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Efficacy of different plant extracts against leafminer, *Liriomyza huidobrensis* Blanchard in potato

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ABSTRACT: Field experiments were conducted to evaluate the efficacy of different plant extracts against potato leafminer, *Liriomyza huidobrensis* Blanchard at Ooty, Nilgiri District, Tamil Nadu. Among different treatments *viz.* neem oil @ 2 %, neem seed kernel extract (NSKE) @ 5 %, *Eupatorium adenophorum* @ 5 %, *Ruta chalepensis* @ 5 %, Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1} and Profenofos 50 EC @ 1000 ml.ha^{-1}, Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1} (87.38%)recorded the least percent reduction over the controland found to be more effective than other treatments followed by NSKE @ 5 % (83.91%) and *R. chalepensis* @ 5 % (82.77%), which were on par with each other and that they can be investigated further and used in leaf miner management in general, and IPM in particular, as a novel botanical for potato ecosystem.

Keywords: Leaf miner, IPM, potato, management, plant extracts

INTRODUCTION

The potato (*Solanum tuberosum*) is a major vegetable crop of India. The pea leaf miner (*Liriomyza huidobrensis* Blanchard), an exotic polyphagous pest is currently threatening potatoes (Parrella and Bethke, 1984). *L. huidobrensis* (Blanchard) was first described in Brazil in 1926 and is now found all over the world (Spencer, 1973). Synthetic insecticides, which are the most widely used form of insect control worldwide, often cause ecosystem pollution, the emergence of resistant pest genotypes and new pests, and the extinction of natural enemies, among other things (Macharia *et al*., 2009). Insecticides made from natural products are becoming more common as crop pesticides in recent years. Plant extracts are safer, more environmentally friendly, and more compliant with environmental components than synthetic pesticides, so they are classified as "green pesticides." With over 2400 bioactive plant species known for their insecticidal and anti-pathogenic properties; botanicals are becoming increasingly popular (Karunamoorthi, 2012). The identification of plant-based products with high effectiveness may be a key component in the environmentally sustainable management of *L. huidobrensis*. Hence, the current study was performed to assess the efficacy of certain botanicals which is commonly available in the potato growing areas of the Nilgiris and occasionally used for stored products pest management by the tribes for the management of *L. huidobrensis* under field condition.

MATERIALS AND METHODS

Two field experiments were conducted in farmers' fields near Kotagiri and Ooty, Nilgiri District, Tamil Nadu to assess the efficacy of different plant extracts against *L. huidobrensis* in potato during summer season in the year 2021. Trial was laid out in the potato variety 'Kufri Jyoti' with seven treatments (Table 1) replicated thrice in Randomized Block Design at the plot size of 25 m^2.

Fresh leaves of *E. adenophorum* and *R. chalapensis* were collected and washed thoroughly with water and shade dried. Neem seed kernels were purchased from organic shop. Dried leaves and Neem seed kernels were pulverized separately in to fine powder and stored for future use. To prepare the required concentration of the botanicals, 500g of leaf/kernel powder wassoaked it in 1liters of water overnight. In the morning, stir with a wooden plank and filter through two layers of muslin fabric and make a volume to 10 liters. Add 0.1% teepol as wetting agent. The spray solution was mixed before use.

Observations were made on a day before and three, five, seven, and fourteen days after the first and second sprays. The per cent leaf damage was calculated. The percent infestation data were transformed into an arc sine (Angular) transformation before analysis. The modified data were then subjected to an analysis of variance (ANOVA). Duncan's Multiple Range Test (DMRT) was used to differentiate the means of the significantly different treatments ($P < 0.05$). The level of significance was fixed at $\alpha = 0.05$. All these procedures were carried out using SPSS software.

