Nat. Volatiles & Essent. Oils, 2020; 7(2):82-87

Allelopathic Efficacy Of *Two Crop Field Weeds* On Growth Attributes Of Some Selected Rice Cultivars

Kavitha D.[1]*, Manikandan V.[2] And Prabhakaran J.[2]

[1]*Department of Botany, Annamalai University
[2]Annamalai Nagar-608 002-Tamil Nadu, India.

***Corresponding Author**: Kavitha D.
*Email: kavipriya2006@gmail.com

ABSTRACT

Weeds are causing huge loss on the crop yield by exhibiting the harmful effects on the from seed germination up to the yield of the crops due to several factors such as competition for space, light and nutrients and allelopathy. In the present study an attempt has been made to evaluate the various concentrations (0,5,10,15,20 and 25%) of whole plant aqueous extracts of weeds, *Cyperus rotundus*L.*(* Purple nut sedge) and *Cynodan dactylon*(L.) Pers. (Bermuda grass) were tested for assessing their allelopathic efficacy on growth attributes of some rice (*Oryza sativa* L.) cultivars i.e.ADT-36,BPT-5204 and IR-20 using pot culture experiments. The experimental results revealed that all the concentrations of both the weed extracts had inhibition on germination percentage, seedling length, number of,dry weight and chlorophyll contents of 15 day old seedlings of all the three rice cultivars and the inhibitory effect of the extracts was concentration dependent. However, at 5% of *C. rotundus* and10% of *C. dactylon* extracts did not affect seed germination of IR-20 . Among the rice cultivars, the higher degree of growth inhibition was observed in ADT-36followed by BPT-5204 and IR-20 . The weed *C.rotundus*exhibited more intense on growth suppression of rice cultivars than*C.dactylon.*

Key Words; Allelopathic efficacy, Cyperus rotundus, Cynodan dactylon, rice cultivars.

Introduction

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 (Whittaker and Fenny, 1971). Allelopathy is of two types, one is true allelopathy and other is functional allelopathy. The true allelopathy is the release of substances that are toxic in the form in which they are produced in the plant. Functional allelopathy is the release of substances that are toxic or a result of transformation by micro-organism (Wittekar, 1999). Allelochemicals are non-nutritive substances produced as plant secondary metabolites or decomposition products of microbes. Examples of allelochemicals that predominate in plants are alkaloids, phenols, terpenoids, glycosides but also acid cinnamic, benzoic acid, flavonoids and others (Ramona Cotrut,2018). Allelochemicals consist of various chemical families and are classified into the following 14 categories based on chemical similarity (Rice, 1974) . According to Muller (1969) the term allelopathy refers to the overall influence of one plant on another, due to the chemical compounds being added to the environment. The phenomenon of allelopathy has reviewed a wide attention in the past three decades in India. Of the total annual loss of agricultural produce due to various pests in India, weeds account for 45%, insects 30%, diseases 20% and other pests, 5% (Rao, 1983). In crops field, weeds and crops mutually infer of each other, which may reduce the growth of one or both species.

Allelopathy can be the most effective form of interference during the juvenile stages of the susceptible plants and allelopathic interactions play a major role in the determining the distributions of plants in nature and yield of different crops(Fisher, 1980).: Hence, in the present investigation an attempt has been made to study the allelopathic effect of *Cyperus rotundus L.* and *Cynodan dactylon* L. on seed germination and seedling growth of some selected rice (*Oryza sativa* L.) cultivars ie.ADT-36,BPT-5204 and IR-20.

