POSITIVE ALLELOPATHIC INTERACTION OF *AMARANTHUS VIRIDIS* WITH *TRITICUM AESTIVUM*

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Abstract: Crop and crop-weed residue (previously growing in the field) allelopathic interactions were investigated in common field plants in simulated isolated pot plantation experiments. *Triticum aestivum* UP-2338 (crop plant) grown in soil treated with *Amaranthus viridis* (crop-weed) dry root powder (ADP), resulted in increased % germination with increase in concentration of ADP. Root length, shoot length and vigour-index were observed maximum in wheat plants grown in soil treated with 0.2% ADP and minimum in soil without ADP (control). Plant biomass, total sugar, chlorophyll a, Chl.b, total chlorophyll and total carotenoid contents increased in all treatments except in plants grown in 0.5% ADP treated soil as compared to control. NRS and organic carbon increased with increasing concentration of ADP whereas nitrogen, phosphorus, RS and phenolics declined as compared to untreated. Total protein, protease, α-amylase activities declined in roots ADP concentration above at 0.2%. Peroxidase activity increased at 0.2% ADP and maintained almost the same level at further increase in ADP concentration. In shoots, protease, α-amylase and peroxidase activities declined though total protein increased with increasing concentration of ADP. The allelochemicals of *Amaranthus viridis* directly influences the root metabolic activities, indirectly influencing (promoting) shoot metabolic activities.

Keywards: Allelopathy, Allelochemicals, α-Amylase, Vigour-index, ADP

INTRODUCTION

Triticum aestivum L. is an annual plant of family Graminae (Poaceae); it is the world's most widely cultivated cereal crop, grown in India since the dawn of civilization. In India, *T.aestivum* is the second most substantial crop after rice and is cultivated in 26.4 million hectare land representing 2900 kg/ha yields (Nagarajan, 2005). A loss of about 32% in yield of various crops has been recorded due to allelopathic interactions of weeds (Oerke and Dehne, 2004). *Amaranthus viridis,* a cosmopolitan crop-weed of family Amaranthaceae is generally recorded to grow in the local field and acts as previous crop-weed (residues) for *T.aestivum.* More than 100 secondary metabolites in plants, such as phenolics, terpenoids, alkaloids, fatty acids and steroids are reported to play an important role on Allelopathy (Narwal, 2004).

Thus, in the present investigation an attempt has been made to evaluate the effect of root residues (allelochemicals) of *Amaranthu viridis* on seed germination and seedling growth of most commonly growing cereal crop *Triticum aestivum* for selecting a proper crop-cropweed combination

MATERIALS AND METHODS

The experiments were conducted at Department of Botany, C.C.S. University Campus, Meerut (Latitude 29^0 01'N; Longitude 77^0 43' E; 730 feet asl) in Uttar Pradesh. For the present study, the tested said crop weed plants (*Amaranthus viridis*) were collected, washed thoroughly with tap water and then rinsed with double distilled water. The roots were separated with a sharp blade, kept in oven at 120^0C for 30 minutes in order to provide heat shock treatment and subsequently placed at 70^0C till the roots were completely dried. The dried root were ground in a mortar and pestle to make a fine powder (ADP) which was mixed with soil in suitable proportions to get 0.2, 0.5 and 1.0% w/w ADP. Healthy seeds of *Triticum aestivum* cv. UP-2338 were disinfected with 0.1% $HgCl_2$ solution for 5 minutes and washed 5-6 times with distilled water to remove its traces. 150 healthy seeds (30 in each replicate) of *T. aestivum* during December were allowed to germinate under each treatment (0.2%, 0.5% and 1.0% w/w ADP) in pots and saturated with tap water on alternate days.

Biochemical analyses of *T. aestivum* seedlings (15 days old) were carried out for estimation of Chlorophyll a, chl b and total chlorophyll (Arnon

1949), Reducing, Non-reducing and total sugar (Nelson 1944), total protein (Lowry *et al* 1951), α-amylase (Filner and Varner 1967) and Peroxidase activity (Maehley and Chance 1967). Morpho-physiological observations were recorded on 15th day after radicle emergence. Germination %, root length, shoots length, fresh weight, dry weight per seedling and moisture% was measured as per standard methods (Anon 1985).

Vigour Index was calculated according to the formula adopted by Abdulbaki and Anderson (1973)

(Vigour Index = Total seedling length × % Germination)

RESULTS AND DISCUSSION

Morpho-physiological parameters indicate that with increasing concentration of *Amaranthus viridis* dry root powder (ADP), increased % germination of *Triticum aestivum*, but decreased root length at vegetative phase (15 DAR). In general, 0.2% and 1.0% ADP resulted in higher shoot length, fresh and dry weight, % moisture and vigour index as compared to control (untreated).0.5% ADP reduced both fresh and dry weight of *T. aestivum* seedlings (Table-1). The results were in conformity with Qasem (1995) who reported that the inhibitory effects were rate dependent; the low concentrations of shoot extracts of *Amaranthus spp*. promoting shoot growth of wheat in laboratory bioassay and dry root extract of *Amaranthus gracilis* increased shoot and root dry weights of wheat in pot experiments.

