I J R B A T, Issue (X), Vol. I, Jan 2022: 54-59
A Double-Blind Peer Reviewed & Refereed Journal

OPEN ACCESS

e-ISSN 2347 – 517X
Original Article

INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY

 www.ijrbat.in

ALLELOPATHIC EFFECT OF AQUEOUS EXTRACTS OF *TRICHODESMA INDICUM* (L.) R. BR. AND *TRIBULUS TERRESTRIS* L. ON SEED GERMINATION AND SEEDLING GROWTH OF MAIZE AND WHEAT

Priyanka A. Gaikwad[1], B. K. Avchar[2] and M. B. Kanade[1]

[1]PG Research Center, Department of Botany, Tuljaram Chaturchand College of Arts, Commerce and Science, Baramati, Dist. Pune, Maharashtra, India (Autonomous).

[2]Vidya Pratishthan's, Arts, Science and Commerce College, Vidyanagari, Baramati, Dist. Pune, Maharashtra, India.

Corresponding author: Email- priyankag906@gmail.com

Communicated: 19.10.21 | Revision : 17.11.21 & 30.12.2021 Accepted: 15.01.2022 | Published: 30.01.2022

ABSTRACT:

Allelopathy is the direct or indirect effect of one plant on another through release of substances in the environment and occurs widely in natural plant communities. The secondary metabolites or natural products involved in allelopathy are called allelochemicals and can be produced in different parts of the plants. The purpose of this study was to evaluate the allelopathic potential of invasive plant weed *Trichodesma indicum* (L.) R. Br. and *Tribulus terrestris* L. on seed germination and seedling growth of maize (*Zea mays* L.) and wheat (*Triticum aestivum* L.). The laboratory bioassay was conducted to study root, stem, leaf and whole plant aqueous extracts of *T. indicum* and *T. terrestris* at 05%, 10%, 15 and 20% concentrations against maize and wheat. It is interesting to note that, the all concentrations of both the weed extracts noticeably inhibited the germination and seedling growth of maize and wheat. Increasing concentrations of extracts (15% and 20%) greatly affected a germination percentage and root shoot length of both the test crops. The plumule length was more affected than radicle growth in all extracts of both the weeds.

Key words: - Allelopathy, *Trichodesma indicum*, *Tribulus terrestris*, seedling growth, maize, wheat.

INTRODUCTION:

Allelopathy is defined as the direct or indirect harmful or beneficial effects of one plant on another through the production and release of secondary metabolites into the environment (Machado, 2007; Baziar *et al.*, 2014). It involves the complex chain of chemical communications between plant species leading to either inhibitory or stimulatory effects (Rice,1986; Harborne,1987). The phytoallexins, phyotoxins and growth inhibitors produced by plant acts as allelochemicals and affect different physiological processes of plants (Callaway and Ridenour, 2004). Different plant parts release allelopathic substances by various ways such as root exudation, volatilization, leaching and decomposition of plant residues.

Invasive alien plants are among the important factors that influence plants growth parameters in and among farming systems and wildlife ecosystems. Integrity of farming system and natural ecosystems are threatened by invasive alien species which displace some of the native species and establishing mono-species in new habitat (Callaway and Aschehoug, 2000). Production and release of allelopathic compounds (allelochemicals) by invasive species are factors that enhance its competitive ability over native species.

Allelochemicals released by invasive species also affect native species through different pathways

that includes interruption of plants nutrients uptake and elongation process in roots and shoots (Cruz-Ortega *et al.,* 2007). Hence, allelopathy has been considered as among the key factor to the success of invasive plant species over native species (Yuan *et al.,* 2013).

Trichodesma indicum (L.) R. Br. is a common wide spread invasive weed of agricultural fields and barren land area of study region. This plant belongs to family Boragenaceae which is an erect, spreading, branched and annual herb (Vanitha *et al.*, 2015). *Tribulus terrestris* L. is a member of the Zygophyllaceae family, and an annual herb also found in agricultural fields from study area. (Abbas *et al.*, 2010)

In this connection the present piece of work was designed to study the allelopathic effects of these two weeds on seed germination and seedling growth of maize and wheat.

