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# POSITIVE ALLELOPATHIC INTERACTION BETWEEN *SORGHUM BICOLOR* AND *COMMELINA BENGHALENSIS*

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## Abstract

*Sorghum bicolor* seeds were sown in 1:10, 1:20 and 1:50 dilutions of *Commelina benghalensis* underground parts (root+rhizome) extracts besides a distilled water control. Seedlings root length, shoot length, fresh weight, dry weight, amylase activity, peroxidase activity, reducing sugar, non reducing sugar, total sugar and nitrogen content were investigated in *S. bicolor* seedlings after seven days of radicle emergence. Root, shoot length, fresh weight and dry weight were higher than control in all dilutions of *C. benghalensis* extract indicating enhance *S. bicolor* seedlings vigour in presence of *C. benhgalensis* as a crop weed in the *S. bicolor* field. Maximum enhancement in growth was recorded in 1:10 dilution. Maximum nitrogen, reducing sugar, non reducing sugar, total sugar and peroxidase activity were recorded in different parts of 1:10 dilution grown seedlings. While amylase activity was moderate in different parts of treated seedlings. This indicate, fresh synthesis of carbohydrates. Leachates were also collected from different dilutions after seven days of *S. bicolor* seedlings growth. *C. benghalensis* extract promoted the growth by leaching out nitrogenous compounds and inhibiting the leaching of carbohydrates and phenolics. *C. benghalensis* extract rich in non reducing sugar which probably acts through stimulating mobilization of non reducing sugar and release of reducing sugar towards growth promotion of *S. bicolor* seedlings.

***Key words:*** Amylase activity, nitrogen, peroxidase activity, phenolics, *Sorghum bicolor, Commelina benghalensis.*

## Introduction

The term allelopathy was coined in 1937 by Hans Molish choosing two greek words “Allelo” and “Pathos” literally meaning mutual sufferings. Allelopathy is a common biological phenomenon by which one organism produces biochemicals that influences the growth, survival, development and reproduction of other organism. These biochemicals are known as allelochemicals and have beneficial and detrimental effects on target organism. Plant allelopathy is one of the modes of interaction between receptor and donor plants and may exert either positive effects (*e.g*. for agricultural management, such as weed control, crop protection and crop re-establishment) or negative effects (*e.g*. autotoxicity, soil sickness and biological invasion).

To ensure sustainable agricultural development it is important to exploit cultivation system that take advantage of the stimulatory/ inhibitory influence of allelopathic plants to regulate plant growth and development. The use of allelopathic crops in agriculture is currently being realized, *e.g*. as component of crop rotation, for intercropping, as cover crops or as green manure (Mahmood *et al*., 2013; Wortman *et al*., 2013; Farooq *et al*., 2014; Silva *et al*., 2014; Wezel *et al*., 2014; Haider *et al*., 2015).

*Sorghum bicolor* is an annual plant belongs to family gramineae. *S. bicolor* grains is eaten by human beings by cooking it in the same way as rice or by grinding it into flour and preparing “chapaties”. Besides, it serve as an important source of cattle feed and fodder. *Commelina benghalensis* is a succulent herb belongs to family commelinaceae. It has been found infesting many plantation, vegetable, fruit and field crops including *Sorghum*.

Therefore, the present study was made to find out the effect of *C. benghalensis* on the growth and metabolism of *S. bicolor* and to evaluate the allelopathic potential of the former.

## Materials and Methods

*Sorghum bicolor* cv. Hariganga was selected as a crop to be tested for the allelopathic effect of *Commelina benghalensis*. Healthy plants of *C. benghalensis* were collected from the Sorghum field of C.C.S. university campus Meerut. Root and rhizome (underground parts) were removed from the plants and prepared fresh extract.

