Short communication

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Integrated approach for controlling water hyacinth

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Water hyacinth (*Eichhornia crassipes* (Mart.) Solms-Laubach: Pontederiaceae) is an erect, free floating, stoloniferous and perennial herb. The leaves of *E. crassipes* transpire more water into the atmosphere than normal evaporation (Bosman 1999). It affects the water quality and makes water unfit for human or livestock use. Water hyacinth infestation causes fish mortality and may serve as host for vectors of diseases (Rai and Datta 1979). 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. This lake and its distributaries have been infested with *Eichhornia crassipes*. Hence there was an immediate need for its control. Manual or mechanical methods of its control are not cost effective. Use of herbicides is effective and economical but may pose potential risk on non-target organisms and water quality. Biological control using insect agents, though accepted to be the only sustainable option, does not completerly control water hyacinth. Biological control requires several years, usually 3 to 5 years, for insect population to increase to a density that could bring down the weed stand to a substantial decline (Harley *et al*. 1996).

An Indian medicinal herb, *Coleus amboinicus/ aromaticus* Benth showed remarkable allelopathic inhibition of *E. crassipes* when applied as water suspension 30 g/l of water, within 24 h and near cent per cent reduction in fresh weight with in one week was achieved. However, the botanical herbicide showed remarkable activity even at minute doses over cut leaves of the weed. Kathiresan (2000) advocted to use this plant for the control of water hyacienth. This offered a clue that there exists ample scope for applying the plant product on the weed as foliar spray with lesser quantity, if integrated with other approach that will leave the weed canopy pre disposed. Based on the above facts, present study was under taken to find out the synergistic interaction between the botanical herbicide and insect agents for integrated and sustainable control of *E. crassipes.*

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The experiments were conducted during 2002-03 at Department of Agronomy, Annamalai University, India (located at 11° 24’ N latitude and 79°41’E longitude at an altitude of 5.79 meters above mean sea level), to explore the possibility of the interaction between the insect bioagent *Neochetina* spp. and botanical herbicide *Coelus* spp. for control of water hyacinth. Different inoculation loads of biocontrol agents *Neochetina* spp. with spray of *Coleus* leaf powder extract were compared in a pot culture study. These inoculation loads comprised three, two and one insect/plant. The studies were conducted in a split plot design separately for each inoculation load with varying concentrations of aqueous extract of leaf powder of *Coleus, viz.* 5, 10, 15, 20 and 25% included, different length of interlude or time lag, *viz.* 10, 20 and 30 days between the release of insect agents and spraying of plant product on weed. These treatments were replicated five times.

The medium growth stage of the water hyacinth with fresh weight of 100-120 g, leaf area of 500-520 cm^2 and plant height of 20 - 24 cm was selected for this experiment. The observations were recorded for reduction in fresh weight and chlorophyll content at 10 days interval, 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 10 days interval by extracting the leaf tissue using dimethyl sulphoxide (DMSO) (Hiscox and Israelstam 1979).

The mortality rates of insects was calculated based on the number of insects died per pot. In order to trace the migrational behaviour of bioagentgent, each 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. Each pot accommodated five plants of water hyacinth. A white marking was made on the back of the insect prior to release into plants. The number of insects,

Table 1. Per cent reduction in fresh weight of *E. crassipes* at different days after insect release (DAIR)

Treatment	3 insects/plant				2 insects/plant			
	20	40	60	80	20	40	60	80
Main treatment								
25% leaf powder extract	38.8	61.1	90.0	90.0	34.39	50.9	90.0	90.0
20% leaf powder extract	37.8	50.2	74.8	90.0	32.4	44.9	68.3	90.0
15% leaf powder extract	35.0	43.8	52.9	90.0	29.1	40.9	49.2	68.1
10% leaf powder extract	34.9	42.9	50.1	72.8	28.4	36.6	39.4	40.6
5% leaf powder extract	33.3	40.1	43.7	47.0	26.4	36.0	38.9	40.1
Control (insect alone)	32.3	39.2	42.9	45.3	25.7	35.0	38.5	38.6
LSD (P=0.05)	1.9	2.5	3.2	2.6	1.9	3.0	3.6	2.7
Sub-treatment								
10 DAIR	39.8	49.8	57.2	66.7	35.5	43.3	52.9	56.9
20 DAIR	32.8	45.2	56.5	66.2	26.4	40.4	50.0	55.2
30 DAIR	33.3	43.3	53.3	63.0	25.9	38.4	49.1	54.7
LSD (P=0.05)	2.24	3.43	3.28	3.34	2.01	3.23	3.72	2.94

