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Bio-Efficacy of Cyazypyr 10% OD, New Anthranilic Diamide Insecticide, against whitefly *Bemisia tabaci* and Jasid *Empoasca flavescens* on brinjal

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ABSTRACT
The experiment was conducted during the 2011 and 2012 in the University farm at Kalyani, West Bengal state of India. Brinjal 'Muktakeshi' was grown in plots measuring 5 m×5 m, at spacing of 1m x 0.75m with three replication during the period from mid- April to July, two year, following recommended package of practices. The plots were set out in a randomized block design with eight treatments including an untreated check. Four doses of cyazypyr 10% OD (60, 75, 90 and 105g a.i./ha in both year 2011 and 2012) were sprayed every year for their efficacy along with fipronil 5% SC @ 60 g a.i./ha, Flubendiamide 40% SC @ 30g a.i./ ha and Profenofos 50% SC @ 500 g a.i./ ha as standard check against. This experiment revealed that all these treatments were significantly superior over untreated control. The most effective treatment was cyazypyr 10% OD @ 105g a.i./ha followed by cyazypyr 10% OD @ 90g a.i./ha.
KEYWORDS: *Brinjal, cyazypyr, Bemisia tabaci and Empoasca flavescens*

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INTRODUCTION

Brinjal (*Solanum melongena* L.) is one of the widely used vegetable crops by most of the people and is popular in many countries *viz.,* Central, South and South East Asia, some parts of Africa and Central America [4]. It is native of India and second largest brinjal producing country after China with 27.1 % share. It is an important vegetable grown in all the seasons. Due to its nutritive value, consisting of minerals like iron, phosphorous, calcium and vitamins like A, B and C, unripe fruits are used primarily as vegetable in the country. Hence, it is subjected to attack by number of insect pests right from nursery stage till harvesting [11]. Among the insect pests infesting brinjal, the major ones are epilachna beetle, *Epilachna vigintioctopunctata* (Fab.), shoot and fruit borer, *Leucinodes orbonalis* (Guen.), whitefly, *Bemicia tabaci* (Genn.), leafhopper, *Empoasca flavescens* (Distant), and non insect pest, red spider mite, *Tetranychus macfurlanei*.

The main constraint in cultivation of brinjal is the occurrence of pests and diseases. Among the different major insect pests infesting brinjal, whitefly, *Bemicia tabaci* (Genn.), leafhopper, *Empoasca flavescens* (Fab.), is very important under West Bengal condition,

There is a greater possibility of carryover of insect pests from one season to other as it grown throughout the year. Whitefly, *Bemicia tabaci* (Genn.), leafhopper, *Empoasca flavescens* (Distant) are the two critical pests of brinjal causing substantial yield loss. To avoid the crop loss by these pests, the frequent use of toxic chemical insecticides has been a common practice to the brinjal growers. However, Among the different management practices, chemical control is commonly practiced by the farmers for management of insect pest on brinjal [5]. The new generation of pesticide molecules have been claimed to be effective as well as safer for non-target organisms [13, 3,8, 12]. The use of insecticides could be more effective depending on selection of chemicals, doses, method and time of application. Hence, keeping the above

point in view, present investigation was carried to evaluate the bio-efficacy of cyazypyr 10% OD on whitefly, *Bemicia tabaci* (Genn.), leafhopper, *Empoasca flavescens* (Distant), under field condition.

MATERIAL AND METHODS

The experiment was conducted during the 2011 and 2012 in the University farm at Kalyani, West Bengal state of India. Brinjal 'Muktakeshi' was grown in plots measuring 5 m×5 m, at spacing of 1m x 0.75m with three replication during the period from mid- April to July, two year, following recommended package of practices. The plots were set out in a randomized block design with eight treatments including an untreated check. Four doses of cyazypyr 10% OD (60, 75, 90 and 105g a.i./ha in both year 2011 and 2012) were sprayed every year for their efficacy along with fipronil 5% SC @ 60 g a.i./ha, Flubendiamide 40% SC @ 30g a.i./ ha and Profenofos 50% SC @ 500 g a.i./ ha as standard check. Cyazypyr 10% OD @ 180 and 360 g a.i./ha were tested for their effect on crop health. The crop was sprayed 5 times with the insecticides using 500 liters of water / ha at an interval of 10 days starting from 30 days after planting. Control plots were treated with equal amount of water only. Data on per cent shoot damage by shoot and fruit borer was recorded from 5 row only selected fixed plants / plot before and 10 days after each spraying. Data on fruit infestation was recorded on whole plot basis at each harvest and the weight of healthy and infested fruits were recorded. The population of natural enemies was also recorded from the selected plants on the above mentioned dates.

