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Influence of seed treatment on the incidence of leafhopper, *Amrasca devastans* Distant (Cicadellidae: Hemiptera) in cotton

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Abstract
An investigation was carried out to study the influence of seed treatment on the incidence of leafhopper, *Amrasca devastans* Distant infesting cotton crop under field condition at Agricultural College and Research Institute, Killikulam, Tuticorin District, Tamil Nadu during 2014 -15. The efficacy of seed treatment with fourteen synthetic insecticides was evaluated and to study the germination and seedling parameters by adopting Paper Roll Towel method under laboratory condition. The leafhopper population was significantly lower in acephate treated cotton seeds plot (0.70/3 leaves) followed by triazophos (1.70/3 leaves), acetamiprid (1.80/3 leaves), monocrotophos (2.30/3 leaves), imidacloprid 48 FS (2.40/3 leaves) and carbosulfan (2.60/3 leaves) than untreated check (5.40/3 leaves) during fourth week after sowing. The germination of cotton was maximum (48.81%) with imidacloprid 48 FS seed treatment. Seed treatment with acephate (10.83 cm), flubendiamide (10.73 cm), imidacloprid 48 FS (10.60 cm) and phosalone (10.23 cm) improved the shoot length of cotton over untreated check. Seed treatment with carbosulfan (20.67 cm) alone was able to improve the root length of cotton.

Keywords: Seed treatment, Incidence, *A. devastans*, Germination, Seedling Parameters, Cotton

1. Introduction
Cotton, *Gossypium hirsutum* L. (family: Malvaceae), is one of the most commercially important fiber crops in the world. In India, it is cultivated in 8.97 million ha with a production of 21.3 million bales of seed cotton [3]. Cotton fiber is an important raw material to the textile industries and plays a key role in national economy in terms of employment generation and foreign exchange. Production of cotton is limited by various factors among which insect pests are also important. During growth period, 148 insect pests have been recorded on cotton crop, out of which only 17 species have been recorded as major insect pests of cotton crop [1]. In cotton, the insect pests infestation caused deterioration in lint quality and 10 - 40 per cent losses in crop production [6]. A complex of sucking pests *viz.,* green leafhopper, *Amrasca devastans Distant*, aphid, *Aphis gossypii* (Glover), whitefly, *Bemisia tabaci* (Gennadius) and thrips, *Thrips tabaci* (Lind.) occupy major pest status and cause considerable damage in cotton. Among the sucking pests, the leafhopper, *A. devastans* that inflicts heavy damage to cotton seedlings in southern tracts of Tamil Nadu [4, 11, 12, 16, 17, 21]. Use of chemical control is not only creating health hazards and ecological contamination but also growing the resistance in the insects and disturbing the balance between the forces of destruction (predators, parasitoids and pathogens) and forces of creation (biotic potential of pests) in agro-ecosystem[2], [9], [22]. So it is imperative to find out an eco-friendly and need based use of chemical pesticides as a component of Integrated Pest Management [13]. Insecticides as seed treatment/dresser emerged most promising, low cost, selective and less polluting with least interference in natural equilibrium. It protects against insect pests and is eco-friendlier to bio-control agents like coccinellids and chrysopids under field condition [20, 15, 14]. Hence, the present investigation was carried out to study the influence of seed treatment on the incidence of *A. devastans* in cotton.

2. Material and Methods
The experiment was conducted at Agricultural College and Research Institute, Killikulam, Tuticorin District, Tamil Nadu, using cotton variety SVPR 2 during 2014 – 2015 under field condition. The crop was sown in 5 x 4 m^2 plots maintaining 30 cm and 60 cm inter plant and

inter row distances. The standard agronomic practices were given at a proper time as per the Crop Production Guide by Tamil Nadu Agricultural University. The acid delinted (with concentrated sulphuric acid @100 ml kg^{-1} of seed) cotton seeds were used for the experiments. To treat one kg of seeds 0.5 g of *Acacia* gum powder and 20 ml of water were used. Gum was dissolved in water and mixed with the stipulated quantity of insecticides. The seeds were thoroughly mixed with gum + insecticide mixture, dried under shade and kept for 24 hours before sowing. Untreated acid delinted seeds served as untreated check.

