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ScienceDirect
South African Journal of Botany 74 (2008) 149–152
SOUTH AFRICAN JOURNAL OF BOTANY
www.elsevier.com/locate/sajb

Short communication

Allelopathic potential of *Tetrapleura tetraptera* leaf extracts on early seedling growth of five agricultural crops

S.O. Amoo [a,b,*], A.U. Ojo [a], J. Van Staden [b]

[a] *Department of Botany, Faculty of Biological Sciences, University of Nigeria, Nsukka, Nigeria*
[b] *Research Centre for Plant Growth and Development, School of Biological and Conservation Sciences, University of KwaZulu-Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa*

Received 8 June 2007; received in revised form 8 August 2007; accepted 24 August 2007

Abstract

Interference of allelochemicals present in some multipurpose trees on growth and development of adjoining crops necessitate the evaluation of the compatibility of the tree with various crops before integration into an agroforestry system. The allelopathic potential of *Tetrapleura tetraptera* (Schum and Thonn.)Taub, a multipurpose tree, considered as a potential agroforestry species, was examined using aqueous leaf extracts at different concentrations in laboratory bioassays. The extractions were done for 24 h and 48 h durations. The extracts stimulated production of lateral roots in *Lycopersicon esculentum* Mill. but inhibited it in *Abelmoschus esculentum* L. The 24 h extract significantly reduced shoot length at 25% concentration and above in *Amaranthus spinosus* L. while the 48 h extract significantly stimulated it at the same concentrations in *L. esculentum* and *A. esculentum*. However, both shoot and root lengths of *Capsicum annum* L. were significantly inhibited at all extract concentrations up to 79 and 73% respectively. Significant inhibition of root length at almost all concentrations in all the bioassay species showed that root length is a more sensitive indicator of phytotoxic activity. The degree of inhibition increased with increasing concentration of the 24 h extract.

Keywords: Intercropping; Litter decomposition; Root length; Tree-crop interaction

1. Introduction

Trees, especially multipurpose ones, are becoming an integral part of agriculture in agroforestry programmes. This practice increases productivity, improves soil quality, microclimate, nutrient cycling, conserves soil and increases overall productivity (Singh et al., 2001). A number of trees do, however, negatively affect performance of crops through allelopathy. These include *Leucaena leucocephala*, *Populus deltoides*, *Eucalyptus* and *Acacia* species (Bansal et al., 1992; Ralhan et al., 1992; Bora et al., 1999; Singh et al., 1999a,b). Allelochemicals are found in all plant parts; roots, stems, rhizomes, flowers, inflorescences and leaves (Putnam, 1988). Often, the release of these allelochemicals from the decomposing litter affects seed germination, growth and development of adjoining crop plants in agroforestry systems. It is therefore important that the allelopathic compatibility of crops with trees be determined before incorporating them into the agroforestry system as phytotoxins released by some intercrop trees could affect the establishment or development of food and fodder crops (King, 1979; Rice, 1979). Seedling growth bioassays have frequently been reported to be more sensitive than germination bioassays (Leather and Einhellig, 1985). Kamara et al. (1999) reported strong allelopathic activity of *Tetrapleura tetraptera* leaf extracts on cowpea germination and early development as well as a reduction of cowpea dry matter in pot experiments irrespective of mulch management. A differential response was observed, however, in maize (Kamara et al., 2000). Similarly, Lal (1989) reported a significant reduction of germination and seedling establishment of cowpea in *Gliricidia*- and *Leucaena*-based systems. However, similar treatments did not affect maize.

To our knowledge, there is presently a paucity of information on the phytotoxic effect of *T. tetraptera* on agricultural crops. This study investigated the phytotoxic activity or allelopathic potential of aqueous extracts of *T. tetraptera* on some agricultural

* Corresponding author. Research Centre for Plant Growth and Development, School of Biological and Conservation Sciences, University of KwaZulu-Natal Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa.
E-mail address: rcpgd@ukzn.ac.za (S.O. Amoo).

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doi:10.1016/j.sajb.2007.08.010

Table 1
Effects of different aqueous concentrations of leaf extracts of *T. tetraptera* on shoot length (cm) of the agricultural crops tested

Extract concentrations	Agricultural crops and extraction time (h)									
	L. esculentum		*A. esculentum*		*A. spinosus*		*C. annum*		*S. melongena*	
	24	48	24	48	24	48	24	48	24	48
Control	8.24±0.33[a #]	8.24±0.33[a]	9.18±0.91[b]	9.18±0.91[b]	3.39±0.11[a]	3.39±0.11[a]	3.33±0.44[b]	3.33±0.44[d]	2.59±0.44[bc]	2.59±0.44[a]
10%	8.63±0.16[a] (+4.73)[@]	8.73±0.30[a] (+5.95)	10.60±0.15[b] (+15.47)	9.66±0.14[b] * (+5.23)	3.41±0.27[a] * (+0.59)	4.56±0.08[d] (+34.51)	1.76±0.36[a] (−47.15)	1.66±0.12[c] (−50.15)	3.53±0.40[cd] * (+36.29)	4.27±0.04[d] (+64.86)
25%	7.95±0.19[a] * (−3.52)	9.90±0.58[b] (+20.15)	6.63±0.78[a] * (−27.78)	9.75±0.17[b] (+6.21)	3.36±0.28[a] * (−0.88)	4.24±0.05[c] (+25.07)	1.60±0.36[a] (−51.95)	1.50±0.21[bc] (−54.95)	4.00±0.23[d] (+54.44)	3.65±0.17[c] (+40.93)
50%	7.93±0.19[a] * (−3.76)	9.71±0.34[b] (+17.84)	4.94±0.76[a] * (−46.19)	7.05±0.10[a] (−23.20)	3.50±0.09[a] * (+3.24)	4.47±0.08[cd] (+31.86)	1.58±0.40[a] (−52.55)	0.97±0.15[ab] * (−70.87)	2.54±0.31[bc] (−1.93)	3.07±0.26[b] (+18.53)
75%	8.51±0.19[a] * (+3.28)	9.52±0.32[b] (+15.33)	4.55±0.79[a] * (−50.44)	6.68±0.30[a] (−27.23)	5.97±2.32[a] (+76.11)	3.93±0.08[b] * (+15.93)	0.82±0.25[a] (−75.38)	0.70±0.10[a] (−78.98)	2.50±0.36[b] (−3.47)	2.84±0.10[ab] (+9.65)
100%	7.92±0.30[a] * (−3.88)	9.27±0.14[b] (+12.50)	5.00±0.83[a] * (−45.53)	11.27±0.45[c] (+22.77)	2.54±0.24[a] * (−25.07)	3.23±0.18[a] (−4.72)	0.88±0.24[a] (−73.57)	0.83±0.33[a] (−75.08)	1.40±0.30[a] * (−45.95)	2.44±0.12[a] (−5.79)