Materials and Methods

The preparation of aqueous weed extracts and germination studies were followed as per the methods of Padhy *et al.* (2000) and Bhatt and Chauhan (2000).The collected fully matured whole parts of *Cyperus rotundus L.* and *Cynodan dactylon* L. were air dried, ground to fine powder and extracted in water. Twenty grams of ground weed material was soaked in one liter of distilled water and kept 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 weed extracts (20%) further dilutions of 15,10 and 5% were prepared with distilled water. The seeds of rice cultivars *ie.*ADT-36,BPT-5204 and IR-20were surface sterilized with 0.03% formalin solution for 20 min. and then washed thoroughly with distilled water (DW). For the germination study 15 seeds were sown in earthen pots(15cm x 30cm) filled with 3.5kg of normal garden soil. Equal quantity of weed extracts/DW was irrigated to all the pots on 0,3, 6, 9, 12 and 15 days after seed sown. Each treatment including control was replicated five times. The number of seeds germinated in each treatment was counted daily up to 7th day after sowing, and germination percentage was calculated. The emergence of radicle was taken as criteria for germination. Five seedlings from each replicate was selected for recording the morphological parameters such as length of shoot and root, dry weight and chlorophyll contents on 15th day after sowing.The mean data was statistically analysed to find out the significance.

Results and Discussion

Cyperus rotundus L. (family Cyperaceae), also known as purple nutsedge or nutgrass, is a common perennial weed with slender, scaly creeping rhizomes, bulbous at the base and arising singly from the tubers which are about 1-3 cm long. The tubers are externally blackish in colour and reddish white inside, with a characteristic odour. The stems grow to about 25 cm tall and the leaves are linear, dark green and grooved on the upper surface. Inflorescences are small, with 2-4 bracts, consisting of tiny flowers with a red-brown husk. The nut is three-angled, oblong-ovate, yellow in colour and black when ripe. *C. rotundus* is indigenous to India, but are now found in tropical, subtropical and temperate regions (Pooley,(1998); Gordon-Gray,(1995)). *Cynodon dactylon* (Family: Poaceae, Arugampullu in Tamil, Dhub in Hindi, Bermuda grass in English). A creeping herb rooting at the joints withsmooth upward stem. The roots are whitish, tough and creeping, almost woody with smooth fibers. Leavestapering to a sharp point, ribbed with smooth sheat hand hairy stipules. Flowers are purplish arranged in two close alternative rows in equally crowed 4 or 5terminal, linear spikes and blooming in the mouth of August to September (Nadkarni, 2000 and Vaidyaratnam,2003).

Aqueous weed extracts of *C.rotundus* and *C. dactylon* caused a significant inhibition on the germination of rice seeds over control. The intensity of inhibition differed depending upon the concentration, weed species and rice cultivars. As the concentration of the weed extracts increased the degree of inhibition on germination percentage was increased in all the three rice cultivars (table-1). The extracts of both the weed species significantly affected the germination percentage of rice cultivars more at their higher concentration (20%) and the effect was more intense by the extracts of *C.rotundus* than *C.dactylon.* The reduction on the germination, seedling length and dry weight (table-2) was observed more in ADT-36 followed by BPT-5204 and IR-20. As the concentration increased, the seedling growth and dry weight of rice seedlings decreased. Similar results were obtained by Alsaadawi and Salih (2009), in which, they reported the root exudates of *C. rotundus* significantly reduced the root and shoot growth of tomato and cucumber plants. The result of Drost and Doll, (1980) favors the present findings, where the plant residues and tuber extracts of yellow nutsedge (*Cyperus esculentus* L.) inhibited the germination and growth of corn (*Zea mays* L.) and soybeans (*Glycine max* (L.) Merr.). Present results are also similar to the findings of Channappagoudar*et al.,*(2005),in which, they reported the extracts of *Cyperus rotundus* and *Commelina bengalensis*had an inhibitory effect on the germination, seedling length of wheat, green gram and soybean. Verma *et al.,* (2002) found the extracts of *Cyperus rotundus* adversely inhibited the seed germination, seedling growth and biomass production of *Brassica* and tomato. Jeyasrinivas *et al.,*(2006) reported the higher concentrations of leaf leachates of *Trianthimum portulacastrum, Cyanodon doctylon* and *C.rotundus,* inhibited the seed germination,shoot length, root length and dry matter production of pearmillet, cowpea, sesamum and cucumber.