MATERIALS AND METHODS

The experiments were conducted under laboratory conditions at Post Graduate Research Centre, Department of Botany, Tuljaram Chaturchand College, Baramati, Dist. Pune, Maharashtra. The healthy and diseased free weeds *viz. Trichodesma indicum* and *Tribulus terrestris* were collected from different agricultural fields of Baramati Tahsil.

The collected weeds were repeatedly washed with distilled water to remove the soil and dust particles. The aqueous extracts of root, stem, leaves and whole plant of both the weeds were prepared using 10g fresh tissue. The aqueous extracts were filtered through Whatman No.1 filter paper and filtrates were brought to 100ml with addition of distilled water. 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.

The test crops *viz.* maize and wheat seeds were surface sterilized with 0.1% $HgCl_2$ (w/v) solution followed by washing with sterilized distilled water for several times, then carefully dried and used for experiments of seed germination and seedling growth.

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 ± 2^0 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) was used to compare the effect of the aqueous extracts on germination and seedling growth of test crops. Treatment effects were considered on the level of $P < 0.05$ significance.

RESULT & DISCUSSION:

The present study clearly demonstrated an inhibitory effect of whole plant as well as three plant parts (roots, stem and leaf) of common weeds *Trichodesma indicum* and *Tribulus terrestris* aqueous extracts on seed germination and seedling growth of *Zea mays* and *Triticum aestivum*.

a) Effect of aqueous extracts of *Trichodesma indicum* (L.) R. Br. on seed germination and seedling growth of *Zea mays* L. and *Triticum aestivum* L.:

Aqueous extracts of root, stem and leaf at various concentration severely inhibited plumule as well as radicle length of *Zea mays* and *Triticum aestivum* seedlings. Whole plant aqueous extracts at 20% concentration showed remarkable inhibitory effect on seedling growth of test crop species. Aqueous extracts of root and stem proved more inhibitory effect on plumule elongation than radicle of *Zea mays* seedlings than *Triticum*

aestivum. Aqueous extracts of all plant parts at 5% concentration have been recorded 76.25% and 76.50% for maize and wheat respectively. However, the order of inhibition of aqueous extracts of *Trichodesma indicum* is whole plant > root > stem > leaf (Table No.1).

b) Effect of aqueous extracts of *T. indicum* (L.) R. Br. on seedling growth of *Z. mays* L. and *T. aestivum* L.:

Aqueous extracts of root, stem and leaf at various concentration severely inhibited plumule as well as radicle length of *Zea mays* and *Triticum aestivum* seedlings. As compare to root, stem and leaf, whole plant aqueous extract at 20% concentration inhibited maximum radicle than plumule length of *Zea mays* seedlings.

Root extract at higher concentration significantly inhibited radicle than plumule length of wheat seedlings. Whereas at lower concentration of aqueous extracts, plumule length has been increased in wheat seedlings (Table No.2).

c) Effect of aqueous extracts of *T. terrestris* L. on seed germination of *Z. mays* L. and *T. aestivum* L.:

Root, stem and leaf aqueous extracts at various concentration severely inhibited seed germination percentage of *Zea mays* and *Triticum aestivum* seedlings. Whole plant aqueous extracts at 20% concentration showed remarkable inhibitory effect on seedling growth of test crop species. Aqueous extracts of root and stem proved more inhibitory effect on plumule elongation than radicle of *Zea mays* seedlings than *Triticum aestivum*. Aqueous extracts of whole plant parts at 5% concentration have been recorded 32.5% and 45% for maize and wheat respectively. However, the order of inhibition of aqueous extracts of *Tribulus terrestris is* stem>whole plant>leaf>root (Table No.3).

d) Effect of aqueous extracts of *T. terrestris* L. on seedling growth of *Z. mays* L. and *T. aestivum* L.:

The effects of root, stem, leaf and whole plant aqueous extract of *Tribulus terrestris* on radicle and plumule length of the maize and wheat seedlings has showed remarkable inhibitory effects when treated with various concentrations. In maize seedlings, radicle length was more hampered than plumule at lower concentration of whole plant extract, where as in case of wheat seedlings there is significant decrease in plumule length when treated with 20% leaf extract concentration (Table No.4).

e) Statistical Analysis of Aqueous Extract Bioassay by Two-way ANOVA Method:

The results obtained from aqueous extracts of *T. indicum* and *T. terrestris* on seed germination and seedling growth on maize and wheat is statistically analyzed by two-way ANOVA method. Data presented in Table No. 5 shows *P* values-0.0149*, 0.8369 and 0.0536 >0.05 so null hypothesis is accepted and the different extracts concentration of *T. indicum* and *T. terrestris* shows homogenous effect on germination of maize and wheat seeds. *P* values-0.566, 0.631, 0.710 and 0.104>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. 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 H_0 and different extracts concentration does not shows homogenous effect on germination and seedling growth of maize and wheat.

