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Efficacy of different botanicals against subterranean insect pests of potato

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Abstract
A field experiment was carried out at instructional cum research (ICR) farm, Assam Agricultural University, Jorhat, Assam in the year 2017-18, to evaluate the efficacy of different bio-pesticides *viz*., Neem oil, Jatropha oil and Karanj oil, against A*grotis ipsilon* and *Dorylus orientalis*. Potato variety 'Kufri Jyoti' was selected for the research. The highest per cent reduction of cut worm population/pit by bio-pesticides was observed in neem oil @ 5% drenching (64.23%) at 15 days after treatment followed by Karanj oil drenching (61.54%), Jatropha oil drenching (56.54%) and Karanj oil spraying (56.54%). The lowest per cent reduction was recorded in jatropha oil @ 2ml/lit spraying at fifteen days after treatment (48.85%). The lowest per cent Hulm cut recorded among the bio-pesticides was neem oil @ 5% drenching at fifteen days (4.50%) and thirty days (9.01%) after treatment. The highest per cent Hulm cut was observed in the treatment jatropha oil @ 2 ml/lit spraying at fifteen days (8.40%) and thirty days (18.48%) of treatment. On the other hand, highest per cent reduction of red ant population (mounds) by bio-pesticides was observed in neem oil @ 5% drenching at 15 days after treatment (67.65%). The lowest per cent reduction was recorded in karanj oil @ 2ml/lit spraying at 15 days after treatment (51.17%). However, amongst all the bio-pesticides, lowest per cent tuber damage caused by the *A. ipsilon* and *D. orientalis* were observed neem oil drenching @ 5% (14.93% and 12.21%) in both weight basis and number basis and highest per cent tuber damage was observed in plot treated with jatropha oil spraying @ 2ml/lit (19.79% and 17.13%) in both weight basis and number basis.

Keywords: Botanicals, subterranean insect pests, potato, *Agrotis ipsilon*, *Dorylus orientalis*, Neem oil, jatropha oil and karanj oil

1. Introduction
Potato (*Solanum tuberosum* L.) is considered as one of the most important food crop for both in developed and developing countries. In order of importance for food production in comparison to other major food crops on fresh weight basis, it ranks 4th in the world and 3rd in India. India is the second largest producer of potato in the world with an area of 2.18 million hectare produced 49.34 million tons with the productivity of 22.63 tons/hectare whereas, in Assam, the total production of potato was 1072.78 thousand tons from an area of 99.7 thousand hectare with productivity of 10.76 tons/hectare in year 2017-18 [1].

Potato crop is attacked by a large numbers of insect pests from the time of planting till harvesting of the tubers, which account for 10-20 per cent loss of total production [2]. Borkakati *et al.*, [3], recorded that *Myzus persicae* is an important pests of potato. Among the important insect pests cut worm and red ant are the major sub terranean pests of potato in India. There are five numbers of cutworms species *viz., Agrotis ipsilon* Hufnagel, *A. interacta* Walk., *A. flammatra* Schiff., *A. spinnifera* Hb. and *A. segetum* Schiff. Have been reported from potato crop in India, amongst all *A. ipsilon* is the most common and destructive species of cut worm reported from almost all parts of India [4]. The losses in tuber yield in potato crop due to cutworm have been estimated to be 12-40 per cent in different parts of India [5]. However, Red ant (*Dorylus orientalis*) are distributed in all over India, including north-east. [6]. Moreover, *D. orientalis* is one of the most important soil pests of potato reducing the yield up to 35- 40% in West Bengal [7]. Apart from potato *D. orientalis* can attack other vegetables especially cauliflower, cabbage, groundnut, sugarcane, and coconut seedlings in the North-Eastern states, Bihar, and Uttar Pradesh [8]. Tuber infestation by *D. orientalis* may be as high as 51.77-61.50 per cent [9]. However, in an investigation carried out by Begam *et al.*, [10] observed that Predatory lady bird beetle, especially, *Coccinella transversalis* and *Micraspis discolor* were the most dominant species observed throughout the cropping season of solanaceous vegetable and there was a positive correlation of the predators with pests.

So, safe pesticides like botanicals are important tool for pest management.