Efficacy of seed treatment with synthetic insecticides

The efficacy of seed treatment with fourteen synthetic insecticides *viz.,* acephate 75 SP, acetamiprid 20 SP, carbosulfan 25 EC, chlorantraniliprole 18.5 SC, chlorpyriphos 20 EC, dimethoate 30 EC, flubendiamide 20 WG, imidacloprid 17.8 SL, imidacloprid 48 FS, monocrotophos 36 WSC, phosalone 35 EC, profenofos 50 EC, thiamethoxam 25 WG and triazophos 40 EC was evaluated in field experiments laid out in Randomized Block Design and were replicated twice. Untreated acid delinted seeds served as an untreated check.

The nymphal and adult population of leafhopper, *Amrasca devastans* (Distant) were recorded at weekly interval from second week to ninth week after sowing on ten plants selected at random per plot. In each plant three leaves, one each from top, middle and bottom strata were observed and mean per leaf was calculated.

Laboratory studies

Effect of seed treatments on germination and seedling growth parameters

The experiments were conducted adopting Paper Roll Towel method to study the germination and seedling parameters *viz.,* shoot length and root length in a Completely Randomized Design with the above insecticide treatments and untreated acid delinted seeds served as an untreated check with three replications.

3. Results and Discussion

Influence of seed treatment on the incidence of *A. devastans*

Of the seven periods of observation, the leafhopper population appeared from second week after sowing (WAS) and was found increasing (0.47 to 8.34 number/3 leaves) upto seventh WAS and declined (7.81/3 leaves) in eighth WAS (Table 1). The overall mean population of leafhopper over seven periods of observation ranged from 3.16 (acephate) to 6.88 (phosalone) number per three leaves.

The variability in leafhopper population due to the treatments as well as periods of observation was noticed. Interaction effect was also found significant. Overall mean population over the periods of observation could not brought out any significant influence of the treatments in reducing the leafhopper population as all the treatments are either on a par with untreated check or had higher population than the untreated check. However, at eighth WAS imidacloprid 17.8 SL and 48 FS are the treatments which recorded the minimum leafhopper injury grade of 2.5. Thiamethoxam recorded a grade of 3.0. Monocrotophos recorded a grade of 3.8. All other treatments recorded the maximum grade of 4.0.

However, considering the individual periods of observation, the leafhopper population was significantly lower in acephate (0.70/3 leaves), triazophos (1.70/3 leaves), acetamiprid (1.80/3 leaves), monocrotophos (2.30/3 leaves), imidacloprid 48 FS (2.40/3 leaves) and carbosulfan (2.60/3 leaves) than untreated check (5.40/3 leaves) during fourth week after sowing. At fifth week after sowing, acephate (1.85/3 leaves), acetamiprid (1.70/3 leaves), imidacloprid 48 FS (1.60/3 leaves) and monocrotophos (2.70/3 leaves) recorded lesser population than the untreated check (7.10/3 leaves).

