

## Allelopathic effects of leachates of *Trichodesma indicum* (L.) R. Br. on seed germination and seedling growth of maize and wheat

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### ABSTRACT

Allelopathy is a natural phenomenon that takes place through release of phytochemicals from one plant which causes beneficial or harmful effects on other. It is interference mechanism, in which live or dead plant materials release allelochemicals, which inhibit or stimulate the plant growth. The purpose of this study was to evaluate the allelopathic potential of invasive plant weed *Trichodesma indicum* (L.) R. Br. on seed germination and seedling growth of maize (*Zea mays* L.) and wheat (*Triticum aestivum* L.) crop. The allelopathic influence of leachates of root, stem, leaf and whole plant of *Trichodesma indicum* (L.) R. Br. was assessed for seed germination and seedling growth of maize (*Zea mays* L.) and wheat (*Triticum aestivum* L.). The allelopathic pattern varied in each of the tests and this depends upon type of plant material used for assessment. The laboratory bioassay was conducted to study root, stem, leaf and whole plant leachates of *T. indicum* (L.) R. Br. at 05, 10, 15 and 20% concentrations against maize and wheat. It is interesting to note that, the all concentrations of the weed leachates noticeably inhibited the germination and seedling growth of maize and wheat. Increasing concentrations of leachates (15 and 20%) greatly affected a germination percentage and root shoot length of both the test crops. The radicle length was more affected than plumule length in all leachates of *T. indicum* (L.) R. Br. Comparison with other leachates, the whole plant leachate highly reduces the seed germination and seedling growth of maize as well as wheat seedlings.

**Keywords :** Allelopathy, leachates, *Trichodesma indicum*, *Zea mays*, *Triticum aestivum*.

Received 24.09.2024

Revised 01.10.2024

Accepted 11.12.2024

### How to cite this article:

Priyanka A. Gaikwad and M. B. Kanade. Allelopathic effects of leachates of *Trichodesma indicum* (L.) R. Br. on seed germination and seedling growth of maize and wheat. Adv. Biores. SPL-1, 2025:01-04

### INTRODUCTION

In agriculture, it is common knowledge that one plant can influence the growth of another. When released into the environment, the secondary metabolites produced by plants (donor) are essential to the physiology, ecology, and growth of nearby plants (receiver). Chemicals that have leached from plants frequently have an allelopathic effect on the germination and development of succeeding crops (1,2,3,6,7). Leachates are compounds that are extracted from plants by the use of aqueous solvents (4). Although the degree of leachability varies depending on the type of tissue, maturation stage, type, quantity and duration of precipitation, all plants appear to be leachable (4). Numerous organic and inorganic allelopathic substances, including phenolic acids, terpenoids, and alkaloids, are leached (5). In the research region, *Trichodesma indicum* (L.) R. Br. is a prevalent invasive weed that spreads widely in agricultural fields and desolate land areas. This plant is an annual herb that is erect, spreading, branched, and a member of the Boraginaceae family (8).

### MATERIAL AND METHOD

The experiments were conducted under laboratory condition at Post Graduate research centre, Department of Botany, Tuljaram Chaturchand College Baramati, Dist. Pune, Maharashtra. The healthy and diseased free weed *Trichodesma indicum* (L.) R. Br. Was collected from different agricultural fields of Baramati Tahsil. The collected weeds were repeatedly washed with distilled water to remove the soil and dust particles. To find out the effectiveness of inhibitors leaching out from the *T. indicum*, 100g of healthy

**Table-1: Effect of leachates of *T. indicum* (L.) R. Br. on seed germination of *Z. mays* L. and *T. aestivum* L.**

| Weed plant Leachates concentration (%) | Sources of Leachates |                |                |                       | Average germination (%) |
|----------------------------------------|----------------------|----------------|----------------|-----------------------|-------------------------|
|                                        | Root Leachates       | Stem Leachates | Leaf Leachates | Whole plant Leachates |                         |
| Maize                                  |                      |                |                |                       |                         |
| Control                                | 100                  | 100            | 100            | 100                   | 100                     |
| 05                                     | 100                  | 90             | 90             | 90                    | 92.50                   |
| 10                                     | 80                   | 90             | 70             | 70                    | 77.50                   |
| 15                                     | 80                   | 80             | 70             | 70                    | 75                      |
| 20                                     | 80                   | 80             | 30             | 30                    | 55                      |
| Wheat                                  |                      |                |                |                       |                         |
| Control                                | 100                  | 100            | 100            | 100                   | 100                     |
| 05                                     | 50                   | 60             | 60             | 50                    | 55                      |
| 10                                     | 40                   | 50             | 30             | 40                    | 40                      |
| 15                                     | 20                   | 40             | 20             | 40                    | 30                      |
| 20                                     | 20                   | 30             | 10             | 30                    | 22.50                   |

