International Journal of Science, Environment and Technology, Vol. 4, No 3, 2015, 682 – 689

ISSN 2278-3687 (O)
2277-663X (P)

INTEGRATED FIELD MANAGEMENT OF APHIDS (*MYZUS PERSICAE* SULZ. AND *APHIS GOSSYPII* GLOV. TOGETHER) ON POTATO (*SOLANUM TUBEROSUM* L.) USING BIO-PESTICIDES

Sunil Kr. Ghosh *
Department of Agricultural Entomology, B.C.K.V. (Agricultural University), AINP on Agril. Acarology, Directorate of Research, Kalyani, Nadia, West Bengal,741235, India
E-mail: sunil_ent69@yahoo.in (**Corresponding Author*)

Abstract: Potato (*Solanum tuberosum* L.) is cultivated in India in a commercial scale and this crop is susceptible to various insect pests of which aphids (both *Myzus persicae* Sulzer and *Aphis gossypii* Glover) cause heavy damage especially by spreading virus diseases. Studies were made to evaluate efficacy of extracts from plants such as *Pongamia pinnata* L. and *Nicotiana tabacum* L. and *Polygonum hydropiper*, botanical insecticide such as azadirachtin (1500ppm), against aphids infesting potato crop under field conditions of the sub-Himalayan region of north-east India during the rabi season. Methanol was used as solvent for extracting from fruits of *Pongamia* and floral part of *Polygonum* and water for leaves of *Nicotiana tabacum.* Imidacloprid (Confidor 17.8 SL) was used as check. Three sprays at 10-day intervals were made, starting with the initiation of infestation. Total aphid numbers (nymphs and adults of both aphids together) per plant were counted at 4 and 9 days after treatment (DAT). Imidacloprid was found the most effective treatment for controlling aphid, followed by plant extract of *Polygonum* flower at 5 % concentration. From overall observation it was revealed that plant extract of *Polygonum* flower at 5 % concentration and tobacco leaf extract at 10 % concentration gave satisfactory result, recording more than 70 % and 65 % aphid suppression respectively. The botanical insecticide azadirachtin was also found very effective against aphid, achieving more than 60% suppression. Plant extracts and botanical insecticide are biopesticides having less or no hazardous effects on human health and the environment, and therefore, they can be incorporated in IPM programmes and organic farming.

Keywords: Botanical extracts, botanical insecticide, vegetable IPM, organic farming.

Introduction

Potato (*Solanum tuberosum* L.) is the forth most important food crop in the world after wheat, rice, and maize in terms of production. It contributes about 22 % of the total vegetables and about 40% of the root and tuber crops produced in the world (FAO, 2001). India is the third largest producer of potato crop in the world and it is grown in a commercial scale (Khurana and Naik, 2003). The crop is susceptible to various insect pests of which aphids (*Myzus persicae* Sulzer and *Aphis gossypii* Glover) cause heavy damage. Potato is usually propagated through seed tubers and the tubers harbour a number of viruses like PVX,

*Received April 19, 2015 * Published June 2, 2015 * www.ijset.net*

PVY PLRV etc which are transmitted by aphids (Verma and Chandla, 1999) The virus spreading ability of aphids, cause the quick degeneration of seed stocks and yield reduction of potato about 40-85 % (Khurana, 1999 and Chandla and Verma, 2000). So the farmers are not interested to produce healthy seed potatoes in this region. But it can easily be produced by proper management practices. More than 40 aphid species have been reported to vector different potato viruses (Salazar, 1996). Out of these, only *Myzus persicae* and *Aphis gossypii* are important on potato in India (Khurana, 1999) as well as West Bengal (Konar and Basu, 1999).

Pongamia pinnata L., an indigenous plant of India, is variously known as karanja. The oil of *Pongamia* repelled brown plant hopper (*Nilaparvata lugens* Stal.) and significantly reduced its ingestion and assimilation of food and both brown plant hopper and white back plant hopper (*Sogatella furcifera* Horv.) suffered heavy mortality (Lim and Bottrell, 1994). *Pongamia* cake was found effective in controlling the attack of ground beetles (*Mesomorphus villager* Blanch. and *Seleron latipes* Guer.) on tobacco. It also did not leave any of harmful residues in the soil. *Pongamia* cake water exterct was found to act as an antifeedant against *Spodoptera litura* in tobacco nurseries and in groundnut crop. Generally, the nicotine contain of the plant (*Nicotiana tabacum* L.) varies from 5-10 % in the leaves and trace amounts in the seeds (Thacker, 2002). Nicotine is effective against a wide range of pests. Its efficacy against soft-bodied insects like aphids is well known, but it has also been found effective against whitefly, thrips, and bollworms in cotton; brown planthopper and green leafhopper in rice, grubs in brinjal, potato and cauliflower, etc. Recently nicotine was found to be highly toxic to eggs and neonate larvae of *Helicoverpa armigera* Hub. and *Spodoptera litura* Fabr. and also effective against *Bemisia tabaci* Genn. (Dhaliwal and Arora, 2001). Use of synthetic and tobacco was more economically beneficial than using synthetics alone (Opolot *et al.,* 2006). *Polygonum* is a well known weed in the terai agro-climatic region of West Bengal, India locally known as “Biskanthali” (Sarkar and Mukharjee, 2005). Badshah *et al*., (2005) reported from Pakistan that crude leaf and flower extracts of *Polygonum hydropiper* were responsible for mortality rates 10 days after feeding of 28% and 52% for *Heterotermes indicola* and 28% and 74.7% for *Coptotermes heimi* respectively.

A suspension of neem seed (*Azadirachta indica*) jues and a dust of silica gel were the best against *Aphis gossypii* Glov. (Asari and Nair1973).Direct contact toxicity of neem product has been demonstrated against termites and aphids (Srivastava, 2003). In cabbage, two neem formulations, Achook and Nimbecidine, in India have provided effective control of aphid

Lipaphis erysimi, although the control was less than that provided by endosulfan (Dhaliwal *et al*., 1998). The objective of this study was to determine the efficacy of the plant extracts and botanical insecticide against aphids (*Myzus persicae* and *Aphis gossypii*) infesting potato as well as production of disease free potato seed tuber.

Material and Methods

Study period and location

This two year (2010-11 and 2011-12) study during rabi season was conducted at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya (State Agricultural University) at Pundibari, Coochbehar, West Bengal, India. The experimental area is situated in the sub-himalayan region of northeast India which is known as terai zone of West Bengal State. This terai zone is situated between 25o 57' and 27o N latitude and 88o 25' E and 89o 54' E longitude.

Cultivation practices

The potato variety Kufri jyoti was grown during the rabi (late December) season in both years under recommended fertilizer levels (150: 125: 125 kg NPK/ha) and cultural practices in 4 m x 5m plots at a spacing of 60 cm. x 10 cm. The treatments were replicated three times in a Randomized Block Design.

Treatments

Three botanical extracts, *Pongamia pinnata* fruit extract @ 1.0% and 5.0%; *Nicotiana tabacum* leaf extract @ 10.0 %; *Polygonum hydropiper* floral part extract @ 1.0% and 5.0 %, and one botanical insecticide neem (Azadirachtin) (commercial formulation available in India in the name nemactin) 1500 ppm @ 2.5 ml/L were evaluated and compared with the ability of imidacloprid (Confidor 17.8 SL) @ 1ml/5 L, to control potato aphid along with no treatment (control) where no insecticide was used. This insecticide is recommended for use against this aphid pest.

Extracts

Pongamia pinnata is a shrub generally grown in tropical and sub-tropical areas in India. Large number of this shrub is available in the locality of sub- Himalayans region of northeast India where the experiment is carried out. *Polygonum hydropiper* is also well known as a weed in this terai agro-climatic region of West Bengal, India. The *Pongamia* fruits and *Polygonum* plants floral parts were extracted in methanol as follows. After washing with water, the plant parts were powdered in a grinder. The powder (50 g) samples of each tested plant were transferred separately to a conical flask (500 ml) and dipped in 250 ml methanol.

The material was allowed to stand for 72 hours at room temperature with occasional stirring. After 72 hours the extract was filtered through Whatman 42 filter paper and residues were washed twice with methanol.

The tobacco (*Nicotiana tabacum)* leaves were extracted in water as follows. After washing with water the leaves were dried and powdered in a grinder. The powdered sample (100 g) were transferred to a container and dipped in 1 litre water. The material was allowed to stand for 72 hours at room temperature with occasional stirring. After 72 hours the extract was filtered through Whatman 42 filter paper and added 15 ml liquid soap.

Data recording

Three sprays at 10 day intervals were made, starting with the initiation of infestation. Population density of aphids was taken before each insecticides spraying as pre-count of the pests. Aphid population densities were recorded 4 and 9 days after each spraying by counting nymphs and adults of both aphids together on each plant from five randomly selected plants per replication. The results were expressed as aphid population suppression (%) compared to densities recorded on the control treatment. The Potato was harvested when they attained maturity and reached marketable size. The yield of marketable produce was calculated in different years separately on the basis of tuber yield per plot and converted to quintal per hectare.