Table 1. Effect of botanicals on leafminer, *L. huidobrensis* on potato (Location: Kotagiri, The Nilgiris, Tamilnadu)

Treatments	PTC	Incidence of leaf miner (Percent leaf damage)												
		First spray						Second spray						
		3 DAT	5 DAT	7 DAT	10 DAT	14 DAT	Mean	3 DAT	5 DAT	7 DAT	10 DAT	14 DAT	Mean	PRC
Neem oil @ 2%	35.31 (36.44)	33.84 (35.55)	32.12 (34.51)	30.70 (33.63)	29.05 (32.60)	27.37 (31.53)	30.62 (34.04) [d]	25.66 (30.42)	22.03 (27.98)	19.52 (26.20)	15.15 (22.89)	13.01 (21.13)	19.07 (25.72) [a]	62.96
NSKE @ 5%	36.84 (37.35)	33.16 (35.14)	30.21 (33.33)	26.07 (30.68)	24.04 (29.35)	22.48 (28.28)	27.19 (32.36) [bc]	20.44 (26.86)	16.30 (23.79)	12.01 (20.26)	9.35 (17.78)	8.04 (16.42)	13.23 (21.02) [c]	74.30
E. adenophorum @ 5%	38.05 (38.07)	35.00 (36.26)	32.95 (35.01)	30.65 (33.60)	29.26 (32.73)	27.10 (31.36)	30.99 (34.51) [d]	24.89 (29.91)	20.14 (26.65)	17.06 (24.38)	14.24 (22.16)	12.13 (20.37)	17.69 (24.69) [a]	65.64
R. chalepensis @ 5%	40.15 (39.30)	35.06 (36.29)	32.02 (34.45)	26.02 (30.66)	24.11 (29.39)	23.06 (28.68)	28.05 (33.13) [b]	20.12 (26.64)	15.28 (22.99)	13.26 (21.34)	10.05 (18.47)	8.09 (16.51)	13.36 (21.19) [c]	74.05
Azadirachtin 0.15 EC @ 2500 ml.ha-1	39.03 (38.65)	35.22 (36.39)	30.29 (33.38)	24.84 (29.88)	22.66 (28.42)	21.35 (27.51)	26.87 (32.37) [b]	17.09 (24.40)	14.01 (21.98)	11.20 (19.53)	8.27 (16.69)	6.16 (14.33)	11.35 (19.39) [b]	77.95
Profenofos 50 EC @ 1000 ml.ha-1	34.91 (36.20)	31.19 (33.94)	27.22 (31.43)	25.02 (29.99)	20.44 (26.86)	18.2 (25.25)	24.42 (30.61) [a]	15.06 (22.82)	11.11 (19.45)	8.34 (16.76)	6.10 (14.29)	5.04 (12.94)	9.13 (17.25) [a]	82.26
Untreated control	38.11 (38.11)	39.40 (38.87)	41.46 (40.06)	42.01 (40.39)	43.16 (41.05)	46.04 (42.71)	42.42 (40.21) [e]	48.50 (44.12)	50.64 (45.35)	51.65 (45.93)	52.77 (46.57)	53.84 (47.18)	51.48 (45.83) [d]	-
SE(d)	0.52	0.51	0.44	0.66	0.43	0.61	0.69	0.65	0.55	0.60	0.60	0.80	0.85	-
CD	1.14	1.13	0.96	1.45	0.95	1.35	0.14	1.44	1.21	1.34	1.34	1.78	1.76	-

DAT - Days After Treatment; PTC – Pretreatment count; PRC – Percent reduction over untreated control

*Figures in parentheses are Arc sine transformed values. Treatment means with letter(s) in common are not significant by DMRT at 5% level of significance.

