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ALLELOCHEMICAL INFLUENCE OF *CYPERUS ROTUNDUS L. AND CYNODAN DACTYLON* L. ON PHYSICOCHEMICAL AND BIOLOGICAL PROPERTIES OF SOIL

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ABSTRACT
Allelopathy is an important mechanism of plant interference by the addition of plant-produced phytotoxins to the plant environment. Allelopathic influence of various concentrations of aqueous extracts of two common crop filed weed species namely *Cyperus rotundus L.* and *Cynodan dactylon* L. were assessed on the physicochemical and biological properties of rice seedlings grown pot soil. The results show that the level of NPK percentage was minimum in the lower concentrations of two weed extracts than their higher concentrations. Among NPK contents, the nitrogen was found higher percentage followed by potassium and phosphorus in all the experimental soil. The population of bacterial, fungi, actinomycetes and total microbial populations were gradually decreased with increasing the concentration of weed extracts and higher rate of reduction of microbes was found in the extracts treated with *C.rotundus* than *C.dactylon*

Key words.; Allelopathic influence, *Cyperus rotundus, Cynodan dactylon,*

INTRODUCTION
Allelopathy can be considered as a type of communication between plants and plants with environment. Chemicals with allelopathic functions in the plants have other ecological roles, such as their defence, nutrient chelation and regulation of soil biota in ways that affect decomposition and soil fertility (Bais *et* al., 2004; Yoneya, Takabayashi, 2014). Plants synthesize a variety of compounds through its secondary metabolism. The production of allelopchemicals in plant systems depends on the existence of precursor molecules and the activation of specialized genes. Activation of genes required for allelochemical biosynthesis is often dependent on environmental stimulants (Croteau *et al*., 2000)

Chemicals released from plants and imposing allelopathic influences are termed allelochemicals or allelochemics. Most allelochemicals are classified as secondary metabolites and are produced as offshoots of the primary metabolic pathways of the plant. Allelochemicals can be present in several parts of plants including roots, rhizomes, leaves, stems, pollen, seeds and flowers. These are released into the environment by root exudation, leaching, volatilization and/or by decomposition of above ground and underground plant parts.Root exudates are released directly from intact live plant roots into its surroundings (Rovira, 1969). Their volume is small i.e. 2-12 % of the total gross photosynthates (Grodzinsky, 1974), but they play significant role in allelopathy (Whittaker, 1971; Rice, 1974). They are the mediators in the interrelationship between higher plants and microorganisms. In some cases, they provide plants with immunity against phytopathogens (or) sustain the life activity of microflora in the rhizosphere and sustain the life of mycorrhiza to improve mineral nutrition in the plants.

The soil is a dynamic system where activity of substances released can be quite transitory, as they are subjected to destruction, soil absorption and inactivation and transformation by soil microflora. The plants may suffer from these chemicals instantly or sustained toxicity may occur as new toxic products are formed in some of the transformations (Patrick et al. 1964). Besides, microorganisms active in decomposition may themselves produce inhibitory allelochemicals i.e. microbial toxins (McCalla and Haskins, 1964;; McCalla and Norstadt, 1974).

There are numerous reports, which indicate that allelopathic potentiality of weeds plays a major role by affecting the crop growth and nutrient status of soil (Bhowmik and Doll, 1984; Oudhia, 2000; Kalita, 2001). The content of allelochemicals may cause changes in soil chemical characteristics. The presence of *Pluchealanceolata,* an aggressive evergreen asteracean weed, apparently influence certain soil properties such as. pH, electrical conductivity, potassium (K^+) and soluble chloride (Cl^-). As the *P. lanceolata* infested soils had significant negative effects on seedling growth of various crop plants compared to non-infested soils, it is possible that the effect of allelopathic plants can be due to the allelochemicals in the soil and/or to altered soil nutrients (Inderjit, 1998). the present investigation has been aimed to assess the allelopathic influence of two weed species, *Cyperus rotundus L. and Cynodan dactylon* L on physico-chemical and biological properties of rice seedling grown soil

