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Bio-efficacy of Econeem Plus® against whiteflies in cotton under field conditions

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Abstract
A field experiment was conducted to evaluate the Bio-efficacy of Econeem Plus® against Whiteflies in Cotton under field conditions at Narendra village, Dharwad district, Karnataka during 2018. Seven treatments comprising of Econeem Plus® at different concentrations *viz.*, 2, 2.5 and 3ml/L, combination of Econeem Plus® + Ecospread® at 2 +0.5 ml/L, 2.5 +0.5 ml/L and 3 +0.5 ml/L. These were compared with an untreated control (water spray) and evaluated. The results revealed that Econeem Plus® is effective against cotton whiteflies at the dosage of 2.5 and 3 ml/L. Addition of Ecospread at 0.5 ml increases the efficacy rate. The per cent reduction of whiteflies at 10 days after first and second spray shows that, Econeem Plus® at 3ml/L+ Ecospread at 0.5 ml/L resulted 78.1% and 84.9% reduction over control respectively. The phytotoxicity study also reveals that the product is safe and controls only the target pest *i.e.*, cotton whiteflies.

Keywords: Cotton, whiteflies, Econeem Plus®, Ecospread™, bio-efficacy

Introduction
Cotton is one of the most important cash and fiber crop in India having significant impact on farmers earning and nation's economy. It is a major raw material in textile industry providing livelihood to 6 million farmers and 40-50 million people are employed in cotton trade and processing. India is the third major producer of cotton with an area of 11.87 million hectares producing 568.29 kg/ha next to USA and China (Anon., 2017) [1]. In spite of the large acreage in the world, India's productivity is low due to menace of pests. The sucking pests, including whiteflies, *Bemisia tabaci* (Genn.), aphids, *Aphis gossypii* (Glover), thrips, *Thrips tabaci* (Linn.) and jassids attack the crop at vegetative stage thus responsible for 21.20 to 22.86 percent of yield reduction (Kulkarni *et al*., 2003) [5]. Among these, whiteflies alone cause losses up to 15-20% whereas in severe infestation the losses may reach up to 30% (Singh, 2015) [7]
To combat the pest problem in cotton the farmers uses about 36- 50% of total insecticides consumed in India while the area under this crop is only 5% of the gross cropped area (Devi, 2010; Bhardwaj and Sharma, 2013) [4, 3]. Pest resurgence due to improper use of pesticides and lack of knowledge with farmers about ill effects of chemical pesticides on food, water and environment as well as carcinogenic effects on human beings urged the researcher to find out alternative eco-friendly management strategy, instead of using synthetic insecticides to control these devastating pests. The present investigation focuses on the environmental friendly approach using bio-pesticides/plant extract which are target specific and easily bio-degradable with lesser residual effect to combat whiteflies population in Cotton.

2. Material and Methods
The present field experiment was conducted at Narendra Village, Dist. Dharwad, Karnataka during 2018-19 to evaluate the Bio-efficacy of Econeem Plus® against Whiteflies in Cotton under field conditions. The latitude and longitude of the experimental site is 15°29'16.1"N and 74°58'28.9"E respectively.
Econeem Plus® is a neem based bio-pesticide with a blend of 10,000 ppm Azadirachtin (1%) and neem oil, providing all the liminoids for effective insecticidal action.
Ecospread™ is silicon based non-ionic adjuvant specially designed for instant and uniform spreading of spray solution on array of crops.
The experiment was laid out in randomized complete block design. There were seven treatments including control and each treatment was replicated thrice. A well-defined neem

product formulation Econeem Plus® was used in this study. The treatments comprise of Econeem Plus® at different concentrations *viz*., 2, 2.5 and 3ml/L; Econeem Plus® + Ecospread™ at 2 +0.5 ml/L; 2.5 +0.5 ml/L and 3 +0.5 ml/L which were compared with an untreated control
(water spray). All together there were 21 plots with plot size of 4 x 3 m each. Row to row and plant to plant distance was maintained at 90 cm by 60 cm respectively. All agronomic practices were followed as per the normal farmer practice.
The treatments were imposed when the population of whiteflies reached the economic threshold level (ETL). The ETL for sucking insect pests were considered as 8-10 whiteflies per leaf. Spray applications were made with hand operated knapsack sprayer. Observations were made on top, middle and bottom leaves of 5 randomly selected plants from each plot. Pre-count of whiteflies was taken before the treatment and thereafter observations were taken at regular intervals of one, three, five, seven and ten days after the treatment. The data recorded on whitefly population was statistically analyzed by square root transformation followed by ANOVA to determine effect of various treatments.

