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ALLELOPATHIC EFFECTS OF SOME WEEDS ON GROWTH AND YIELD OF PADDY RICE (TAROM VARIETY) IN NORTHERN IRAN

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ABSTRACT

Allelopathic effects of aqueous whole plant leachates of dominant weed (Cyperus difformis and Echinochloa crusgalli) and non dominant weed (Paspalum paspaloides and Sagittaria trifolia) were examined by foliar application on biochemical and physiological growth and yield parameters of paddy rice (Tarom variety) of northern Iran. Spraying aqueous whole plants leachates (5%) showed that the content of phenols in flag leaf of treated crop was significantly increased by whole leachates of Cyperus difformis and Echinochloa crusgalli at P=0.05 by ANOVA. The content of total chlorophyll in flag leaf of treated crop was significantly decreased by whole leachates of Cyperus difformis and Sagittaria trifolia. This study also showed that whole plant leachates of selected weeds did not show much inhibitory effect on growth parameters (number of total tillers pot^{-1}, plant height and elongation of flag leaf). On the contrary, elongation of panicle and total grain fill panicle^{-1} were inhibited by foliar application of whole selected weeds. In case of number of effective tillers pot^{-1}, Cyperus difformis along with Sagittaria trifolia significantly hampered the number of effective tillers pot^{-1} only; while 1000 grain weight and the number of grain panicle^{-1} were not affected by whole leachates of all treatments. However, whole plant leachates of Cyperus difformis and Sagittaria trifolia strongly hampered grain yield of Tarom variety as compared with control by 30.4 and 29.6%, respectively.

Keywords: Allelopathy, Rice weeds, Foliar application, Growth and yield parameters.

INTRODUCTION

The problem of weed is as old as cultivation of crop plant itself. Weeds species are considered as rich source of secondary metabolites (allelochemicals) and these chemicals improve a certain kind of environmental system on other plants growing in their vicinity and the

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phenomenon is known as allelopathy (Nandal *et al*. 1994). One of the important factors of decrease or increase in rice yield is the release of chemicals (allelopathic compounds) by weeds. The huge biomass generated by these luxuriantly growing dominant weeds viz *Cyperus difformis* and *Echinochloa crusgalli* as well as second dominant weeds viz *Paspalum paspaloides* and *Sagittaria trifolia* in paddy field of northern Iran particularaly in Babol is wasted every year by weeding and other manual activities, which otherwise can be exploited as herbal agrochemicals, weedicides and antimicrobial compounds in sustainable agriculture. To exploit allelopathic potential as a source of natural herbicides, effect of aqueous whole plant leachates of *Cyperus difformis, Echinochloa crusgalli, Paspalum paspaloides and Sagittaria trifolia* was investigated on biochemical and physiological growth and yield parameters.

MATERIAL AND METHODS

Collection of Plant Materials

Whole mature selected weeds viz. *Cyperus difformis, Echinochloa crusgalli, Paspalum paspaloides and Sagittaria trifolia* were collected from different farm of paddy fields of Babol (Mazandran province- Iran) during harvesting stage of their life cycle for the correct botanical identification. Then these weeds were washed in distilled water for removing dust and soil particles (these may influence the chemical composition of leachate) for minimum period (to avoid leaching losses of water soluble allelochemicals) and then were dried in shade for a week at room temperature (because sunlight decomposes healthy plant tissues). The dried selected weeds were stored in plastic bags for one month at room temperature (average during day: 25 ^{o}C) before used for experiment.

Experiments

A plastic pot experiment was carried out during 2008 to determine leachates effects of some weed species like *Cyperus difformis*, *Echinochloa crusgalli*, *Paspalum paspaloides* and *Sagittaria trifolia* on Tarom variety (paddy rice of Iran) which is an early maturity variety. Whole plant leachates were done for bio prospecting of allelopathic effects of weed species through foliar application.

