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Management of sucking pest complex in okra by sequential strategy

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Abstract
An experiment entitled "Efficacy of different insecticides against pest complex of okra (*Abelmoschus esculentus* L. Moench) by sequential strategy" was conducted at the All India Co-ordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist: Ahmednagar (Maharashtra) during *summer* 2022. During the course of study, six sequential strategies were evaluated against sucking pest complex of okra. The results showed that treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25 g/l followed by pongamia oil 1% @ 10ml/l was found to be most effective and recorded least average survived population of aphids, leaf hoppers, whitefly and mites.

Keywords: Okra, aphid, leafhopper, whitefly, mites, sequential strategy

Introduction

In India, vegetables have occupied the important place in human diet. Among different vegetables okra, (*Abelmoschus esculentus* L. Moench) belonging to Malvaceae family is an important annual vegetable crop widely cultivated round the year in india. The attack of sucking pest complex and mite pests is one of the significant factors limiting okra cultivation, they damage the crop by sucking cell sap and devitalise the plant. The sugary substance 'honey dew' secreted by sucking pests also causes major problem leads to reduction in photosynthetic activity of plant. In sucking pests aphid, leafhopper, white fly, and mites pose a major threat to the okra production. Aphids is an major sucking pest causes heavy damage in okra, cause yellowing, stunted growth, curling and crinkling of leaves). Leaf hopper (*Amrasca bigutulla bigutulla) is* a very destructive pest. In the early stages of the crop, leaf hoppers are a significant pest that weaken and reduce yield by sucking sap from the plants. It was reported that failure to control them in the early stages resulted in a yield loss of 54.04%. (Chaudhary and Dadeech, 1989) [6]. Leaf hoppers cause characteristics 'hopper burn' symptoms due to its toxic saliva inserted into the plants and then plant get devitalized and crop growth is retorted Whitefly on okra is a significant pest that is present throughout the growing seasone from sowing to harvesting. Whitefly damages the crop by sucking the cell sap from under side of leaves and also by transmitting viral diseases (Basu, 1995 [4]. Whitefly on okra is a significant pest that is present throughout the growing seasone from sowing to harvesting. Whitefly damages the crop by sucking the cell sap from under side of leaves and also by transmitting viral diseases (Basu, 1995) [4]. The red spider mite, *Tetranychus cinnabarinus* (Boisduval) a polyphagous species that attacks an okra crop, has become a serious threat and can result in yield losses of up to 7 to 48% (Anonymous, 1996) [3]. The mite colony is made up of nymphs and adults that feed on the ventral leaf surface and weave silken webs to shield themselves from pesticides and other natural enemies. Heavy infestation causes leaf shedding, which interferes with normal growth and reduces the plant's ability to bear fruit. (Kale *et al.*, 2021) [13] These insect pests damage the okra crop both qualitatively and quantitatively, affected plants produces lower yield and fruits that are infested become unsutable for human consumption.

However, synthetic insecticides, which have been used extensively for a long time to control these pests, are currently the most effective method. However, recent research has shown that using synthetic pesticides is dangerous to human health and has long-lasting effects. In addition to these, the chemicals have negative effects on the populations of ants, spiders, and ladybird beetles. (Solangi and Lohar 2001) [21]. Natural enemies like coccinellids also plays important role in controlling insect pests. In order to avoid the issues associated with the indiscriminate use of pesticides, natural bio-pesticides have long been used in commercial agriculture and horticulture. For the management of pest complex in okra, earlier research workers, suggested a various types of pesticides. But chemical insecticides in high quantities cause pest resurgence, insecticide resistance, residual problems and destruction of natural enemies. However, the use of chemical pesticides can be reduced by integrating them with botanical and microbial pesticides by adopting sequential strategy to produce healthy and high-quality crop.

