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Allelopathic Influence of Sunflower (*Helianthus annuus*) on Germination and Seedling Growth of Linseed (*Linum usititatissimum*)

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Abstract: Allelopathic influence of aqueous extracts of sunflower on linseed, germination and seedling growth have been evaluated. It was found that linseed's, germination, seedlings, fresh and dry weights and roots and shoots lengths were increased at 25% concentration. These parameters showed decrease with the increase in the concentrations at 50, 75 and 100% treatment. The chemical analysis also indicated that seedlings grown in 25% sunflower aqueous extract had higher protein, potassium, phosphorus and starch contents in comparison to control and at higher concentration of 50, 75 and 100%. It has been concluded that sunflower water extract exhibit stimulatory effect at lower concentration and inhibitory effect at higher concentrations.

Key words: Allelopathic influence, sunflower, linseed

Introduction

Allelopathy is the direct or indirect influence of plants on one another through the production of allelochemicals. These compounds are released by the plants through volatilization, leaching or decomposition of their residues (Rice, 1984; Muller, 1966; Menges, 1988; Qasem and Hill 1989). These substances have selective effects, depending upon their concentration, either inhibitory or stimulatory to the growth of comparison or subsequent crops or weeds (Purvis *et al.,* 1985; Cheema, 1988). It is also reported that these chemicals have harmful effects on the crop in the ecosystem, resulting in the reduction and delaying in germination and mortality of seedlings and reduction in growth and yield. Sunflower and sorghum are reported to be allelopathic in nature and their water extracts exhibited in inhibitory effects both on radical are shoot growth of wheat as well as on subsequent crops and weeds (Anderson *et al.,* 1978; Leather, 1983; Wilson and Rice, 1968; Ghaffar, 1999). Linseed or flax (*Linum usititatissimum*) has recently been recognized as a good vegetable oil seed crop containing 45-60% linolenic acid. It is grown in an area of about 5.85 thousand hectares with the total annual production of about 5.5 thousand tons which give rise to an average yield of 522 kg per hectare which is low as compared to other countries (Anonymous, 1998). One of the limitation of low yield may be the poor germination in our cropping patterns. Sunflower and linseed are the crops of same cropping system and allelopathic influence of sunflower on the germination of linseed needs to be investigated.

The aim of the present study is to evaluate the allelopathic influence of sunflower water extracts on linseed's germination, growth of seedlings and their quality when grown in laboratory conditions.

Materials and Methods

Mature plants SF-187 sunflower variety were collected from experimental fields of University of Agriculture, Faisalabad. They were dried and ground and stored at room temperature. Healthy seeds of Chandani linseed variety were obtained from Oilseed Section, AARI, Faisalabad.

Preparation of Sunflower water extracts: The ground plant material was dissolved in distilled water in the ratio of 1:20, stored for 24 hours and the filtrate was designated as stock solution of 100% concentration other concentrations of 25, 50 and 75% were made by diluting the stock solution with distilled water and the control contained only distilled water (Hussain and Gadoon, 1981).

Linseed's Germination and Seedlings Growth: Ten seeds of linseed variety were grown in petridishes of 9 cm diameter replicated four times in completely randomized design. Whattman #42 filter paper was used as medium of germination. In total, 4 cm^3 of solution was applied, half (2 cm^3) of which was used as moisture for filter paper receiving seeds in the dishes and remaining half was applied to the covering filter paper. The control treatment received 4 cm^3 of distilled water in the same fashion. Both control and treated petri dishes were kept moist by applying distilled water whenever needed. The dishes were kept at $22^{\circ}C \pm 2$ for seed germination in the laboratory and germination counts were recorded daily for a period of ten days. Root and shoot lengths in cm and fresh and dry weights in gms were also recorded (Hussain and Gadoon, 1981).

Seedling quality: Quality parameters like starch, protein, K, P and Ash were determined following A.O.A.C. methods (AOAC, 1994).

Statistical Analysis: CRD (completely randomized design) was used to analyze the data and compared the concentration ratios regression effect of germination on time was studied by fitting regression lines (Steel and Torrie, 1992).

