

# Allelopathic Influence of Aqueous Leaf Extracts of Ber (*Ziziphus mauritiana* L.) on Germination, Seedling Growth and Phytomass of Groundstorey Crops

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## ABSTRACT

The investigation was carried out to determine allelopathic influence of ber (*Ziziphus mauritiana* L.) leaf aqueous extracts on four test crops viz. groundnut (*Arachis hypogea*), cluster bean (*Cyamopsis tetragonoloba*), wheat (*Triticum aestivum*) and mustard (*Brassica campestris*) under laboratory conditions. The seed germination of mustard was significantly inhibited by ber leaf extracts and the reduction was 77.60 per cent over control (treated with distilled water). Whereas, the germination of wheat did not influence significantly but it was reduced to some extent in case of groundnut and cluster bean. The response on vigour parameters exhibited variable trend. There was no significant difference in shoot length between treated and control plants except in case of mustard, where shoot length reduced significantly. In general, the root length of treated plants was more affected than shoot length except in cluster bean. The other vigour parameters like number of roots per plant, root: shoot ratio and vigour index also showed almost same trend. The seedling phytomass in terms of fresh and dry weight did not vary significantly in all the crops with the treatment of ber leaf extracts. Among different groundstorey crops, the water-soluble allelochemicals of ber leaf extracts had maximum inhibitory effect on mustard and minimum on cluster bean with respect to germination, seedling vigour and seedling phytomass while other crops showed variable response exhibiting sensitivity in one character and tolerance in another.

**Key words :** Allelopathy, *Arachis*, *Brassica*, *Cyamopsis*, germination, groundstorey crops, phytomass, seedling vigour, *Triticum*, *Ziziphus*.

## 1. INTRODUCTION

The ber (*Ziziphus mauritiana* L.) is an important fruit crop of arid and semi arid regions of the country. The integration of ber as perennial component in various agroforestry systems is becoming popular in recent years and now ber based agroforestry system is considered as one of the remunerative enterprises (Faroda, 1998). The ber is precocious and prolific bearing fruit plant, it gives multiple outputs like; fruit, fuel wood, leaf fodder and various processed products and assure some production even under adverse edaphoclimatic conditions (Gupta and Sharma, 1997). Being a deciduous fruit tree, it add considerable amount of organic matter through leaf litter and thus improves physio-chemical properties of the growing site.

There are several annual crops grown with ber plantation by the farmers without ascertaining the interferences between the components integrated on a land management unit. Though, the growers are aware of the competition (allelopathy) particularly the adverse effect of fully grown up perennial trees on annual crops but they are least aware of addition of allelochemicals from one or more species in the association (allelopathy). Therefore, present investigation has been planned to see the allelopathic influence of *Ziziphus mauritiana* on four groundstorey crops viz., groundnut, cluster bean, wheat

and mustard integrated with ber based agroforestry system, which are important crops of the arid region.

## 2. MATERIALS AND METHODS

The present investigation was carried out under laboratory conditions at Central Institute for Arid Horticulture, Bikaner (Rajasthan) during 2001-2002. For preparation of aqueous leaf extracts, fully mature and about to senescent leaves of ber (*Ziziphus mauritiana*) cultivar Gola were collected from field plantation at Research Farm of CIAH, Bikaner. The leaf samples were washed gently with tap water only for few seconds to avoid leaching losses of water soluble chemicals, followed by quick rinsing in distilled water and drying with clean blotting paper. The samples were further dried in oven at 60°C till constant weight. After complete drying, the samples were ground to fine powder in a Wiley mill and sieved through 2-mesh (0.846 mm) screen. The powdered material was mixed thoroughly to prepare representative sample. The leaf powder (20 g) was soaked in 1 litre distilled water followed by rigorous shaking for 25 minutes. The sample was kept for 24 hours at room temperature in order to allow complete dissolving of water-soluble allelochemicals in the solvent (water). The sample was filtered through muslin cloth and filtrate was again filtered through Whatman filter paper No. 1 to remove suspended particles (Narwal, 1994).

Table 1. Effect of ber leaf aqueous extracts on seed germination, seedling vigour and phytomass production of groundstorey crops

