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ORIGINAL RESEARCH ARTICLE

Allelopathic effects of weed extracts on germination of wheat

Nitesh Joshi* and Ambika Joshi[2]

[1]Department of Botany, Rizvi college of Arts, Science and Commerce, University of Mumbai, India
[2]Head of Department of Botany, Jaihind College, University of Mumbai, India.

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Abstract: Effect of various aqueous extracts of weed plants, *Hyptis sauveolens* (L.), *Ricinus communis* (L.), *Alternanthera sessilis* (L.), *Ipomoea carnea* (Jacq), *Malachra capitata* (L.) and *Cymbopogon citrutus* (Stapf), on seed germination, of Triticum aestivum L. var k9 were studied. Extracts of 1%, 2%, 3% & 5% concentrations of weed extracts were prepared. the seeds of *Triticum aestivum* L. var k9 were germinated in petridishes. Final germination percentage, weight of germinated seeds and their corresponding radicle and coleoptile length was recorded at the end of 7 days along with total chlorophyll and total proteins. Seedling vigor index was calculated (SVI) using the formula percent germination× by average radical length. A control was maintained by watering the seeds with water. Statistical analysis was done to compare the mean values using T test. There was a significant reduction in all the parameters at high concentrations of the weed extracts in all the plant species under the study. The tolerance level of allelopathic activities of various weed extractsin terms of seed vigor index represented *as Cymbopogon strictus* > *Ipomoea carnea* > *Hyptis saveolens* > *Malachracapitata* > *Ricinus communis* > *Alternanthera sessilis*. All the weed extracts studied had a marked effect on all the parameters studied, suggesting sever allelopathic effects on seed germination of Wheat

Key Words: Allelopathy; Seed Germination; Weeds; Wheat.

Introduction

The term allelopathy, was introduced by Molisch in 1937, and is derived from the Greek words allelon 'of each other' and pathos 'to suffer' and mean the injurious effect of one upon the other. However, the term is today generally accepted to cover both inhibitory and stimulatory effects of one plant on another plant (Rice 1984). Some use the term in a wider sense, for instance entomologists, who include the effects of secondary compounds on plant-insect interactions. Allelopathy is defined as the direct harmful or beneficial effect of one plant on another through the production of chemical compounds that escape into the environment (Brown *et al*., 1991). Allelopathy arises from the release of chemicals by one plant species, which may affect other species in its vicinity, usually to their determinantThese chemicals are largely classified as secondary plant metabolites (such as alkaloids, isoprenoids, phenolics, flavonoids, terpanoids and gluconolates etc.). Allelochemicals are present in virtually all plant tissues, including leaves, flowers, fruits, stems, roots, rhizomes, seeds and pollen. Several chemicals can be released together and may exert toxicities in an additive or synergistic manner (Putnam andTang, 1986). Allelopathic interactions between plants have been studied in both managed and natural ecosystems. In agricultural systems allelopathy can be part of the interference between crops and between crops and weeds and may therefore affect the economical outcome of the plant production. Both crop and weed species with allelopathic activity are known (Inderjit & Dakshini, 1998; Inderjit & Foy 1999; Putnam & Weston 1986; Weston 1996).

In the current work the effects of leaf aqueous extracts of certain weeds are studied on seed germination of a common leguminous crop, Wheat *Triticum aestivum L. var k9*. Laboratory bioassay is the first step to investigate probable involvement of Allelopathy (Foy, 1999). Aqueous extract bioassays have been widely employed to evaluate Allelopathy of a suspected donor species. Extract bioassays are simple, rapid, inexpensive and straight forward.

Materials and Methods

Selection of the plants:

Aqueous extracts of leaves of *Hyptis sauveolens (L.), Ricinus communis (L.), Alternanthera sessilis (L.), Ipomoea carnea (Jacq), Malachra capitata (L.)* and *Cymbopogon citrutus (Stapf)*, were studied for their effects on seed germination on *Triticum aestivum* (L.) i.e Wheat

Plant sampling and preparation of extracts:

Leaves were washed several times with water. Leaves from local area were collected, dried in oven, grounded and sieved. 1%, 2%, 3% & 5% solutions of water extracts of the weed powder were prepared and stored in bottles. The bottles were shaken every 24 hours in the 48 hours' period. The extracts filtered through muslin cloth and stored in dark bottles.

Seed germination studies: Ten surface sterilized seeds *Triticum aestivum (L.)* were placed in a Petri dish (9 cm diameter) on double-layered Whatman filter paper No. 1. The filter paper was moistened with 5mL of leaf extract concentrations 1, 2, 3, and

Corresponding Author
Dr. Nitesh Joshi,
Associate Professor,
Department of Botany, Rizvi College of Arts,
Science and Commerce, Bandra West,
Mumbai 400050, Maharashtra, India.

