International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 53, 2016, pp.-2621-2625.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EFFICIENCY OF SELECTED INSECTICIDES AGAINST GREEN PEACH APHID, *Myzus persicae* L. AND VIRUS INCIDENCE ON POTATO

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Received: August 22, 2016; Revised: September 17, 2016; Accepted: September 18, 2016; Published: November 01, 2016

Abstract- Studies were conducted in two locations of Chikkamagaluru district on the efficiency of some insecticides against *Myzus persicae* L. on potato crop at malnad (Hilly zone) belt of Karnataka during *Rabi* 2014-15. Results showed that, At Lakshmipura (Location 1), thiamethoxam followed by imidacloprid and acephate were effective in controlling aphid population. PVY incidence was low in thiamethoxam treated plots compared to other insecticide treated plot. However, none of the insecticides were effective in reducing PLRV incidence. At Karkipete (Location 2), imidacloprid, thiamethoxam, acetamiprid and acephate were effective. Pooled data of both the locations indicated, thiamethoxam and imidacloprid were superior in controlling aphid population. The implication of the study in seed potato production is discussed.

Keywords- *Myzus persicae,* Potato, Thiamethoxam, PVY, PLRV

Citation: Kumara B. B., et al., (2016) Efficiency of Selected Insecticides against Green Peach Aphid, *Myzus persicae* L. and Virus Incidence on Potato. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 53, pp.-2621-2625.

Academic Editor / Reviewer: Dr Neeraj Kumar

Introduction

The green peach aphid, *Myzus persicae* Sulzer (Hemiptera: Aphididae) is a worldwide distributed pest causing both direct and indirect damage on several crops [1]. Green peach aphids can attain very high densities on young plant tissue, causing water stress, wilting and reduced growth rate of the plant. Prolonged aphid infestation can cause appreciable reduction in yield of root crops and foliage crops [2]. The major damage caused by green peach aphid is through transmission of plant viruses. Indeed, this aphid is considered by many to be the most important vector of plant viruses throughout the world. Nymphs and adults are equally capable of virus transmission [3].

More than 100 viruses transmitted by this species [4]. Among them, Potato leaf roll virus (PLRV), potato virus X (PVX) and potato virus Y (PVY) are important in potato [5]. A major role for the spread of the virus is also attributed to the period of appearance of the first viruliferous aphids [6]. Use of insecticides is ineffective in preventing potato virus Y which is non-persistently transmitted by aphids from an external source of infection. However, insecticides can exhibit efficacy in preventing potato virus Y transmission from infected plants to healthy plants within a crop, which can have an overall positive effect only if seed potato is grown in areas that have no external source of infection [7]. Chikkamagaluru could be a place where potato seed production can be taken up [8]. This means insecticides can be used to avoid the secondary spread. Hence the study was undertaken to know the efficacy of newer insecticides to management of these viruses. These viruses are also known to be transmitted by seed tubers, making the problem difficult to combat viral diseases and reduce the loss.

Materials and methods

Experimental site

A field experiment was carried out during *Rabi* 2014-15 at Lakshmipura (location 1, N 13^{0}17'537"; E 75^{0}47'271"; 1010 m, high incidence level ≥ 20 aphids per plant) and Karkipete (location 2, N 13^{0}20'926"; E 75^{0}46'455"; 1082 m low incidence level < 20 aphids per plant) villages of Chikkamagaluru district in order to find out the efficiency of newer insecticides against potato aphids and virus incidence. The field experiment was laid out in randomized block design (RBD) with three replication and eight treatments with the plot size of 3 m x 3 m. In each plot, five plants were selected and tagged. First spray was given on 4th January-2015 in location 2 and 11th January-2015 in location 1. Similarly second spray was given on 19th January-2015 in location 2 and 25th January-2015 in location 1, respectively. In location 2, there was a negligible incidence of potato viruses. Hence, incidence of two different viruses was taken only in location 1. Virus incidence was determined by counting the number of plants showing the virus symptoms in each treatment. These were expressed as proportion of the total plants in the plot to give virus incidence (%). The treatments included were imidacloprid 17.8SL@0.3 ml/l, acetamiprid 20SP@0.3g/l, acephate 75SP@1.5g/l, thiamethoxam 25WG@0.5g/l, dinutefuron 20SG@0.3g/l, deltamethrin 2.8EC@0.5ml/l, dimethoate 30EC@1.7ml/l and control.

