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Eco-friendly management of cowpea thrips (*Megalurothrips distalis*) using plant extracts

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The cowpea [*Vigna unguiculata* (L.) Walp.], an annual herbaceous legume, is grown as an important vegetable crop and edible legume. The plant is used as cattle feed, hay crop and green manure crop. Thrips complex *Megalurothrips distalis* (Karny), *M. usitatus* (Bagnall) and *Thrips palmi* (Karny) (Thysanoptera: Thripidae) damage is caused by scrapping plant cells which reduce the photosynthetic activity (Shipp *et al.* 2000). Yield is reduced and the whole plant dies. Damage is a major biotic stresses which limits the production of cowpea (Jackai and Daoust 1986). Indiscriminate use of pesticides leads a quick development of resistance in thrips against insecticides, which render the insecticide treatments ineffective (Morse and Hoddle 2006). Plant extracts act in many ways, viz. feeding deterrents, insect growth regulators, confusants and repellents (Schmutterer 1990). Azadirachtin is a good phyto-pesticide because of its low toxicity to vertebrates, easy biodegradable, and safety to environment and non-target organisms (Jacobson 1989). Chakraborty and Ghosh (2010) found that azadirachtin was less lethal to predators. Use of mixture of pesticides with tobacco was more economical than pesticide alone (Opolot *et al.* 2006). *Acmella paniculata* (Wall. ex DC.) R K Jansen, is locally available weed and its floral parts contain pesticide properties (Mandal and Ghosh 2021). The present investigation was done to evolve a treatment schedule for safe management of thrips on cowpea using plant extracts.

The studies were carried out at Kalyani Farm of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal during pre-*kharif* in 2018 and 2019. The soil is gangetic alluvial and sandy loam. The plant extracts were prepared in the Chemistry Laboratory of BCKV. Cowpea plant variety Kashi Kanchan was raised under West Bengal Government recommended fertilizers and cultivation practices with spacing of 20 cm × 30 cm in 5 m × 5 m plot size with 3 replications. The 1st season study during pre-*kharif*-2018 was done as; showing date on 03 Feb 2018 and the 2nd season study during pre-*kharif*-2019 was done as; showing date on 21 Feb 2019.

One neem based pesticide procured from market, azadirachtin (1500 ppm), 4 homemade botanical extracts, viz. tobacco (*Nicotiana tabacum* L.) leaf extract, *Spilanthes* floral parts extract, neem fruit aqueous extract and garlic (*Allium sativum* L.) bulb extract evaluated and compared with the insecticide, imidacloprid (17.8 SL). Water was used for tobacco leaves extraction by following the method developed by Ghosh and Chakraborty (2012). The leaves were washed and chopped. Then they were dried and converted them in powdered form by using a grinder. The powdered sample (100 g) was taken to a container and dipped in one litre water. The materials were kept to stand for 72 h with occasional shaking at room temperature. After 72 h the materials were filtered through Whatman 42 filter paper and 20 ml liquid soap was added. Extraction of *Spilanthes* floral parts, Garlic bulb, and neem fruit aqueous extract, were done in methanol by following the method developed by Mandal *et al.* (2016). The plant parts were washed with water. They were dried and made powder. Then 50 g powder was kept separately to the conical flask and filled with 250 ml methanol. The materials were dipped in 250 ml of methanol and kept to stand for 72 h with occasional shaking at room temperature. After 72 h the materials were filtered through whatman 42 filter paper and residues were washed with methanol. Neem fruit aqueous extract was prepared as follows. The extraction of fresh neem fruits was done in water by following the method developed by Saloni Nag *et al.* (2020), collected by personal communication before publication. Fresh neem fruits were dried and made powder using electric grinder, passing through a 20 mesh sieve and taken in a polythene bag. Then 60 g of powder were soaked in 1 litre of water and stirred for 2 h in a mechanical shaker and kept overnight. The extract was filtered and separated by using fine muslin cloth. The filtrate material was collected to have desired concentration of 6%. Some combinations

