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Allelopathic effect of *Azadirachta indica* leaf extract on seed germination of different test crops under bioassay

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Abstract

The study was conducted to determine the effect of leaf extract of *Azadirachta indica* on seed germination and related parameters of different test crops namely wheat, chickpea, lentil, barley and mustard. The study showed that leaf extract of *Azadirachta indica* has maximum effect on wheat germination and barley was the least affected test crop and recorded 100% germination. The study also showed that different germination parameters such as shoot- root length, shoot- root ratio, vigour index, germination index were also affected by different concentration of leaf extract.

Keywords: *Azadirachta indica*, germination, shoot- root length test crops, vigour index

Introduction

Azadirachta indica is an important agroforestry tree species of arid and semiarid region of the country (Trops 1921) [10]. This species is found on farm boundaries particularly in drier region and retained by the farmers due to various uses of the species. This species is grown along with other species and therefore interact with each other. These interactions result in positive and negative effect on components of an agroforestry system (Singh *et al.*, 2008) [3]. Generally the field crops grown along with *A. indica* are wheat, chickpea, barley, lentil and mustard, paddy, sesamum etc. The tree species is known to have same allelopathic effect on intercrops grown with it (Dhanai *et al.*, 2013) [6]. The allelopathic effect is different for different plant parts of *A. indica*. The present study was aimed to study the effect of different concentrations of leaf extract of *Azadirachta indica* on germination and related parameters of 5 crops to determine the suitability of these crops along with *Azadirachta indica* for semiarid region of country.

Material and Methods

The present study was conducted at Bundelkhand University Jhansi, located at an elevation of 300m above the mean sea level (a msl) and situated in semiarid region of central India between 24°11' N latitude and 78° 17' E longitude. The leaf extract was prepared using standard bioassay procedure to test the allelopathic effect under laboratory conditions. Fresh leaves collected of 5yrs old superior tree of *Azadirachta indica* were collected sun dried and grounded in mechanical grinder and passed through a mesh sieve to remove the visible plant residues. The aqueous extracts were prepared by soaking 50, 100, 150 and 200gm of leaf in 1000ml distilled water for 24hrs at room temperature for preparation of 5, 10, 15 and 20% concentration and replicated 3times 10 seeds of each of the 5 test crops for each replication were placed uniformly on the top of double layered Whatman filter paper No.1 in petridish. The media was watered doing with the leaf extract at the rate of 2ml per petridish to maintain the moisture for proper germination. The observation on seed germination percentage (%), shoot root length (cm), shoot root ratio, vigour index, germination index were recorded as affected by different leaf extract concentration for these test crops. The data was analyzed statistically and presented in the form of Table.

Result and Discussion

The results obtained from the present study revealed that aqueous leaf extract of *Azadirachta indica* affected seed germination and related parameters for all the 5 test crops.

Seed germination

The data presented in Table 1 and 2 showed that wheat crop was most affected by leaf extract of *Azadirachta indica*.

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The 20% leaf extract resulted in 76.67% germination in wheat whereas same extract and concentration resulted in 100% germination for chickpea, lentil and barley and 93.3% for wheat. Leaf extract were significant for all test crops except barley.

Shoot length (cm)

It is quite clear from the data that lentil recorded least values for shoot length for leaf extract as well as concentrations. The maximum values for shoot length were observed for mustard followed by wheat. Within a particular test crops leaf extract has the most adverse effect on shoot length. The data presented in table 1 and 3 showed that the maximum shoot length for wheat 12.53 cm was recorded under control and minimum 10.60 cm for 20% leaf extract. The minimum shoot length of 4.28 cm was observed for 20% leaf extract for lentil. The concentrations of leaf extract were significant for all test crops except lentil.

Root length (cm)

It is evident from the data in the table 3 and 5 that lentil recorded least values for root length. The maximum values for root length were observed for wheat followed by barley. Within a particular test crop leaf extract has the most adverse effect on root length. For barley the maximum root length 10.82 cm was recorded under control and minimum 7.71cm for 20% leaf extract. The minimum root length of 3.16 cm was observed for 20% leaf extract for lentil. The interaction between different concentrations was nonsignificant.

Vigour index

The data showed in Table 5 that lentil recorded least values for vigour index for leaf extract as well as concentrations. The maximum value for vigour index was observed for barley followed by wheat. Leaf extract resulted in most adverse effect for three crops wheat, chickpea and barley. For barley the maximum vigour index 2269.33 was recorded under control and minimum 1696.00 for 20% leaf extract.

Shoot root ratio

The data showed in table 4 that barley was the most affected crop for shoot root ratio under leaf extract. The maximum values for shoot root ratio observed for mustard. Within a particular test crop leaf extract has the most adverse effect on shoot root ratio. For mustard the maximum shoot root ratio 2.53 was recorded under 5% leaf extract and minimum 2.06 was recorded under control. The difference between different concentrations irrespective of leaf extract was non-significant for all test crops except mustard.

Germination index

The data related to germination index showed in table 5 revealed that wheat crop recorded least value for this parameter for leaf extract of *Azadirachta indica*. The maximum values for germination index were observed for barley followed by lentil. Within a particular test crop leaf extract has the most adverse effect on germination index. For barley the maximum germination index 1.43 was recorded under leaf extract. The leaf extract irrespective of concentrations was non-significant for wheat, chickpea and barley and significant for lentil and mustard.

