

Preemption of *Hydrilla* on Competition with *Ceratophyllum*

*Dr. Anju Mittal

Abstract

Ceratophyllum growth was studied in 7, 14, 21, 28 days old *Hydrilla*. This was done to evaluate competitive interaction between these species in eutrophic condition. The mixed cultures were allowed to grow for a definite period and then harvested to assess impact of preemption of *Hydrilla* on the growth of the new invader *Ceratophyllum*.

Keywords: *Hydrilla*, *Ceratophyllum*, growth, mix culture

Introduction

The submerged macrophytes exhibit two major types of growth forms. Some like *Charophytes*, *Isoetes*, *Vallisneria* and submerged species of *Eleocharis* are *stoloniferous* and form rosettes with limited height of shoot or leaves. The other macrophytes whether rooted (i.e. *Hydrilla verticillata*, *Myriophyllum spicatum*, *Najas graminea*, *Potamogeton pectinatus* etc) or not (e.g. *Ceratophyllum demersum* and *Utricularia* species) tend to develop long shoots and branch out near the water surface forming a canopy (Spencer & Lekie, 1974) whereas the rosette forming species may face competition for space at high densities.

The canopy forming species can attain a much higher density before the competition for space sets in. The rosette forming species are also differentiated into two groups according to their growth strategies (a) species which maximize on horizontal space by developing numerous distantly placed space ramets and (b) species which produce fewer closely placed and larger ramets. Most of the submerged macrophytes form dense stands, but the effects of density (Intra specific competition) have rarely been examined.

In recent years, interspecific competition has however been investigated in some detail. Among submerged macrophytes *Hydrilla verticillata* is a strong competitor compared with other submerged species like *Vallisneria neotropicalis* (Haller and Sutton, 1975; Langeland, 1996). *H. verticillata* not only forms a dense canopy at the water surface which reduce light penetration by 95%, but has several other biological and physiological attributes that add to its success. Zutshi and Vass (1976) however, reported that *Myriophyllum* species is able to outgrow *Hydrilla verticillata*, *Potamogeton lucens* and *Ceratophyllum demersum* in water culture, because it forms adventitious roots from its cut ends within 12- 20 hours which give it competitive advantage over other species in colonizing the area. The competitive ability of some *Potamogeton* worker species has been investigated in detail by

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Dr. Anju Mittal

several (Pip, 1984, 1987; Spencer and Van Vierssen, 1988; Spencer, 1988; McCreary, 1991; Kautsky, 1991, Krolikowska, 1997).

Method and Material

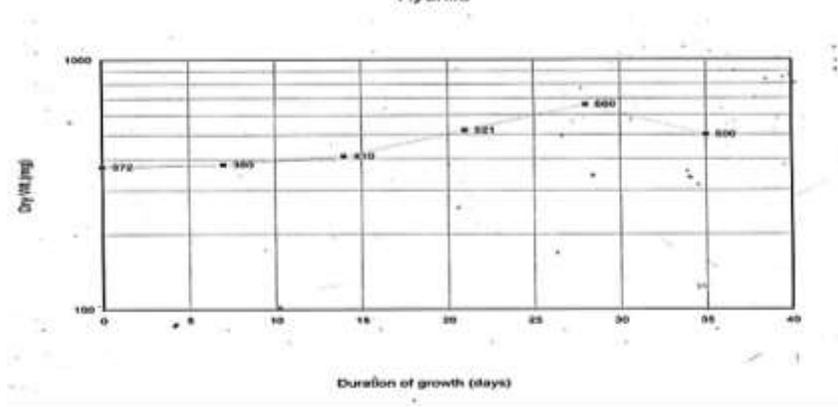
During this study *Hydrilla verticillata* was first established separately in the earthen pots, followed by the introduction of *Ceratophyllum demersum* at different time intervals. The mixed cultures were allowed to grow for a definite period, and then harvested to assess impact of pre-emption of *Hydrilla* on the growth of a new invader, the *Ceratophyllum*.

This study was performed in 48 earthen pots during summer of 1995 from 2nd June -1995 July. The bottom of the pots was sealed with a mixture of cement and gravel. Their volume was 7L. About 1 Kg of soil, a mixture of clay and garden soil in 1: 2 ratio, was filled in each earthen pot. Earthen pots were used to avoid heating of water during the study period which might result in *algae* growth. 5 L water was added in each pot along with a known volume of concentrate solution of KNO₃ and KH₂FO₄ to raise the level of nitrate and phosphate to 50 ppm and 5 ppm respectively.

This was done to evaluate competitive interactions between these species in eutrophic conditions, which is quite often observed in the water bodies on account of input of sewage and agricultural runoff in our country.

The earthen pots were kept in the Botanical garden of the department at a place where building and tree shade remained almost throughout the day. This precaution was taken again to avoid water heating, resulting in algae growth which often resulted in detrimental effect on these plant growths. 10 g (f.wt) of *Hydrilla* *Ceratophyllum* was added separately in four earthen pots for a species. The remaining 40 pots were classified into 5 groups viz. 0, I, II, III, and IV, each comprising 8 pots. Each group was further divided into 2 sub-groups A & B having 4 pots each. In the 0 group, subgroup A had 5 g (fresh weight) each of *C. demersum* and *H. verticillata* while subgroup B had only g of *H. verticillata*. These sets were harvested at the end of study i.e. after their 5 weeks growth. (35 days).

