

Allelopathic Effect of Tree Leaf Extracts on Germination of Sorghum and Rice

H.T. CHANNAL, M.B. KURDIKERI AND P.A. SARANGAMATH

Department of Agricultural Chemistry & Soil Science
University of Agricultural Sciences, Dharwad - 580 005

(Received : September, 1998)

Abstract . Allelopathic effect of seven tree leaf extracts viz., *Azadirachta indica*, *acacia arabica*, *Eucalyptus tereticornis*, *Tamarindus indica*, *Tectona gradis*, *Samanea saman* and *Syzygium cumini* each at 5 and 10 per cent concentration was tried on seed germination, vigour index, seedling length and seedling dry matter of sorghum and rice. The study revealed a differential response on these parameters. All the tested leaf extracts were found to promote germination in sorghum while *A. indica* and *A. arabica* increased germination in rice. Concentrations of leaf extracts also found to exhibit differential response on various parameters and so also the interaction effect between leaf extracts and concentrations.

Introduction

Allelopathic chemicals are considered as secondary plant metabolites that have roles in plant - plant, plant - soil, plant - disease, plant - insect and plant - predator interactions that may be beneficial or detrimental to the plant. Studies on allelopathic potential of multipurpose trees have been done in many crop associations. Differential response (positive/negative) of various allelopathetic chemicals have been reported in several field crops on seed germination, seedling length and vigour index (Datta and Bhakat, 1985; Khosla and Kholi, 1987; Suresh and Vinayrai, 1987 and Vidyathakur and Bhardwaj, 1992). Hence, a study was conducted to ascertain allelopathic effect of leaf extracts of some tree species which are commonly grown in Karnataka on sorghum and rice.

Material and Methods

Four hundred grams of freshly collected matured leaves of seven tree species (Table-1) were collected, chopped into small pieces and soaked in 1000 ml of water for 24 hours from which five and ten per cent concentration of

aqueous solutions were prepared. The germination tests on sorghum and rice seeds were conducted as per ISTA method (Anon., 1985) by wetting the germination towels with tree leaf extracts and with water as control. The observations on seedling length, vigour index [$VI = \text{Germination (\%)} \times \text{Seedling length (cm)}$] and dry matter were recorded on ten randomly selected seedlings at the end of germination test.

Results and Discussion

Irrespective of concentrations, all the tree leaf extracts except *S. cumini* and *E. tereticornis* were found to stimulate germination significantly in sorghum (15 to 32%) over control (Table-1). While, in case of rice, only *A. indica* and *A. arabica* were found to enhance the germination by 3.50 to 3.81 per cent, respectively over control. Inhibitory effect on seed germination (5 to 8%) only in rice was evident due to *T. gradis*, *E. tereticornis* and *S. cumini*. Similar differential response on seed germination in field crops were reported by Datta and Bhakat (1985) and was ascribed to presence of various allelo-chemicals such as sterols, terpenes

Table 1. Effect of aqueous leaf extracts of different tree species and their concentrations on germination (%) and seedling length (cm) in sorghum and rice

Treatments	Germination (%)				Seedling length (cm)							
					Sorghum				Rice			
	Concentration (%)				Concentration (%)				Concentration (%)			
	5	10	Mean	PIC	5	10	Mean	PIC	5	10	Mean	PIC
T ₁	72.00	70.50	71.25	1.78	77.25	78.25	77.25	-8.79	23.6	20.3	21.9	19.2
T ₂	82.25	84.50	83.37	19.10	87.25	89.75	88.50	3.81	30.7	28.5	29.6	21.8
T ₃	81.25	79.75	80.75	15.35	83.00	79.00	81.00	-4.98	25.4	24.7	25.0	21.1
T ₄	71.25	69.25	70.50	0.71	80.75	79.75	80.25	-5.86	24.2	26.4	25.3	19.3
T ₅	87.25	88.50	87.87	25.52	88.00	82.25	85.12	-0.15	28.2	26.6	27.4	19.5
T ₆	95.00	90.00	92.50	32.14	85.25	86.50	85.87	0.72	30.1	28.3	29.2	21.3
T ₇	88.00	90.00	89.00	27.14	86.75	89.75	88.25	3.50	29.6	28.5	29.1	19.8
T ₈	--	--	70.00	--	--	--	85.25	--	--	--	27.4	--
Mean	82.57	81.79			84.11	83.54			27.4	26.9	20.3	20.6
For comparing means	C.D.(5%)				C.D.(5%)				C.D.(5%)			
Leaf extract (E)	2.32				2.04				1.9			
Concentration (C)	NS				NS				1.01			
E x C	3.28				2.89				NS			

Note:

T₁ = Syzygium cuminiT₂ = Acacia arabicaT₃ = Tactona grandisT₄ = Eucalyptus tereticornisT₅ = Tamarindus indicaT₆ = Samanea samanT₇ = Azadirachta indicaT₈ = Control (water)

PIC = Per cent increase over control

coumarins, flavonoids, saponins and tanins in tree leaf extracts (Rice, 1984).

Between the concentrations, no significant reduction or increase in germination of sorghum and rice was observed.

The interaction effect due to leaf extracts and their concentrations found to influence the germination significantly in both sorghum and rice. In sorghum, germination was markedly increased due to *A. arabica*, *T. indica*, *T. grandis*, *S. saman* and *A. indica* at 5 and 10 per cent concentration over control. In rice, it was increased markedly by *A. arabica* and *A. indica* at 10 per cent concentration over control (water). Such differential interactions effect due to leaf extracts and concentrations on germination may be attributed to the nature, properties and amount of allelochemicals exerting influence on cell response and also to genotypic character.

