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Research article

IMPACT OF CERTAIN AGROCHEMICALS ON THE POPULATION OF COCCINELLID BEETLES (COLEOPTERA: COCCINELLIDAE) IN BHENDI (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH) ECOSYSTEM

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ABSTRACT: Two supervised field experiments were conducted in the bhendi hybrid MH 10 during *kharif*, 2012 and *rabi*, 2012-13 to study the impact of agrochemicals on coccinellid population. The agrochemicals used were fertilizer, insecticide and herbicide individually as well as in combinations. It was found that the population of coccinellids was higher in the untreated check (0.20 to 1.13/plant) while a low population was recorded in the treatment with herbicide + insecticide which ranged from 0.03 to 0.33/plant during *kharif,* 2012. In *rabi,* 2012-13, a higher population was recorded in the untreated check (0.16 to 1.06/plant) while a low population was observed in the treatment with herbicide + insecticide (0.06 to 0.50/plant). It was also found that, the population was higher in the treatment with fertilizer alone (0.47 and 0.50/plant in *kharif* and *rabi* respectively) compared to the other treatments.

Key words: Coccinellids, impact, agrochemicals

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench), commonly known as 'bhendi' or lady's finger in India, is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. This crop is suitable for cultivation as a garden crop as well as on large commercial farms. It is grown commercially in India, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malayasia, Brazil, Ghana, Ethiopian, Cyrpus and the Southern United States. Bhendi contains proteins, carbohydrates and vitamin C [2,5], and plays a vital role in human diet [17]. In India, 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 [1]. Bhendi accounts for 60 per cent of export of fresh vegetables excluding potato, onion and garlic [18]. Bhendi is susceptible to a large range of insect pests and diseases. Various growth stages of the crops are susceptible to the different insect pests and diseases [7,8] has reported 72 insect pest species that attack and damage bhendi. The population growth of any pest species is effectively controlled by their natural enemies [22]. The lady bird beetles are predacious both at larval and adult stages and feed on various crop pests such as aphids and other soft bodied insects [12]. The female lady bird beetles are more effective in aphid predation in compared to the male beetles [3]. Rajpal and Joshi [16] reported that, the spiders and beetles were the main defenders in bhendi ecosystem. It was also reported that, 6 species and 4 genera of coccinellids occurred in bhendi ecosystem [21]. The indiscriminate use of pesticides has resulted in the development of resistance and resurgence in the pest besides environmental and health hazards. High intensity of insecticide sprays causes mortality of beneficial arthropods associated with predation or parasitism [4]. Biological control of insect pests with predators and/or parasitoids is the most important and ecofriendly components of IPM. However, for selections and strategic application of insecticides, a comprehensive knowledge of their lethal residual effects on insect pest and associated biocontrol agents is required [13, 14]. The present study was carried out to investigate the effect of certain agrochemicals (fertilizer, herbicide, insecticide) on the population of coccinellid predators in the bhendi field.

MATERIALS AND METHODS

Two field experiments were conducted to assess the impact of certain agrochemicals on coccinellids population in bhendi during *kharif,* 2012 and *rabi,* 2012-13 at Eastern farm of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA and RI), Karaikal, U.T. of Puducherry, India on the bhendi hybrid MH 10. The experiment was laid out in a Randomized Block Design with three replications and eight treatments in a 5.4 x 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 were taken at weekly intervals on ten randomly selected plants of middle three rows, leaving the border row plants. The total number of coccinellids 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 [15]. 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) [9].

RESULTS AND DISCUSSION

During *kharif* and *rabi*, nine species of coccinellids *viz., Brumoides suturalis* Fabricius, *Cheilomenes sexmaculata* Fabricius, *Coccinella transversalis* Fabricius, *Epilachna viginctioctopunctata* Fabricius, *Harmonia octomaculata* Fabricius, *Hyperaspis maindroni* Sicard, *Illeis cincta* Fabricius, *Micraspis discolor* Fabricius, *Propylea dissecta* Mulsant were observed. During *kharif*, the impact of agrochemicals on the population of coccinellids in bhendi ecosystem are presented in Table 1. At 1st and 2nd week after sowing there was no coccinellids and hence the population of coccinellids was observed from 3rd week and continued upto 12th week after sowing.

Table 1. Impact of agrochemicals on the population of coccinellids in bhendi ecosystem during *kharif*, 2012 (Field experiment I)