Table 1. Influence of seed treatment against *A. devastans* on cotton

Treatment	Dose (Kg $^{-1}$)	Leafhopper population (No. / 3leaves) Week after sowing (WAS)								Reduction over UTC (%)	LHG WAS		
		2	3	4	5	6	7	8	Mean		6	7	8
Acephate 75 SP	10 g	0.35 A (0.91) a	1.70 A (1.47) a	0.70 A (1.09) a	1.85 A (1.40) a	5.20 B (2.32) abc	6.70 B (2.68) abcd	5.60 B (2.46) abc	3.16 (1.76) a	-13.66	2.3	3.3	4.0
Acetamiprid 20 SP	10 g	0.50 (1.00) a	0.90 (1.18) a	1.80 (1.51) ab	1.70 (1.48) ab	7.20 (2.77) bcd	8.20 (2.94) bcde	4.70 (2.25) ab	3.57 (1.87) abc	-2.46	2.2	3.0	4.0
Carbosulfan 25 EC	10 ml	0.55 (1.02) a	0.50 (1.00) a	2.60 (1.74) bcd	6.70 (2.68) cd	5.40 (2.42) abcd	5.00 (2.31)ab	10.50 (3.31) fg	4.46 (2.07) bcdef	21.86	2.3	3.1	4.0
Chlorantraniliprole 18.5 SC	10 ml	0.30 (0.89) a	0.90 (1.18) a	4.30 (2.12) bcde	3.90 (2.10) bcd	8.00 (2.91) cd	8.30 (2.97) cde	8.10 (2.93) cdefg	4.83 (2.16) defg	31.97	3.1	4.0	4.0
Chlorpyriphos 20 EC	10 ml	0.85 (1.16) a	0.90 (1.18) a	5.10 (2.36) de	3.90 (2.10) bcd	5.50 (2.45) abcd	5.10 (2.37) abc	9.80 (3.19) efg	4.45 (2.11) cdef	21.58	3.1	3.5	4.0
Dimethoate 30 EC	10 ml	0.15 (0.80) a	1.20 (1.29) a	5.60 (2.47) e	2.90 (1.84) abc	4.20 (2.14) ab	5.80 (2.48) abc	6.80 (2.63) bcde	3.81 (1.95) abcd	4.10	2.9	3.1	4.0
Flubendiamide 20 WG	10 g	0.30 (0.89) a	0.80 (1.13) a	3.80 (2.07) bcde	9.10 (3.09) de	4.40 (2.21) ab	5.70 (2.49) abc	4.10 (2.12) ab	4.03 (2.00) abcde	10.11	3.4	4.0	4.0
Imidacloprid 17.8 SL	10 ml	0.55 (1.02) a	0.90 (1.18) a	3.40 (1.97) bcde	6.30 (2.50) cd	8.00 (2.91) cd	10.10 (3.25) def	8.20 (2.95) cdefg	5.35 (2.25) fg	46.17	1.8	2.2	2.5
Imidacloprid 48 FS	10 ml	1.60 (1.45) b	0.70 (1.09) a	2.40 (1.70) abc	1.60 (1.45) a	6.20 (2.59) abcd	9.40 (3.15) de	7.00 (2.73) bcdef	4.13 (2.02) bcdef	12.84	1.9	2.1	2.5
Monocrotophos 36 WSC	10 ml	0.20 (0.83) a	0.70 (1.09) a	2.30 (1.66) abc	2.70 (1.79) ab	6.70 (2.68) bcd	4.70 (2.28) a	5.70 (2.49) bcd	3.28 (1.83) ab	-10.38	2.0	2.1	3.8
Phosalone 35 EC	10 ml	0.60 (1.05) a	1.70 (1.46) a	4.50 (2.23) cde	5.80 (2.51) cd	8.90 (3.06) d	14.90 (3.91) g	11.80 (3.51) g	6.88 (2.53) h	87.98	2.8	3.2	4.0
Profenophos 50 EC	10 g	0.25 (0.85) a	1.00 (1.22) a	3.80 (2.07) bcde	2.80 (1.82) ab	8.10 (2.93) cd	9.40 (3.14) de	10.9 (3.36) fg	5.18 (2.20) efg	41.53	2.8	3.0	4.0
Thiamethoxam 25 WG	10 ml	0.35 (0.92) a	1.00 (1.21) a	3.60 (2.02) bcde	11.30 (3.43) e	7.20 (2.59) abcd	11.80 (3.51) efg	9.20 (3.11) defg	6.35 (2.40) gh	73.50	1.4	2.5	3.0

