Eco. Env. & Cons. 28 (August Suppl. Issue) : 2022; pp. (S347-S351)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i04s.053

Allelopathic Interference of Weeds on Rice Germination

P.N. Dongre[1]* and Balram Prasad Yadav[2]

[1]KN Government P.G. College, Gyanpur, Bhadohi 221 304, U.P., India
[2]Nagarik P G College, Janghai, Jaunpur, U.P., India

(Received 16 December, 2021; Accepted 3 February, 2022)

ABSTRACT

In an *in vitro* study, effect of different weed leaf leachates on average seed germination and root length in two varieties of rice, *viz.*, Nati Mansuri and Sonam was estimated at different leachate concentrations. The selected 12weed species included *Caesulia axillaris*, *Chenopodium album*, *Commelina benghalensis*, *Cyperus difformis*, *Cyperus rotundus, Cyperus squarrosus*, *Echinochloa crus-galli*, *Eclipta alba, Lathyrus aphaca, Melilotus indica*, *Parthenium hysterophorus* and *Panicum frumentaceae.* The leaf leachates of nearly all the test weeds were found to have inhibitory effects on percent germination, shoot length and root length of both the test cultivars of rice at different concentrations. The inhibitory response was found to be positively correlated with the leachate concentration and in most cases of test cultivar-weed interactions, statistically significant decrease in percent germination, shoot length and root length was observed at 15% treatment level in all treatments.

Key words*: Allelopathy, Rice, Interference, Weeds*

Introduction

Weeds are the plants that grow where they are not wanted. They grow in the crop field where they compete with crops for water, soil nutrients, light and space and thus reduce crop yields (Tata, 1980), according to Rice (1984), the competition offered by weeds to crops is also accompanied by release of some chemicals, which may also have some deleterious effects on growth of crops. Such chemicals are usually referred as allelochemicals and direct or indirect harmful effect of one plant through such chemical on another referred as allelopathy. The overall response of one plant on another through both competition and allelopathy is referred as interference.

Most of studies on crop weed interference in first half of twentieth century were primarily concerned with estimation of crop yield losses in fields infested with weed and in most cases losses in yields of crops were supposed to be due to competition offered by weeds. But in last fivedecades increasing number of efforts have been directed towards supplementing yield loss data with effect of weed leachates/extracts on germination and growth responses of crop seeds *in vitro.* With rapid advancement in biochemistry, a wide variety of chemicals have been identified to possess allelopathic potential and have been reviewed by Neish (1964), Whittaker and Feeny (1971), Robinson (1983), Rice (1984), Kobayashi and Ito (1998) and Mizutani (1999). Most of the allelochemicals are secondary metabolites in nature.

Many weed species are considered troublesome in cropping systems (Aldrich and Kremer, 1997; Holm *et al.,* 1997), and approximately 250 weed species are known to be problematic in agriculture

(Worsham, 1989). Up to the first half of twentieth century the drastic effects of most weeds on crops were attributed to *competition* but since then increasing number of researches have indicated allelopathy as an important mechanism of crop *interference* by weeds. In most studies the scientists have usually based their experiments on treatment of crop seeds by weed leachates/ extracts to observe their effect on germination and seedling growth in laboratory. A huge amount of scientific literature on this aspect of allelopathy has been published in last three decades, most of which comes from developed countries. India takes only a middle rank in allelopathy research and most of the research papers published by Indian scientists are based on bioassay studies (Narwal, 1999). The allelopathic research in India has gained a new impetus in last 25 years as about 65% of total research papers published by Indian scientists have appeared after 1990 (Narwal, 1999). However, very little amount of allelopathic research has been conducted in Uttar Pradesh, especially Eastern Uttar Pradesh.

In India, studies on allelopathic effects have not been given due attention considering the extent of weed flora which remains closely associated with different crop fields in wake of poor cultural practices and poor weed management strategies. Germination studies constitute an important methodology to establish weed allelopathy as an important mechanism of crop interference. In such studies observations are usually recorded on the effect of the different concentration of weed leachates/extracts on percent germination, plumule length and radicle length. In this study an attempt has been made to observe the allelopathic effects of weeds dominantly growing in crop fields of eastern Uttar Pradesh on germination and seedling growth of rice (*Oryza sativa* L.).

