Available online at http://www.journalijdr.com

International Journal of DEVELOPMENT RESEARCH

ISSN: 2230-9926

International Journal of Development Research
Vol. 5, Issue, 2, pp. 3621, 3624, 2014

Full Length Research Article

ALLELOPATHIC EFFECT OF *CROTON BONPLANDIANUM* BAIL. ON GROWTH AND DEVELOPMENT OF RICE (*ORYZA SATIVA* L.)

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ARTICLE INFO

Article History:
Received 1st October, 2014
Received in revised form
14th November, 2014
Accepted 15th January, 2015
Published online 28th February, 2015

Key words:
Allelopathy,
Croton bonplandianum,
Rice cultivars.

ABSTRACT

Aqueous plant extracts of *Croton bonplandianum* Bail. was evaluated for their allelopathic effect on growth and developmental changes of two rice cultivars(BPT-5204 and IR-20). The plant extracts was applied at 5, 5, 10, 15,20 and 25% concentrations on the seeds of rice cultivars to understand the germination, growth and pigment changes by conducting pot culture experiments. The experimental results revealed that the seed germination, shoot length, chlorophyll, carotenoids contents were gradually declined with increasing the concentrations of plant extracts. The higher level of germination and growth reduction was noticed in BPT-5204 than IR-20.

INTRODUCTION

Allelopathy is a direct or indirect effect of one plant to other plant through their production of phyto toxins or chemical compounds (allelochemicals), which were released to the environment (Rice, 1974). Some plants exert influence on the neighboring plants through production and release of secondary plant metabolites called allelochemicals (Wardle *et al.*, 1992). Phenols are common secondary metabolites involved in such phytotoxic activity as they occur in higher concentrations in plant tissues and soil (Whittaker, 1970). The compositions of plant residues yield many phenolic acids viz. p-aminobenzoic, p-coumaric, ferulic, vanillic and cinnamic acids, which accumulate in soil (Stevenson, 1967). The occurrence of allelochemicals in higher plants and microorganisms has to documented by several workers. These are produced in above or below the ground plant parts or in both to cause allelopathic effects in a wide range of plant communities. These allelochemicals are accumulated in the soil and affect the growth of plants (Weston *et al.*, 2002 and Azania *et al.*, 2003). Plant parts known to contain allelochemicals are *Roots and rhozome:* In general, they contain fewer and less potent or smaller amounts of allelochemicals than leaves, but sometimes it may be the reverse also. *Stems:* They contain allelochemicals and are sometimes the principal sources of toxicity. *Leaves:* They are the most important sources of allelochemicals specific inhibitors in leaves have been demonstrated by many workers. *Flowers / inflorescene and pollen:* Although studies on flowers or inflorescence are limited, there is growing evidence that the pollen of corn and *Parthenium* have allelopathic properties. *Fruits:* Many fruits are known to contain toxins and have been found inhibitory to microbial growth and seed germination. Seeds: Seeds of many plants families or species have been found to inhibit seed germination and microbial growth. Allelopathy has received increased attention over the last 30 years with studies on effect of weed interference on crop yields, allelopathic effects of crop plants on other crop plants, crop plants on weeds and allelopathic effects of woody seed plants on crop plant in forestry and Horticultural fields. In the present investigation an attempt has been made to study the allelopathic influence of *Croton bonplandianum* Bail. on growth and development of two rice cultivars. *C.bonplandianum* (Euphorbiaceae) is an exotic weed commonly grown in wastelands and cropfields.

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MATERIALS AND METHODS

The weed species *Croton.bonplandianum* Bail. (Plate-1) were collected freshly from the post-harvest rice fields of Cuddalore District, Tamil Nadu for the experimental study.

