CHAPTER VI

ALLELOPATHY

1. Introduction
2. Observations
3. Result and discussion
Theory of allelopathy was first given by Malish (1937) to know about toxic substances which are produced by weeds and act as inhibitors. The role of toxic substances produced by weeds inhibitory the growth of surrounding plants is now well recognised. A number of workers have noticed numerous examples of inhibition of one species by another and many others, who have examined successfully sequences mainly from competition point of view in terms of allelopathy. (Martin, 1950; Gormann and Hull, 1962; Kever, 1950; Rice, 1974; Shukla, 1977; Pathak, 1981; Sharma, 1982; Vinod Shankar, 1983; Sharma, 1984 and Harrison, 1986).

The allelopathic effects have important implications in agricultural science and have been responsible to a considerable extent for the development of many agricultural present century the allelopathic studies have drawn a considerable attention of scientists. Csapók (1903) reported these substances as negative catalyst or antiferments. The inhibitory action of these substances have also been reported by Borner (1950), Granmer and Boyer (1976), Tukey (1969), Rice (1974), Dubey (1973), Ashraf and Sen (1980), Verma (1981), Pathak (1981) and Harrison et al., (1986). Establishment, survival and continuation of a species is totally dependent on its seed germination. Thus the seed germination is the basic aspect of ecological studies. Phytotoxic effect of weeds in agricultural fields, on crops is
a subject of great interest and importance because the inhibitor affects the germination and early seedling growth of crop seeds.

Some important contributions reporting the detrimental effect of chemical substances released by plant populations in their environment affecting seed germination as well as seedling growth of neighbouring plants are those of Pickering (1903), Evenari (1949), Whittaker and Peana (1970), Covatal (1976), Bokharia (1978), Pathak (1981), Sharma (1984).

Plants release those substances into the substratum via root exudation, volatilisation, rainwash from their aerial parts and also by leaching and decomposition of litter (Kanchan, 1978). The inhibitory action of these substances is usually related to the quantity of weed plant material and soil moisture content present within the field to dilute exudate.

Decandolle (1832) has emphasised the importance of root exudation by plants, which inhibit growth of plants. Some workers like Gray and Bonner (1948), Martin et al. (1964), Orman et al. (1960), Bilel et al., Rizivi et al. (1980) and Sharma (1984) have examined successional sequences mainly from competition point of view in terms of allelopathy.

Invasion and perpetuation of a species in an established community depends either on a more efficient use of it or the
potential of resources essential for its survival and the production of materials that would prevent the effect of potential competition. Whatever be the mechanism productivity and vigour of individuals near the invader get reduced and have been referred to as competition and allelopathy respectively (Muller, 1968 and Bell and Koopze, 1972).

Dubey and Mall (1976) while studying the phenomenon of allelopathy in M. gangetica reported that this species has not only a strong allelopathic effect on crop and other associated species, but its own population gets checked.

The experiments were performed to understand the effect of aqueous stem, leaf and root leachates of M. sparsifolia on seed germination and seedling growth of some associated 'kharif' crops following 'rabi' crop. Most of the experiments were distinguishing interaction under field conditions. Harper (1964) and Muller (1968) have also designed their experiments in laboratory condition to overcome the difficulties.

OBSERVATIONS

Observations given in table 5 reveal that most of aqueous leachates come out in water within a period of six days. Rates of leaching of exudates were more or less similar in leaves and root in contrast to stem. In all cases there is a slight decrease in pH and then there is a little increase and then it stabilises.
Effect of leachates of different plant parts of *M. emarginata* on crop seeds:

Observations of these experiments are shown in table 5. Leaf and root leachates were found to be most detrimental for seed germination and seedling growth of rice, jwar and wheat, while stem extract of the same concentration did not show appreciable effect. On the basis of their inhibitory effect the inhibition may be arranged in the following decreasing order: Root > Leaf > stem.

There was a significant correlation between dilution of inhibitor and percentage germination and seedling growth of crop seeds (Table 5.3, 5.8 and Fig. 5.1). The most depressive effect of inhibitor was observed at concentrations 1:0, 1:10, 1:50 and 1:100. The seedlings were stunted; they could not survive further. The most detrimental effect of root and leaf leachates were observed on percentage germination of rice, jwar and wheat seeds, which was observed 54, 57 and 60% respectively.

DISCUSSION

In India weeds, pests and diseases cause damage to the agricultural production upto the tune of rupees 50,000 millions annually. Out of this damage 33% is caused by weeds alone (Mani, 1977). Recent researches have shown that the losses in crop caused by weeds are not only due to weed competition with crops for
M. emarginata is widely distributed in most part of India. It is a common weed of cultivated fields and associated with both 'kharif' and 'rabi' crops in Malwa clay and loam soils of Ujjain, but during the present investigation it was also found to occur in black cotton (Parua) soils of northern Bundelkhand region.

