Research Article

BIOEFFICACY OF IMIDACLOPRID AND THIACLOPRID AGAINST CHILLI APHID (*Aphis gossypii* GLOVER) IN MID HILLS OF MEGHALAYA

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ABSTRACT
The field experiment was conducted to evaluate the bioefficacy of imidacloprid and thiacloprid against chilli aphid (*Aphis gossypii*) during post *kharif* season of 2017at ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya, India. The experiment was laid out in randomized block design (RBD) with seven treatments and three replications. Chilli (cultivar: Guntur Hope) seedlings (35 days old) were transplanted in 3mX4 m area with a spacing of 60 cm (R-R) × 40 cm (P-P). Total treatments *viz.* imidacloprid 17.8% SL (25 and 50 g a.i./ha), thiacloprid 21.7% SC (54 and 108 g a.i./ha) and dimethoate 30% EC (300 and 600 g a.i./ha) were applied twice at fifteen days intervals along with untreated control. The bioefficacy study revealed that the overall mean reduction of chilli aphid population was highest in imidacloprid at 50 g a.i. ha^{-1} with 80.33% reduction followed by thiacloprid (79.84%). The maximum fruit yield was also recorded in imidacloprid @ 50 g a.i./ha with 28.80 q/ha.

INTRODUCTION

India is the world's largest producer, consumer and exporter of spices. Chilli is the largest produced spice in India and it is also named as wonder spice. Different varieties are cultivated for various uses like vegetable, spice, pickles and condiments. Chillies are the most important ingredient in many different cuisines around the world as it adds pungency, taste, flavour and colour to the dishes. Indian chilli is famous for two important commercial qualities namely, colour and pungency levels. Some varieties are famous for the red colour because of the pigment and other quality parameters in chilli are length, width and skin thickness. India is the world leader in chilli production followed by China and Pakistan. In India, chilli is grown in almost all states. It is grown in an area of 774.9 thousand hectare with production of 1492.10 thousand tonnes and the productivity is 1.93 tonnes per hectare. In Meghalaya, chilli is grown in an area of 0.26 thousand ha with a production of about 0.11 thousand tonnes (Das, 2016). Although India's share in global chilli production is high, there are different factors that contribute to its low productivity and production which includes unfavourable climate condition, low quality seeds, insect pests, mites and diseases. The insect pests and mites are of prime importance which altogether significantly affects both the quality and production of chilli. About 51 insect and 2 mite species, belonging to 27 families and 9 orders were found infesting chilli (Reddy and Puttaswamy, 1983). Among these whitefly, *Bemisia tabaci*; thrips, *Scirtothrips dorsalis*; jassid, *Amrasca biguttula biguttula*; aphid, *Aphis gossypii* and mites, *Polyphagotarsonemus latus* are important sucking pests contributing 60 to 75 % yield loss in chilli crop (Tukaram *et al*., 2017). These sucking pests cause serious damage by direct feeding and they also transmit different viral diseases of chilli. Chilli aphid, (*Aphis gossypii* Glover) is one of the limiting factors in achieving expected higher productivity of improved varieties of chilli in India (Kumar *et al.,* 2010). Under favourable conditions, chilli aphid reproduces at a faster rate and may cause damage up to 15-30% of total chilli production (Reddy and Puttaswamy, 1984). Aphids constitute the largest vector group transmitting plant viruses. In chilli, this aphid have been known to be a vector of viruses such as *Chilli mosaic virus* (CMV), *Chilli veinal mottle virus* (CVMV), *Potato Virus Y* (PVY) and *Pepper vein banding virus* (PVBV). In India, CVMV and PVBV are economically important viruses causing yield loss to an extent of 50 percent when chilli crop becomes infected at early stage (Ong *et al*., 1980; Ravi *et al*., 1991). In Meghalaya the occurrence of *Chilli veinal mottle virus* in naga chilli (*Capsicum chinense*) has also been reported (Banerjee *et al.,* 2014). Chilli growers in India depend heavily on conventional synthetic pesticides to combat sucking pests in chilli. Due to indiscriminate use of these insecticides, there are several problems like resistance development among pests and environmental pollution. To overcome these problems, use of molecules like neonicotinoids with different biochemical targets as well as low dose are very much essentials. Therefore, the present experiment was conducted to evaluate some neonicotinoid insecticides for effective management of chilli aphid.