5% of different weed extracts. There were three replicates of each treatment in completely randomized designed. Seeds were incubated at 20°C±2 and Petriplates were regularly checked for moisture. For biochemical Studies entire seedling was used for estimation of total protein (Lowrys *et al.,* 1951), for total chlorophylls the cotyledons were used (Arnon,1949). A separate control series was placed up using water. Moisture in the petri dishes was maintained by adding about two ml of extract or water every day for 7 days. On the 7th day. final germination percentage, weight of germinated seeds radicle and plumule length was recorded. Seed Vigor Index was calculated (SVI) using the formula percent germination by average radicle length (Abdul and Anderson, 1973). A control was maintained by watering the seeds with water. Statistical analysis was done to compare the mean values using students T Test.

Results and Discussions

Length of Radicle: All the weeds extract with concentraction of 3 and 5 % showed significant decrease in the length of the radicle of wheat. *Ipomoea carnea*, *Alternanthera sessilis* and *Malachra capitata* extracts affected the most. *Ipomoea* affected the radicle growth the most at all the concentrations. A decrease in length of the radicle however was observed in all the weed extracts. The decrease in length of the radicle was significant in nearly all concentrations of weed extracts. (Table 1.0 and Fig 1.0).

Table 1.0: Effect of various concentrations of aqueous weed extracts on radicle length of *Triticum aestivum* after 7 days in cms.

Concentration of extract	*Ipomoea*	*Cymbopogon*	*Ricinus*	*Hyptis*	*Malachra*	*Alternanthera*
0%	4.7933	4.793	4.793	4.793	4.793	4.793
1%	2.8*	3.463*	3.289*	4.463	4.404	3.4*
2%	0.518*	3.38*	3.2*	3.493	4.025	3.09*
3%	0.681*	2.87*	2.966*	3.233	3.73*	2*
5%	0.237*	1.93*	2.482*	2	3*	2*

*Significant at P<.05. Values are mean of 60 samples

Table 2.0: Effect of various concentrations of aqueous weed extracts on length of plumule of *Triticum aestivum* after 7 days in cms

Concentration of extract	*Ipomoea*	*Cymbopogon*	*Ricinus*	*Hyptis*	*Malachra*	*Alternenthera*
0%	10.76	10.76	10.76	10.76	10.76	10.76
1%	9.823	9.72*	10.38	9.836	9.931	4.64*
2%	8.024*	9.72*	10.726	8.09*	9.27*	3.52*
3%	7*	8.44*	10.406	8.25*	9.1*	2.19*
5%	6*	8.336*	7.871*	8*	9*	2*

*Significant at P<.05. Values are mean of 60 samples.

Length of Plumule: From the five different concentrations of weed extracts, *Alternanthera* affected the growth of the plumule of Wheat the most. All the weed extracts showed an significant decrease in the length of the plumule of wheat. Khan *et al*., 2008, demonstrated the allelopathic effects of *Eucalyptus camaldulensis* L on wheat seedling growth. Ghodake *et al*., (2012) studied the allelopathic effect of *Euphorbia* species on the germination of Wheat and exhibited inhibition in germination percentage and root-shoot length. The reduction of seed germination, radicle, plumule length, biomass of Wheat (Gella *et al*., 2013), seedlings was reported due to effect of various weed extracts. Findings are in accordance with (Bora *et al., 1999 and* Hussain *et al.,* 1992) who found that the inhibitory effect of leaf extracts of *Acacia auriculiformis* on germination of some agricultural crops was proportional to the concentration of the extract.and also by Jadhar and Gayanar, 1992, where percentage of germination, plumule and radicle length of rice and cowpea decreased with the increasing concentration of *Acacia auriculiformis* leaf leachates. These results supported the findings that seed vigor index decreases significantly with increase in concentration compared to that of control in Gliricidia and Acacia leaf extract on Maize (Oyun, 2006). Femina *et al*., 2012 showed that, the aqueous leaves extracts of *Tridax procumbens* L. had inhibitory effect on germination, root, shoot elongation and fresh as well as dry weight of leguminous. *Ricinus communis* weed extracts affected the length of plumule the least in the current study. (Table 2.0 and Fig 2.0)

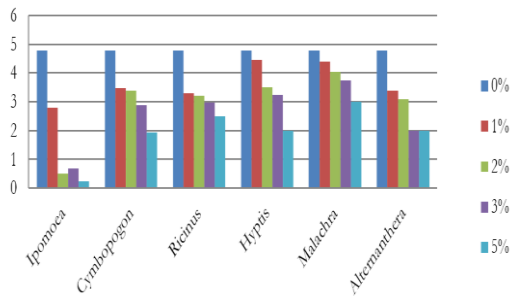

Figure 1: Effect of various concentrations of aqueous weed extracts on radicle length of *Triticum aestivum* after 7 days in cms.