Materials and Methods

A field trial with six sequential strategy along with untreated control (Table 1) were carried out in Randomized Block Design with three replications, during *summer* 2022 at All India Coordinated Research Project on Vegetable Crops at MPKV, Rahuri for the management of sucking pest complex on okra. The seeds of okra variety 'Phule Vimukta' were sown during 1st fortnight of January in a plot size 5.0 x 3.0 m. with plant spacing 30 x 15 cm. In each sequential strategy, three sprays were applied at 10 days interval by using 500 lit. of water per hector with the help of hand operated knapsack sprayer as pest appearance starting from 30 days after sowing. The treatments are illustrated in (Table 1). In order to find out effective sequential strategy for control of pests complex in okra, five plants from each treatment plot were selected randomly and tagged for recording the observations. The nymphs of leaf hopper on three leaves (bottom, middle and top), whitefly population on three leaves (bottom, middle and top), aphid population on three leaves (bottom, middle and top) observed and their numbers were recorded on three leaves per plant. The mite population was counted on both, upper and lower surfaces of each of the three leaves (bottom, middle and top), with 1 sq. cm. area by using magnifying lens (10X) and their numbers were recorded on three leaves per sq. cm (Kale *et al.*, 2021) [13]. The observations were recorded a day before treatment application as pre-count, and then at 3rd, 7th and 10th days after each spraying as post-counts.

Table 1: Treatment details

Treatment No.	Treatment
T1	Spraying of NSE 5% followed by flupyradifurone 200 SL @ 2.5 ml/l followed by *Metarhizium anisopliae* @ 5 g/l
T2	Spraying of *Metarhizium anisopliae* @ 5 g/l followed by emamectin benzoate 5% SG @ 0.5 g/l followed by *Azadirachtin* (10000 ppm) @ 2 ml/l
T3	Spraying of *Lecanicillium lecanii* @ 5g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% @ 10ml/l
T4	Spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l
T5	Spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by Imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l
T6	Spraying of *Beauveria bassiana* @ 5 g/l followed by lambda-cyhalothrin 5 EC @ 0.6 ml/l followed by NSE 5%
T7	Untreated control

Results and Discussion

It is revealed from the pooled data (Table -2-5), that all the sequential strategy treatments were found significantly superior over untreated control for control of sucking pests on okra.

1. Effective sequential strategies for control of aphid (*Aphis gossypii*), in okra

The results from the Table no. 2 revealed that treatment with sequential strategy (T3) spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25 g/l followed by pongamia oil 1% was found superior to all the remaining treatments and recorded 11.94 average survived aphid population/three leaves/plant after first spray. Whereas, (T5) spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l was found on par with.

After second spray, the treatment including (T3) spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% found superior in recording least of (3.04 aphid population/3 leaves/plant) as against (24.22 aphids/3 leaves/plant) in untreated control. Nearly similar trend of observation in respect of aphid population was recorded after third sprays. Overall averages of post-count of three sprays indicate that the treatment with spraying of (T3) *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% emerged as most superior with least count of aphid (5.54 aphids/3 leaves/plant). The next superior treatments were (T5) spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l (7.25 aphids/3 leaves/plant) and (T4) spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l (8.50 aphids /3leaves/plant) which were on par with each other.

Similar results in respect of effectiveness of this insecticide against aphids was documented earlier by Janghel *et al.* (2015) [12], Bisen *et al.* (2020) [5], Pawar *et al.* (2016) [18], Dhanalakshami and Mallapur (2008) [8]. Result in respect of effectiveness of *Lecanicillium lecanii* for aphids documented by Naik (2009) [17]. Superiority of pongamia oil in controlling aphids population was earlier proved by Sarkar *et al.* (2016) [19] which is in line with present findings. The relative study as documented by earlier workers could support the present results.

