PHYTOTOXIC ACTIVITY OF *CYANODON DACTYLON* (L.) PERS. AND *CYPERUS ROTUNDUS* L. ON GOWTH AND BIOCHEMICAL CHANGES OF ORYZA *SATIVA* L.

LEELA. P

Department of Botany, PG Research Department, Rani Anna Government college for women, Tirunelveli, India.

Email: leela_anand@yahoo.co.in

ABSTRACT

Laborotory bioassay was conducted to establish the phytotoxic activity of aqueous extracts of the weed *Cyanodon dactylon* (L.) Pers. and *Cyperus rotundus* L. on seed germination, early seedling performance and pigment profile of *Oryza sativa* L. The different concentractions (2%, 5%, 10%, 20%, 30% and 50%) of aqueous extracts of *C.dactylon* and *C.rotundus* were employed to investigate their influence on the seedling physiology of *O. sativa*. The aqueous whole plant extracts (from 5% to 50% concentrations) of *C.dactylon* and *C.rotundus* exhibited an inhibitory effects on germination percentage, root length, shoot length, vigour index, pigments, proteins, carbohydrates and amino acid contents of *O. sativa* over control. The extracts of both weeds caused a stimulatory effect on rice seedlings at 2% concentrations and the intensity of inhibition increased when the extract concentrations increased. The photosynthetic pigments such as chl-a, chl-b and total chlorophyll exhibited significant reduction while carotenoid content was found to be increased in all treatments as compared to control. The aqueous extracts of *C.rotundus* showed more inhibiton on *O. sativa* than *C.dactylon*. In general, the aquous extracts of the bioparts of *C.dactylon* and *C.rotundus* were phytotoxic to the cereal crop *O. sativa.*

Key words : Phytotoxic, seed germination, Vigour index, *Cyanodon dactylon, Cyperus rotundus.*

INTRODUCTION

Weeds are undesirable plants which compete with main crops in the growth media for nutrients, moisture, space, light and hamper the healthy growth ultimately reducing the growth and yield both qualitatively and quantitatively. Alam *et al*. (1990) reported that weeds are known to exhibit allelopathy by releasing water-soluble allelochemicals from leaves, stems, roots, rhizomes, flowers, fruits and seeds. Weeds which compete with main crop plants for nutrients and environmental variables normally appear to be toxic to the germination and seedling growth of the plants. Kato-Noguchi *et al*. (2002) studied various weeds allelopathic potential in the laboratory. Batish *et al*. (2007b) conducted experiment using residue of *Chenopodium murale* on the growth of chick pea and found that their root and shoot length significantly decreased. The phytotoxic effects can be attributed either to allelochemicals present in the plant or weed residues or to microbial toxins produced during decomposition (Rice, 1984). Allelopathy is an important mechanism of plant interference by the addition of plant-produced phytotoxins to the plant environment. Many of the phytotoxic substances suspected of causing germination and growth inhibition have been identified from plant tissues and soil. Plants produce a large variety of secondary metabolites like phenols, tannins, terpenoids, alkaloids, polyacetylenes, fatty acids and steroids, which have an allelopathic effect on the growth and development of the same plant or neighbouring plants. One of the most worked out aspects of allelopathy is manipulated in ecosystems is its role in agriculture. Some of the toxic effects of decomposition products on plants are inhibition of seed germination, stunted growth, inhibition of the primary root system and increase in secondary roots, inadequate nutrient absorption, chlorosis, slow maturation and delay of failure or reproduction (Patrick and Koch, 1958; Patrick *et al.*, 1964). Quayyam *et al*. (2000) reported that the *Cyperus rotundus* aqueous extracts and leachate of leaves and tubers significantly reduced the germination and seedling growth of rice.

Rice (*Oryza sativa* L.) is one of the most predominant food crop that is being extensively cultivated in India. More than 90 per cent of the world's rice is grown and consumed in Asia. India is the primary, has the leading position in acreage and next to China in production. Harikarasuthan, 2011 reported that rice yield levels in India are low at 2.20 tonnes per hectare compared to the other major rice producing countries such as Japan (6.50 t/ha), China (6.70 t/ha), Egypt (7.50 t/ha) and Israel (5.50 t/ha). The planning commission estimates that our country requires 122.1 million tones of rice by 2020, to meet food security norms (Prabhakaran Nair, 2011). Many countries have the major goal to reach the self sufficiency in rice production. In agricultural systems allelopathy can be part of the interference between crops and between crops and weeds and therefore affect the economical outcome of the plant production. The rice crops growing along with weed species, the and crop is subjected to compete for space, light, nutrition from seed germination to harvest period of the lifecycle. The weeds are causing inhibition on germination and growth crops as well as reducing the yield of the desirable crops through releasing allelochemicals from the dead or live weeds . Rice is one of the important cereal crop cultivated in India. Hence the present investigation has been made to determine the allelopathic effect of two weed species. *C.dactylon* and *C.rotundus* in rice. The main purpose of this study was to asses the phytotoxic activity of the two weed species of *C.dactylon* and *C.rotundus* on rice cultivars by laboratory study.

