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Allelopathic Effect of Aqueous Extracts of Weed Species on Germination and Seedling Growth of Some Crops

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Abstract: Allelopathic effect of *Cyperus rotundus, Commelina benghalensis, Parthenium hysterophorus* and *Prosopis juliflora* at two concentrations (5 and 10 % W/V) on sorghum, wheat, green gram, soybean, and sunflower and groundnut was studied. The results revealed that *Commelina* and *Cyperus* extracts had greater inhibitory effect on germination, seedling length and seedling vigour index, among the crops tested. Groundnut and wheat were more resistant to allelopathic effect to weeds.

Introduction

Alleopathy is an important factor in determining the vegetation pattern, species diversity and vegetation dynamics. It plays a significant role in plant plant and plant microbe interactions, which are important in the management of one species by another mainly through biochemical inhibition of germination and seedling growth of the existing species by the intruder species.

Weeds cause greater losses in the production of cereals, pulses and oilseeds than any other pest and diseases, (Norris, 1991 and Bridges and Davide, 1992). Weeds interfere with crop plants in many ways through competition (Crafts and Robbins, 1973 and Bridges and Davide, 1992) or allelopathic effects (Narwal, 1994 and Duhan and Laxminarayan, 1995). Several weed species have strong allelopathic influence on crop species (Duhan and Laxminarayan, 1995). However, there is no much information available on the influence of prominent weed species viz., *Cyperus rotundus, Commelina benghalensis, Parthenium hysterophorus* and *Prosopis juliflora* on predominant crops viz., sorghum, wheat, greengram, soybean, sunflower and groundnut of this transitional tract of northern Karnataka. Hence, the present laboratory experiment was conducted with an objective to study the allelopathic potential of weed species on germination and seedling growth in cereals, pulses and oilseeds.

Material and Methods

A laboratory experiment was conducted in the Department of Crop Physiology, College of Agriculture, Dharwad during August, 1999-2000. Leaf samples of *Commelina benghalensis*, *Cyperus rotundus, Parthenium hysterophorous* and *Prosopis juliflora* were collected before flowering. These samples were ground and soaked over night in 100 ml of distilled water. The leachates were filtered by using muslin cloth and the same was used for the experiment. Aqueous weed leaf extracts @ 5 and 10 per cent were made on fresh weight / volume (W/V) basis. Filter papers were placed in each petriplate and 25 seeds of each crops (sorghum, wheat, greengram, soybean, sunflower and groundnut) were spread evenly on the paper. Five ml of weed sample extract was applied according to treatment and incubated for a period of nine days. Observations on germination % seedling length, seedling vigour index were recorded and statistically analysed, at 5 per cent probability level. The seedling vigour index was calculated by the following method suggested by Abdul-Baki and Anderson (1973)

$$SVI = \text{Germination per cent} \times (\text{root length} + \text{shoot length})$$

Results and Discussion

The data indicated that soybean (57.7%) recorded significantly lower germination percentage while higher per cent germination was noticed in groundnut (93.7%) (Table 1). Among weed species, *Commelina* (80.1%) and *Cyperus* (85.3%) affected the germination to a greater extent as compared to other weed species. At 10 per cent concentration, germination was significantly reduced as compared to 5 per cent concentration of weed extract. Irrespective of weed species, higher concentration of aqueous extract had significant influence on germination of the crops tested. These observations are in agreement with the findings of Singh *et al.* (1989), Uppar *et al.* (1993) and Leela (1995).

Among the crops, soybean (8.6 cm) was more affected by allelopathic effect of weed extracts and recorded lesser seedling length as compared to groundnut (10.9 cm). Among the weeds. *Commelina* (10.0 cm) inhibited the seedling length to a greater extent as compared to *Prosopis* (14.4 cm) (Table 2). Among the interactions, all the weed species at higher

Table 1. Allelopathic effect of weed species and its aqueous leaf extracts on per cent germination in different crop species

	T x C						T x W				T
Treatments	C_1	C_2	C_3	C_4	C_5	C_6	W_1	W_2	W_3	W_4	Mean
	95.6	96.8	97.4	91.2	91.0	100	96.1	95.2	94.5	96.0	95.4
	86.2	90.3	84.4	46.1	67.6	93.7	89.3	81.9	76.0	91.7	84.7
	80.4	83.8	78.3	36.0	61.3	87.4	82.9	78.9	69.9	88.2	80.0
W x C	87.4	90.3	86.7	57.7	73.3	93.7	89.5	85.3	80.1	92.0	86.7

	T x C x W											
Treatments	C_1				C_2				C_3			
	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4
T_1	96.0	95.0	94.3	97.0	98.7	96.0	96.0	97.0	97.0	98.0	96.5	98.0
T_2	91.2	87.8	83.1	93.2	94.9	93.2	90.9	95.1	93.2	92.1	90.1	94.4
T_3	83.5	83.1	71.3	91.3	91.6	88.5	78.6	91.7	91.7	85.5	82.6	92.7
W x C	90.2	88.6	82.9	93.9	94.1	92.6	88.5	94.6	94.0	91.9	89.7	95.0

