Journal of Phytology 2011, 3(6): 51-55
ISSN: 2075-6240
www.scholarjournals.org

JOURNAL OF PHYTOLOGY

www.journal-phytology.com

Allelopathic Effect of *Ixora coccinea* Linn. on Seed Germination and Early Seedling Growth of Paddy (*Oryza sativa* L.)

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Article Info

Article History

Received : 21-03-2011
Revised : 03-06-2011
Accepted : 07-06-2011

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Summary

Experiments were conducted to evaluate the allelopathic potential of *Ixora coccinea* aqueous (leaf, flower and leaf-flower) extracts on paddy (*Oryza sativa* L.) var. *ambai*-16 seed germination and seedling growth under *in vitro* condition. The results indicated that the leaf extract of *Ixora* showed more negative allelopathic (stimulatory) effect on seed germination, seedling growth, biomass production, seedling vigour index and tolerance index of paddy at low concentration as compared to control, while the higher concentrations of leaf extract and all concentrations of flower and leaf-flower extracts showed positive allelopathic (inhibitory) effect on seed germination and seedling growth parameters of paddy recorded.

Key Words: Allelopathy, *Ixora coccinea*, Aqueous extracts, Leaf extract, Flower extract, Leaf-flower extract, Paddy, *Oryza sativa*

Introduction

Use of phytochemicals and biopesticides has recently been given much emphasis against the use of chemical fungicides and pesticides due to their eco-friendliness. This is more relevant, where vegetable parts such as leaves are the economic products [1]. Many of this alternative biochemical has been reported to have allelopathic effects which inhibit seed germination and growth in many other crop plants. Many workers [2-8] reported that the extract from fresh flowers inhibited seed germination at all concentrations compared to water control. On the other hand, at certain low level of concentration of the allelochemicals, the stimulation of the growth of the affected plant could be detected [9]. The stimulatory (negative) allelopathic effects of any plant on the other plant can be used to develop eco-friendly, cheap and effective green growth promoters [10]. For achieving these targets it is essential to evaluate the allelopathic potential of the common weeds [10-12].

Ixora coccinea Linn, (Rubiaceae) is known as 'Jungle of Geranium (or) Flame of the Woods or Idly Poo (in Tamil) or vetchi in Ayurvedha. It is a common flowering shrub native to Asia. It is traditionally used as hepatoprotective, chemoprotective, antimicrobial, and antioxidant, antinociceptive, anti-mitotic and anti-inflammatory activities. Decoction of roots used for nausea, hiccups and anorexia. Powered roots used for sores and chronic ulcers In indo – china, root decoction used to clarify the urine, poultice fresh leaves and stems for sprains, eczema, boils and contusions [13]. The appearance of orange colour in flowers is due to the presence of flavonoids and anthocyanins [14]. The present study was carried out to assess the allelopathic effect of *Ixora coccinea* aqueous extracts on germination and early seedling growth of paddy var. Ambai-16.

Materials and Methods

The leaf and flower of *Ixora coccinia* were collected, about 20 grams of leaf and flower was taken, washed with water and blend by using an electric mixer by adding 100ml water. For leaf + flower extract preparation, 10grams of leaf and 10grams of flower were taken. Then, the extracts were filtered with double layered muslin cloth, centrifuged at 5000rpm for 5 minutes and the supernatant was collected. The supernatant of flower extract was made up to 100ml of final volume (20% w/v), considered as 100% stock solution. This stock solution (100%) was diluted with water for preparing different concentrations of aqueous leaf and flower extracts viz. 10, 20, 50, and 100% (v/w) level and used for germination studies with paddy seeds.

The paddy (var. Ambai-16) seeds were spread in new plastic cups (20 seeds/cup) lined with double layered filter paper. Then, the paddy seeds were treated with 20ml of aqueous leaf, flower and leaf + flower extracts of *I. coccinea* at different concentrations (10%, 20%, 50%, and 100% v/v, level) separately, and water was used as control. For each treatment, including control, three replications were maintained. Thereafter, the paddy seeds were moistened with water whenever necessary throughout the study period.