Phytotoxicity observations
At ten days interval two foliar applications were made on healthy plants. The phytotoxic effects such as chlorosis, tip burning, necrosis and epinasty were observed and 0-10 rating was recorded with various treatments.

Results and Discussion
Bio-efficacy of Econeem Plus® against Whiteflies
Whitefly control after 1st spray: At pre-count the mean population of whiteflies ranged between 14.00 to 19.33 per three leaves and there was no significant difference between the treatments. At 10 day after first spray results shows that, Econeem Plus® at 3ml/L + Ecospread™ at 0.5 ml/L resulted superior results by recording the average population of 3.67.
per three leaves. All the treatments were shown good results compared to control population (Table 1).

Table 1: Evaluation of Econeem Plus® against Whiteflies (First spray)

Tr. No	Mean number of whiteflies population per 3 leaves					
	Pre count	First spray				
		1 DAS	3 DAS	5 DAS	7 DAS	10 DAS
T1	15.33 (3.98)	14.67 (3.89)	10.00 (3.24)	8.00 (2.92)	8.67 (3.03)	9.33 (3.14)
T2	14.00 (3.81)	14.00 (3.81)	8.67 (3.03)	7.33 (2.80)	8.00 (2.92)	8.67 (3.03)
T3	17.33 (4.22)	12.00 (3.54)	6.33 (2.61)	5.00 (2.35)	5.33 (4.42)	7.33 (2.80)
T4	17.67 (4.26)	15.33 (3.98)	11.67 (3.49)	8.67 (3.03)	7.00 (2.74)	9.33 (3.14)
T5	15.67 (4.02)	10.33 (3.29)	6.33 (2.61)	6.00 (2.55)	8.33 (2.97)	8.67 (3.03)
T6	19.33 (4.45)	10.67 (3.34)	6.00 (2.55)	4.33 (2.20)	4.00 (2.12)	5.33 (2.42)
T7	17.00 (4.18)	19.33 (4.45)	19.33 (4.45)	25.33 (5.08)	22.33 (4.78)	24.33 (4.98)
SEm	NS	0.23	0.27	0.21	0.22	0.22
CD at 5%		0.71	0.82	0.65	0.67	0.67
CV (%)		10.66	14.75	12.32	12.54	11.67

*DAS- Days after spray
Figures in the parentheses are √(x+0.5) transformed values.

Whitefly control after 2nd spray: At 10 day after second spray results shows that, all the treatments with Econeem Plus® resulted good control compared to control. The population trend recorded was same as first spray results, Econeem Plus® at 3ml/ ltr + Ecospread™ at 0.5 ml/ltr shown superior results by recording residual population of 1.33 per three leaves (Table 2).

Table 2: Evaluation of Econeem Plus® against Whiteflies (Second spray)

Tr. No	Mean number of whiteflies population per 3 leaves				
	Second spray				
	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS
T1	8.67 (3.03)	5.67 (2.48)	5.33 (2.42)	6.67 (2.68)	8.33 (2.97)
T2	6.33 (2.61)	6.33 (2.61)	5.00 (2.35)	6.33 (2.61)	6.00 (2.55)
T3	4.33 (2.20)	2.33 (1.68)	2.00 (1.58)	2.67 (1.78)	4.00 (2.12)
T4	7.67 (2.86)	5.00 (2.35)	4.33 (2.20)	5.67 (2.48)	6.67 (2.68)
T5	6.33 (2.61)	5.67 (2.48)	3.33 (1.96)	3.33 (1.96)	5.67 (2.48)
T6	3.00 (1.87)	2.00 (1.58)	1.33 (1.47)	2.67 (1.78)	2.62 (1.78)
T7	27.33 (5.28)	22.67 (4.81)	24.33 (4.98)	20.33 (4.56)	17.67 (4.26)
SEm	0.22	0.25	0.21	0.28	0.25
CD at 5%	0.67	0.78	0.66	0.85	0.77
CV (%)	12.91	17.18	15.41	18.93	16.13

*DAS- Days after spray
Figures in the parentheses are √(x+0.5) transformed values.

Percent Reduction of Whiteflies at 10 days after first and second spray:
The percent reduction of whiteflies at 10 days after first and second sprays shows that, Econeem Plus® at 3ml/L+ Ecospread™ at 0.5 ml/L resulted 78.1% and 84.9% reduction over control respectively (Table 3).

Table 3: Percent Reduction of Whiteflies at 10 days after first and second spray.