Treatmens	T x C x W											
	C_4				C_5				C_6			
	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4
T_1	91.2	91.0	90.2	92.2	91.3	91.0	90.0	91.7	100	100	100	100
T_2	80.1	55.1	59.1	86.5	78.6	73.6	44.3	86.4	95.6	94.6	93.5	96.6
T_3	62.8	53.5	44.8	77.9	72.1	71.2	32.1	81.7	92.8	91.8	89.8	94.0
W x C	78.0	66.5	63.8	85.5	80.7	78.6	57.8	86.6	91.1	95.5	94.4	96.8

For comparing the means of

	SEm ±	CD at 5 %
Weeds (W)	0.609	1.687
Crops (C)	0.746	2.067
Concentrations (T)	0.527	1.460
Conc. x Crops	1.292	3.580
Conc. x Weeds	1.055	2.923
Crops x Weeds	1.492	4.134
Conc. x Crops x Weeds	2.585	7.162

T_1= Control
T_2= 5 % leaf extracts
$T_{3=}$ 10% leaaf extracts

T_1= *Parthenium hysterophorus*
T_2= *Cyperus rotundus*
T_3= *Commelina benghalensis*
T_4= *Prosopis juliflora*

C_1= Sorghum
C_2= Wheat
C_3= Green gram
C_4= Soybean
C_5= Sunflower
C_6= Groundnut

Table 2. Allelopathic effect of weed species and its aqueous leaf extracts on seedling length (cm) in different crop species

Treatments	T x C						T x W				T
	C_1	C_2	C_3	C_4	C_5	C_6	W_1	W_2	W_3	W_4	Mean
	14.6	21.0	17.9	11.9	16.1	12.9	15.7	15.6	15.5	15.9	15.8
	11.5	14.9	14.2	8.0	14.0	10.5	13.2	10.9	8.9	14.7	11.9
	8.7	11.3	10.3	5.9	11.0	8.4	10.4	8.0	5.7	12.5	9.1
W x C	11.6	15.7	14.1	8.6	13.7	10.9	13.1	11.5	10.0	14.4	12.3

Treatments	T x C x W											
	C_1				C_2				C_3			
	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4
T_1	14.7	14.2	14.4	14.6	21.1	20.8	20.9	21.0	17.9	17.9	17.7	18.1
T_2	13.4	9.3	8.6	14.1	15.5	15.0	11.6	18.8	14.3	12.1	9.8	16.5
T_3	11.1	4.5	3.6	12.4	13.6	12.1	8.8	16.5	10.2	9.3	8.3	12.8
W x C	13.0	9.5	8.9	13.8	15.9	16.0	13.8	18.8	14.2	13.5	12.0	15.8

Treatments	T x C x W											
	C_4				C_5				C_6			
	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4
T_1	12.0	12.0	11.7	12.1	16.1	16.0	16.0	16.3	13.2	13.0	13.0	13.2
T_2	9.1	5.8	4.3	10.4	15.4	12.3	11.3	15.8	11.1	10.3	7.7	11.6
T_3	6.8	4.2	3.5	9.4	11.5	7.9	4.9	13.8	9.0	8.2	4.8	9.7
W x C	9.3	7.4	6.5	10.8	14.3	12.1	10.7	15.3	11.1	10.5	8.5	11.5

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concentration reduced the seedling length of all the test crops but, soybean and sunflower were more susceptible than other crops. This maybe due to genotypic variation in response to higher concentration of aqueous extracts. Similar results of inhibitory effect of *Commelina* and *Cyperus* were also reported by Patterson (1981), Singh et al.(1989), Uppar et al. (1993), Parwal and Mundra (1992), Velu and Rajagopal (1996) and Beres and Kazinczi (2000).

The seedling vigour index (Table 3) in soybean (556) and sunflower (1029) was low as compared to groundnut (1002) and wheat (11442) indicating the allelopathic effect of the weeds.

Table 3. Allelopathic effect of weed species and its aqueous leaf extracts on seedling vigour index in different crop species

	T x C						T x W				T
Treatments	C_1	C_2	C_3	C_4	C_5	C_6	W_1	W_2	W_3	W_4	Mean
T_1	1396	2033	1744	1089	1465	1290	1518	1511	1511	1512	1512
T_2	992	1346	1199	369	946	984	1171	917	681	1339	1027
T_3	699	947	807	212	674	731	870	639	406	1106	755
W x C	1029	1442	1249	556	1029	1002	1186	1022	866	1319	1098