RESULTS AND DISCUSSION

Bio-efficacy of cyazypyr 10% OD against whitefly, *Bemisia tabaci* Genn.

The population of whitefly, *B. tabaci* recorded / 5 leaves before and 3, 7 and 10 days after each spray in two different seasons are presented in Table 1 and 2. The data clearly showed that cyazypyr 10% OD @ 105g and 90g a.i/ha harboured lowest post treatment population of the insect in most of the observations (0.53 - 3.33, 0.40 - 3.40 and 0.87 - 2.60, 0.73 - 3.20 whiteflies / 5 leaves, respectively in 2011 and 2012). Flubendiamide 40% SC @ 30g a.i. /ha harboured maximum whitefly populations among the insecticidal treatments (3.33 - 7.40 and 1.87 - 9.80 whiteflies / 5 leaves, respectively in 2011 and 2012) though it was found to be statistically homogeneous with cyazypyr 10% OD @ 60g and 75g a.i. / ha and profenofos 50% EC @ 500g a.i. / ha (2.60 and 6.0,1.0 6.67, 1.20 - 4.20 and 0.73 - 4.53, and 2.13 - 5.67 and 1.53 - 6.20 whiteflies / 5 leaves, respectively in 2011 and 2012) in some of the observations. Flubendiamide 40% SC @ 30g a.i. / ha was the least effective treatment which was often on a par with cyazypyr 10% OD @ 60g a.i / ha (2.60 - 6.0 and 1.0 - 6.67 whiteflies / 5 leaves, respectively in 2011 and 2012).

In the season 2012, cyazypyr 10% OD @ 105g and 90g a.i. / ha were superior to all other insecticidal treatments up to 10 days after spray (1.41 – 2.23 and 1.70 – 2.18 whiteflies / 5 leaves, respectively). Cyazypyr 10% OD @ 75g a.i. / ha (2.52 - 3.12 whiteflies / 5 leaves) and fipronil 5% SC @ 60g a.i. / ha (2.89 - 3.32 whiteflies / 5 leaves), though were on a par with earlier two treatments, showed similar performance with profenofos 50% EC @ 500g a.i. / ha after 3 and 10 days of sprays (3.13 – 4.08 whiteflies / 5 leaves). Fipronil 5% SC @ 60g ai /ha was, however, at par with cyazypyr 10% OD @ 60g a.i. / ha (3.24 - 4.17 whiteflies / 5 leaves) up to 7 days after the treatment. In this year also, flubendiamide 40% SC @ 30g a.i. / ha was the least effective insecticide with an average population of 4.11- 6.13 whiteflies / 5 leaves. This treatment, however, was on a par with cyazypyr 10% OD @ 60g a.i. / ha after 10 days of sprays (Table 2). These results are also in line with the findings of Borad *et al.* [2]; Muthukumar & Kalyanasundaram [9]; Patel *et al.* [10]; Biswas & Chatterjee [1] and Mandal *et al.* [6].

Average post-treatment populations in different insecticidal treatments derived from 5 sprays in 2011 and 2012, showed superiority of cyazypyr 10% OD @ 105 and 75g a.i. / ha over other treatments up to 10 days after spray with 0.97 - 1.27 and 1.24 - 1.70 whiteflies / 5 leaves respectively. Cyazypyr 10% OD @ 75g a.i. / ha, fipronil 5% SC @ 60g a.i. / ha and profenofos 50% EC @ 500g a.i. / ha were at par among them up to 10 days after treatment (2.78 - 3.07, 2.63 - 3.67 and 3.28 - 373 whiteflies / 5 leaves, respectively). Cyazypyr 10% OD @ 60g a.i. / ha (3.95 whiteflies / 5 leaves) was on a par with profenofos 50% EC @ 500g a.i. / ha up to 3 days after sprays, but became at par with fipronil 5% SC @ 60g ai/ha also thereafter. Flubendiamide 40% SC @ 30g a.i. /ha harboured high population of whiteflies (4.23 – 6.21 whiteflies / 5 leaves), among the insecticidal treatments and it showed with similar performance with cyazypyr 10% OD @ 60g a.i. / ha only at 3 days after the sprays.

