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MUTUAL ALLELOPATHIC EFFECTS OF MAIZE AND *TRIANTHEMA PORTULACASTURM* ON GERMINATION AND SEEDLING GROWTH

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Mutual allelopathic effects of maize and *Trianthema portulacastrum* on germination and seedling growth were investigated in the Weed Science Laboratory, University of Agriculture, Faisalabad. Results indicated that water extracts of both the plants were allelopathic to each other. Germination of *Trianthema portulacastrum* was slightly suppressed while root and shoot length was promoted by maize extract. On the contrary, germination, root and shoot length of maize were suppressed by *Trianthema* extract.

Key words: allelopathic, germination and seedling growth, maize, *Trianthema portulacastrum*

INTRODUCTION

Allelopathy is a new potential area of research due to its implications in ecosystem. Allelopathy results when living organisms produce bioactive compounds and these compounds enter the environment and produce direct or indirect effects on the growth and development of the same or other species (Seigler, 1996). These bioactive compounds are also known as allelochemicals (Whittaker and Feeney, 1971) and are phytotoxic and suspected of causing germination and growth inhibition. Based on the recent work of Weidenhamer (1996), the range of these compounds, biochemical sites and their obvious effects need to be given consideration. These compounds may be water soluble that are released through leaching, root exudation as well as through decomposition of plant residues. Different plants are reported to contain allelochemicals which influence seed germination of other plants negatively or positively i.e. they either promote or suppress each other. Associat10n of certain plants (weeds) with some crops may be due to the allelopathic phenomenon.

Guenzi and McCalla (1966) identified five phenolic acids Le. ferulic, p-coumaric, syringic, vanilic and J> hydroxybenzoic acid in .corn, wheat, sorghum and oats residues. Arshad (1995) quantitatively estimated phenolic acids as p-hydroxybenzoic, syringic, vanilic, ferulicand p-coumaric from maize, sorghum and pearl millet roots. Similarly, many weed species including *Trianthema portulacasturm* possess different allelochemicals. Hussain *et al.* (1987) reported that *Trianthema portulacastrum* contains caffeic, chlorogenic, p-hydroxybenzoic, p_ coumaric and ferulic acids which may inhibit or promote seed germination of other plants. This in view, laboratory trials were conducted with the objective to assess the mutual allelopathic effects of maize and *Trianthema portulacasturm* on their germination, root and shoot growth.

MATERIALS AND METHODS

Mature above ground herbage of maize and *Trianthema portulacastrum* was collected from agronomic research area, sun dried and chopped into 2-3 cm pieces. The chopped material was dried in an oven at 70°C for 48 hours and then ground into powder form. The powdered material was soaked in distilled water for 24 hours at room temperature (34 ± 4°C) in the ratio of 19 herbage: 20 ml water (Hussain and Gadoon, 1981).

Water extracts of both plants were filtered and diluted to prepare solutions of different concentrations (0) (Co),25% (Cl), 50% (C2), 75% (C3) and 100% (C4»). Seed germination was evaluated by placing 10 seeds on Whatman No. 42 filter paper in 9 cm diameter petri dishes. Four millilitres of the extract were added to each petri dish. Later on distilled water was added as and when required to maintain appropriate moisture. The trials were laid out in a completely randomized design with four replications. Germination count was recorded daily for a period of 10 days and root and shoot length of the seedlings was measured on lOth day. Data collected were analysed using analysis of variance technique (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Seed germination of Trianthema was promoted by 14.28% at lower concentration (25%) of maize water extract over control in both the trials while the highest concentration (100%) showed slight inhibition in 2nd trial.. Treatments of 50 and 75% maize extract indicated slight promotive effect on germination of Trianthema in 2nd trial but their effect in 1st trial was statistically equal to control. The trials demonstrated a concentration dependent response of test species to water extract. Root length of Trianthema was promoted at 75 and 100% concentration of maize water extract (Table 1),

while 25% concentration did not show a significant effect. Application of 100% maize water extract (MWE) increased root length up to 56.36% and 50.22% over control in 1st and 2nd trial, respectively. Similarly, shoot length of Trianthema was also promoted by 100% (C4) MWE followed by 75 and 50% MWE (Table 2). However, effect of Cl, was statistically equal to Co. These results are in agreement with the previous investigations of Purvis and Jessop (1985) who reported that allelochemicals of wheat crop stimulated germination and growth of *Avena sterilis* weed. These results clearly indicate that maize is an allelopathic crop which promoted growth of Trianthema possibly due to smaller quantity of allelochemicals. These results also agree with those of Cheema (1988) who reported that crops containing allelochemicals in smaller amounts usually promote growth of other plants.

Table 1. Effect of different concentrations of maize water extract on root length (cm) of *Trianthema portulacastrum*

Treatment	Trial I	Trial II	Mean
Co (Control)	2.20 cd	2.21 cd	2.21
C1 (25% MWE)	2.15 d	2.147 c	2.15
C2 (50% MWE)	2,44 c	2,43 b	2,44
Cs (75% MWE)	3.02 b	3.14 a	3.08
C4 (100 % MWE)	3.44 a	3.32 a	3.38

Any two means not sharing a letter differ significantly at 5% level of probability according to DMR test; MWE=Maize water extract.