MATERIALS AND METHODS

The field experiment was conducted to evaluate the bioefficacy of imidacloprid and thiacloprid against chilli aphid (*Aphis gossypii*) during post *kharif* season of 2017at ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya, India. The experiment was laid out in randomized block design (RBD) with seven treatments and three replications. Chilli (cultivar: Guntur Hope) seedlings (35 days old) were transplanted in 3mX4 m area with a spacing of 60 cm (R-R) × 40 cm (P-P). Total treatments *viz.* imidacloprid 17.8% SL (25 and 50 g a.i./ha), thiacloprid 21.7% SC (54 and 108 g a.i./ha) and dimethoate 30%EC (300 and 600 g a.i./ha) were applied twice at fifteen days intervals along with untreated control. The insecticides were applied in the form of foliar spray during morning hours with the help of pneumatic knapsack sprayer using spray fluid @ 400 l/ha. The observations on pest incidence were recorded one day before spraying as pre-treatment count and subsequently on 1, 3, 7, 10 and 14 days after insecticide spray. Aphis population was recorded from top, middle and bottom leaves/plant covering randomly selected five plants /plot. Mean mortality of aphid was calculated and then the data was subjected to suitable transformation and Critical Difference (CD) was worked out at 5% level of significance. Mean values were compared by Duncan Multiple Range Test. Method for estimation the reduction in aphid population was calculated with the following formula:

$$\text{Reduction }\% = \frac{(\text{Population in control} - \text{Population in treatment})}{\text{Population in control}} \times 100$$

RESULTS AND DISCUSSION

Bioefficacy of insecticidal treatments against chilli aphids during first spray

The result on efficacy of different insecticidal treatments on aphid population after first spray is presented in Table 1. The mean per cent reduction of aphid population at different day's intervals of spraying showed that all the treatments were significantly superior over untreated control. After one and third day of spray, there was no significantly different among the treatments except control but seven day after spray there was a significant difference among the treatments. Imidacloprid at 50 g a.i. ha^{-1} recorded the highest population reduction of 80.73.87% which was at par with thiacloprid @108g a.i./ha (78.61%). Among the insecticidal treatments, diamethoate at recommended dose was relatively less effective but significantly superior over untreated control plots. On 10 and 14 days after spray there was slight variation of efficacy among the treatments but mean population reduction showed the similar trend of efficacy found as in 7th day after spray.

Bioefficacy of insecticidal treatments against chilli aphids during first spray

The efficacy of different treatments on reduction of aphid population during second spray is presented in Table 2. All the treatments were superior over untreated control. The per cent reduction of aphid population was varied significantly at different days interval except on 7th day after spray. Imidacloprid at 50 g a.i. ha^{-1} gave the highest per cent reduction of aphid population of 82.68% and was at par with other treatments except dimethoate at 300 g a.i. ha^{-1} which recorded the lowest aphid population (69.39%). After three and ten and fourteen day of spray, the similar trend was also found. Mean data indicated that imidacloprid @ 50 g a.i./ha was the best treatment in reducing the aphid population(85.77%) followed by thicloprid @108 g a.i./ha (83.66%). Recommended dose of imidacloprid and thicloprid were at par with 81.78 and 80.73% reduction of aphid population, respectively. Among the insecticidal treatments, dimethoate at both doses were not as effective as new insecticides.

Pooled efficacy of treatments on aphid population and on yield

Of all insecticidal treatments, the highest per cent aphid population reduction was found in imidacloprid at 50 g a.i. ha^{-1} with 80.33% reduction followed by thiacloprid at 108 g a.i. ha^{-1} (79.84%). The next effective treatments were thiacloprid at 54 g a.i.ha^{-1}(74.84%) and imidacloprid at 25 g a.i. ha^{-1} (74.64%). Green fruit yield of all the treated plots were significantly higher over untreated control. Maximum green fruit yield was recorded in plots treated with imidacloprid at 50 g a.i. ha^{-1} (28.80 q/ha) followed by thiacloprid at 108 g a.i. ha^{-1} (27.49 q/ha). Among the treated plots, the minimum yield (20.73 q/ha) was observed in dimethoate at 300 g a.i. ha^{-1} while in control plots the yield was only 17.25 q/ha. Pooled data on the effects of insecticides on reduction of aphid population and on yield of chilli is given in Figure 1.

Table 1. Efficacy of different insecticidal treatments against chilli aphid during first spray