Triazophos 40 EC	10 ml	0.05 (0.74) a	1.20 (1.28) a	1.70 (1.48) ab	13.40 (3.73) e	3.30 (1.95) a	14.60 (3.88) fg	12.00 (3.53) g	6.61 (2.37) gh	80.60	2.5	3.4	4.0
Untreated check (UTC)	-	0.50 (0.96) a	0.80 (1.13) a	5.40 (2.42) e	7.10 (2.70) cde	3.60 (2.02) a	5.40 (2.43) abc	2.80 (1.82) a	3.66 (1.92) abcd	-	4.0	4.0	4.0
Mean	-	0.47 (0.97) A	0.99 (1.20) B	3.40 (1.92) C	5.40 (2.31) D	6.13 (2.53) E	8.34 (2.92) G	7.81 (2.83) F	4.65 (2.10)				

LHG - Leafhopper Injury Grade

Mean of three replications. Figures in parentheses are √X+0.5 transformed values. In a column/row, means followed by a common letter are not significantly different at 5 % level (LSD).

	T	P	T x P
Significance	0.01	0.01	0.01
CD (p=0.05)	0.24	0.16	0.64

Germination and seedling growth parameters

Germination

Germination was maximum with imidacloprid 48 FS seed treatment. It was better than all other treatments except imidacloprid 17.8 SL. Imidacloprid 48 FS and 17.8 SL were on a par with each other. Both the treatments improved the germination by 48.81 and 41.17 per cent respectively over untreated check (Table 2) (Fig 1). All other treatments were unable to improve the germination. They registered germination on a par with untreated check.

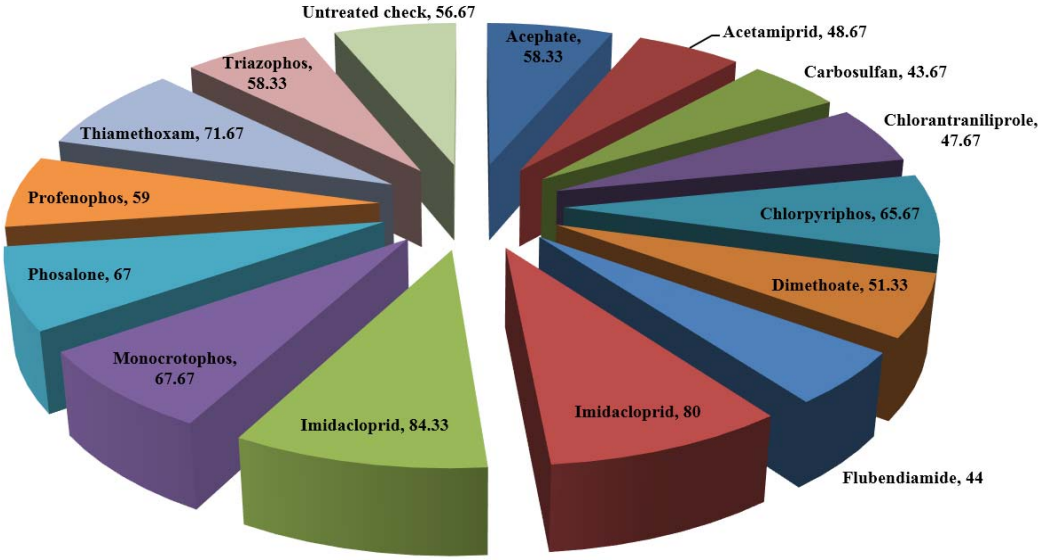

Fig 1: Influence of seed treatment with synthetic insecticides on germination

Shoot length

Acephate (10.83 cm), flubendiamide (10.73 cm), imidacloprid 48 FS (10.60 cm) and phosalone (10.23 cm) improved the shoot length over untreated check. Phosalone (10.23 cm) and dimethoate (9.70 cm) did not affect the shoot length; they were on a par with untreated check (9.83 cm). All other treatments reduced the shoot length by 7.43 cm to 43.85 cm (Table 2) (Fig 2).