Table 1. Effect of *A. indica* leaf extract on seed germination and growth parameters of *Triticum aestivum* under bioassay

<i>Triticum aestivum</i>						
Treatment	Germination (%)	Shoot Length (cm)	Root Length (cm)	Vigour Index	Shoot Root Ratio	Germination Index
20%	76.67	10.60	8.73	1489.90	1.21	1.10
15%	76.67	10.71	9.06	1513.73	1.91	1.10
10%	83.33	10.97	9.14	1675.87	1.20	1.19
5%	83.33	11.03	9.22	1666.93	1.20	1.19
0%	93.33	12.53	10.01	2106.93	1.25	1.33
Mean	82.67	11.19	9.23	1689.49	1.21	1.18
C.D. (0.005)	P= NS	C= 5.76	P*C= NS			

Table 2: Effect of *A. indica* leaf extracts on seed germination and growth parameters of *Cicer arietinum* under bioassay

<i>Cicer arietinum</i>						
Treatment	Germination (%)	Shoot Length (cm)	Root Length (cm)	Vigour Index	Shoot Root Ratio	Germination Index
20%	93.33	7.91	4.09	1120.37	1.94	1.33
15%	100.00	8.02	4.13	1215.53	1.94	1.43
10%	100.00	8.27	4.20	1247.67	2.01	1.43
5%	100.00	8.41	4.32	1272.67	1.95	1.43
0%	100.00	9.82	5.04	1486.00	1.99	1.43
Mean	98.67	8.49	4.36	1268.41	1.97	1.41
C.D. (0.005)	P= NS	C= 2.09	P*C= NS			

Table 3: Effect of *A. indica* leaf extracts on seed germination and growth parameters of *Lens esculenta* under bioassay

<i>Lens esculenta</i>						
Treatment	Germination (%)	Shoot Length (cm)	Root Length (cm)	Vigour Index	Shoot Root Ratio	Germination Index
20%	100.00	4.28	3.16	744.33	1.38	1.43
15%	93.33	4.40	3.24	713.80	1.37	1.33
10%	100.00	4.57	3.57	814.33	1.29	1.43
5%	96.67	4.83	3.85	839.90	1.26	1.38
0%	100.00	6.25	4.10	1034.67	1.53	1.43
Mean	98.00	4.87	3.58	829.41	1.57	1.40
C.D. (0.005)	P= 2.91	C= 3.36	P*C= 5.83			

Table 4: Effect of *A. indica* leaf extract on seed germination and growth parameters of *Brassica campestris* under bioassay

<i>Brassica campestris</i>						
Treatment	Germination (%)	Shoot Length (cm)	Root Length (cm)	Vigour Index	Shoot Root Ratio	Germination Index
20%	86.67	10.47	4.28	1280.00	2.45	1.24
15%	93.33	11.32	4.57	1484.93	2.48	1.33
10%	96.67	11.51	4.61	1555.93	2.51	1.38
5%	96.67	11.65	4.68	1577.47	2.53	1.38
0%	96.67	12.12	5.92	1744.13	2.06	1.38
Mean	94.00	11.41	4.81	1528.49	2.41	1.34
C.D. (0.005)	P= 4.68	C= 5.3.4	P*C= NS			

Table 5: Effect of *A. indica* leaf extracts on seed germination and growth parameters of *Hordeum vulgare* under bioassay

<i>Hordeum vulgare</i>						
Treatment	Germination (%)	Shoot Length (cm)	Root Length (cm)	Vigour Index	Shoot Root Ratio	Germination Index
20%	100.00	9.25	7.71	1696.00	1.26	1.43
15%	100.00	9.37	8.23	1760.00	1.16	1.43
10%	100.00	9.42	8.44	1786.33	1.12	1.43
5%	100.00	9.53	8.71	1823.33	1.14	1.43
0%	100.00	11.87	10.82	2269.33	1.10	1.43
Mean	100.00	9.89	8.78	1867.00	1.15	1.43
C.D. (0.005)	P= NS	C= NS	P*C= NS			

The present findings corroborate the earlier report by Ashrafi et al (2009) [1] also observed allelopathic effect of n-hexane, acetone and water soluble extracts of *Azadirachta indica* on 6 weeds and found of acetone extract of *A. indica* shoots inhibited the germination of root and shoots of all the 6 test plant species.

These findings were similar to the present study Hussain (1985) [7] also reported that *A. indica* leaf extract reduced radical growth fresh and dry biomass and productivity of wheat, millet, maize, lettuce and mustard. Our findings also reported that lower concentration of leaf extracts had minimum effect on germination and related parameters of test crops and higher concentration exhibited maximum allelopathic effect.

Bano et al., (2012) [2], also reported that aqueous leaf extract of neem had different concentrations with minimum effect of lower concentration and maximum effect at higher concentration. There are several reports like Kaletha et al., (1996) [8], Dhanai et al., 2008 [4] Todaria et al., 2010 [9] and Dhanai et al., 2017 [5] which was reported allelopathic effect of different aqueous extracts on germination and growth of test crops. They also found that lower concentration of these aqueous extracts have minimum effect whereas higher concentration have maximum effect on test crops. Thus we can conclude that like many other agroforestry tree species like Eucalyptus, Subabool, and Acacias; *A. indica* also exhibited allelopathic effect on crops like wheat, chickpea, barley, lentil and mustard and the allelopathic effect increased with increasing concentration of aqueous leaf extract. Therefore it is necessary to incorporate this species into different agroforestry programme in such a way that there is minimum yield production of intercrop due to allelopathic effect.

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