Observations were made on the number of aphids per compound leaf per plant from tagged plants of each replication. Aphid population was recorded at one day before, seventh and fourteen days after application of insecticides. Observations on PVY and PLRV were recorded based on number of plants out of total (expressed in per cent) showing mosaic (PVY) and leaf roll (PLRV) symptoms from each treatment. Obtained data were analysed using ANOVA.

Results and discussion

Location 1: Lakshmipura, Chikkamagaluru taluk

Effect of insecticides on aphids

I spray

After 7 days of treatment imposition, the results showed significant differences among the treatments, where the lowest aphid population per plant was recorded with the thiamethoxam (4.87), which were followed by imidacloprid (9.60). Significantly higher aphid population per plant was recorded with the deltamethrin (44.87) followed by dinutefuron (37.87), dimethoate (37.80), acetamiprid (24.83) and acephate (17.54). In control, aphid population was 79.40 per plant which was significantly higher compared to other treatments [Table-1]. With regard to 14 days after treatment imposition, the lowest aphid population per plant was recorded with the thiamethoxam (14.20), which was followed by imidacloprid (17.73). However, higher aphid population per plant was recorded in deltamethrin (66.80) followed by dimethoate (58.66), dinutefuron (52.40), acetamiprid (40.93) and acephate (30.46). In control, aphid population was 117.86 per plant which was inferior among the treatments and significantly higher compared to other treatments [Table-1].

II spray

Observation of 7 days after treatment, the lowest aphid population per plant was recorded with the thiamethoxam (4.33), which was followed by imidacloprid (6.73). Significantly higher aphid population per plant were recorded with the deltamethrin (52.40) followed by dimethoate (37.47), dinutefuron (34.73), acetamiprid (23.73) and acephate (18.93). In control, aphid population was 125.47 per plant which was significantly higher compared to other treatments [Table-1]. The lowest aphid population per plant was recorded with the thiomethoxam (5.33) treated plot at 14 days after treatment imposition and was closely followed by imidacloprid (6.33). Meanwhile, higher aphid population per plant was recorded with the deltamethrin (48.33) followed by dimethoate (35.93), dinutefuron (31.13), acephate (18.40) and acetamiprid (17.80). In control, aphid population was 137.27 per plant which was significantly higher compared to other treatments [Table-1].

Location 2: Karkipete, Chikkamagaluru taluk

Effect of insecticides on aphids

I spray

Observation after 7 days of treatment imposition, the results showed significant differences among the treatments. Lowest aphid population per plant was recorded with the thiamethoxam (1.20), which was followed by imidacloprid (1.47) and acephate (2.33). Significantly higher aphid population per plant was recorded in deltamethrin (5.33) followed by dimethoate (4.73), dinutefuron (2.70), and acetamiprid (2.67). In control, aphid population was 5.73 per plant which was significantly higher compared to other treatments [Table-2]. After 14 days of treatment imposition, the lowest aphid population per plant was recorded with the acephate (2.20) which was followed closely by imidacloprid (2.73) and thiomethoxam (2.80). While higher aphid population per plant was recorded with the dimethoate (7.13) followed by, deltamethrin (6.53), dinutefuron (3.20) and acetamiprid (3.07). In control, aphid population was 10.73 per plant which was significantly higher compared to other treatments [Table-2].