Results and Discussion

The germination of Chandani linseed variety have been influenced by SF-187 sunflower water extracts as shown in Fig. 1 significant differences can be noted among the treatments. Maximum germination was observed in 25% treatment which was 85% and showed 21% increase in germination as compared to the control. The germination was 82 and 72.5% in the 50 and 75% sunflower extracts showing 17 and 3.5% increase in seed germination as compared to the control. The germination was depressed by 39% in 100% concentration as compared to the control treatment. The linseed, germination in 100% sunflower extract have been found to be only 42.5% which is low as compared to 70% in the control. It is concluded that allelopathic activity in the s unflower water extract is

Table 1: Chemical composition of ten days old linseed seedling treated with sunflower water extract (SWE)

Treatment	Protein (%)	Starch (%)	Phosphorus (%)	Potassium (%)	Ash (%)
0%	*0.23	65.0	0.95	1.50	3.0
25%	2.20	68.0	0.53	2.09	5.0
50%	2.01	67.0	1.21	2.09	5.5
75%	1.50	64.4	1.18	1.99	6.0
100%	0.12	64.0	1.23	0.75	4.0

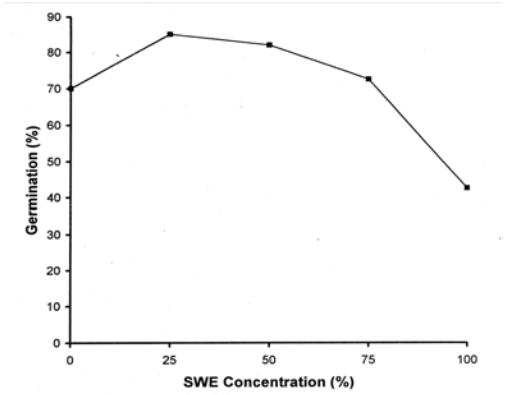

Fig. 1: Effect of various concentrations of sunflower water extract on germination of linseed seedlings

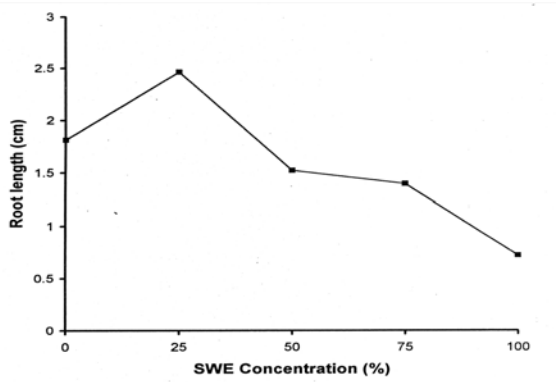

Fig. 2: Effect of various concentrations of sunflower water extract on root length of linseed seedlings (Ten days old)

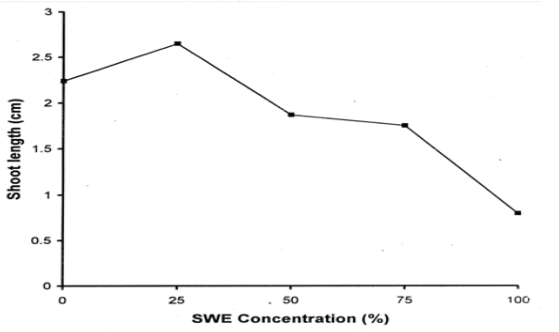

Fig. 3: Effect of various concentrations of sunflower water extract on shoot length of linseed seedling (Ten days old)

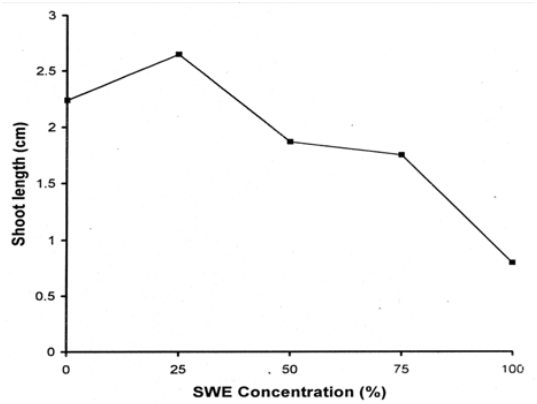

Fig. 4: Effect of various concentrations of sunflower water extract on fresh weight of linseed seedlings (Ten days old)

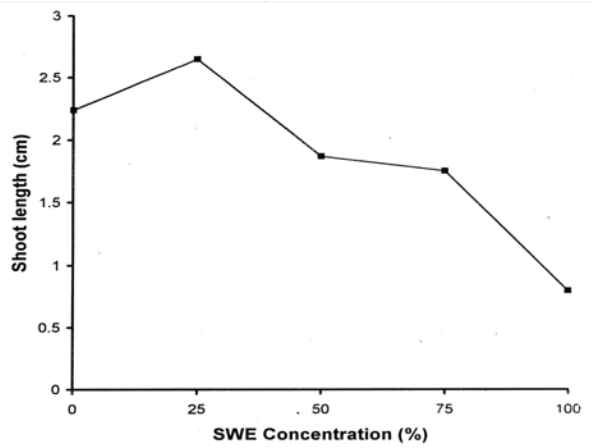

Fig. 5: Effect of various concentrations os sunflower water extract on dry weight of linseed seedlings (Ten days old)

attributed to the presence of allelochemicals already reported (Guenzi and McCalla, 1966; Hussain and Gadoon, 1981; Rice, 1984).

The effect of sunflower water extract on linseed's root length have been presented in Fig. 2. It can be seen that except 25% concentration all other treatment showed inhibitory effected and significant difference among the treatments. 25% concentration showed 35% increase in root length as compared to the control. Whereas 50, 75 and 100% concentration decreased the root length by 16, 32 and 60% respectively in comparison to the control. The minimum root length (0.7232 cm) was found in 100% concentration SWE treatment in comparison to the control (1.81 cm). 25% SWE showed the enhancing effect on linseed root length while other concentrations showed inhibitory effect. These studies are in confirmatory to the work of Anderson *et al*. (1978) who reported that sunflower plant significantly inhibit both radical and shoot length of wheat and this may be due to the presence of allelochemicals which in smaller quantity showed stimulatory effect and in greater quantities exert negative or inhibitory effects.

In Fig. 3, Sunflower water extracts have significantly

influenced linseed's shoot length and the trend was found similar to the root length and also support the findings of Anderson *et al.* (1978) and Tongma *et al.* (1998). The maximum average shoot length in 25% SWE treatment was 2.65 cm, showing 18.33% increase in shoot length as compared to the control (2.24 cm). The decrease in shoot length observed was 16, 21 and 64% in 50, 75 and 100% respectively in comparison to the control (Fig. 3). In Fig. 4 describes the effect of different SWE treatments on linseed's seedlings fresh weight. The data revealed that all treatments have influenced the fresh weight but difference among the treatments was non-significant. The maximum fresh weight was observed in 25% SWE treatment which showed 16.27% increase in the fresh weight as compared to the control. The fresh weight exhibited a corresponding decrease at 50, 75 and 100% concentrations indicating the presence of allelopathic activity in SWE confirming the findings of Guenzi and McCalla (1966).

The results pertaining to dry weight of linseed's seedlings have been illustrated in Fig. 5 and revealed non significant differences amongst treatments. There was a slight increase in dry weight in 25, 50 and 75% concentrations treatments and a fall at 100% treatment in comparison to the control.

The influence of various concentrations of SWE on seedling quality parameters have been reported in Table 1. The %age of protein contents increased form 25-75% concentration as compared to control. Decrease in protein contents have been obtained in 100% concentration of SWE. The protein contents were 2.2, 2.01 and 1.50% in 25, 50 and 75 SWE treatments respectively.

The control and 100% treatment showed 0.23 and 0.12% protein. The increase or decrease in the protein contents is due to the activity of Allelochemicals. These findings are in close confirmatory to the studies reported earlier, in which minimum and maximum protein were 1.6 and 2.3% in peas (Stoddard *et al.*, 1993). It is also reported in Table 1 that potassium contents increased from 25 to 75% concentrations as compared to control, while 100% showed a decrease in potassium content. A similar trend was observed in linseeds germination studies and increase or decrease in potassium contents is probably due to the presence of allelochemicals in sunflower plant (Pirog, 1993).

The chemicals analysis of linseed's seedlings indicated that amount of phosphorus contents increased in 50, 75 and 100% treatment showing 1.23, 1.18, 1.21% respectively (Table 1). The phosphorus contents in 25% treatment was found to be 0.53% in comparison to the control treatment which showed 0.95% P-content. These variations in the phosphorus contents are attributed to the influence of Allelochemicals in SWE treatments and support the findings of Alsaadawi *et al*. (1985).

The results pertaining to ash contents of linseed's seedling under the influence of SWE treatments have been described in Table 1. The 25, 50, 75% SWE treatment showed 6, 5 and 5.5% ash contents respectively. The amount of ash contents in 25% SWE treatment was found more than control and 50 and 75% SWE treatments but 100% treatment showed 4% ash contents which was lesser than the control and these variations can be because of the stimulatory or inhibitory effects of the allelochemiclas present in SWE treatments. The chemicals analysis for starch as indicated in Table 1 showed that the starch contents at 25, 50, 75 and 100% concentrations were 68, 67, 64.4 and 64% respectively as compared to 65% obtained in the control. It can be concluded that sunflower water extracts of 25 and 50% concentration had shown stimulatory effect on starch contents where as 75 and 100% concentrations showed more or less the same effect as that of control. These effects on the starch contents can be attributed to the allelochemicals interactions at different levels.

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