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Research Article

# EVALUATION OF ALLELOPATHIC EFFECT OF *ABUTILON INDICUM* LEACHATES WITH VARIED CONCENTRATION AND DURATION OF SOAKING ON CROP GERMINATION, SHOOT AND ROOT LENGTH

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**Abstract-** Laboratory experiments were carried out to evaluate the allelopathic effect of *Abutilon indicum* leachates on crop and weed seeds germination and crop seedling establishment. The experiment was conducted with an objective of finding farmer's friendly method of preparation of "green herbicides" comprising of weed leachates and to identify the potential leachate to naturally control weed seed germination without affecting crop germination and growth. The experimental results revealed that 30 % concentrated leachate produced more inhibitory effect than 20 % and 10 %. The 10 % leachate was less allelopathic. Among, varied duration of soaking lower the soaking duration (one DAS) higher was allelopathic effect, whereas the highest soaking duration (11 DAS) showed less allelopathic effect and was nearly equivalent to control.

**Keywords**- *Allelopathic effect, Leachate, DAS-Days of Soaking, Concentrations, Green herbicide, Abutilon indicum*

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## Introduction

Allelochemical which inhibited the growth of some species at certain concentrations may stimulate the growth of same or different species at lower concentrations [1]. Different parts of weeds have potentiality to produce different allelopathic effects on test crops [2]. Allelopathy is relatively a new branch of science [3]. With the help of allelopathy, weed-crop, crop-weed, crop-crop and weed-weed interactions can be easily explained. Allelopathic effects are both positive and negative both of these effects can be utilized for higher crop production [4]. Negative (stimulatory) allelopathic effects of any weed or crops on weeds can be utilized to develop "Green herbicides" [5]. Results of many studies revealed that, allelopathic effect of crop plants [6].

## Materials and Methods

In the experiment conducted whole plant of *Abutilon indicum* weed was collected from fields and barren lands adjacent to agriculture college campus with flowering, without roots and were thoroughly washed off the soil. The washed plants were cut into fine pieces and immersed in distilled water in different ratios (*i.e.*, 1/10, 1/20, 1/30 in weight/volume basis) separately in open plastic cups. The weeds were decayed in distilled water for varied duration of 24, 72, 120, 168, 216 and 264 hours. The experiment was carried out in plastic cups of 350 ml size filled with soil weighing 200 g. The crop seeds of cowpea, sorghum, black gram, were sown at the rate of 10 seeds per cup and groundnut @ 5 seeds per cup due to its larger seed size. The leachate was prepared by filtering the plant sample-soaked solution with a 2 mm sieve. 200 ml of the leachate was added to each cup on the first day of sowing with subsequent watering with regular water. The crop seed germination and seedling elongation (shoot and root length) were recorded on 11 DAS. The data recorded were transformed to square root scale of Sqr (x + 0.5). Statistical analysis of the data was carried out using the method [7].

## Results and Discussion

### Germination (%)

The germination percentage recorded among the four crops tested were of similar trend and showed significant difference among different days of soaking and levels of concentration. The treatment T7 (Control) registered significantly highest germination percentage among all the crops.

However, in cowpea, T6 (11 DAS) (77.77) was comparable with T7 (Control) (93.33) and were significant over other treatments and comparable with each other. In Black gram T7 (Control) (90.03) was significantly higher over T5 (9 DAS) and T6 (11 DAS), with 58.83 and 73.30, respectively and these were comparable with each other. Among different treatments in sorghum crop, T7 (Control) (90.0) was significantly higher over T6 (11 DAS), T3 (9 DAS) and T4 (11 DAS), with 76.67, 62.17 and 44.40, respectively. The best performing treatment of T7 (Control) recorded highest germination percentage of 45.5 and was followed by T5 (9 DAS) and T6 (11 DAS) with 32.20 and 26.63, respectively.

The lowest germination percentage was recorded with T1 (1 DAS) followed by T2 (3 DAS) and T3 (5 DAS) in cowpea, black gram, sorghum and in groundnut all were comparable among each other. The varied duration of soaking namely, T1 (1 DAS), T2 (3 DAS), T3 (5 DAS), T4 (7 DAS), T5 (9 DAS), T6 (11 DAS) showed significant differences. The lower the soaking duration higher the allelopathic effect, whereas higher the soaking duration T6 (11 DAS) was equivalent to control (with only water) and showed less allelopathic effect. This may be attributed due to volatilization of phenols during decaying and was confirmed with the bad odour produced while soaking.

For cowpea, black gram and sorghum, among different concentrations, C1 (10 %) registered significantly higher germination percentage than C2 (20 %) and C3 (30 %). In groundnut there was no significant difference among the concentration levels.