RESULTS AND DISCUSSION

Effect of botanicals on leaf miner, *L. huidobrensis* affecting potato

Location I: Kotagiri, The Nilgiris, Tamilnadu

On one day before first spray, the percent leaf damage recorded in different treatments was 35.31, 36.84, 38.05, 40.15, 39.03, 34.91and 38.11 percentrespectively (Table 1). At 10days after first spray, Profenofos 50 EC @ 1000 ml.ha^{-1} (an insecticidal check) recorded the lowest percent leaf damage (20.44%) followed by Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1} (22.66%), NSKE @ 5 % (24.04%), *R. chalepensis* @ 5 % (24.11%) (both on par with each other), Neem oil @ 2 % (29.05%), *E. adenophorum* @ 5 % (29.26%) (both on par with each other) in decreasing order of their efficiency by increasing range of percent leaf damage. However, the percent leaf damage in all the treatments were significantly less than the untreated control (43.16%). The mean percent damage of leafminer for the first spray was lowest with Profenofos 50 EC @ 1000 ml.ha^{-1}(24.42) and considering botanicals, the least damage was recorded with Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1}(26.87%) followed by NSKE @ 5 % (27.19%), *R. chalepensis* @ 5 % (28.05%), Neem oil @ 2 % (30.62%)and *E. adenophorum* @ 5 % (30.99%). The percent mean leaf damage during the second spray was least for Profenofos 50EC (9.13%) followed by Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1}(11.35%), NSKE @ 5% (13.23%), *R. chalepensis* @ 5 % (13.36%), *E. adenophorum* @ 5 % (17.69%), and Neem oil @ 2 % (19.07%).

Profenofos 50 EC @ 1000 ml.ha^{-1} recorded the least percent damage with about 82.26 percentage reduction over the control. The percent reduction over control of the test botanicals were ranked as follows: Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1} (77.95%) >NSKE @ 5 % (74.30%) >*R. chalepensis* @ 5 % (74.50%) >*E. adenophorum* @ 5 %(65.64 %)> Neem oil @ 2 % (62.96%) (Table 1).

Location II: Ooty, The Nilgiris, Tamil nadu

Table 2 shows that, when compared to the untreated control, all of the treatments were successful against leafminer damage. Prior to application, the percent leaf miner damage in different treatments were 23.35, 26.12, 22.05, 25.29, 27.09, 26.02and 25.12 percent respectively. At 10days after first spray Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1} recorded the lowest percent leaf damage (13.08%) followed by NSKE @ 5 % (14.05%), *R. chalepensis* @ 5 % (15.00%), Neem oil @ 2 % (18.24%), *E. adenophorum* @ 5 % (18.01%) (both on par with each other) and profenofos 50 EC @ 1000 ml.ha^{-1} in decreasing order of their efficiency by increasing range of percent leaf damage. However, the percent leaf damage in all the treatments were significantly less than the untreated control (37.97%).

The mean percent leaf damage after first spray in the order of the highest efficacy was 15.53, 16.91, 17.47, 19.13, 19.71 and 21.04 percent for Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1}, *R. chalepensis* @ 5 %, NSKE @ 5 %, *E. adenophorum* @ 5 %, Neem oil @ 2 % and profenofos 50 EC @ 1000 ml.ha^{-1}respectively. Similarly, for the second spray, the mean leaf miner damage recorded was lowest for Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1}(6.34%) followed by NSKE @ 5 % (8.08%), *R. chalepensis* @ 5 % (8.65%), profenofos 50 EC @ 1000 ml.ha^{-1} (8.72%), *E. adenophorum* @ 5 % (11.74%)and Neem oil @ 2 % (11.78%) respectively.

The order of effectiveness of different treatments was determined based on the mean percent reduction in leaf damage compared to the untreated control are as follows: Profenofos 50 EC @ 1000 ml.ha^{-1} (82.63%), Azadirachtin 0.15 EC (Commercial formulation) @ 2500 ml.ha^{-1} (87.38%) > by NSKE @ 5 % (83.91%) >*R. chalepensis* @ 5 % (82.77%) >*E. adenophorum* @ 5 % (76.61 *%)* > Neem oil @ 2 % (76.53%) (Table 2).

Weintraub and Horowitz, 1997 reported that neem-based insecticides like azadirachtin are expanding the spectrum of compounds available to control *L.huidobrensis*. According to Azam (1991), neem oil concentrations of 1.0 and 1.25 percent killed more than 80% of leafminer larvae and pupae. The efficiency of neem seed kernel extract 4 % against *L. trifolii* on tomato was also documented by Viraktamath *et al.* (1993). According to Dimetry *et al.,* (1995), neem products were proven to be effective feeding and ovipositional deterrents against *L. trifolii*. Murthy and Prasad (1996), Wankhede *et al*., (2007), Mishra and Shantipriya (2008), and others have observed similar findings. Barde and Shrivastava (2017) also reported that NSKP 10% (10.93% leaf infestation) and neem oil 3% (11.92% leaf infestation) treatments proved significantly superior in controlling leafminer.

