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# Allelopathic Effects of Wheat (*Triticum aestivum* L.) Straw on Germination and Seedling Growth of Two Weed Species and Cotton

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*ABSTRACT*

Allelopathic potential of wheat straw aqueous extract was evaluated in laboratory and wirehouse experiments. The effect was tested for germination and growth response of *Convolvulus arvensis* and *Dactyloctenium aegyptium* and cotton *Gossypium hirsutum* L. with different extract concentrations (v/v) control, 25% v/v, 50% v/v, 75% v/v and 100% v/v. Wheat straw aqueous extract showed some inhibitory effect on the germination of cotton, however shoot and root development was stimulated with moderately diluted extract in root, lab. and pot experiments. Germination and growth of *C. arvensis* was significantly inhibited with all extract concentrations. Wheat straw aqueous extract reduced the germination of *D. aegyptium*, whereas its growth remained unaffected.

*INTRODUCTION*

Cotton (*Gossypium hirsutum* L.) occupies a pivotal position in Pakistan's economy. It fetches 1114 million US$ (38.15% of total exports) through the export of raw and finished products (Anonymous, 1986). Fine fibre and better staple length of Pakistan cotton meets the international standards but the average yield (521 kg ha$^{-1}$) is too low as compared to leading cotton growing countries like Australia (1069 kg ha$^{-1}$), Egypt (875 kg ha$^{-1}$), USSR (703 kg ha$^{-1}$), USA (639 kg ha$^{-1}$) (Anonymous, 1988). Low per hectare yield of cotton besides many other factors may be attributed to serious weed infestation. Weeds compete with crops for nutrients, water, light etc., causing considerable losses, ranging from 16-30% and even more (Zimdahl, 1980). Introduction of the chemical weed control technology, however, has been reported to be economical and efficient but frequent use of herbicides may induce weed resistance against herbicides and may enhance herbicide biodegradation in the soil resulting in reduced herbicidal effectiveness (Lebaron, 1986; Skipper *et al.* 1986). The hazards of pollution from the excessive use of pesticides have also been reported and are well known (Dommergues, 1981). It is imperative to search for alternate methods for the control of weeds.

Allelopathy is emerging as a new science which may prove to be a unique organic source of weed control. Allelochemicals are reported to be present in many crop plants such as wheat (Almeida, 1985), barley (Norman and Davies, 1980), sorghum (Purvis *et al.* 1985) and sunflower (Paris *et al.* 1985). It was therefore, considered appropriate to initiate a study to explore the possibility of using wheat straw allelochemicals for minimising weed infestation in cotton.

*MATERIALS AND METHODS*

The laboratory wirehouse study

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was carried out in the Department of Agronomy, University of Agriculture, Faisalabad, during 1987, to find possible allelopathic effects of wheat straw on cotton and some of its weed seeds. The straw of wheat variety LU 26S was used as source of allelochemicals. Weeds seeds were collected from Crop Physiology Section, Ayub Agricultural Research Institute Faisalabad and treated with Captan to protect these from fungus infection. Seeds of cotton cv. Niab-78 were delinted with $H_2SO_4$ (commercial grade). Weed seeds tested for germination and seedling growth comprised, *Convolvulus arvesis, Dactyloctenium aegyptium* and *Trianthema monogyna*. Five grams of wheat straw passed through 40 mesh screen after grinding was soaked in 100ml distilled water for 24 hours at room temperature and then filtered (Hussain and Gadoon, 1981). Following concentrations of the extract were used, 25% v/v, 50% v/v, 75% v/v and 100% v/v and control (No extract). The treatments were replicated 4 times according to completely randomized design. Two separate experiments were carried out.

(a) *LABORATORY EXPERIMENT*

Petri dishes of 9 cm diameter were filled with 100 g sandy loam soil. Ten seeds each of cotton, *Convolvulus arvensis, Dactyloctenium aegyptium and Trianthema monogyna* were placed in each petri-dish. 30 ml aqueous extract solution of respective treatment and 30 ml water for control was used. All the petri dishes were placed in the laboratory, and watered with distilled water when needed.