Bio-efficacy of cyazypyr 10% OD against jassid, *Empoasca flavescens* Distant

Treatment wise populations of jassid nymphs and adults recorded in two different seasons, cyazypyr 10% OD @ 105 and 90g a.i. / ha had lowest infestation of jassid (1- 3.53, 1.2 - 4.07 and 1- 3.40, 0.80 - 3.40 / 5 leaves, respectively in 2011 and 2012) in both the seasons, though their relative position changed in different observations (Table 3 and 4). These two treatments showed similar performance with fipronil 5% SC @ 60g a.i. / ha (1.20 - 4.67 and 1.60 - 3.40 jassids / 5 leaves, respectively in 2011 and 2012) more

frequently as compared to profenofos 50% EC @ 500g a.i. / ha (1.80-5.87 and 1.20 - 5.80 jassids / 5 leaves, respectively in 2011 and 2012) and cyazypyr 10% OD @ 75g a.i. / ha (1.80 - 5.20 and 1.60 - 5.07 jassids / 5 leaves, respectively in 2011 and 2012). Flubendiamide 40% SC @ 30g a.i. / ha harboured maximum jassid populations (3.92 - 7.07 and 3.20 - 6.67 jassids / 5 leaves, respectively in 2011 and 2012) among the insecticidal treatments, though it was found to be statically homogeneous with cyazypyr 10% OD @ 60 and 75g a.i. / ha and profenofos 50% EC @ 500g a.i. / ha in some of the observations.

In the year 2012, cyazypyr 10% OD @ 105 and 90g a.i. / ha (2.17 and 2.51 jassids / 5 leaves, respectively) failed to show any significant difference from fipronil 5% SC @ 60g a.i. / ha (2.61 jassids / 5 leaves) and cyazypyr 10% OD @ 75g a.i. / ha (2.73 jassids / 5 leaves) up to 3 days after spray. After 7 days of spray, however cyazypyr 10% OD @ 90g a.i. / ha was on a par with fipronil 5% SC @ 60g a.i. / ha (2.71 jassids / 5 leaves). The later, however, failed to show any significant difference from cyazypyr 10% OD @ 75g a.i. / ha (3.03 jassids / 5 leaves) and profenofos 50% EC @ 500g a.i. / ha (3.28 jassids / 5 leaves). After 10 days of spray, cyazypyr 10% OD @ 105g and 90g a.i. / ha was superior to rest of the treatments in harbouring lowest number of jassid (1.0 – 3.53 and 0.80 – 4.33 / 5 leaves, respectively). Fipronil 5% SC @ 60g a.i. / ha, cyazypyr 10% OD @ 75g a.i. / ha and profenofos 50% EC @ 500g a.i. / ha was statically homogeneous among them (3.33, 3.68 and 3.93 jassids / 5 leaves, respectively). The last two treatments, however, failed to show better performance than cyazypyr 10% OD @ 60g a.i. / ha. Flubenbiamide 40% SC @ 30g a.i. / ha (3.93- 5.29 jassids / 5 leaves) was on a par with cyazypyr 10% OD @ 60g a.i. / ha and profenofos 50% EC @ 500g a.i. / ha after 3 days of spray, and with cyazypyr 10% OD @ 60g a.i. / ha at 10 days after the spray. Mandal [6], reported that cyazypyr 10% OD @ 90 g a.i./ha may be recommended for effective control of pest complex of tomato.

The mean values of jassid population (average of 5 treatments), recorded in two different crop seasons have been presented in Table 5. In the year 2011 and 2012, cyazypyr 10% OD @ 105g and 90g a.i. / ha showed its superiority over other treatments in most of the observations (1.93 - 2.17 and 2.17 - 2.57 jassids / 5 leaves, respectively). Among the standard checks, flubendiamide 40% SC @ 30g a.i. / ha showed poor performance with 3.92 - 5.07 jassids / 5 leaves. Average jassid population, observed in profenofos 50% EC @ 500g a.i. / ha was 3.38 - 4.04 jassids / 5 leaves and this treatment was on a par with cyazypyr 10% OD @ 75g a.i. / ha (3.33 jassids / 5 leaves) up to 7 days after treatment, and with cyazypyr 10% OD @ 60g a.i. / ha (4.07 jassids / 5 leaves) up to 10 days after treatment. Fipronil 5% SC @ 60g a.i. / ha, though showed similar performance with cyazypyr 10% OD @ 105g and 90g a.i. / ha up to 3 days after treatment (2.65 jassids / 5 leaves), showed relatively lower performance thereafter and was on a par with cyazypyr 10% OD @ 75g a.i. / ha after 7 days of spray (2.95 jassid / 5 leaves) and cyazypyr 10% OD @ 75 and 60g a.i. / ha after 10 days of after spray (3.53 jassid / 5 leaves). Table 6.

