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INTERACTIVE ACTIVITY OF *ASPHODELUS TENUIFOLIUS* ON GERMINATION AND GROWTH OF WHEAT (*TRITICUM AESTIVIUM* L.) AND SORGHUM (*SORGHUM BICOLOR* L.)

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Abstract

The allelopathic interactions of weed specie *(Asphodelus tenuifolius* Cavase) were investigated using two test crop i.e. wheat (*Triticum aestivum* L.) and *sorghum* (*Sorghum bicolor* L.) in a greenhouse experiment. The growth of *A. tenuifolius* (Weed) was suppressed by *Sorghum bicolor*, which acted as an allelopathic crop. By contrast, in second test crop i.e., *Triticum aestivum*, the germination and growth were suppressed by *Asphodelus tenuifolius.* The possible mechanisms of allelopathic effects were discussed.

Introduction

The science of allelopathy, introduced by Molish in 1937, is mainly concerned with the inhibitory as well as the stimulatory biochemical interactions between plant species including fungi and bacteria. A great deal of allelopathic research has been conducted in various fields of agricultural and biological sciences. Hence, International Allelopathy Society in 1996 broadened the definition of allelopathy to include any processes involving secondary metabolites produced by plants, micro-organisms, viruses and fungi that influence the growth and development of agricultural and biological systems. (Anon., 1996). In future, worldwide, there would be increasing demands for better quality and quantity of food due to rapid increase in human population. Therefore, for sustainability of agriculture, we need to minimize the use of present pesticides (such as weedicides, insecticides, nematicides, fungicides etc), to control various pests, weeds, insects, nematodes, and fungal pathogens in field crops, through the use of allelopathic strategies for pest management (Grainge & Ahmed, 1988; Heisey, 1990).

One of the most studied aspects of allelopathy has the role of allelopethy in agriculture. Current research is focused on the effects of weeds on crops and crops on weeds. This research sees the potential of allelochemicals as growth regulators and natural herbicides to promote sustainable agriculture. A number of such allelochemicals are commercially available or in the process of large scale manufacture. The weed control is the basic requirement and the major component of management in the production system (Norris, 1982; Young *et al.*, 1996). The control of weeds in agriculture is an immense problem. Weeds consume the soil nutrients, available moisture, and compete for space and sunlight with crop plants, thereby causing yield reduction of crops. In addition, weeds decrease the quality and quantity of farm produce and consequently reduce their market value (Hanif *et al*., 2004; Pervaiz & Quazi, 1999).

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The uses of herbicides or synthetic chemicals are usually not environmental friendly. Persistence of herbicides in soil and their residual toxicity in plants resulted in adverse activity with regard to non-target species and development of resistance to weeds. These are some of the problems associated with the application of herbicides. Attempts have been made to use the allelopathic plants for the discovery of new organic compounds with their novel mode of actions that have tremendous herbicidal potential. Thus, certain allelochemicals present in allelopathic plants can be employed as pesticide (Grainge & Ahmed, 1988; Yang & Tang, 1988). For example, pyrethoids derived from a number of family Asteraceae have provided a model for insecticide production from allelopathic plants (Davis *et al.*, 1988).

Weeds are those plants which vigorously interfere with the human activity in crop and non-crop areas (Anon., 1994). In weed research, one of the main purposes of studies on allelopathy is to gain insight into the mechanisms of weed/crop interactions and to utilize such information for improving the weed management strategies (Purvis, 1990).

Current research has been focused on the effects of weed on crops, and crops on weed with respect to germination and growth of the test plants. In this paper, we will illustrate the procedure using two crop plants and a weed of agricultural ecosystem that possesses allelopathic potential.

Asphodelus tenuifolius Cavase (Onion weed) is a native to the Mediterranean region, but it is widespread, extending from Mediterranean region east through the Arabian Peninsula to the Indian Subcontinent, also in Malaysia, Australia, Chile New Zealand, Mexico and United States of America.(Nasir & Ali,1980-1989).

