Similarly, Kumar *et al.* (1994) tested the effect of carbosulfan 25 STD @ 150,300 and 450 g a.i/ha on seeds of okra and observed that it produced no adverse effect on the germination and root and shoot length.

Finally, it could be concluded that the use of biopesticides *viz.*, TNAU NO 60 EC (C) 20 ml/kg and *P. fluorescens* 7 gm/kg as seed dressers were as effective as chemical insecticides like imidacloprid and carbosulfan. Biopesticides like *P. fluorescens* induces multigenic resistance by activating several defense genes encoding proteins and chemicals and thus, it is effective against early sucking pests attacking the bhendi crop.

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Research Notes

Biopesticide seed treatment for the management of sucking pests in bhendi

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Bhendi, *(Abelmoschus esculentus* (L.) Mqench), one of the world's oldest cultivated crops belonging to the family Malvaceae, is ravaged by many insect pests right from germination of seeds to harvest of fruits. In the early stage, sucking pests like aphid, *Aphis gossypii* Glover, the leaf hopper, *Amrasca biguttula biguttula* Ishida and the whitefly, *Bemisia (abaci* Gennadius desap the leaves. Farmers rely solely on the chemical insecticides

Table 1. Effect of biopesticides and insecticides as seed treatment on the aphids and leafhopper population in bhendi (Experiment -1)

(Mean of four replications)

S.No	Treatments	Mean population per plant (DAS)							
		Aphids				Leafhopper			
		30	60	90	Mean	30	60	90	Mean
1	*P.fluorescens* 10 g/kg	1.15 (1.28)°	1.37 (1.35)	2.20 (1.64)[a]	1.53 (1.42)[b]	1.00 (1.22)'	1.27 (1.31)'	2.40 (1.70)[c]	1.58 (1.43)[c]
2	Neem oil 20 ml/kg	1.72 (1.48)[d]	2.00 (1.53)	2.80 (1.81)[a]	2.17 (1.63)[c]	0.90 (1.12)[ab]	0.72 (1.08)[ab]	2.00 (1.58)[b]	1.25 (1.31)[bc]
3	TNAU NO 60 EC (C) 20 ml/kg	2.3 (1.67)[e]	2.52 (1.66)	3.10 [3] (1.89)[a]	2.63 (1.76)[d]	0.65 (1.06)[ab]	0.77 (1.12)[ab]	2.00 (1.58)[b]	1.31 (1.32)[c]
4	Imidacloprid 7 g/kg	0.67 (1.08)[b]	2.12 (1.53)	1.50 (1.41)[a]	1.19 (1.29)'	0.10 (0.76)'	0.27 (0.87)[a]	1.40 (1.37)'	0.67 (1.05)'
5	Carbosulfan 7 g/kg	0.72 (1.10)[b]	0.95 (1.19)	1.80 (1.51)[a]	1.16 (1.28)'	0.97 (1.14)[ab]	1.02 (1.17)'[b]	1.60 (1.44)[a]	1.18 (1.29)[bc]
6	Control	4.55 (2.24)[f]	3.00 (1.87)	6.00 (2.54)[b]	4.36 (2.19)[e]	1.17 (1.27)[b]	3.00 (1.29)[b]	6.00 (2.54)[d]	3.26 (1.88)[d]

Figures in the parentheses are x + 0.5 transformed values

Means followed by the same letter(s) in a column are not significantly different by (P=0.05) DMRT

DAS - Days After Sowing

Table 2. Effect of biopesticides and insecticides as seed treatment on the aphids and leafhopper population in bhendi (Experiment -1I)

(Mean of four replications)

S.No	Treatments	Mean population per plant (DAS)							
		Aphids				Leafhopper			
		30	60	90	Mean	30	60	90	Mean
1	*P.fluorescens* 10 g/kg	9.75 (3.19)°	24.15 (4.95)^{b}	25.27 (5.04)^{a}	17.99 (4.24)^{a}	15.67 (4.01)^{b}	18.90 (4.38)°	24.22 (4.96)^{a}	20.47 (4.56)^{a}
2	Neem oil 20 ml/kg	8.32 (2.96)^{bc}	18.97 (4.39)^{ab}	18.30 (4.25)^{a}	14.54 (3.78)^{a}	14.40 (3.81)^{b}	17.77 (4.26)^{c}	21.67 (4.69)^{a}	18.31 (4.3l)^{a}
3	TNAU NO 60 EC (C) 20 ml/kg	8.55 (2.99)^{bc}	17.92 (4.27)^{ab}	18.15 (4.30)^{a}	16.16 (4.04)^{a}	10.95 (3.37)^{ab}	6.67 (2.65)^{a}	19.80 (4.47)^{a}	14.14 (3.74)^{a}
4	Imidacloprid 7 g/kg	4.42 (2.20)^{a}	16.27 (4.08)^{a}	16.42 (4.10)^{a}	13.40 (3.63)^{a}	5.85 (2.49)^{a}	12.22 (3.55)^{b}	23.47 (4.87)^{a}	13.67 (3.67)^{a}
5	Carbosulfan 7 g/kg	8.32 (2.96)^{bc}	19.05 (4.39)^{ab}	18.52 (4.35)^{a}	14.17 (3.78)^{a}	6.30 (2.41)^{a}	11.40 (3.42)^{b}	24.30 (4.95)^{a}	15.31 (3.89)^{a}
6	Control	27.52 (5.26)^{d}	115,27 (10.74)°	158.92 (12.60)^{b}	101.00 (9.55)^{b}	20.02 (4.34)^{b}	43.80 (6.62)^{d}	100.72 (10.03)^{b}	60.76 (7.51)^{b}