Table 1: Number of whiteflies (adults) / 5 leave in different treatment (2011)

TREATMENT	1st spray			2nd spray			3rd spray			4th spray			5th spray			
	PT 1	3DAS	7DAS	PT2	3DAS	7DAS	PT3	3DAS	7DAS	PT4	3DAS	7DAS	PT5	3DAS	7DAS	10DAS
Cyazypyr 10% OD@ 60g a.i./ha	11.60 (3.40)	3.53 (1.88)	3.87 (1.97)	6.00 (2.45)	4.07 (2.01)	4.27 (2.06)	5.60 (2.36)	4.20 (2.05)	4.67 (2.15)	5.87 (2.42)	4.80 (2.18)	5.00 (2.24)	4.20 (2.04)	3.13 (1.77)	2.60 (1.61)	4.53 (2.12)
Cyazypyr 10% OD @ 75ga.i./ha	12.07 (3.47)	2.60 (1.60)	3.20 (1.79)	4.20 (2.05)	2.47 (1.57)	3.33 (1.83)	4.00 (2.00)	2.60 (1.61)	3.20 (1.79)	3.33 (1.83)	3.93 (1.98)	4.07 (2.02)	2.93 (1.70)	2.27 (1.51)	1.20 (1.09)	3.13 (1.77)
Cyazypyr 10% OD @ 90ga.i./ha	10.20 (3.18)	1.47 (1.20)	1.87 (1.37)	1.93 (1.39)	1.33 (1.15)	2.40 (1.54)	2.53 (1.59)	2.20 (1.09)	2.33 (1.52)	2.60 (1.61)	1.00 (1.00)	1.07 (1.03)	1.00 (1.00)	1.20 (1.10)	0.87 (0.89)	2.17 (1.47)

2.24 (1.50)	4.08 (2.02)	3.33 (1.83)	6.13 (2.48)	8.60 (2.93)	0.11
0.53 (0.72)	3.00 (1.81)	1.67 (1.28)	5.67 (2.38)	5.40 (2.32)	0.30
1.00 (1.00)	2.80 (1.67)	2.67 (1.63)	3.33 (1.83)	4.87 (2.21)	0.39
1.00 (1.00)	3.87 (1.97)	3.13 (1.77)	5.60 (2.36)	10.53 (3.24)	0.30
0.87 (0.93)	4.37 (2.09)	4.20 (2.04)	6.00 (2.44)	8.80 (2.79)	0.24
0.53 (0.72)	4.13 (2.03)	4.00 (1.99)	5.33 (2.29)	11.80 (3.43)	0.37
3.33 (1.82)	5.67 (2.38)	5.93 (2.43)	6.93 (2.63)	11.87 (3.42)	0.38
1.20 (1.09)	4.07 (2.01)	4.33 (2.06)	6.20 (2.48)	9.13 (3.02)	0.38
1.00 (1.00)	3.93 (1.98)	2.00 (1.41)	4.60 (2.14)	9.93 (3.15)	0.29
2.27 (1.49)	4.20 (2.04)	4.07 (2.02)	6.00 (2.45)	8.33 (2.87)	0.36
1.87 (1.36)	3.60 (1.90)	4.00 (2.00)	5.93 (2.44)	7.67 (2.76)	0.24
1.07 (1.03)	3.40 (1.82)	2.60 (1.60)	4.40 (2.09)	9.60 (3.10)	0.33
1.87 (1.37)	4.13 (2.03)	3.93 (1.98)	7.40 (2.72)	11.60 (3.40)	0.17
1.60 (1.25)	2.60 (1.61)	3.00 (1.73)	5.40 (2.32)	11.53 (3.39)	0.30
1.27 (1.12)	2.13 (1.46)	1.87 (1.36)	3.40 (1.84)	14.33 (3.78)	0.26
10.47 (3.23)	12.73 (3.57)	9.13 (3.12)	12.20 (3.49)	12.53 (3.25)	NS