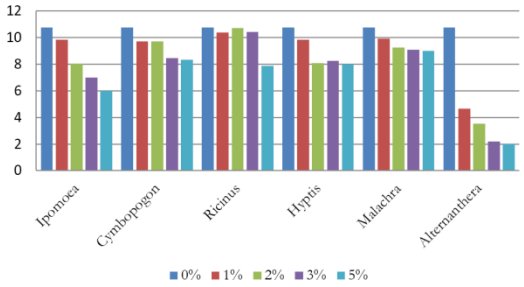

Figure 2.0: Effect of various concentrations of aqueous weed extracts on length of plumule of *Triticum aestivum* after 7 days in cms

Fresh weight of seedlings: *Ipomoea carnea* leaf extracts affected weight of the seedlings the most. at concentrations of 3 % and 5% the fresh weight showed more than 50% decrease in fresh weight in comparison to the control. *Ipomoea* and *Alternanthera* affected the weight of seedlings the most. (Table 3.0 and Fig 3.0)

Table 3.0: Effect of various concentrations of aqueous weed extracts on fresh weight of seedlings of *Triticum aestivum* after 7 days in cms.

Concentration of extract	Ipomoea	Cymbopogon	Ricinus	Hyptis	Malachra	Alternenthera
0%	0.251	0.251	0.251	0.251	0.251	0.251
1%	0.271	0.2488	0.25	0.232	0.208	0.2
2%	0.04*	0.2475	0.24	0.219	0.212	0.2
3%	0.05*	0.1975*	0.238	0.205	0.201	0.1*
5%	0.04*	0.206*	0.195*	0.19*	0.191*	0.1*

*Significant at P<.05. Values are mean of 60 samples

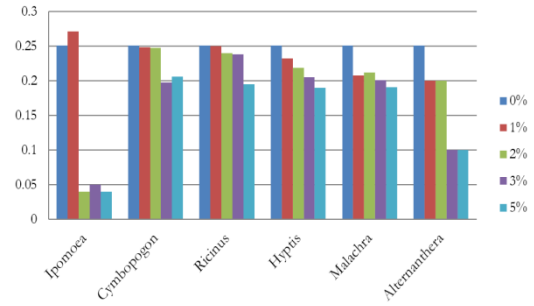

Figure 3.0: Effect of various concentrations of aqueous weed extracts on weight of seedlings of *Triticum aestivum* after 7 days in cms

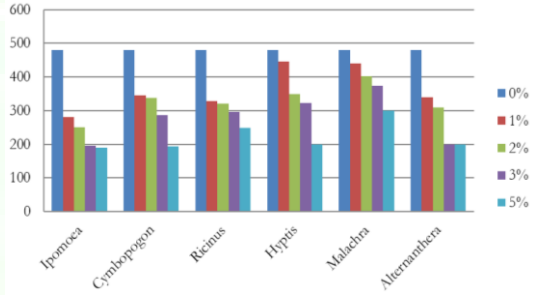

Figure 4.0: Seed Vigor Index of *Triticum aestivum* exposed to aqueous weed extracts

Table 4.0: Seed Vigor index of Wheat exposed to aqueous weeds extracts

Concentration in %	Ipomoea	Cymbopogon	Ricinus	Hyptis	Malachra	Alternanthera
0%	479	479	479	479	479	479
1%	280	346	328	446	440	340
2%	250	338	320	349	402	309
3%	195	287	296	323	373	200
5%	190	190	248	200	300	200

*Significant at P<.05. Values are mean of 60 samples

Table 5.0: Total proteins in mg/gm of fresh weight in seedlings of Wheat

Concentration of Extract	Ipomoea	Cymbopogon	Ricinus	Hyptis	Malachra	Alternanthera
0%	1.18	1.18*	1.18*	1.18	1.18	1.18
1%	0.347*	1.25	1	1.173	1*	0.24*
2%	0.38*	1.32*	0.115*	1*	0.54*	0.08*
3%	0.454*	1.09*	0.147	1*	0.34*	0.0
5%	0.16*	1.01*	0.1	0.5*	0.3*	0.0

*Significant at P<.05.

Seed vigor index: Weed extracts above 3% and 5% on wheat showed inhibitory effect on Seed Vigor Index. Leaf extracts of *Ipomoea carnea* affected seed vigor index the most. Weed extracts of all the plant species showed an decrease in in seed vigor index as the concentrations increased. (Table 4.0 and Fig 4.0) The present findings corroborate the earliest report by (Rose and Anitha, 2012)20 in *Euphorbia hirta* L. extract on Groundnut, that as the concentration increases the seed vigor index decreases and the same results were recorded by (Tanveer *et al.,* 2010)21 using extract of *Euphorbia heliscopia* L. against wheat, chick pea and lentil. The seed vigor index

decreases as the concentration of weed extracts increases because of presence of water soluble inhibitors. (Rehman *et al.,* 1991 and Mohammadi *et al.,* 2004) 22,23. All the weed extracts showed an decrease in seed vigor index as the concentrations increased.