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MATERIALS AND METHODS

Whole parts (tubers/root,stem, leaves, flowers and seeds) of weed species (*C.rotundus* and *C.dactylon*) were collected from post harvest rice fields of Cuddalore District, Tamil Nadu and washed thoroughly and cut into small pieces. Each (250g) sample was of ground in a mixer using distilled water. The slurry was filtered through muslin cloth and the volume was made up-to 2.5l with distilled water and stored as stock solution. For the preparation of combined weed extracts, equal amount of three weed samples were taken from the stock solution, 15,10,5, and 2.5% concentrations of extracts were prepared by adding distilled water and stored in deep freezer until they were used. Distilled water was used as a control. The weed extracts were prepared freshly every three days upto 15th day. Earthen pots (30 x 15cm) each filled with 3kg of garden soil were used for the germination studies. The viable seeds were surface sterilized for two minutes in 0.2% mercuric chloride ($HgCl_2$), washed thoroughly in running tap water and sown @15 seeds/pot^{-1}.

Each pot was irrigated uniformly with different concentrations of individual and combined weed extracts. Each experiment was carried out with five replicates and repeated thrice. The extracts/water was added to the pots on alternate days up to the 15th day. Germination was recorded after four days. Physico-chemical properties of soil such as pH, electrical conductivity, Available nitrogen (Subbiah and Asija, 1956).Phosphorus (Olsen *et al*. (1954), potassium (Stanford and English, 1949), Organic carbon (Piper,1966) were estimated in the soil sample was collected from all the experimental pots. The total microbial populations (bacteria+fungi+actinomycetes) and dehydrogenase activity (Stevenson,1959).The number of colony forming units (CFU) was taken as an index of total microbial population (Baron *et al*. 1994). The data was statiscally analysed byTurkey's Multiple range Test (TMRT) at $P < 0.05$.

RESULTS AND DISCUSSION

In agricultural systems allelopathy can be part of the interference between crops and between crops and weeds and thereby affecting the economical outcome of the plant production. The weeds are causing inhibition on germination and growth of crops as well as reducing the yield of the desirable crops through releasing allelochemicals from the dead or live parts (Narwal,1994). The results of present results revealed that the percentage of NPK levels (table-1) was minimum in the lower concentrations of two weed extracts than their higher concentration. Among NPK contents, the nitrogen was found higher percentage followed by potassium and phosphorus in all the experimental soil.

Most of these allelochemicals are initially found to be inactive. Subsequent transformations (hydrolysis, oxidoreduction, methylation and demethylation) generate new products with distinct allelopathic properties. Different parts of plants can have these allelopathic properties, from foliage and flowers to roots, shell, soil and mulch. Most of the allelopathic plants retain their protective chemicals in their leaves, especially during autumn. As the leaves fall and decompose, these toxins can affect the nearby plants. Some plants also release toxins through their roots, which are then absorbed by other plants and trees (Ramona Cotrut,2018) The population of bacterial, fungi, actinomycetes and total microbial populationswere drasticallydecreased with increasing the concentration of weed extracts and more reduction was found in *C.rotundus* than *C.dactylon* treated soil(Table-2).

The chemical exudates from allelopathic plants are proposed to play a major role. Higher plants release diverse allelochemicals into the environment, which includes phenolics, alkaloids, long-chain fattyacids, terpenoids and flavanoids (Rice,1984 and Chou,1995). Allelopathic effects of these compounds are often observed to occur early in the life cycle, causing inhibition of seed germination and/or seedling growth. The compounds exhibit a wide range of mechanisms of action, affect on DNA (alkaloids), photosynthetic and mitochondrial function (quinones), phytohormone activity, ion uptake and water balance (phenolics) (Einhellig, 2002).Soil is an important factor for agricultural productivity. The physico-chemical analysis) present contrasting trends. While pH, electrical conductivity, NPK and organic carbon levels increased, the biological spectrum declined sharply. The contribution of the decomposing residues to the observed increases cannot be denied. Perhaps, the toxicity of the residues might have eroded the microbial diversity.