and cleaned plant parts were soaked separately in equal amount of distilled water for 72h. Each leachate was filtered through Whatman No.1 filter paper and these were served as stock solutions and used for bioassay. Dilutions were made from the stock solutions at 05%, 10%, 15% and 20% w/v. Surface sterilized 10 seeds of maize and 10 seeds of wheat were placed in sterilized petridish (14cm and 9cm diameter respectively) containing Whatman No.1 filter paper moistened with 10-15ml of aqueous extracts of each weed of variable concentrations in separate petridishes. Control was made by using distilled water. These petridishes were wrapped by brown paper so as to avoid direct light and kept in room temperature ( $28 \pm 20^\circ\text{C}$ ). The emergence of radicle was considered as the criterion for seed germination and was observed up to 72 hours and expressed as percentage seed germination. The seedling growth was measured after 7 days by measuring the radicle and plumule length. The two-way analysis of variance (ANOVA): The R software was used to compare the effect of the aqueous extracts and leachates on germination and seedling growth of test crops. Treatment effects were considered on the level of  $P < 0.05$  significance.

## RESULTS AND DISCUSSION

The present study clearly demonstrated an inhibitory effect of whole plant as well as three plant parts (roots, stem and leaf) of common weed *T. indicum* leachates bioassay on seed germination and seedling growth of *Zea mays* and *Triticum aestivum*.

### Effect of leachates of *T. indicum* (L.) R. Br. on seed germination of *Z. mays* L. and *T. aestivum* L.

Leachates of all plant parts at 5% concentration have been recorded: 92.5% for maize and 55% for wheat. The lowest seed germination has been observed at the highest concentration (20%) of whole plant leachate and leaf leachate, i.e., 30% in maize. The lowest seed germination has been observed at the highest concentration (20%) of root leachate and leaf leachate, i.e., 20% and 10% respectively in wheat. However, the order of inhibition of leachates in *T. indicum* was whole plant = leaf > root > stem (Table No. 1). This gradual decrease in germination percentage was due to the allelopathic effect of weed (*T. indicum*) leachates from lower to higher concentrations as compared to the control. The reduction in germination and growth are attributable to restrain cell division, reduction in mineral uptake, hinder or augments respiration, hamper the production of protein.

### Effect of leachates of *T. indicum* (L.) R. Br. on seedling growth of *Z. mays* L. and *T. aestivum* L.

Leachates of root, stem and leaf at various concentration inhibited plumule as well as radicle length of *Zea mays* and *Triticum aestivum* seedlings. As compare to root, stem and leaf, whole plant leachate at 20% concentration inhibited maximum radicle than plumule length of *Zea mays* seedlings. Leaf leachate at the higher concentration significantly inhibited plumule than radicle length of maize seedlings. Whereas at lower concentration of root and whole plant leachates, plumule and radicle length has been increased in maize seedlings (Table No.2). Whole plant leachate at higher concentration significantly inhibited plumule and radicle length of wheat seedlings. Whereas at lower concentration of root and stem leachates, plumule and radicle length has been increased in wheat seedlings (Table No.2). The higher concentrations of leachates (15 and 20%) significantly reduced the radicle and plumule length however, lower concentration of leachates did not affect the radicle and plumule length. The radicle and plumule length decreased as the concentrations of the leachates was increased.

**Table-2: Effect of leachates of *T. indicum* (L.) R. Br. on seedling growth of *Z. mays* L. and *T. aestivum* L.**

| Crop  | Variables   | Factor    | Df | MS     | F value | P value       |
|-------|-------------|-----------|----|--------|---------|---------------|
| Maize | Germination | Block     | 3  | 89.58  | 2.263   | <b>0.1501</b> |
|       |             | Treatment | 3  | 239.58 | 6.053   | 0.0153*       |
|       |             | Residual  | 9  | 39.58  |         |               |
|       | Radicle     | Block     | 3  | 13.702 | 3.113   | <b>0.0812</b> |
|       |             | Treatment | 3  | 25.882 | 5.881   | 0.0166*       |
|       |             | Residual  | 9  | 4.401  |         |               |
|       | Plumule     | Block     | 3  | 19.03  | 3.154   | <b>0.0789</b> |
|       |             | Treatment | 3  | 33.76  | 5.595   | 0.0192*       |
|       |             | Residual  | 9  | 6.03   |         |               |
| Wheat | Germination | Block     | 3  | 356.3  | 9       | 0.00451**     |
|       |             | Treatment | 3  | 406.2  | 10.26   | 0.00291**     |
|       |             | Residual  | 9  | 39.6   |         |               |
|       | Radicle     | Block     | 3  | 3.93   | 2.142   | <b>0.1649</b> |
|       |             | Treatment | 3  | 44.9   | 24.488  | 0.000116***   |
|       |             | Residual  | 9  | 1.83   |         |               |
|       | Plumule     | Block     | 3  | 5.94   | 2.599   | <b>0.1167</b> |
|       |             | Treatment | 3  | 56.29  | 24.62   | 0.000113***   |
|       |             | Residual  | 9  | 2.29   |         |               |