Based on the findings, it was determined that Azadirachtin 0.15 EC @ 2500 ml.ha^{-1} and NSKE @ 5 % were effective and comparable to *R. chalepensis* @ 5 %, and that they can be used in leaf miner management in potato ecosystem.

Table 2. Effect of botanicals on leaf miner, *L. huidobrensis* affecting potato (Location: Ooty, The Nilgiris, Tamilnadu)

Treatments	PTC	Incidence of leaf miner (Percent leaf damage)												
		First spray						Second spray						
		3 DAT	5 DAT	7 DAT	10 DAT	14 DAT	Mean	3 DAT	5 DAT	7 DAT	10 DAT	14 DAT	Mean	PRC
Neem oil @ 2%	23.25 (28.81)	22.11 (28.03)	21.01 (27.27)	20.12 (26.64)	18.24 (25.27)	17.06 (24.38)	19.71 (26.73) [d]	15.06 (22.83)	13.13 (21.23)	11.44 (19.76)	10.12 (18.54)	9.17 (17.62)	11.78 (20.00) [c]	76.53
NSKE @ 5%	26.12 (30.72)	24.05 (29.35)	20.02 (26.56)	17.14 (24.45)	14.05 (22.00)	12.08 (20.33)	17.47 (25.57) [e]	9.98 (18.40)	9.01 (17.46)	8.24 (16.67)	7.03 (15.36)	6.14 (14.34)	8.08 (16.46) [b]	83.91
E. adenophorum @ 5%	22.05 (27.99)	21.02 (27.28)	20.48 (26.89)	19.12 (25.92)	18.01 (25.09)	17.03 (24.36)	19.13 (26.26) [d]	15.13 (22.88)	13.18 (21.28)	11.16 (19.49)	10.11 (18.53)	9.14 (17.59)	11.74 (19.95) [c]	76.61
R. chalepensis @ 5%	25.29 (30.18)	22.14 (28.06)	18.09 (25.16)	16.17 (23.69)	15.00 (22.78)	13.15 (21.25)	16.91 (25.19) [b]	11.15 (19.50)	9.92 (18.35)	9.05 (17.49)	7.02 (15.35)	6.10 (14.28)	8.65 (16.99) [b]	82.77
Azadirachtin 0.15 EC @ 2500 ml.ha-1	27.09 (31.35)	22.12 (28.04)	17.03 (24.36)	14.17 (22.11)	13.08 (21.19)	11.24 (19.57)	15.53 (24.44) [a]	9.09 (17.54)	7.30 (15.65)	6.33 (14.55)	4.92 (12.79)	4.05 (11.59)	6.34 (14.42) [a]	87.38
Profenofos 50 EC @ 1000 ml.ha-1	26.02 (30.66)	24.18 (29.44)	22.04 (27.98)	21.05 (27.29)	19.81 (26.41)	18.1 (25.19)	21.04 (27.83) [f]	15.04 (22.81)	12.08 (20.33)	8.18 (16.59)	5.15 (13.09)	3.16 (10.21)	8.72 (16.61) [b]	82.63
Untreated control	25.12 (30.06)	28.21 (32.07)	31.20 (33.94)	36.15 (36.95)	37.97 (38.03)	40.04 (39.24)	34.72 (35.05) [g]	44.00 (41.54)	48.22 (43.96)	50.01 (44.99)	53.38 (46.92)	55.44 (48.11)	50.21 (45.10) [d]	-
SE(d)	0.70	0.64	0.29	0.20	0.27	0.39	0.89	0.39	0.47	0.67	0.53	0.43	1.02	-
CD	1.55	1.40	0.63	0.44	0.59	0.87	1.84	0.85	1.02	1.48	1.17	0.94	2.12	-

DAT - Days After Treatment; PTC – Pretreatment count; PRC – Percent reduction over untreated control

*Figures in parentheses are Arc sine transformed values. Treatment means with letter(s) in common are not significant by DMRT at 5% level of significance.

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