All the three sets of plastic cup containing *I. coccinea* extracts treated seeds were incubated at room temperature ($28^{o}C \pm 2^{o}C$) for 10 days in a seed germination rack illuminated with fluorescent light during day time till the day of final measurements recorded. The per cent seed germination was calculated at the end of 10^{th} day after sowing. The protrusion of radical through seed coat was taken as the criterion of germination. Ten paddy seedlings from each replication of all treatments including control were selected randomly for recording the morphological parameters, such as seedling growth (root, shoot and total length), and biomass production

(fresh and dry weight). The seedling vigour index [15], seedling tolerance index [16] and seedling root/shoot ratio were also determined.

Results and Discussion

The seed germination of paddy was generally promoted by the *Ixora* leaf aqueous extract at all concentrations, tested, as compared to control (Table 1) and followed by flower extract upto 50% concentration (Table 2) and by leaf + flower extract upto 5% concentration (Table 3). Maximum germination of 96.67%, 95% and 93.33% was recorded in leaf extract (5%), flower extract (10%) and leaf + flower extract (5%) of *I. coccinea*. The seed germination paddy was gradually decreased with increasing concentration of *I. coccinea* extracts.

The leaf extract of *Ixora* increased the seedling growth (root, and shoot) of paddy upto 20% level, followed by a reduction at higher concentrations as compared to control, while flower and leaf-flower extracts showed inhibitory effect at all concentrations, tested (Table 1-3; Fig. 2,3). The increasing concentrations of all extracts gradually decreased the seedling growth of paddy. Maximum increase of 9.95cm/pl root growth (48.76%), and 10.64cm/pl shoot growth (41.11%) was noted at 5% level of leaf extract over control. The extracts favoured more shoot growth than the root growth of paddy at all concentrations (Table 3, Fig. 4). The effect of leaf and flower extract on root/shoot ratio was significant, while the effect was non-significant in leaf-flower extract of *Ixora*.

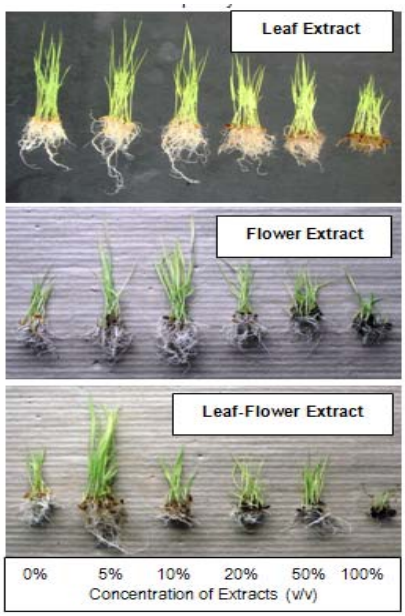


Table 1. Allelopathic effect of *Ixora coccinea* plant aqueous leaf extract on seed germination and seedling growth# of paddy (*Oryza sativa,* L.) var. Ambai-16

Concentration of Ixora leaf extract	Seed Germination (%)	Seedling growth (cm/pl) Root Length	Shoot Length	Root/ Shoot Ratio	Seedling Vigour Index	Seedling Tolerance Index	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
T_1- Control	86.39	6.69	7.54	0.89	1230.33	1.00	84.72	16.78
	±3.36	±0.33	±0.39	±0.02	±84.92	±0.00	±5.69	±0.55
T_2 – 5%	96.67	9.95	10.64	0.94	1994.33	1.48	101.00	18.67
	±2.36	±1.58	±0.65	±0.17	±189.80	±0.16	±4.32	±0.47
T_3 – 10%	95.00	9.17	9.48	0.97	1772.00	1.38	100.67	18.67
	±0.00	±2.11	±0.25	±0.24	±190.00	±0.36	±7.59	±1.70
T_4 – 20%	95.00	7.31	8.44	0.88	1495.00	1.09	89.00	17.33
	±4.08	±0.26	±0.65	±0.09	±35.33	±0.04	±3.74	±0.47
T_5 – 50%	93.33	5.92	6.63	0.90	1180.33	0.88	82.00	17.33
	±4.71	±1.46	±0.83	±0.21	±243.12	±0.19	±7.12	±0.47
T_6 – 100%	91.67	1.93	6.10	0.32	744.33	0.29	76.33	16.67
	±6.24	±0.17	±0.60	±0.05	±46.06	±0.04	±3.68	±3.30
S. Ed	3.62	1.22	0.58	0.14	152.57	0.18	6.08	1.51
CD (P=0.05)	8.07	2.72	1.3	0.32	339.94	0.4	13.55	3.37
One way ANOVA: F-value	1.980 NS	10.807 **	17.525 **	6.040 **	17.314 **	10.970 **	5.497 **	0.692 NS