Groundstorey crops parameter	Response		Reduction* (%)	't' value
	Treated	Control		
<b>Groundnut</b>				
Germination (%)	87.600	94.200	6.60	5.7886 (0.0004)**
Shoot length (cm)	15.720	18.160	13.44	2.1079(0.0681)
Root length (cm)	6.540	10.300	36.50	6.4330 (0.0002)
No. of roots / plant	4.000	6.200	35.48	1.7720(0.1140)
Root:shoot	0.420	0.570	--	-----
Vigour index	1377.070	1710.670	--	-----
Fresh weight (g)	2.163	2.862	24.42	1.3590(0.2111)
Dry weight (g)	0.394	0.461	14.53	1.3840 (0.2030)
<b>Cluster bean</b>				
Germination (%)	95.200	98.000	2.80	5.7150(0.0004)
Shoot length (cm)	6.960	7.060	1.42	0.1556(0.8800)
Root length (cm)	6.240	6.340	1.58	0.1639(0.8730)
No. of roots / plant	2.680	2.660	-0.75	0.1118(0.9137)
Root:shoot	0.900	0.900	--	-----
Vigour index	1787.860	2101.120	--	-----
Fresh weight (g)	0.229	0.217	-5.529	0.2670 (0.7960)
Dry weight (g)	0.021	0.019	-10.526	0.3840(0.7100)
<b>Wheat</b>				
Germination (%)	96.600	98.400	1.80	1.3720(0.2070)
Shoot length (cm)	6.260	7.380	15.18	3.0040(0.0170)
Root length (cm)	5.180	13.980	62.94	12.4220(0.0001)
No. of roots / plant	2.200	4.200	47.62	3.7790 (0.0054)
Root:shoot	0.830	1.890	--	-----
Vigour index	604.720	726.190	--	-----
Fresh weight (g)	0.203	0.267	23.97	4.9271 (0.0012)
Dry weight (g)	0.064	0.066	3.03	0.2680 (0.7950)
<b>Mustard</b>				
Germination (%)	13.600	91.200	77.60	39.8080(0.0001)
Shoot length (cm)	4.840	7.200	32.78	6.6320 (0.0002)
Root length (cm)	4.220	6.720	37.20	3.8310 (0.0050)
No. of roots / plant	2.400	4.600	47.83	3.3940 (0.0094)
Root:shoot	0.870	0.930	--	-----
Vigour index	65.820	656.640	--	-----
Fresh weight (g)	0.108	0.158	31.645	0.6725 (0.5200)
Dry weight (g)	0.013	0.012	-8.33	1.3850(0.2030)

\* Per cent reduction over control, \*\* Values in parentheses are 'p' value

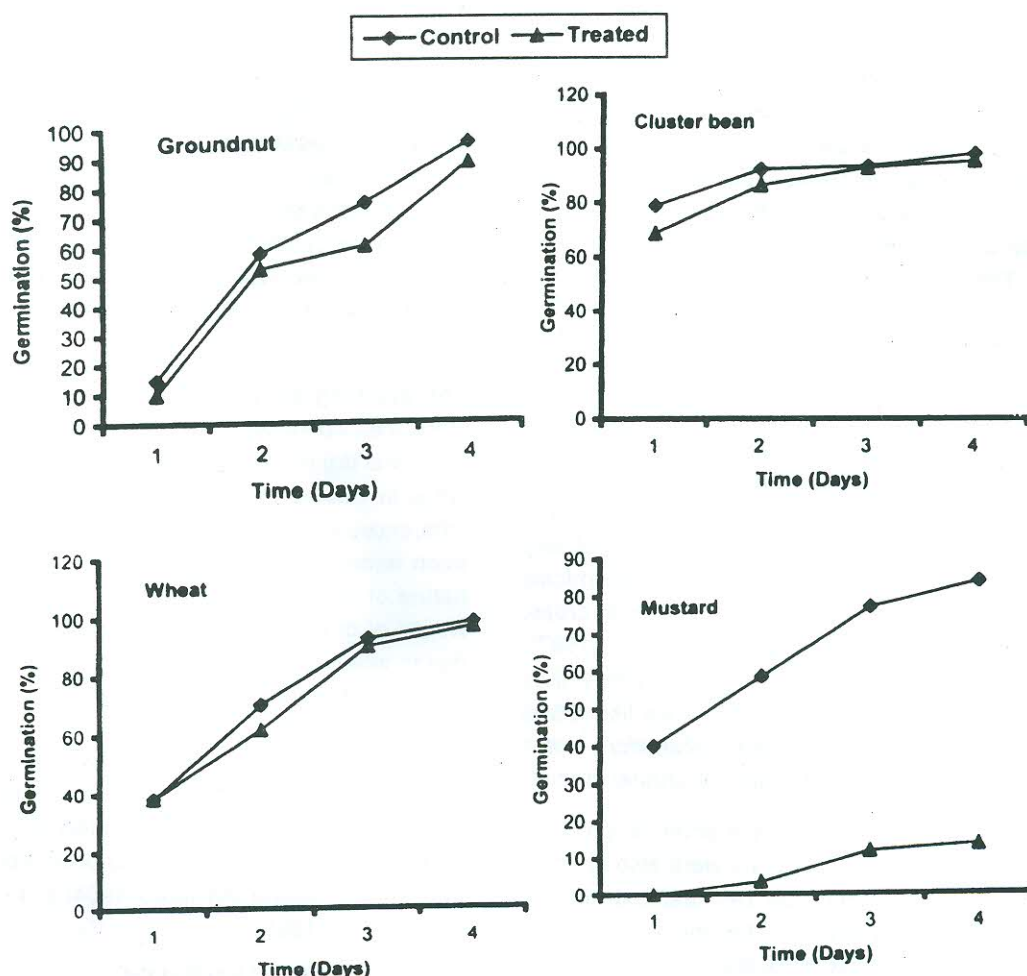


Fig. 1. Germination of different crops as influenced by aqueous extracts of ber leaf

