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Aphid (*Aphis gossypii*, Glover) control activity of some new broad spectrum insecticides and their effect on predatory coccinellid population on cucumber

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Abstract
Field evaluation studies conducted in the experimental plots of Department of Entomology, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar in RBD during *Kharif*, 2016 and rabi, 2016-17 with 9 treatments replicated three times against the aphid (*Aphis gossypii* Glover) on cucumber revealed that the newer insecticide molecules tolfenpyrad, spinosad, cartap hydrochloride and chlorantraniliprole remained on par with the chemical check acephate as regards the superiority in suppressing aphid population/sq. inch (2.00–2.33) is concerned compared to other insecticides and control (9.33) at 15 days after spraying (DAS) during *kharif*, 2016. The same treatments recorded 65.49 to 78.56% reduction in aphid population over control. Contrary to this, only tolfenpyrad, chlorantraniliprole and acephate recorded significantly lowest aphid population/sq. inch (0.67–1.00) compared to other insecticides and control (4.88) at 15 DAS during rabi, 2016-17 registering 79.96 – 82.28% reduction in aphid population over control. The predatory lady beetle population/5 leaves remained on par with untreated control at 5, 10 and 15 DAS both during *Kharif* and rabi seasons in the tolfenpyrad, indoxacarb, flubendiamide, chlorantraniliprole, and spinosad treated plots signifying their harmlessness towards the natural enemy. On the other hand fipronil, cartap and acephate proved toxic to the coccinellid predators.

Keywords: *Aphis gossypii*, control, newer insecticides, cucumber

1. Introduction
Cucumber (C*ucumis sativus* L.) is one of the most important vegetable crops grown for use as pickle or salad throughout India. The crop is attacked by a number of insect pests from germination till the fruits are harvested from which the sucking pests are important. Of the sucking insect-pests, the cotton aphid, *Aphis gossypii* Glover is important [16]. Nymphs and adults of the pest suck plant sap from tender plant parts and leaves devitalizing the plant. It can quickly build up a large population under favourable conditions and cause considerable economic damage by sucking sap directly from the phloem, producing honeydew and transmission of plant viruses in cucumber [14]. Generally, the control of aphids has relied on a wide array of chemical insecticides which adversely affect non target organisms, are environmentally dangerous and insects frequently build up resistance to them [17, 3]. Therefore, in the present study an attempt has been made to evaluate the efficacy of some of the new generation broad spectrum insecticides along with the conventional ones against the aphids infesting cucumber in the field condition which are expected not only to control other insect pests of cucumber besides aphids with relative safety to the natural enemies.

2. Materials and Methods
A field trial was conducted at the experimental field site of Department of Entomology, College of Agriculture, Orissa University of Agriculture and Technology, Bhubaneswar in a randomized block design (RBD) with 9 treatments replicated 3 times during *Kharif*, 2016 and rabi, 2016-17. Cucumber variety “Machaar” was sown in plots of size 3.5m x 4m during both the seasons with a spacing of 1.5m x 1.5m between pits. Chemical fertilizers @ 70:25:25 kg N: P2O: K2O /ha were applied and other agronomic practices were followed as recommended for the state. The chemical insecticide treatments included, T_1 = Tolfenpyrad 15% EC @ 150 g a.i./ha, T_2 = Fipronil 5% SC @ 50 g a.i./ha, T_3 = Indoxacarb 14.5% SC @ 72.50 g a.i./ha, T_4 =

Flubendiamide 480 SC @ 78.70 g a.i./ha, T_5 = Chlorantraniliprole 18.5% SC @ 30.83 g a.i./ha, T_6 = Spinosad 45% SC @ 75 g a.i./ha, T_7 = Cartap hydrochloride 50% SP @ 375 g a.i./ha, T_8 = Acephate 75% SP @ 375 g a.i./ha and T_9 = untreated control. The pesticide treatments were given as foliar sprays first on 28 days after sowing (DAS), the second and third sprays being done at 20 days interval with a hand compression sprayer using 500 litres of spray fluid/ha. Observations were recorded on the incidence of aphid population (both nymphs and adults) per square inch on five terminal leaves at random from each treatment at pre-treatment and at 5, 10, 15 days after each application using a 10X hand lens. The number of ladybird beetle adults present per five leaves was also counted one day before and at 5, 10, 15 days after each insecticide spray.

3. Statistical Analysis

The mean data of three sprayings in each season were subjected to transformation before statistical analysis following Gomez and Gomez (1984) to test the significance of treatment effects and arriving at a meaningful conclusion.

4. Results and Discussion

The aphid population was low both during *Kharif* and rabi seasons (Table 1). On 1 day before spraying (DBS) the number of aphids per sq. inch did not differ significantly (6.89 -8.44) during *Kharif*, 2016 and rabi 2016-17 (4.13–5.45) among treatments indicating uniform distribution of the pest. All the chemicals evaluated controlled the pest ranging from 21.33 to 82.28% over control up to 15 DAS. Among the chemicals evaluated only tolfenpyrad and acephate proved their superiority over other insecticides in suppressing aphid population up to 10 DAS during *Kharif*, 2016. But, on 15 DAS tolfenpyrad, chlorantraniliprole, spinosad, cartap hydrochloride and acephate performed better in reducing aphid population/sq. inch (2.00–3.22) compared to rest of the treatments (5.00-7.34) and untreated control (UTC) (9.33) registering 65.49 to 78.56% reduction over control.