**Table 1:** Seeding vigour in terms of seeding (parts) length (cm) and biomass (mg) of *S. bicolor* after 7 days of treatment with different dilutions of *C. benghalensis* extract.

| Extract dilutions | Shoot | | | | Root | | | |
|---|---|---|---|---|---|---|---|---|
| | Length | F. wt. | D. wt. | M % | Length | F. wt. | D. wt. | M % |
| 1:10 | 14.15±1.63 | 62.30±2.00 | 2.23±0.25 | 96.42±3.17 | 12.55±3.02 | 13.11±1.17 | 1.98±0.12 | 84.89±2.00 |
| 1:20 | 13.9±1.22 | 65.80±1.89 | 1.50±0.10 | 97.72±1.18 | 11.15±3.04 | 10.70±1.50 | 2.23±0.25 | 79.16±1.18 |
| 1:50 | 13.45±1.21 | 60.00±0.99 | 1.23±0.17 | 97.95±1.19 | 10.50±2.59 | 6.00±1.31 | 1.77±0.17 | 70.50±1.11 |
| Control | 13.25±1.71 | 54.80±1.77 | 1.20±0.18 | 97.81±0.98 | 10.25±1.44 | 5.60±1.37 | 1.67±0.20 | 70.18±1.00 |

### Preparation of extract

5 gm. Fresh material was homogenized in 25 ml. distilled water, centrifuged, supernatant was made to a final volume of 50 ml. with distilled water and used as stock. Different dilutions *i.e*. 1:10, 1:20 and 1:50 (v/v) were prepared from the mentioned stock using distilled water.

### Physical analyses

After 7 days of *S. bicolor* seedling growth in *C. benghalensis* extract seedling vigour in term of length and biomass were observed.

### Biochemical analyses

Following biochemical analyses were carried out.

1. Total sugar, reducing and non reducing sugars using arsenomolybdate reagent (Nelson, 1944).

2. Total nitrogen using Nessler's reagent (Snell and Snell, 1967).

3. Assay of amylase activity (Filner and Varner, 1967).

4. Assay of peroxidase activity using benzidine (Maehlay and Chance, 1967).

5. Estimation of phenolics (Sadasivam and Manickam, 1992).

Seeds of *S. bicolor* were disinfected by 0.1% mercuric chloride solution and washed 5-6 times with distilled water to remove its traces. 25 seeds of *S. bicolor* were sown in Petriplate lined with filter paper above cotton layer. Seeds were irrigated with 2 ml extract per day, besides distilled water. All the analyses have been carried out in at least triplicate and the data has been verified statistically.

## Results and Discussion

*C. benghalensis* are generally recorded to grow in the local fields simultaneously with *S. bicolor*. Hence, an analysis of the crop-weed, root and rhizome allelochemicals affecting *S. bicolor* growth and physiology was felt pertinent. Since, the distance between weed and crop plant or in other words, dilution of the allelochemicals of the weed affecting the growth of crop plant is also an important factor. 1:10, 1:20 and 1:50 dilutions of underground parts (root + rhizome) extract were used for growing *S. bicolor* seedlings. Leaf fall of *Commelina* is very small as they are in growth phase during *S. bicolor* growth. Hence, only root and rhizome parts of crop weed given due attention.

*S. bicolor* shoot and root length were recorded to be maximum in 1:10 dilution of *C. benghalensis* extract. Increase in dilution of extract treatment, decrease the shoot and root length. The root, shoot length, fresh weight and dry weight were higher than control in all dilutions of

**Table 2:** Biochemical analyses of different parts of *S. bicolor* seedlings grown in different dilutions of *C. benghalensis* extract.