2. Effective sequential strategies against for control of leaf hoppers, (*Amrasca bigutulla bigutulla*) in Okra

All the six sequential strategies were found superior over untreated control in reducing the leaf hopper population observed at 3rd, 7th and 10th days after each of the three applications. Among the treatments, the treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% recorded (6.17 leaf hoppers /3 leaves/plant) and found superior to all the remaining treatments and it was on par with spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l after first spray. After second spray it was also noticed that the treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% recorded a minimum of (2.10

leaf hoppers/3 leaves/plant) and found the most superior treatment among all. Nearly, similar trend of observation in respect of leaf hopper population was observed after third spray. From the cumulative counts of surviving leaf hoppers populations of three sprays, it showed that treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% proved to be superior to all the remaining ones and recorded least of (3.12 leaf hoppers/3 leaves/plant. The next superior treatments were spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l (4.54 leaf hoppers/3 leaves/plant) and spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l (5.28 leaf hoppers /3leaves/plant) which were on par with each other.

The effectiveness of thiamethoxam against leaf hoppers was reported earlier by Karthik *et al.* (2020) [14], Gadekar *et al*. (2016) [9], which are in conformity with the present findings. Effectiveness of imidacloprid against leaf hoppers was earlier proved by Kumar *et al.* (2021) [16], Bisen *et al.* (2020) [5], Anand *et al.* (2013) [2] and Pawar *et al.* (2016) [18] which are in confirmation with present investigations. Similar findings were also reported by Acharya *et al.* (2002) [1] which are in line with present investigations.

Result in respect of effectiveness of *Lecanicillium lecanii* for leaf hoppers documented by Janghel *et al.* (2015) [12]. The relative study as documented by earlier workers could support the present results. Similarly, Alam *et al.* (2010) [14] and Sarkar *et al.* (2016) [19] reported efficacy of pongamia oil against leaf hoppers which are in collaboration with present findings.

3. Effective sequential strategies for control of whitefly (*Bemisia tabaci)* in okra

In case, control of whitefly on okra all the sequential strategies showed significant results over the untreated control. Among the tested six sequential strategies, the treatment with spraying of*Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% was found significantly better for controlling whitefly over other sequential strategies and recorded 5.80 whitefly /3 leaves/plant and found on par with spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l which recorded 6.34 whitefly /3 leaves/plant after first spray.

After second spray, the treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% recorded a minimum of 2.20 whitefly population/3 leaves/plant and found the most superior treatment among all. The same trend was observed after third spray in respect of whitefly population. It is seen from the mean of post-counts of surviving whitefly populations of three applications that treatment with spraying of *Lecanicillium lecanii* followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% proved significantly superior to all the remaining ones and recorded least *i.e* 3.10 whitefly population/3 leaves/plant. The next superior treatments were spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l (4.54 whitefly/3 leaves/plant) and spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l (5.28 whitefly /3leaves/plant) which were on par with each other.

The present investigations of effectiveness of thiamethoxam against whitefly was reported earlier by Karthik *et al*. (2020) [14], which is in conformity with the present findings. Effectiveness of imidacloprid against whitefly was recorded by Hemadri *et al.* (2018), Kumar *et al.* (2017) [15], Pawar *et al.* (2016) [18] and Dhar and Bhattacharya (2015) [8]. The effectiveness of *Lecanicillium lecanii* in reducing damage caused by whitefly was earlier reported by Halder *et al.* (2021) [10] which confirms present findings. Sarkar *et al.* (2015) [19] reported pongamia oil was found promising for management of whitefly which is in tune with the present investigations.

4. Effective sequential strategies for control of mite (*Tetranychus cinnabarinus*) in okra

After 1st spray treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% was superior and recorded 7.25 mites/leaf/sq.cm as against 22.74 mites/leaf/sq.cm in untreated control. It is observed from the mean of second spray that the treatment including spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% recorded a minimum 1.90 mites population/leaf/sq.cm and found superior over all treatments. Nearly, similar trend of results was noticed when the surviving mites populations were observed after third spray.It is revealed from the post-counts of surviving mites populations of three sprays, the treatment with spraying of *Lecanicillium lecanii* @ 5 g/l followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1% proved significantly superior to all the remaining ones and recorded least mites (3.62 mites/leaf/sq.cm). The next superior treatments were spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l (5.78 mites/leaf/sq.cm); spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l (6.09 mites /leaf/sq.cm) and spraying of NSE 5% followed by flupyradifurone 200 SL @ 2.5 ml/l followed by *Metarhizium anisopliae* @ 5 g/l (6.33 mites/leaf/sq.cm) which were on par with each other.