MATERIALS AND METHODS

The weed plants, *C.dactylon* and *C.rotundus* were collected from the crop fields freshly for the experimental study, whenever needed. The entire plants (root and shoot parts) used for the preparation of extracts. The extracts of whole plant were employed to study their effect on the germination and seedling growth of *O. sativa*. The rice seeds cv. were procured from Tamil Nadu Agricultural University, Coimbatore. Seeds with uniform size, colour and weight were selected and stored in metal tins. All the experiments were conducted in the Department of Botany , Rani Anna Government college for women.

Preparation of aqueous extract

Fresh plants of two weeds were washed thoroughly and cut in to small pieces and were allowed to dry under shade for 20-25 days then made it to fine powder. 50g of powder were soaked in 1 litre distilled water and keep 48 hours at room temperature with occasional shaking. The infusion was decanted and filtered through three layers of Whatman No.1 filter paper. From this (100%), different concentrations (2, 5, 10, 20, 30 and 50%) were prepared with using distilled water for further studies.

Germination study

The seeds of rice were steeped in water to determine their viability those that floated were discarded. The viable seeds were sterilized for two minutes in 0.2% mercuric chloride ($Hgcl_2$) solution. The seeds were then thoroughly washed with tap water. The seeds were arranged in sterilized petri dishes of 10 cm diameter lined with filter paper. Each petri dish was moistened uniformly by different concentrations of weed extracts and the distilled water was used as control. The petric dishes were covered and kept at room temperature (30º±2º) and were opened periodically for proper aeration. Germination percentage was recorded on 5th day while root and shoot length, Biomass,vigour index and pigment contens were recorded on 10th day after treatment. All measurements were made on samples drawn replicated five times. The obtained data were statistically (ANOVA) analysed to find out the significance ($P < 0.5\%$ level) of the treatments on crops.

RESULTS AND DISCUSSION

Weed species, *C.dactylon* and *C.rotundus* tested for their allelopathic potential on germination and seedling growth of rice by applying weed extracts. Aqueous extracts of *C.dactylon* and *C.rotundus* caused a significant inhibition on the germination of the rice over control (fig-1). The intensity of inhibition differed depending upon the type of extracts. *C.dactylon* extracts stimulated the seed germination only at 2 % concentrations but in their higher concentrations (5, 10, 20, 30 and 50%) there was an inhibitory effects over control. All the concentrations of *C.rotundus* extracts showed retarding effects on germination percentage of rice seeds. More inhibition was observed in rice crops when treated with *C.rotundus* extract treatments. Similar inhibition of seed germination by weed extract was observed by different workers. The inhibitory effects of *Ipomea carnea* spp. *Fistulosa*, *Cyperus rotundus*, *Cynodon dactylon*, *Echinochloa colonum*, *Portulaca oleracea* and *Lagasca mollis*. on sorghum, wheat, kidney bean, rice,onion and radish (Jadhav *et al*., 1997; Challa and Ravindra, 1998).

The study of Bendall, (1975) showed that the root extract of *Canada thistle* inhibited the germination of *Trifolium subterraneum* seed by 87%. These studies clearly support the present findings. The *C. rotundus* weed extract treatment showed greater inhibition on seed germination of rice. Numbeer of workers has reported similar inhibition os deed germination by weed extract treatment. The inhibitory effect of stem extract of *Polygonum orientalle* on the sermination of mustard, lettuce, rice and pea was reported by Datta and Chatterjee (1978,1980). Qasem . (1995) found that the inhibitory effect *Amaranthus retroflesus*, *Asclepias syriaea*, *Chrysanthemum vulgare* and *Datura stramonium* exhibited on cabbage, carrot, eggplant, pepper, sunflower and soyabean (Beres and Kazincz., 2000) . Saxena and Varshney .(1995) also reported that the shoot extract of *Cyperus rotundus* stimulated the seed germination in pea and chickpea. These results favour the present findings. The reason for the inhibitory effects of weed on rice may be due to the presence of higher amounts of growth inhibitory substances in the extracts. The study of Tripathi *et al.* (1998) revealed that the leaf extracts of *Tectone grandis*, *Albizia procera* and *Acacia nilotica* stimulated germination in soya bean.