Figures in the parentheses are x + 0.5 transformed values

Means followed by the same letter(s) in a column are not significantly different by (P=0.05) DMRT

DAS - Days After Sowing

for the management of pests of bhendi because of easy adaptability, immediate and spectacular knockdown effects (Pawar *et al.,* 1988). The use of persistent insecticides acquires special concern on vegetables and fruits especially where there is a little time lag between treatment and consumption. So the increasing concern for environmental safety and global demand for pesticide residue free food has evoked interest in exploring eco-friendly method of pest management like biopesticide seed treatment. Seed treatment is one of the best methods, since it ensures not only the presence of insecticide residues through out seedling stage, but is also relatively inexpensive and easy to adopt when compared to foliar spray or soil application.

With a view to find out the efficacy of biopesticides *viz., Psuedomonas fluorescens*, Neem Oil and TNAU NO 60 EC (C) against sucking pests on bhendi in comparison with chemical insecticides like imidacloprid and carbosulfan, two field experiments were conducted one at Neem Park in Tamil Nadu Agricultural University, Coimbatore and the another one at Devinayakanpatti of Dindigul District with bhendi variety Arka Abhay and the treatments were replicated four times. The population of nymphs and adults of aphids and leaf hoppers were recorded in ten plants pre-tagged at random. In each plant, three leaves one each from top, middle and bottom region were selected. Thus, in all, 30 leaves from 10 plants were observed every time per plot at monthly intervals. The data were analysed statistically for each observation and the summary of results are furnished in Tables 1 and 2 for the experiments I and II, respectively.

The results of the experiment I revealed that the aphid population varied from 0.67 to 6.00 aphids / plant upto three months. Among the different treatments, carbosulfan, recorded minimum mean population of 1.16 aphids / plant and imidacloprid (1.19 aphids / plant) which were on a par followed by *Psuedomonas fluorescens*, Neem Oil and TNAU NO 60 EC recording 1.53, 2.17 and 2.63 aphids / plant, respectively. In the second experiment, mean population varied between 13.40 - 17.99 aphids / plant in various biopesticides and insecticidal treatments and all are on par as against 101.0 aphids / plant in the untreated check indicating that biopesticides are equally effective as that of chemical insecticides.

In both the field experiments the leaf hopper incidence was minimum in imidacloprid treated plot (0.67 and 13.67 leaf hoppers / plant). In the experiment II the mean minimum leaf hopper population observed in imidacloprid was on par with carbosulfan and biopesticides. Even though the population of aphids and leaf hoppers was higher in biopesticides like NO, TNAU NO 60 EC (C), and *P. fluorescens* treated plots, the efficacy was comparable to that of chemicals that have the systemic action. Patel and Patel (1996) reported that seed treatment with imidacloprid 70 WS at 10 g / kg was effective in keeping leaf hopper population below ETL upto 40 DAS. The foreseen findings are in line with Jotwani and Srivastava (1981) who reported that NO 1.0 per cent was quite effective against *A. gossypii.*

In conclusion, though the chemical insecticides recorded less number of aphids and leaf hoppers per plant when compared to biopesticides, the efficacy of later one was comparable to that of former one. In addition, chemical insecticides cast not only an environmental problem but pose a hazardous effect on man also. Therefore, use of chemical insecticides should be discouraged as far as possible. We can support the seed

treatment with *P.fluorescens* 10 g / kg or TNAU NO 60 EC (C) 20 ml / kg or No 20 ml / kg to manage the aphids and leafhoppers on bhendi.

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Research Notes

Efficacy of Neem Products And Insecticides Against Cotton Stem Weevil, *Pempherulus afflnis* Faust in Coimbatore

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In India, cotton crop is damaged by over 160 different species of insects from the time of sowing to harvest and thus stability of cotton production has been frequently threatened by the outbreak of insect pests. Cotton stem weevil has been reported as a major pest of cotton next to boll worms in South India (Fletcher, 1914; Ayyar, 1918; Parameswaran, 1983). There was 65.8 per cent mortality, 72.0 per cent reduction in boll production and 78.9 per cent reduction of seed cotton yield when cotton plants are infested by this pest (Parameswaran and Chelliah, 1984). The young grub feeds on medulla and cambial regions of the plant leading to gall formation and wilting of plant. Further, high speed winds cause breakage of plant. Hence, study was conducted to know effective product among neem products and insecticides for the control of the pest.

A field experiment was conducted with MCU 5 cotton variety at farm, TNAU, Coimbatore during summer, 2003 to evaluate efficacy of different insecticides along with neem cake and neem oil. The experiment was laid in randomized block design with $20m^2$ plots and all the treatments were replicated thrice. Normal cultural practices were followed (Crop Production Guide, 1999). Neem cake @ 500 kg ha^{-1} was given as basal application. Drenching of other treatments was followed commencing from 15 days after sowing (DAS) at 10 days interval for three times at 100