In the IPM module in which the treatment *Lecanicillium lecanii*, thiamethoxam and pongamia oil are incorporated against mites for effectiveness are reported earlier by Bisen *et al.* (2020) [5] and Kumar *et al.* (2021) [16] which are in conformity with the present findings.

Table 2: Cumulative effect of different sequential strategies on aphids (Aphis gossypii) population of okra. (Av. of 3 sprays)

Sr. No.	Treatments	Number of aphids/3 leaves/plant			
		3 DAS	7 DAS	10 DAS	Mean
1	Spraying of NSE 5% followed by flupyradifurone 200 SL @ 2.5 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	11.39 (3.44)	8.99 (3.07)	9.64 (3.18)	10.01 (3.24)
2	Spraying of *Metarhizium anisopliae* @ 5 g/l followed by emamectin benzoate 5% SG @ 0.5 g/l followed by *Azadirachtin* (10000 ppm) @ 2 ml/l	14.19 (3.83)	11.72 (3.48)	12.18 (3.55)	12.70 (3.63)
3	Spraying of *Lecanicillium lecanii* followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1%	7.39 (2.80)	4.62 (2.25)	4.61 (2.25)	5.54 (2.46)
4	Spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l	10.00 (3.23)	7.40 (2.80)	8.10 (2.92)	8.50 (3.00)
5	Spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	9.02 (3.07)	6.09 (2.55)	6.64 (2.65)	7.25 (2.78)
6	Spraying of *Beauveria bassiana* @ 5 g/l followed by lambdacyhalothrin 5 EC @ 0.6 ml/l followed by NSE 5%	13.34 (3.71)	11.09 (3.40)	11.77 (3.50)	12.07 (3.54)
7	Untreated control	23.39 (4.88)	24.06 (4.95)	24.67 (5.01)	24.04 (4.95)
	SE ±	0.06	0.09	0.09	0.08
	CD at 5%	0.19	0.29	0.28	0.25

*Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

Table 3: Cumulative effect of different sequential strategies on leaf hoppers (*Amrasca bigutulla bigutulla*) population of okra. (Av. of three sprays)

Sr. No.	Treatments	Number of leaf hoppers/3 leaves/plant			
		3 DAS	7 DAS	10 DAS	Mean
1	Spraying of NSE 5% followed by flupyradifurone 200 SL @ 2.5 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	6.66 (2.67)	5.52 (2.45)	6.27 (2.60)	6.15 (2.58)
2	Spraying of *Metarhizium anisopliae* @ 5 g/l followed by emamectin benzoate 5% SG @ 0.5 g/l followed by *Azadirachtin* (10000 ppm) @ 2 ml/l	8.33 (2.97)	7.67 (2.85)	8.14 (2.93)	8.05 (2.92)
3	Spraying of *Lecanicillium lecanii* followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1%	3.63 (2.01)	2.54 (1.72)	3.19 (1.91)	3.12 (1.90)
4	Spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l	5.83 (2.51)	4.70 (2.27)	5.15 (2.38)	5.28 (2.40)
5	Spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	5.09 (2.36)	3.93 (2.10)	4.59 (2.25)	4.54 (2.24)
6	Spraying of *Beauveria bassiana* @ 5 g/l followed by lambda-cyhalothrin 5 EC @ 0.6 ml/l followed by NSE 5%	7.99 (2.91)	7.14 (2.76)	7.80 (2.87)	7.64 (2.85)
7	Untreated control	12.61 (3.62)	13.18 (3.69)	14.06 (3.81)	13.28 (3.71)
	SE ±	0.06	0.06	0.04	0.06
	CD at 5%	0.20	0.18	0.13	0.17

*Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

Table 3: Cumulative effect of different sequential strategies on whitefly *(Bemisia tabaci*) population of okra. (Av. of three sprays)