A plastic pot with 16 inch height and 14 inch width was filled up with soil. The physicochemicals of soil were measured. Seedling of rice varieties from nursery were transplanted into plastic pots with distinctive space (three hills per pot). Each treatment had three replicates. Fertilizer requirement of the experimental plastic pot was calculated according to fertilizer recommendation which was

recommended by (Malakoti and Gheybi, 1997 & Dobermann and Fairhurst, 2000) and then added the same rate to all plastic pots and all plastic pots were irrigated at the same height (5 cm). Because of competition can be selectively eliminated by adding limiting resources. For the preparation of whole plant leachates, five gram of whole plant was allowed to decay at room temperature for 72 hours in 100 ml distilled water (5 %) then filtered using filter paper (Machado, 2007). However, after rice transplanting, whole leachates were sprayed on the rice plant varieties in the distinctive plastic pots at weekly intervals till flowering stage.

The growth parameters like the total number of tillers in each hill (which measured maximum tillering stage for Tarom variety 35 days and for Neda and Fajer varieties 45 days after transplanting), Plant height at 100% panicle initiation which is maximum stage of height elongation and elongation of flag leaf (because flag leaf is near to panicles and commonly photosynthetic compounds transfer from nearest source to nearest sink) were measured. The yield parameters also were determined which included the number of effective tillers $hill^{-1}$ then $plastic\ pot^{-1}$, panicle length, the number of total grain $panicle^{-1}$, the total number of filled grain $panicle^{-1}$, 1000 grain weight with humidity of 14% and grain yield. Estimation of Phenols from flag leaf of 3 varieties with different treatments carried out by Folin-Ciocalteau reagent (Farkas and Kiraly, 1962). And also estimation of total chlorophyll (a and b) was done according to method of Arnon (1949) by using UV-visible spectrophotometer (Shimadzv-1601).

Statistical Analysis

The results of the experiment were tested by analysis of variance (ANOVA). The means of treatments which had significant differences have been compared by Duncan's Univariete multiple comparison ($\alpha = 0.05$ %) and standard deviation (Std. D) for each analyze were given in Table. All statistical analyses were done using Statistical Program for Social Science (SPSS, Version 9).

RESULTS AND DISCUSSION

Physiological and biochemical parameters

Results of quantitative estimation of phenols in flag leaf of treated crop by foliar application showed in Table-1 indicated that the content of phenols in flag leaf of test crop was significantly increased by whole plant leachates of *Cyperus difformis* (19.52mg/g) and *Echinochloa crusgalli* (9.45mg/g) while there were little increase by whole plant leachates of *Sagittaria trifolia* (5.41mg/g) and *Paspalum paspaloides* (7.23mg/g) in comparison with control (3.46mg/g). It was

also found that the content of chlorophyll in treated crop was significantly decreased by whole leachates of *Cyperus difformis* (1.27mg/g) and *Sagittaria trifolia* (1.11 mg/g). It is worth mentioning that the content of chlorophyll was increased by foliar application of whole plant leachates of *Paspalum paspaloides* (3.13mg/g) in comparison with control (2.54mg/g) though the difference was not significant. As indicated by Ambika and Smitha (2005), Banerjee and Kalloo (1989) and Dhumal (1983) the significant increases in phenolic contents may be due to induction of stress, which might be playing an important role in providing biotic and abiotic stress resistance. The negative effect on growth and other parameters might be due to its strong allelopathic potential causing alteration in physiological, biochemical and enzymological processes.

Table-1. Effect of whole plant leachates of studied weeds on chlorophyll and phenols content of paddy rice of Tarom variety.

Whole plant leachates of studied weeds	Growth parameters	
	Chlorophyll content (mg/g)	Phenols content (mg/g)
Cyperus difformis	1.27±0.41*c**	19.52±2.27*a*
Echinochloa crusgalli	1.77±0.84*bc*	9.54±0.57*b*
Paspalum paspaloides	3.13±0.69*a*	7.23±4.33*bc*
Sagittaria trifolia	1.11±012c	541±2.48*bc*
Control	2.54±0.31*ab*	3.46±3.14*c*
Mean	1.96±0.92	9.03±6.28

*Mean (±) Standard deviation and groups based on Duncan's Univariate comparison with 95% confidence intervals (*n=3*).

Growth parameters

Results shown in Table-2 revealed that whole plant leachates of selected weeds did not show much effect on growth parameters like number of total tillers pot^{-1}, plant height and elongation of flag leaf.

