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POSSIBLE ALLELOPATHIC EFFECTS OF THREE DIFFERENT WEEDS ON GERMINATION AND GROWTH OF MAIZE (*ZEA MAYS*) CULTIVARS

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Abstract

The experiment was designed to determine the allelopathic effects of three different weeds *viz.,* Onion weed (*Asphodelus tenuifolius* Cavase), pill-bearing spurge/Asthma plant (*Euphorbia hirta* Linn) and Fumitory *(Fumaria indica* Haussk H.N.) on the growth of maize. The weed powders toxicity and their inhibitory effects on germination and growth of maize crop were observed. It was demonstrated that different weed species responded differently to the maize. It was observed that the *Asphodelus tenuifolius* and *Fumaria indica* inhibited % germination and germination index of maize. The growth parameters of maize did not show consistent effects by these weeds. During the present study, allelopathic effects were not revealed and more experiments are suggested before making any conclusion about the allelopathic characteristic considering these weed species.

Introduction

Allelopathy is a mechanism in which chemicals produced by weed plants may increase or decrease the associated plant growth. Molish (1937), coined the term "allelopathy" as an interaction among the plants and the microorganisms. Rice (1984), defined allelopathy as the effects of one plant (including microorganisms) on another plant via the release of chemicals into the environments.

Allelopathy is an interference mechanism, in which live or dead plant materials release chemical substances, which inhibit or stimulate the associated plant growth (Harper, 1977; May & Ash, 1990). Allelopathy, may also play an eminent role in the intraspecific and interspecific competition and may determine the type of interspecific association. The plant may exhibit inhibitory or rarely stimulatory effects on germination and growth of other plants in the immediate vicinity.

Several workers have shown that allelopathy plays an important part in weed and weed interaction (Wilson & Rice, 1968; Rasmussen & Rice, 1971; Newman & Rovira, 1975; Tajuddin *et al*., 2002) and weed crop interaction (Colton & Einhellig, 1980).

Pakistan development is largely based on agriculture, which contributed about 25% to the national economy, provides employment for over 50% of the labour force and is main source of income generation in rural areas. During the last four years (2004-2008), the average annual growth in agriculture sector has been frustrating due to low production of the main crops. The main factors which contribute the low yield of crops include less water for irrigation, high cost of inputs, poor quality seed, conventional sowing methods low level of farm mechanization, unavailability of fertilizers and the poor weed management practices.

Maize is the third important cereal after wheat and rice in Pakistan, while it ranks third of the most growing crop in the world with an area of more than 365 million acres

with an annual production of about 750 million metric tons (Anon., 2008). Asia grows 30% of the global area in acres with China itself growing 74 million area plus significant in India 24 million, Indonesia 12.5 million, Philippines 9.5 million and Thailand 6.5 million. In Pakistan the area under maize is over 2.4 million acres with production of 3.25 million metric tons. Punjab and NWFP contribute 40% and 58% of the total area under maize, respectively, while around 2% of the total area under maize is contributed by Sindh & Balochistan, 30% of total production is contributed by Punjab, while 60% by NWFP. Maize is also an important crop for Azad Jammu and Kashmir with about 0.25 million acres of maize being planted (Anon., 2008).

Like elsewhere in Pakistan, weeds pose a serious problem in crop production. Because of lack of education and financial resources, the smaller farmers cannot afford to remove them from their fields. Weeds growing among crop plants adversely affect yield and quality of the harvest and increase production costs, resulting in high economic losses (Alam, 1991). Weeds are undesirable plants. Plants which interfere human activity in crop and non-crop areas are considered as weed (Anon., 1994). They compete with the main crops for nutrients and other resources and hamper the healthy growth ultimately, reducing the yield both qualitatively and quantitatively.

Loses caused by weeds are well documented in many studies (King, 1966; Reeves, 1976). Roberts & Chancellor (1980), Sen *et al*., (1984) mentioned that the weeds caused more loss to agriculture than all pests, put together. Understanding the nature of weeds, it is necessary in order to learn how to reduce their effects on agricultural crops.

The purpose of this study was to determine the possible allelopathic effects of commonly distributed weeds in the agricultural fields of the country (*Asphodelus tenuifolius, Euphorbia hirta* and *Fumaria indica)* on germination and growth of (*Zea mays)* maize.

Salient features of the weeds used

1. Onion weeds (*Asphodelus tenuifolius* Cavase): In English it is called Onion weeds/wild onion and locally known as paizi and basri.It is an annual herb and commonly found in wheat, tobacco, mustard and gram during winter season. As a medicinal plant, it is used externally to cure ulcer and inflamed parts (yunani) and seed is used as diuretic.

2. Pill-bearing spurge/Asthma plant (*Euphorbia hirta* Linn.): Common name is hazardani while in English called pill-bearing spurge or asthma Plant. Commonly found in waste places, roadsides, garden, in open grassland, shady poplar forest, on river, banks, in cultivated fields and abandoned cultivations. It also associated with soyabean, mung bean maize and rice fields through out the hotter parts of Pakistan. Powder of fruit is useful for diarrhoea and haemorrhoids. Fermented liquor prepared from the fruit is used in jaundice and cough.