Treatments	Dose (g a.i./ha)	Number of aphids	Percent reduction of aphid population at different days intervals					
			1DAS	3DAS	7DAS	10DAS	14DAS	Mean
Imidacloprid 17.8 SL	25	13.00^{a} (3.66)	64.53^{a} (54.30)	75.58^{a} (61.07)	76.13^{ab} (61.43)	69.98^{ab} (57.54)	51.24^{ab} (46.35)	67.49^{ab} (55.88)
Imidacloprid 17.8 SL	50	16.33^{a} (4.04)	79.87^{a} (64.18)	84.54^{a} (67.69)	80.73^{a} (64.69)	69.67^{ab} (57.33)	62.20^{a} (52.67)	74.90^{a} (60.60)
Thiacloprid 21.7 SL	54	12.33^{a} (3.57)	67.18^{a} (55.72)	74.63^{a} (60.78)	73.32^{ab} (59.55)	72.42^{a} (59.39)	57.23^{a} (49.87)	68.96^{ab} (56.96)
Thiacloprid 21.7 SL	108	13.33^{a} (3.69)	77.86^{a} (62.74)	81.98^{a} (65.78)	78.61^{a} (63.16)	73.79^{a} (59.92)	67.86^{a} (56.11)	76.02^{a} (61.37)
Dimethoate 30 EC	300	14.33^{a} (3.84)	64.06^{a} (54.11)	70.11^{a} (57.87)	59.78^{b} (51.22)	55.21^{c} (48.57)	36.21^{b} (37.58)	57.07^{c} (49.67)
Dimethoate 30 EC	600	11.33^{a} (3.43)	66.41^{a} (55.55)	73.53^{a} (60.18)	67.34^{ab} (55.76)	56.75^{bc} (49.50)	39.87^{b} (39.67)	60.78^{bc} (51.82)
Control	-	12.00^{a} (3.53)	0.00^{b} (5.74)	0.00^{b} (5.74)	0.00^{c} (5.74)	0.00^{d} (5.74)	0.00^{c} (5.74)	0.00^{c} (5.74)
SEm (±)	**-**	**-**	**3.39**	**2.76**	**3.26**	**2.80**	**3.16**	**1.81**
CD at 5%	**-**	**NS**	**10.44**	**8.50**	**10.04**	**8.63**	**9.74**	**5.59**

*Figures in parenthesis are angular transformed values; Difference in mean values was determined by DMRT. Mean sharing same letters in a column are not significantly different at 5% level of significance

Table 2. Efficacy of different treatments against chilli aphid during second spray

Treatments	Dose (g a.i./ha)	Number of aphids	Percent reduction of aphid population at different days intervals					
			1DAS	3DAS	7DAS	10DAS	14DAS	Mean
Imidacloprid 17.8 SL	25	8.00[bc] (2.90)	80.83[ab] (64.80)	85.39[ab] (68.54)	85.64[a] (68.96)	82.27[ab] (66.29)	74.77[abc] (60.74)	81.78[ab] (65.60)
Imidacloprid 17.8 SL	50	6.33[c] (2.61)	82.68[a] (66.40)	90.79[a] (73.71)	87.16[a] (70.85)	85.64[a] (68.96)	82.61[a] (66.31)	85.77[a] (68.81)
Thiacloprid 21.7 SL	54	7.00[c] (2.72)	78.76[ab] (63.46)	80.47[ab] (64.85)	83.79[a] (67.72)	80.76[ab] (65.07)	79.87[ab] (64.66)	80.73[ab] (64.84)
Thiacloprid 21.7 SC	108	5.33[c] (2.41)	78.87[ab] (63.74)	85.28[ab] (68.72)	88.27[a] (71.40)	83.91[a] (67.43)	81.95[a] (66.14)	83.66[ab] (76.11)
Dimethoate 30 EC	300	10.67[b] (3.34)	69.39[b] (57.15)	72.84[b] (59.51)	73.47[a] (59.74)	70.10[b] (57.61)	62.81[c] (53.07)	69.72[c] (57.35)
Dimethoate 30 EC	600	10.00[b] (3.23)	77.02[ab] (62.14)	76.66[b] (62.04)	76.61[a] (62.37)	77.28[ab] (62.32)	66.63[bc] (55.36)	74.84[bc] (60.71)
Control	-	16.67[a] (4.14)	0.00[c] (5.74)	0.00[c] (5.74)	0.00[b] (5.74)	0.00[c] (5.74)	0.00[d] (5.74)	0.00[d] (5.74)
SEm (±)		**0.16**	**2.54**	**2.58**	**2.75**	**2.44**	**2.86**	**1.73**
CD at 5%		**0.49**	**7.84**	**7.94**	**8.47**	**7.50**	**8.82**	**5.32**

*Figures in parenthesis are angular transformed values; Difference in mean values was determined by DMRT. Mean sharing same letters in a column are not significantly different at 5% level of significance