Similar to germination, significant influence was observed on seedling length (Table-1) due to leaf extracts in sorghum and rice. Seedling length was markedly decreased in sorghum due to *S. cumini*, *T. grandis* and *E. tereticornis* and in paddy due to *E. tereticornis* and *T. indica*. While, marked increase in seedling length was observed in sorghum due to *A. arabica* and in rice due to *A. indica*, *S. saman* and *A. arabica*. Similar differential response due to three leaf extracts on seedling growth was reported (Rice, 1984 and Vidya Thakur and Bhardwaj, 1992). Though stimulatory effect of allelopathic tree leaf extract on germination were noticed initially in sorghum and rice but subsequently they exhibited inhibitory effects on seedling length. This may be due inhibitory effect of various chemical compounds on root cell elongation and cell division (Singh, 1993).

Interaction effect between concentration on seedling length was evident only in sorghum. Higher concentration (10%) of leaf extracts were found to reduce seedling length in sorghum.

The interactions effect due to tree leaf extracts and concentration was found to influence the seedling length of rice. Only *T. indica* at 10 per cent was found to decrease seedling length while other treatments had no inhibitory effect.

Almost all the test tree leaf leachates were found to enhance vigour index (Table-2) in sorghum, while, in paddy the leachates other than *A. arabica* and *S. saman* showed decrease in vigour index. Both 5 and 10 per cent concentration of leachates, except in sorghum resulted in increase of vigour index. While in rice, they resulted in marginal decrease. Among the interaction effects between leaf extracts and concentrations, *A. arabica*, *S. saman* and *A. indica* at 5 or 10 per cent concentration found to enhance vigour index compared to control in sorghum and *A. arabica* and *S. saman* at 5 or 10 per cent concentration in rice. Marked decrease in vigour index was observed in sorghum due to *E. tereticornis* and *S. cumini* at 5 or 10 per cent concentrations and in rice due to *S. cumini*, *T. grandis* and *E. tereticornis*. Similar decrease in vigour index due to allelopathic effects of leaf extracts was reported by Vidya Thakur and Bharadwaj (1992).

The seedling dry matter (Table-2) was markedly decreased in sorghum and rice due to various leaf extracts irrespective of concentrations. Similarly it was considerably decreased at 5 or 10 per cent concentration over control. The interaction effect between tree leaf extracts and their concentration was found in

Table 2. Effect of aqueous leaf extracts of different tree species and their concentrations on vigour index and seedling dry matter in sorghum and rice

Treat- ments	Yigour index						Seedling dry matter (mg)							
	Sorghum			Rice			Sorghum			Rice				
	Concentration (%)			Concentration (%)			Concentration (%)			Concentration (%)				
	5	10	Mean	5	10	Mean	5	10	Mean	5	10	Mean		
T ₁	1699	1431	1565	1483	1659	1571	205	195	200	173	165	169		
T ₂	2525	2408	2466	1913	1928	1920	168	163	165	150	150	150		
T ₃	2076	1969	2023	1751	1627	1689	178	200	189	155	167	161		
T ₄	1736	1828	1782	1558	1618	1588	190	183	186	158	153	155		
T ₅	2460	2354	2407	1716	1529	1623	180	167	174	165	163	164		
T ₆	5700	2497	4098	1815	1790	1803	183	190	186	160	147	154		
T ₇	2499	2565	2531	1717	1902	1810	168	160	164	158	160	159		
T ₈	—	—	1917	—	—	1747	—	—	210	—	—	168		
Mean	2670	2150		1707	1722		181	180	—	160	158	—		
For comparing means			C.D.(5%)			C.D.(5%)			C.D.(5%)					
Leaf extract (E)			72			70			9			8		
Concentration (C)			38			NS			NS			NS		
E x C			102			57			13			NS		

Note :

T₁ = Syzygium cuminiT₂ = Acacia arabicaT₃ = Tectonia grandisT₄ = Eucalyptus tereticornisT₅ = Tamarindus indicaT₆ = Samanea samanT₇ = Azadirachta indicaT₈ = Control (water)

PIC = Per cent increase over control

sorghum but not in rice. Almost all the test tree species resulted in decrease of seedling dry matter in sorghum except *S. cumini* at 5 and 10 per cent and *T. grandis* at 10 per cent concentration. Similar differential allelopathic effect on accumulation of seedling dry matter in

crop plants has been reported (Suresh and Vinay Rai, 1987).

The present study indicated that allelopathy has both beneficial and harmful effects on seed germination and seedling vigour of cereal crops.

References

- ANONYMOUS, 1985, International Rules for Seed Testing. *Seed Science and Technology*, **13**:322-326.
- DATTA, S.C., DAS, T. AND BHAKAT, R.K., 1985, Inhibition in leaves of road side trees during various seasons. *Science and Culture*, **51**:313-315.
- KHOSLA, P.K. AND KHOLI, R.K., 1987, Eucalyptus and anti-social tree for social forestry. In, *Social forestry for Rural Development* (Eds. P.K. Khosla and R.K. Kholi), Indian Society of Tree Scientist, Solan, India, pp.235-241.
- RICE, E.L., 1984, *Allelopathy*. Second Edition, New York, Academic Press, p.422.
- SINGH, H.R., 1993, Allelopathic effect of tree species on crop plants. In : *Proceedings and recommendations of national workshop on Farm Forestry Management* (Ed. T.H. Badu), Indian Institute of Forest Management, Bhopal, pp.18-22.
- SURESH, K.K. AND VINAYARAI, R.S., 1987, Studies on the allelopathic effects of some agro forestry trees on crops. *International Tree Crop Journal*, **4**: 109-115.
- VIDYATHAKUR AND BHARADWAJ, S.D., 1992, Allelopathic effect of tree leaf extracts on germination of wheat and maize. *Seed Research*, **20**:153-154.