Healthy and uniform seeds of groundnut (*Arachis hypogea*), cluster bean (*Cyamopsis tetragonoloba*), wheat (*Triticum aestivum*) and mustard (*Brassica campestris*) were surface sterilized with 0.1 per cent mercuric chloride ( $\text{HgCl}_2$ ) for five minutes followed by five washing with distilled water and air dried in shade. Twenty seeds of each crop were sown in pre-sterilized petri plates (15 cm dia.) on double lined moist filter paper and kept at room temperature. Seven ml of aqueous extracts of ber leaves or distilled water (control) was added to each petri plate and thereafter, 5 ml every day up to 4 days. The emergence of radicle was considered as criterion for seed germination, which was completed within 4 days in all the crops. After completion of germination, five seedlings of each crop were planted carefully in poly-containers filled with pre-sterilized sand medium as test plant for subsequent growth studies. As per treatment, 10 ml of same extracts or distilled water was added every day to

each container up to 15 days. At the termination of the experiment (i.e. after 15 days), the data on seedling vigour parameters were recorded. The vigour index (VI) was computed as suggested by Abdul-Baki and Anderson (1973). After recording the fresh weight of seedlings, the dry weight was recorded by placing the samples (five seedlings) in oven at  $60 \pm 2^\circ\text{C}$  for 24 hours. Among the annual crops, there were two types of crops i.e. *Kharif* season crops (groundnut and cluster bean) and *Rabi* season crops (wheat and mustard), hence, two sets of experiment were conducted into their respective growing seasons by adopting same methodology. To test the statistical significance, the data were analyzed by using 't' test.

### 3. RESULTS AND DISCUSSION

In present investigation, the effect of ber leaf aqueous extracts on seed germination was recorded at 24 hours

interval. It is evident from Fig. 1 that seed germination was started within 24 hours and completed within 96 hours in all the crops. The earliest and highest germination was recorded in cluster bean followed by mustard, wheat and lowest in groundnut at 24 hours after treatment. The inhibitory effect of leaf extracts on germination of test crops was very apparent and it had not only delayed germination but reduced the germination percent in all the crops. The magnitude of reduction in germination over control ranged from 1.80 to 77.60 per cent (Table 1). The highest reduction in germination was recorded in mustard (77.60%), which was highly significant over control while reduction in germination of groundnut and cluster bean was only 6.60 per cent and 2.80 per cent, respectively. Whereas, inhibition of germination was non-significant in case of wheat. The results indicated that the inhibition of germination of test crops was probably due to presence of some water soluble allelochemicals in ber leaf extracts but the response varied with crops. The results are in conformity with Sharma et al. (1967), Hussain et al. (1991) and Lal et al. (1997) where they have reported inhibitory effect of fruit crops like *Citrus aurantium*, *Morus alba*, *Juglans regia*, *Mangifera indica* and *Syzygium cumini* on germination of annual crops.

The seedling vigour parameters like shoot length, root length and number of roots per plant were also affected with the treatment of seeds by ber leaf extracts as compared to control (Table 1). The shoot length was significantly reduced in case of mustard and wheat while in groundnut and cluster bean, though it was reduced but the differences between treated and control were non-significant. However, root length was significantly reduced in all the crops except cluster bean. The maximum inhibitory effect on root length was observed in case of wheat, where two and half times reduction was recorded over control. The number of roots per plant did not differ significantly in both the *Kharif* season crops (groundnut and cluster bean) but it decreased significantly in *Rabi* season crops (wheat and mustard). The root: shoot ratio also followed the same trend and it was less in treated plants than in control plants except in cluster bean. The abnormal root: shoot ratio in case of wheat under control conditions was due to more root length than shoot length. The vigour index was also computed and it was less under treated plants as compared to control in all the crops. The reduction in vigour index of treated plants over control was very much apparent in case of mustard. Based on growth parameters, mustard was found as most sensitive crop while cluster bean was most tolerant to

water-soluble allelochemicals of ber leaf extracts. Similar selectivity has been observed in case of walnut, where quince, black raspberry, carrot, bean and maize proved resistant to *Juglans* and grew better within root zone of the walnut trees than outside. The inhibitory response of *Ziziphus mauritiana* on chickpea and mustard has already been reported by Dalal et al. (1992). Contrary to this, either no allelopathic effect or stimulatory effect has been reported by Narwal (1994) and Lal (1998) in case of *Ziziphus jujuba* and *Mangifera indica* on annual crops, respectively.

The seedling phytomass of annual crops were not influenced significantly by ber leaf extracts, though both, fresh and dry weight were reduced marginally in all the crops in treated plants except in cluster bean. These differences in fresh weight and dry weight of annual crops even under the same treatment were due to diverse nature of crop species. The reduction in fresh and dry weight of groundnut, wheat and mustard was might be due to inhibitory response of allelochemicals present in the ber leaf extracts. Whereas, the same treatment did not affect adversely the same parameters in case of cluster bean, rather presence of allelochemicals/nutrients in ber leaf extracts has positive influence. Similar stimulatory effect of some perennials on growth and dry weight of annual crops have also been reported by Bisla et al. (1992), Narwal and Tauro (1994) and Taheruzzaman and Kushari (1995).

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