[#] Mean values in the same column followed by the same letter(s) are not significantly different ($p=0.05$) based on Duncan's Multiple Range Test.
[@] Values in parenthesis indicate percentage inhibition (−) or stimulation (+) relative to control.
* Mean value in the same row per plant followed by an asterisk (*) indicates significant difference at 95% confidence interval.

crops. *T. tetraptera* is a leguminous multipurpose tree (Mimosoideae) indigenous to tropical Africa. It thrives in lowland forest areas. Adewunmi (1993) has suggested the cultivation of this plant along water courses due to its potential for the local control of schistosomiasis. We wished to determine whether leaf extracts of this tree have allelopathic effects on a number of crops in order to ascertain possible crop responses upon their integration with *T. tetraptera* in agroforestry systems.

2. Materials and methods

Leaves of *T. tetraptera* (Schum and Thonn.) Taub were collected from Nsukka, Enugu State in Nigeria. Freshly senescent leaves (400 g) were soaked in 2 l of distilled water at room temperature for 24 or 48 h. The crude extracts were filtered and diluted with distilled water which served as control. The extract concentrations used were 100%, 75%, 50%, 25% and 10% respectively.

The agricultural crops selected were *Lycopersicon esculentum* Mill., *Abelmoschus esculentum* L., Amaranthus *spinosus* L., *Capsicum annum* L. and *Solanum melongena* L. Following an imbibition period of 10–15 min, ten seeds of each of the crops were placed in a Petri dish lined with a double layer of Whatman no. 1 filter paper moistened initially with 5 ml of the prepared aqueous extracts. One ml of the extracts were subsequently added daily to keep the filter paper moistened. Each treatment had five replicates and the Petri dishes were kept at 25±2 °C for 14 days.

At the end of the 14 days, the length of the primary root, length of the main shoot, and the number of lateral roots were measured and recorded. The data were subjected to analysis of variance and the mean values separated using Duncan's Multiple Range Test at a 5% probability level. The statistical analysis was done using SPSS/PC version 11 software. Percentage inhibition or stimulation relative to control was calculated using the formula

$$I = \frac{100(R_2 - R_1)}{R_1}$$

where I = percentage inhibition or stimulation, R_1 = response of control crop and R_2 = response of tested crop.

3. Results and discussion

Table 1 shows the mean shoot lengths of the assayed crops when using different extract concentrations. *C. annum* displayed significant inhibition at all extract concentrations; the level of which increased with increased extract concentration up to 75%. Only two of the crops (*L. esculentum* and *A. esculentum*) produced lateral roots. A significant inhibitory effect on the number of lateral roots was observed at all concentrations of both the 24 and 48 h extracts in *A. esculentum* (Table 2).

The root length of all the assayed crops was significantly inhibited at 50% extract concentration and above (Table 3). The

Table 2
Effects of different aqueous concentrations of leaf extracts of *T. tetraptera* on number of lateral roots of the agricultural crops tested

Extract concentrations	Agricultural crops and extraction time (h)			
	L. esculentum		*A. esculentum*	
	24	48	24	48
Control	1.30±0.40[a #]	1.30±0.40[a]	22.85±2.25[d]	22.85±2.25[e]
10%	1.38±0.16[a] (+6.15)[@]	1.55±0.27[a] (+19.23)	22.73±1.73[d] (−0.53)	19.40±0.63[d]* (−15.10)
25%	1.18±0.15[a] * (−9.23)	1.70±0.24[a] (+30.77)	12.25±1.43[c] (−46.39)	10.10±0.46[b]* (−55.80)
50%	3.34±0.19[c] (+156.92)	1.25±0.31[a]* (−3.85)	16.00±0.74[c] (−29.98)	6.90±0.28[a]* (−69.80)
75%	2.15±0.31[b] (+65.38)	1.45±0.26[a]* (+11.54)	2.04±0.96[a]* (−91.07)	12.50±0.70[c] (−45.30)
100%	3.03±0.19[c] (+133.08)	1.55±0.22[a]* (+19.23)	7.70±1.29[b]* (−66.30)	18.10±0.28[d] (−20.79)

[#] Mean values in the same column followed by the same letter(s) are not significantly different ($p=0.05$) based on Duncan's Multiple Range Test.
[@] Values in parenthesis indicate percentage inhibition (−) or stimulation (+) relative to control.
* Mean value in the same row per plant followed by an asterisk (*) indicates significant difference at 95% confidence interval.