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RELATIVE IMPACT OF INSECTICIDAL APPLICATIONS ON POPULATION OF NATURAL ENEMIES IN OKRA

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ABSTRACT

An experiment was conducted at Anand Agricultural University, Anand to study the impact of insecticides on the activity of coccinellids and spiders, a potential predator of sucking pests during two consecutive seasons summer and *kharif*, 2012-13. Two insecticides *i.e.* thiamethoxam 25 WG (I_1) and dimethoate 30 EC (I_2) were evaluated on two different application strategies *i.e.* schedule based (S_1) and need (ETLs) based (S_2) with two different doses *i.e.* concentration (D_1) and g a. i./ha (D_2) for their adverse impact on natural enemies *i.e.* spiders and coccinellids. Among the insecticidal application strategies, the schedule based application of thiamethoxam 25 WG @ 0.0125% ($S_1I_1D_1$) was relatively safer to the activity of these two predators in okra ecosystem by recording the highest population.

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench), also known as lady's finger or bhendi, belongs to family Malvaceae and is an important vegetable crop grown throughout the year in India. Besides India, it is grown in many tropical and subtropical parts of the world. Tender fruits are used as vegetables or in culinary preparations as sliced and dried pieces. It is also used for thickening gravies and soups, because of its high mucilage content. The roots and stems of okra are used for cleaning cane juice (Chauhan, 1972). One of the important limiting factors in the cultivation of okra is insect pests. Many of the pests occurring on cotton are found to ravage okra crop. As high as 72 species of insects have been recorded on okra (Srinivasa and Rajendran, 2003), of-which, sucking pests comprising of Aphids, *Aphis gossypii* (Glover), leafhopper, *Amrasca biguttula biguttula* (Ishida), whitefly, *Bemisia tabaci* (Gennadius) and mite, *Tetranychus cinnabarinus* (Boisduval) causes significant damage to the crop. Sucking insect pests caused 37.18 and 69.91 per cent damage in okra production during monsoon and summer seasons, respectively (Mote, 1977). Among the natural enemies, coccinellids and spiders are important predators feeding on various sucking pests. 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 (Gogi*et al.*, 2006; Desneux *et al.*, 2007). Biological control of insect pests with predators and/or parasitoids is the most important and ecofriendly components of IPM (Naranjo, 2001). Recently, highly efficacious insecticides with novel mode of action are available and becoming an important tool of integrated pest managementand resistance management strategies. These insecticides are required only in few grams in comparison to older class of compounds and are perceived to carry higher safety/ environmental risks (Wing *et al.*, 2000). The insecticides applied in agroecosystem not only affect the target pest but also have adverse impact on natural enemies. The population of predators has declined by 68.4 percent during the last two decades and many parasitoids have been eliminated (Dhawan and Simwat, 1996). Therefore, before incorporating newer insecticides with novel mode of actions in IPM programmes, it is imperative to screen them for their safety to natural enemies. The reduction of natural enemies caused by the use of non-selective insecticides may invite serious consequences for the pest population dynamics. One of them is the important phenomena of resurgence and eruption of secondary pests (Gallo *et al.*, 2002). High risks of pestoutbreak are expected. Before application of insecticides, it is necessary to choose a product that is efficient to pests and selective to natural enemies. Integration of selective insecticides with biological control can minimize adverse effects to natural enemies (Johnson and Tabashnik, 1999). Coccinellids, popularly known as ladybird beetles or ladybugs are the most successful group of predators. About 90 per centof approximately 4,200 coccinellid species are considered asbeneficial because of their predatory activity, mainly against homopterous insects and mites (Swaminathan *et al.*, 2010). Conservation of predators particularly coccinellids and spiders is essential. An attempt was made to determine the comparative toxicity of some commonly used insecticides for okra sucking pests and their impact on predatory coccinellids and spiders. Normally, the insecticides are recommended on the basis of concentration or active ingredient, both of which can be applied either on schedule base or need base. A study was carried out during summer and *kharif*, 2012 to find out the less toxic application strategy of insecticides to coccinellids and spiders in okra.