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Table 1 Overall pooled efficacies of plant extracts (bio-formulations) against thrips pest on cowpea (Overall pooled of 2018 and 2019)

Treatment	Dose (ml/litre) (%)	Overall efficacy (% reduction) (Pooled of 2018 and 2019)				
		Pre-treatment obs. (Thrips/Leaf)	3 DAT	6 DAT	10 DAT	Mean
T_1	2.5 ml/l	11.25	70.21 (57.17)^{b}	64.97 (54.64)^{b}	60.18 (50.73)^{b}	65.12 (54.18)
T_2	75.00 ml/l (7.5%)	11.35	57.77 (49.51)^{c}	45.65 (42.06)^{c}	36.69 (37.26)^{d}	46.71 (42.94)
T_3	60.00 ml/l (6%)	12.04	55.66 (48.51)^{c}	49.31 (44.67)^{c}	46.43 (42.81)^{c}	50.47 (45.33)
T_4	75.00 ml/l (7.5%)	10.97	55.23 (48.10)^{c}	48.85 (43.56)^{c}	45.57 (41.65)^{cd}	49.85 (44.44)
T_5	1 ml/3 l	12.96	83.28 (67.75)^{a}	80.44 (63.56)^{a}	72.58 (57.92)^{a}	78.77 (62.91)
T_6	75.00 ml/l (7.5%)	11.66	57.37 (49.49)^{c}	47.65 (43.38)^{c}	43.47 (40.08)^{cd}	49.50 (44.98)
T_7	2.5 ml/l + 75.00 ml/l	10.82	81.90 (65.32)^{a}	75.92 (61.00)^{a}	66.44 (55.64)^{ab}	74.76 (60.65)
T_8	2.5 ml/l + 75.00 ml/l	13.07	83.30 (68.07)^{a}	75.94 (61.07)^{a}	66.94 (56.13)^{ab}	75.39 (61.76)
T_9		11.71	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	
SEm (±)			2.19 6.59	1.80	1.97	
CD (P=0.05)		NS		5.39	5.89	

Figure in the parentheses are angular transformed values. DAT, Days after treatment; NS, Not significant. Refer to methodology for treatment details.

of treatments, viz. azadirachtin (1500 ppm)+*Spilanthes* flower extract and azadirachtin (1500 ppm)+garlic bulb extract were also used.

Three sprayings at an interval of 11 days were done. The population of thrips was counted at 3, 6 and 10 days after each spraying. Mean population of thrips after 3 days spray, 6 days spray and 10 days spray were calculated respectively. Thrips population per leaf basis from bottom, middle and top leaves was counted from five plants randomly selected from each plot. Per cent reduction of thrips population over control was calculated (Sheoren 1998).

$$\text{Per cent reduction over control} = \frac{\text{Per cent in treatment} - \text{Per cent reduction in control}}{100 - \text{Per cent reduction in control}} \times 100$$

The statistical method RBD (Randomized block design) was followed for analysis of data. INDO-STAT- software was used for analysis of variance. CD Test (critical difference) at 5% level of significance was applied for separating treatment means. The phyto-toxicity symptoms, viz. epinasty, leaf injury, vein clearing, wilting, necrosis and hyponasty on the crops in different treatments were counted at 3, 6, and 10 days after each spraying by using the 10 scores basis (Ghosh 2020; work done 2015–16).