= Data recorded on 10th DAS ± = Standard Deviation (SD) NS = Non-significance */ ** = significance at 5% and 1% level, respectively.

Table 2. Allelopathic effect of *Ixora coccinea* aqueous flower extract on seed germination and seedling growth# of paddy (*Oryza sativa,* L.) var. Ambai-16

Concentration of Ixora leaf extract	Seed Germination (%)	Seedling growth (cm/pl) Root Length	Shoot Length	Root/ Shoot Ratio	Seedling Vigour Index	Seedling Tolerance Index	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
T_1- Control	86.39	6.69	7.54	0.89	1230.3	1.00	84.72	16.78
	±3.36	±0.33	±0.39	±0.02	±84.92	±0.00	±5.69	±0.55
T_2 – 5%	96.67	9.95	10.64	0.67	1099.0	0.73	85.00	17.00
	±2.36	±1.58	±0.65	±0.12	±98.29	±0.09	±4.90	±0.00
T_3 – 10%	95.00	4.81	7.08	0.80	1035.7	0.72	87.33	17.00
	±4.08	±0.42	±0.94	±0.14	±62.11	±0.04	±6.85	±0.82

T_4 – 20%	91.6 ±2.36	4.32 ±0.39	5.46 ±0.71	0.80 ±0.04	894.3 ±82.83	0.65 ±0.07	71.33 ±3.40	18.67 ±0.94
T_5 – 50%	91.67 ±6.24	3.34 ±0.50	5.03 ±0.67	0.66 ±0.02	771.6 ±136.28	0.50 ±0.06	71.00 ±3.74	18.67 ±1.25
T_6 – 100%	78.33 ±4.71	1.62 ±0.70	3.24 ±0.75	0.47 ±0.13	374.33 ±94.79	0.24 ±0.10	48.67 ±4.92	19.67 ±1.25
S. Ed	4.54	0.47	0.72	0.09	104.38	0.07	3.59	0.99
CD (P=0.05)	10.12	1.05	1.60	0.19	232.57	0.16	7.99	2.20
One way ANOVA: F-value	3.327 *	25.995 **	9.952 **	5.799 **	16.887 **	24.086 **	33.253 **	2.939 NS

Ixora extracts increased the fresh biomass of paddy seedling at low concentrations as compared to control, followed by a reduction at higher concentrations. On the other hand, the dry biomass of paddy was highly reduced at lower concentrations and it was increased with increasing concentrations of flower and leaf-flower extracts, while the dry biomass was more at low concentrations (upto 50%) of leaf extract

The seedling vigour index and tolerance index of paddy towards the treatment with *Ixora* extracts was reduced with the increasing concentrations (Table 1-3, Fig. 5,6). But, the low concentration (5%) of leaf extract showed more SVI and STI over control, while higher concentrations of leaf extract and all concentrations of flower and leaf-flower extracts reduced the same.

Among the extracts of *Ixora coccinea*, the leaf extract showed more stimulatory (negative allelopathic) effect on seed germination and most of the seedling growth parameters of paddy var. ambai-16 as compared to flower and leaf-flower extracts