Cyazypyr 10% OD@105ga.i./ ha	Profenofos 50% EC @500ga.i./ha	Fipronil 5% SC @ 60g a.i./ ha	Flubendiamide 40% SC @ 30g a.i /ha	Untreated Control	CD

*Values within parentheses are square root transformed

Table 2: Number of whiteflies (adults) / 5 leave in different treatment (2012)

TREATMENT	1st spray			2nd spray			3rd spray			4th spray			5th spray		
	PT	3DAS	7DAS	PT	3DAS	7DAS	PT	3DAS	7DAS	PT	3DAS	7DAS	PT	3DAS	7DAS	10DAS
Cyazypyr 10% OD @ 60 ga.i./ha	13.80 (3.71)*	1.00 (1.00)	3.20 (1.79)	6.47 (2.53)	3.67 (1.91)	5.00 (2.24)	6.00 (2.36)	2.07 (1.44)	5.07 (2.24)	6.33 (2.51)	4.80 (2.19)	5.00 (2.24)	5.40 (2.32)	4.67 (2.16)	2.60 (1.61)	4.53 (2.12)
Cyazypyr 10% OD @ 75ga.i./ha	14.27 (3.76)	0.73 (0.84)	1.87 (1.29	2.40 (1.55)	3.07 (1.75)	3.47 (1.86)	3.80 (1.92)	1.80 (1.34)	2.20 (1.48)	3.67 (1.91)	4.33 (2.08)	4.53 (2.12)	4.00 (2.00)	2.60 (1.61)	2.27 (1.49)	3.13 (1.77)
Cyazypyr 10% OD @ 90ga.i./ha	17.87 (4.22)	0.73 (0.84)	1.22 (1.10)	2.00 (1.41)	1.80 (1.34)	2.00 (1.41)	2.20 (1.48)	1.20 (1.09)	2.00 (1.41)	2.67 (1.63)	3.13 (1.77)	3.07 (1.75)	3.20 (1.79)	1.60 (1.25)	1.20 (1.08)	2.17 (1.47)

Cyazypyr 10% OD @ 105ga.i./ha	Profenofos 50% EC @ 500g a.i./ha	Fipronil 5% SC @ 60g a.i./ ha	Flubendiamide 40% SC @ 30g a.i /ha	Untreated Control	CD
2.24 (1.50)	4.08 (2.02)	3.33 (1.83)	6.13 (2.48)	8.60 (2.93)	0.12
1.00 (1.00)	3.33 (1.83)	3.30 (1.82)	4.53 (2.50)	6.33 (2.50)	0.45
1.40 (1.17)	4.33 (2.08)	3.73 (1.92)	5.53 (2.35)	7.00 (2.63)	0.38
3.40 (1.84)	5.20 (2.28)	5.00 (2.22)	5.60 (2.36)	7.33 (2.71)	0.31
3.00 (1.73)	4.00 (2.00)	4.60 (2.14)	6.20 (2.48)	11.00 (3.31)	0.24
2.67 (1.63)	4.60 (2.14)	4.53 (2.12)	5.33 (2.30)	9.53 (3.09)	0.25
3.40 (1.84)	6.20 (2.49)	5.93 (2.42)	6.40 (2.53)	9.93 (3.14)	0.29
2.50 (1.58)	4.87 (2.21)	2.07 (1.44)	6.07 (2.46)	8.80 (2.95)	0.29
1.00 (0.99)	2.00 (1.38)	1.80 (1.34)	3.20 (1.78)	6.40 (2.52)	0.35
2.27 (1.49)	4.53 (2.13)	4.47 (2.11)	5.60 (2.36)	7.40 (2.70)	0.42
2.33 (1.53)	4.07 (2.01)	3.20 (1.79)	5.53 (2.35)	6.80 (2.60)	0.31
1.60 (1.26)	3.13 (1.77)	3.07 (1.73)	4.60 (2.13)	6.80 (2.60)	0.32
1.60 (1.26)	3.27 (1.81)	2.33 (1.53)	9.80 (3.11)	13.20 (3.63)	0.35
1.00 (1.00)	2.73 (1.65)	2.00 (1.41)	5.00 (2.23)	12.00 (3.46)	0.23
0.40 (0.62)	1.53 (1.24)	1.33 (1.15)	1.87 (1.34)	10.47 (3.23)	0.32
14.13 (3.76)	15.07 (3.85)	14.20 (3.75)	14.20 (3.74)	16.80 (4.09)	NS