Total proteins: Total proteins showed an decrease in all the leaf extracts of weeds. The weed extracts of *Alternanthera*, and *Ipomoea* affected the total proteins in Wheat. The growth in *Alternanthera* weeds extracts was poor and thus the samples were in adequate to take the samples for protein content. Moreover, all the concentrations of Alternanthera showed low protein contents. *Ricinus communis* affected the total proteins the most, particularly from concentrations higher than 1%.all the plant extracts at 3% and 5% showed low protein contents. (Table 5.0 and Fig 5.0)

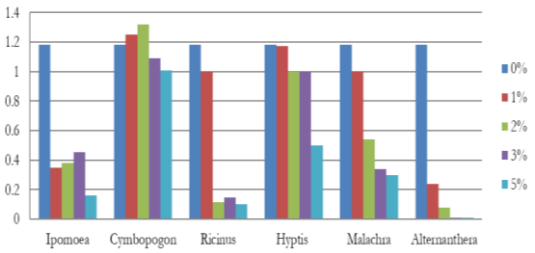

Figure 5.0.: Total proteins in mg/gm of fresh weight in seedlings of Wheat
*Significant at P<.05.

Table 6.0: Total Chlorophylls in mg/gm of fresh weight in seedlings of wheat

Concentration of extract	Ipomoea	Cymbopogon	Ricinus	Hyptis	Malachra	Alternanthera
0	0.2	0.2	0.2	0.2	0.2	0.2
1%	0.05*	0.1*	0.15*	0.2	0.0415*	0.03*
2%	0.03*	0.06*	0.09*	0.12*	0.0399*	0.03*
3%	0.02*	0.04*	0.06*	0.08*	0.043*	0.04*
5%	0.01*	0.01*	0.02*	0.05*	0.0297*	0.03*

*Significant at P<.05.

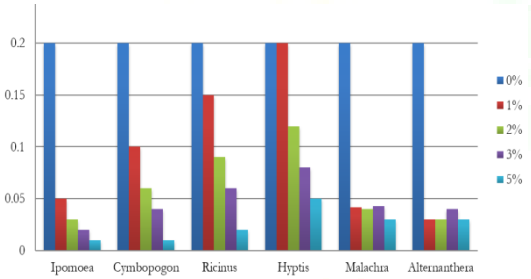

Figure 6.0: Total Chlorophylls in mg/gm of fresh weight in seedlings of wheat

Total chlorophylls: An decrease in chlorophyll content was observed in all the concentrations when compared with the control values at the seventh day. The extracts of *Ipomoea carnea* and *Alternanthera sessilis* showed the significantly lower values reduction. There was a gradual decrease in total chlorophyll contents as the concentrations of the weed extracts increased. The present findings corroborate the earliest report by Oyerinde *et al.,* (2009), who revealed the decrease in chlorophyll-a, chlorophyll-b and total chlorophyll accumulation in young plants of maize after being treated with fresh shoot aqueous extract of *Tithonia diversifolia* which possess allelopathic ccharacteristics. Stupnicka-Rodzynkiewicz *et al.,* (2006), reported similar results regarding the effects of allelochemicals on chlorophyll content and photosynthesis process in plants. The present study definitely suggests that the addition of aqueous extracts of these weed species strongly affects the germination efficiency and growth characters of wheat compared to the control. In addition, an indirect association between lower seed germination and allelopathic inhibition may be the consequence of the inhibition of water uptake (El-Khatib 1997). Various bioassay studies have also proved that different plant parts release toxic metabolites into the soil that effect adversely germination and growth of food crops (Quasem 2002). (Table 6.0 and Fig 6.0)

Conclusion

Weed extracts of all the plants above 3% and 5% had a decreasing effect on all the parameters studied. Marked decrease in seed vigour index was observed and it followed the trend *Cymbopogon strictus* > *Ipomoea carnea*> *Hyptis saveolens* >*Malachracapitata*> *Ricinus communis*> *Alternanthera sessilis*. The weed extracts of Ipomoea carnea and Alternanthera sessilis had the most allelopathic effect on seed germination of Wheat. total proteins showed a marked decrease in all the concentrations of weed extracts, in the seven day seedlings, so also total chlorphylls. All the weed extracts affected the germination parameters and physiological development, reflecting the severeity of the weeds in growth of an important indian crop. Clearance of weeds and ploughing could be the remedy for such affects not to affect the seed germination. Field trials would further help in understanding the role of weeds in decreasing plant productivity.

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