Figures are angular transformed values

Table 2. Per cent reduction in chlorophyll content of *E. crassipes* at different days after insect release (DAIR)

Treatment	3 insects/plant					2 insects/plant				
	20	30	40	50	60	20	30	40	50	60
Main treatment										
25% leaf powder extract	39.2	59.4	79.5	90.0	90.0	33.9	58.0	71.9	79.2	90.0
20% leaf powder extract	37.9	57.1	75.6	90.0	90.0	31.9	52.4	63.4	75.6	90.0
15% leaf powder extract	36.5	53.6	62.3	73.6	90.0	30.5	47.2	58.2	61.1	90.0
10% leaf powder extract	35.2	48.9	51.9	71.1	90.0	25.6	33.3	36.5	39.9	43.9
5% leaf powder extract	31.7	37.6	39.8	44.4	45.7	25.2	32.4	35.4	37.8	41.9
Control (insect alone)	29.6	32.2	34.7	37.7	40.9	24.1	31.6	34.4	36.1	38.5
LSD (P=0.05)	2.6	2.6	2.8	2.5	1.5	3.2	2.9	3.0	3.6	1.4
Sub-treatment										
10 DAIR	44.0	55.5	58.5	64.1	65.8	36.4	48.9	51.9	54.9	58.1
20 DAIR	30.5	51.9	56.8	63.0	65.3	24.2	44.89	49.5	53.9	57.9
30 DAIR	30.0	36.9	50.4	59.0	64.4	24.5	33.9	46.1	50.0	57.9
LSD (P=0.05)	2.4	2.9	3.1	2.3	2.0	3.4	3.2	3.0	3.7	1.8

Figures are angular transformed values

moved to untreated plants was counted at regular intervals and were considered insect migrated from the pots.

The experimental data were statistically analyzed as described by Panse and Sukhatme (1978). The data on percentage values were transformed by angular transformation, before analysis.

All the treatments registered significant reduction over fresh weight and chlorophyll content, insect migration rate and weed nutrient content. Among the different inoculation load of bioagents, three insects/plant was found most effective in reducing 100% fresh weight and chlorophyll content by 60 days, while bioagents (three/plant) followed by spraying of extract of *Coleus* leaf powder at 25% proved significantly superior in reducing the fresh weight and chlorophyll content by 100% on 50 days (Table 1 and 2). Reduction in nutrient contents in weed also recorded in three insects/plant treatment. Reduced concentration of leaf powder extract, *viz.* 20, 15 and 10% with insects also cause 100% mortality of water hyacienth but over a prolonged period. Inoculation load of two in sects/plant controlled the weed by 90 days at 25, 20 and 15% concentration of leaf powder extract.

Two insects/plant were found sufficient to cause injury in the plant to absorb aquaous extract readealy. However, one insect/plant could not offer adequate leaf scrapings to favour absorption of the leaf powder extract. Biochemi-

Table 3. Insect migration rate at different days after spray (DAS) of aquaous extract

Treatment	3 insects/plant						2 insects/plant					
	1	2	3	4	7	14	1	2	3	4	7	14
Main treatment												
25% leaf powder extract	44.4	50.8	57.5	58.9	75.0	90.0	45.0	52.7	61.1	61.1	79.5	90.0
20% leaf powder extract	43.1	49.4	54.7	57.5	72.7	90.0	43.1	52.7	54.7	61.1	75.0	90.0
15% leaf powder extract	37.9	43.1	49.5	52.1	68.6	90.0	39.2	45.0	52.7	52.7	68.6	90.0
10% leaf powder extract	36.6	39.2	46.9	49.5	58.9	90.0	39.2	43.1	48.8	52.7	56.8	58.9
5% leaf powder extract	33.9	37.9	46.2	44.4	49.5	48.2	33.2	43.1	45.0	46.9	50.8	50.8
Control (insect alone)	32.5	36.6	44.4	40.5	44.4	48.2	28.9	37.3	39.2	41.2	43.1	50.8
LSD (P=0.05)	2.4	2.4	2.5	4.0	5.1	1.6	2.0	2.6	3.5	3.8	5.0	2.0
Sub-treatment												
10 DAIR	25.8	31.1	41.2	42.5	56.1	66.8	26.6	34.2	42.1	45.0	57.8	64.7
20 DAIR	35.9	43.7	54.1	54.7	57.5	67.7	41.4	47.9	50.8	52.7	62.3	64.7
30 DAIR	51.4	53.4	54.7	58.2	67.7	67.7	49.8	54.7	57.8	60.0	64.7	65.9
LSD (P=0.05)	2.5	3.2	3.3	3.4	4.2	1.8	2.4	3.0	4.0	3.6	4.0	2.2