MATERIALS AND METHODS

With a view to find out the safer insecticidal application strategies for natural enemies in okra, the experiment was carried out at Agronomy farm, Anand Agricultural University, Anand. The observations on the activity of coccinellids and spiders per plant were recorded at 5 days interval at 20 days after germination from the randomly selected plants to record the effect of the insecticidal treatments (Anon., 2013). Firstspray application of insecticides was given at initiation of sucking pests and subsequent five sprays were given at 10 days interval (Khedkar and Ukey, 2003). In case of need based applications, sprays were carried out as and when any one of sucking pests (aphids, leaf hopper and whiteflies) reach or cross the ETL (5 insects/ leaf) (Nemade *et al.*, 2007; Preetha *et al.*, 2009).

RESULTS AND DISCUSSION

The pooled data over periods and seasons for population of coccinellid adults presented in Table 1 revealed a non-significant difference among the various treatments indicating a uniform distribution of coccinellids in all the treatments. Both the insecticides sprayed either on schedule or need based with their different doses *i.e.* concentration or g a.i./ha were more or less equally toxic to coccinellids than both controls during both the seasons. There was non-significant difference between the controls *i.e.* one control kept for schedule based sprays (CS_1) and another for need based sprays (CS_2) during both the seasons. The insecticidal treatments exerted some adverse effect on adults of coccinellid and recorded lower population (2.80 to 3.41/plant) than the controls (3.75 and 3.70 per plant in CS_1 and CS_2, respectively). The order of insecticides in comparison to controls based on number of coccinellid adults per plant given in bracket was: control CS_1 (3.75) > control CS_2 (3.70) >$S_1I_1D_1$ (3.41) >$S_1I_2D_1$ (3.28) >$S_2I_2D_2$ (3.27) >$S_1I_2D_2$ (3.23) >$S_2I_1D_2$ (3.16) >$S_2I_1D_1$ (2.95) >$S_1I_1D_2$ (2.91) >$S_2I_2D_1$ (2.80). In order to determine the adverse effect of these insecticidal treatments, a Control vs Rest (insecticidal treatments) was also carried out. The ANOVA for this character clearly suggested that there was no any significant adverse impact on the activity of coccinellid adults in okra crop when thiamethoxam 25 WG (I_1) and dimethoate 30 EC (I_2) applied either on schedule based (S_1) or need based (S_2) with their two different doses, concentration based (D_1) or g a.i./ha (D_2). However, among the insecticidal treatments, the insecticide treatments, the highest population was recorded in the plots treated with thiamethoxam 25 WG @ 0.0125% on schedule based ($S_1I_1D_1$) followed by dimethoate 30 EC @ 0.03% on schedule based ($S_1I_2D_1$) and dimethoate 30 EC @ 150 g a.i./ha on need based ($S_2I_2D_2$). The performance of various insecticidal treatments was consistent over the periods and seasons.

The pooled data over periods and seasons for population of spiders presented in Table 1 revealed a non-significant difference among the various treatments indicating an uniformity in the population of spiders in all the treatments. Both the insecticides applied either on schedule or need based with their different doses *i.e.* concentration or g a.i./ha were more or less equally toxic to spiders than both controls during both the seasons. As per the data, there was no significant difference between the controls *i.e.* control kept for schedule based sprays (CS_1) and control kept for need based sprays (CS_2) during both the seasons. The insecticidal treatments

Table 1: Impact of insecticides on coccinellids and spiders in okra

Treatments	Number of natural enemies/plant					
	Coccinellids (adult)			Spiders		
	Summer, 2012	*Kharif, 2012*	Pooled over seasons	Summer, 2012	*Kharif, 2012*	Pooled over seasons
$S_1 I_1 D_1$	3.37	3.45	3.41	3.35	3.30	3.33
$S_2 I_1 D_1$	2.95	2.94	2.95	2.90	3.00	2.95
$S_1 I_1 D_2$	2.90	2.92	2.91	2.86	3.05	2.96
$S_2 I_1 D_2$	3.13	3.18	3.16	3.10	3.14	3.12
$S_1 I_2 D_1$	3.27	3.29	3.28	3.20	3.17	3.19
$S_2 I_2 D_1$	2.79	2.82	2.80	3.15	3.19	3.17
$S_1 I_2 D_2$	3.17	3.29	3.23	2.76	2.86	2.81
$S_2 I_2 D_2$	3.20	3.33	3.27	3.10	3.17	3.14
Control (CS_1)	3.72	3.78	3.75	3.51	3.67	3.59
Control (CS_2)	3.62	3.77	3.70	3.53	3.80	3.67
S. Em. ± Treatment	0.31	0.30	0.22	0.30	0.31	0.22
Season (Se)	-	-	0.13	-	-	0.12
Control vs. Rest	0.24	0.24	0.43	0.24	0.25	0.31
Between control	0.31	0.30	0.22	0.30	0.31	0.22
CD (5%) Treatment	NS	NS	NS	NS	NS	NS
Season (Se)	-	-	NS	-	-	NS
Control vs. Rest	NS	NS	NS	NS	NS	NS
Between control	NS	NS	NS	NS	NS	NS
C. V. %	18.94	18.19	18.57	18.67	18.98	18.83