Root length

Carbosulfan (20.67 cm) alone was able to improve the root length. Seed treatment with triazophos (19.17 cm), thiamethoxam (19.17 cm), dimethoate (18.67 cm), monocrotophos (18.17 cm), acetamiprid (18.17 cm), flubendiamide (17.67 cm), imidacloprid 17.8 SL (17.67 cm) and acephate (17.67) did not affected the root length of the seedlings. Imidacloprid 48 FS (15.67 cm), profenofos (14.67 cm), chlorpyriphos (13.67 cm) and phosalone (11.17 cm) seed treatments adversely affected the root length; they reduce the root length by 24.34 to 37.94 per cent (Table 2) (Fig 2).

Peswani *et al.* [18] concluded that seed treatment with either phorate or disulfoton impaired the viability of cotton seeds. Graham *et al.* [7] reported that imidacloprid and aldicarb seed treatments increased plant height, per cent square retention, total square counts and bloom counts when compared with control. Gupta and Lal [8] proved that imidacloprid (0.5 per cent W/W seed treatment was most effective against leafhoppers and protected the cotton crop up to 63 days from the date of sowing and the cotton seed treated with imidacloprid 70 WS even at the rate of 5 g kg $^{-1}$ of seed enhanced germination percentage by 4.8 per cent as compared to no seed treatment under field condition. Chinnaiah and Ali [5] concluded that coating the cotton seeds with carbosulfan 25 DS @ 50 g kg $^{-1}$ of seed effectively controlled the incidence of aphids and leafhoppers. They also recommended carbosulfan 25 DS and RIL-18 as desired chemicals for seed treatment than the foliar treatments which have neither phytotonic effect on plants nor adverse effect on germination. Thiamethoxam 70 WS seed treatment had an excellent phytotonic effect, as indicated by more number of leaves, plant height and also increased fruiting bodies and cotton yield in these treatments [19]. Murugesan and Kavitha [13] reported that imidacloprid, monocrotophos and *Pseudomonas fluorescens* improved germination and increased shoot length whereas, neem oil had

adverse effect on shoot length. The cotton cultivar produced significantly higher yield when seeds were treated with imidacloprid (Gaucho 70 WS) at 5.5 g kg^{-1} fuzzy seed [10].

Table 2: Influence of seed treatment on germination and seedling growth parameters (laboratory study)

Treatment	Dose (kg^{-1})	Germination		Shoot length		Root length	
		(%)	(+) /(-) over UTC (%)	(cm)	(+)/(-) over UTC (%)	(cm)	(+) /(-) over UTC (%)
Acephate 75 SP	10 g	58.33 cdef	2.93	10.83 a	10.18	17.67 c	-1.83
Acetamiprid 20 SP	10 g	48.67 ef	-16.44	9.10 e	-7.43	18.17 bc	0.94
Carbosulfan 25 EC	10 ml	43.67 f	-29.77	8.67 f	-11.80	20.67 a	14.83
Chlorantraniliprole 18.5 SC	10 ml	47.67 ef	-15.88	7.13 g	-27.47	4.33g	-75.94
Chlorpyriphos 20 EC	10 ml	65.67 bcd	15.88	7.10 g	-27.77	13.67 e	-24.06
Dimethoate 30 EC	10 ml	51.33 def	-9.42	9.70 d	-1.32	18.67 bc	3.72
Flubendiamide 20 WG	10 g	44.00 ef	-22.36	10.73 a	9.16	17.67 c	-1.83
Imidacloprid 17.8 SL	10 ml	80.00 ab	41.17	10.20 c	3.76	17.67c	-1.83
Imidacloprid 48 FS	10 ml	84.33 a	48.81	10.60 ab	7.83	15.67 d	-24.34
Monocrotophos 36 WSC	10 ml	67.67 bc	19.41	7.10 g	-27.77	18.17 bc	0.94
Phosalone 35 EC	10 ml	67.00 bc	18.23	10.23 bc	4.07	11.17 f	-37.94
Profenofos 50 EC	10 ml	59.00 cde	4.11	9.07 e	-7.73	14.67 de	-18.50
Thiamethoxam 25 WG	10 g	71.67 abc	26.47	8.51f	-13.43	19.17 b	6.5
Triazophos 40 EC	10 ml	58.33 cdef	2.93	5.52 h	-43.85	19.17 b	6.5
Untreated check	-	56.67 cdef	-	9.83 d	-	18.00 bc	-
Mean		60.27	-	8.96	-	16.3	-
Significance		0.01	-	0.01	-	0.01	-
CD (P=0.5)		15.32	-	0.36	-	1.04	-