Table-1 *Effect of Abutilon indicum leachates on germination, shoot and root length of cowpea, black gram, sorghum and groundnut*

| Treatments | Cowpea | | | Black gram | | | Sorghum | | | Groundnut | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Germination % | Shoot length (cm) | Root length (cm) | Germination % | Shoot length (cm) | Root length (cm) | Germination % | Shoot length (cm) | Root length (cm) | Germination % | Shoot length (cm) | Root length (cm) |
| | 11 DAS | 11 DAS | 11 DAS | 11 DAS | 21 DAS | 21 DAS | 11 DAS | 21 DAS | 21 DAS | 11 DAS | 21 DAS | 21 DAS |
| Decaying period | | | | | | | | | | | | |
| $T_1$ (1 Day) | 2.19(8.87) | 3.04(9.29) | 4.27(18.28) | 3.65(15.53) | 2.49(6.27) | 1.65(7.78) | 3.71(14.43) | 4.47(20.00) | 3.19(10.26) | 3.50(14.40) | 1.13(2.72) | 1.87(12.37) |
| $T_2$ (3 Day) | 3.23(14.44) | 3.12(10.14) | 4.57(20.89) | 4.96(25.50) | 2.68(7.19) | 1.73(9.02) | 4.52(21.10) | 4.83(23.32) | 3.48(12.19) | 4.26(17.73) | 1.16(3.39) | 1.92(13.60) |
| $T_3$ (5 Day) | 5.19(27.78) | 3.29(10.90) | 4.80(23.07) | 5.65(33.33) | 2.82(7.96) | 1.80(10.61) | 5.90(34.43) | 5.14(26.42) | 3.74(14.10) | 4.59(22.20) | 1.19(3.97) | 1.95(14.52) |
| $T_4$ (7 Day) | 6.00(37.78) | 3.44(11.88) | 5.04(25.40) | 6.41(48.87) | 2.93(8.64) | 1.86(11.98) | 6.64(44.40) | 5.40(29.21) | 4.01(16.14) | 5.12(24.40) | 1.21(4.58) | 1.98(15.48) |
| $T_5$ (9 Day) | 6.82(47.78) | 3.57(12.78) | 5.22(27.28) | 7.51(58.83) | 3.05(9.34) | 1.90(12.96) | 7.94(62.17) | 5.58(31.19) | 4.27(18.35) | 5.11(26.63) | 1.23(5.25) | 2.01(16.51) |
| $T_6$ (11 Day) | 8.80(77.77) | 3.71(13.79) | 5.47(29.71) | 8.14(73.30) | 3.16(10.01) | 1.95(14.50) | 8.74(76.67) | 5.81(33.79) | 4.49(20.22) | 5.72(32.20) | 1.25(5.86) | 2.05(17.72) |
| $T_7$ (Control) | 9.65(93.33) | 4.40(19.34) | 5.54(30.71) | 9.48(90.03) | 3.90(15.23) | 2.09(19.10) | 9.48(90.00) | 6.54(42.79) | 5.56(30.97) | 6.74(45.5) | 1.36(8.93) | 2.16(21.8) |
| S Ed | 0.66 | 0.07 | 0.03 | 0.41 | 0.04 | 0.01 | 0.3 | 0.04 | 0.04 | 0.49 | 0.03 | 0.005 |
| CD (0.05%) | 1.33 | 0.15 | 0.06 | 0.82 | 0.09 | 0.03 | 0.6 | 0.09 | 0.09 | 0.1 | 0.05 | 0.011 |
| Concentration | | | | | | | | | | | | |
| $C_1$ (10 %) | 6.77(53.81) | 3.67(13.62) | 5.16(26.75) | 7.24(55.21) | 3.16(10.16) | 3.74(13.49) | 7.21(55.20) | 5.54(30.96) | 4.40(19.75) | 5.23(28.06) | 1.26(5.91) | 2.05(17.68) |
| $C_2$ (20 %) | 5.89(42.38) | 3.60(13.10) | 5.00(25.07) | 6.60(46.63) | 2.99(9.14) | 3.66(12.49) | 6.68(48.56) | 5.43(29.91) | 4.07(17.13) | 4.96(26.16) | 1.21(4.73) | 1.99(16.00) |
| $C_3$ (30 %) | 5.28(35.71) | 3.28(11.04) | 4.90(23.32) | 5.78(39.04) | 2.86(8.41) | 3.45(10.72) | 6.22(43.33) | 5.22(27.72) | 3.84(15.51) | 4.84(24.24) | 1.18(4.23) | 1.94(14.32) |
| S Ed | 0.43 | 0.05 | 0.02 | 0.27 | 0.03 | 0.01 | 0.19 | 0.03 | 0.03 | 0.32 | 0.02 | 0.003 |
| CD (0.05%) | 0.87 | 0.1 | 0.4 | 0.54 | 0.06 | 0.02 | 0.39 | 0.06 | 0.06 | 0.65 | 0.03 | 0.007 |