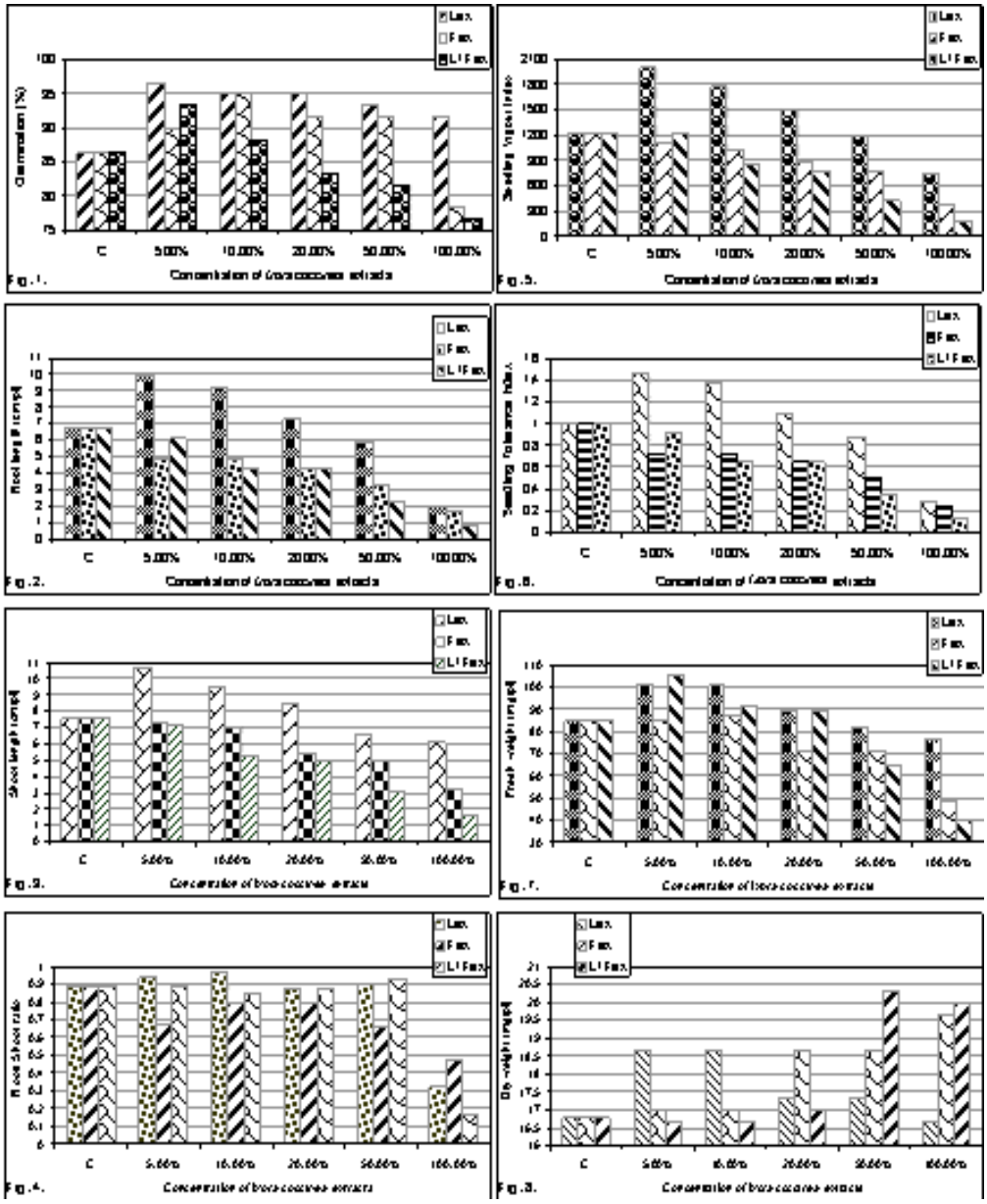
Table 3. Allelopathic effect of *Ixora coccinea* aqueous leaf + flower extract on seed germination and seedling growth# of paddy (*Oryza sativa,* L.) var. Ambai-16