Results and Discussion

The different treatments and their persistence at different days after application varied significantly in their suppression of aphid populations (Tables 1&2). Among the seven treatments (Table 2), immidacloprid provided the best suppression of populations (83.16 %), followed by botanical extract of *Polygonum* flower at higher concentration (71.41% suppression). Among the biopesticides, *Polygonum* flower extract at higher concentration was the most effective followed by the tobacco leaf extract at 10 % concentration (65.41 % suppression). From overall observation it was revealed that botanical extract of *Polygonum* flower and tobacco leaf extract at 10 % concentration gave better result, recording more than 70 % and 65 % aphid suppression respectively. The least effective treatments were the *Pongamia* fruit extracts at the lower concentration (29.32 % suppression) and at higher concentration (49.57 % suppression). The botanical insecticide azadirachtin gave better result, recording 60.30 % suppression of the aphid population.

Table 1: Effect of different application schedules of plant extracts against aphids *(Myzus persicae and Aphis gossypii together)* on potato

Treatments	Dose (ml or g/L)	Pretreatment count(nymphs & adults/plant)	% Supression on different days after treatment (DAT)					
			1st Spraying		2nd Spraying		3rd Spraying	
			Days after treatment					
			4	9	4	9	4	9
T_1=Karanja plant extract (1%)	10 ml	21.33	35.22 (36.36)	29.31 (32.74)	31.95 (34.38)	22.31 (28.12)	33.01 (35.04)	24.12 (29.16)
T_2=Karanja plant extract (5%)	50 ml	18.33	48.25 (43.99)	44.38 (41.75)	50.59 (45.34)	47.59 (43.62)	56.77 (48.89)	49.85 (44.91)
T_3=Tobacco leaf extract (10%)	100 ml	21.00	64.00 (53.15)	57.58 (49.38)	65.12 (53.82)	63.35 (54.08)	73.46 (59.14)	68.92 (56.22)
T_4= *Polygonum* flower extract (1%)	10 ml	17.00	49.50 (44.69)	47.30 (43.45)	52.93 (46.68)	46.82 (43.17)	59.40 (50.43)	50.33 (45.20)
T_5= *Polygonum* flower extract (5%)	50 ml	20.66	70.50 (57.13)	66.67 (54.37)	74.83 (59.89)	67.66 (55.35)	74.92 (59.95)	75.96 (60.66)
T_6= Azadirachtin (1500ppm)	2.5 ml	20.66	60.34 (50.97)	47.59 (43.62)	65.56 (54.07)	61.27 (51.55)	67.86 (55.46)	59.16 (50.31)
T_7= Imidacloprid (Confidor 17.8 S.L.)	1ml./5L	18.00	83.05 (65.71)	75.96 (60.66)	87.82 (69.58)	70.35 (57.05)	88.19 (69.91)	93.61 (75.37)
T_8=Untreated check(control)	-	20.33	121.32	140.21	202.33	210.66	170.23	75.33
SEm(±)	-	-	2.03	1.39	1.67	1.86	2.11	1.7
CD(p=0.05)	-	NS	6.03	4.01	5.06	5.63	6.22	4.90

Figures in parentheses are angular transformed values, NS = Not significant

Table 2: Overall efficacy of plant extracts against aphids *(Myzus persicae* and *Aphis gossypii* together) and the tuber yield of potato

Treatments	Dose (ml or g/L)	Pretreatment count(nymphs & adults/plant)	Overall efficacy (% reduction) Days after treatment			Tuber yield(q/ha)
			4	9	Mean	
T_1=Karanja plant extract(1%)	10 ml	21.33	33.39 (35.26)	25.25 (30.01)	29.32 (32.63)	200.33
T_2=Karanja plant extract (5%)	50 ml	18.33	51.87 (46.07)	47.27 (43.43)	49.57 (44.82)	203.66
T_3=Tobacco leaf extract (10%)	100 m l	21.00	67.53 (55.37)	63.28 (53.23)	65.41 (54.30)	211.18
T_4= *Polygonum* flower extract (1%)	10 ml	17.00	53.94 (47.27)	48.15 (43.94)	51.04 (45.61)	203.11
T_5= *Polygonum* flower extract (5%)	50 ml	20.66	73.42 (57.95)	70.10 (56.79)	71.41 (57.37)	214.72
T_6= Azadirachtin(1500ppm)	2.5 ml	20.66	64.59 (53.50)	56.01 (48.49)	60.30 (50.99)	207.33
T_7= Imidacloprid (Confidor 17.8 S.L.)	1ml./5L	18.00	86.35 (68.40)	79.97 (64.36)	83.16 (66.38)	216.23
T_8=Untreated check(control)	-	20.33	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	195.66
SEm(±)	-	-	1.94	1.65	-	2.39
CD(p=0.05)	-	NS	5.77	4.85	-	7.12

Figures in parentheses are angular transformed values, NS = Not significant

Four days after spraying, immidacloprid was the most effective (86.35 % suppression) against the pest, followed by botanical extract of *Polygonum* flower at higher concentration (73.42 suppression). Tobacco leaf extract at 10 % concentration and botanical insecticide azadirachtin provide better results against the pest (67.53 % and 64.59 % suppression respectively). Likewise, the ability of immidacloprid to suppress aphid populations extended to nine days after spraying. At nine days after spraying, among the biopesticides, the botanical extract of *Polygonum* flower at higher concentration was found very effective against the aphid (70.10 % suppression) followed by the tobacco leaf extract at 10 % concentration (63.28 % suppression).

