

SOME RECENT OBSERVATIONS ON THE BIOLOGICAL CONTROL OF SALVINIA

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Salvinia molesta D.S. Mitchell, misidentified in some literature as *S.auriculata* (Forno *et al.*, 1983), was introduced to Sri Lanka in 1939 by a botanist, probably for purposes of study (Williams, 1956) and was first observed in fields in 1943 (Senaratna, 1943). Being an alien to this country, this floating water fern had hardly any local regulatory mechanisms to arrest its rapid multiplication. This made the plant colonize at an alarming rate covering more than 22,000 acres of rice fields and at least 2000 acres of canals and water ways in coastal areas of the Western part of the country by 1954. These observations made salvinia to be declared a weed under the Plant Protection Ordinance in 1952.

Control of salvinia had been attempted initially with mechanical methods followed by extensive application of several herbicides during the period from 1957-1964 (Dias, 1967). These control methods were found to be

ineffective in the long run due to several factors in which marginal activity and high cost of herbicides, rapid growth and colonizing ability of salvinia were of particular significance.

Investigations conducted by the Department of Agriculture and Kelaniya University during the period 1986-87 revealed that *Cyrtobagous salviniae*, a weevil (Coleoptera: Curculionidae) introduced from Australia, could effectively control salvinia. The adult weevil feeds selectively on buds, slowing the growth of salvinia while its larvae tunnel through the floating rhizome. Consequently, the plants rot and eventually sink. Hence the weed gets destroyed primarily due to larval feeding of the weevil.

Following pilot scale verification studies on the effectiveness of the weevil on salvinia which proved to be successful, the biological control programme of salvinia was entrusted to the Plant Protection

Service of the Department of Agriculture in early 1990. During the last 5-6 year period, plant protection service has been responsible for the maintenance and multiplication of the weevil, its introduction to salvinia infested water bodies and conducting training programmes for field officers on biological control of salvinia.

Awareness programmes launched through mass media and training classes during early nineties generated a great interest among the public on biological control of salvinia. Consequently, plant protection service received a large number of inquiries from environmentalists, farmers organizations, government institutions, extension officers and school children requesting the biological agent.

Based on the requests received from April 1995 to October 1996, the insects were released to 90 salvinia infested water bodies of which 50 were in the dry zone while the remaining 40 were in the wet zone. Officers from plant protection service visited eight reservoirs to introduce the bio-control agent while the rest received the agent through parcel-post accompanied

with instructional leaflets containing information on salvinia, the weevil and technical details on how to introduce the weevil into Salvinia, etc.

There were no feed back on the effectiveness of the bio-agent from any of these tanks. Therefore, a study was undertaken with the following objectives.

1. To identify the specific agro-ecological regions/districts where salvinia has become a major problem at present.
2. To evaluate the effectiveness of the weevil on salvinia control after its release to different agro-climatic regions.