Germination of seed was recorded daily for 12 days. fresh weight, shoot and root length were recorded and samples were dried in open and then placed in oven for drying.

(b) *POT EXPERIMENT*:

Plastic pots of 14cm diameter were filled with 1.0 kg of sandy loam soil. Soil was soaked with different concentrations by adding 300 ml extract while in control 300 ml of canal water was used. Ten seeds of each test species were placed in each pot. Pots were watered when needed. Observations similar to laboratory experiment were recorded. The pots were kept in a wirehouse.

The data collected from both experiments were tabulated and analysed statistically. Duncan's New Multiple Range Test at five percent probability was applied to compare treatment means (Steel and Torrie, 1980).

## *RESULTS AND DISCUSSION*

### *EFFECTS ON COTTON*

Germination of cotton in lab experiment was not affected with any extract concentration. In pot experiment, however wheat straw aqueous extract caused 15-20% inhibition of germination, whereas the average of both experiments was statistically non significant indicating that wheat straw could have some allelopathic effect on cotton germination (Table 1). Interestingly growth of cotton seedlings was promoted with the application of diluted extract concentrations. Dry weight was increased by about 7 and 6 per cent (average of both experiments) over control with 50% and 75% wheat straw aqueous extract. Shoot and root length was also stimulated with the same extract concentrations. Avergage increase in shoot and root length was about 15.8

Table 1. Effect of wheat straw aqueous extract on the germination and seedling growth of cotton

| Treatments % v/v | Germination (%) | | | Dry weight (mg) | | |
|---|---|---|---|---|---|---|
| | Lab | Pots | Average | Lab | Pots | Average |
| 0 | 82.5[NS] | 92.5 a[1] | 87.5[NS] | 48.13 b[1] | 428.8 c | 238.45 c |
| 25 | 82.5 | 72.5 b | 77.5 | 52.03 b | 418.2 c | 234.11 c |
| 50 | 80.0 | 75.0 b | 77.5 | 62.93 ab | 447.4 ab | 255.16 a |
| 75 | 77.5 | 67.5 b | 72.2 | 53.17 b | 452.9 a | 253.04 ab |
| 100 | 77.5 | 75.0 b | 76.25 | 44.86 b | 443.1 ab | 243.97 bc |

NS Non significant at 5 probability level

1. Any two means not sharing a letter in common differ significantly at 5 probability level (DMR)

and 15.7 per cent respectively over control with 75% wheat straw aqueous extract (Table 2). These findings are supported by the work of Leather (1983), Lehle (1983) and Chivinge (1985).

*EFFECT ON WEEDS*

Effect of wheat straw aqueous extract on the germination and growth of weed species tested in this study was more pronounced than cotton.

Inhibition of germination in *Convolvulus arvensis and Dactyloctenium aegyptium* was found to be significant with higher extract concentrations. Germination decrease in both petridish and pot experiments was found to be 43.5, 33.3, 16.6 and 14.7 per cent in case of *C. arvensis*, (Table 3) whereas it was 48, 43.6, 32.5 and 9.46 per cent over control in *D. aegyptium* (Table 5) with the application of 100%, 75% and 25% wheat straw aqueous extract, respectively. Seedling mortality was only observed in *C.arvensis* and it was reduced significantly with all extract concentrations, however, maximum reduction (average of two experiments) of 13.8 per cent was observed with 100% wheat straw equeous extract (Table 3). The highest extract concentration (100%) caused reduction (average) of 33.1 and 11.19 percent over control in shoot and root length of *C. arvensis* in both the studies, although inhibitory effects at lower extract concentrations were also significant. Wheat straw aqueous extract showed no affect on shoot-root, length of *D.aegytium*. *Allelopathic (suppressive) effects on some broad leaved weeds have been reported by different researchers (Lehle et.al* 1983, Shilling et al. 1987, Steinstek, et al. 1982). These allelopathic effects were dependent on concentrations used and species tested.