Among the 9 treatments including one untreated check (Table 1), imidacloprid showed most effective against thrips recording 78.77% reduction, followed by azadirachtin+garlic recording 75.39% reduction and azadirachtin+*Spilanthes* (74.76% reduction). Over all observation showed that botanical pesticide azadiractin, neem fruit aqueous extract, *Spilanthes* flower extract, garlic bulb extract, tobacco leaf extract, provided moderate to higher results, showing about 65.12%, 50.47%, 49.85 %, 49.40%, and 46.71% thrips reduction respectively. Three days after spraying (Table 1), imidacloprid seemed most effective against thrips recording 83.28% reduction, followed by azadirachtin+garlic treatment recording 83.30% reduction and azadiractin+*Spilanthes* (81.90% reduction). No significant differences were found among these three treatments. Six days after spraying, imidacloprid was found better (80.44% reduction) followed by Azadirachtin+garlic treatment recording 75.94% reduction and Azadirachtin+ *Spilanthes* (75.92% reduction). No significant differences were found among these three treatments. Nine days after spraying, imidacloprid seemed most effective (72.58% reduction) against thrips, followed by azadirachtin+ garlic (66.94% reduction) and azadirachtin+*Spilanthes* (66.44% reduction). There are no significant differences between imidacloprid and azadirachtin+garlic treatments, but these two treatments are significantly different from Azadirachtin+*Spilanthes* treatment. In the year 2018 (Table 2), imidacloprid seemed highly effective against thrips recording 79.83% reduction, followed by azadirachtin+*Spilanthes* providing 75.92% reduction and azadirachtin+garlic (73.57% reduction). In 2019 (Table 2), imidacloprid seemed highly effective against thrips recording 77.71% reduction, followed by azadirachtin+garlic (77.22% reduction) and azadirachtin+*Spilanthes* (73.60% reduction). Phyto-toxic symptoms were not found irrespective of doses of different treatments in respect of wilting, leaf injury, necrosis, vein clearing, epinasty and hyponasty.

From the observation (Table 3) it was found that highest yield of green cowpea obtained from imidacloprid (17.8 SL) treated plot recording 15.88 tonnes/ha followed by azadirachtin+*Spilanthes* (14.22 tonnes/ha) and azadirachtin+garlic (13.22 tonnes/ha). In the year 2018, imidacloprid produced highest yield of 16.33 tonnes/ha which were at par with azadirachtin+*Spilanthes* (14.67 tonnes/ha) and azadirachtin+garlic (13.11 tonnes/ha). There

Table 2 Efficacy of plant extracts (bio-formulations) against thrips pest (*Megaleurothrips* spp.) on cowpea (2018 and 2019)

Treatment	Dose (ml/litre) (%)	Overall efficacy (% reduction) 2018					Overall efficacy (% reduction) 2019				
		Pre-treatment obs. (Thrips/ Leaf)	3 DAT	6 DAT	10 DAT	Mean	Pre-treatment obs. (Thrips/ Leaf)	3 DAT	6 DAT	10 DAT	Mean
T_1	2.5 ml/l	11.83	70.26 (57.42)[b]	65.99 (54.55)[c]	61.75 (51.85)[a]	66.00 (54.61)	10.67	70.16 (56.93)[b]	63.95 (54.74)[b]	58.62 (49.61)b	64.24 (53.76)
T_2	75.00 ml/l (7.5%)	12.07	58.72 (50.07)[c]	47.50 (42.71)[d]	37.62 (37.81)[b]	47.95 (43.53)	10.58	56.83 (48.95)[c]	43.81 (41.42)[c]	35.76 (36.71)d	45.47 (42.36)
T_3	60.00 ml/l (6%)	12.96	54.60 (48.14)[c]	48.98 (44.41)[d]	45.43 (42.27)[b]	49.67 (44.94)	11.12	56.72 (48.89)[c]	49.65 (44.93)[c]	47.43 (43.35)c	51.27 (45.72)
T_4	75.00 ml/l (7.5%)	11.98	54.71 (48.14)[c]	49.18 (45.40)[d]	46.55 (42.38)[b]	50.15 (44.64)	9.97	55.75 (48.07)[c]	48.52 (43.72)[c]	44.39 (41.93)c	49.55 (44.24)
T_5	1 ml/3 l	13.01	84.33 (67.15)[a]	82.09 (65.44)[a]	73.08 (58.43)[a]	79.83 (63.67)	12.92	82.24 (67.36)[a]	78.79 (63.68)[a]	72.09 (57.42)a	77.71 (62.15)
T_6	75.00 ml/l (7.5%)	12.30	57.86 (49.99)[c]	46.96 (42.38)[d]	43.97 (41.58)[b]	49.60 (44.98)	11.03	56.89 (48.99)[c]	48.34 (43.38)[c]	42.97 (40.58)cd	49.40 (44.98)
T_7	2.5 ml/ l + 75.00 ml/litre	11.77	83.35 (65.62) [a]	76.46 (61.45)[ab]	67.94 (55.54)[a]	75.92 (60.87)	9.87	80.45 (65.03)[a]	75.39 (60.56)[a]	64.95 (55.74)a	73.60 (60.44)
T_8	2.5 ml/l + 75.00 ml/l	13.27	81.28 (64.99) [a]	74.49 (59.59)[b]	64.95 (54.74)[a]	73.57 (61.12)	12.87	85.33 (68.15)[a]	77.39 (62.56)[a]	68.94 (56.53)a	77.22 (62.41)
T_9		12.67	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)		10.75	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	
SEm (±)			2.18	1.78	2.25			2.21	1.82	1.69	
CD (P=0.05)		NS	6.55	5.33	6.75		NS	6.64	5.45	5.03	