3. Fumitory (*Fumaria indica* Haussk H.N.): Local name is shahtarah or shahtarah pit para and English name is Fumitory. It is an annual herb and grows in winter season as weed in various crops like in wheat, mustard and gram. The plant is a purgative tonic; alter active astergent, sedative, depurative and laxative. The drug is used in the treatment of low fever, skin diseases and as blood purifier.

Materials and Methods

Plants of these three fresh weeds were collected from Karachi, Hub and Dadu agricultural fields in the province of Sindh.Washed several time with water and dried in an open air and sun light. All the samples were ground in Wiley Mill. These powders were stored in plastic bottles at room temperature.

These weed powders were weighed out separately in the quantity of 10, 25, 50 and 100g. For each weed species five replicates and five treatment including control were used. The powder of each weed with above quantity was mixed thoroughly with 500g soil separately and sufficient quantity of water was added to all the plastic bags and kept for one week in the glass house to develop any possible microbial activity. The sufficient quantity of the healthy seeds of maize were sterilized with 3 percent sodium hypochlorite solution and then thoroughly washed with water several times.

Ten healthy seeds of maize were sown (field sowing density) to all the treated (control, 10, 25, 50 and 100g) plastic bags. Each treatment was replicated five times and kept in randomized complete design. The numbers of seeds germination were counted daily till completion of germination, which were completed in eighteen days. Percentage germination and speed of germination index "S" were calculated following Khandakar and Brad bear (1983).

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

where N1, N2, N3……Nn, proportion of seeds which germinated on day 1, 2, 3 ...n following set up of the experiment. S varies from 100 (if all seeds germinated on the first day following set up) to 0 (if no seeds have germinated by the end of experiment). This has advantage over per cent germination, because it is usually more sensitive "S" indicator of alllelopathic (Wardle *et al.,* 1991).

To assess the growth of maize plant, the plants were thinned and only three healthy plants were kept in each bag. After one month, the plants were harvested for fresh weights of shoots and roots. They were then kept in paper bags and tagged properly and air-dried for two weeks for taking the dry weigh of shoots and roots. Mean of each parameter was calculated.

Results and Discussion

Effect of these weed powders on germination percentage, speed of germination, fresh weight and dry weight of maize were recorded and summarized (Tables 1, 2 and 3). Results of each weed species are discussed separately.

***Asphodelus tenuifolius* Cavase:** Table 1 showed that the weed powder of *A. tenuifolius* with treatment-2 (25g) negatively affected percentage germination *i.e.*, (-69.69%). Where it was markedly reduced as compared to control. This showed that weed powder in the soil contains some inhibiting chemicals resulting in the reduced germination of maize. It was observed that the speed of germination index was extremely low (2.68) as compared to control in treatment-2. According to Rice (1984), plants are known to exhibit allelopathy by releasing water soluble phytoxins from leaves, stem, roots fruits and seeds and such metabolites play an inhibitory role in delay or complete inhibition of seed germination, stunted growth and injury to root systems of plants.

Effect of different concentrations of three weeds powder on growth of maize (Zea *mays)* plants

Table 1. Effect of *Asphodelius tenuifolius* powder on maize growth.

Treatments *A. tenuifolius	Germination (%) after 18 days	Speed of germination index (S)	Fresh shoot weight (g)	Dry shoot weight (g)	Fresh root weight (g)	Dry root weight (g)
Control = To (no weed powder)	66 (-)	22.09	5.64 (-)	1.46 (-)	3.46 (-)	1.10 (-)
T1 (10g)	24 (-63.63)	9.2	8.05 (+42.73)	2.49 (+70.54)	7.13 (+106.06)	1.15 (+4.54)
T2 (25g)	20 (-69.69)	2.68	10.03 (+77.83)	1.92 (+31.50)	5.82 (+68.20)	1.52 (+38.18)
T3 (50)	24 (-63.63)	3.17	7.52 (+33.33)	1.33 (-8.90)	4.27 (+23.41)	1.25 (+13.63)
T4 (100)	26 (-60.60)	5.15	5.20 (+7.80)	1.09 (-25.34)	1.88 (-45.66)	0.44 (-60)

Table 2. Effect of *Euphorbia hirta* powder on maize growth.

Treatments *E. hirta	Germination (%) after 18 days	Speed of germination index (S)	Fresh shoot weight (g)	Dry shoot weight (g)	Fresh root weight (g)	Dry root weight (g)
Control = To (no weed powder)	52 (-)	14.22	5.49 (-)	1.30 (-)	3.26 (-)`	1.00 (-)
T1 (10g)	46 (-11.53)	21.64	4.57 (-16.75)	1.12 (-13.84)	1.80 (-44.78)	.66 (-34)
T2 (25g)	54 (+3.84)	29.27	6.16 (+12.20)	1.37 (+5.38)	2.06 (-36.80)	0.59 (-41)
T3 (50)	66 (+26.92)	26.35	8.77 (+59.74)	1.89 (+45.38)	2.83 (+13.19)	0.78 (-22)
T4 (100)	50 (-3.84)	13.79	Dead	Dead	Dead	Dead

Table 3. Effect of *Fumaria indica* powder on maize growth.