Fig. 2 : *Ceratophyllum* growth curve on semi log scale in the mixed cultures with *Hydrilla*



Preemption of *Hydrilla* on Competition with *Ceratophyllum*

Dr. Anju Mittal

Fig.1 : *Ceratophyllum* growth in the mixed cultures with *Hydrilla*

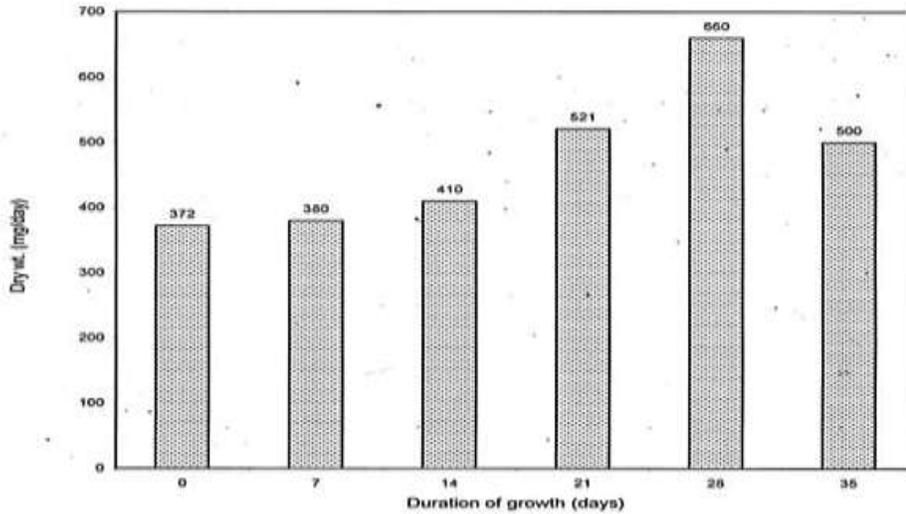


TABLE 1 : *Ceratophyllum* growth (mixed cultures) with *Hydrilla* stands of varying ages

Age of <i>Hydrilla</i> monoculture	Duration of <i>Ceratophyllum</i> growth in Mixed culture	Standing crop (mg)	Productivity (mg/d)	R.G.R. (mg/mg/d)
28	Initial Weight	372		
21	7	380 + 79	1.14	0.003
14	14	410 + 135.2	4.2	0.018
7	21	521.2 + 100	15	0.034
0	28	660 ± 105	20	0.033
	35	500.2+112.2	-14.3	-0.039
	Control	1708.0±115	48.8	

± SE

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Dr. Anju Mittal

Experimental Studies

Both age of *Hydrilla* monocultures at the time of *Ceratophyllum* introduction as well duration of growth of *Ceratophyllum* in the mixed cultures markedly affected performance of *Ceratophyllum* (Table 1, Fig 1). *Ceratophyllum* grew slowly in mixed cultures with well developed 28 days old *Hydrilla* stands as evident with the increase in its dry weight during 7 days of growth in comparison to initial dry weight of *Ceratophyllum* added in the beginning of the experiment (372 mg) Decrease in age of *Hydrilla* monocultures coupled with the increase in duration of *Ceratophyllum* growth in mixed cultures favoured *Ceratophyllum* growth.

Percentage increase in dry weight of *Ceratophyllum* after 14,21 and 28 days of its growth in the mixed cultures were 7%,27% and 28% respectively. *Ceratophyllum* dry weights, however, decreased markedly (25%) when it was grown with *Hydrilla* from the beginning (35d old mixed cultures). Thus, it is evident that age of *Hydrilla* monocultures at the time of introduction of *Ceratophyllum* into its stand governs outcome of competition with *Ceratophyllum* (Table 1). Introduction of *Ceratophyllum* at an earlier stage of *Hydrilla* growth in the monoculture (7 days old) resulted in better growth of the former.

This was, however adversely affected when introduction of *Ceratophyllum* was made in the relatively old culture of *Hydrilla*. And so, *Ceratophyllum* growth was minimum in 28 days old *Hydrilla* monocultures. Thus, the outcome of competition was governed by the duration of pre-emption of *Hydrilla*. When *Hydrilla* and *Ceratophyllum* grew together from the beginning, *Ceratophyllum* growth was reduced markedly (70%) in mixed cultures in comparison to its monocultures (control), suggesting *Hydrilla* is a good competitor.

Thus, present study revealed that *Hydrilla* is a good competitor suppressing growth of *Ceratophyllum* in mixed cultures. *Ceratophyllum* growth was inversely proportional to the age of *Hydrilla* monocultures but directly proportional to the duration of mixed cultures. Thus, the duration of pre-emption of *Hydrilla* had a significant role on the development of *Ceratophyllum* in the mixed cultures

Discussion

During pre-emption studies *Ceratophyllum* growth was monitored in *Hydrilla* stands of varying ages (Table 1). Primary productivity and relative growth rate of *Ceratophyllum* growing with *Hydrilla* were significantly lower than control plants, especially in 21 and 28 days old *Hydrilla* stands and also when these two species were growing together from the beginning (table 1). This suggests that *Hydrilla* competes well in the mature stands and also when it grows as a pioneer species.

Conclusion

During pre-emption study of *Ceratophyllum* in *Hydrilla* stands of varying ages, it was noted that *Ceratophyllum* growth was lower in 21,28 days old *Hydrilla* stands than 7 and 14 days old stands, indicating competitive, advantages to *Hydrilla* on account of pre-emption in the habitat.

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