Concentration of Ixora leaf + Flower extract	Seed Germination (%)	Seedling growth (cm/pl) Root Length	Seedling growth (cm/pl) Shoot Length	Root/ Shoot Ratio	Seedling Vigour Index	Seedling Tolerance Index	Fresh Weight (mg/pl)	Dry Weight (mg/pl)
T_1- Control	86.39 ±3.36	6.69 ±0.33	7.54 ±0.39	0.89 ±0.02	1230.3 ±84.92	1.00 ±0.00	84.72 ±5.69	16.78 ±0.55
T_2 – 5%	93.33 ±4.71	6.09 ±0.93	7.14 ±1.78	0.89 ±0.21	1230.0 ±202.60	0.91 ±0.11	105.33 ±8.81	16.67 ±0.94
T_3 – 10%	88.33 ±8.50	4.31 ±0.35	5.30 ±1.08	0.85 ±0.20	856.3 ±161.32	0.65 ±0.07	91.00 ±9.42	16.67 ±1.25
T_4 – 20%	83.33 ±6.24	4.30 ±0.49	4.99 ±0.46	0.87 ±0.12	778.7 ±119.45	0.65 ±0.07	89.67 ±7.13	17.00 ±0.82
T_5 – 50%	81.67 ±6.24	2.26 ±0.31	3.05 ±1.32	0.93 ±0.50	428.3 ±71.35	0.34 ±0.06	65.00 ±3.74	20.33 ±0.47
T_6 – 100%	76.67 ±4.71	0.85 ±0.64	1.63 ±0.77	0.17 ±0.17	184.3 ±93.96	0.13 ±0.10	40.33 ±6.65	20.00 ±0.82
S. Ed	6.22	0.52	1.12	0.25	134.72	0.07	7.84	0.82
CD (P=0.05)	13.85	1.15	2.49	0.55	300.18	0.16	17.46	1.83
One way NOVA: F-value	1.715 NS	37.171 **	8.408 **	1.020NS	19.603 **	44.108 **	17.416 **	9.116 **

= Data recorded on 10th DAS ± = Standard Deviation (SD) NS = Non-significance */ ** = significance at 5% and 1% level, respectively.

The allelopathic substances in plants are mainly found to be secondary metabolites [17]. In some plants, the apparent colours of the leaves, flowers and fruits are the effects of the presence of flavonoids, which exert allelopathic effect on certain plants [18]. Allelochemicals may be water soluble substances that are released into the environment through leaching, root exudation volatilization and decomposition of plant residues. The response of allelochemicals may be concentration dependent and inhibit the growth of some species at certain concentrations might infact stimulate the growth of the same or different species at different concentrations [19-20]. It is, thus, essential to identify concentrations at which each specific response occurs if allelopathic interactions are to be used in weed management programs. The allelopathicity increased with increase in concentration of plant part extracts tested in this study as reported by many workers [2, 5-7]. In addition, various plant parts used in this study was also showed variations in their allelopathic potential as suggested by [5, 21, 22]. Many reports revealed that the aqueous flower extract significantly inhibited seed germination and seedling growth parameters when compared with distilled water control [4, 6-8]. Similar observations were made in this study with the flower and leaf-flower extract of *I. coccinea*.

In this study the water extracts of *I. coccinea* showed more pronounced effects on radicle growth than on hypocotyls growth or shoot growth as reported by many workers [2, 3, 23, 24]. Such an outcome might be expected, because it is likely that roots are the first to absorb the allelochemicals or auto-toxic compounds from the environment [2, 24].



Acknowledgement

The author expresses his gratitude to the authorities of S.T. Hindu College Management, Principal and HOD, Department of Botany & Research Centre, S. T. Hindu College, Nagercoil for providing necessary facilities and encouragement.

References

[1] Pratheesh Kumar, P. M. and K. Vijayan. 1999. Effects of extracts of different plants on seed germination and seedling growth of Mulberry (*Morus indica* L) Indian J. Plant Physiol., 4(4): 343-345.

[2] Turk, M.A. and M. Tawaha. 2002. Inhibitory effects of aqueous extracts of barley on germination and growth of lentil. Pakistan J. Agronomy, 1: 28-30.

[3] Turk, M.A. and A.M. Tawaha. 2003. Allelopathic effect of black mustard (*Brassica nigra* L.) on germination and growth of wild oat (*Avena fatua* L.), Crop Protection, 22: 673-677.

[4] Turk, M.A., K.D. Lee and A.M. Tawaha. 2005. Inhibitory effects of aqueous extracts of black mustard on germination at growth of Radish. Research Journal of Agriculture and Biological Sciences, 1(3): 227-231.

[5] Ashrafi, Z.Y., H.R. Mashhadi and S. Sadeghi. 2007. Allelopathic effects of barley (*Hordeum vulgare*) on germination and growth of wild barley (*Hordeum spontaneum*). Pakistan Journal of Weed Science Research, 13(1-2): 99-112.

