in okra for the year 2023-24.

Treatment	Dose (ml/L)	No. of leaf hoppers per 3 leaves after 1st spray					No. of leaf hoppers per 3 leaves after 2nd spray				Average	Suppression (%)
		1 DBTI	3 DATI	5 DATI	7 DATI	10 DATI	3 DATI	5 DATI	7 DATI	10 DATI		
Flonicamid 50WG	0.2g/l	9.22	7.25 (2.77)	5.66 (2.48)	5.31 (2.41)	5.18 (2.38)	5.84 (2.51)	5.45 (2.44)	4.40 (2.20)	6.01 (2.55)	5.63	48.08
Flonicamid 50WG	0.3g/l	7.64	5.67 (2.48)	4.08 (2.13)	2.50 1.68)	1.88 (1.53)	3.66 (2.03)	2.50 (1.72)	2.08 (1.56)	1.97 (1.56)	3.04	72.00
Flonicamid 50WG	0.4g/l	9.27	5.15 (2.37)	3.20 (1.92)	1.84 (1.52)	1.70 (1.48)	2.91 (1.83)	2.38 (1.69)	1.73 (1.47)	1.30 (1.33)	2.53	76.75
Flupyridifurone 200SL	1.5 ml/l	8.53	6.09 (2.55)	4.21 (2.16)	2.77 (1.79)	2.14 (1.62)	3.85 (2.07)	2.95 (1.85)	2.79 (1.81)	2.34 (1.68)	3.39	68.78
Flupyridifurone 200SL	2.0 ml/l	9.06	5.53 (2.44)	3.43 (1.98)	2.22 (1.65)	1.86 (1.52)	3.54 (2.00)	2.51 (1.71)	1.94 (1.56)	1.83 (1.52)	2.86	73.68
Flupyridifurone 200SL	2.5 ml/l	8.65	4.06 (2.13)	2.33 (1.67)	1.09 (1.26)	0.85 (1.16)	1.87 (1.52)	1.62 (1.44)	0.98 (1.21)	0.86 (1.16)	1.71	84.29
Imidacloprid 17.8 SL	0.35ml/l	9.04	7.62 (2.84)	6.69 (2.68)	5.14 (2.37)	5.33 (2.41)	5.80 (2.49)	5.51 (2.42)	5.45 (2.43)	6.37 (2.62)	5.99	44.85
Untreated Control	-	8.86	9.46 (3.55)	9.88 (3.22)	10.22 (3.26)	10.80 (3.35)	10.94 (3.38)	11.32 (3.43)	11.89 (3.51)	12.36 (3.58)	10.86	-
SEm±		NS	0.16	0.12	0.16	0.12	0.15	0.14	0.15	0.09	-	-
CD @ 5%			0.45	0.34	0.48	0.34	0.45	0.41	0.45	0.26	-	-

* - *Values in the brackets indicate square root transformed; DATI: Days after treatment imposition*

followed by Flonicamid 50 WG @ 0.4g/L (1.74) (Table 2) with percent population suppression over control of 83.45 and 81.24 respectively. The present finding corroborates with Ghosal *et al* (2013) and Sujay Anand *et al* (2013) also observed the superiority of newer neonicotinoids among different treatments tested in their experiment. The next best treatments were Flupyridifurone 200 SL @ 2.0ml/L (2.65) and Flonicamid 50 WG @ 0.3g/L (3.54) which were in line with each other. This is in accordance with the observations of Raghuraman and Birah (2011) who found that the Imidacloprid @ 80g ai/ha statistically suppressed leafhopper populations simultaneously increased the yield. The maximum yield was observed in imidacloprid (80g ai/ha) followed by its next lower dose 40g a.i./ha was superior in managing leafhopper population in okra. The current findings were in accordance with Begum and Patil (2016)'s results, indicated that imidacloprid (17.8 SL) was effective in managing population of leafhoppers and whiteflies. Ahmad *et al* (2023) reported same findings, which supports present results, indicating that imidacloprid (17.8 SL) was effective in reducing the leafhoppers and whiteflies population both of which are systemic neonicotinoids.

Economic analysis of the insecticides

Economic analysis of different insecticides against leafhoppers and whiteflies was done and presented in table 3. It was evident that all the treatments recorded significantly maximum net returns compared to the treatments. Among different tested treatments highest economic yield was recorded in Flupyridifurone 200 SL @ 2.5ml/L treated plots (11.08) followed by Flonicamid 50 WG @ 0.4g/L (10.76) (Table 3) with highest Benefit: Cost ratio of 2.8 in both the treatments. Similarly Ahmad *et al* (2023) got similar results, which supports present results wherein they observed that imidacloprid insecticide sprayed plot showed maximum economic return (1: 15.80) followed by acetamiprid (1: 13.25) both of which are systemic neonicotinoids.

CONCLUSION

The outcomes suggest that the present neonicotinoid insecticide were effective alternatives over conventional insecticides in formulating improved pest management strategy against sucking pests in okra leading to better crop protection and increased yields. Their systemic action ensured prolonged protection, reducing the frequency of applications, thereby lowering labour and input costs while minimizing environmental impact and enhancing sustainability in integrated pest management programs.

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Table 2: Number of whiteflies per 3 leaves after spray in okra for the year 2023-24

Treatments	Dose (ml/L)	No. of leaf hoppers per 3 leaves after 1st spray					No. of leaf hoppers per 3 leaves after 2nd spray				Average	Suppression over control (%)
		1 DBTI	3 DATI	5 DATI	7 DATI	10 DATI	3 DATI	5 DATI	7 DATI	10 DATI		
Flonicamid 50WG	0.2g/l	7.44	5.52 (2.45)	4.20 (2.16)	4.60 (2.25)	4.22 (2.17)	6.27 (2.60)	5.29 (2.40)	3.58 (2.02)	2.82 (1.82)	4.56	50.67
Flonicamid 50WG	0.3g/l	8.26	4.73 (2.27)	3.25 (1.93)	2.56 (1.74)	1.93 (1.51)	5.52 (2.44)	4.51 (2.23)	3.29 (1.93)	2.51 (1.92)	3.54	61.76
Flonicamid 50WG	0.4g/l	9.19	2.35 (1.68)	1.81 (1.51)	1.40 (1.37)	0.93 (1.19)	2.92 (1.81)	2.02 (1.57)	1.50 (1.40)	0.96 (1.20)	1.74	81.24
Flupyridifurone 200SL	1.5 ml/l	10.01	5.21 (2.38)	3.56 (2.00)	3.08 (1.84)	2.65 (1.72)	6.09 (2.56)	4.85 (2.30)	4.11 (2.12)	2.60 (1.75)	4.02	56.55
Flupyridifurone 200SL	2.0 ml/l	7.97	3.35 (1.94)	2.67 (1.78)	2.01 (1.58)	1.33 (1.34)	4.26 (2.17)	3.24 (1.91)	2.40 (1.69)	1.90 (1.55)	2.65	71.39
Flupyridifurone 200SL	2.5 ml/l	9.63	2.27 (1.64)	1.48 (1.40)	1.11 (1.26)	0.80 (1.14)	2.83 (1.79)	1.85 (1.51)	1.09 (1.25)	0.81 (1.13)	1.53	83.45
Imidacloprid 17.8 SL	0.35ml/l	9.04	6.56 (2.65)	5.57 (2.46)	4.23 (2.16)	3.94 (2.10)	6.97 (2.73)	5.87 (2.52)	4.51 (2.22)	4.21 (2.16)	5.23	43.43
Untreated Control	-	8.35	8.51 (3.00)	8.64 (3.02)	8.79 (3.05)	8.90 (3.07)	9.19 (3.11)	9.81 (3.21)	10.03 (3.24)	10.16 (3.26)	9.25	-
SEm±		NS	0.15	0.12	0.16	0.17	0.17	0.14	0.16	0.12	-	-
CD @ 5%			0.43	0.36	0.48	0.51	0.49	0.42	0.46	0.35	-	-

* *- Values in the brackets indicate square root transformed; DATI: Days after treatment imposition*

Table 3: Economic yield of okra during 2023-24

Treatments	Dose (ml/L)	Yield (t/ha)	B: C Ratio
Flonicamid 50WG	0.2g/l	6.10	1.0
Flonicamid 50WG	0.3g/l	7.40	1.5
Flonicamid 50WG	0.4g/l	10.76	2.9
Flupyridifurone 200SL	1.5 ml/l	6.24	1.1
Flupyridifurone 200SL	2.0 ml/l	7.33	1.8
Flupyridifurone 200SL	2.5 ml/l	11.08	2.6
Imidacloprid17.8 SL	0.35ml/l	6.19	1.0
Untreated Control	-	3.11	
SEm+		0.57	
CD @ 5%		1.67	
CV (%)		13.60	

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