Materials and Methods

The present *in vitro* was study was carried out at K. N. Govt P G College, Gyanpur, Bhadohi. Mature plants of 12 major weed species of study area) namely *Caesulia axillaris*, *Chenopodium album* L. (Common lambsquarters), *Commelina benghalensis* L. (Day flower),, *Cyperus difformis*, *Cyperus rotundus*, *Cyperus squarrosus*, *Echinochloa crus-galli*(L.) Beauv. (Barnyard grass), *Eclipta alba* Hassk. (Trailing eclipta), *Lathyrus aphaca, Melilotus indica* (All.) Fl. Pedem. (Yellow sweet clover), *Parthenium hysterophorus* L. (Congress grass) and *Panicum frumentaceae* were collected from crop fields and brought to the laboratory. The fresh leaves were cut into small pieces ($1cm^2$) and soaked into sterilized water in ratio of 1: 2 (w/v) for 24h. The leachates were filtered through Whatmann filter paper no.1 and filtrates were considered to be 50% leachate concentration that were stored in glass bottles in dark. The seeds of two varieties of rice (*Oryza sativa* L.), namely, Nati Mansuri and Sonam were treated with different concentrations of leaf leachates. Twenty-five seeds were placed equidistantly in 10 cm dia. petriplates fitted with two layers of filter paper. 15 ml of 5, 10, 15 and 20% leachates of each weed species were added into the petriplates as per treatments. Sterilized water was used as control. The treatments were replicated five times in complete randomized design. Number of seeds germinated was counted on 1, 2, 3, 4, 5, 6 and 7 days after sowing (DAS) and seedling growth was measured at 7 DAS. The data were analyzed statistically using critical difference at 5% level of significance.

Results and Discussion

Table-1 shows the comparison of effect of different weed leaf leachates on average seed germination, shoot length and root length in two varieties (Nati Mansuri and Sonam) of rice at 15% concentration. It is evident that maximum inhibition of germination as compared to control was caused by leaf leachates of *Parthenium hysterophorus* (35.6%) followed by *Eclipta alba* (31.9%), *Ageratum conyzoides* (28.6%), *Lathyrus aphaca* (21.9%), *Chenopodium album* (20.6%), *Melilotus indica* (20.2%), *Cyperus difformis* (17.8%), *Commelina benghalensis*, *Cyperus squarrosus* (both 15.7%), *Cyperus rotundus* (14.8%), *Caesulia axillaris*, (13.2%), *Panicum frumentaceae* (12.77%) and *Echinochloa crus-galli* (12.3%).

In caseof shoot length, maximum inhibition of shoot length was caused by leaf leachates of *Parthenium hysterophorus* (34.8%) followed by *Eclipta alba* (33.3%), *Caesulia axillaris*, *Cyperus difformis* (both 30.4%), *Panicum frumentaceae* (30.3%), *Cyperus rotundus*, *Cyperus squarrosus* (both 28.2%), *Echinochloa crus-galli* (28.1%), *Commelina benghalensis* (26.6%), *Melilotus indica* (24.7%), *Chenopodium album* (24.0%) and *Lathyrus aphaca* (22.2%).

Maximum inhibition of root length was caused by leaf leachates of *Parthenium hysterophorus* (32.8%) followed by *Eclipta alba* (31.3%), *Panicum*

Table 1. Effect of leaf leachates of selected weeds on germination and seedling growth of two varieties of rice (*Oryza sativa* L.) at 7 DAS

