ALLELOPATHIC PROCLIVITIES OF *ACACIA NILOTICA* (L.) WILLD. EX DEL.

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SWAMINATHAN, C., VINAYA RAI, R. S. & SURESH, K. K. 1989. Allelopathic proclivities of *Acacia nilotica* (L.) Willd. ex Del. Aqueous extracts of bark and leaf of *Acacia nilotica* (L.) Willd. ex Del. were tested for potential inhibitory effects on eight arable crops. Seed germination of the arables was significantly inhibited by the extracts. To a greater extent, radicle and plumule growth too were affected. The inhibition by bark extract was greater than by leaf extract. It is assumed that the effective substances are phytotoxins, mostly tannin, which are present in the extract. However, the response of the crops was disparate, tomato being the most susceptible and sunflower the least. The poor growth reported in some areas, of crops irrigated from tanks, the foreshores of which have been grown to stands of *A. nilotica* may be related to tannin leached mostly from bark of the tree in rain wash.

Key words: Allelopathy - *Acacia nilotica* - tannin - phytotoxin - root growth - plumule extension

Introduction

Acacia nilotica is an important multipurpose tree native to the Sind, Punjab and Deccan areas of Pakistan and India. Its wood is a popular fuel and ideal for making agricultural implements. The leaves and pods are widely used as fodder and in arid Indian regions comprises the principal diet for goats and sheep. The pods contain 15% crude protein. The bark and pods possess 12 - 20% tannin. Its gum is used in manufacturing matches, ink, paint and confectionery. The tree withstands extremes of temperature and also prolonged inundation (NAS 1980). Under Phase One of the Swedish International Development Authority aided Social Forestry Project in Tamil Nadu, India, extensive plantations of *A. nilotica* have been established on foreshores of minor irrigation tanks. However, there have been a few reports of the plantations deleteriously altering the quality of irrigation water and depressing crop growth and yield (Anonymous 1983).

Phytotoxic substances exuded by many tree species allelopathically retard growth of associate weed and crop species (del Moral & Muller 1969, Al-Mousawi & Al-Naib 1976, Nakasuga & Yamada 1979, Chou & Yang 1982, Chou

& Kuo 1986, Suresh & Vinaya Rai 1988). Though many physiological processes are affected by allelochemicals (Fisher 1979, Rice 1979, 1984), retardation of growth is indicated to be the frequent response (Fisher 1980).

Studies were therefore designed to investigate whether the growth penalty sustained by crops irrigated from tanks grown to *A. nilotica* could be due to phytotoxin released by the tree.

Materials and methods

Bark and foliage of *A. nilotica* from a six-year old stand at Forestry Research Station, Mettupalayam (11° 19' N, 76° 56' E, 300 *m* a.s.l.) were collected and soaked separately in distilled water at the weight/volume ratio of 1:10 for 24 *h*. This ratio produces low osmolality. Furthermore, soaking results in more conservative tests of activity (Richardson & Williamson 1988) than recycled rinses (Dunevitz & Ewel 1981, Stevens & Tang 1985) or concentrated rinses (Chou & Muller 1972). The extracts were filtered through Whatman Number 1 filter paper. The extract possessed relatively neutral pH values (6.9 to 7.2) which obviated the need for adjusted controls (Stout & Tolman 1941, Bell 1974, Reynolds 1975a, b). The eight crop species selected for the test were sorghum (cv. Co. 26), cotton (cv. MCU 10), cowpea (cv. Co. 4), sunflower (Modern elite), egg plant (cv. Co. 2), tomato (cv. Co. 2), lady's finger (cv. Co. 1) and chilli (cv. Co. 1). Twenty-five seeds of each of the crop species were sown in sterile 10 *cm* petri dishes lined with one sheet of germination paper saturated with 4 *ml* of the extract. Moisture in the paper was maintained by adding 4 *ml* of the extracts every alternate day. Distilled water served as control. The treatments were set up in triplicate. Per cent germination, radicle length and plumule elongation of each crop under both bark and leaf extracts were recorded seven days after sowing (ISTA 1985). The magnitude of inhibition versus stimulation in the bioassay was compared through the Response Index (RI) (Richardson & Williamson 1988) determined as follows:

$$\text{if } T > C, \text{ RI} = 1 - (C/T)$$
$$\text{if } T = C, \text{ then RI} = 0$$
$$\text{if } T < C, \text{ then RI} = (T/C) - 1$$

where **T** is the treatment mean and **C** is the control mean. A negative RI reflects the proportional disparity in output (germination, radicle length or plumule growth) of test crop in the treatment relative to output in the control. The results were subjected to an analysis of variance and mean RI values tested for significant differences (LSD) were computed following Panse and Sukhatme (1967).

Results and discussion

Germination of all test species was inhibited by extracts of both bark and leaf. This inhibition is thought to be due to phytotoxins present in the extracts, instead of osmotic inhibition because use of 10% extract ensures low osmolality (Richardson & Williamson 1988). The inhibition as measured by RI means ranged from 1 to 10% due to bark extract, 0.2 to 7% due to leaf extract (Table 1). In contrast, suppression of radicle and plumule growth was comparatively greater. The reduction in radicle growth due to bark extract varied from 2 to 14% and that due to leaf extract 4 to 13%. The corresponding figures for plumule growth were 0.2 to 13% (bark) and 3 to 13% (leaf). Leaf extract is thus indicated to be less inhibitory than bark extract. In fact, leaf extract had either no deleterious effect on radicle growth of some crops (sorghum and sunflower) or enhanced this attribute in others (cowpea). The bark of *A. nilotica* contains 12 to 20% tannin (NAS 1980) which has been reported to repress nitrifying bacteria (Rice & Pancholy 1973). The phytotoxin in the species is thus assumed to be tannin.

Table 1. Response index values for eight receiver crops exposed to bark (B) and leaf (L) leachates of *Acacia nilotica*

Receiver crop	Germination		Radicle length		Plumule elongation	
	B	L	B	L	B	L
Sorghum	-0.03	-0.04	-0.08	+0.03	-0.013	+0.05
Cotton	-0.05	-0.06	-0.09	-0.10	-	-
Cowpea	-0.01	-0.02	-0.02	+0.21	-0.12	-0.11
Sunflower	-0.01	-0.07	+0.02	+0.02	-0.002	-0.07
Egg plant	-0.03	-0.002	-0.005	-0.07	-0.05	-0.03
Tomato	-0.04	-0.06	-0.14	-0.13	-0.12	-0.06
Lady's finger	-0.03	-0.03	-0.06	-0.09	-0.11	-0.13
Chilli	-0.10	-0.06	-0.08	-0.04	-0.11	-0.09
Least significant difference	0.03	0.02	0.05	0.10	0.04	0.06

The present study also reveals the disparate response of the different crops to the extracts. Of the eight species, sunflower proved less susceptible and tomato more so to the phytotoxin present in the extract. Unlike in other crops, radicle length in sunflower was unaffected by either the bark or the leaf extract and reduction in its plumule length due to bark extract was only 0.2% while in others it ranged between 5 to 13%. The differential response of the test species cautions against the use of a single assay species in insinuating any allelopathic interference (del Moral & Cates 1971, Fisher 1979, Rice 1979). Richardson and Williamson (1988), in a study on the allelopathic effect of shrubs on pines, found inhibition of germination to be highly correlated with precipitation.

Therefore foliar run-off may provide an appropriate conduit mechanism for water soluble inhibitors. Thus, there are plausible grounds to attribute poor growth of crops irrigated from tanks grown to *A. nilotica* to tannin leached mostly from the bark of the tree in rain wash. This needs further examination.

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