Chlorophyll a, chl b, total chlorophyll, carotenoids, total sugar and non-reducing sugar underwent a rise at 0.2% ADP followed by a decline and then rise as compared to respective control (Table-2).

Hence, chlorophyll as well as biomass increased with increasing concentration of ADP, indicating a positive correlation between total chlorophyll and biomass production in *T. aestivum* seedlings.

Total protein, α-amylase activities declined in roots beyond 0.2% ADP. Peroxidase activity increased at 0.2% ADP and maintained almost the same level at further increase in ADP concentration. In shoots, protease, α-amylase and peroxidase activities declined though total protein increased with increasing concentration of ADP (Table-3), indicating synthesis and accumulation of structural proteins in shoots as against roots.

The natural growth inhibitors such as phenolics reduce the hydrolytic enzymes activity in germinating maize seeds (Devi and Prasad, 1992). Hegab *et al* (2008) also reported that the aqueous leaf extract of *Beta vulgaris* inhibited protein content and α-amylase activities of *T.aestivum* with increasing concentration.

The present investigation emphasis that the effect of the allelochemicals of *Amaranthus viridis* directly influences the root metabolic activities, indirectly influencing (promoting) shoot metabolic activities.

Table 1. Morphophysiological profile of (of pot grown *Triticum aestivum* seedlings during vegetative phase i.e. 15 days old) under 0.2%, 0.5% and 1.0% *Amaranthus viridis* dry root powder (ADP) treatments amended to soil.

Treatments	% G	R.L	S.L	F Wt.	Dry Wt.	% M	V.Index
Control	85	4.30 ± 1.83	13.62 ± 1.66	0.222	0.055	75.22	1162
0.2% ADP	85	5.49 ± 1.96	18.35 ± 0.21	0.331	0.057	82.77	2026

O.5% ADP	90	4.90 ± 0.70	15.80 ± 0.98	0.218	0.042	80.73	1863
1.0% ADP	95	3.95 ± 0.49	16.15 ± 3.18	0.368	0.057	84.51	1909

Table 2. Chloroplastic pigment status of pot grown *Triticum aestivum* seedlings during vegetative phase (15 days old) under 0.2%, 0.5% and 1.0% *Amaranthus viridis* dry root powder (ADP) treatments.

Treatments	Chlorophyll a	Chlorophyll b	Total Chlorophyll	Carotenoids	T.S	R.S	N.R.S
Control	15.56×10^{-4} ± 3.28×10^{-4}	7.77×10^{-4} ± 7.20×10^{-5}	23.21×10^{-4} ± 2.80×10^{-5}	7.57×10^{-4} ± 4.42×10^{-5}	1.89 ± 0.05	1.12 ± 0.12	0.77
0.2% ADP	15.69×10^{-4} ± 1.20×10^{-4}	8.13×10^{-4} ± 6.60×10^{-5}	24.12×10^{-4} ± 1.78×10^{-5}	8.17×10^{-4} ± 1.14×10^{-4}	3.83 ± 0.82	2.21 ± 0.16	1.62
0.5% ADP	12.88×10^{-4} ± 5.58×10^{-4}	6.85×10^{-4} ± 1.86×10^{-4}	19.42×10^{-4} ± 7.02×10^{-4}	6.17×10^{-4} ± 2.30×10^{-4}	1.36 ± 0.40	1.10 ± 0.18	0.26
1.0% ADP	16.11×10^{-4} ± 1.40×10^{-5}	7.74×10^{-4} ± 1.11×10^{-5}	24.14×10^{-4} ± 2.43×10^{-5}	7.82×10^{-4} ± 1.03×10^{-5}	4.77 ± 0.65	1.04 ± 0.16	3.73

Table 3. Protein content and enzyme activities of pot grown *Triticum aestivum* seedlings during vegetative phase (15 days old) under 0.2%, 0.5% and 1.0% *Amaranthus viridis* dry root powder (ADP) treatments.

Treatments	Protein	α-Amylase	Peroxidase
Control Root	51.42 ± 5.12	1016.76 ± 36.09	84.44 ± 33.51
Control Shoot	351.04 ± 45.60	1164.08 ± 132.37	86.66 ± 46.03
0.2% ADP Root	127.45 ± 8.87	1062.98 ± 8.20	102.22 ± 17.82
0.2% ADP Shoot	337.73 ± 40.29	1197.29 ± 16.25	178.89 ± 96.21
0.5% ADP Root	89.44 ± 18.47	987.88 ± 70.10	102.77 ± 32.50
0.5% ADP Shoot	357.76	1179.96	220.55

	± 50.34	± 32.37	± 32.50
1.0% ADP Root	81.61 ± 6.98	963.32 ± 4.99	115.55 ± 49.17
1.0% ADP Shoot	374.53 ± 70.60	1138.80 ± 38.77	125.00 ± 69.65

ACKNOWLEDGEMENT

Authors are grateful to UGC for granting a project (Prof. Vimala Y. as Prinicipal Investigator and Anuj Kumar Ahalavat as Project fellow) and to the Head, Department of Botany, C.C.S. University, Meerut for providing facilities.

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