II spray

Observation of 7 days after treatment, the lowest aphid population per plant was recorded with the imidacloprid (0.73), which was followed by thiamethoxam (1.00) and acephate (1.20). Significantly higher aphid population per plant was recorded in dimethoate (5.47) followed by deltamethrin (3.53), dinutefuron (2.27) and acetamiprid (1.73). In control, aphid population was 13.93 per plant, which was significantly higher compared to other treatments [Table-2]. After 14 days of treatment imposition, the lowest aphid population per plant was recorded with the dinutefuron (0.73), which was followed by imidacloprid (0.93) and thiamethoxam (1.13). Significantly higher aphid population per plant was recorded with dimethoate (7.80) followed by deltamethrin (4.47), acephate (2.87) and acetamiprid (2.00). In control, aphid population was 17.40 per plant which was significantly higher compared to other treatments [Table-2].

Pooled data of both the locations (effect of insecticides against aphids)

I spray

After 7 days of treatment imposition, the results showed significant differences among the treatments, where the lowest aphid population per plant was recorded with thiamethoxam (3.03), which was followed by imidacloprid (5.53). While higher aphid population per plant was recorded with deltamethrin (25.10) followed by dimethoate (21.27), dinutefuron (20.28), acetamiprid (13.80) and acephate (9.94). In control, aphid population was 42.57 per plant, which was inferior among the treatments [Table-3]. With regard to 14 days after treatment imposition, the lowest aphid population per plant was recorded with thiamethoxam (12.10), which was followed by imidacloprid (13.00). However, higher aphid population per plant was recorded with deltamethrin (35.20) followed by dimethoate (26.80), acetamiprid (20.90), acephate (19.80) and dinutefuron (18.50). In control, aphid population was 57.90 per plant, which was inferior among the treatments [Table-3].

II spray

Observation of 7 days after treatment, the lowest aphid population per plant was recorded with thiamethoxam (2.67), which was followed by imidacloprid (3.73). While higher aphid population per plant was recorded with deltamethrin (27.97) followed by dimethoate (21.47), dinutefuron (18.50), acetamiprid (12.73) and acephate (10.07). In control, aphid population was 69.73 per plant which was significantly higher compared to other treatments [Table-3]. The lowest aphid population per plant was recorded with thiamethoxam (3.23) and closely followed by imidacloprid (3.83). Meanwhile, higher aphid population per plant was recorded with deltamethrin (26.40) followed by dimethoate (21.87), dinutefuron (15.93), acephate (10.63) and acetamiprid (17.80). In control, aphid population was 137.27 per plant which were significantly higher compared to other treatments [Table-3]. The effectiveness of thiomethoxam in reducing the aphids is in confirmation with Syed *et al*. [9] who reported that lowest mean aphid population per leaf recorded with actara (thiamethoxam) followed by confidor (imidacloprid). Sannio [10] found confidor with high performance against *Myzus persicae*. Link *et al.* [11] reported that imidacloprid was efficient in control of *Myzus persicae*. According to Patil and Lingappa [12] imidacloprid was highly effective against *Myzus persicae* as compared to acephate on tobacco. So our experimental results tally with above mentioned workers.

Incidence of PVY and PLRV in insecticide treated plots

The data presented in [Table-4], reveals that none of the systemic insecticides could able to reduce the PVY incidence in potato field as indicated by non-significant differences among the treatments, both during first and second spray. However, thiamethoxam was found to reduce PVY incidence both at 7 and 14 DAS compared to other treatments. The PLRV incidence in different treatments remained same including untreated control as indicated by non-significant differences among the treatments. It means to say that, none of the systemic insecticides could reduce the PLRV incidence in different treatments [Table-5]. Insecticides were effective in controlling aphid population but failed to control potato viruses transmitted by aphids. As the certified seed were used, the seed tubers might have already infected with viruses and insecticides were only helpful in reducing secondary spread. In the experiment, only thiamethoxam reduced PVY incidence but not PLRV. This may be due to interference of insecticides in acquisition of virus by aphids. So, secondary spread of PVY was avoided to some extent by using insecticides. However, PLRV which is transmitted persistently could not be reduced using insecticides, as few aphids are enough to transmit to number of healthy plants once virus is acquired. Findings of Suranyi *et al*. [13] revealed that spray with a registered insecticides on aphids to prevent further spread of potato viruses by wingless aphids, which were colonized on potato plants. The effect of insecticide treatment on PVY transmission by *Myzus persicae,* pirimicarb and imidacloprid did not significantly affect on probing behaviour and PVY transmission efficiency [14]. Imidacloprid was reported to be ineffective in reducing PVY spreading potato crops in Canada when applied in soil at planting followed by two foliar treatments after mid July [15]. Daniels *et al.* [16] reported that thiamethoxam affects the feeding behaviour of the cereal aphid *Rhopalosiphum padi* on wheat and finally they speculated that thiamethoxam may have anti-feeding effects when applied at low doses and they recommended further studies to investigate effect of sub lethal doses on virus transmission. PVY transmission was significantly decreased in imidacloprid treated plants but they