A very variable species, whose several forms have been given various specific names. It is a weed of cultivated fields, especially during winter in wheat, mustard gram and tobacco. In Pakistan, it is a troublesome weed in wheat fields, particularly in Punjab and Sindh.

Triticum aestivum L. (common bread wheat) is widely cultivated in the country. In Pakistan, spring wheat is grown as Rabi Crop (winter crop) in the Sindh, Punjab, NWFP and Balochistan provinces. Some winter wheat is cultivated on small scale. The wheat growing area was 8.37 million hectares and production was 18.90 million tons in 2008-09. The major production area is (71.17%) in Punjab followed by in (13.38%) Sindh Province. (Anon., 2009).

Sorghum bicolor (L.) Moench (grain *Sorghum*) is one of the most extensively cultivated cereals in the world, after rice, wheat and maize and particularly in arid to semi arid regions. In Asia, *Sorghum* is restricted almost exclusively to two countries, China and India. It is also grown in Pakistan as a rain fed crop. *Sorghum* is also emerging as a feed stock for ethanol production.

Materials and Methods

Experiment 1: The experiment to study the interaction between wheat crop (*Triticum aestivum* L.) and the weed species *Asphodelus tenuifolius* was carried out in the green house of Federal Urdu University of Arts, Science and Technology, Karachi. There were only two treatments one was wheat in monoculture (control) and the other was combined culture in which wheat and *Asphodelus* were grown together side by side. Before sowing, the seeds of wheat were sterilized with Sodium hypochlorite for one minute and then rinsed thoroughly with distilled water several times. After sterilization 10 healthy wheat seeds were sown in between the two weeks old plants of *Asphodelus* with five replications. The ten seeds of wheat were also sown alone in pots that served as control (monoculture). Germinating seeds of both species were counted daily in each treatment.

The numbers of germinating seeds were counted daily till the completion of germination period. Speed of germination "S" was also calculated following Khandar & Bradbear formula (1983).

$$S = [N1/1+N2/2+N3/3 \ldots\ldots\ldots Nn/n] \times 100/1$$

where N1, N2, N3. . . . Nn are proportion of seeds, which germinated on day 1, 2, 3 . . . n following setup of the experiment. S varies from 100 (if all seeds were germinated on the first day following setup) to 0 (if no seeds were germinated by the end of experiment). This has advantage over percent germination, because it is usually more sensitive and indicates allelopathy (Wardle *et al.,* 1991).

Experiment 2: In this experiment similar method was used as in experiment 1 but in this experiment the test crop was *Sorghum bicolor* instead of wheat crop.

Statistical analysis: The data collected for germination percentage, speed of germinations and growth of plants (plant height) were subjected to analysis of variance (ANOVA) with repeated measures design. In this design, Wilks'Lambda, Pillar's Trace, Hotelling-Lawlely Trace & Roy's Greatest Root was available. In the vast majority of cases, the observed significant levels for these statistics will be the same. However the Repeated Measures Design (Wilks'Lambda,Pillar's Trace) was performed using Statistical Analysis Software Predictive (SPSS) Version 7.0, Nie *et al*., (2009).

Results and Discussion

Wheat (*Triticum aestivium* L.): In both treatments, the monoculture (wheat) and in combined culture the final germination percentages did not differ significantly (Table 1), but germination speed (S) of wheat was markedly high when grown in the mixture as compared to monoculture of wheat.

The greatest plant height of wheat seedling was recorded in (wheat) monoculture Fig. 1, while the reduction of wheat plant height was observed in the combined culture as compared to monoculture of wheat as shown in Fig. 1. Only in the first week of growth all treatments were significantly different from each other (Fig. 1). In mono and combined culture, wheat plant did not show significant differences from 2^{nd} to 4^{th} week of observations. However, in *Asphodelus* in combined culture, significant growth was recorded from 2^{nd} to 4^{th} weeks (Fig. 2).

Statistical analysis by Gerneral Linear Model (GLM) with Repeated Measures Design showed highly significant differences among treatments for plant height of eight weeks growth *i.e*. 68.263 ($P<0.001$). It was suggested that the reduction of growth in wheat may be due to the allelopathic effects of weed present in the growth medium.