Table 2. Effect of different concentrations of maize water extract on shoot length (cm) of *Trianthema portulacasturm*

Treatment	Trial I	Trial II	Mean
Co (Control)	1,33 c	1,34 a	1,34
Cl (25% MWE)	1,42 c	1,36 c	1,39
C2 (50% MWE)	2.09 b	2.10 b	2.10
C3 (75% MWE)	2.24 b	2.25 b	2.25
C4 (100 % MWE)	2.90 a	2.87 a	2.89

Any two means not sharing a letter differ significantly at 5% level of probability according to DMR test; MWE= Maize water extract.

Regarding the allelopathic effect of Trianthema water extract on seed germination of maize, the results showed that germination was suppressed by 100% concentration of Trianthema water extract compared to 25% concentration. However, effect of all other concentrations remained statistically equal to each other in trial I, while 100% concentration appeared to be significantly suppressive compared to 25 and 50% concentration in trial Il. This finding agrees with that of Hussain *et al.* (1987) who also found suppression of maize seed germination with higher concentration of Trianthema water extract. A significant decrease in root length of maize was also recorded in response to Trianthema water extract. Each increase in concentration caused a corresponding decrease in root length (Table 3). Suppression of maize root in response to Trianthema water extract was also reported by Hussain *et al.* (1987). Similarly, different concentrations (50, 75 and 100%) significantly decreased the shoot length of maize (Table 4).

Table 3. Effect of different concentrations of Trianthema water extract on root length (cm) of maize

Treatment	Trial I	Trial II	Mean
Co (Control)	3.83 a	3.81 a	3.82
Cl (25% TWE)	3.68 a	3.61 b	3.64
C2 (50% TWE)	3,40 b	3,47 b	3,43
Ca (75% TWE)	3.07 c	3.14 c	3.12
C4 (lOO% TWE)	2.26 d	2.25 a	2.26

Any two means not sharing a letter differ significantly at 5% level of probability according to DMR test; TWE = Trianthema water extract.

Table 4. Effect of different concentrations of *Trianthema portulacastrum* water extract on shoot length (cm) of maize

Treatment	Trial I	Trial II	Mean
Co (Control)	2.98 a	2.99 a	2.99
Cl (25% TWE)	2.86 a	2.89 ab	2.87
C2 (50% TWE)	2.36 b	2.60 b	2,48
C3 (75% TWE)	2.03 c	2.04 c	2.04
C4 (100 % TWE)	1,82 d	1,81 c	1,82

Any two means not sharing a letter differ significantly at 5% level of probability according to DMR test; TWE = Trianthema water extract.

The minimum shoot length (1,82 cm) was observed with 100% concentration. However, 25% concentration did not statistically differ from control. The results showed that Trianthema possesses different allelochemicals which could have inhibited seedling growth of maize. Perhaps allelochemicals in water of this weed inhibited cell division. Phenolics represent one of the largest groups of allelochemicals and Avers and Goodwin (1956) have shown that various phenolic compounds inhibited cell division in plants. It is also possible that cell elongation was affected by water extracts of Trianthema.

From the above discussion· it could be concluded that water extracts of maize and Trianthema possess allelopathic activity. The Trianthema water extracts generally have inhibitory effect on maize seedling, while the effect of maize water extract on Trianthema was promotive. This may be the possible reason for .common occurrence of Trianthema in maize fields.

REFERENCES

Arshad, M. 1995. Influence of tillage and fertilizer levels on wheat and weed response to the allelopathic effects of crop residues (roots). Ph.D. Thesis, Univ. Agri., Faisalabad.

Avers, C.J. and RH. Goodwin. 1956. Studies on standard root growth pattern of *Phleum pratense.* Am. J. Bot. 43: 612-620.

Cheema, Z.A. 1988. Weed control in wheat through sorghum allelochemicals. Ph.D. Thesis, Univ. Agri., Faisalabad.

Guenzi, W.D. and T.M. McCalla. 1966. Phenolic acids in oats, wheat, sorghum and corn residues and their phytotoxicity. Agron. J. 58(3): 303-304.

Hussain, F. and M.A. Gadoon,1981. . Allelopathic effects of *Sorghum vulgare* Pers. Oecologia (l3erl),51: 284-288.

Hussain, F., Yasmin and F. Rehman. 1987. *Trianthema portulacastrum* Linn. exhibits allelopathy: Advances in weed Sci. Proc. Pak-Indo Weed Control Workshop, pp. 325-334, Islamabad.

Purvis, C.E. and RS. Jessop. 1985. Biochemical regulation of wild oat germination and growth by wheat crop residues. In Proc. British Crop Prot. Conf. Weeds, 2: 661-668 (Weed Abst. 35(6): 2103, 1986).

Seigler, D.S. 1996. Chemistry and mechanisms of allelopathic interactions. Agron. J. 88: 876-885.

Steel, RG.D. and J.H. Torrie. 1984. Principles and Procedures of Statistics. McGraw Hill Book Co., Tokyo.

Weidenhamer, J.D. 1996. Distinguishing resource competition and chemical interference: Overcoming the methodological impasse. Agron J. 88: 866-875.

Whittaker, RH. And P.P. Feeney 1971. Allelochemicals: Chemical interactions between species. Science, 171: 757-770.