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Effect of Different Fertilizer Additives in Enhancing the Foliar Activity of Plant Product on Water Hyacinth (Eichhornia Crassipes (Mart.) Solms)

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Abstract: A study was conducted at Annamalai University, India during 2002, to study the efficacy of different fertilizer additives in enhancing the foliar activity of the plant product *Coleus amboinicus/aromaticus* on water hyacinth control, in integrated bio-control approach, with an ultimate aim of reducing the dose involved. Three different fertilizers used were ammonium sulphate, urea and di ammonium phosphate. Addition of fertilizer additives was effective in enhancing the activity of plant product in the integrated package. The integrated bio-control using insects +plant product @20 per cent + 2 per cent ammonium sulphate and insects +plant product @20 per cent + 2 per cent urea recorded the cent per cent reduction in fresh weight and chlorophyll content on 40 and 30 days after spraying, respectively. No insect mortality rate was observed in any of the treatments.

Key words: *Eichhornia crassipes*, Integrated biological control, Insects, Plant product, Fertilizer additives

INTRODUCTION

Water hyacinth (*Eichhornia crassipes* (Mart.) Solms - Laubach : Pontederiaceae) is one of the most troublesome aquatic weeds all over the world and is considered to be the most damaging aquatic weed in India. It was originated in South America and it was introduced to Bengal, India in 1889 as an ornamental plant and by now it has been recorded from all types of water bodies like ponds, canal and drainage in all most of the cities and villages including major river system Brahmabutra, Cauvery, ganges etc. in India[2] and subsequently spread to throughout India. At present, it has spread over 200000 ha of water surface in India. Excessive infestations of the weed deleteriously affect water traffic, fishing potential, infrastructure for pumping, hydro electricity generation, water use and biodiversity. Other damages include water loss due to evapotranspiration and an increased population of vectors of human and animal diseases. In the state of Tamilnadu, India, the Veeranum Lake and its distributaries form the major irrigation source that covers a large proportion of the rice tract of the state with a command area of 18,000 ha. The weed has started invading the Veeranum distributaries[4]. The water flow in distributaries of Veeranum is blocked due to infestation of the weed and the weed also results in excessive loss. Hence, control of this weed has received prime attention by the planners and Government. Several methods have been used to control water hyacinth viz., mechanical, chemical and biological. Manual or mechanical methods of its control are not cost effective. Use of herbicide is effective and economical but may have potential risks on non-target organisms and water quality. Biological control is cost effective, self sustaining and eco-friendly but takes long time (20-30 months after inoculation of bio agents) to control of water hyacinth after first release. Further, the success of biological control depends on the availability of a continued range of weed host. In India, most of the water bodies are constrained with seasonal water flow and interrupted host range, as weed dries off in hot summer. Integrated control of *E.crassipes* has been achieved by integrating biocontrol agents *Neochetina eichhorniae* and *N.bruchi* with other biocontrol agents and plant pathogens. Based on the above facts, the present study was taken up to evluate the effect of the integrated biological control using insect agents *Neochetina* spp. and a plant product *C.amboinicus/ aromaticus*. It has been reported that releasing the insect agents @ two plant^{-1} first followed by spraying the plant product at 25 per cent over the weed after 10 days proved effective in controlling the water hyacinth. Based on the results obtained from the preliminary study, a study was conducted to increase the efficacy of plant product spray by using various fertilizer additives, with an ultimate aim of reducing the dose involved (The concentration of plant product was reduced to 20 per cent from 25 per cent which has been tried as highest concentration in the preliminary studies).

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MATERIALS AND METHODS

The experiment was conducted at Department of Agronomy, Faculty of Agriculture, Annamalai University, and Tamilnadu, India, to increase the efficacy of plant product spray by using various fertilizer additives. Three different fertilizer viz., ammonoium sulphate, urea, di ammonium phosphate were added to plant product to enhance the foliar activity in the integrated approach to control *E. crassipes*. The concentration of plant product was reduced to 20 per cent from 25 per cent, which has been tried as highest concentration in the previous studies. Two different concentrations from each fertilizer were added to plant product. Insect agents were released at two insects plant^{-1} prior to foliar spray. The foliar spray of plant product with fertilizer additives was taken up 10 days after releasing the insects. The experiment was conducted in a completely randomized design with five replications. The observations recorded were percentage reduction in fresh weight and chlorophyll content at 10 days intervals and insect migration and mortality rate at 1,2,3,4,7,14 DAS (days after spraying) The reduction in fresh weight was recorded at 10 days intervals (in comparison with initial fresh weight of plants in the same treatment). Chlorophyll content of *E. crassipes* was estimated at 10days interval by extracting the leaf tissue using dimethyl sulphoxide (DMSO)[3]. The mortality rate of insects was calculated based on the number of insects died per pot. In order to trace the migrational behaviour of insect agents, every treatment container was accompanied by another container with untreated *E.crassipes* plants (without plant product or insect) and both these containers were covered by fish net stretched over steel frames of dimension 35 x 30 x 30 cm. A white marking was made on the back of the insect prior to release into plants. The numbers of insects moved to the pot kept by the side (without insect release or any other control treatment originally) were counted at regular intervals and were considered as the insects migrated from the pots subjected to treatment.