The reduction in the seedling growth and biomass production may be due to imbalance in water uptake or osmotic balance of the tissues for germination and growth by the allelochemical toxicity of the extracts (Blum *et al.,*1999).The inhibitory effects may be due to the presence of higher amounts of growth inhibitory substances in the tuber extracts that were released during extraction. The differential degree of inhibitory (5,10, 15,20 and 25%) effect on the growth of rice cultivars may be due to the presence of various allelochemicals at different levelin both the weed extracts. Previous phytochemical studies on *C. rotundus* revealed the presence of alkaloids, flavonoids, tannins, starch, glycosides and furochromones, and many novel sesquiterpenoids (Raut*et al*.,(2006); EL-Habashy*et al*.,(1989); . Kapadia*et al.,(*1967); Jeong*et al*.,(2000); Sayed*et al*.,(2007);, Xu*et al*.,(2008)). The herb *C.dactylon* contains beta sitosterol, beta-carotene, vitamin C, palmitic acid, andtriterpenoids. Alkaloids like ergonovine, ergonovivine,others include ferulic acid, syringic acid, vanillin acid,p-coumaric acid (Ravindra,2003). Akobundu (1987), listed factors such as soil temperature, soil moisture regime, alternate wetting and drying of soil, soil nitrate level among others as those that affect seed germination. These results are supported by the findings of Oke (1988) that siamweed extract inhibited the germination of seeds of cowpea, soybean and tridax. JaiKnox*et al*.,(2010) reported that *Cassia occidentalis*, *Rumex dentatus*, *Calotropis procera* and *Withaniasomnifera* inhibited germination and growth of *Parthenium hysterophorus.* water-soluble organic acids, straightchain alcohols, aliphatic aldehydes, and ketones; simple unsaturated lactones; longchain fatty acids and polyacetylenes; benzoquinone, anthraquinone and complex quinones; simple phenols, benzoic acid and its derivatives; cinnamic acid and its derivatives; coumarin; flavonoids; tannins; terpenoids and steroids; amino acids and peptides; alkaloids and cyanohydrins; sulphide and glucosinolates; and purines and nucleosides. Plant growth regulators, including salicylic acid, gibberellic acid and ethylene, are also considered to be allelochemicals (Cheng, Cheng, 2015). The presence of inhibitory chemicals in higher concentrations of the extract might be the reason for differential behaviour of the extracts and causing maximum reduction in growth of the seedlings. Phytotoxicity of allelochemicals present in the weed extracts might be caused synergistic activity on the germination and growth of rice seedlings rather than single chemical. The statistically observed significances are evident for the inhibitory effects of *C.ortundus* and *C.dactylon* on the growth of rice cultivars.

Acknowledgement

Authors convey their sincere thanks to University Grants Commission, New Delhi, India for providing financial assistance under Major Research Project Scheme (F.43-140/2014(SR) Dt.:17.08.2015). Authors are also thankful to the Professor and Head, , Department of Botany, and authorities of Annamalai University, Annamalai Nagar, Tamil Nadu, India for providing good infrastructure facilities during the course of work.

References

1. Akobundu, I.O.1987. Weed Science in the tropics: Principles and practices.John Whiley and Sons; 522 pp.
2. Alsaadawi I.S., Salih N.M.M., 2009,Allelopathic potential of *Cyperus rotundus* L. Interference with crops *Allelopathy Journal* 23(1).
3. Bhatt, B.P. and Chauhan, D.S., 2000. Allelopathic effects of *Quercus* spp.on crops of Garhawal Himalaya.*Allelopathy Journal,* 7(2): 265-272.Tripathi, S., Tripathi, A., Kori, D.C. and Tiwari, S., 1998. Effect of tree leaves aqueous extracts on germination and seedlings growth of soybean. *Allelopathy Journal,* 5 (1): 75-82.