Reduction in percentage germination of crops was due to the effect of weeds. This clearly indicates that weed problem is responsible for loss in production of crops. Fig. 5.1 shows that as dilution decreases the percentage germination increases. It may be due to increase in concentration of allelochemical potential with the duration of storage of leachates as indicated by its increased inhibitory nature of crop seed germination.

The existence of allelopathic principle has been well documented over the past few decades particularly in relation to its significance in both natural and agroecosystem (Puthan and Duke, 1978; Rice, 1979). A variety of substances produced by the weeds provide a competitive advantage for weeds over the crop (Dutta and Sinha Ray 1974). It is very surprising to
note that once the phytotoxins are produced and released in
the environment the allelochemics of the plant may have
severe effect on the associated species, depending on the
number of factors both external and internal. Very
important is the critical to this biochemical problem
(Solomon and Bhardwaj, 1981).

Though allelopathy has drawn a considerable attention
in this century (Gray and Bonner, 1948; Goodwin and Tawes,
1950; Decock et al., 1955; Marton, 1956; 1957, 1958; Kanchan,
1975; Rao et al., 1977; Verma, 1981 and Sharma, 1984), the
effect of inhibitor from weed to its associated crops has
been observed here (Table 5.5 and Fig. 5.1 & 5.2). It was
observed that weed checked crop seedling growth through the
production of inhibitor at higher concentrations. Inhibitor
showed its deleterious effect up to the concentration of
1:250 ppm, afterwards seedling growth improved though the
percentage germination remained unaffected. Growth of radicle
and plumule also showed retardary effect under treatment of
1:250 and 1:100 ppm dilutions. The maximum length of radicle
and plumule of rice seedlings 2.0 and 1.7 cm in stem extract
and 1.2 and 1.0 cm in comparison to that of 4.1 and 3.8 cm in
control. Thus it might be concluded that plant part leachates
of *M. emarginata* at lower concentration retarded the early
seedling growth.

It was observed that the various plant parts of the
weed contained varying amount of allelochemic concentrations.
Thus maximum 72% inhibition to crop seed germination was recorded in case of leachate obtained from root, while it was minimum (25%) by stem. These results are contrary to the production of minimum amount of inhibitor by seeds in Commelina benghulensis (1981) and to the possibility of production of inhibitor in roots of Celosia argentea as suggested by Pandya (1975). The present findings are similar to that of Sugha (1979), Verma (1981), Vinod Shanker (1982) and Sharma (1984), who observed the allelopathic effect of Ageratum conyzoides and Ephedra geniculata. On wheat seed germination, leaf leachate obtained from E. geniculata was most retarding to crop seed germination. The inhibitory effect of extract obtained from root was more prominent than that of leaf and stem in Digera alternifolia (Ashraf and Sen, 1970). In all cases leaf and root leachates reported to be much effective. On the basis of harmful effect the inhibitors from M. enarainata might be arranged in order of Root > Leaf > stem. Such sequence was recorded by (Sharma, 1976; Mall and Dagar, 1978; Verma, 1981 and Pathak, 1981).

The decreases in germination inhibition from root and leaf extract to the extract made from stem, might indicate that the allelopathic principle is produced in the leaves and is translocated to roots (Sugha, 1979). On the other hand it is also possible that it is synthesized in another part of the plant and accumulated in the leaves and roots as in case of nicotins in Nicotina (Dawson, 1942). It seems to be a possible
region for more germination inhibition in extract of leaves and roots and less inhibition in stem leachate of this weed species.

Effect of inhibitor leachates from weed plant on seed germination and seedling growth of crop seeds have been studied earlier by various workers (Pandya, 1975; Sharma et al., 1975; Singh, 1978 and Soloman and Bhandari, 1981). But the weed plants not only affect the germination and seedling growth of its associated crops it also affects the crop of the next season which will be cultivated in the same field. The crop production retarded by inhibitory substances vis. leaching of dried weed plant parts incorporated in the soil.

It is earlier reported by a number of workers (Dubey, 1968; Verma, 1981) that to a certain extent, a very high moisture level proved to be harmless, because some allelochemical released by leaves. It was concluded, the release of inhibitor depends upon the amount of weed material present in the field and the moisture in soil. Increased soil moisture level by heavy irrigation practices or through heavy rains, lessen the toxic effect of inhibitor due to dilution. Present results are in conformity with the findings of Dubey (1968), Pathak (1981) and Verma (1981).