S. No.	Treatments	Population of coccinellids #										Overall mean	Per cent reduction over control
		3rd week	4th week	5th week	6th week	7th week	8th week	9th week	10th week	11th week	12th week		
1.	Untreated check	0.20 (0.49)^{c}	0.30 (0.59)^{b}	0.43 (0.68)^{b}	0.36 (0.64)^{bc}	0.66 (0.84)^{d}	0.70 (0.86)^{e}	0.80 (0.92)^{e}	0.76 (0.90)^{c}	0.96 (1.00)^{d}	1.13 (1.08)^{e}	0.63 (0.80)^{g}	--
2.	Herbicide	0.06 (0.33)^{ab}	0.10 (0.37)^{a}	0.16 (0.45)^{a}	0.40 (0.66)^{c}	0.46 (0.71)^{bc}	0.43 (0.69)^{bcd}	0.46 (0.71)^{cd}	0.43 (0.69)^{b}	0.50 (0.73)^{b}	0.76 (0.90)^{cd}	0.37 (0.63)^{de}	41.26
3.	Fertilizer	0.13 (0.42)^{bc}	0.23 (0.49)^{ab}	0.26 (0.56)^{ab}	0.36 (0.63)^{bc}	0.53 (0.76)^{cd}	0.56 (0.78)^{cde}	0.50 (0.73)^{d}	0.66 (0.84)^{c}	0.63 (0.82)^{c}	0.83 (0.93)^{d}	0.47 (0.70)^{f}	25.39
4.	Insecticide	0.06 (0.31)^{ab}	0.10 (0.37)^{a}	0.16 (0.46)^{a}	0.16 (0.46)^{ab}	0.33 (0.61)^{ab}	0.26 (0.55)^{ab}	0.30 (0.58)^{ab}	0.30 (0.58)^{ab}	0.33 (0.61)^{a}	0.40 (0.67)^{b}	0.24 (0.52)^{b}	61.90
5.	Herbicide+fertilizer	0.03 (0.27)^{a}	0.13 (0.40)^{ab}	0.13 (0.40)^{a}	0.30 (0.58)^{bc}	0.43 (0.69)^{bc}	0.36 (0.64)^{abc}	0.33 (0.61)^{abc}	0.30 (0.59)^{ab}	0.43 (0.69)^{ab}	0.66 (0.84)^{cd}	0.31 (0.58)^{c}	50.79
6.	Herbicide+insecticide	0.03 (0.27)^{a}	0.10 (0.37)^{a}	0.10 (0.37)^{a}	0.10 (0.37)^{a}	0.26 (0.56)^{a}	0.23 (0.50)^{a}	0.23 (0.53)^{a}	0.23 (0.53)^{a}	0.33 (0.61)^{a}	0.26 (0.54)^{a}	0.19 (0.47)^{a}	69.84
7.	Fertilizer+insecticide	0.03 (0.27)^{a}	0.13 (0.40)^{ab}	0.20 (0.48)^{a}	0.26 (0.56)^{bc}	0.40 (0.66)^{abc}	0.33 (0.61)^{ab}	0.40 (0.67)^{bcd}	0.36 (0.64)^{ab}	0.40 (0.66)^{ab}	0.73 (0.88)^{cd}	0.32 (0.59)^{cd}	49.21
8.	Herbicide+fertilizer+insecticide	0.10 (0.37)^{abc}	0.16 (0.46)^{ab}	0.23 (0.51)^{ab}	0.30 (0.57)^{bc}	0.56 (0.78)^{cd}	0.60 (0.80)^{de}	0.53 (0.76)^{d}	0.40 (0.66)^{ab}	0.46 (0.71)^{b}	0.56 (0.78)^{bc}	0.39 (0.65)^{e}	38.09
	CD(P=0.05)	0.129**	0.166**	0.169*	0.174*	0.104**	0.141**	0.106**	0.122**	0.070**	0.111**	0.086**	--

**- Significant at P=0.01, *- Significant at P= 0.05, # - Mean of 10 plants, 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 √X+0.5 transformed values

The population of coccinellids ranged from 0.03 to 1.13/plant irrespective of the treatments from 3rd week to 12th week after sowing. It was found that the population of coccinellids was low in all the treatments which ranged from 0.03 to 0.83/plant compared to the untreated check which ranged from 0.20 to 1.13/plant from 3rd week to 12th week after sowing. It was found that, a low population of coccinellids was observed irrespective of the treatments throughout the crop growth period. The overall mean population of coccinellids ranged from 0.19 to 0.63/plant. It was found that the population of coccinellids was low in the treatment with herbicide + insecticide (0.19/plant) followed by the treatment with insecticide alone (0.24/plant) compared to the untreated check which recorded a higher population of coccinellids (0.63/plant). It was found that, a higher per cent reduction of coccinellids population was observed in the treatment with herbicide + insecticide (69.84%) while a lower per cent reduction of coccinellids population was observed in the treatment with fertilizer alone (25.39%) compared to the untreated check. During *rabi*, the impact of agrochemicals on the population of coccinellids in bhendi ecosystem are presented in Table 2. At 1st and 2nd week after sowing there was no coccinellids and hence the population of coccinellids was observed from 3rd week and continued upto 12th week after sowing. The population of coccinellids ranged from 0.03 to 1.06/plant irrespective of the treatments from 3rd to 12th week after sowing. It was found that the population of coccinellids was low in all the treatments which ranged from 0.03 to 0.86/plant compared to the untreated check which ranged from 0.16 to 1.06/plant from 3rd week to 12th week after sowing. It was found that a low population was observed irrespective of the treatments throughout the crop growth period.