4. Blum,U.,Shafer,S.R.and Lehman,M.E.1999.Evidence of inhibitory allelopathic interactions involving phenolic acids in field soils: concepts vs. an experimental model. *Crit. Rev. Plant Sci.* 18:673–693.
5. ChannappagoudarBB,Jalager,BR and Biradar,N.R. 2005.Allelopathic effect of aqueous extracts of weed species on germination and seedling growth of some crops. *Karnataka J.Agriculture*.18:916-920.
6. Cheng F., Cheng Z., 2015. Research Progress on the use of Plant Allelopathy in Agriculture and the Physiological and Ecological Mechanisms of Allelopathy. Front. Plant Sci. 6:1020.
7. Drost, D., A.and J. D.,Doll.,1980.Allelopathic effect of yellow nutsedge (*Cyperus esculentus*) on corn (*zea mays*) and soyabeans (*Glycine max*), *Weed Science*, Weed Science Society of America 28(2)..
8. EL-Habashy, I..; Mansour, R.M.A.; Zahran, M.A.; EL-Hadid, M.M.; Saleh, N.A. Leaf flavonoids of *Cyperus* species in Egypt. Bio. Syst. Ecol. 1989, 17, 191-195.
9. Fisher,R.F.,1980.In:"Plant disease"- Anadvance Treatise (F.G. Horrfall and E.B. Cawling, Eds.,). Academic press, New York.pp: 313.
10. Gordon-Gray, K.D. Cyperaceae in Natal; National Botanical Institute: Pretoria, South Africa, 1995; pp. 45-76.
11. Jai Knox, DishaJaggi and M.S. Paul,2010.Allelopathic Effect of Selected Weeds on Biochemical Activity of *Parthenium hysterophorus,* Current Research J. of Biol.Sci.,2(4): 238-240.
12. Jeong, S.J. Miyamoto, T., Inagaki, M., Kim, Y.C., Higuchi, R. Rotundines A-C, three novel sesquiterpene alkaloids from *Cyperus rotundus*. J. Nat. Prod. 2000, 63, 673-675.
13. Jeyasrinivas, Senthil, A., Chinnusamy, C. and prabukumar, G.,2006. Allelopathic influence of weed species on the established of field crops. J. Allelopathy 17(1): 123-128.
14. Kapadia, V.H.; Naik, V.G.; Wadia, M.S.; Dev, S. Sesquiterpenoids from Essential oil of *Cyperus rotundus*.Tetrahedron Lett.1967, 4661.
15. Muller, C.H., 1969. Allelopathy as a factor in ecological process.*Vegetation,* 18: 348-357.
16. Nadkarni A.K., Indian MeteriaMedica, Vol 1,Mumbai, India Popular Prakashan,2000,425.
17. Oke, A.E.1988. The allelopathic potential of*Chromolaenaodorata*on seed germination and seedling growth of *vigina unguiculata* var. K59 and *Zea mays* var DMR-SRW and germination of *C. odorata* and *Tridaxprocumbens*weed seeds. B. Agric. Tech. (Crop production) Project Report; The Federal University of Tech., Akure, Nigeria. 14p.
18. Padhy, B., Patinaik, P.K. andTripathy, A.K., 2000. Allelopathic potential of *Eucalyptus* leaf litter leachates on germination and seedling growth of finger millet. *Allelopathy Journal*, 7: 69-78.
19. Pooley, E. 1998.A Field Guide to Wild Flowers in KwaZulu-Natal and Eastern Region; Natal Flora Publications Trust: Durban, South Africa,p.562.
20. Ramona Cotrut,2018. Allelopathy and allelochemical interactions among plants Scientific Papers. Series A. Agronomy, Vol.LXI, No.1 :188-193.
21. Rao, V.S.1983. *Principles of Weed Science*.Oxford and IBH Publishing Co.NewDelhi,India.
22. Raut, N.A.; Gaikwad, N.J.2006.Antidiabetic activity of hydro-ethanolic extract of *Cyperus rotundus*in alloxan induced diabetes in rats. Fitoterapia, 77, 585–588.
23. Ravindra S., 2003. Medicinal plants of India anEncyclopedia, Daya Publishing House, New Delhi, 79-80.
24. Sayed, H.M.; Mohamed, M.H.; Farag, S.F.; Mohamed, G.A.; Proksch, P.A new steroid glycoside and furochromones from *Cyperus rotundus* L. Nat. Prod. Res. 2007, 21, 343-350.
25. Seigler D.S., 2006. Basic pathways for the origin of Allelopathic compounds. In Manuel J. Reigosa, Nuria Pedrol, Luís González (eds.), Allelopathy: A Physiological Process with Ecological Implications, 11-61.
26. Vaidyaratnam P.S.V., AryaVaidyaSala, Kottakkal,Vol II, Chennai: Orient Longham, 2003, 289.