In column, means followed by a common letter are not significantly different at 5% level (LSD)

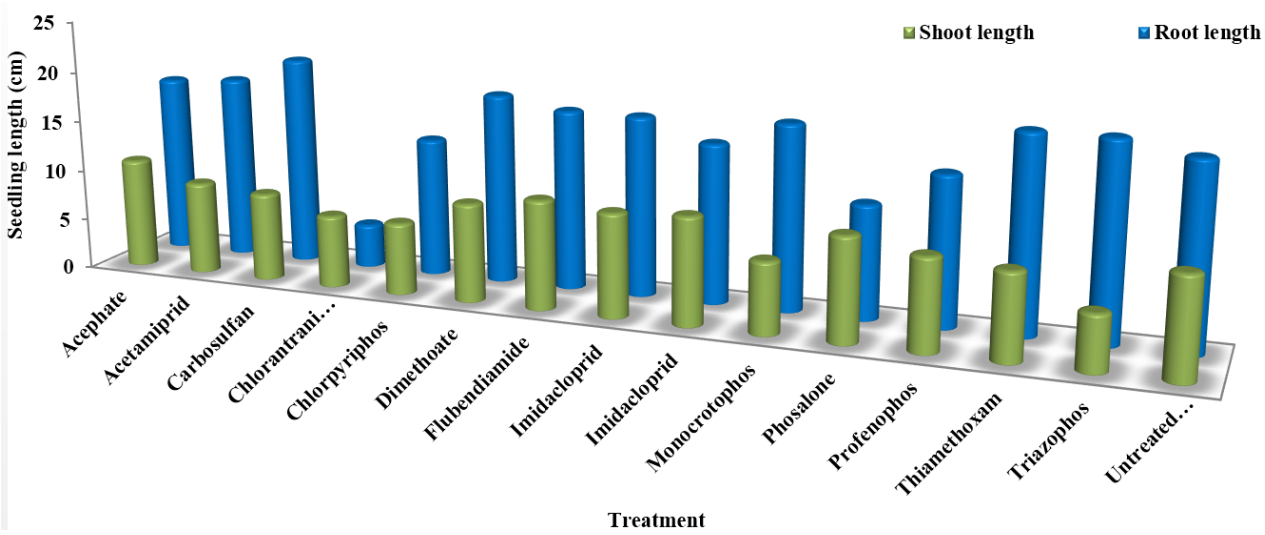

Fig 2: Influence of seed treatment with synthetic insecticides on seedling growth parameters

4. Conclusion

The leafhopper population was significantly lower in acephate treated cotton seeds plot (0.70/3 leaves) followed by triazophos (1.70/3 leaves), acetamiprid (1.80/3 leaves), monocrotophos (2.30/3 leaves), imidacloprid 48 FS (2.40/3 leaves) and carbosulfan (2.60/3 leaves) than untreated check (5.40/3 leaves) during fourth week after sowing. The germination of cotton was maximum (48.81%) with imidacloprid 48 FS seed treatment. Seed treatment with acephate (10.83 cm), flubendiamide (10.73 cm), imidacloprid 48 FS (10.60 cm) and phosalone (10.23 cm) improved the shoot length of cotton over untreated check. Seed treatment with carbosulfan (20.67 cm) alone was able to improve the root length of cotton.

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