The *aqueous e\xtracts of C. dactylon* and *C. rotundus* stimulated the seedlings length in their lower concentrations but when increasing the concentration the shoot and root length were reduced .All the concentrations of *C. rotundus* showed adverse effects on the growth of rice seedlings (Fig-2). *C. rotundus* caused more retardation on root growth than shoot growth. Pande *et al*. (1998) reported that the aqueous extract of aerial parts of *Prunus amygdalus* inhibited the root and shoot length of wheat and figermillet. Patil (1994) reported that the leaf extracts of *Glyricidia maculate* inhibited the seedling growth of rice, sorghum, green gram . Joshi *et* al. (1996) found that the leaf extract of *Faxinus micranta* inhibited root and shoot length of *Raphanus sativa*, *Eleusine corcana*, *Trictum aestivum* and *Brassica campestris*. Afzal *et al.(*2000) reported that the seedling growth and biomass production of *Vigna radiata* and *Phaseolus vulgaris* were significantly reduced by aqueous shoot extract of *Imperata cylindrical*. The study of Lovett and Sagar (1978) noticed that the aqueous leaf extracts of *Camellina sativa* stimulated the growth of radicals of flax seedlings. Similarly the study of Tripathi *et al*. (1998) showed that the leaf extracts of *Albizia procera*, *Tectona grandis* and *Acacia nilotica* stimulated root and shoot length in soybean. Maqbool *et al*. (2012), reported that low concentrations of allelopathic water extracts as seed treatment before sowing or planting can improve germination percentage, germination power, germination index, radical length, plumule length, fresh weight and dry weight of plants. These studies are in conformity with the present findings.

The photosynthetic pigments (Table-1) exhibited significant reduction as compared to control in rice crops due to the allelopathic influence of *C. dactylon* and *C. rotundus* weeds. Chlorophyll estimation is an indicator of biomass and the reduction in the pigment level in the test crops indirectly indicate retardation in photosynthetic activity . In the present investigation Chl.a, chl.a, and total chlorophyll contents were highly affected by the *C. rotundus* in rice seedlings while carotenoids content were found to be increased from lower to higher concentration in all treatments. Between Chl.a and Chl.b, the inhibition was more in Chl.b than Chl.a in the test crops which indicates its susceptibility to stress (Djanaguiraman *et al*., 2003). Singh *et al*. (2009) reported that the allelochemicals have immense role on the reduction of photosynthetic pigments. Yang *et al* . (2004) found that the chlorophyll degradation may be due to the lowering of biosynthesis of chlorophyll molecules .). Carotenoids serve as antioxidants against free radicals and photochemical damage (Mishra *et al*., 2006). The allelopathic treatments can be attributed to its antioxidant property and protective role for photosynthetic membrane under the stress conditions (Omidpanah *et al* ., 2011). These studies strongly support the present findings.

Aquous extracts of *C.dactylon* and *C.rotundus* decreased in the biochemical contents of rice over control (Fig -3). *C.rotundus* weed extract showed more inhibitory effect than *C.dactylon* weed extract. Only at 2% extract concentration treatment of test crop showed the stimulatory effect on the stach, protein, Aminoacid and catalase contents of the test crop over control. *C.rotundus* weed extracts showed less inhibitory effect in catalase and Amino acid contents in rice than C.dactylon weed extract treatment on crops . Prasad *et al*. (1999) reported that extracts of Rhamnus virgattus significantly decreased the sugar and starch content in *Triticum aestivum*, *Eleusine coracan*a, *Lens culinaris* and *Phaseolus mungo.* Bansal, (1997) noticed that the aqueous extractsof *Ranunculus arvensis* linearly decreased the protein content. The rhizome and soil extract of *Dendroclamus strictus*, increased the protein content of the groundnut seedlings in the lower concentrations (Tripathi *et al*., 1998).

The decreasing of biochemical contents may be due to action of allelochemicals which is present in the weeds. The allelochemicals are 1,8-cineole, 4α-5β-oxidoeusesm,alkaloids, α-cyperone,β-selinene, Calcium, Camphene, Copaene, Cyperol, Cyperolone, D-fructose, D-glucose, Limonene, Linoleic –acid, Magnesium, Pectin, Sugeonol, Rotundone, Selinatriene, Sitosterol, Stearic acid etc. A wide variety of phytoprinciples have been isolated from *C. viscos* (Mali, 2010). All basic plant processes such as hormonal balance, protein synthesis, repiration, photosynthesis,chlorophyll formation, permeability and plant water relations may be disturbed by allelopathy (Yamana *et al*., 1992). The statistical analysis of all the parameters tested in the present investigation showed that significance effect of these two weed species on germination , growth and biochemical constituents of rice seedlings.