Treatments *F. indica	Germination (%) after 18 days	Speed of germination index (S)	Fresh shoot weight (g)	Dry shoot weight (g)	Fresh root weight (g)	Dry root weight (g)
Control = To (no weed powder)	46 (-)	17.49	4.77 (-)	1.21 (-)	4.46 (-)	1.21 (-)
T1 (10g)	12 (-73.91)	3.32	14.38 (+201.46)	3.01 (+148.76)	15.36 (+244.39)	2.49 (+105.78)
T2 (25g)	16 (-65.21)	5.75	6.37 (+33.54)	0.93 (-23.14)	7.00 (+56.95)	1.27 (+4.95)
T3 (50)	N.G	N.G	N.G	N.G	N.G	N.G
T4 (100)	20 (-56.52)	3.95	9.14 (+91.61)	1.82 (+50.41)	11.11 (+149.10)	3.26 (+169.42)

Legend as for tables 1, 2 and 3

*Powder of *A. tenuifolius*, *E. hirta* and *F. indica;* N.G = not germinated

The figures in the parentheses indicate percent increase (+) or decrease (-) over control.

All other treatments showed comparable responses except the treatment 4(100g) for the test specie (maize). In treatment-4, both fresh and dry weight of roots (*i.e*., -45.66 and -60g respectively) were significantly decreased compared to control. The dry matter of root was more drastic inhibited or reduced by treatment-4. Leather & Einhellig (1985), considered dry weight of crop to be a better indicator of injury due to presence of weed. Fig. 1 also showed that weed powder inhibited maize growth. On the basis of this trial, it may be concluded that this weed species considerably depressed percent germination and speed of growth of maize, while fresh and dry weight of plants were affected only at higher concentration of used weed material in soil.

***Euphorbia hirta* Linn.:** Effects of this weed powder on percent of germination, speed of germination, fresh and dry weights of shoots and roots of maize are shown in Table 2. The minimum -11.53% reduction for germination was observed in treatment-1(with 10g weed plant material). This may presumably be due to the release of phytotoxins from the decaying material that remains active and stable for considerable duration in soil (Shaukat *et al.*, 1985; Burhan & Shaukat, 1999) they also found adverse effects on the growth of millet plants by decaying *Citrullus colocynthis* and inhibitory effects of *Argemone maxicana*, respectively. Speed of germination was slightly affected in treatment-4 as compared to control.

It was found that in treatment-4 (soil containing 100g weed powder), that plant growth completely inhibited after 8 weeks (Fig. 2). There was a detectable impact on the growth by the weed explained according to Shaukat & Siddiqui (2001) inhibitory compounds in soil cause marked reduction or stop growth of plant. Present trial also showed the same effect.

In many of the individual treatments, fresh and dry weights of shoots were higher (Table 2). In treatment three, 59.74 and 45.38 grams, respectively. Rice (1986) reported that these stimulatory effects were likely to emerge either from growth promoting compounds in the tissues themselves or enhanced microbial activity and concomitant nutrient availability. Therefore, it seems that in low quantity the decomposing material of this weed; promote growth while at high quantity it was toxic to the maize, growth.

***Fumaria indica* Haussk H.N.:** Table 3 indicated the percentage germination, speed of germination, fresh and dry weight of shoots and roots in the absence and in the presence of weed in soil. Percent germination and speed of germination index was markedly inhibited in treatment-1 (-73.91% and speed was 3.32) as compared to control.

In treatment-1 (10g), fresh weight of shoot and root increased considerably (201.46g and 244.39g) over the control (Fig. 2). Rice (1984) has studied that these stimulatory effects may be due to growth enhancing chemicals released. Wilson & Rice (1968) have reported both stimulatory and inhibitory effects on various crop species with decaying materials. In the present study, the dry weight of shoots in treatment-2 seemed be more sensitive, while in other treatments, it did not show any clear effects.

The result of this study has indicated that these three weed species inhibited the seed germination, while *A. tenuifolius* and *F. indica* depressed seed germination and speed of germination index of maize. As a plant growth was concerned, these weeds have no consistant inhibitory or stimulatory effects on maize. Therefore, conclusion could be made to characterize these weeds under allelopathic weeds and more detailed investigation is required to obtain scientific knowledge about these weeds and their specific role in different crops.

Fig. 1. Effect of *Asphodelus temifolius* powder on growth.

Fig. 2. Effect of *Euphorbia hirta* powder on growth.

Fig. 3. Effect of *Fumaria indica* powder on growth.

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