Therefore, keeping in view of seriousness of the problem and as there are very limited works on these pests, the present investigation was undertaken to find out effective ecofeindly botanicals for the management of these subterranean pests.

2. Materials and Methods

Investigation were carried out at instructional cum research farm, Assam Agricultural University, Jorhat, Assam in the year 2017-18, to evaluate the efficacy of different bio-pesticides against *A. ipsilon* and *D. orientalis*. Potato variety 'Kufri Jyoti' was selected for the research. The experiment was conducted on field by adopting randomized block design with three (3) replication and eleven (11) treatments. The treatments were,- T_1: Neem Oil@5% (Foliar Spraying); T_2: Neem Oil@5%(Soil Drenching); T_3: Jatropha Oil@2ml/lit (Foliar Spraying); T_4: Jatropha Oil@2ml/lit(Soil Drenching); T_5: Karanj Oil@2% (Foliar Spraying); T_6: Karanj Oil@2%(Soil Drenching); T_7: Imidacloprid 70 WG@70g *a.i.*/ha(Foliar Spraying); T_8: Imidacloprid 70 WG@70g *a.i.*/ha(Soil Drenching); T_9: Chlorpyriphos 20 EC@200g *a.i.*/ha(Foliar Spraying); T_{10}: Chlorpyriphos 20 EC@200g *a.i.*/ha(Soil Drenching); and T_{11}: Control. All the treatments were applied as soon as the insects were observed in the field. Sprayings were done by hydraulic knapsack sprayer. Soil Drenching was done by digging a ridge near the plant pouring water directly to the ridge. Pre-count of both the insects were done one day before applying treatment. Post-treatment count were made after one day, three day, seven days and fifteen days of treatment. Cut worm population were observed by counting the larvae of *A. ipsilon* by digging randomly 5 pits of 20 cm × 20 cm × 20 cm from 2nd week of transplanting. Incidence of Red ant was observed when tuber formation started. Red ant population were counted by the number of mound present in each plots [10].

Per cent plant damage with respect to Hulm cut was recorded after occurrence of the pest and by following the formulae:

$$\text{Per cent hulm cut} = \frac{\text{Initial plant population} - \text{Total numbers of plant at the time of observation}}{\text{Initial plant population}} \times 100$$

Estimation of tuber damage

The marketable tuber from each plot was harvested and sort by healthy and infested tubers and per cent damage on the basis of number and weight was calculated by the following formula-

$$\text{Per cent tuber damage (number basis)} = \frac{\text{Total numbers of damaged tubers}}{\text{Total number of both healthy and infested tuber}} \times 100$$

$$\text{Per cent tuber damage (weight basis)} = \frac{\text{Weight of damaged tubers}}{\text{Weight of both healthy and damaged tubers}} \times 100$$

3. Results and Discussion

3.1 Cutworm

Among the bio-pesticides tested, the lowest cut worm population/pit was recorded in neem oil @ 5% spraying (1.87 nos.) which differed significantly with jatropha oil @ 2 ml/lit spraying (2.07 nos.) and at par with other bio-pesticides treatments after one day of treatment. After fifteen days of treatment the lowest cut worm population/pit was recorded in neem oil @ 5% drenching (0.93 nos.) which differed significantly with Jatropha oil @ 2 ml/lit spraying (1.33) and neem oil @ 5% spraying (1.20 nos.) and at par with other bio-pesticidal treatments (Table 1).

The highest per cent reduction of cut worm population/pit by bio-pesticides was observed in neem oil @ 5% drenching (64.23%) at 15 days after treatment followed by Karanj oil drenching (61.54%), Jatropha oil drenching (56.54%) and Karanj oil spraying (56.54%). The lowest per cent reduction was recorded in jatropha oil @ 2ml/lit spraying at fifteen days after treatment (48.85%) (Table 1).

The lowest per cent Hulm cut recorded among the bio-pesticides was neem oil @ 5% drenching at fifteen days (4.50%) and thirty days (9.01%) after treatment. The highest per cent Hulm cut was observed in the treatment jatropha oil @ 2 ml/lit spraying at fifteen days (8.40%) and thirty days (18.48%) of treatment (Table 2).