Insect mortality rate (%) =

$$\frac{\text{Total no. of insets released into the pot - No. of insects alive in the pot}}{\text{Total no. of insects released into the pot}} \text{X100}$$

RESULTS AND DISCUSSIONS

The use of fertilizer additives was observed to significantly enhance the activity of plant product sprayed after releasing the insect bio-control agents on the weed *E. crassipes*. Fertilizer additives @ 2 per cent proved superior to the same @ 1 per cent and simple plant product spray (without adjuvant). Ammonium sulphate proved superior among the three fertilizer additives in enhancing the activity of plant product in the integrated package. Accordingly, the highest fresh weight (82.29 per cent) and chlorophyll content (79.91 per cent) reduction of *E. crassipes* were observed on 20 and 30 DAS (days after spraying), respectively with the integrated bio-control using insects + plant product + 2 per cent ammonium sulphate. The cent per cent reduction in fresh weight and chlorophyll content were obtained on 30 and 20 DAS, respectively with the integrated bio-control using insects+ plant product+2 per cent ammonium sulphate and insect+ plant product+ 2 per cent urea (Table 1). The least fresh weight and chlorophyll content reduction of *E.crassipes* observed with the integrated approach where in no adjuvant was involved. Addition of fertilizer additives to plant product spray without exposing the *E.crassipes* to insect agents earlier did not show any significant reduction in fresh weight and chlorophyll content of the weed. No insect mortality rate was observed in any of the treatments. However, highest insect migratory behaviour was observed with the most effective adjuvant *viz*., 2 per cent ammonium sulphate. Integrated bio-control using insects + plant product + 2 per cent ammonium sulphate recorded the highest migration rate of 40.00, 60.00, 70.00 and 100.00 per cent on 1, 2, 3 and 4 DAS, respectively. This was followed by integrated bio-control using insects+ plant product+ 2 percent urea (Table 2). The least insect migration was observed with plant product spray alone. The higher percentage of insect migration could be attributed to the degree of injury suffered by the weed as a result of combined action of both plant product and insects rather than to the direct repulsion of the insects by the plant product. The fact that depletion of food reserve is the cause for the insect migration rather than deterrence by the plant product.

All the fertilizer additives were observed to enhance the foliar activity of the plant product sprayed after releasing the insect agents. Among the fertilizer additives compared, ammonium sulphate at 2 per cent concentration performed better in enhancing the uptake and bio-efficacy of plant product in the integrated bio-control approach. This is possibly due to its action on plant membranes enabling better absorption of sprayed plant product as suggested by[1]. Further, ammonium sulphate has already been observed to prevent precipitation of the applied organic molecule on the leaf surface, aiding its better absorption[5]. Similarly, urea also favoured better performance of the sprayed plant product probably by virtue of enhancing foliar

Table 1: Effect of various fertilizer additives in enhancing the foliar activity of plant product spray on E.crassipes