27. Verma, R., Rao., P.B. and Rawat, Y.S., 2002. Allelopathic effects of certain weed extracts on seed germination of ten varieties of the genus *Brassica.Nature and Biosphere*, 7(1-2): 26-31.
28. Whittaker, R. H. 1999. In Chemical Ecology (E. Sondheimer and J. B. Simeone, eds.) pp. 43-70. Academic Press, New York.
29. Whittaker, R.H. and Feeny, P.P.1971.Allelochemics: Chemical interactions among species, *Science*. **171**:757-770.
30. Xu, Y. Zhang, H., Yu, C., Lu, Y., Chang, Y.,Zou, Z. 2008.Norcyperone, a Novel Skeleton Norsesquiterpene from *Cyperus rotundus* L. *Molecules*, 13, 2474-2481.

Table-1. Germination percentage of rice cultivars exposed to aqueous extracts of *C.rotundus* and *C. dactylon*

Extract Concentrations (%)	*C.rotundus*			*C.dactylon*		
	ADT-36	**BPT**	**IR-20**	**ADT-36**	**BPT**	IR-20
Control	98.0 -	96.0 -	98.0 -	98.0 -	96.0 -	98.0 -
5%	85.0 (- 13.3)	86.8 (-9.6)	91.5 (-6.6)	89.6 (-8.6)	89.0 (-7.3)	94.2 (-3.9)
10%	72.5 (-26.0)	74.6 (-22.3)	82.6 (-15.7)	80.2 (-18.2)	83.5 (-13.0)	85.6 (-12.6)
15%	60.8 (-38.0.)	65.0 (-32.3)	71.5 (-27.0)	65.3 (-33.4)	68.5 (-28.5)	76.2 (-22.2)
20%	56.0 (-42.8)	60.5 (-37.0)	65.3 (-33.3)	59.2 (-40.0)	62.5 (-34.8)	71.5 (27.04)
25%	44.0 (-55.1)	47.3 (-50.7)	59.2 (-40.0)	50.5 (-48.4)	58.6 (-39.0)	63.6 (-35.1)

*Value in parenthesis indicate the percentage of decrease (-) over control

Table-2. Seedling Growth (Root length and shoot length (cm/plant) of rice cultivars exposed to aqueous extracts of *C.rotundus* and *C. dactylon*