*Values within parentheses are square root transformed

Table 3: Number of jassid (nymph & adults) / 5 leaves in different treatments (2011)

TREATMENTS	1st spray			2nd spray			3rd spray			4th spray			5th spray			
	PT	3DAS	7DAS	PT	3DAS	7DAS	PT	3DAS	7DAS	PT	3DAS	7DAS	PT	3DAS	7DAS	10DAS
Cyazypyr 10% OD @ 60 ga.i./ha	7.07 (2.66)*	4.48 (2.12)	6.00 (2.45)	4.40 (2.10)	3.28 (1.81)	4.00 (2.00)	5.30 (2.30)	3.48 (1.84)	3.80 (1.95)	4.60 (2.14)	3.19 (1.77)	4.40 (2.09)	3.80 (1.95)	2.88 (1.70)	3.00 (1.73)	2.00 (1.41)
Cyazypyr 10% OD @ 75ga.i./ha	6.80 (2.61)	3.93 (1.98)	4.60 (2.14)	3.13 (1.77)	3.40 (1.83)	3.93 (1.98)	4.20 (2.05)	3.53 (1.88)	3.93 (1.98)	4.60 (2.14)	5.20 (2.27)	5.07 (2.25)	2.60 (1.61)	2.80 (1.67)	3.67 (1.90)	1.80 (1.34)
Cyazypyr 10% OD @ 90ga.i./ha	6.53 (2.55)	2.47 (1.57)	3.20 (1.78)	2.80 (1.67)	2.40 (1.55)	2.73 (1.65)	3.00 (1.73)	2.53 (1.59)	2.80 (1.67)	2.70 (1.64)	3.40 (1.84)	4.07 (2.02)	1.80 (1.34)	2.00 (1.41)	2.73 (1.65)	1.20 (1.09)
Cyazypyr 10% OD @ 105ga.i./ha	6.47 (2.54)	2.00 (1.41)	2.93 (1.70)	2.27 (1.50)	2.13 (1.46)	1.53 (1.23)	3.53 (1.87)	2.13 (1.45)	2.47 (1.57)	2.20 (1.48)	2.87 (1.69)	3.53 (1.88)	1.40 (1.18)	1.73 (1.29)	2.53 (1.58)	1.00 (1.00)
Profenofos 50% EC @ 500g a.i./ha	6.93 (2.63)	3.00 (1.73)	4.27 (2.06)	3.80 (1.95)	3.93 (1.98)	5.00 (2.23)	4.60 (2.14)	3.13 (1.77)	4.00 (2.00)	5.87 (2.42)	4.00 (2.00)	5.60 (2.37)	4.20 (2.05)	3.00 (1.72)	3.40 (1.84)	1.80 (1.34)
Fipronil 5% SC @ 60g a.i./ ha	6.47 (2.54)	2.40 (1.55)	4.00 (2.00)	4.00 (2.00)	2.80 (1.66)	3.33 (1.82)	4.53 (2.13)	3.00 (1.73)	3.33 (1.82)	4.67 (2.16)	3.00 (1.71)	3.67 (1.91)	3.27 (1.81)	2.00 (1.41)	2.40 (1.54)	1.20 (1.10)
Flubendiamide 40% SC @ 30g a.i /ha	6.40 (2.53)	6.12 (2.47)	7.07 (2.66)	4.53 (2.13)	4.72 (2.12)	4.00 (2.00)	5.60 (2.37)	3.92 (1.98)	4.87 (2.20)	5.40 (2.32)	5.28 (2.30)	5.40 (2.32)	4.80 (2.18)	3.72 (1.93)	4.00 (2.00)	4.20 (2.05)
Untreated Control	7.13 (2.67)	7.67 (2.76)	6.00 (2.44)	7.07 (2.66)	8.00 (2.83)	8.53 (2.91)	9.00 (3.00)	8.27 (2.87)	9.00 (3.00)	8.53 (2.92)	9.33 (3.05)	8.20 (2.84)	6.13 (2.47)	7.00 (2.64)	6.5 (2.56)	6.20 (2.48)
CD	NS	0.30	0.30	0.18	0.20	0.30	0.22	0.30	0.30	0.19	0.40	0.40	0.21	0.30	0.26	0.19

*Values within parentheses are square root transformed

Table 4: Number of jassid (nymph & adults) / 5 leaves in different treatments (2012)