Figures are angular transformed values

cal constituents like a-humulene, carvacrol, thymol, a-pinene and a-terpenein in leaf powder were esponsible for its herbicidal functions (Vasquez *et al.* 1999). All the four concentration (25, 20, 15 and 10%) recorded 100% insect migration from the treated plant to untreated plants by 14 days after spraying the extract (Table 3). No insect mortality was observed in any of the concentration of the extract.

Among the different interludes or time lags of insect release, *viz.* 10, 20 and 30 days, 10 days proved more effective in reducing the fresh weight and chlorophyll content of the weed with all the concentration of leaf powder extract. Minimum migration rate and weed nutrient content were also recorded with shorter interlude of 10 days.

SUMMARY

The experiment was conducted at Annamalai University, Tamilnadu, India to study the possibility of interaction between botanical herbicide *Coleus amboinicus/ aromaticus* with insect agents *Neochetina eichhorniae/ bruchi.* Single control options was found inefficient for managing the worlds worst aquatic weed water hyacinth. The integrated approach of releasing the insect agents *Neochetina* spp. onto the weed and spraying the aqueous extract of leaf powder of *Coleus* spp. showed synergistic interaction in reducing the fresh weight and chlorophyll content of water hyacinth. Among the three inoculation loads of insect agents,*viz.* three, two and one insects/plant, three/plant followed by spraying the extract of *Coleus* spp. leaf powder at 25% proved significantly superior in reducing the fresh weight and chlorophyll content to on 60 and 50 days after releasing the insects, respectively. Among the different interludes or time lag compared for evolving a standardized method of integrating foliar spray of leaf powder extract, *viz.* 10, 20 and 30 days, 10 days performed superior by achieving fresh weight and chlorophyll content reduction and least weed nutrient content of water hyacinth. No insect mortality was observed in any of the treatments.

REFERENCES

Bosman HH. 1999. Environmental conditions influencing biological and integrated control of water hyacinth, pp.168-173. In: *Proceedings of the I IOBC Working Group Meeting for the Biological and Integrated Control of water hyacinth*. (Eds. Hill MP, Julien MH and Center Ted D. PPRI, Pretoria, South Africa,

Harley KLS, Julien MH and Wright AD. 1996. Water hyacinth: A tropical worldwide problem and methods for its control, pp. 639-644. In: *Proceedings of the Second International Weed Control Congress,* Copenhagen, Denmark.

Hiscox JD and Israelstam GF. 1979. A method for extraction of chlorophyll from leaf tissue without maceration. *Canadian Journal of Botany* **57:** 1332-1334.

Kathiresan RM. 2000. Allelopathic potential of native plants on water hyacinth. *Crop Protection* **19** (8-10): 705-708.

Panse VG and Sukhatme PV. 1978. *Statistical Methods for Agricultural Workers*. Indian Council of Agricultural Reseach, New Delhi, 3rd ed.

Rai DN and Datta Munshi J. 1979. The influence of thick floating vegetation (water hyacinth: *Eichhornia crassipes*) on the physico-chemical environment of a fresh water wetland. *Hydrobiologia* **62:** 65-69.

Vasquez EA, Morallo Rejesus B, Punzalan EG and Kraus W. 1999. Biological studies on the essential oil of *Coleus amboinicus,* p. 29. In: *Abstracts of the XIV International Plant Protection Congress,* Jerusalem, Israel.