Treatment	Nati Mansuri			Sonam		
	Germination (%)	Shoot length (cm)	Root Length (cm)	Germination (%)	Shoot length (cm)	Root Length (cm)
			Caesulia axillaris			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	94.4(-0.84)	8.98(-7.0)	5.62(-15.6)	93.6(-4.0)	9.36(-5.4)	6.34(-8.6)
10	92.0(-3.3)	7.96(-17.5)	4.96(-25.5)	88.8(-9.0)	8.46(-14.5)	5.84(-15.8)
15	87.2(-8.4)	6.86(-28.9)	4.68(-29.7)	80.0(-18.0)	6.84(-30.9)	5.22(-24.7)
20	82.4(-13.4)	6.14(-36.4)	4.32(-35.1)	80.0(-18.0)	6.00(-39.3)	4.70(-32.2)
CD at 5%	3.80	0.13	0.09	1.80	0.19	0.11
			Chenopodium album			
Control	91.2	7.54	4.96	93.6	8.14	6.82
5	89.6(-1.7)	7.20(-4.5)	4.6(-7.2)	86.4(-7.6)	7.24(-11.0)	6.30(-7.62)
10	80.8(-11.4)	6.02(-20.1)	3.94(-20.6)	74.4(-20.5)	6.62(-18.6)	5.56(-18.4)
15	76.8(-15.7)	5.60(-25.7)	3.84(-22.5)	69.6(-25.6)	6.32(-22.3)	5.14(-24.6)
20	71.2(-21.9)	5.18(-31.2)	3.44(-30.6)	66.4(-29.0)	5.86(-28.0)	4.40(-35.4)
CD at 5%	2.02	0.36	0.12	1.75	0.14	0.15
			Commelina benghalensis			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	93.6(-1.6)	9.04(-6.4)	6.28(-5.7)	92.8(-4.9)	9.52(-3.8)	6.16(-11.2)
10	92.0(-3.3)	7.96(-17.5)	5.96(-10.5)	88.8(-9.0)	8.52(-13.9)	5.50(-20.7)
15	81.6(-14.2)	7.04(-27.1)	5.28(-20.7)	80.8(-17.2)	6.72(-32.1)	4.98(-28.2)
20	74.4(-21.8)	6.56(-32.0)	4.82(-27.6)	77.6(-20.4)	6.70(-32.3)	3.98(-42.6)
CD at 5%	2.58	0.39	0.08	3.00	0.09	0.12
			Cyperus defformis			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	95.2(-0.0)	9.00(-6.8)	6.28(-5.7)	92.8(-4.9)	9.42(-4.8)	6.84(-1.4)
10	90.4(-5.0)	8.16(-15.5)	5.86(-12.0)	87.2(-10.6)	8.56(-13.5)	6.46(-6.9)
15	78.4(-17.6)	6.88(-28.7)	5.44(-18.3)	80.0(-18.0)	6.72(-35.3)	6.00(-13.5)
20	73.6(-22.6)	6.46(-33.1)	4.42(-33.3)	77.6(-20.4)	6.40(-35.3)	5.36(-22.7)
CD at 5%	2.67	0.10	0.22	2.53	0.11	0.10
			Cyperus rotundus			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	94.4(-0.8)	9.02(-6.6)	6.12(-8.1)	92.8(-4.9)	9.34(-5.6)	6.40(-7.7)
10	91.2(-4.2)	8.08(-16.3)	5.60(-15.9)	88.8(-9.0)	8.46(-14.5)	5.60(-19.3)
15	84.8(-10.9)	6.90(-28.5)	5.24(-21.3)	79.2(-18.8)	7.12(-28.0)	4.86(-29.0)
20	77.6(-18.4)	6.30(-34.7)	4.86(-27.0)	75.2(-22.9)	6.88(-30.5)	4.40(-36.5)
CD at 5%	3.14	0.38	0.10	1.99	0.19	0.12
			Cyperus squarrosus			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	93.6(-1.6)	8.60(-10.9)	5.88(-11.7)	92.0(-5.7)	9.50(-4.0)	6.64(-4.3)
10	88.0(-7.5)	7.98(-17.3)	5.08(-23.7)	88.0(-9.8)	8.48(-14.3)	5.44(-21.6)
15	82.4(-13.4)	6.88(-28.7)	4.82(-27.6)	80.0(-18.0)	7.14(-27.8)	4.82(-30.5)
20	76.8(-19.3)	6.20(-35.8)	4.50(-32.4)	75.2(-22.9)	6.70(-32.3)	4.30(-38.0)
CD at 5%	2.17	0.40	0.64	2.42	0.18	0.09
			Echinochloa curs-galli			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	92.8(-2.5)	9.02(-6.6)	6.14(-7.8)	93.6(-4.0)	9.34(-5.6)	6.32(-8.9)
10	88.0(-7.5)	7.86(-18.6)	5.50(-17.4)	89.6(-8.9)	8.52(-13.9)	5.24(-24.4)
15	85.6(-10.0)	6.90(-28.5)	4.88(-26.7)	83.2(-14.7)	7.14(-27.8)	5.02(-27.6)
20	80.8(-15.1)	6.16(-36.2)	4.62(-30.6)	80.0(-18.0)	6.56(-33.7)	4.26(-38.6)
CD at 5%	2.32	0.09	0.11	2.37	0.21	0.15