Yield was directly related to the efficacy of the insecticides. The highest yield was obtained from plots treated with immidacloprid (216.23 q/ha), closely followed by *Polygonum* flower extract at higher concentration (214.72 q/ha) and azadirachtin (207.33 q/ha) (Table 2). There was no significant difference in yield among these two treatments. In general, the botanical extract of *Polygonum* flower (the higher concentration) and tobacco

leaf and botanical insecticide azadirachtin gave satisfactory aphid suppression and better yield. Based on their moderate to high efficacy levels, as well as low toxicity to natural enemies and minimum impact on human health, we conclude that plant extracts and botanical insecticides (both bio-pesticide) can be incorporated in future IPM programme and organic farming in potato cultivation.

Acknowledgements

This study was carried out with the support of the Department of Agricultural Entomology, UBKV, for providing laboratory and field for the study. We thank the Department, as well as all those who have contributed to it.

References

[1] Asari PAR, Nair MRGK (1973). On the control of brinjal pests using deterents. *Agric. Res. J. Kerala.,* **10** (2): 133-135.

[2] Badhshah H, Khan AS, Farid A, Khan A (2005). Toxic effect of palpoluck (*Polygonum hydropiper* L.) plant extract against termites (*Heterotermes indicola* Was. and *Coptotermes heimi* Was.). *Songklanakarin J. Sci. Technol.,* **27**(4): 705-710.

[3] Chandla VK, Verma KD (2000). Potato Aphids in: *Diseases and Pests of Potato- a manual,* (ed. S. M. Paul Khurana), CPRI, Shimla, India, pp. 48-52.

[4] Dhaliwal GS, Arora R (2001). Role of phytochemicals in integrated pest management. In: O. Koul and G.S. Dhaliwal (eds) *Phytochemical Biopesticides.* Harwood Academic Publishers, Amsterdam, The Netherlands, pp. 97-117.

[5] Dhaliwal GS, Gill RS, Dilawari VK (1998). Management of insect pest complex of cabbage with neem based insecticides. Ecological Agriculture and and Sustainable Development. Vol. 2. Indian Ecological Society and Centre for Research in Rural and Industrial Development, Chandigarh, India, pp. 306-314.

[6] FAO (2001). *Production Yearbook of Food and Agriculture Organization of the United Nations.* Rome, Itali. Vol. 55, pp.97-98.

[7] Khurana SMP (1999). *Potato Viruses and Viral Diseases*. Tech. Bull. No. 35, CPRI, Shimla, Himachal Pradesh, pp. 94.

[8] Khurana SMP (1999). *Potato Viruses and Viral Diseases*. Tech. Bull. No. 35 (Revised), CPRI, Shimla, Himachal Pradesh, pp. 2.

[9] Khurana SMP, Naik PS (2003). CPRI: Five decades of potato research and development. *Souvenir of the National Symposium on Potato Research towards national Food and Nutritional Security,* 2-3 October, 2003, CPRI, Shimla, pp.10.

[10] Konar A, Basu A (1999). Build up of aphids on potato in Hoogly district of West Bengal. *Proc. Global Conference on Potato*, New Delhi, India, 6-11 December, 1999, pp.477-79.

[11] Opolot HN, Agona A, Kyamanywa S, Mbata GN, Adipala E (2006). Integrated field management of cowpea pests using selected synthetics and botanical pesticides. *Crop Prot.,* **25** (11): 1145-1152.

[12] Verma KD, Chandla VK (1999). *Potato Aphids and Their Management*, Tech. Bull.No. 26 (Revised), pp. 1.

[13] Salazar LF (1996). *Potato Viruses and their Control*, CIP, Lima, Peru, pp. 205.

[14] Sarkar A, Mukherjee PK (2005). Ecology of Polygonum: a predominant weed in terai Agro-climatic region of West Bengal. *Ann. Agric. Res*., **26**(3): 462-463.

[15] Thacker JRM (2002). *An Introduction to Arthropod Pest Control.* Cambridge University Press, Cambridge.

[16] Lim GS, Bottrell, DG (1994). *Neem Pesticides in Rice: Potential and Limitation*, International Rice Research Institute, Manila, Philippines.

[17] Srivastava RP (2003). Neem tree (*Azadiracta indica* A Juss) and insect pest management. Biopesticides and Bioagents in Integrated Pest Management of Agricultural Crops. International Book Publishing Co., Lucknow, pp. 31-220.