Extract Concentrations (%)	*C.rotundus*						*C.dactylon*					
	Root length			Shoot length			Root length			Shoot length		
	ADT-36	BPT	IR-20	ADT-36	BPT	IR-20	ADT-36	BPT	IR-20	ADT-36	BPT	IR-20
Control	3.3	4.0	4.3	12.5	16.0	19.8	3.3	4.0	4.3	12.5	16.0	19.8
5%	2.85 (-13.6)	3.49 (-12.7)	3.87 (-10.0)	10.86 (-13.1)	14.43 (-10.0)	19.38 (-2.2)	3.04 (-7.9)	3.68 (-8.0)	4.1 (-4.6)	11.44 (-8.4)	14.96 (-6.5)	19.62 (-1.0)
10%	2.59 (-21.5)	3.25 (-18.7)	3.76 (-12.5)	10.00 (-20.0)	13.47 (-15.8)	18.35 (-7.3)	2.72 (-17.5)	3.46 (-13.5)	3.89 (-9.5)	10.39 (-17.2)	14.19 (-11.3)	18.74 (-5.3)
15%	2.19 (-33.6)	2.72 (-32.0)	3.21 (-25.3)	8.37 (-33.0)	11.55 (-28.1)	15.86 (-20.0)	2.29 (-30.6)	2.96 (-26.0)	3.44 (-20.0)	8.93 (-28.6)	12.41 (-22.4)	17.12 (-13.5)
20%	1.78 (-46.1)	2.25 (-43.7)	2.75 (-36.0)	7.02 (-44.0)	9.42 (-41.1)	14.22 (-28.1)	2.02 (-38.8)	2.52 (-37.0)	3.33 (-23.2)	7.65 (-37.5)	11.18 (-30.1)	16.26 (-17.8)
25%	1.48 (-55.1)	1.87 (-53.2)	2.39 (-44.4)	6.27 (-49.8)	8.73 (-45.4)	12.01 (-40.0)	1.66 (-50.0)	2.32 (-42.0)	2.72 (-36.7)	6.63 (-47.0)	10.33 (-35.3)	15.69 (-20.8)

*Value in parenthesis indicate the percentage of decrease (-) over control

Table-3. Dry matter (g/plant) and Total Chl. Content (mg/g.fr.wt.) of rice cultivars exposed to aqueous extracts of *C.rotundus* and *C. dactylon*

Extract Concentrations (%)	*C.rotundus*						*C. dactylon*					
	Dry weight			Total Chl.			Dry weight			Total Chl.		
	ADT-36	BPT	IR-20	ADT-36	BPT	IR-20	ADT-36	BPT	IR-20	ADT-36	BPT	IR-20
Control	0.55	0.72	0.93	0.963	0.989	1.152	0.55	0.72	0.93	0.963	0.989	1.152
5%	0.41 (-25.4)	0.67 (-7.0)	0.87 (-6.4)	0.845 (-12.6)	0.888 (-10.2)	0.972 (-15.6)	0.43 (-21.8)	0.69 (-8.3)	0.91 (-2.2)	0.859 (-10.7)	0.913 (-5.2)	0.968 (-16.0)
10%	0.38 (-31.0)	0.58 (-19.4)	0.75 (-19.3)	0.768 (-20.2)	0.818 (-17.3)	0.944 (-18.1)	0.38 (-30.0)	0.62 (-13.8)	0.82 (-11.5)	0.832 (-13.6)	0.868 (-13.4)	0.957 (-17.0)

15%	0.26 (-52.7)	0.54 (-25.0)	0.74 (-20.4)	0.619 (-35.7)	0.722 (-27.0)	0.810 (-30.0)	0.29 (-47.2)	0.55 (-23.6)	0.79 (-15.5)	0.787 (-18.3)	0.765 (-22.6)	0.865 (-25.0)
20%	0.21 (-61.8)	0.42 (-41.7)	0.60 (-35.5)	0.544 (-43.5)	0.583 (-41.0)	0.763 (-33.7)	0.22 (-60.0)	0.49 (-32.0)	0.65 (-30.0)	0.586 (-40.2)	0.655 (-36.8)	0.785 (32.0)
25%	0.18 (-67.3)	0.38 (-47.2)	0.55 (-40.8)	0.452 (-54.3)	0.519 (-47.5)	0.611 (-29.0)	0.20 (-63.6)	0.40 (-44.4)	0.62 (-33.3)	0.523 (-45.7)	0.586 (-40.7)	0.689 (-40.2)

*Value in parenthesis indicate the percentage of decrease (-) over control