CONCLUSION

The differential degree of inhibitory effect of two weed extracts on germination and seedling growth of rice may be due to the presence of various inhibitory allelochemicals at different concentrations in weed organs of *C.dactylon* and *C. rotundus* in the present study. The phytotoxicity of allelochemicals present in the weed extracts might be caused synergistic activity on the growth and biochemical changes of rice seedlings. The two weed species was found potentially harmful to crop species through te release of toxic chemicals from their aqueous extracts. Allelopathy has a crucial role in future weed and pest management strategies. The stimulatory activity of the weed extract in most of the parameters at lower concentrations warrants further study on its utilization as a biofertilizer and the inhibitory activity of the higher concentration of the extract as herbicides.

Fig -1. Allelopathich influence of *Cyanodon dactylon* and *Cyperus rotundus* extracts on germination (%) of *Oryza sativa*.

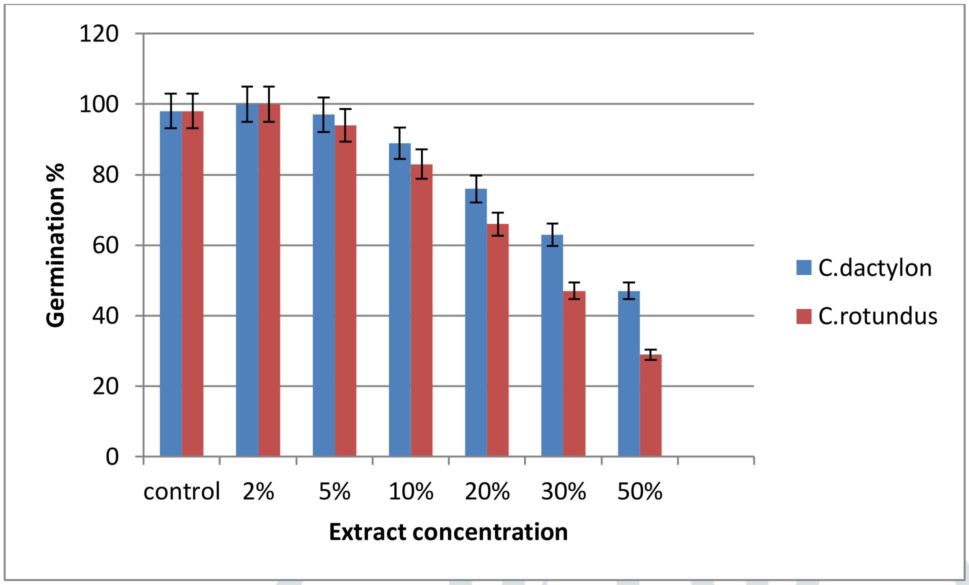


Fig : 2 Allelopathic Influence of *C. dactylon* and *C. rotundus* extracts on **root length(cm/seedling), shoot length(cm/seedling) and dry weight (mg/seedling) of rice.**