Table 2. Impact of agrochemicals on the population of coccinellids in bhendi ecosystem during *rabi*, 2012-13 (Field experiment II)

S. No.	Treatments	Population of coccinellids #										Overall mean	Per cent reduction over control
		3rd week	4th week	5th week	6th week	7th week	8th week	9th week	10th week	11th week	12th week		
1.	Untreated check	0.16 (0.45)	0.36 (0.64)b	0.46 (0.71)b	0.40 (0.66)	0.53 (0.75)b	0.70 (0.86)c	0.83 (0.93)c	0.86 (0.95)d	1.00 (1.02)c	1.06 (1.05)c	0.64 (0.81)e	--
2.	Herbicide	0.13 (0.42)	0.23 (0.53)ab	0.33 (0.61)ab	0.26 (0.52)	0.36 (0.63)ab	0.43 (0.69)bc	0.50 (0.73)abc	0.56 (0.78)bc	0.60 (0.79)ab	0.53 (0.76)ab	0.39 (0.65)c	39.06
3.	Fertilizer	0.13 (0.40)	0.20 (0.46)ab	0.26 (0.51)ab	0.33 (0.59)	0.46 (0.70)b	0.56 (0.78)c	0.70 (0.86)bc	0.70 (0.84)cd	0.80 (0.91)bc	0.86 (0.95)bc	0.50 (0.72)d	21.87
4.	Insecticide	0.10 (0.37)	0.23 (0.49)ab	0.20 (0.46)a	0.20 (0.46)	0.23 (0.49)a	0.16 (0.46)a	0.30 (0.58)a	0.40 (0.66)ab	0.56 (0.78)ab	0.56 (0.78)ab	0.29 (0.57)ab	54.69
5.	Herbicide+fertilizer	0.03 (0.27)	0.16 (0.42)a	0.20 (0.48)a	0.26 (0.54)	0.36 (0.64)ab	0.50 (0.73)c	0.60 (0.78)abc	0.70 (0.86)cd	0.70 (0.85)ab	0.70 (0.84)abc	0.42 (0.66)c	34.37
6.	Herbicide+insecticide	0.06 (0.31)	0.20 (0.49)ab	0.13 (0.40)a	0.20 (0.46)	0.30 (0.58)ab	0.10 (0.37)a	0.26 (0.54)a	0.33 (0.61)a	0.50 (0.73)a	0.43 (0.68)a	0.25 (0.53)a	60.94
7.	Fertilizer+insecticide	0.10 (0.37)	0.13 (0.42)a	0.16 (0.46)a	0.26 (0.55)	0.30 (0.58)ab	0.23 (0.51)ab	0.40 (0.66)ab	0.43 (0.69)ab	0.63 (0.82)ab	0.53 (0.75)ab	0.32 (0.59)b	50.00
8.	Herbicide+fertilizer+insecticide	0.03 (0.27)	0.13 (0.40)a	0.16 (0.46)a	0.23 (0.51)	0.30 (0.58)ab	0.26 (0.54)ab	0.46 (0.71)abc	0.43 (0.69)ab	0.66 (0.84)ab	0.76 (0.90)abc	0.35 (0.60)b	45.31
	CD(P=0.05)	NS	0.187**	0.193**	NS	0.167**	0.161**	0.211*	0.138**	0.147**	0.190*	0.099**	--

NS -Not significant, **- Significant at P=0.01, *- Significant at P= 0.05, # - Mean of 10 plants, 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 √X+0.5 transformed values

The overall mean population of coccinellids ranged from 0.25 to 0.64/plant. It was found that the population of coccinellids was low in the treatment with herbicide + insecticide (0.25/plant) which was at par with insecticide alone (0.29/plant) compared to the untreated check which recorded a higher population of coccinellids (0.64/plant). It was found that, a higher per cent reduction of coccinellids population was observed in the treatment with herbicide + insecticide (60.94%) followed by the treatment with insecticide alone (54.69%) while a lower per cent reduction of the population of coccinellids was observed in the treatment with fertilizer alone (21.87%) compared to the untreated check. The present findings revealed that, there was a higher reduction of coccinellids 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 coccinellids while fertilizer alone found to have a lesser impact on the population of coccinellids. Echegaray [6] reported that coccinellid predators are vulnerable to insecticides over most of its life. Sunitha *et al.* [20] reported that newer insecticides namely imidacloprid, spinosad, novaluron and combination treatments with novaluron + spinosad and *B.t.* + spinosad were found to be relatively less toxic to coccinellids when compared to conventional insecticide like dichlorvos.

Jyoti and Goud [11] reported that emamectin benzoate 5 SG @ 8 g a.i./ha was safer to coccinellids, chrysopids and spiders in brinjal ecosystem. Sheeba Jasmine and Kuttalam [19] stated that emamectin benzoate 5 SG and 1.9 EC was found to be safer to coccinellids. He et al. [10] concluded that imidacloprid systemically applied at the recommended field rate showed less toxicity against coccinellid predators. The present findings are in accordance with the above findings.

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