Table-1 *Evaluation of insecticide molecules against aphids on potato# under field condition at Lakshmipura, Chikkamagaluru*

Treatments	I SPARY			II SPRAY	
	DBS	7DAS	14DAS	7DAS	14DAS
T_1- Imidacloprid @ 0.3 ml/l	42.80 (6.51)	9.60^{de} (3.08)	17.73^{ef} (4.23)	6.73^{e} (2.54)	6.73^{e} (2.58)
T_2- Acetamiprid @ 0.3 g/l	46.20 (6.83)	24.73^{bc} (5.01)	40.93^{d} (6.43)	23.73^{cd} (4.92)	17.80^{d} (4.24)
T_3- Acephate @ 1.5 g/l	46.40 (6.82)	17.54^{cd} (4.14)	30.46^{de} (5.51)	18.93^{d} (4.38)	18.40^{d} (4.33)
T_4- Thiomethoxam @ 0.5 g/l	37.86 (6.19)	4.87^{e} (2.09)	14.20^{f} (3.79)	4.33^{e} (2.14)	5.33^{e} (2.39)
T_5- Dinutefuron@ 0.3 g/l	46.53 (6.84)	37.87^{b} (6.13)	52.40^{bcd} (7.16)	34.73^{c} (5.89)	31.13^{cd} (5.62)
T_6- Deltamethrin@ 0.5 ml/l	43.46 (6.54)	44.87^{b} (6.68)	66.80^{b} (8.15)	52.40^{b} (7.26)	48.33^{b} (6.98)
T_7- Dimethoate 1.7 ml/l	51.86 (7.23)	37.80^{b} (6.15)	58.66^{bc} (7.65)	37.47^{bc} (6.14)	35.93^{bc} (6.03)
T_8- Control	52.60 (7.27)	79.40^{a} (8.93)	117.86^{a} (10.86)	125.47^{a} (11.21)	137.27^{a} (11.73)
SEm ±	**0.46**	**0.57**	**0.55**	**0.42**	**0.32**
CD @ P= 0.05	**1.39**	**1.73**	**1.69**	**1.28**	**0.96**
CV %	**13.10**	**20.87**	**16.06**	**13.15**	**10.03**
F	**NS**	*	*	*	*

DBS- Day before spraying, DAS- Day after spraying; Figure in the parentheses are √X + 1 transformed value

Mean number of aphid population per plant

Table-2 *Evaluation of insecticide molecules against aphids on potato# under field condition at Karkipete, Chikkamagaluru*

Treatments	I SPARY			II SPRAY	
	DBS	7DAS	14DAS	7DAS	14DAS
T_1- Imidacloprid @ 0.3 ml/l	3.27 (2.06)	1.47^{bc} (1.57)	2.73^{cd} (1.93)	0.73^{f} (1.32)	0.93^{e} (1.39)
T_2- Acetamiprid @ 0.3 g/l	4.13 (2.26)	2.67^{b} (1.91)	3.07^{c} (2.02)	1.73^{de} (1.65)	2.00^{c} (1.73)
T_3- Acephate @ 1.5 g/l	3.80 (2.19)	2.33^{bc} (1.82)	2.20^{d} (1.79)	1.20^{ef} (1.48)	2.87^{c} (1.96)
T_4- Thiomethoxam @ 0.5 g/l	5.67 (2.55)	1.20^{c} (1.48)	2.80^{cd} (1.94)	1.00^{f} (1.41)	1.13^{d} (1.46)
T_5- Dinutefuron@ 0.3 g/l	4.27 (2.29)	2.70b (1.92)	3.20^{c} (2.05)	2.27^{d} (1.81)	0.73^{e} (1.32)
T_6- Deltamethrin@ 0.5 ml/l	7.40 (2.89)	5.33^{a} (2.48)	6.53^{b} (2.74)	3.53^{c} (2.12)	4.47^{bc} (2.34)
T_7- Dimethoate 1.7 ml/l	7.53 (2.92)	4.73^{a} (2.39)	7.13^{b} (2.85)	5.47^{b} (2.54)	7.80^{b} (2.97)
T_8- Control	4.73 (2.39)	5.73^{a} (2.59)	10.73^{a} (3.43)	13.93^{a} (3.86)	17.40^{a} (4.29)
SEm ±	**0.17**	**0.13**	**0.06**	**0.08**	**0.05**
CD @ P= 0.05	**0.51**	**0.40**	**0.19**	**0.24**	**0.15**
CV %	**12.13**	**12.12**	**4.97**	**7.23**	**4.12**
F	**NS**	*	*	*	*

DBS- Day before spraying, DAS- Day after spraying; Figure in the parentheses are √X + 1 transformed value

Mean number of aphid population per plant

Table-3 *Evaluation of insecticide molecules against aphids on potato# under field condition pooled data, at Chikkamagaluru*

Treatments	I SPRAY			II SPRAY	
	DBS	7DAS	14DAS	7DAS	14DAS
T_1- Imidacloprid @ 0.3 ml/l	23.30 (4.93)	5.53^{de} (2.56)	13.00^{ef} (3.74)	3.73^{e} (2.18)	3.83^{e} (2.20)
T_2- Acetamiprid @ 0.3 g/l	25.05 (5.10)	13.80^{bc} (3.85)	20.90^{d} (4.68)	12.73^{d} (3.71)	9.90^{d} (3.30)
T_3- Acephate @ 1.5 g/l	26.40 (5.23)	9.94^{cd} (3.31)	19.80^{de} (4.56)	10.07^{d} (3.33)	10.63^{d} (3.41)
T_4- Thiomethoxam @ 0.5 g/l	22.05 (4.80)	3.03^{e} (2.01)	12.10^{f} (3.62)	2.67^{e} (1.91)	3.23^{e} (2.06)
T_5- Dinutefuron@ 0.3 g/l	28.00 (5.39)	20.28^{b} (4.61)	18.50^{de} (4.42)	18.50^{c} (4.42)	15.93 (4.12)
T_6- Deltamethrin@ 0.5 ml/l	27.20 (5.31)	25.10^{b} (5.11)	35.20^{b} (6.02)	27.97^{b} (5.38)	26.40^{b} (5.23)
T_7- Dimethoate 1.7 ml/l	28.70 (5.45)	21.27^{b} (4.72)	26.80^{c} (5.27)	21.47^{c} (4.74)	21.87^{c} (4.78)
T_8- Control	29.35 (5.51)	42.57^{a} (6.60)	57.90^{a} (7.67)	69.70^{a} (8.41)	77.33^{a} (8.85)
SEm ±	**0.30**	**0.37**	**0.29**	**0.27**	**0.21**
CD @ P= 0.05	**0.90**	**1.12**	**0.89**	**0.83**	**0.63**
CV %	**9.89**	**15.69**	**9.91**	**11.19**	**8.44**
F	**NS**	*	*	*	*

DBS- Day before spraying, DAS- Day after spraying; Figure in the parentheses are √X + 1 transformed value

Mean number of aphid population per plant

Table-4 *PVY# incidence in different insecticide treated plots at Lakshmipura, Chikkamagaluru*

