CHAPTER 1

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1.1 The jute plant, an annual shrub belonging to the family Tiliaceae, produces golden fibre. The fibre is extracted from phloem tissue in the stem of cultivated varieties of two species Corchorus olitorius L. and Corchorus capsularis L.

The fibre is mainly used for manufacture of gunny bags, hessian, upholstery fabric and many other multipurpose uses. The jute sticks are used in producing high quality paper, insulation board etc.

India, Bangladesh, China, Thailand, Burma, Nepal and Brazil are the principal producers of raw jute. India and Bangladesh produce roughly 30% and 26% of the world's total production (3.8 million metric tons), respectively. Its cultivation stretches in the Northern hemisphere from 16° 46'N in Burma to 27° 28'N in India. India and Bangladesh are also the biggest exporter of jute goods. It provides work for millions of farmers, industrial workers and indirectly provides jobs for many others. India earns about Rs. 230 crores of foreign exchange from export of jute goods.

Today the bast-fibre bag is facing challenge from cheaper synthetic bags. Efforts, therefore, is being continued to keep it cheaper by increasing yield per hectare and reducing cost of cultivation.

In India jute is cultivated in 12.7 lakh hectare area among which nearly 50% of the area falls under West Bengal. It grows well in loam and clayloam soils with pH 6.2 to 6.7 and having good drainage facility.
There are several problems limiting the production of this crop. It is largely a monsoon planted crop. A moist climate is considered ideal for good growth of jute crop, but such condition also favours profuse growth of weeds. In West Bengal, during the jute cropping season the rainfall varies from 600 mm to 1300 mm when the majority of grassy weed species and nutsedges germinate simultaneously with jute. These weeds compete for moisture, nutrient and light throughout the crop's life and the competition is severe during the early stage of crop growth and extends up to 50 days of emergence.

Jute is a C\textsubscript{3} plant, but the weeds that infest the crop are mostly C\textsubscript{4} plants, viz., *Cynodon dactylon* (L) Pers., *Echinochloa colona* (L) link., *Leptochloa chinensis* (L) Nees., *Dactylcodentium aegyptiacum* (L) Beauv., *Eleusine indica* (L) Gaertn., *Digitaria sanguinalis* Scop., *Cyperus rotundus* L., *Amaranthus viridis* L., *Portulaca oleracea* Boerhaavia repens L. etc. In hot tropical climate C\textsubscript{4} plants grow faster, become larger and become more competitive than C\textsubscript{3} plants, which do not exhibit these characteristics.

The weed growth in jute is usually kept under check by manual labour, which besides being costly, requires 120 - 150 mandays per hectare exclusively for hand weeding for two times. About 35% of the total cost of cultivation is spent for manual weeding alone, sometimes manual weeding is difficult because of non-availability of manual labourers or due to unfavourable soil and climatic conditions.
As jute, especially the *olitorius* type, is slow in establishing up to first 40 days from emergence, weed control in the early stage of this crop is very important and delay in weed control may not compensate losses which the crop suffers in the early growth stage. Since a large number of labourers are required for weeding out each individual population of grassy weeds (60%) and nutsedges (35%), consequently weeds in a large farm remain either uncontrolled or partially controlled. Timely weed control in jute is essential because delay in weeding will lead to more dry matter production by weeds. The dry matter of uncontrolled weeds bears a negative correlation with the yield of jute (Biswas and Das, 1987). Therefore, all efforts are concentrated to keep the crop free from weeds or to minimize weed growth in the field. To minimize weed problem in crop fields, rotation of crops involving puddled rice cultivation is suggested since puddling destroys many weed seeds by inducing them to sprout and excluding air from the soil. Moody (1977) suggested that a carefully selected crop rotation can bring about a reduction in weed problem and in the rice growing areas of Asia. Some jute based crop rotations involving puddled rice were explored at Jute Agricultural Research Institute, Barrackpore, West Bengal (Pandey and Goswami, 1968, Mitra *et al.* (1972) but adequate attention was not given to solve the weed problem in crop fields. On the other hand, it was observed that puddled rice cultivation under midland rice environment was favourable for broadleaf dicot weeds and nutsedges, when the fields were drained intermittently (Biswas and Saraswat 1983). Even in the
lateritic belt of West Bengal, severe weed infestation resulted in 25.8% reduction in yield of transplanted rice (Mukhopadhyay et al., 1985). Moreover simply rotating the crops did not minimize the weed problems in crop fields, rather it brought about changes in weed community (Jereza and De Dutta, 1976) and increased the infestation of annual weeds by 62% and perennials by 20% (Dospekhov et al., 1980). Certain crop rotation increased some pests (Summer et al., 1975), each crop has its characteristic weeds and on growing the same crop continuously on the same land tends to increase them (Akobundu and Fagade, 1978). Vegetatively propagated weed species are likely to be spread by continuous cultivation of crops, the usual tendency for grass weeds to be more prevalent (Anderson and Whan 1974), *Cyperus rotundus* increased in rice-wheat-green gram and maize-potato-wheat rotation, as reported in All India Co-ordinated Research Project on Weed Control (AICRPW, 1989).

Implications of multiple cropping on weeds, how weed control practice in one crop affects the weed growth of a subsequent crop, all these aspects are needed to be studied by conducting field experiments over several years on the same site. Similar views were also suggested at the Biennial conference of Indian Society of Weed Science conducted at Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpore India (Sankaran, 1990).

One of the alternative innovations in agricultural practice has been the wide spread use of herbicide as a substitute to reduce the dependance on
manual labour. The weed control schedule for herbicide use in individual crop field was suggested as reviewed in literature, but there is no authentic information on the effect of continuous use of herbicides on all crops of multiple cropping.

Possibilities of repeated use of herbicides in multiple cropping sequences to ensure economy and efficiency in controlling weeds in crops need to be explored and perfected. The direct, residual and cumulative effect of herbicide on growth and yield of crops and change in the composition of weed flora of jute and rice fields of jute based crop rotations have not yet been systematically worked out under West Bengal condition.

At present, little is known about the effects of repeated application of herbicides on soil microflora. Investigation of such effects on the microbial population would be one step nearer to understand what might happen in practical agricultural situations. There are of course, many other factors which will interact, even then this aspect need to be considered since soil microflora makes a valuable contribution to soil fertility.

Since no dependable recommendation in respect of chemical weed control in jute based crop rotation has yet been made for wide adoption by the farmers which could effectively reduce dependence on manual weeding in jute, the economic aspect of weed control need to be worked out to see its feasibility under West Bengal condition.
Keeping all these points in view, the field experiment was carried out with the following objectives:

1. To study the comparative performance of different jute based crop rotations namely, jute-rice-wheat, jute-rice-potato, jute-rice-maize, in controlling weed species of jute and rice.

2. To study the direct, residual and cumulative effect of herbicide on the weed species of jute and rice.

3. To study the comparative efficiency of different weed management systems on the weed dry weight and yield attributes and yield of jute and rice.

4. To find out the correlation of weed population and weed dry weight on yield of jute and its components under the influence of weed management systems and crop rotation.

5. To determine the direct, residual and cumulative effect of herbicides on the microbial population of soil (bacteria, fungi and actinomycetes).

6. To compare the economics of jute based crop rotations with particular reference to net return and cost-benefit ratio of jute and rice cultivation, under weed management systems.