TREATMENT		Cyazypyr 10% OD@ 60 ga.i./ha	Cyazypyr 10% OD @ 75ga.i./ha	Cyazypyr 10% OD @ 90ga.i./ha	Cyazypyr 10% OD @105ga.i./ha	Profenofos50% EC@500ga.i./ha	Fipronil 5%SC @ 60g a.i./ha	Flubendiamide4 0% SC@ 30g a.i /ha	Untreated Control	CD
1st spray	PT 1	6.20 (2.48)	5.00 (2.23)	3.60 (1.89)	5.13 (2.24)	5.47 (2.34)	4.27 (2.06)	5.60 (2.36)	6.53 (2.53)	NS
	3DAS	1.73 (1.31)	1.60 (1.26)	1.33 (1.13)	1.13 (1.05)	1.80 (1.34)	1.33 (1.15)	4.00 (2.00)	7.67 (2.77)	0.25
	7DAS	5.00 (2.24)	3.40 (1.82)	2.47 (1.57)	2.00 (1.41)	3.00 (1.73)	2.40 (1.55)	6.00 (2.44)	7.53 (2.74)	0.34
2nd spray	PT2	5.40 (2.32)	4.60 (2.14)	3.00 (1.73)	2.80 (1.67)	4.27 (2.06)	4.20 (2.04)	6.47 (2.54)	6.60 (2.56)	0.42
	3DAS	3.93 (1.98)	2.47 (1.57)	2.73 (1.65)	1.53 (1.23)	4.00 (2.00)	2.60 (1.60)	4.00 (2.00)	8.00 (2.83)	0.33
	7DAS	3.80 (1.95)	3.00 (1.73)	2.40 (1.55)	2.13 (1.46)	6.40 (2.52)	3.40 (1.84)	4.20 (2.05)	8.53 (2.91)	0.31
3rd spray	PT 3	6.00 (2.28)	4.80 (2.19)	3.00 (1.73)	2.60 (1.61)	5.40 (2.32)	4.00 (2.00)	5.80 (2.40)	9.80 (3.13)	0.34
	3DAS	4.00 (2.00)	3.33 (1.82)	2.80 (1.66)	2.47 (1.57)	5.00 (2.23)	3.13 (1.77)	3.80 (1.95)	8.27 (2.87)	0.28
	7DAS	3.40 (1.84)	2.53 (1.59)	2.13 (1.45)	3.53 (1.88)	4.07 (1.98)	3.00 (1.73)	4.00 (2.00)	9.00 (3.00)	0.43
4th spray	PT4	5.00 (2.23)	4.20 (2.05)	2.60 (1.61)	2.40 (1.55)	4.60 (2.14)	3.60 (1.89)	5.40 (2.32)	7.40 (2.72)	0.28
	3DAS	3.80 (1.94)	3.00 (1.72)	3.40 (1.84)	3.13 (1.77)	5.80 (2.41)	3.00 (1.72)	4.00 (2.00)	8.20 (2.84)	0.43
	7DAS	4.40 (2.09)	5.07 (2.25)	4.33 (2.08)	3.00 (1.73)	5.60 (2.37)	3.40 (1.84)	5.53 (2.34)	8.60 (2.93)	0.28
5th spray	PT 5	4.20 (2.05)	3.20 (1.79)	1.80 (1.34)	3.40 (1.84)	4.20 (2.05)	3.20 (1.79)	5.00 (2.23)	6.13 (2.47)	0.34
	3DAS	3.40 (1.84)	2.73 (1.65)	2.27 (1.50)	2.53 (1.59)	2.40 (1.54)	3.00 (1.73)	4.00 (2.00)	7.00 (2.64)	0.25
	7DAS	2.80 (1.66)	2.47 (1.56)	2.00 (1.41)	1.73 (1.29)	3.00 (1.72)	2.00 (1.41)	3.20 (1.79)	6.53 (2.55)	0.41
	10DAS	2.00 (1.41)	1.60 (1.26)	0.80 (.89)	1.00 (1.00)	1.20 (1.09)	1.60 (1.26)	3.60 (1.90)	6.00 (2.45)	0.47

*Values within parentheses are square root transformed

Table 5: Number of jassid / 5 leaves in different treatment (Average of 5 sprays)