ACKNOWLEDGEMENT:

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

REFERENCES:

Abbas, A. M., Ahmed, A. H., Heba, H. I. and Amir, H. A. (2010): Study the biological activities of Tribulus terrestris extracts. World Academy of Science (Engineering and Technology), Vol 4(1): Pp. 413-415.

Baziar, M. R., Farahvash, F., Mirshekari, B., Rashidi, V. (2014): Allelopathic effect of ryegrass (Lolium persicum) and wild mustard (Sinapis arvensis) on barley. Pakistan Journal of Botany, Vol 46(6): Pp.2069-2075.

Callaway, R. M. and Aschehoug, E. T. (2000): Invasive plants versus their new and old neighbours: a mechanism for exotic invasion. Science (Washington), 290: Pp.521–523.

Callaway, R. M. and Ridenour, W.M. (2004): Novel weapons: invasive success and the evolution of increased competitive ability. Frontiers in Ecology and Evolution, Vol 2: Pp.436– 443.

Cruz-Ortega, R., Lara-Nunez, A., and Anaya, A. L. (2007): Allelochemical stress can trigger oxidative damage in receptor plants: mode of action of phytotoxicity. Plant Signaling and Behavior, Vol 2(4): Pp.269–270.

Harborne, J.B. (1987): Chemical signals in the ecosystem. Ann. Bot., Vol 60: Pp.39-57

Machado, S. (2007): Allelopathic potential of various plant species on downy brome: implications for weed control in wheat production. Agronomy Journal, Vol 99(1): Pp.127-132.

Rice, E. L. (1986): Allelopathic growth stimulation in the science of allelopathy. John Wiley & Sons, New York.

Vanitha, A., Renganayagi, R., Prabakaran, R., Mohammed and Sudheer, M. M. (2015): Pharmacognostic Studies on Trichodesma indicum Linn. (Boraginaceae) An Ethnobotanically Important Herb from Tropics, Pharmacie Globale (IJCP), Vol 6(1): Pp.1-5.

Yuan, Y., Wang, B., Zhang, S., Tang, J., Tu, C., Hu, S., Yong, J. W. and Chen, X. (2012): Enhanced allelopathy and competitive ability of invasive plant Solidago canadensis in its introduced range. Journal of Plant Ecology, Vol 6(3): Pp. 253–263.

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

Weed plant extract concentration (%)	Sources of extracts				Average germination (%)
	Root extract	Stem extract	Leaf extract	Whole plant extract	
Maize (*Z. mays* L.)					
Control	85	80	90	85	85
05	80	80	80	65	76.25
10	70	65	65	40	60
15	60	60	60	30	52.50
20	40	45	50	15	37.50
Wheat (*T. aestivum* L.)					
Control	90	95	85	90	90
05	75.5	85.5	70	75	76.5
10	70	65.5	75	70	70.12
15	60	60	75	65	65
20	60	60	60	60	60

OPEN ACCESS

e-ISSN 2347 – 517X
Original Article

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

Weed plant extract concentration (%)	Sources of extracts							
	Root extract		Stem extract		Leaf extract		Whole plant extract	
	R	P	R	P	R	P	R	P
Maize seedling growth (cm)								
Control	6.7	7.6	5.2	5.7	6.6	6.9	6	6.6
05	6	5.1	3.3	3.6	3.2	3.4	4.1	4.7
10	4.4	4.8	3.5	3.9	4.1	3.7	4.7	4.8
15	3.9	2.9	3.6	2.9	4.5	4.1	4.1	3.1
20	**2.8**	2	3.2	2.8	5	4.2	2.6	3
Wheat seedling growth (cm)								
Control	14.7	12.9	13.2	11.1	11.6	9.3	15.2	14.7
05	15.7	10.8	13.8	11	8.7	8.1	12.6	9.9
10	21.8	11.4	12.6	9.9	11.7	9.7	15.3	11.8
15	15.5	10.2	12	9.7	9.6	8.3	12.4	10.4
20	8	7.3	9.3	8.2	9.5	6.2	10.1	8.6

R:Radicle, P: Plumule

Table-3: Effect of aqueous extracts of *T. terrestris* L. on seed germination of *Z. mays* L. and *T. aestivum* L.