| Parameters | 1:10 | | | 1:20 | | | 1:50 | | | Control (DW) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Shoot | Root | Residual seeds | Shoot | Root | Residual seeds | Shoot | Root | Residual seeds | Shoot | Root | Residual seeds |
| Total Amylase activity* | 27.09 ±1.93 | 13.39 ±2.78 | 23.13 ±1.14 | 28.84 ±0.69 | 11.12 ±0.58 | 25.83 ±0.70 | 25.90 ±2.76 | 11.51 ±3.67 | 23.30 ±2.69 | 29.24 ±2.21 | 23.79 ±0.45 | 35.80 ±2.44 |
| Total Peroxides activity** | 226.50 ±1.35 | 353.93 ±0.80 | 328.83 ±0.80 | 207.07 ±0.28 | 302.49 ±4.22 | 346.13 ±17.05 | 195.13 ±5.49 | 360.44 ±0.83 | 351.40 ±0.72 | 201.90 ±1.90 | 306.82 ±0.33 | 340.20 ±0.53 |
| Nitrogen (mg/gdwt.) | 35.82 ±1.76 | 4.55 ±0.09 | 8.15 ±0.22 | 35.54 ±4.21 | 5.32 ±0.10 | 4.92 ±0.05 | 37.87 ±2.35 | 4.41 ±0.22 | 2.98 ±0.04 | 4.37 ±0.09 | 4.20 ±0.03 | 3.86 ±0.02 |
| RS (mg glucose eq./gdwt.) | 2.91 ±0.59 | 2.70 ±1.04 | 2.10 ±0.05 | 1.49 ±0.20 | 2.21 ±1.05 | 1.72 ±0.32 | 2.41 ±0.04 | 2.15 ±0.15 | 0.66 ±0.15 | 0.86 ±0.0 | 3.79 ±0.37 | 2.02 ±0.01 |
| NRS (mg glucose eq./gdwt.) | 5.69 | 2.39 | 22.95 | 4.80 | 10.78 | 2.64 | 6.11 | 9.35 | 1.29 | 0.38 | 17.66 | 1.96 |
| TS (mg glucose eq./gdwt.) | 8.60 ±2.73 | 5.09 ±0.46 | 25.05 ±2.21 | 6.29 ±1.06 | 12.99 ±0.66 | 4.36 ±0.67 | 8.52 ±0.42 | 11.50 ±0.26 | 1.92 ±0.047 | 1.25 ±0.19 | 21.45 ±0.31 | 3.98 ±0.07 |

* mg starch degraded/min./gfwt; ** $\Delta A_{475}$/min./gfwt.

**Table 3:** Biochemical analysis of *C. benghalensis* extract and leachates collected after 7 days of *S. bicolor* seedlings growth.

| Dilutions | ***C. benghalensis* extract and leachates of *S. bicolor* seedlings** | | | | | |
|---|---|---|---|---|---|---|
| | **pH** | **Nitrogen** | **Reducingsugar** | **Non Reducingsugar** | **Total sugar** | **Phenolics** |
| Extractmg/11ml 1:10 | 6.6 | 0.07 | 0.05 | 0.19 | 0.24 | 11.37 |
| 1:20 | 6.6 | 0.04 | 0.02 | 0.1 | 0.12 | 5.69 |
| 1:50 | 6.6 | 0.01 | 0.01 | 0.04 | 0.05 | 2.28 |
| LeachatesMg/5ml 1:10 | 5.4 | 1.51±0.07 | 0.02±0.0 | 0.05 | 0.07±0.02 | 225.70±2.58 |
| 1:20 | 5.5 | 1.87±0.01 | 0.02±0.0 | 0.04 | 0.07±0.0 | 270.15±2.68 |
| 1:50 | 5.8 | 1.77±0.01 | 0.03±0.0 | 0.01 | 0.04±0.0 | 309.72±3.56 |
| Control | 6.0 | 1.68±0.01 | 0.03±0.0 | 0.02 | 0.05±0.0 | 345.53±5.12 |

*C. benghalensis* extract indicating enhanced *S. bicolor* seedlings vigour in the presence of *C. benghalensis* as a crop-weed in *S. bicolor* fields (Table 1).

Maximum nitrogen, reducing sugar, non reducing sugar, total sugar and peroxidase activity were recorded in different parts of 1:10 dilution grown seedlings. On the other hand, amylase activity was moderate in treated seedlings. Thus, indicate fresh synthesis of carbohydrate (Table 2).This is in conformity with Weir *et al*., 2004 who reported that allelochemicals present in cucumber root extract significantly increased peroxidase activity. After exposure to allelochemicals, the recipient plants may rapidly produce reactive oxygen species (ROS) in the contact area (Bais *et al*., 2003; Ding *et al*., 2007) and alter the activity of antioxidant enzyme such as superoxide dismutase and peroxidase (Zing *et al*., 2001; Yu *et al*., 2003).

Leachates were also collected from different dilutions after 7 days of *S.bicolor* seedlings growth. *C. benghalensis* extract promoted the growth by leaching out nitrogenous compounds and inhibiting the leaching of carbohydrate and phenolics. *C. benghalensis* extract rich in non reducing sugar (Table 3) which probably acts through stimulating mobilization of non reducing sugar and release of reducing sugar towards growth promotion of *S. bicolor* seedlings.

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