3.2 Red ant

Regarding red ant, the lowest population (mounds) was observed in neem oil @ 5% drenching (39.00 nos.), which was at par with all other bio-pesticidal treatments after one day of treatment. After three days of treatment, the lowest population (mounds) was observed in neem oil @ 5% drenching (33.00 nos.) which differed significantly with neem oil @5% spraying (38.00 nos.), jatropha oil @ 2ml/lit spraying (38.67 nos.) and karanj oil @ 2% spraying (40.33 nos.) and at par with other bio-pesticidal treatment. The lowest population (mounds) after seven days and fifteen days of treatment was observed in neem oil @ 5% drenching (24.00 nos. and 18.33 nos.) which differed significantly with other bio-pesticidal treatments (Table 1).

The highest per cent reduction of red ant population (mounds) by bio-pesticides was observed in neem oil @ 5% drenching at 15 days after treatment (67.65%). The lowest per cent reduction was recorded in karanj oil @ 2ml/lit spraying at 15 days after treatment (51.17%).

4. Tuber damage

Among the bio-pesticides, lowest per cent tuber damage caused by the *A. ipsilon* and *D. orientalis* were observed neem oil drenching @ 5% (14.93% and 12.21%) in both weight basis and number basis and highest per cent tuber damage was observed in plot treated with jatropha oil spraying @ 2ml/lit (19.79% and 17.13%) in both weight basis and number basis (Table 3).

In all the treatments, neem oil showed highest reduction of population of both cut worm and red ant. Similar trend of results was also observed by Sainath (2016), where recorded neem oil showed the highest mortality of BPH as compared to karanj oil and jatropha oil. According to Pandey and Tiwari [12], around 43.4% of larval mortality of *Agrotis ipsilon* was found when neem powder was applied to the farmer's field. Similar trend of result was also observed by Dutta, 2017 [13], in which neem oil was recorded more toxic against termites and white grub followed by karanj oil and jatropha oil. Pavela *et al.* [14], also found same kind of results, in which Neem Azal gave the highest larval mortality of *Plutella xylostella*. Sharma and Bhatnagar [15] found that both neem oil and karanj oil reduced the *Chillo partellus* feeding and Neem oil gave the best result.

Different bio-pesticides also reduced the population of red ant, in which neem oil was highest followed by karanj oil. These findings are in conformity with Shekharappa and Kulkarni [16] who also reported that the population of *Chillo*

partellus reduced when NSKE @ 5% was applied. Among the chemicals used in the present study chlorpyriphos reduced the red ant mounds significantly which was similar with the findings of Pathak *et al.* [17], who found that chlorpyriphos reduced the infestation of the red ant significantly.

Bio-pesticides showed significant difference in plant damage, in which neem oil drenching showed lowest amount of Hulm cut followed by karanj oil drenching on fifteen days of treatment. These results are in agreement of the findings of Sidding *et al.* [18], who reported that the application of neem extract soaked in water @ 1kg/40 lit reduced the infestation of *A. ipsilon.* Ahmed *et al.* [19] also found similar trend of result, which stated that neem derived products reduced the maize stem borer infestation effectively. Least amount of plant damage caused by *Chillo partellus* in maize was found, when Jose *et al.* [20] treated the plot with neem products. Similarly, Borkakati *et al*., 2019 also reported *B. bassiana* is very much effective to control sucking pests of another solanaceous vegetable *Bhut Jalakia* [21]. Therefore, care must be taken to selection of pesticide to control both phytophagous and subterranean insect pests of solanacious pests.

Table 1: Effect of bio-pesticides on cut worm (*Agrotis ipsilon*) population and *Dorylus orientalis* (mounds)