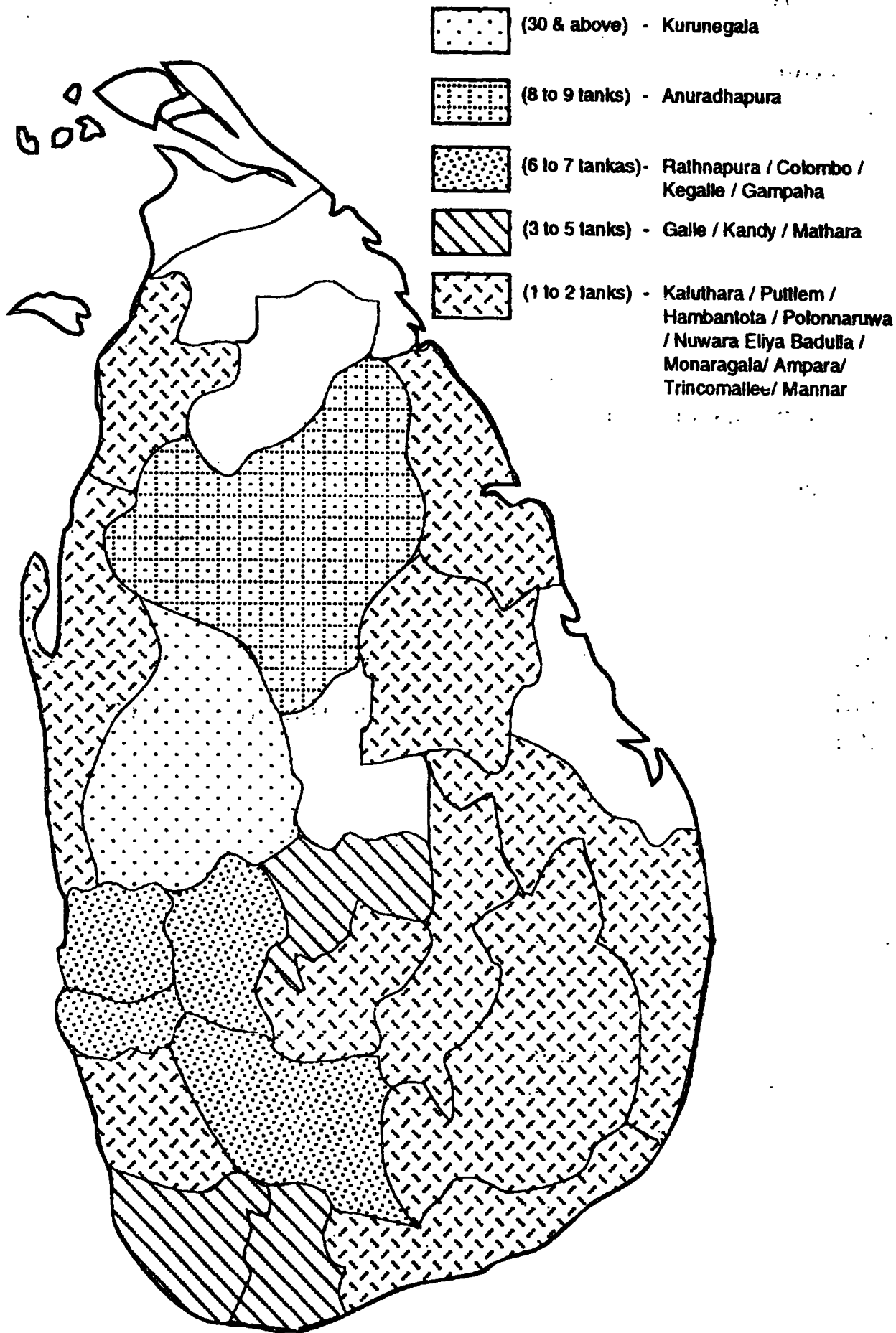
MATERIALS AND METHODS

A specially prepared questionnaire was circulated among all 90 recipients of the weevil during the period from April 1995 to October 1996 to collect feed back on performance of the biological agent on salvinia.

RESULTS AND DISCUSSION

During the study period, majority of the requests were from Kurunegala district followed by Anuradhapura district. A considerable number of request were also received from Gampaha,

Figure 1: Salvinia infested reservoirs in different district



Kegalle, Ratnapura and Colombo districts. These results show that salvinia has become a major problem in Kurunegala district compared to the other districts and this could largely be due to the presence of a large number of minor tanks in the Kurunegala district (Figure 1). It is a well-known fact that minor tanks offer an attractive ecological niche for

rapid colonization of salvinia. Thus, control of salvinia in Kurunegala and Anuradhapura districts must receive high priority as the water bodies play a vital role in agricultural production in these two districts.

Feed-back information on the post-release performance of the insect was received only from 49 locations of the total 90

Table 1: Number of tanks in different districts of the dry and wet zones that received *Certobagous salviniae*, per cent success of control and per cent resurgence of salvinia.

District	No of tanks introduced	No of tanks reported back	Percent success	Percent resurgence
<i>Dry zone</i>				
Kurunegala	31	20	55	45
Anuradhapura	9	5	80	50
Hambantota	2	1	100	0
Puttlam	2	—	—	—
Polonnaruwa	1	—	—	—
Badulla	1	1	0	—
Monaragala	1	—	—	—
Ampara	1	—	—	—
Tricomalee	1	1	100	—
Mannar	1	—	—	—
Total	50	28	60.7	41
<i>Wet Zone</i>				
Ratnapura	7	4	75	66
Colombo	6	4	100	0
Kegalle	6	3	33	0
Gampaha	6	5	100	20
Kandy	5	3	100	33
Matara	4	—	—	—
Galle	3	1	100	0
Kaluthara	2	1	0	0
Nuwara Eliya	1	—	—	—
Total	40	21	81	23

reservoirs that received the biological agent (Table 1). Thus, evaluation of the post-release performance of the insect was limited to these 49 locations. According to the results from these 49 locations, salvinia was effectively controlled in 34 locations giving a success rate of 60% in the dry zone and 81% in the Wet Zone. Resurgence of salvinia has been observed in 11 locations where initial control had been successful (Table 1). It is interesting to note that of these 11 locations, 9 were from the dry zone indicating that the probability of re-infestation is very high in the dry zone compared to wet zone. Results further indicate that bio-control agent was more effective in wet zone than that in the dry zone.

Cyrtobagous salvineae is quite sensitive to higher temperatures and the favourable temperature range for its rapid multiplication is from 18–30 °C. Above 35 °C, it does not multiply at all (Forno *et al.*, 1983). Seasonality in rainfall and long dry spells leave most of the minor tanks in the dry zone with little water during the dry season. Thus decrease in water depth can raise the temperature high enough to curtail population increase of the weevil in most of the minor tanks in the Dry Zone, eventually leading to a poor control of salvinia. Room *et al.* (1988) also

observed poor establishment of the weevil in some tanks in the dry zone due to drought. After a long dry spell, salvinia in tanks resumes its growth with the onset of rain as the effect of weevil may be either minimum or totally absent at this time.

Population increase of *C. salvineae* is also affected by nitrogen content of salvinia plant. The insect population increases rapidly on salvinia containing higher nitrogen levels and drops with decreasing nitrogen content in the plant (Room *et al.*, 1988). Prolong drought in the Dry Zone may reduce the amount of nitrogen entering into minor tanks and this can also affect population build up of the weevil.

Thus water temperature and nitrogen content of salvinia appear to be critical factors for population increase of the weevil. Therefore, timing of the introduction of the bio-control agent to minor tanks in the dry zone seems to be very crucial for effective control of salvinia. Micro-climate of the water bodies in the wet zone, in contrast to that in the dry zone, is favourable throughout the year for unimpeded growth and multiplication of *C. salvineae*. Successful control of salvinia in the wet zone could be largely accounted for this factor.

CONCLUSION

The results indicate that control of salvinia in water bodies needs further attention with respect to the time of introduction of the bio-control agent. Unlike in the wet zone, introduction of the weevil to dry zone should be done during the wet season to ensure effective multiplication of the bio-control agent. However, best time to introduce the bio-control agent is not known as no information is available on temporal fluctuations of either nitrogen content of salvinia or water temperature in tanks in dry

zone. Thus it is essential to generate this information to implement an effective salvinia management programme with the bio-control agent in dry zone.

It is also important that a continuous monitoring programme is needed for re-introduction of the bio-control agent to arrest any resurgence of the weed. Such an exercise can be successfully implemented through systematic monitoring of the bio-control agent, salvinia growth and related micro-environmental factors in dry zone water bodies.

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