Table 1. *Continued ...*

Treatment	Nati Mansuri			Sonam		
	Germination (%)	Shoot length (cm)	Root Length (cm)	Germination (%)	Shoot length (cm)	Root Length (cm)
			Eclipta alba			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	87.2(-8.40)	8.60(-10.9)	6.06(-9.0)	87.2(-10.6)	9.20(-7.0)	6.30(-9.22)
10	69.6(-26.8)	7.62(-21.1)	5.54(-16.8)	81.6(-16.3)	8.04(-18.7)	5.66(-18.4)
15	61.6(-35.2)	6.52(-32.5)	4.28(-35.7)	69.6(-28.6)	6.52(-34.1)	5.06(-27.0)
20	59.2(-37.80)	6.08(-37.0)	3.78(-43.2)	60.8(-37.7)	5.92(-40.2)	4.28(-38.3)
CD at 5%	4.31	0.17	0.10	1.55	0.14	0.10
			Lathyrus aphaca			
Control	91.2	7.54	4.96	93.6	8.14	6.82
5	89.6(-1.7)	7.26(-3.7)	4.52(-8.8)	87.2(-6.8)	7.32(-10.0)	6.36(-6.7)
10	82.4(-9.6)	6.12(-18.8)	4.04(-18.5)	76.0(-18.8)	6.72(-17.4)	5.72(-16.1)
15	77.6(-14.9)	5.76(-23.6)	3.94(-20.5)	66.4(-29.0)	6.36(-21.8)	5.18(-24.0)
20	72.0(-21.0)	5.42(-28.1)	3.60(-27.4)	64.8(-30.7)	5.92(-27.2)	4.84(-29.0)
CD at 5%	1.96	0.15	0.12	2.08	0.12	0.11
			Melilotus indica			
Control	91.2	7.54	4.96	93.6	8.14	6.82
5	89.6(-1.7)	6.92(-8.2)	4.50(-9.2)	89.6(-4.2)	7.26(-10.8)	6.44(-5.5)
10	84.8(-7.0)	6.06(-19.6)	3.98(-19.7)	75.2(-19.6)	6.62(-18.6)	5.72(-16.1)
15	80.0(-12.2)	5.60(-25.7)	3.68(-25.8)	67.2(-28.2)	6.20(-23.8)	5.18(-24.0)
20	73.6(-19.2)	5.32(-29.4)	3.48(-29.8)	65.6(-29.9)	5.92(-27.2)	4.66(-31.6)
CD at 5%	1.59	0.17	0.11	2.42	0.08	0.14
			Parthenium hysterophorus			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	83.2(-12.6)	8.56(-11.3)	5.92(-11.1)	85.6(-12.2)	9.08(-8.2)	6.28(-9.5)
10	64.0(-32.7)	7.48(-22.5)	5.54(-16.8)	80.8(-17.2)	7.88(-20.4)	5.56(-19.8)
15	57.0(-40.1)	6.34(-34.3)	4.20(-36.9)	67.2(-31.1)	6.40(-35.3)	4.94(-28.8)
20	55.2(-42.0)	5.76(-40.3)	3.72(-44.1)	57.6(-40.9)	5.86(-40.8)	4.14(-40.3)
CD at 5%	2.64	0.19	0.10	1.64	0.13	0.10
			Panicum frumentaceae			
Control	95.2	9.66	6.66	97.6	9.90	6.94
5	92.8(-2.5)	9.02(-6.6)	6.08(-8.7)	93.6(-4.0)	9.42(-4.8)	5.96(-14.1)
10	90.4(-5.0)	8.00(-17.1)	4.92(-26.1)	89.6(-8.1)	8.54(-13.7)	5.50(-20.7)
15	85.6(-10.0)	6.92(-28.3)	4.40(-33.9)	82.4(-15.5)	6.70(-32.3)	5.10(-26.5)
20	78.4(-17.6)	6.02(-37.6)	4.02(-39.6)	80.0(-18.0)	6.68(-32.5)	4.72(-31.9)
CD at 5%	1.83	0.16	0.20	2.36	0.10	0.10

frumentaceae (30.2%), *Cyperus squarrosus* (29.0%), *Caesulia axillaris* (27.2%), *Echinochloa crus-galli* (27.1), *Cyperus rotundus* (25.6%), *Melilotus indica* (24.9%), *Commelina benghalensis* (24.4%), *Polygonum plebeium* (24.1%), *Chenopodium album* (23.5%), *Lathyrus aphaca* (22.2%), and *Cyperus difformis* (15.9%).

Increase in leachate concentration was invariably associated with further decrease in germination performance of each test variety irrespective of weed species. These and other related weed species have also been shown to inhibit crop growth in several other reports (Abdelsamed *et al.* (2019); Agarwal and Anand, 1992; Chon and Nelson (2010); Dafaallah *et al.* (2017); Dhawan and Dhawan, 1995; Indarjit and Dakshini, 1996; Gulzar and Siddiqui (2014); Ishak and Sahid (2014); Joshi *et al.* (2015); Kalita, 1999; Kong *et al.* 1999; MacDonald (2013); Mukhtar *et al.* (2011); Nurul *et al.* (2017); Rehman *et al.* (2010); Varshney *et al.*, 2001).

References

Abdelsamed I. Elshamy, Abdelsamed I. , Ahmed M. AbdElGawad, Yasser A. ElAmier , Abd ElNasser G. El Gendy, Saud L. and AlRowaily, 2019. Interspecic variation, antioxidant and allelopathic activity of the essential oil from three *Launaea* species growing naturally in heterogeneous habitats in Egypt. *Flavour and Fragrance Journal.* 34(5).

Agarwal, C. and Anand, A. 1992. Ecological studies on allelopathic potential of *Parthenium hysterophorus* L. in relation to *Phaseolus aureus* L. and *Triticum aestivum* L., In: *Proceedings of First National Symposium on Allelopathy in Agroecosystems* (Eds., P. Tauro and S. S. Narwal) Haryana Agricultural University, Hisar, India, 64-65.

Aldrich, R. J. and Kremer, R. J. 1997. *Principles in Weed Management*, Iowa State Univ. Press, Ames.

Chon, S. U. and Nelson, C. J. 2010. Allelopathy in Compositae plants. A review, *Agronomy for Sustainable Development.* 30 : 349–358

Dafaallah, Awadallah, B. Amna, O. Abdelrhman and Muna H. Yousif. 2017. Allelopathic effects of pigweed (*Amaranthus viridis* L.) on seed germination and seedling growth of some poaceous crops. *University of Bakht Alruda Scientific Journal.* 20 : 151-163.

Dhawan, P. and Dhawan, S. R. 1995 Allelochemical effect of *parthenium hysterophorus* on the germination behaviour of some agriculture crops. *Floara and Founa*. 1 : 59-60.

Gulzar, Aasifa and Siddiqui, M. B. 2014. Allelopathic effect of aqueous extracts of different part of *Eclipta alba* (L.) Hassk. on some crop and weed plants. *Journal of Agricultural Extension and Rural Development.* 6(1) : 55-60

Holm, L. G., Holm, E., Pancho, J. and Herberger , J. 1997. *World Weeds: Natural Histories and Distribution*. Wiley New York.

