INTRODUCTION

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The members of the green algal genus *Chara* form a peculiar group of benthic and gregarious macrophytes having an apparent morphological resemblance with the higher plants by their whorled appearance. They are endowed with an incredibly high power of reproduction through both sexual and asexual means. *Chara* is considered to have originated in India and is variously known as Rosunia, Jhanji, Genda and Ganj in West Bengal. The systematic position of this group in the plant kingdom is still debated (Grambast, 1974) and many taxonomists prefer to keep it under the independent division "Charophyta" along with five allied genera (Pal *et al.*, 1962).

Chara has wide adaptability and grows in almost all types of aquatic environments like rice fields, ponds, lakes, streams and even in seas. Therefore, the different ecological factors such as depth, pH, salinity, nutrient content and flow of water and type, chemical and physical composition of substrates have been found to vary within a wide range in the habitat of the alga. However, high phosphorus concentration (>0.02 ppm), sudden change in water depth and increase in turbidity reducing light penetration into the water are reported to have detrimental effect on its growth. Therefore, the ecological control of this weed which is not only the most natural, effective and economical but also free from pollution hazards, needs to be explored.

The water-logged rice fields provide a congenial environment for excessive growth of *Chara* and are reported to be

infested by this alga throughout the world particularly in countries like India, Thailand, Java and Fiji Islands. In India the rice fields situated in the high rainfall (>1300 mm/year) areas of eastern, north-eastern and coastal regions remain inundated with water almost throughout the 'Kharif' season (July - December) providing excellent opportunity for its execessive propagation. Out of 19.5 million hectares of such water-logged area in India, about 0.4 million hectares in West Bengal alone are reported to be chronically infested (Mukherji, 1968). The degree of infestation is even greater in Orissa. Under the aforesaid agro-ecological condition, the weed competes severely with rice for nutrients, space and light. In such a crop-weed competition, the tiller and spikelet productions are mainly affected leading to yield reduction to the extent of 20 per cent in general and even a complete crop failure in extreme cases. This menacing infestation and losses seem to persist defying the traditional control measures adopted by the farmers of the problem areas where the rice yields are consistently low. Therefore, an immediate attention on the development of an appropriate technology for increasing the rice yield by minimising the losses becomes imperative.

Weed control in aquatic environment is confronted with several problems and is often not properly attempted envisaging the difficulties. The lowland rice fields are frequently overflown and connected with fish ponds during the rainy season. This often does not warrant application of chemicals due to their hazardous effects on the whole aquatic eco-system. Therefore,

control measures of Chara, so far developed, are not adequate. Mechanical or manual means of controlling this alga is cumbersome, time consuming, costly, incomplete and often entails injury to the rice plants. Moreover, the clones, inadvertently left after hand weeding, quickly re-establish and grow into individual plants. The algal mass produced through such reinfestation, liberates billions of oospores per hectare on drying. These soil-borne oospores cause intense infestation in the subsequent year, often attaining an alarming proportion. This, however, has not been studied adequately and thus, the regeneration capacity of the clones and reinfestation potentialities of Chara after manual weeding need proper evaluation.

Among the other methods of control, use of herbicides like butachlor, copper sulphate, 2,4-D, nitrofen, oxadiazon, propanil, thiobencarb and zineb have shown some positive effects. However, their algicidal efficacy have not been proved to be consistent and their combination has not yet been studied in relation to Chara . Hence, for consistent and satisfactory results, it is imperative to decide the dose, time and method of application of the herbicide on the basis of the extent and intensity of the infestation and its recurrence under the rice field environment.

The appropriate dose of any herbicide varies due to several factors, among which the time and method of application are generally considered important. The rice field environment, weed biology and intensity of infestation are seldom taken into

consideration, though these are also of considerable importance. Consequently, the informations on these aspects are lacking. It is therefore, envisaged that selection of a dose of a herbicide taking into account all these aspects will be of greater applicability, being effective, safe and economical.

For effective control of Chara, the time of application of herbicide plays a vital role particularly because the oospore germination and subsequent infestation is not simultaneous but spans over a long period. Moreover, the infestation is dependent on rains, which being erratic, disrupts any definite schedule of control measures. In such situations, pre-emergence application though better than post-emergence one, seldom proves to be satisfactory unless the herbicide has long persistence. Thus, not only the time of application, but also the residual effect has to be taken into account while selecting a chemical for controlling the alga.

The post-emergence treatment in water-logged rice fields entails several problems like difficulties in establishing a prolonged contact between the target weed and the applied herbicide at lethal concentration and its removal with run-off water from the treated area. This particularly may become grave when a contact herbicide like oxadiazon and a highly water soluble one like copper sulphate are used making the post-emergence treatment comparatively less effective. Inspite of this, the farmers generally adopt a control measure only when the infestation is visibly evident and threatening. Consequently, the efforts for

controlling the alga often become futile particularly when herbicides are used. This may be due to either failure of the herbicides to kill the aged target plants, or prior to the application, the damage to the crop is large enough to make the benefits insignificant. Therefore, application at proper time coinciding with the vulnerable growth stage of the weed becomes imperative. This cannot always be done by looking at the height or biomass accumulation of the plants rather it could be more accurately decided after the identification of initiation, formation and maturation of reproductive structures. However, studies are inadequate on the life cycle of Chara in relation to time, season and rate pertaining to control measures in the water-logged rice fields. Therefore, it was deemed essential to examine the different aspects of life cycle in order to pin-point the most succeptible growth stage for evolving an appropriate control measure of this obnoxious alga. Further, the dearth of a suitable technical know-how as to the method of application of herbicides under these limitations has been felt since long and requires to be developed.

The detection of mode of action of herbicides involve studies on the weed physiology which would elucidate the pathways of metabolic disruption responsible for herbicidal effect. This may enable the investigator to be more specific in selecting a herbicide for combating the weed within a short period. As regards Chara, almost nothing is known at present. Therefore, studies on physiology of this alga as affected by some promising herbicides were considered important for the present investigation.

In view of the different aspects mentioned above, it appeared that any field measure evolved to completely suppress the growth of this menacing weed for increasing rice production under water-logged condition would be of immense benefit. Therefore, the whole programme of study was aimed to attain the following broad objectives :

1. To estimate and evaluate the yield losses in rice caused by Chara under varying water-logged conditions.

2. To find out the causes of heavy infestation of Chara in rice fields.

3. To generate informations on the different aspects of phenology and physiology of this weed pertaining to its control measure.

4. To increase rice yield in the affected areas by evolving a suitable control measure.