Allelopathic effects are often due to synergistic activity of several allelochemicals rather than to single compounds (Williamson, 1990). Under field conditions, additive or synergistic effects become significant even at low concentrations (Einhellig and Rasmussen,1978). Inderjit and Duke (2003) pointed out that allelochemically-enriched soils might generate chemical stress, which in turn would lead to a higher content of allelocompounds in the acceptor plants either due to the uptake or via de novo synthesis in response to the exposure of allelopathy stress. Inderjit and Dakshimi (1992) noted that a higher content of phenolics retarded the growth of asparagus bean (*Vigna unguiculata* var.sesqupedalis) grown in soil emended with *Pluchea lanceolata* as compared to free soil.

The analysis of the ethyl acetate organic fraction of the aqueous extracts of *C.rotundus* leaves and tubers by GC-MS revealed 19 compounds consisting of organic acids; phenolic, benzoic, and cinnamic derivatives; and fatty acids (Quayyum, *et al*.,2000). The role of phenolic, benzoic, and cinnamic acid derivatives, such as p-coumaric, ferulic, and salicylic acids, and water-soluble organic acids, such as succinic, malonic, citric, acetic, butyric, and propionic acids, as phytotoxic compounds is well documented (Rice, 1984; Blum *et al.*, 1999). Fatty acids, such as decanoic, palmitic, and stearic acids, were also reported as toxic, and their toxicity increased with the increase of double bonds (AlSaadawi*et al.,* 1983). The weed, *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).These allelochemicals might be the reason for altering the NPK, OC contents and biological properties of the weed extract applied rice seedling grown soil. However,the detailed study is required to understand the decomposition dynamics and mechanism of action of weed allelochemicals on soil health along with crop growth.

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ISSN-2394-5125 VOL 6, ISSUE 7, 2019

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Table – 1. Physico-chemical properties of experimental soil exposed to *C.rotundus and C.dactylon* extracts

Physico- chemical parameters	Control	*C.rotundus*				*C.dactylon*			
		1%	2%	3%	4%	1%	2%	3%	4%
pH	7.21d	7.30c	7.33c	7.41b	7.48a	7.30c	7.31c	7.39b	7.45a
EC	1.12d	1.18c	1.23b	1.26b	1.32a	1.19c	1.22b	1.25b	1.33a
N(%)	1.12g	1.47d	1.55c	1.66b	1.73a	1.48d	1.56c	1.65b	1.72a
P(%)	0.75d	0.13bc	0.14b	0.15b	0.17a	0.13bc	0.14b	0.15b	0.17a
K(%)	0.12e	1.03b	1.08a	1.11a	1.13a	0.85d	0.87d	0.93c	0.99b
OC(%)	0.13ab	0.12b	0.13ab	0.14a	0.15a	0.12b	0.13ab	0.14a	0.15a

Mean with different alphabets in a row differed significantly
as per Turkey's Multiple range Test (TMRT) ($P < 0.05$)

Table – 2. Biological properties of experimental soil exposed to *C.rotundus and C.dactylon* extracts

Biological parameters	**Control**	***C.rotundus***				***C.dactylon***			
		1%	2%	3%	4%	1%	2%	3%	4%
Bacteria ($CFU \times 10^6 g^1$)	45.3d	42.1a	39.2a	34.3b	31.2bc	43.2a	40.1a	36.3b	33.2b
Fungi ($CFU \times 10^4 g^1$)	15.3e	11.1a	10.2b	9.2c	7.2d	12.2a	10.2a	9.1c	8.2d
Actinomycetes ($CFU \times 10^5 g^1$)	9.3f	6.1b	4.1d	4.0d	3.2e	7.1a	5.0c	5.0c	4.2d
Total microbial Population ($CFU \times 10^6 g^1$)	6.13e	4.92a	4.78b	4.62bc	4.36d	5.08a	4.92a	4.76b	4.51d
Microbial activity (5µl H/5g)	6.78g	5.63c	5.41d	5.32de	5.16f	6.16a	6.05a	5.92ab	5.74c

Mean with different alphabets in a row differed significantly
as per Turkey's Multiple range Test (TMRT) ($P < 0.05$)