***Sorghum* (*Sorghum bicolor* L.):** Final germination of *Sorghum* was 100% in both monoculture and combined culture (Table 2) therefore the treatment and control was non-significant effect on germination of *Asphodelus.* However, the speed of germination was high in combined culture (55.66) as compared to monoculture (43.66).

Table 1. Interaction between *Triticum aestivum* and *Asphodelus tenuifolius*.

Treatments	Final germination (%)	Speed of germination index "S"
Monoculture (control wheat)	94	35.33
Combined culture wheat + *Asphodelus tenuifolius*	94	55.33

Table 2. Interaction between *Sorghum bicolor* and *Asphodelus tenuifolius*.

Treatments	Final germination (%)	Speed of germination index "S"
Sorghum (control)	100 ± 0	43.66
Combined culture *Sorghum* + *Asphodelus tenuifolius*	100 ± 0	55.66

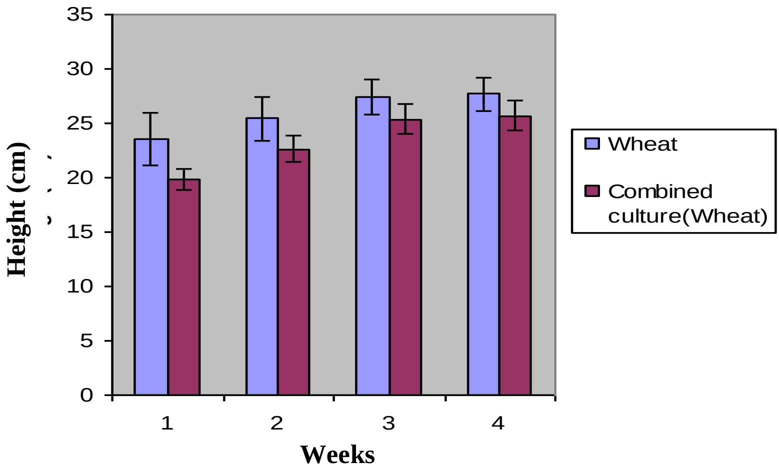

Fig. 1. Growth of Wheat in monoculture and in combination with *Asphodelus tenuifolius*.

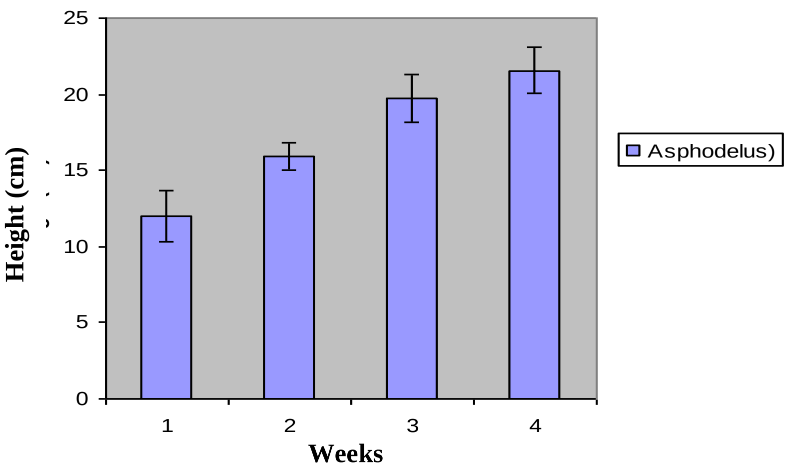

Fig. 2. Growth of *Asphodelus tenuifolius* in combined culture.