Inderjit and Dakshini, K. M. M. 1996. Allelopathic potential of *Pluchea lanceolata*: A comparative study of weed infested cultivated fields. *Weed Science.* 44 : 712- 724.

Ishak, Muhamad and Ismail Sahid, 2014, Allelopathic Effects of the Aqueous Extract of the Leaf and Seed of *Leucaena leucocephala* on Three Selected Weed Species, *AIP Conference Proceedings*. 1614, 659, 659-664.

Joshi, Nitesh, Neha Nangia and Ambika Joshi, 2015. Seed Germination Studies on Allelpathic Effects of Weedson*Vigna radiata* L., *Int. J. Bioassays*. 4(02) : 3664-3666.

Kalita, D. 1999. Allelopathic effects of weeds on physicochemical properties of rice and nutrient status of soil. *J. Agric. Chem.* 32 : 7-15.

Kobayashi, Y. and Ito, M. 1998. Valuation of phytotoxic activity of naturally occurring phenolic compounds. *Journal of Weed Science and Weed Technology.* 43 : 341-348.

Kong, C. H., Fei Hu, Tao Xu and Yonghuilu, 1999. Allelopathic potential and chemical constituents of volatiles from *Ageratum conyzoides*, *J. Chem. Ecol*. 25(10): 2347-2356.

MacDonald, Idu and Ovuakporie-Uvo Oghal, 2013, Studies on the Allelopathic Effect of Aqueous Extract of*Ageratum conyzoides* Asteraceae on Seedling Growth of*Sesamumindicum* L. (Pedaliaceae). *International Journal of Science, Environment and Technology,* 2(6): 1185–1195.

Mizutani, J. 1999. Selected Allelochemicals. *Critical Reviews in Plant Sciences*. 18 : 653-671.

Mukhtar, Irum and Rukhsana Bajwa, 2011. Effect of Aqueous Extracts of Some Weeds on Germination and Seedling Growth of Tomato (*Lycopercicon esculentum* Mill.), *Pak. J. Phytopathol.* 23(2) : 138-143.

Narwal, S.S. 1999. *Research on Alleiopathy in India*. In *Allelopathy Update, Vol I, International Status* (ed. S. S. Narwal), Oxford and IBH Pub.Co. New Delhi, 123-184.

Neish, A.C. 1964. Major pathways of biosynthesis of phenols, In: *Biochemistry of Phenolic Compounds* (Eds., J.B. Harborne), New York : Academic Press, 295-359.

NurulAin, M.B., Nornasuha, Y. and Ismail, B.S. 2017. Evaluation of the Allelopathic Potential of Fifteen Common Malaysian Weeds. *Sains Malaysiana.* 46(9): 1413–1420.

Rehman, Tanveer, A. A., Javaid M. M., Abbas R. N., Sibtain M., Ahmad A., Ibin-I-Zamir M. S., Chaudhary, K. M. and Aziz, A. 2010. Allelopathic potential of *Euphorbia helioscopia* L. against wheat (*Triticum aestivum* L.), chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medic.) Turk J Agric For 34: 75-81.

Rice, E.L. 1984. *Allelopathy* (II ed.). New York: Academic Press

Robinson, T. 1983. *The Organic Constituents of Higher Plants*. 5th ed., North Amherst, Massechusetts , USA: Corus Press.

Tata, S.N. 1980. *Handbook of Agriculture.* Indian Council of Agricultural Research, New Delhi, p-263.

Varshney, J. G., Singh, B. D. and Prakash, Om. 2001. Effect of aqueous extracts of winter weed species on nutsedge (*Cyperus rotundus*) germination and growth. *Allelopathy Journal.* 8: 85-88.

Whittaker, R.H. and Feeney, P.P. 1971. Allelochemics: Chemical Interactions between species. *Sceince.* 171: 757-770.

Worsham, A. D. 1989. Current and Potential Techniques using Allelopathy as an Aid in Weed Management. In Chou C H and GR waller, eds, *Phytochemical Ecology: Allelochemicals, Mycotoxins, and Insect Pheromones and Ailomones.* Taipei, Taiwan: Academia Sinica Monograph Series, Pp. 275-291.