Treatment	*Agrotis ipsilon*					*Dorylus orientalis* (mounds)				
	1 DAT	3 DAT	7 DAT	15 DAT	% DOC at 15DAT	1 DAT	3 DAT	7 DAT	15 DAT	% DOC at 15DAT
Neem oil spraying @5%	1.87	1.73	1.47	1.20	-53.85	40.67	38.00	29.67	23.00	-59.41
Neem oil drenching@5%	1.93	1.47	1.20	0.93	-64.23	39.00	33.00	24.00	18.33	-67.65
Jatropha oil spraying@2 ml/lit	2.07	1.87	1.73	1.33	-48.85	41.00	38.68	33.00	27.33	-51.77
Jatropha oil drenching@2 ml/lit	1.93	1.73	1.47	1.13	-56.54	40.00	34.00	29.33	26.33	-53.54
Karanj oil spraying@2%	1.93	1.73	1.47	1.13	-56.54	42.33	40.33	34.67	27.67	-51.17
Karanj oil drenching@2%	1.87	1.46	1.20	1.00	-61.54	41.33	35.67	30.33	26.33	-53.54
Imidacloprid 70WG spraying@70 g *a.i.*/ha	1.73	1.53	1.20	0.8	-69.23	39.00	35.00	25.33	18.33	-67.65
Imidacloprid 70WG drenching@70 g *a.i.*/ha	1.53	1.26	0.93	0.53	-79.62	33.33	30.00	21.33	14.33	-74.71
Chlorpyriphos 20EC spraying@200 g *a.i.*/ha	1.60	1.33	0.93	0.73	-71.92	38.33	32.33	22.33	16.33	-71.18
Chlorpyriphos 20EC drenching@200 g *a.i.*/ha	1.33	1.07	0.67	0.47	-81.92	33.67	28.67	18.00	13.00	-77.06
Control	2.33	2.40	2.47	2.6		50.67	52.33	54.67	56.67	
S.Ed±	0.09	0.10	0.10	0.10		1.81	1.64	1.92	1.52	
CD(P=0.05)	0.20	0.21	0.23	0.22		3.78	3.44	4.00	3.17	

DAT= Days after Transplanting; DOC= Decrease over Control

Table 2: Effect of different treatments on per cent Hulm cut caused by *Agrotis ipsilon* in potato crop

Treatments	Initial plant population	Hulm cut (%)	
		15 DAT	30 DAT
Neem oil spraying @5%	118	6.45	13.19
Neem oil drenching@5%	118.33	4.50	9.01
Jatropha oil spraying@2 ml/lit	118	8.40	18.48
Jatropha oil drenching@2 ml/lit	118.67	5.30	16.83
Karanj oil spraying@2%	118.67	7.26	14.80
Karanj oil drenching@2%	118.67	4.77	12.38
Imidacloprid 70WG spraying@70 g *a.i.*/ha	118.33	5.05	9.54
Imidacloprid 70WG drenching@70 g *a.i.*/ha	118	2.54	6.51
Chlorpyriphos 20EC spraying@200 g *a.i.*/ha	118.33	4.47	8.95
Chlorpyriphos 20EC drenching@200 g *a.i.*/ha	118.33	2.50	6.12
Control	118	6.48	25.42
S.Ed±	NS	0.87	0.82
CD(P=0.05)	-	1.81	1.72

Table 3: Effect of different treatment against sub-terranean insect pests of potato on tuber damage

Treatment	Dose	Tuber damage (%)	
		weight basis	number basis
Neem oil spraying @5%	5%	16.45	14.33
Neem oil drenching@5%	5%	14.93	12.21
Jatropha oil spraying@2 ml/lit	2 ml/lit	19.79	17.13
Jatropha oil drenching@2 ml/lit	2 ml/lit	17.15	15.29
Karanj oil spraying@2%	2%	18.02	16.39
Karanj oil drenching@2%	2%	15.95	14.84
Imidacloprid 70WG spraying@70 g *a.i.*/ha	70 g *a.i.*/ha	11.87	9.22
Imidacloprid 70WG drenching@70 g *a.i.*/ha	70 g *a.i.*/ha	9.21	8.57
Chlorpyriphos 20EC spraying@200 g *a.i.*/ha	200 g *a.i.*/ha	9.76	8.18
Chlorpyriphos 20EC drenching@200 g *a.i.*/ha	200 g *a.i.*/ha	7.41	6.70
Control	-	24.52	21.82
S.Ed±	-	0.12	0.16
CD(P=0.05)	-	0.25	0.34

5. Conclusion

From the present investigation it can be concluded that Neem oil exhibited highest reduction of population of both cut worm and red ant and it can be recommended as a safe and Ecofriendly components for management of subterranean insect pests of potato.