[6] Ashrafi, Z.Y., H.R., Mashhadi, S. Sadeghi and H.M. Alizade. 2008a. Allelopathical effects of sunflower (*Helianthus annuus*) on germination and growth of wild

barley (*Hordeum spontaneum*). In. J. Agric. Tech., 4:219-229.

[7] Ashrafi, Z.Y., S., Sdeghi, H.R. Mashhadi, and H.M. Alizade. 2008b. Study of allelopathical effects of barley on inhibition of germination and growth of seedling green foxtail. An open Access Journal Published by ICRISAT. SAT eJournal/ejournal.icriraf.org., 6:1-6.

[8] Sadeghi, S., A. Rahnavard. and Z.Y. Azhrafi. 2010. Allelopathic effect of *Helianthus annus* (sunflower) on *Solanum nigrum* (Black Nightshade) seed germination and growth in laboratory condition. J. Hort. Sci. & Ornamen. Plants, 2(1): 32-37.

[9] Rice, E.L. (1984). Allelopathy. 2nd edn, Academic Press, NewYork and London.

[10] Oudhia, P., S.S. Kolhe and R.S. Tripathi. 1998. Allelopathic effect of *Blumea lacera* L. on rice and common Kharif weeds. Oryza., 35: 175-177.

[11] Oudhia, P. 2000a. Allelopathic effect of some obnoxious weeds on germination of soybean. Indian J. Plant Physiol., 5(3): 295-296.

[12] Oudhia, P. 2000b. Germination and seedling vigour of Kodomillet as affected by allelopathy of *Ipomoea carnea* Jacq. Indian J. Plant Physiol., 5(4): 383-384.

[13] *The Wealth of India*. 2002. Dictionary of Indian Raw Materials and Industrial products – Raw Materials, National Institute of science communication New Delhi, 3: 351.

[14] Vankar P.S. and J. Srivastava. 2008. Comparative Study of Total Phenol, Flavonoid Contents and Antioxidant Activity in *Canna indica* and *Hibiscus rosa sinensis*, Prospective Natural Food Dyes, International Journal of Food Engineering, 4(3): 1-17.

[15] Abdul-Baki, A. S. and J. O. Anderson. 1973. Vigour determination in soybean seed by multiple criteria. Crop Sci., 13: 630-633.

[16] Turner, R. C. and C. Marshal. 1972. Accumulation of zinc by sub-cellar fraction of *Agrostis tenuis* root growth in relation to zinc tolerance. New Phytol., 671-676.

[17] Waller, G.R. and E.K. Noweiki. 1975. "Alkaloid Biology and Metabolism in Plants". Academic Press, New York and London.

[18] Horowtiz, R.M. 1986. In: "Plant Flavonoids in Biology and Medicine". Alan R. Liss, New York. pp. 163-175.

[19] Narwal, S.S. 1994. Allelopathy in Crop Production. Scientific Publishers. Jodhput, India, pp 288.

[20] Azania, A.A.P.M., C.A.M. Azania, P.L.C.A. Alives, R. Palaniraj, H.S. Kadian, S.C. Sati, L.S. Rawat, D.S. Dahiya and S.S. Narwal. 2003. Allelopathic Plants. 7. Barley (*Hordeum vulgare,* L.). Allelopathy Journal, 11: 1-20.

[21] Chon, S-U. and J.D. Kim. 2002. Biological activity and quantification of suspected allelochemicals from alfalfa plant parts. Journal of Agronomy and Crop Science, 188.

[22] Economou, G., O. Tzakou, A. Gani, A. Yannitsaro and D. Bilalis. 2002. Allelopathic effect of *Conyza albida*. Ecology, 17: 2021-2034.

[23] Chung, I.M. and D.A. Miller. 1995. Natural herbicide potential of alfalfa residues on selected weed species. Agron. J., 87:920-925.

[24] Turk, M.A., M.K. Shatnawi and A.M. Tawaha. 2003. Inhibitory effects of aqueous extracts of black mustard on germination and growth of alfalfa. Weed Biol. Manag., 3: