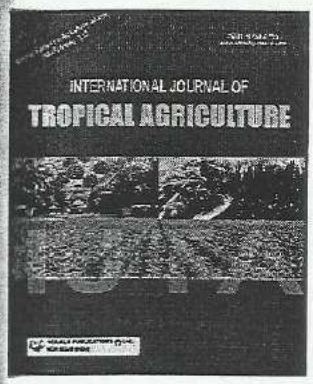

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Impact of Certain Agrochemicals on Leafhoppers, *Amrasca biguttula biguttula* (Ishida) (Homoptera: Cicadellidae) in Bhendi, *Abelmoschus Esculentus* (L.) Moench, Ecosystem

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Abstract: Two supervised field experiments were conducted in the bhendi during kharif, 2014 and rabi, 2014-15 to study the impact of agrochemicals on leafhoppers population. The agrochemicals used were fertilizer, insecticide and herbicide individually as well as in combinations. It was found that the population of leafhoppers was higher in the untreated check (4.53 to 7.06/plant) while a low population was recorded in the treatment with herbicide + insecticide (1.43 to 2.63/plant) during kharif. In rabi, a higher population was recorded in the untreated check (4.33 to 5.96/plant) while a low population was observed in the treatment with herbicide + insecticide (1.13 to 2.36/plant). It was also found that, the population was higher in the treatment with fertilizer (3.94 and 4.05/plant in kharif and rabi respectively) alone compared to the other treatments in both the seasons. Hence, a need based application of agrochemicals protect the ecosystem with a lesser impact on the insects and natural enemies.

Key words: Leafhoppers, *Amrasca biguttula biguttula*, impact, agrochemicals.

INTRODUCTION

India is a major vegetable producing and consuming country and vegetables form an important dietary component. Among them okra, (*Abelmoschus esculentus* (L.) Moench) is one of the popular and commercially cultivated vegetable crops, popularly known as Bhendi or ladies finger and is a potential foreign exchange earner, accounting for 60 per cent of

export of fresh vegetables [11]. In India, Uttar Pradesh, Assam, Bihar, Orissa, Maharashtra, West Bengal and Karnataka are important bhendi producing states. It is grown in an area of 0.49 million hectares with an annual production of 5.80 million tonnes and productivity of 11.6 tonnes per hectare in India [2].

Among many factors responsible for low production of okra, the damage inflicted by insect pests has been considered important; leafhoppers, *Amrasca biguttula biguttula* (Ishida) (Homoptera: Cicadellidae) are undoubtedly more severe among the many destructive pests of okra. Leafhopper is especially important in the tropics and subtropics because environmental conditions are often conducive year round for growth and development of host and pest. It was described that the leafhoppers, *A. biguttula biguttula* was amongst the most important sucking insects that attack bhendi in India [8]. It lays maximum number of eggs in the midrib of the leaves and thus becomes suitable place for survival and feeding [10]. The nymphs and adults suck the plant sap mainly from the lower surface of leaves and cause phytotoxic symptoms known as hopper burn which results in complete desiccation and has become one of the limiting factors in economic productivity of the crop.

Hence, the protection of crops from the attack of leafhopper assumes importance to supply quality production to farmers. The present method of production with large application of chemical spray will lead to incomplete management of pest complex of bhendi. In order to achieve higher yield of quality products, the protection of crop right from sowing until harvest is essential. Hence, present study was undertaken to investigate the impact of certain agrochemicals on the population of leafhoppers, *A. biguttula biguttula* in bhendi.

MATERIALS AND METHODS

Two field experiments were conducted to assess the impact of certain agrochemicals on leafhoppers, *A. biguttula biguttula* population in bhendi during *kharif*, 2014 and *rabi*, 2014-15 at farmers field of Khowai district, Tripura, India on the bhendi hybrid MH 10. The experiment was laid out in a Randomized Block Design (RBD) with three replications and eight treatments in a 5.4 × 4.5 square meter plots.

The treatments include untreated check, herbicide only (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 days after sowing (DAS)), fertilizer only (NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS), insecticide only (Carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS), herbicide + fertilizer (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 DAS and NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS), herbicide + insecticide (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 DAS and carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS), fertilizer + insecticide (NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS and carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS) and herbicide + insecticide + fertilizer (Oxyflourfen 23.5 EC @ 0.15 kg a.i/ha applied as pre emergence application at 3 DAS and NPK applied @ 20:50:30 kg/ha as basal and the remaining N 20 kg/ha applied at 30 DAS and carbaryl 50 WP @ 2g/lit as foliar spray at 50 DAS). *Insitu* counts was recorded early in the morning at weekly intervals on 3 leaves (top, middle and bottom leaves) of ten randomly selected plants of middle three rows, leaving the border row plants. The total number of leafhoppers were counted and expressed as number/plant.

The data obtained from the field experiments were analysed in a Randomized Block Design by 'F' test for significance as described by Panse and Sukhatme [9]. Critical difference values were calculated at 5% probability level and the treatment mean values of the experiment were compared using Duncan's Multiple Range Test (DMRT) [5].

RESULTS AND DISCUSSION

Field Experiment I (*Kharif*, 2014)

The impact of agrochemicals on the population of leafhoppers in bhendi ecosystem during *kharif*, 2014 are presented in Table 1. At 1st and 2nd week after sowing there was no leafhoppers population and hence the population of leafhoppers was observed from 3rd week and continued upto 12th week after sowing. At 3rd week, the leafhoppers population ranged from 1.63 to 4.53/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (1.63/plant) followed by insecticide (2.03/plant). All the treatments recorded a lower population compared to the untreated check which recorded a higher population of leafhoppers (4.53/plant).

At 4th week, the leafhoppers population was in an increasing trend and ranged from 1.73 to 4.90/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (1.73/plant) followed by insecticide treatment alone (2.06/plant). The population was lower in all the treatments compared to the untreated check which recorded a higher population of leafhoppers (4.90/plant). At 5th week, the leafhoppers population ranged from 1.56 to 5.00/plant. The treatment with herbicide + insecticide recorded a low population (1.56/plant) followed by insecticide alone (2.03/plant) compared to the untreated check which recorded a higher population (5.00/plant). Similar trend was observed upto 6th week after sowing.

At 7th week, the leafhoppers population ranged from 2.23 to 6.26/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (2.23/plant) and are at par with the insecticide treatment alone (2.40/plant) compared to the untreated check which recorded a higher population of leafhoppers (6.26/plant). Similar trend was observed upto 9th week after sowing. At 10th week after sowing, the leafhoppers population ranged from 2.23 to 7.06/plant. The treatment with herbicide + insecticide recorded a lower population of 2.23/plant followed by the treatment with insecticide alone (2.86/plant) compared to the untreated check which recorded a higher population of 7.06/plant. It was observed that, from 11th week after sowing the population number was in a decreasing trend and ranged from 1.76 to 5.80/plant and continued upto 12th week after sowing irrespective of the treatments.

The mean leafhoppers population ranged from 1.85 to 5.68/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (1.85/plant) followed by the treatment with insecticide alone (2.19/plant) compared to the untreated check which recorded a higher population of leafhoppers (5.68/plant). It was found that, a higher per cent reduction of leafhoppers population was observed in the treatment with herbicide + insecticide (67.42%) followed by the treatment with insecticide alone (61.44%) while a lower per cent reduction of leafhoppers population was observed in the treatment with fertilizer alone (30.63%) compared to the untreated check.

Field Experiment II (*Rabi*, 2014-15)

The impact of agrochemicals on the population of leafhoppers in bhendi ecosystem during *rabi*, 2014-15 are presented in Table 2. At 1st and 2nd week after sowing there was no leafhoppers population and hence the population of leafhoppers was observed from 3rd week and continued upto 12th week after sowing. At 3rd week, the leafhoppers population ranged from 1.70 to 4.33/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (1.70/plant) followed by insecticide (1.83/plant). All the treatments recorded a lower population compared to the untreated check which recorded a higher population of leafhoppers (4.33/plant). Similar trend was observed upto 5th week.

Table 1

Impact of agrochemicals on the population of leafhoppers in bhendi ecosystem during *kharif*, 2014 (Field experiment I)

Sl. No.	Treatments	*Leafhopper population in numbers #*											
		3rd week	*4th week*	*5th week*	*6th week*	*7th week*	*8th week*	*9th week*	*10th week*	*11th week*	*12th week*	*Mean population*	*Per cent reduction over control*
1.	Untreated check	4.53(2.14)^{f}	4.90(2.22)^{g}	5.00 (2.24)^{e}	5.50(2.35)^{e}	6.26(2.51)^{d}	6.16(2.49)^{d}	7.00(2.65)^{e}	7.06(2.66)^{d}	5.80(2.41)^{e}	4.66(2.17)^{e}	5.68(2.38)^{f}	–
2.	Herbicide	2.63(1.63)^{d}	2.86(1.70)^{e}	2.63(1.63)^{d}	2.70(1.65)^{c}	3.43(1.86)^{b}	3.06(1.75)^{b}	3.90(1.98)^{c}	3.63(1.91)^{c}	3.70(1.93)^{cd}	2.56(1.61)^{c}	3.11(1.77)^{d}	45.24
3.	Fertilizer	3.46(1.87)^{e}	3.56(1.90)^{f}	3.76 (1.95)^{d}	4.26(2.07)^{d}	4.10(2.03)^{c}	4.16(2.05)^{c}	4.43(2.11)^{d}	4.20(2.05)^{c}	4.33(2.09)^{d}	3.23(1.81)^{d}	3.94(1.99)^{e}	30.63
4.	Insecticide	2.03(1.44)^{b}	2.06(1.45)^{b}	2.03(1.44)^{b}	2.06(1.45)^{b}	2.40(1.56)^{a}	1.80 (1.35)^{a}	2.56(1.61)^{a}	2.86(1.70)^{b}	1.96(1.41)^{a}	2.16(1.48)^{b}	2.19(1.49)^{b}	61.44
5.	Herbicide + fertilizer	2.43(1.57)^{cd}	2.56(1.61)^{d}	2.66 (1.64)^{c}	2.43(1.57)^{bc}	3.30(1.83)^{b}	2.73(1.66)^{b}	3.63(1.91)^{c}	3.76(1.95)^{c}	2.90(1.71)^{b}	2.70(1.65)^{c}	2.91(1.71)^{cd}	48.76
6.	Herbicide + insecticide	1.63(1.29)^{a}	1.73(1.33)^{a}	1.56(1.27)^{a}	1.56(1.27)^{a}	2.23(1.51)^{a}	1.43(1.21)^{a}	2.63(1.63)^{a}	2.23(1.51)^{a}	1.76(1.34)^{a}	1.83(1.37)^{a}	1.85(1.37)^{a}	67.42
7.	Fertilizer + insecticide	2.10(1.46)^{b}	2.20(1.49)^{bc}	2.06(1.45)^{b}	2.40(1.55)^{bc}	3.53(1.89)^{b}	2.46(1.58)^{b}	3.46(1.87)^{b}	4.13(2.04)^{c}	2.96(1.73)^{b}	2.63(1.63)^{c}	2.79(1.67)^{c}	50.88
8.	Herbicide + fertilizer + insecticide	2.16(1.48)^{bc}	2.33(1.54)^{c}	2.26(1.52)^{c}	2.36(1.55)^{bc}	3.20(1.80)^{b}	2.56(1.61)^{b}	3.66(1.92)^{bc}	4.16(2.04)^{c}	3.13(1.77)^{bc}	2.60(1.62)^{c}	2.84(1.69)^{c}	50.00
	CD (P = 0.05)	0.094**	0.061**	0.079**	0.149**	0.090**	0.164**	0.078**	0.150**	0.170**	0.059**	0.133**	–

**- Significant at P = 0.01, #- Mean of 10 plants and Mean of 3 Replications, In a coloum mean followed by a common letter are not significantly different by DMRT (P = 0.05), Values in parentheses are $\sqrt{X} + 0.5$ transformed values

Table 2

Impact of agrochemicals on the population of leafhoppers in bhendi ecosystem during *rabi*, 2014-15 (Field experiment II)

		Leafhopper population in numbers #											
Sl. No.	*Treatments*	*3rd week*	*4th week*	*5th week*	*6th week*	*7th week*	*8th week*	*9th week*	*10th week*	*11th week*	*12th week*	*Mean population*	*Per cent reduction over control*
1.	Untreated check	4.33 (2.09)^{e}	4.53 (2.14)^{e}	4.60 (2.15)^{e}	4.83 (2.20)^{g}	4.90 (2.22)^{e}	5.26 (2.30)^{f}	5.70 (2.39)^{f}	5.70 (2.39)^{f}	5.96 (2.45)^{e}	5.63 (2.38)^{e}	5.14 (2.27)^{f}	–
2.	Herbicide	2.43 (1.57)^{c}	2.66 (1.64)^{c}	2.40 (1.56)^{c}	2.83 (1.69)^{e}	2.86 (1.70)^{c}	3.53 (1.89)^{d}	3.80 (1.96)^{d}	3.93 (1.99)^{d}	3.76 (1.95)^{c}	3.46 (1.87)^{c}	3.17 (1.78)^{d}	38.33
3.	Fertilizer	3.26 (1.82)^{d}	3.36 (1.84)^{d}	3.30 (1.83)^{d}	3.60 (1.91)^{f}	3.66 (1.92)^{d}	4.26 (2.07)^{e}	4.90 (2.22)^{e}	4.53 (2.14)^{e}	4.93 (2.23)^{d}	4.40 (2.10)^{d}	4.05 (2.02)^{e}	21.21
4.	Insecticide	1.83 (1.37)^{a}	1.93 (1.40)^{b}	2.03 (1.44)^{b}	2.23 (1.51)^{b}	2.26 (1.52)^{b}	1.63 (1.29)^{b}	2.46 (1.58)^{ab}	2.63 (1.63)^{b}	2.96 (1.73)^{b}	2.86 (1.70)^{b}	2.32 (1.53)^{b}	54.86
5.	Herbicide + fertilizer	2.23 (1.51)^{bc}	2.43 (1.57)^{c}	2.40 (1.56)^{c}	2.63 (1.63)^{d}	2.43 (1.57)^{b}	3.50 (1.88)^{d}	4.06 (2.02)^{d}	3.86 (1.97)^{d}	3.93 (1.99)^{c}	3.70 (1.93)^{c}	3.12 (1.76)^{d}	39.29
6.	Herbicide + insecticide	1.70 (1.32)^{a}	1.53 (1.25)^{a}	1.76 (1.34)^{a}	1.90 (1.39)^{a}	1.96 (1.41)^{a}	1.13 (1.08)^{a}	2.20 (1.49)^{a}	2.33 (1.54)^{a}	2.36 (1.55)^{a}	2.33 (1.54)^{a}	1.92 (1.39)^{a}	62.65
7.	Fertilizer+ insecticide	1.90 (1.39)^{a}	2.36 (1.55)^{c}	2.20 (1.49)^{b}	2.26 (1.52)^{b}	2.33 (1.54)^{b}	2.53 (1.60)^{c}	2.73 (1.66)^{bc}	3.13 (1.78)^{c}	2.93 (1.72)^{b}	2.63 (1.63)^{ab}	2.50 (1.59)^{bc}	51.36
8.	Herbicide+ fertilizer+ insecticide	1.96 (1.42)^{ab}	2.26 (1.52)^{bc}	2.40 (1.56)^{c}	2.43 (1.57)^{c}	2.46 (1.58)^{b}	2.20 (1.49)^{c}	3.10 (1.77)^{c}	3.30 (1.83)^{c}	3.20 (1.80)^{b}	2.73 (1.66)^{b}	2.61 (1.62)^{c}	49.22
	CD (P = 0.05)	0.099**	0.115**	0.059**	0.045**	0.070**	0.124**	0.129**	0.072**	0.075**	0.105**	0.134**	–

**- Significant at P = 0.01, #- Mean of 10 plants and Mean of 3 Replications, In a coloum mean followed by a common letter are not significantly different by DMRT (P = 0.05), Values in parentheses are $\sqrt{X} + 0.5$ transformed value

At 6th week, the leafhoppers population ranged from 1.90 to 4.83/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (1.90/plant) followed by insecticide treatment alone (2.23/plant). The population was lower in all the treatments compared to the untreated check which recorded a higher population of leafhoppers (4.83/plant). Similar trend was observed upto 7th week. At 8th week, the leafhoppers population ranged from 1.13 to 5.26/plant. The treatment with herbicide + insecticide recorded a low population (1.13/plant) followed by insecticide alone (1.63/plant) compared to the untreated check which recorded a higher population of 5.26/plant. Similar trend was observed upto 10th week after sowing.

At 11th week, the leafhoppers population ranged from 2.36 to 5.96/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (2.36/plant) followed by fertilizer + insecticide (2.93/plant) compared to the untreated check which recorded a higher population of leafhoppers (5.96/plant). Similar trend was observed upto 12th week after sowing.

The mean leafhoppers population ranged from 1.92 to 5.14/plant. It was found that the population of leafhoppers was low in the treatment with herbicide + insecticide (1.92/plant) followed by the treatment with insecticide alone (2.32/plant) compared to the untreated check which recorded a higher population of leafhoppers (5.14/plant). It was found that, a higher per cent reduction of leafhoppers population was observed in the treatment with herbicide + insecticide (62.65%) followed by the treatment with insecticide alone (54.86%) while a lower per cent reduction of leafhoppers population was observed in the treatment with fertilizer alone (21.21%) compared to the untreated check.

It was found that imidacloprid 17.8 SL @ 0.006 per cent against aphids and leafhoppers [13], imidacloprid 70 WS @ 5 g/kg seed + monocrotophos 36 SL @ 500 g a.i./ha against leafhoppers [1], imidacloprid 70 WS @ 5 g/kg seed and thiamethoxam 70 WS @ 5 g/kg seed against aphids, leafhoppers [1,4], thiamethoxam 25 WG @ 20 g a.i./ha and fipronil 5 SC @ 250 g a.i./ha against leafhoppers population [7] was found to reduce the population in bhendi. Baidoo and Mochiah [3] reported that, higher doses of nitrogenous fertilizer increased the pest attack while potash fertilizer made plants more resistant and also stated that, the incidence of flea beetle, *Podagrica puncticollis* Weise was highest on NPK treated plots while the lowest population on manure treated plots in bhendi. Mallapur et al. [6] stated that, a ready mixture of indoxacarb 14.5 SC + acetamiprid 7.7 SC @ 300 and 400 ml/ha were found to be more effective against the pests of bhendi. The present findings are in corroborate with the above findings.

CONCLUSIONS

The present findings revealed that, there was a higher reduction of leafhoppers in the treatment with the herbicide + insecticide followed by insecticide alone and other treatments. The results also showed a lower per cent reduction was observed in the treatment with fertilizer alone. Hence, it was concluded that the agrochemicals namely herbicide + insecticide found to have an impact on the population of leafhoppers while fertilizer alone found to have a lesser impact on the population of leafhoppers. Hence, a need based application of agrochemicals protect the ecosystem with a lesser impact on the insects and natural enemies.

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