Treatments	2011				2012			
	PT	3DAS	7DAS	10DAS	PT	3DAS	7DAS	10DAS
Cyazypyr 10% OD @ 60 ga.i./ha	7.07 (2.66)*	3.88 (1.97)	3.85 (1.96)	4.07 (2.02)	6.20 (2.48)	3.80 (1.95)	4.11 (2.02)	4.47 (2.11)
Cyazypyr 10% OD @ 75ga.i./ha	6.80 (2.61)	3.77 (1.94)	3.33 (1.83)	3.27 (1.81)	5.00 (2.23)	2.63 (1.62)	3.03 (1.74)	3.68 (1.92)
Cyazypyr 10% OD @ 90ga.i./ha	6.53 (2.55)	2.57 (1.60)	2.17 (1.47)	2.30 (1.51)	3.60 (1.89)	2.51 (1.58)	2.27 (1.51)	2.23 (1.49)
Cyazypyr 10% OD @ 105ga.i./ha	6.47 (2.54)	2.17 (1.47)	1.93 (1.39)	2.07 (1.44)	5.13 (2.24)	2.17 (1.47)	2.08 (1.44)	2.13 (1.46)
Profenofos 50% EC @ 500ga.i./ha	6.93 (2.63)	3.41 (1.84)	3.38 (1.84)	4.04 (2.09)	5.47 (2.34)	3.37 (1.83)	3.28 (1.81)	3.93 (1.98)
Fipronil 5% SC @60g a.i./ ha	6.47 (2.54)	2.65 (1.63)	2.95 (1.72)	3.53 (1.88)	4.27 (2.06)	2.61 (1.61)	2.71 (1.65)	3.33 (1.83)
Flubendiamide40% SC @ 30g a.i /ha	6.40 (2.53)	4.40 (2.10)	3.92 (1.98)	5.07 (2.25)	5.60 (2.36)	3.93 (1.98)	5.07 (2.83)	5.29 (2.30)
Untreated Control	7.13 (2.67)	8.07 (2.84)	7.65 (2.76)	7.40 (2.72)	6.53 (2.53)	7.83 (2.80)	8.04 (2.83)	7.57 (2.74)
CD	NS	0.18	0.12	0.17	NS	0.15	0.19	0.22

*Values within parentheses are square root transformed

Table 6: Number of whiteflies / 5 leaves in different treatment (Average of 5 sprays)

Treatments	2011				2012			
	PT	3DAS	7DAS	10DAS	PT	3DAS	7DAS	10DAS
Cyazypyr 10% OD @ 60 ga.i./ha	11.60 (3.40)*	3.95 (1.99)	4.07 (2.02)	4.53 (2.13)	13.80 (3.71)	3.24 (1.80)	4.17 (2.04)	5.63 (2.37)
Cyazypyr 10% OD @ 75ga.i./ha	12.07 (3.47)	2.78 (1.67)	3.00 (1.73)	3.07 (1.75)	14.27 (3.76)	2.52 (1.58)	2.87 (1.69)	3.12 (1.77)
Cyazypyr 10% OD @ 90ga.i./ha	10.20 (3.18)	1.24 (1.11)	1.70 (1.30)	1.67 (1.29)	17.87 (4.22)	1.70 (1.30)	1.90 (1.38)	2.18 (1.47)
Cyazypyr 10% OD @ 105ga.i./ha	10.47 (3.23)	0.97 (0.98)	1.20 (1.09)	1.27 (1.12)	14.13 (3.76)	1.41 (1.18)	1.97 (1.40)	2.23 (1.49)
Profenofos 50% EC @ 500ga.i./ha	12.73 (3.57)	3.28 (1.81)	3.53 (1.88)	3.73 (1.93)	15.07 (3.85)	3.13 (1.77)	3.81 (1.95)	4.08 (2.02)
Fipronil 5% SC @60g a.i./ ha	9.13 (3.12)	2.63 (1.62)	3.23 (1.79)	3.67 (1.91)	14.20 (3.75)	2.89 (1.70)	3.04 (1.74)	3.32 (1.82)
Flubendiamide 40% SC @ 30g a.i /ha	12.20 (3.49)	4.23 (2.05)	5.84 (2.41)	6.21 (2.49)	14.20 (3.74)	4.11 (2.02)	5.47 (2.34)	6.13 (2.48)
Untreated Control	12.53 (3.25)	10.17 (3.18)	7.93 (2.81)	10.10 (3.17)	16.80 (4.09)	8.07 (2.84)	8.99 (2.99)	8.69 (2.95)
CD	NS	0.21	0.24	0.24	0.67	0.19	0.14	0.15

*Values within parentheses are square root transformed

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