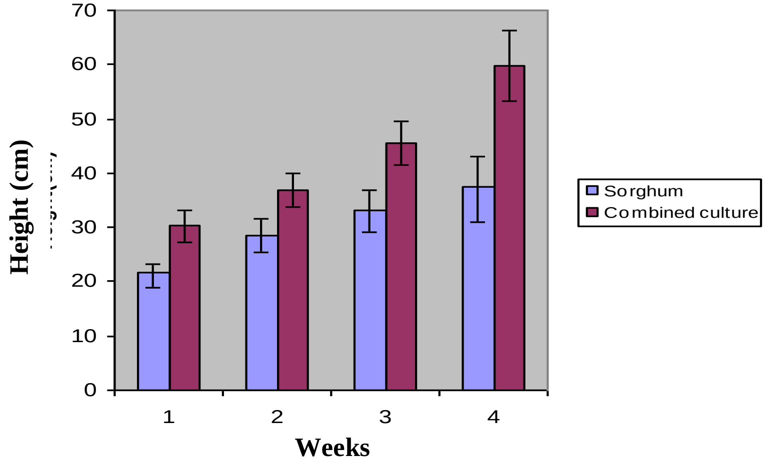

Fig. 3. Growth of Sorghum in monoculture and in combination with *Asphodelus tenuifolius*.

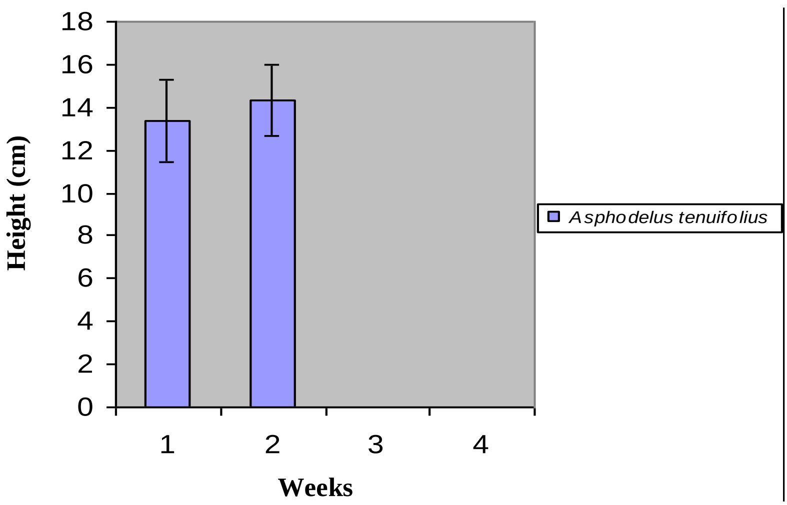

Fig. 4. Growth of *Asphodelus tenuifolius* in combined culture.

The height (growth) of *Sorghum* alone and in combined culture increased steadily over the four week period. However, in the combined culture *Sorghum* showed greater height in as compared to monoculture (Fig. 3). From 3rd and 4th week *Asphodelus* growth was gradually eliminated by *Sorghum* in the combined culture (Fig. 4).

Statistical analysis by Repeated Measures Design showed significant differences among treatments for plant height in four weeks growth (F=57.0, p<0.001). *Sorghum* was considered to be a strong allelopathic agent against many weeds (Einhellig & Rasmussen, 1989). During present study, *Sorghum* was also found to depress the growth of *Asphodelus* weed considerably.

Above trial showed that weed *Asphodelus tenuifolius* has allelopathic effect on wheat (*Triticum aestivium* L.).However, this weed was enable to suppress *Sorghun*, in contrast

Sorghum has strong allelopathic effect on *Asphodelus.* Therefore, it could be suggested that for the management and control of this particular weed in wheat cultivation, *Sorghum* could be used as a biological controlling agent. *Sorghum* allelopathic properties have been successfully used in suppressing several weeds growth in crops such as wheat, maize and soybean with minimum cost (Ahmed, 1998; Cheema *et al.,* 2002*;* Khaliq *et al.*, 1999). Similar work has been done by Hussain *et al.*, (2007) where he has suggested that *Senna occidentalis* can be successfully used in the control of weed management particularly for the control of *Avena fatua* in the cultivation of wheat.

Further studies are needed to isolate and identify the active compounds from *Asphodelus tenuifolius* and *Sorghum bicolor* that can be exploited for weed management. Allelopathic plants whether weeds or crops are being screened for the ability to reduce possible weed density in agricultural fields and forests. Present study give additional support to this weed management plan rather than using synthetic environmentally hazardous chemicals and biological controlling agent should be used in our agriculture crop growing system.

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