Sr. No.	Treatments	Number of whitefly/3 leaves/plant			
		3 DAS	7 DAS	10 DAS	Mean
1	Spraying of NSE 5% followed by flupyradifurone 200 SL @ 2.5 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	6.66 (2.67)	5.52 (2.45)	6.27 (2.60)	6.15 (2.58)
2	Spraying of *Metarhizium anisopliae* @ 5 g/l followed by emamectin benzoate 5% SG @ 0.5 g/l followed by *Azadirachtin* (10000 ppm) @ 2 ml/l	8.33 (2.97)	7.67 (2.85)	8.14 (2.93)	8.05 (2.92)
3	Spraying of *Lecanicillium lecanii* followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1%	3.63 (2.01)	2.54 (1.72)	3.19 (1.91)	3.10 (1.90)
4	Spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l	5.83 (2.51)	4.70 (2.27)	5.15 (2.38)	5.28 (2.40)
5	Spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	5.09 (2.36)	3.93 (2.10)	4.59 (2.25)	4.54 (2.24)
6	Spraying of *Beauveria bassiana* @ 5 g/l followed by lambdacyhalothrin 5 EC @ 0.6 ml/l followed by NSE 5%	7.98 (2.91)	7.14 (2.76)	7.80 (2.87)	7.64 (2.85)
7	Untreated control	12.61 (3.62)	13.18 (3.69)	14.06 (3.81)	13.28 (3.71)
	SE ±	0.06	0.06	0.04	0.06

	CD at 5%	0.20	0.18	0.13	0.17

*Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

Table 4: Effect of different sequential strategies on mite (*Tetranychus cinnabarinus*) population after first spray on okra

Sr. No.	Treatments	Pre count	Number of mites/leaf/sq.cm.			
			3 DAS	7 DAS	10 DAS	Mean
1	Spraying of NSE 5% followed by flupyradifurone 200 SL @ 2.5 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	21.33 (4.67)	14.63 (3.89)	8.23 (2.95)	7.37 (2.80)	10.08 (3.25)
2	Spraying of *Metarhizium anisopliae* @ 5 g/l followed by emamectin benzoate 5% SG @ 0.5 g/l followed by *Azadirachtin* (10000 ppm) @ 2 ml/l	21.60 (4.70)	19.57 (4.47)	18.37 (4.34)	17.83 (4.28)	18.59 (4.37)
3	Spraying of *Lecanicillium lecanii* followed by thiamethoxam 25 SG @ 0.25g/l followed by pongamia oil 1%	21.03 (4.64)	11.83 (3.51)	5.40 (2.43)	4.53 (2.24)	7.25 (2.78)
4	Spraying of NSE 5% followed by tolfenpyrad 15% SC @ 2 ml/l followed by *Beauveria bassiana* @ 5 g/l	21.60 (4.70)	14.50 (3.87)	8.03 (2.92)	7.23 (2.78)	9.92 (3.23)
5	Spraying of *Azadirachtin* (10000 ppm) @ 2 ml/l followed by imidacloprid 200 SL @ 0.30 ml/l followed by *Metarhizium anisopliae* @ 5 g/l	21.83 (4.72)	13.97 (3.80)	7.50 (2.82)	6.57 (2.66)	9.35 (3.14)
6	Spraying of *Beauveria bassiana* @ 5 g/l followed by lambda-cyhalothrin 5 EC @ 0.6 ml/l followed by NSE 5%	21.80 (4.72)	17.83 (4.28)	14.33 (3.85)	13.37 (3.72)	15.18 (3.96)
7	Untreated control	21.73 (4.71)	22.13 (4.75)	22.73 (4.82)	23.37 (4.88)	22.74 (4.82)
	SE ±	0.08	0.09	0.05	0.06	0.07
	CD at 5%	NS	0.28	0.15	0.19	0.21

*Figures in the parentheses are $\sqrt{X + 0.5}$ transformed values
DAS: Days after spray

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