The extracts of entire plant of weeds were employed to study their allelopathic effect on the germination and seedling growth of two cultivars of rice, (*Oryza sativa* L.), BPT-5204 and IR-20. The paddy seeds were procured from Tamil Nadu Rice Research Station, Aduthurai. Seeds with uniform size, colour and weight were selected for the experiments. The weed species were washed thoroughly and cut in to small pieces. Each of the chopped 25g samples was ground in a pestle and mortar with distilled water. Aqueous extracts thus obtained were filtered through muslin cloth and the volume was made up-to 100ml with distilled water. From this stock solution 25,20,15,10, and 5 % solutions were prepared by adding distilled water. The extracts were stored in a deep freezer until they were used. Distilled water used as a control. The selected healthy seeds of rice cultivars were sown in earthen pots, which were previously filled with 3kg of normal garden soil at pH 7.3. Extracts/Distilled water were irrigated alternative days up to 13 DAS. The germination percentage, seedling growth, biomass and pigment contents (Arnon,1949) were analysed on 15 day old seedlings of rice cultivars

RESULTS AND DISCUSSION

Allelopathy depends on chemical compounds mainly added to the environment from living plants (Through washings or leachates of foliage, root exudates, volatilization from aerial parts) or dead and decaying plant parts (Tukey, 1969). The compounds involved in allelopathic interactions are known as allolochemicals. The number and diversity of the compounds involved in allolopathy are growing rapidly. Over 10, 000 secondary plant products have been recorded (Pandya and Sidha, 1987) the total number however exceed 4,00,000 (Narwal, 1994).

The aqueous whole plant extracts of the *C. bonplandianum* strongly reduced the germination of test crops over control and the magnitude of reduction differed depending upon the concentration of the extracts employed. Lower concentrations of *C.bonplandianum* extracts slightly inhibited the germination while the extracts of other concentrations showed an increased inhibition of various intensities. As the concentration of the extracts increased from 5% to 25% the percentage of germination decreased and in 25% aqueous whole plant extract caused a higher inhibition on germination of rice seeds (Fig.1-3). The study of Bendall (1975) showed that the root extract of Canada thistle inhibited the germination on *Trifolium subterraneum* seed by 87%. Similar inhibition of seed germination by root extract was observed by different workers. The inhibitory effect of *Ipomea carnea spp. Fistulosa*, *Cyperus rotundus*, *Cynodon dactylon*, *Echinochloa colonum*, *Portulaca oleracea* and *Lagasca mollis*, on sorghum, wheat, kidney bean, rice, onion, radish and knol knoll (Jadhav *et al.*, 1997; Challa and Ravindra, 1998), clearly supports the present findings. But on the contrary the study of Pope *et al*. (1985) revealed that the root exudates of *Cynodon dactylon* promoted seed germination in soybean.

The stem extracts of *Trianthema portulacastrum* inhibited the seedling growth of soybean. (Umarani and Selvaraj, 1996). The aqueous extract of aerial parts of *Prunus amygdalus* inhibited the growth of root and shoot length on wheat and finger millet (Pande *et al.*, 1998). The study of Patil (1994) revealed that the leaf extracts of *Glyricidia maculata* L.

Plate-1.*Croton bonplandianum* Bail

Fig.1.Allelopathic Effect of *Croton bonplandianum* Bail extracts on germination Percentage of rice cultivars

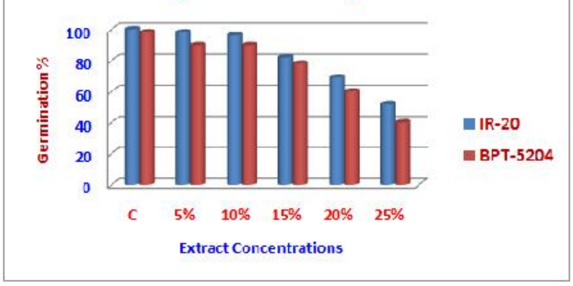


Fig.2. Allelopathic Effect of *Croton bonplandianum* Bail extracts on pigments (Chlorophyll a, b and Carotenoid contents (mg/g.fr.wt.) of Rice cultivars