*Figures in parenthesis are original value*

**Shoot and root length (cm)**

The shoot and root length recorded among different soaking durations recorded significant difference. In cowpea highest shoot length of 19.34 cm was recorded with T7 (control) and it was followed byT5 (9 DAS) (12.78 cm) and T6 (11 DAS) (13.79 cm) and were comparable with each other. The lowest shoot length of 9.29 cm and 10.14 cm was observed with T1 (I DAS) and T2 (3 DAS), respectively and were comparable with each other. C3 (30 %) showed poorest shoot length of 11.04 cm, followed by C1 (10 %) and C2 (20 %). Root length observed in T1 (1 DAS) was poorest with 18.28 cm and it was followed by T2 (3 DAS) with 20.89 cm. The best treatment was T7 (control) with significantly highest root length of 30.71 cm followed by T6 (11 DAS) and T5 (9 DAS). In Black gram, shoot length recorded significant difference among treatments. Highest shoot length of 15.23 cm was recorded with T7 (control) and it was followed byT5 (9 DAS) (10.01 cm) and T6 (11 DAS) (9.34 cm) and were comparable with each other. The lowest shoot length of 6.27 cm was observed with T1 (I DAS) followed by T2 (3 DAS) and T3 (5 DAS), respectively. C3 (30 %) showed poorest shoot length of 11.04 cm, followed by C1 (10 %) and C2 (20 %). Root length observed in T1 (1 DAS) was poorest with 18.28 cm and it was followed by T2 (3 DAS) with 20.89 cm. The best treatment was T7 (control) with significantly highest root length of 30.71 cm followed by T6 (11 DAS) and T5 (9 DAS). In Sorghum, highest shoot length of 42.76 cm was observed in T7 (control) followed by T6 (11 DAS), T5 (9 DAS) and T4 (7 DAS) with 33.79, 31.19 and 29.21 cm, respectively. The lowest shoot length of 20.00 cm was recorded in T1 (1 DAS) followed by T2 (3 DAS) (23.32 cm). The root length recorded with T7 (control) was highest followed by T6 (11 DAS) and T5 (9 DAS). The lowest root length was observed in T1 (1 DAS) (10.26) followed by T2 (3 DAS) (12.19 cm).

In groundnut, the shoot length of T7 (control) was significantly highest with 42.76 cm followed by T6 (11 DAS) and T5 (9 DAS) with 5.86 and 5.25 cm, respectively. The least shoot length of 2.72 cm was observed in T1 (1 DAS) followed by T2 (3 DAS) (3.39 cm). Similar trend was observed among root length also. Root length recorded with T7 (control) was highest followed by T6 (11 DAS) and T5 (9 DAS). The lowest root length was observed in T1 (1 DAS) (12.37 cm) followed by T2 (3 DAS) (13.60 cm). The concentration levels recorded similar trend among all the four crops tested viz., Cowpea, Black gram, Sorghum and Ground nut. The Concentration level C1 (10 %) registered lowest shoot and root length followed by C2 (20 %) and C3 (30 %). The varied levels of concentrations recorded its impact on germination, shoot and root length among all crops tested (cowpea, black gram, sorghum and groundnut). The 30 % concentrated leachate recorded more inhibitory effect on germination percentage, shoot and root length than the lower concentrations of 20 % and 10 %. The 10 % concentration leachate was less allelopathic. During initial days, there existed no weeds but on later stages all the cups were dominated only with *Trianthema protulacastrum* thus concluding that it has no effect on carpet weed.

**Conclusion**

*Abutilon* sps. has positive allelopathic effect on crop species with decreased duration of soaking. *Abutilon indicum* is found to have stronger allelopathic effect and mottling symptoms with deformities were recorded with cowpea. These leachates cannot be used as green herbicides. The higher duration of soaking lowers the allelopathic effect with more production of phenols and release to the atmosphere producing bad odour. In all the crops tested, the germination percentage was on par with control in higher duration of soaking (11 DAS). Germination percentage recorded with T6 (11 DAS) was on par with T7 (Control). Among the varied concentrations tried germination % in C1 with (10 %) was significant over C2 (20 %) and C3 (30 %) and both were on par with each other. The different concentrations recorded its negative impact on germination of cowpea, black gram, sorghum and groundnut. The 30 % leachate produced more inhibitory effect than 20 % and 10 %.

The highest shoot and root length in all four crops (Cowpea, Black gram, Sorghum, Groundnut) was recorded in T4 (7 DAS), T5 (9 DAS) and T 6 (11 DAS) and were on par with T7 (Control). The lowest shoot and root length registered with T1 (1 DAS) and followed by T2 (3 DAS). The concentration C1 (10 %) recorded the highest shoot and root length followed by C2 (20 %) and C3 (30 %). The lower the soaking duration higher was the allelopathic effect, whereas higher the soaking duration T6 (11 DAS) recorded less allelopathic effect nearly equivalent to control. This may be attributed due to the volatilization of the compounds during decaying. This can be in confirmatory with the foul odour produced during soaking.

**Application of research:** Allelopathy has a wide range of applications in organic agriculture as this can help in synthesis of "green herbicides" from naturally available plants. Different days of soaking the plant material in water helps in getting leachates of different concentrations and can be used as green herbicide or plant growth promoting substances based on their allelopathic effect. Higher the concentration and lesser the duration of soaking higher positive allelopathy and can be used as "Green herbicide" when there is no negative effect on crop plants.

**Research Category:** Organic Weed Management

**Abbreviations:** DAS-Days of Soaking, C-Concentration

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**Cultivar / Variety / Breed name:** Groundnut / VRI - 6

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