R: Radicle, P: Plumule

#### Statistical analysis of leachates bioassay by two-way ANOVA Method

The results obtained from aqueous extracts and leachates of *T. indicum* on seed germination and seedling growth on maize and wheat is statistically analyzed by two-way ANOVA method in R software. Data presented in Table No. 3 shows P values-0.1501>0.05 so null hypothesis is accepted and the different leachates concentration of *T. indicum* shows homogenous effect on germination of maize and wheat seeds. P values-0.0812, 0.0789, 0.1649 and 0.1167>0.05 so null hypothesis is accepted and the different extracts concentration of *T. indicum* shows homogenous effect on radicle and plumule length of maize and wheat. When P values are greater than 0.05 so null hypothesis is accepted and shows homogenous effect on germination and seedling growth of maize and wheat. P value<=0.05 reject H0 and different extracts concentration does not shows homogenous effect on germination and seedling growth of maize and wheat.

**Table-3: Statistical analysis of leachates bioassay of *Trichodesma indicum* (L.) R. Br. by two-way ANOVA Method in R software**

| Weed plant leachate concentration (%) | Sources of leachates |      |               |      |               |      |                      |      |
|---------------------------------------|----------------------|------|---------------|------|---------------|------|----------------------|------|
|                                       | Root leachate        |      | Stem leachate |      | Leaf leachate |      | Whole plant leachate |      |
|                                       | R                    | P    | R             | P    | R             | P    | R                    | P    |
| Maize seedling growth (cm)            |                      |      |               |      |               |      |                      |      |
| Control                               | 17.5                 | 17.2 | 17.9          | 18.7 | 17.6          | 18.1 | 18.3                 | 18.8 |
| 05                                    | 21.2                 | 22.6 | 17.6          | 18.2 | 17            | 17.4 | 20.4                 | 19.4 |
| 10                                    | 20.3                 | 18.6 | 17.3          | 17.9 | 12.8          | 14.2 | 14.5                 | 17.4 |
| 15                                    | 16.5                 | 17.6 | 14.7          | 16.4 | 10.1          | 11.3 | 13.5                 | 15.6 |
| 20                                    | 14.8                 | 16.2 | 11.4          | 13   | 7.2           | 10.8 | 9.8                  | 13.2 |
| Wheat seedling growth (cm)            |                      |      |               |      |               |      |                      |      |
| Control                               | 11.3                 | 15.2 | 13.2          | 17.3 | 12.7          | 15.1 | 11.4                 | 15.5 |
| 05                                    | 11.2                 | 13.9 | 12.8          | 16.5 | 10.5          | 14.3 | 6.6                  | 10.5 |
| 10                                    | 10.4                 | 13.4 | 11.2          | 14.4 | 9.3           | 13.9 | 5.8                  | 9.1  |
| 15                                    | 9.4                  | 11.8 | 10            | 11.8 | 6.7           | 12.9 | 5.7                  | 8.2  |
| 20                                    | 6                    | 9.4  | 7.5           | 10.7 | 6.7           | 10.7 | 3.2                  | 5.6  |

Significant results showed by bold letters.

Two-way ANOVA was used, Df- Degree of freedom, MS- Mean Square.

Significance codes: 0 '\*\*\*', 0.001 '\*\*', 0.01 '\*', 0.05 '.', 0.1 ' ', 1.

#### ACKNOWLEDGEMENT

The first author is thankful to the Council of Scientific and Industrial Research (CSIR) for providing CSIR NET-SRF fellowship for research work. I am also very grateful to Hon. Principal Prof. (Dr.) A. S. Jagtap and Prof. (Dr.) B. S. Mali, Head, P. G. Research Centre, Department of Botany, Tuljaram Chaturchand College, Baramati for their valuable guidance and inspiration.

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