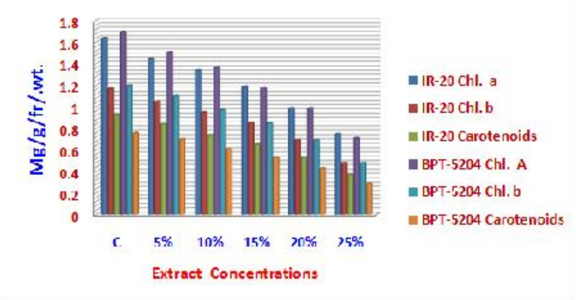
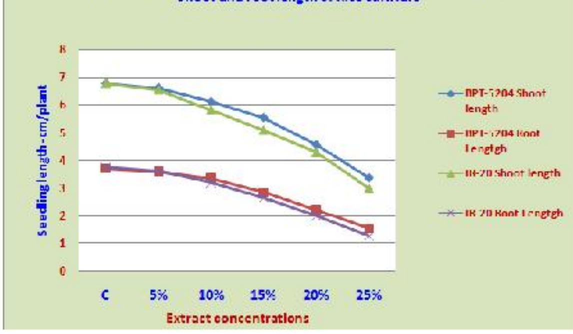


Fig.3. Allelopathic Effect of *Croton bonplandianum* Bail extracts on Shoot and root length of Rice cultivars



inhibited the seedling growth of rice, sorghum, black gram and green gram. The leaf extract of *Faxinus micrantha* L. inhibited the growth of root and shoot length of *Raphanus sativus,* *Eleusine coracana*, *Triticum aestivum* and *Brassica campestris* (Joshi *et al.*, 1996). These studies are in conformity with the present findings. But on the contrary the study of Lovett and Sagar (1978) showed that the aqueous washings of leaves of *Camellina sativa* stimulated the growth of radicles of flax seedlings.

Prasad *et al*. (1999) have reported that the aerial and shoot biomass of *Rhamnus virgatus* significantly decreased the protein content in all test crops (*Triticum aestivum*, *Eleusine coracana*, *Lens culinaris* and *Phaseolus mungo*) as compared to control. The aqueous extract of *Ranunculus arvensis* plant materials caused a decrease in the protein content of wheat cultivars (Bansal, 1997). The aqueous extracts of root, shoot and whole plant *C.bonplandianum* showed an antagonistic effect on germination and growth of rice seedlings but their effect was more severe on BPT than IR-20 rice cultivars.

The reduction in chlorophyll contents observed in all the concentrations might be due to the degradation of chlorophyll pigments or reduction in their synthesis and the action of flavonoids, terpenoids or other phytochemicals present in the leaf extracts. (Tripathi *et al.*, 1998). The more reduction of chlorophyll b than chlorophyll a, indicated its susceptibility to stress and during stress situation, in tolerant species conversion of chlorophyll b to chlorophyll a may occur (Djanaguiraman *et al.*, 2003). Carotenoids may decrease the photosynthesis and thereby substantially decrease all the metabolities viz., total sugars, proteins and soluble amino acids (Singh and Rao, 2003). Reduction in pigments was previously reported as a result of allelochemical stress (Ervin and Wetzel,2000; Singh *et al*., 2009). A correlation between photosynthetic alternation and the action of some allelochemical compounds was shown in previous works (Einhellig, 1986; Heji *et al.*, 1993) being the disruption of electron transport chain one of the most usual ways for affecting photosyntheisis by allelochemical compounds (Nimbal *et al*., 1996 and Gonzelz *et al*., 1998). Dutta *et al.,(*2013) detected the high percentage of alkaloid (59.60 ± 4.79 g/100g), saponin (17.35 ± 1.35 g/100g), phenolic content (75.39 ± 3.19 mg/g), protein (55.04 ± 2.09 mg/g), lipid (37.53 ± 2.43 mg/g), tannin (26.18 ± 2.63 mg/100g), thiamine (26.18± 2.36 mg/100g) and very satisfactory quantity of riboflavin or vitamin B2 (0.55 ± 0.03 mg/100g), ascorbic acid (0.71 ± 0.05 mg/100g) in *C. bonplandianum.* The inhibitory effect of *C. bonplandianum* might be the synergistic action of all of these allelochemicals present in the weed extracts on seed germination and seedling growth of rice cultivars.

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