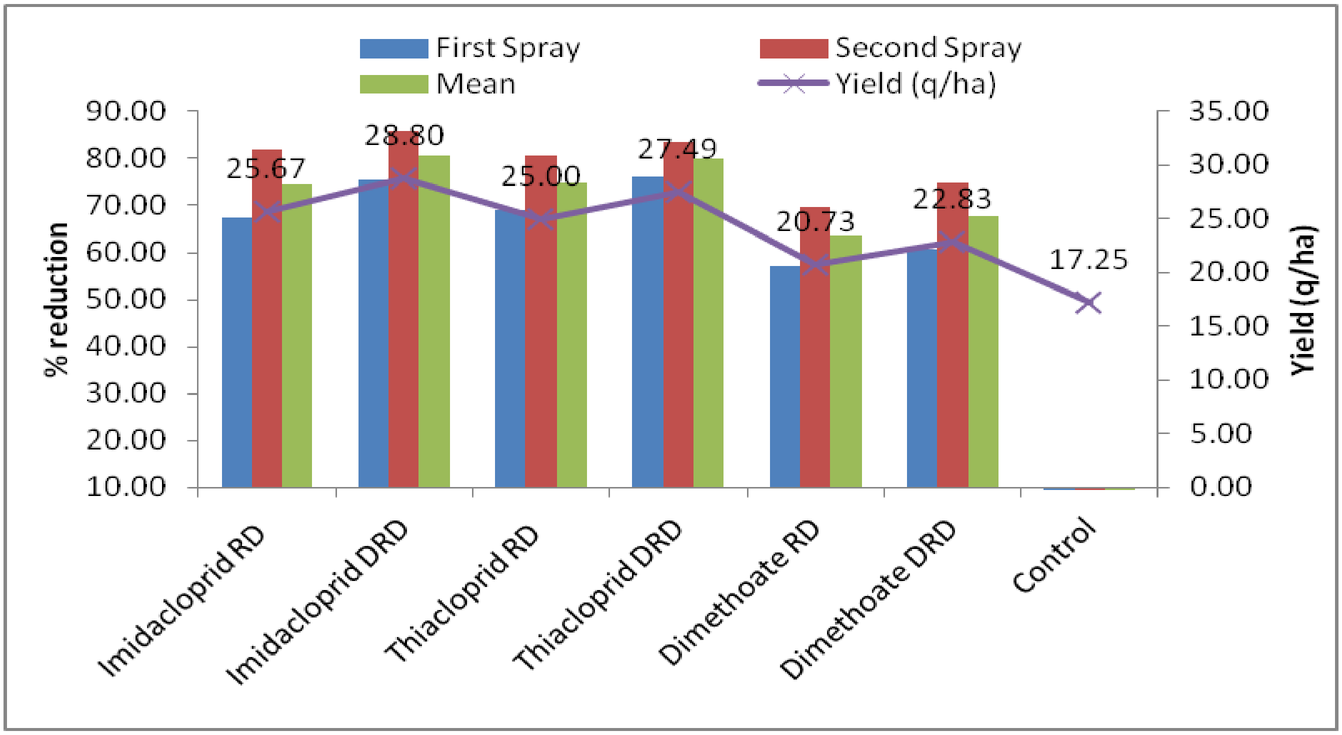

Fig. 1. Pooled effects of insecticides on reduction of aphid population and on yield of chilli

Findings from present study showed that all the insecticidal treatments were effective in reducing aphid population over untreated check. Pooled data of first and second spray showed that imidacloprid gave the highest population reduction of aphids followed by thiacloprid. The highest fruit yield was observed in plots treated with imidacloprid. The present findings are in agreement with the results of Rana *et al*. (2016) who reported that imidacloprid caused highest reduction of aphid, jassids and thrips in chilli along with the highest marketable yield. Similarly, Varghese and Mathew (2012) also reported that imidacloprid was effective in controlling aphid population which caused cent percent mortality at one day after spraying. While, findings of Agrawal *et al*. (2015) proved that imidacloprid 17.8 SL at 50 g a.i. ha^{-1} was the second best treatment after fipronil 5% SC at 50 g a.i. ha^{-1} against aphids. The results are in well conformation with finding of earlier workers Konar *et al.* (2013); Joshi and Sharma (2009); Ghosal *et al.* (2013); Jadhav *et al*. (2016) and Pawar and Patil (2018). Thiacloprid was also next best treatment in the present experiment in reducing aphid population. The results are in line with the findings of Walunj and Pawar (2004) who found that thiacloprid was effective in controlling aphids and whiteflies in chilli. The results are also in accordance with findings of Marcic *et al*. (2007) who reported that imidacloprid and thiacloprid gave over 95% efficacies while dimethoate showed low efficacy towards the aphid, *Myzus persicae* in chilli. According to Purhematy *et al*. (2013) thiacloprid 480 SC at 24 hrs after spray caused significant reduction in aphid population which is comparable with the present results. Rajawat *et al.* (2017) who stated that thiomethoxam 25% WG was significantly effective against aphid followed by thiacloprid 21.7% SC in urdbean. Thiacloprid in combination with flubendiamide at 120 g a.i ha^{-1} showed lower population of bollworms, aphids, whitefly and leaf hopper. However, Rounani *et al.* (2013) reported that imidacloprid and flonicamid are more effective against aphids in pomegranate than thiacloprid, and thiamethoxam. Efficacy of dimethoate are in agreement with Patel *et al.* (2017) who showed dimethoate was effective in controlling mustard aphid after thiamethoxam and imidacloprid.

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