Yield parameters

Results presented in Table-3 showed that the elongation of panicle was decreased by whole plant leachates of all selected weeds over control with same level of inhibitory effect statistically. It was also recorded that whole leachates of *Cyperus difformis* inhibited total filled grain per panicle (76.67) over control (105.33) followed by *Echinochloa crusgalli* (82.66) as well as *Sagittaria trifolia* (81.33). However, in case of *paspalum paspaloides* total filled grain per panicle were increased (111.67) as compared to control. In case of number of effective tillers pot^{-1}, *Cyperus difformis* (11) along with *Sagittaria*

trifolia (10.22) significantly hampered the number of effective tillers pot^{-1}. On the contrary, 1000 grain weight and the number of grains panicle^{-1} were not affected by whole leachates of all treatments.

Table-2. Effect of whole plant leachates of studied weeds on growth parameters of paddy rice of Tarom variety.

Whole plant leachates of studied weeds	Growth parameters		
	Total number of tillers pot^{-1}	Plant height (cm)	Elongation of flag leaf (cm)
Cyperus difformis	17.11±1.57*a*	103.76±13.67*a*	21.89±3.04*a*
Echinochloa crusgalli	14.45±0.69*a*	97.29±5.55*a*	22.22±0.75*a*
Paspalum paspaloides	15.56±1.17*a*	99.80±9.20*a*	25.41±2.58*a*
Sagittaria trifolia	16.44±1.17*a*	94.75±5.75*a*	22.36±1.55*a*
Control	16.44±1.17*a*	100.72±3.02*a*	24.23±2.85*a*
Mean	16.02±1.66	99.26±7.70	23.22±2.42

*Mean (±) Standard deviation and groups based on Duncan's Univariate comparison with 95% confidence intervals (*n=3*).

However, whole plant leachates of *Cyperus difformis*, *Sagittaria trifolia* and *Echinochloa crusgalli* strongly hampered grain yield of Tarom variety (17.22, 17.41 and 18.59) as compared with control (24.74 g pot^{-1}), respectively. Results of present study suggested that the Tarom variety is not resistant variety by foliar application of whole plant leachates of selected weeds. It can be recommended to farmer for cultivation of another variety in the area where the studied weed species are dominant and these weed species had the least allelopathic effects on rice. It is further suggested to exploit the huge biomass generated by these luxuriantly growing weeds as weedicidal and antimicrobial compounds in sustainable agriculture by local farmers. The results of present investigation will be helpful to researchers, agriculturists and agro-biotechnologists.

Table-3. Effect of whole plant leachates of studied weeds on yield parameters of paddy rice of Tarom variety

Weeds species	Yield Parameters					
	Elongation of panicle (cm)	Number of effective tillers pot^{-1}	Number of total grain panicle^{-1}	Number of filled grain panicle^{-1}	1000 grain weight (g)	Grain yield pot^{-1} (g)
Cyperus difformis	20.57±.0.50*b**	11.00±1.20*b*	90.79±10.40*a*	76.67±6.17*c*	21.39±0.91*a*	17.22±2.47*c*
Echinochloa crusgalli	19.32±1.38*b*	11.44±0.51*ab*	94.21±8.48*a*	82.66±7.57*bc*	20.76±0.21*a*	18.59±1.86*bc*
Paspalum paspaloides	21.85±1.46*ab*	13.77±0.77*a*	120.78±24.13*a*	111.67±17.84*a*	21.91±1.17*a*	28.70±5.67*a*
Sagittaria trifolia	19.98±1.09*b*	10.22±1.17*b*	97.30±24.72*a*	81.33±18.78*bc*	21.01±0.56*a*	17.41±5.48*c*
Control	23.81±1.93*a*	13.66±1.66*a*	112.65±13.88*a*	105.33±16.59*ab*	20.99±0.83*a*	24.74±1.26*ab*
Mean	21.11±2.00	12.02±1.17	103.15±19.15	91.55±19.03	21.21±0.80	21.33±5.75

* Indicated that mean (±) Standard deviation and groups based on Duncan's Univariete comparison with 95% confidence intervals (*n=3*). c approach, 2nd edition, McGraw Hill Book Co. Inc. Tokyo.

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