Treatments	Percentage reduction in fresh weight					Percentage reduction in chlorophyll content			
	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	10 DAS	20 DAS	30 DAS	40 DAS
control	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product spray alone	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 1% urea spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 2% urea spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 1% $(NH_4)_2$ SO_4 spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 2% $(NH_4)_2$ SO_4 spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 1% DAP spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 2% DAP spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 `(0.00)	0.01 (0.00)
Insects alone	24.97 (17.82)	29.34 (24.00)	33.83 (31.00)	36.87 (36.00)	39.81 (41.00)	25.25 (18.20)	31.05 (26.60)	34.33 (31.80)	37.46 (37.00)
Insects + 20 % plant product spray	42.64 (45.89)	46.15 (52.02)	51.83 (61.82)	64.34 (81.25)	90.00 (100.00)	44.98 (49.97)	52.54 (63.00)	65.78 (83.17)	90.00 (100.00)
Insects + 20% plant product + 1% urea spray	46.97 (54.43)	54.33 (66.00)	65.11 (82.29)	74.78 (93.11)	90.00 (100.00)	48.29 (55.73)	56.75 (69.93)	68.66 (86.76)	90.00 (100.00)
Insects + 20% plant product + 2% urea spray	54.94 (67.00)	62.73 (79.00)	90.00 (100.00)	90.00 (100.00)	90.00 (100.00)	60.69 (76.03)	90.00 (100.00)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 1% $(NH_4)_2$ SO_4 spray	47.66 (54.63)	54.99 (67.10)	66.79 (84.47)	76.15 (94.27)	90.00 (100.00)	50.94 (60.29)	60.34 (75.51)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 2% $(NH_4)_2$ SO_4 spray	56.08 (68.86)	65.11 (82.29)	90.00 (100.00)	90.00 (100.00)	90.00 (100.00)	63.37 (79.91)	90.00 (100.00)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 1% DAP spray	45.37 (50.64)	51.57 (61.36)	61.90 (77.82)	69.88 (88.17)	90.00 (100.00)	46.39 (52.43)	53.55 (64.70)	63.64 (78.69)	90.00 (100.00)
Insects + 20% plant product + 2% DAP spray	52.38 (62.74)	60.34 (75.52)	72.54 (91.00)	90.00 (100.00)	90.00 (100.00)	58.11 (72.09)	58.44 (68.44)	63.64 (80.29)	90.00 (100.00)
SE_D	1.04	1.40	1.74	2.05	1.80	2.04	2.25	1.84	2.10
CD (p=0.05)	2.06	2.82	3.49	4.09	3.60	4.06	4.49	3.68	4.20

Figures in parentheses are original values before angular transformation DAS- days after spraying

Table 2: Effect of various fertilizer additives in enhancing the foliar activity of plant product spray on E.crassipes (insect migration rate (%))

Treatments	1 DAS	2 DAS	3 DAS	4 DAS	7 DAS	14 DAS
control	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product spray alone	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 1% urea spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 2% urea spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 1% $(NH_4)_2$ SO_4 spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 2% $(NH_4)_2$ SO_4 spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)

Table 1: Continued.

20 % plant product + 1% DAP spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
20 % plant product + 2% DAP spray	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
Insects alone	26.56 (20.00)	33.21 (30.00)	33.21 (30.00)	39.23 (40.00)	39.23 (40.00)	50.76 (60.00)
Insects + 20 % plant product spray	26.56 (20.00)	33.21 (30.00)	45.00 (50.00)	50.76 (60.00)	63.43 (80.00)	90.00 (100.00)
Insects + 20% plant product + 1% urea spray	33.21 (30.00)	39.23 (40.00)	39.23 (40.00)	63.43 (80.00)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 2% urea spray	39.23 (40.00)	45.00 (50.00)	50.76 (60.00)	71.56 (90.00)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 1% $(NH_4)_2SO_4$ spray	33.21 (30.00)	39.23 (40.00)	45.00 (50.00)	56.78 (70.00)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 2% $(NH_4)_2SO_4$ spray	39.23 (40.00)	50.76 (60.00)	56.78 (70.00)	90.00 (100.00)	90.00 (100.00)	90.00 (100.00)
Insects + 20% plant product + 1% DAP spray	26.56 (20.00)	33.21 (30.00)	39.23 (40.00)	50.76 (60.00)	71.56 (90.00)	90.00 (100.00)
Insects + 20% plant product + 2% DAP spray	33.21 (30.00)	39.23 (40.00)	45.00 (50.00)	63.43 (80.00)	90.00 (100.00)	90.00 (100.00)
SE_D	2.04	1.93	2.61	2.33	2.26	2.51
CD (p=0.05)	4.08	3.89	5.20	4.68	4.52	5.10

Figures in parentheses are original values before angular transformation
DAS- days after spraying

absorption at cuticular and / or cellular levels. The better performance of the fertilizer additives are reflected on greater reduction in fresh weight and chlorophyll content of *E.crassipes* compared to those integrated treatments without fertilizer additives and plant product spray taken up independently with additives (without insect bio-control agents).

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