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Table 2. Effect of wheat straw aqueous extract on shoot and root length of cotton seedlings

| Treatments (% v/v) | Shoot lenght (mm) Lab | Pots | Average | root length (mm) Lab | Pots | Average |
|---|---|---|---|---|---|---|
| 0% | 98.39 b[1] | 87.29 b | 92.84 b | 64.59 c | 89.43 c | 77.01 b |
| 25% | 106.78 ab | 91.10 b | 98.94 b | 78.61 ab | 97.37 a | 87.99 a |
| 50% | 102.76 b | 93.88 a | 98.32 b | 79.7 ab | 96.01 a | 87.85 a |
| 75% | 119.39 a | 92.37 a | 107.5 a | 83.48 a | 94.71 ab | 89.09 a |
| 100% | 97.35 b | 90.17 b | 93.76 b | 68.75 bc | 93.10 b | 80.92 b |

1. Any two means not sharing a letter in common differ significantly at 5% probability level.

Table 3 Effect of wheat straw aqueous extract on the germination and seedling growth of convolvulus arvensis

| Treatments (% v/v) | Germination (%) Lab | Pots | Average | Mortality (%) Pots | Dry weight (mg) Lab | Pot | Average |
|---|---|---|---|---|---|---|---|
| 0% | 95.0 a[1] | 100.0 a | 97.5 a | 5.00 | 16.08 a | 193.85 a | 104.96 a |
| 25% | 82.5 ab | 85.0 a | 83.75 b | 14.68 | 13.35 b | 174.07 b | 93.71 b |
| 50% | 77.5 b | 82.5 b | 80.0 b | 21.72 | 13.24 b | 175.45 b | 94.34 b |
| 75% | 60.0 c | 80.0 b | 70.0 c | 24.65 | 12.44 b | 173.15 b | 92.79 b |
| 100% | 37.5 d | 72.5 b | 55.0 c | 60.06 | 10.28 c | 170.67 b | 90.47 b |

1. Any two means not sharing a letter in common differ significantly at 5% probability level (DMR

Table 4. Effect of wheat straw aquenous extract on the shoot and root length of *Convolvlus arvensis*

| Treatment (% v/v) | Shoot lenght (mm) Lab | Pots | Average | Root length (mm) Lab | Pots | Average |
|---|---|---|---|---|---|---|
| 0% | 137.4 a | 40.28 a | 88.86 a | 73.60 a | 311.8 a | 192.7 a |
| 25% | 122.4 b | 35.44 b | 78.92 b | 69.09 ab | 300.29 b | 184.69 b |
| 50% | 122.6 b | 35.48 b | 79.06 b | 66.66 bc | 289.64 bc | 178.15 c |
| 75% | 120.4 b | 35.40 b | 77.90 b | 62.94 c | 287.55 c | 175.24 cd |
| 100% | 86.6 c | 32.05 b | 59.32 c | 56.02 d | 286.22 c | 171.12 d |

1. Any two means not sharing a letter in common differ significantly at 5% probability level.(DMR)

Table 5. Effect of wheat straw aquenous extract on the germination and shoot and root length of *Dactyloctenium aegyptium*.

| Treatments (% v/v) | Germination (%) Lab | Pots | average | Shoot lenght (mm) Lab | Root length (mm) Lab |
|---|---|---|---|---|---|
| 0% | 73.05 a[1] | 62.25 a | 67.65 a | 10.29[ns] | 5.91 |
| 25% | 67.5 a | 55.00 b | 61.25 b | 11.12 | 4.91 |
| 50% | 45.0 b | 46.25 bc | 45.62 c | 10.12 | 5.29 |
| 75% | 37.5 b | 38.45 c | 37.97 d | 12.29 | 6.04 |
| 100% | 37.5 b | 27.5 b | 32.5 d | 10.75 | 5.50 |

ns: Non-significant.

1. Any two means not sharing a letter in common differ significantly at 5% probability level (DMR).

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