6. References

1. http://www.agricoop.gov.in. 30 January, 2020.
2. Kishore R, Misra SS. Field evaluation of synthetic insecticides and neem cake for the management of cutworm, *Agrotis ipsilon* (HFN.), damaging potatoes in different agro-climatic zones of India. Journal of Entomological Research. 2001; 25(1):31-35.
3. Borkakati RN, Saikia DK, Buragohain P. Natural enemy fauna of Agri-horti ecosystem of Assam. Indian Journal of Entomology. 2018; 80(3):658-661.
4. Nirula KK. Insecticidal control of *Agrotis ipsilon* Hufn. (Lepidoptera: Noctuidae). Plant protection Bulletin. 1987; 37(2):34-36.
5. Saxena AP, Misra SS. Potato pests in hilly tracts and their control. Seeds and Farms. 1990; 6:43-50.
6. Bharti H, Guénard B, Bharti M, Economo EP. An updated checklist of the ants of India with their specific distributions in Indian states (Hymenoptera: Formicidae). Zoo Keys. 2016; 551:1-83.
7. Konar A, Paul S, Basu A, Chattri M. Integrated management of mole cricket attacking potato in Eastern Gangclic plains of West Bengal. Potato Journal, 2005, 32(250).
8. Roonwal ML. Plant pest status of root eating ants *Dorylus orientalis* with notes on taxonomy, distribution and habits (Insects: Hymenoptera). Journal of Bombay Natural History Society. 1976; 72:305-313.
9. Hoque Chowdhury M. Effects of irrigation and liming on the incidence of soil insect pests on potato. M.Sc. thesis, Assam Agricultural University, Jorhat, Assam, 1997, 32.
10. Begam N, Saikia DK, Borkakati RN. Seasonal incidence of major insect-pests and their natural enemies of Bhut Jolokia. Annals of Plant Protection Science. 2016; 24(2):259-264.
11. Drees BM, Calixto AA. Survey-Based Management of Red Imported Fire Ants. Texas A&M Agri Life Extension, 2002, 1-4.
12. Pandey RK, Tiwari JN. Field efficacy of some insecticides against *A. ipsilon* (Hufn.) and the effect of larval control on grain yield in rice. Pest Management and Economic Zoology. 1999; 7(2):147-150.
13. Dutta D. Bioassay of some plant oils against white grub, *Lepidiota mansueta* (Coleoptera: Scarabaeidae) and Termite, *Odontotermes obesus* (Isoptera: Termitidae). M.Sc. theis, Assam Agricultural University, Jorhat, Assam, 2017, pp. 37.
14. Pavela R. Efficacy of botanical insecticides against *Plutella xylostella.* Journal of Biopesticide. 2012; 5(1):62-70.
15. Sharma VK, Bhatnagar A. Studies on the effects of non edible seed oils on *Chilo partellus*. Proceedings Symposium Botanical Pesticides in IPM, Rajahmundri, 1993, pp. 351-359.
16. Shekharappa, Kulkarni KA. Bioefficacy of neem formulations on the management of stem borer, *Chilo partellus* (Swinhoe) in sorghum. Pestology. 2006; 30(12):19-21.
17. Pathak HP, Chiluwal KN. Verification of botanicals and commonly used pesticides against red ant, *Dorylus orientalis* on potato under rainfed condition. Proceeding of the 11th National Outreach Workshop, RARS, Lumle, Kaski, 2014, 194-198.
18. Sidding SA, Schmutterer H, Ascher KRS. Natural pesticides from the neem tree (*Azadirachta indica* A.) and other tropical plants. In proceedings of the 3rd international neem conference, Nairobi, Kanya, 22-24 November, 1993, 449-459.
19. Ahmed AAI, Schmidt GH, Breuer M. The Neem kernel extract as a bioinsecticide against the black cutworm larvae. In International conference on pests in agriculture at le Corum, Montpelllier, France. 1997; 3:1163-1170.
20. Jose D, Shekharappa, Patil RK. Evaluation of biorational pesticides for the management of stem borer, *Chilo partellus* Swinhoe in sweet sorghum. *Kar*. Journal of Agricultural Science. 2008; 21(2):293-294.
21. Borkakati RN, Saikia DK, Ramanujam B. Evaluation of certain bio pesticides against sucking pests of Bhut Jalakia Journal of Biological Control. 2019; 32(3):172-178.