During rabi, 2016-17 tolfenpyrad and acephate recorded lowest aphid population/sq inch (0.00) remaining on par compared to rest of the treatments and UTC (5.67) on 5 DAS. But, on 10 DAS only tolfenpyrad was the superior treatment (0.33) compared to other insecticides in suppressing aphid population over control (5.90). On 15 DAS tolfenpyrad, chlorantraniliprole and acephate recorded significantly lower population of aphid/sq. inch (0.67–1.00) among the insecticides evaluated registering 79.96 to 82.28% reduction over control (4.88). Bajpai *et al*. [1] concluded that tolfenpyrad 15 EC @ 150 g and 125 g a.i./ha and cartap hydrochloride @ 500 g a.i./ha to be the superior insecticides in suppressing cabbage aphid on cabbage crop which is in line with the present results. Misra and Mukherjee [11] and Misra [10] found a related diamide compound cyantraniliprole 10% OD @ 90 and 105 g a.i./ha recording lowest aphid population in tomato and gherkin crops, respectively which is partially in agreement with the present finding that chlorantraniliprole is effective against aphids on cucumber.

The predatory ladybird beetle population/5 leaves on 1 DBS did not vary significantly (4.67–5.88) during *Kharif*, 2016 and rabi, 2016-17 (3.83-5.33) signifying uniform distribution in the treatments plots before chemical application (Table 2). However, their number remained significantly low in fipronil, cartap hydrochloride and acephate treated plots on 5,10 and 15 DAS during *Kharif*, 2016 (1.52-2.12) who remained at par with control (4.67) compared to other chemical treatments (3.50–5.00). Similar results as *Kharif*, 2016 was observed during rabi, 2016-17. The coccinellid predator population/5 leaves remained at par with control (4.67) in the treatments tolfenpyrad, indoxacarb, flubendiamide, chlorantraniliprole and spinosad (3.25–5.96) in comparision to fipronil, cartap hydrochloride and acephate (1.67-2.66) indicating the later 3 treatments being harmful to the natural enemy population. Whereas, the former 5 treatments are safe to the predatory lady beetles in the cucumber crop environment. Earlier Shane [15], Hall [7], Misra [12], Chakraborty and Sarkar [4] reported safety of flubendiamide to coccinellids and spiders on vegetable crop. Similarly, Misra [12], Brugger [2], Chakroborty and Sarkar [4] reported rynaxypyr (chlorantraniliprole) to be safe to the natural predatory coccinellids. Mittal and Ujagir [13], Ghosh *et al*. [5], Heng *et al*. [8] found spinosad as the safest insecticide to the nymphs and adults of coccinellids in different crop ecosystem. Mallick *et al.* [9] concluded that tolfenpyrad 15 EC @ 125 and 150 g a.i./ha is safer to natural enemies in okra ecosystem. All the above findings are in consonant with the present finding.

Table 1: Bio- efficacy of different chemicals against aphids on cucumber at Bhubaneswar

Tr. No.	Treatments	Dose (g/ml, a.i/ha	No. of aphid/sq.inch of leaf *Kharif*, 2016				Reduction over control (%) at 15 DAS	No. of aphid/sq.inch of leaf rabi, 2016-17				Reduction over control (%) at 15 DAS
			1 DBS	5 DAS	10 DAS	15 DAS		1 DBS	5 DAS	10 DAS	15 DAS	
T_1	Tolfenpyrad 15% EC	150	8.11 (2.93)	0.33 (0.91)	0.67 (1.08)	2.00 (1.58)	78.56	4.13 (2.15)	0.00 (0.71)	0.33 (0.91)	0.66 (1.08)	82.28
T_2	Fipronil 5% SC	50	7.66 (2.86)	2.67 (1.78)	3.45 (1.99)	5.89 (2.53)	33.16	5.33 (2.41)	1.85 (1.53)	2.33 (1.68)	2.00 (1.58)	59.02
T_3	Indoxacarb 14.5% SC	72.5	8.11 (2.93)	5.32 (2.41)	5.78 (2.51)	7.34 (2.80)	21.33	5.15 (2.38)	2.65 (1.77)	3.33 (1.95)	3.00 (1.87)	36.37
T_4	Flubendiamide 480 SC	78.7	8.44 (2.99)	3.55 (2.01)	4.11 (2.15)	5.00 (2.35)	48.50	4.85 (2.31)	2.65 (1.77)	2.00 (1.58)	2.11 (1.62)	52.48
T_5	Chlorantraniliprole 18.5% SC	30.83	7.66 (2.86)	1.20 (1.30)	1.56 (1.44)	2.33 (1.68)	73.56	5.45 (2.44)	2.13 (1.62)	2.00 (1.58)	1.00 (1.22)	79.96
T_6	Spinosad 45% SC	75.0	8.11 (2.93)	1.60 (1.46)	2.67 (1.78)	3.22 (1.93)	65.49	5.15 (2.38)	3.13 (1.90)	2.11 (1.62)	2.33 (1.68)	50.59
T_7	Cartap hydrochloride 50% SP	375	6.89 (2.72)	1.44 (1.39)	1.67 (1.47)	2.33 (1.68)	70.60	5.33 (2.41)	1.67 (1.47)	1.88 (1.54)	1.33 (1.35)	72.75
T_8	Acephate 75% SP	375	6.89 (2.72)	0.33 (0.91)	1.33 (1.35)	2.33 (1.68)	70.60	4.85 (2.31)	0.00 (0.71)	1.00 (1.22)	0.88 (0.88)	80.18

T9	Control	8.11	8.11 (2.93)	8.43 (2.99)	8.84 (3.06)	9.33 (3.14)	-	5.33 (2.41)	5.67 (2.48)	5.90 (2.53)	4.88 (2.32)	-
	SE(m)±		(0.10)	(0.09)	(0.11)	(0.16)		(0.11)	(0.09)	(0.10)	(0.07)	
	CD (P=0.05)		NS	(0.27)	(0.34)	(0.47)		NS	(0.28)	(0.29)	(0.23)	
	C.V (%)			9.26	10.73	13.21			11.75	10.16	8.44	

Figures in the parentheses are √(x+0.5) transformed values, DBS = Day before spraying, DAS= Days after Spraying

Table 2: Population of predatory lady beetles as affected by various chemical insecticide application on cucumber at Bhubaneswar

Tr. No.	Treatments	Dose g/ml a.i./ha	No. of lady beetle /5 leaves *Kharif*, 2016				No. of lady beetle/5 leaves rabi, 2016-17			
			1 DBS	5 DAS	10 DAS	15 DAS	1 DBS	5 DAS	10 DAS	15 DAS
T1	Tolfenpyrad 15% EC	150	5.33 (2.31)	4.17 (2.16)	4.33 (2.20)	4.67 (2.27)	4.87 (2.32)	4.35 (2.20)	4.67 (2.27)	4.67 (2.27)
T2	Fipronil 5% SC	50	4.33 (2.19	1.33 (1.35)	1.95 (1.56)	2.12 (1.62)	4.33 (2.19)	0.67 (1.08)	1.13 (1.28)	1.67 (1.47)
T3	Indoxacarb 14.5% SC	72.5	4.67 (2.27)	4.00 (2.12)	3.44 (1.98)	4.10 (2.14)	3.83 (2.08)	3.27 (1.94)	3.95 (2.11)	3.25 (1.94)
T4	Flubendiamide 480 SC	78.7	4.88 (2.32)	3.66 (2.04)	3.23 (1.93)	3.50 (2.00)	4.87 (2.32)	4.33 (2.20)	4.12 (2.15)	4.45 (2.22)
T5	Chlorantraniliprole 18.5% SC	30.83	5.13 (2.37)	5.07 (2.36)	4.92 (2.33)	5.00 (2.35)	5.15 (2.38)	5.00 (2.35)	4.82 (2.31	5.00 (2.35)
T6	Spinosad 45% SC	75.0	4.67 (2.27)	3.74 (2.05)	3.90 (2.10)	4.11 (2.14)	5.33 (2.31)	4.56 (2.25)	5.27 (2.40)	5.96 (2.54)
T7	Cartap hydrochloride 50% SP	375	4.67 (2.27	1.82 (1.52)	2.97 (1.86)	2.05 (1.60)	4.33 (2.20)	2.05 (1.60)	2.47 (1.72)	2.10 (1.61)
T8	Acephate 75% SP	375	5.33 (2.31	1.33 (1.35)	1.66 (1.47)	1.52 (1.42)	4.67 (2.27)	2.00 (1.58)	2.33 (1.68)	2.66 (1.78)
T9	Control		5.88 (2.88)	4.67 (2.27)	4.33 (2.20)	4.67 (2.27)	4.85 (2.31)	4.33 2.20)	4.67 (2.27)	4.67 (2.27)
	SE(m)±		(0.11)	(0.07)	(0.09)	(0.09)	(0.12)	(0.09)	(0.07)	(0.07)
	CD (P=0.05)		NS	(0.24)	(0.27)	(0.27)	NS	(0.26)	(0.20)	(0.25)

Figures in the parentheses are √(x+0.5) transformed values, DBS = Day before spraying, DAS= Days after Spraying

5. Conclusion
Thus, it may be concluded from the present study that the newer insecticide molecules tolfenpyrad 15% EC @ 150 g a.i./ha and chlorantraniliprole 18.5% SC @ 30.83 g a.i./ha may be genuinely recommended and included in the IPM programmes for the control of aphids in cucumber crop looking at their effectiveness and safety to natural enemies in place of cartap hydrochloride 50 SP @ 375 g a.i./ha and acephate 75% SP @ 375 g a.i./ha which though are broad spectrum insecticides and effective against aphids but are used since long with harm to the natural coccinellid population.

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