Treatments	I SPRAY			II SPRAY	
	DBS	7DAS	14DAS	7DAS	14DAS
T_1- Imidacloprid @ 0.3 ml/l	0.0173	0.0173	0.0173	0.0173	0.0263
T_2- Acetamiprid @ 0.3 g/l	0.0173	0.0173	0.0173	0.0173	0.0173
T_3- Acephate @ 1.5 g/l	0.0306	0.0306	0.0306	0.0306	0.0306
T_4- Thiomethoxam @ 0.5 g/l	0.0130	0.0086	0.0086	0.0086	0.0433
T_5- Dinutefuron@ 0.3 g/l	0.0306	0.0306	0.0306	0.0306	0.0306
T_6- Deltamethrin@ 0.5 ml/l	0.0263	0.0263	0.0220	0.0263	0.0263
T_7- Dimethoate 1.7 ml/l	0.0216	0.0216	0.0216	0.0216	0.0216
T_8- Control	0.026	0.026	0.0306	0.0306	0.0306
SEm ±	**0.0043**	**0.0045**	**0.0051**	**0.0050**	**0.0056**
CD @ P= 0.05	**0.0131**	**0.0139**	**0.0157**	**0.0153**	**0.0172**
F	**NS**	**NS**	**NS**	**NS**	**NS**

DBS- Day before spraying, DAS- Day after spraying

Plants showing PVY symptoms in each treatment expressed in percentage

Table-5 *PLRV# incidence in different insecticide treated plots at Lakshmipura, Chikkamagaluru*

Treatments	I SPRAY			II SPRAY	
	DBS	7DAS	14DAS	7DAS	14DAS
T_1- Imidacloprid @ 0.3 ml/l	0.0130	0.0130	0.0130	0.0130	0.0130
T_2- Acetamiprid @ 0.3 g/l	0.0216	0.0216	0.0260	0.0260	0.0260
T_3- Acephate @ 1.5 g/l	0.0216	0.0263	0.0263	0.0263	0.0263
T_4- Thiomethoxam @ 0.5 g/l	0.0173	0.0263	0.0263	0.0263	0.0263
T_5- Dinutefuron@ 0.3 g/l	0.0353	0.0353	0.0353	0.0306	0.0306
T_6- Deltamethrin@ 0.5 ml/l	0.0263	0.0263	0.0263	0.0263	0.0310
T_7- Dimethoate 1.7 ml/l	0.0173	0.0173	0.0263	0.0263	0.0263
T_8- Control	0.0216	0.0216	0.0216	0.0216	0.0216
SEm ±	**0.0172**	**0.0187**	**0.0204**	**0.020**	**0.0205**
CD @ P= 0.05	**0.0522**	**0.0569**	**0.0621**	**0.0608**	**0.0623**
F	**NS**	**NS**	**NS**	**NS**	**NS**

DBS- Day before spraying, DAS- Day after spraying

Plants showing PLRV symptoms in each treatment expressed in percentage.

observed 2.3 to 2.7 fold increase in virus infection at imidacloprid treated plants at the end of growing season [17]. Margarito-poulos, *et al*. [18] reported that pymetrozine, a systemic insecticide, significantly reduced both virus acquisition and inoculation, which was superior over untreated control. Usually 6 breeder seeds are free of viruses. If breeder seeds are used for seed production, virus infection should be avoided in order to supply good quality certified seeds to growers. Insecticides are the important option to avoid primary and secondary spread of viruses [7]. This trail conclusively demonstrated that, insecticides are not the good option for eliminating complete virus spread, there by jeopardise the seed production programme. Hence, additional strategies need to be adopted for potato seed production.

Conclusion

The present study, highlighting efficacy of insecticides against aphids in potato. Thiamethoxam followed by imidacloprid and acephate were effective in controlling aphid population. PVY incidence was low in thiamethoxam treated plots compared to other insecticides and none of the insecticides were effective in reducing PLRV incidence.

Conflict of Interest: None declared

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