Sl. No	Treatments	Dosage	% Reduction of whiteflies at 10 days after spray	
			First Spray	Second Spray
1	Econeem® Plus	2 ml/ L	61.6	52.8
2	Econeem® Plus	2.5 ml/ L	64.4	66.0
3	Econeem® Plus	3 ml/ L	69.9	77.4
4	Econeem Plus® + Ecospread	2 ml/ L + 0.5 ml/ L	61.6	62.3
5	Econeem Plus® + Ecospread	2.5 ml/ L+ 0.5 ml/L	64.4	67.9
6	Econeem Plus® + Ecospread	3 ml/ Ltr + 0.5 ml/ Ltr	78.1	84.9
7	Untreated Control	Water	--	--

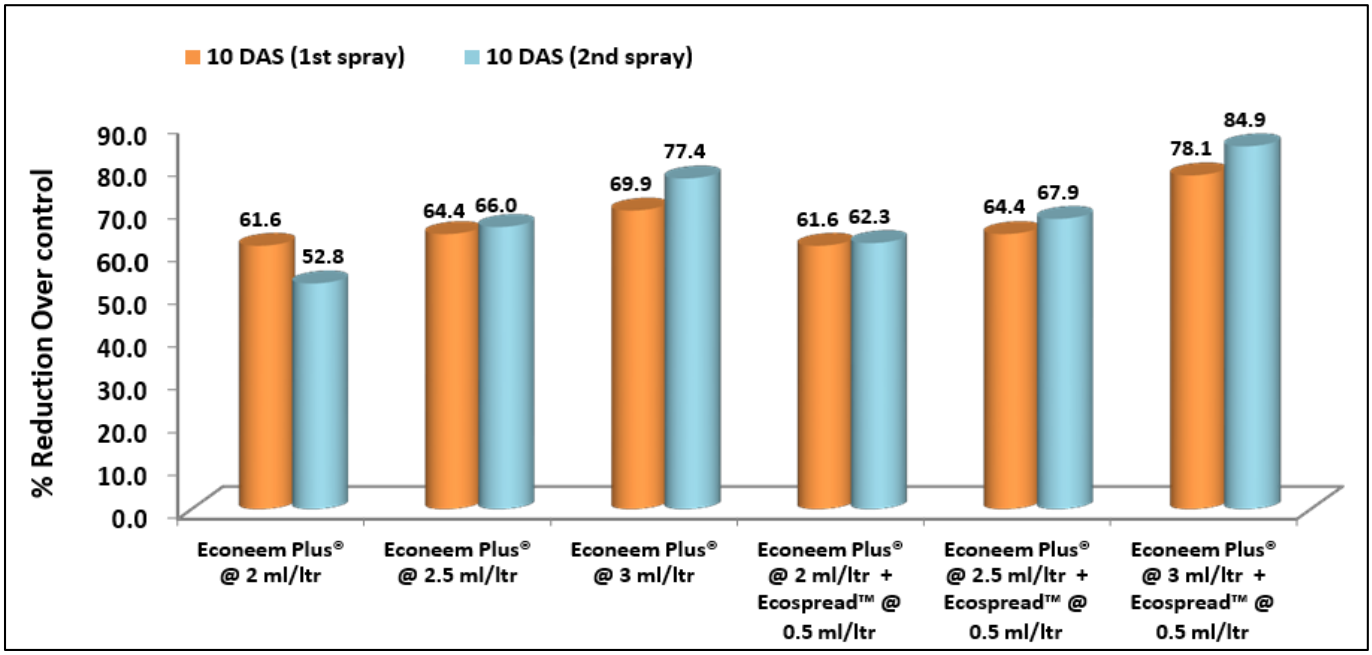

Fig 1: Graphical Representation of Percent Reduction of Whiteflies at 10 days after first and second spray.

Phytotoxicity

The treatments did not show any observable phytotoxic symptoms on leaves after application of both sprays up to the end of the observation period of 10+10 days.

Summary and conclusion

Based on the results obtained it can be concluded that, Econeem Plus® is effective against cotton whiteflies at the dosage of 2.5 and 3 ml/ L. Addition of Ecospread™ at 0.5 ml increases the efficacy rate and helpful in management of cotton whiteflies. These findings are in corroboration with Nboyine *et al*., 2013 who reported that neem based bio-pesticides were effective in controlling whiteflies in cotton. Asif *et al*., 2018 findings also corroborates the present investigation which reveals that neem oil and neem seed water extract at 5% recorded highest percentage mortality of target pests in cotton.

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