Figure in the parentheses are angular transformed values. DAT, Days after treatment; NS, Not significant. Refer to methodology for treatment details.

Table 3 Yield component of cowpea at different treatments

Treatment	Dose (ml/litre)(%)	Yield (tonnes/ha)		
		2018	2019	Pooled of 2018 and 2019
T_1	2.5 ml/l	12.55^{b}	12.0^{b}	12.27
T_2	75.00 ml/l (7.5%)	9.18^{cd}	9.00^{cd}	9.09
T_3	60.00 ml/l (6%)	11.24^{bc}	11.07^{bc}	11.15
T_4	75.00 ml/l (7.5%)	9.05^{cd}	10.02^{bcd}	9.53
T_5	1 ml/3 l	16.33^{a}	15.44^{a}	15.88
T_6	75.00 ml/l (7.5%)	9.22^{cd}	10.00^{bcd}	9.61
T_7	2.5 ml/l + 75.00 ml/l	14.67^{ab}	13.77^{ab}	14.22
T_8	2.5 ml/l + 75.00 ml/l	13.11^{ab}	13.33^{ab}	13.22
T_9		7.47^{d}	8.00^{d}	7.73
SEm (±)		1.08	0.97	
CD (P=0.05)		3.22	2.89	

Refer to methodology for treatment details.

were no significant differences among these treatments. In the year 2019, similar trend of yield was found.

From overall observations, imidacloprid was found most effective against thrips recording more than 78% reduction followed by azadirachtin+garlic and azadirachtin+*Spilanthes* recording more than 74% reduction. Aliakbarpour *et al.* (2011) reported that 2% neem oil was found effective against adult thrips 96 h after 2nd spraying (59.8% reduction) and caused 24.9% reduction of pollinators. Subba and Ghosh (2016) reported that azadirachtin+*Spilanthes* recorded 72.72% thrips reduction that supports the present investigation. Neem oil provided better result against *Bemisia tabaci* (Rao *et al.* 1990). However, azadirachtin+*Spilanthes* provided more than 74% thrips reduction which is supported by Subba and Ghosh (2016). Use of mixture of pesticides and plant extracts, viz. tobacco/neem/*Spilanthes* was more economical than pesticides alone (Ghosh 2017).

SUMMARY

Mixed formulation, azadirachtin+garlic and azadirachtin+*Spilanthes* provided 66.94% and 66.44% thrips reduction 10 days after application respectively in cowpea crop, which was at par with imidacloprid. There are no significant differences among those treatments. Yield of these two treatments are also at par with the imidacloprid. Recommended doses of azadirachtin (1500 ppm) mixing with garlic or *Spilanthes* is good for thrips reduction. So they are recommended for thrips management. These treatments have no phyto-toxic effect on plants. So plant extract may be recommended for thrips management and included in Integrated Pest Management (IPM).

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