Notes: S_1: Schedule based spray; S_2: ETLs based spray; I_1: Thiamethoxam 25 WG ; I_2: Dimethoate 30 EC; D_1: concentration (%); D_2: g a. i./ ha ; NS: Not significant at 5% level; Bet. Controls: between controls; CS_1: control for schedule based sprays; CS_2: control for ETLs based sprays; Se: Seasons.

imposed some adverse impact on spiders and recorded lower population (2.81 to 3.33/plant) than the controls (3.59 and 3.67 per plant in CS_1 and CS_2, respectively). The order of insecticides in comparison to controls based on number of spiders per plant given in bracket was: control CS_2 (3.67) > control CS_1 (3.59) >$S_1I_1D_1$ (3.33) >$S_1I_2D_1$ (3.19) >$S_2I_2D_1$ (3.17) >$S_2I_2D_2$ (3.14) >$S_2I_1D_2$ (3.12) >$S_1I_1D_2$ (2.96) >$S_1I_1D_1$ (2.95) >$S_1I_2D_2$ (2.81). Control vs Rest was also carried out to determine the adverse effect of these insecticidal treatments and it clearly suggested that there was no any significant adverse impact on the activity of spiders in okra crop when thiamethoxam 25 WG (I_1) or dimethoate 30 EC (I_2) applied either on schedule based (S_1) or need based (S_2) with their two different doses, concentration based (D_1) or g a.i./ha (D_2). However, among the insecticidal treatments, the highest population was recorded in the plots treated with thiamethoxam 25 WG @ 0.0125% on schedule based ($S_1I_1D_1$) followed by dimethoate 30 EC @ 0.03% on schedule based ($S_1I_2D_1$) and dimethoate 30 EC @ 0.03% on need based ($S_2I_2D_1$). The performance of various insecticidal treatments was consistent over the periods and seasons.

Sabry *et al.* (2014) clearly mentioned that thiamethoxam was less toxic to the natural enemies. Ahmed *et* al. (2014) opined that neonicotinoids can be suitable candidates for inclusion in Integrated Pest Management of sucking insect pests in major cotton growing areas because they were comparatively less toxic to predators as compared to non-selective insecticides. Prabhaker *et al.*, (2011) reported that thiamethoxam was safe to the natural enemies. Amirzade *et al.* (2014) suggested that thiamethoxam is less toxic to predatory ladybird beetles as compared to other neonicotinoids. Although thiamethoxam is approximately safe for the ladybird beetle, more care should be taken when it is used in IPM programmes (Rahmani *et al.,* 2013). Subhadra Acharya *et al.* (2002) reported the safety of acetamiprid, thiamethoxam and imidacloprid to ladybird beetles. In contrast, despite higher safety margin of neonicotinoids to coccinellid predators as compared to aphids, still showed very low LC_{50} value which was much below than its recommended value (Awasthi *et al.,* 2013). Neonicotinoids could be a better option for the management of sucking pests due to their safety to the natural enemies and systemic action (Vastrad, 2003; Dhawan and Simwat, 2002; Vadodaria *et al.*, 2001). In the present investigation, the activity of these predators was comparatively higher in okra plots treated with thiamethoxam 25 WG. Thus, present finding tallies with the earlier reports.

In nutshell, all the insecticidal treatments (S x I x D) did not impose any significant adverse impact on the activity of spiders and coccinellid adults. Among them, thiamethoxam 25 WG @ 0.0125% ($S_1I_1D_1$) and dimethoate 30 EC @ 0.03% ($S_1I_2D_1$) on schedule based recorded higher population and comparatively safer.

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