Weed plant extract concentration (%)	Sources of extracts				Average germination (%)
	Root extract	Stem extract	Leaf extract	Whole plant extract	
Maize (*Z. mays* L.)					
Control	85	85	90	95	88.75
05	40	20	40	30	32.5
10	20	10	20	10	15
15	10	0	0	0	10
20	0	0	0	0	0
Wheat (*T. aestivum* L.)					
Control	90	85	90	95	90
05	50	30	60	40	45
10	40	10	30	20	25
15	30	0	20	10	15
20	10	0	20	0	7.5

Table-4: Effect of aqueous extracts of *T. terrestris* L. on seedling growth of *Z. mays* L. and *T. aestivum* L.

Weed plant extract concentration (%)	Sources of extracts							
	Root extract		Stem extract		Leaf extract		Whole plant extract	
	R	P	R	P	R	P	R	P
Maize seedling growth (cm)								
Control	10.4	12.4	10.7	12.3	11.4	13.4	10.2	11.4
05	9.8	10.3	6.7	7.3	8.3	8.8	4	6.8
10	7.4	8.8	3.6	5.1	4.1	6	3.4	4.8
15	4.2	5.3	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
Wheat seedling growth (cm)								
Control	13.5	12.4	12.5	13.7	12.8	13.2	12.6	13.8
05	11.3	11.9	12.7	11.5	8.4	10.3	10.1	11.3
10	9.2	10.3	5.7	6.9	6.2	8.1	8.7	9.6
15	7.9	9.1	0	0	4.9	5.7	3.2	2.9
20	2.5	2.1	0	0	2.1	2.8	0	0

Table-5: Statistical Analysis of Aqueous Extract Bioassay by Two-way ANOVA Method

Weed	Crop	Variable	Factor	*Df*	MS	*F* value	*P* value
T. indicum	Maize	Germination	Block	3	647.4	33.00	3.48e-05***
			Treatment	3	1039.1	52.97	4.48e-06***
			Residual	9	19.6		
		Radicle	Block	3	0.6342	0.717	0.566
			Treatment	3	0.5308	0.600	0.631
			Residual	9	0.8847		
		Plumule	Block	3	0.2958	0.470	0.710
			Treatment	3	1.7358	2.759	0.104
			Residual	9	0.6292		
	Wheat	Germination	Block	3	9.22	0.282	0.8369
			Treatment	3	199.64	6.111	0.0149*
			Residual	9	32.67		
		Radicle	Block	3	19.684	3.571	0.0600
			Treatment	3	25.164	4.565	0.0331*
			Residual	9	5.512		
		Plumule	Block	3	3.604	8.369	0.0057.3***
			Treatment	3	7.156	16.617	0.000518***
			Residual	9	0.431		
T. terrestris	Maize	Germination	Block	3	83.3	3.75	0.0536
			Treatment	3	883.3	39.75	1.61e-05***
			Residual	9	22.2		
		Radicle	Block	3	9.13	5.534	0.0198*
			Treatment	3	43.86	26.596	8.33e-05***
			Residual	9	1.65		
		Plumule	Block	3	8.68	6.252	0.0139*
			Treatment	3	61.82	44.529	1e-05***
			Residual	9	1.39		
	Wheat	Germination	Block	3	506.2	17.78	0.000401***
			Treatment	3	1056.2	37.10	2.15e-05***
			Residual	9	28.5		
		Radicle	Block	3	7.19	1.814	0.214642
			Treatment	3	67.82	17.105	0.000464***
			Residual	9	3.97		
		Plumule	Block	3	9.80	2.88	0.095138
			Treatment	3	79.48	23.383	0.000139***
			Residual	9	3.40		

-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