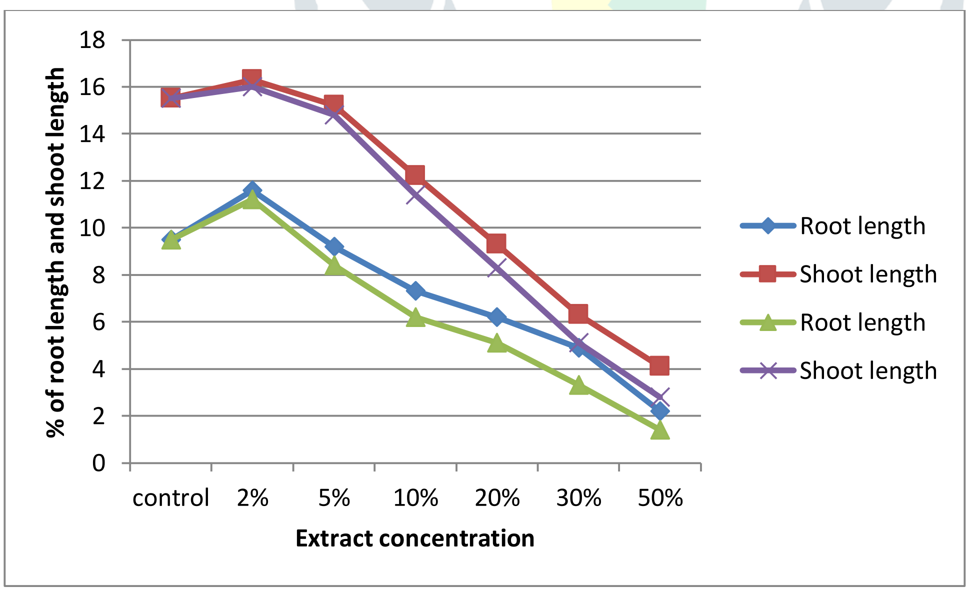
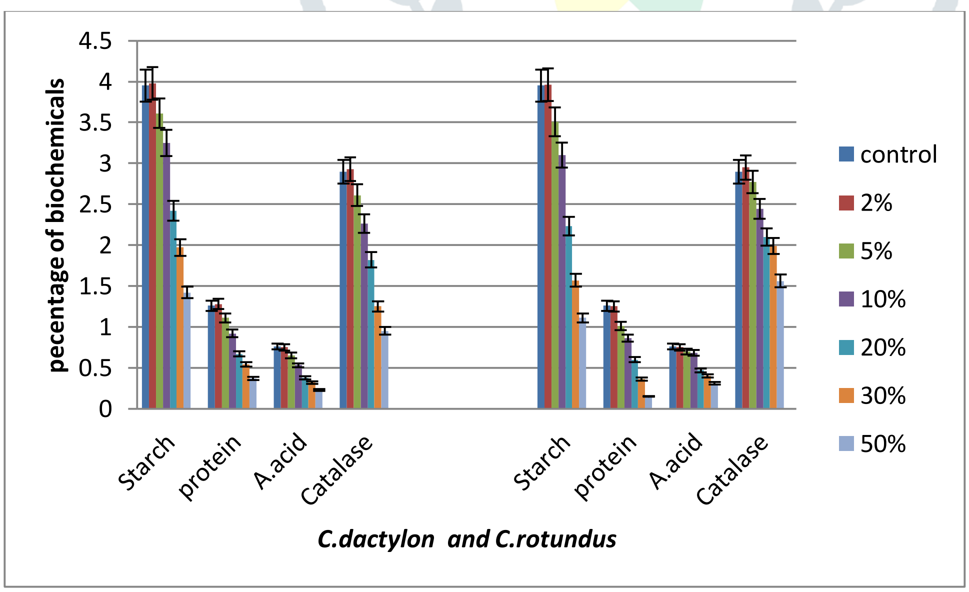


Table -1 Allelopathic Influence of *C. dactylon* and *C. rotundus* extracts on Chl.a (mg/g fr.wt.), Chl.b (mg/g fr.wt.), Total chlorophyll (mg/g fr.wt.) and Carotenoid (mg/g fr.wt.) contents of *Oryza sativa.*

Extract concentrations	*C. dactylon*				*C. rotundus*			
	Chl.a	Chl.b	Total chlorophyll	Carotenoid	Chl.a	Chl.b	Total chlorophyll	Carotenoid
control	0.375	0.196	0.571	0.163	0.375	0.196	0.571	0.163
2%	0.379 (1.1)	0.199 (1.5)	0.578 (1.2)	0.165 (1.2)	0.378 (0.8)	0.198 (1.0)	0.576 (0.9)	0.167 (2.5)
5%	0.343 (-8.5)	0.184 (-6.1)	0.527 (-7.7)	0.152 (-6.7)	0.339 (-9.6)	0.18 (-8.2)	0.519 (-9.1)	0.158 (-3.1)
10%	3.26 (-13.1)	0.165 (-15.8)	0.491 (-14.0)	0.135 (-17.2)	0.302 (-19.5)	0.156 (-20.4)	0.458 (-19.8)	0.142 (-12.9)
20%	2.67 (-23.8)	0.142 (-27.6)	0.409 (-28.4)	0.12 (-26.4)	0.248 (-33.9)	0.131 (-33.2)	0.379 (-33.6)	0.125 (-23.3)
30%	0.211 (-43.7)	0.12 (-38.8)	0.331 (-42.0)	0.1 (-38.7)	0.193 (-48.5)	0.11 (-43.9)	0.303 (-46.9)	0.11 (-32.5)
50%	0.125 (-66.7)	0.09 (-54.1)	0.215 (-62.3)	0.08 (-50.9)	0.08 (-78.7)	0.06 (-69.4)	0.14 (-75.5)	0.089 (-45.4)

Data in parentheses indicates % increase/decrease over control.

Fig -3 Allelopathic Influence of *C. dactylon* and *C. rotundus* extracts on Starch (mg/g fr.wt.), protein (mg/g fr.wt.), Amino acid (mg/g fr.wt.) and catalase (mg/g fr.wt.) contents of *Oryza sativa*



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