	T x C x W											
Treatments	C_1				C_2				C_3			
	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4
T_1	1411	1410	1409	1416	2068	2060	2056	2058	1746	1754	1744	1764
T_2	1222	817	715	1309	1471	1393	1054	1788	1333	1114	883	1558
T_3	929	374	257	1132	1246	1071	692	1513	959	855	745	1216
W x C	1187	867	794	1284	1595	1508	1268	1786	1346	1764	1124	1513

	T x C x W											
Treatments	C_4				C_5				C_6			
	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4	W_1	W_2	W_3	W_4
T_1	1092	1092	1089	1094	1470	1466	1457	1476	1320	1318	1314	1320
T_2	729	320	211	900	1210	905	501	1365	1061	944	720	1121
T_3	427	225	157	732	829	563	157	1128	826	748	431	912
W x C	749	546	483	909	1170	978	704	1322	1069	1003	822	1118

For comparing the means of

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Commelina and *Cyperus* significantly reduced the vigour index (866 and 1022, respectively) thus, indicating the harmful effects of *Commelina* and *Cyperus* on per cent germination and seedling length. Higher concentration of weed extract registered lower vigour index. Interaction effect indicated that higher concentration produced lower vigour index in all the crops. The increased inhibitory effect at higher concentration of weed extract may be due to increase in the concentration of allelo chemicals like phenolic acids namely, P-hydroxy benzoic acid, p-coumaric acid, caffeic acid, o-coumaric acid and ferulic acid (Dhuhan and Laxminarayana, 1995) Similar results were noticed by Singh *et al*. (1989), Uppar *et al.* (1993), Leela (1995) Wibowo *et al.* (1996) and Beres and Kazinczi (2000).

From the study it can be concluded that *Commelina* and *Cyperus* aqueous extract had greater inhibitory effect on germination, seedling length and seedling vigour index. Among the crops, groundnut and wheat were comparatively resistant to allelopathic effect of weeds and 10 per cent concentration caused more harmful effects than 5 per cent.

References

ABDUL-BAKI A. AND ANDERSON, J.D. 1973, Vigour determination in soybean seed by multiple criteria. *Crop Science*, **13**: 630-3

BERES, I. AND KAZINCZI, 2000, Allelopathic effects of shoot extracts and residues of weeds on field crops. *Allelopathy Journal*, **7** (1) : 93-98.

BRIDGES AND DAVIDE, 1992, Crop losses due to weeds in the United States. *Weed Science Society of America,* 4: 213-222

NORRIS, R.F., 1991, Sugarbeet tolerance and weed control efficency with split applications of phemedipham and desmedipham. *Weed Research*, **31**:317-331

CRAFTS, A.S. AND ROBBINS, W.W., 1973, *Weed Control*. TATA Mc Graw- Hill Publishing Company Ltd., New Delhi, pp. 10-34

JANGAURD, N.O., SCKERI, M.M. AND SCHIEFERTEIN, R.H., 1971, The role of phenolics and ascorbic acid in nutesedge tuber dormancy. *Weed Science*, **19**: 17-20

LEELA, D., 1995, Allelopathic effects of Purple nutsedge (*Cyperus rotundus* L.) tubers on growth of field crops. *Allelopathy Journal*, **2**:89-92.

NARWAL, S.S., 1994, *Allelopathy in Crop Production*. Scientific Publishers, Jodhpur, pp. 19-160.

PATTERSON, D.T., 1981, Effect of allelopathic chemicals on growth and physiological responses on soybean (*Glycine max*). *Weed Science*, **29**:53-59

PORWAL, M.K. AND MUNDRA, S.L., 1992, Allelopathic effect of aqueous extracts of *Cyperus rotundus* and *Echinocloa colunum* on germination and growth of blackgram and paddy. *Proceedings of First National Symposium on Allelopathiy in Agro-ecosystem*, Feb.12-14 Haryana Agricultural University , Hisar.

SINGH, S.P., PAL, V.R. AND LUKA, K., 1989, Allelopathy in Crop Production. *Journal of Agronomy and Crop Science*, **162**:236-240.

UPPAR, D.S., NALINI, A.S., HIREMATH, S.M. AND KAMATAR, M.Y., 1993, Allelopathic effects of weeds on germination and vigour index of wheat. *Current Research*, **22**: 47-48.

VELU, G. AND RAJAGOPAL, A., 1995, Allelopathic impact of purple nut sedge (*Cyperus rotundus*) and Bermuda grass (*Cynodon dactylon*) on soybean (*Glycine max*). *Indian Journal of Agricultural Sciences*, **66**: 363-365.

WIBOWO, D.N., TJITROSEMITO, S. AND SOEDIRMAN, I., 1996, Effect of root and shoot extracts of purple nut sedge (*Cyperus rotundus* L.) at different concentrations on root nodule formation, growth and yield of soybean (*Glycine max* (L) Merr.). *Proceedings of the Symposium on Biology and Management of Weeds and Fourth Tropical Weed Science Conference*, Bogor, Indonesia, 22-24 November 1994. BIOTROP Special Publication No. **58,** 139-147.