

Effect of leaf leachate of *Prosopis juliflora* (Swartz DC) and *Acacia raddiana* (Brenan) on early growth of *Sorghum sudanense* (Piper Stapf)

Hasabelrasoul Fadlelmula Mustafa & Rona Abdallah Bushra Ali

Department of Environmental Science and Natural Resources, Faculty of Agricultural Sciences,
University of Gezira, Medani, Sudan

Corresponding author: hasabelrasoul_56@yahoo.com

Abstract

Prosopis juliflora (Swartz) DC provokes contradictive allegations on its ecological significance. To contribute in elucidating the dispute on its allelopathic behaviour, leachate was extracted from the leaves of both *P. juliflora* and *Acacia raddiana* (Brenan), the dominant indigenous tree species in arid region of Sudan to investigate their impact on the early growth of *Sorghum sudanense* (Piper) Stapf. Seeds of *S. sudanense* were sown in transparent plastic cups (297 cm³) placed into glass growth chamber in split plot design in three replications. The main plots were allotted for the two tree species and the subplots for the leachate concentrations at 0%, 1%, 2%, 3%, 4% and 5% of volume of dry matter to distilled water. The results revealed insignificant effect of the leachate of both tree species at any concentration level on the early growth of *S. sudanense*. Therefore, it could be concluded that *P. juliflora* had no allelopathic suppression on the early growth of boaceace species basing on the conditions of the experiment.

Key words: *Acacia raddiana*, allelopathy, attribute, concentration, growth, leachate, *Prosopis juliflora*

Résumé

Le *Prosopis juliflora* (Swartz) DC provoque des allégations contradictoires sur son importance écologique. Afin de contribuer à élucider le différend sur son comportement allélopathique le « leachate » a été extrait à partir des feuilles des deux *Acacia raddiana* *P. juliflora* and (Brenan), les espèces dominantes d'arbres indigènes dans la région aride du Soudan, pour enquêter sur leur impact sur la croissance précoce du *sorgho soudanais* (Piper) Stapf. Des graines de Sorgho soudanais ont été semées dans des récipients en plastique transparents (297 cm³) placés dans la chambre de croissance en verre à la forme de parcelles subdivisés à trois répétitions. Les parcelles principales ont été attribuées pour les deux espèces d'arbres et les petites parcelles pour les concentrations de « leachate » à 0%, 1%, 2%, 3%, 4% et 5% du volume de matière sèche à l'eau distillée. Les résultats ont révélé un effet

négligeable de « leachate » sur toutes les espèces d'arbres à n'importe quel niveau de concentration sur la croissance précoce de Sorgho soudanais. Par conséquent, on peut conclure que *P. juliflora* n'a pas aucune suppression allélo-pathique sur la croissance précoce des espèces « boaceace », en se basant sur les conditions de l'expérience.

Mots clés: *Acacia raddiana*, allélopathie, attribut, la concentration, la croissance, le « leachate », *Prosopisjuliflora*

Background

Algarroba (*Prosopis juliflora*) is a species well adapted to arid regions of the world. It was introduced to Sudan in 1917 (Wunder, 1966; Burkart, 1976; Habit and Saavedra, 1988 ; Elfadl and Luukkanen, 2003) and soon became naturalised it has since become very noxious and invaded both natural and managed habitats such as watercourses, highways, abandoned land and irrigated areas. The rate of spread observed during 1978 - 1996 was 370 - 460 hectare per annum (Elsidig *et al.*, 1998). In most of the infested sites algarroba forms impenetrable thickets that smother and exclude native vegetation and substantially change vegetation structure.

Literature Summary

The leaves of *P. juliflora* contain various chemicals including tannins, flavonoids, steroids, hydrocarbons, waxes and alkaloids (Sola *et al.*, 1992). Alkaloids and flavonoids are known to degrade rapidly following leaf senescence but other chemicals may accumulate under tree crowns (Sola *et al.*, 1992). Extracts from parts of *P. juliflora* decreased growth of almost all plants tested in several studies, indicating that allelopathic effects are important in the ecology of the species (Lahari and Gaur, 1969). Fresh leaf extracts of *P. juliflora* were found to have greater negative effects on germination than extracts from stems, dry litter or fruit (Sundaramoorthy *et al.*, 1995). Sen and Chawan (1970) assessed the effects of *P. juliflora* extracts on germination and growth of *Euphorbia* species and concluded that the phytotoxicity was without ecological significance. *Acacia* species in Sudan have been observed to promote the growth of the grasses under their canopy. In tall savannah, it stimulates heavy growth of the grasses in a phenomenon called *Acacia - Balanites* cycle. Saffan and Salama (2005) found that aqueous leaves extract of *Acacia* contained phenolic compounds and flavonoids that might be implicated as allelochemicals agent.

Study Description

The study was conducted in glass house at Nishishiba Compass of the Gezira University in Sudan. The temperature was kept inside the glass house during the day at 35°C and relative humidity above 50%. Transparent plastic cups of 3.0 cm midiameter and 10.5 cm height were filled with clay soil volume of 297 cm³ to raise the seedlings of the test crop *Sorghum sudanense*. The cups were arranged in the house in split plot setting (Steel and Torrie, 1992) out replicated thrice. The two main plots were allocated for the two species. Each main plot was divided into six subplots, containing six leachate concentrations at 0%, 1%, 2%, 3%, 4% and 5% of volume of dry matter to distilled water. Each cup contained one seedling of *S. sudanense* originated from seeds sown in the pots and then thinned at erection of the cotyledons to one. Each of the five cups formed the observational unit for each treatment. The seedlings were irrigated with distilled water without diluting the concentration by adding equivalent of the amount evaporated. The amount of the evaporated water was calculated according to daily records of evaporation inside the glass house and the area of the opened top end of the cup. Observations on shoot height, leafing depth (the shoot length at the point of bottom leaves to the top) and number of leaves were taken every week from thinning for a period of one month.

Research Application

The growth attributes of *S. sudanense* are given in Table (1) which shows insignificant difference between the two types of the leachate in the various growth characters. Increasing the concentration of the leachate of both species did not result in significant differences in shoot height, leafing depth or number of leaves except when the concentration increased to more than 3%.

References

- Burkart, A. 1976. A Monograph of the genus *Prosopis* (Leguminosae subfam. Mimosoideae). *J. Arnold Arb.* 57:217-249; 450-525.
- Elfadl, M.A. and Luukkanen, O. 2003. Response of *Prosopis juliflora* to pruning evidence for a resource potential for parkland agroforestry in the drylands. *Journal of Arid Environment* 53: 441- 455.
- El Siddig, E.A., Eltayeb, A.M. and Abdelgadir, A.Y. 1998. Sustainable management of natural forests in Jebel Marra with consideration to community needs. Sudanese Environmental Conservation Society, Khartoum. 68 p.
- Lahiri, A.N and Guar, Y.D. 1969. Germination studies on arid zone plants. The nature and rates of germination inhibitors

Table 1. Growth attributes of the seedlings of *Sorghum sudanense* raised in glass house for one month and irrigated with leachate extracted from leaves of *Prosopis juliflora* and *Acacia raddiana*

Leachate Conc.	<i>P. juliflora</i>	<i>A. raddiana</i>	<i>P. juliflora</i>	<i>A. raddiana</i>	<i>P. juliflora</i>	<i>A. raddiana</i>
	leachate	leachate	leachate	leachate	leachate	leachate
	Shoot height (cm)		Leafing depth (cm)		Number of leaves	
0%	23.7	21.4	6.2	5.7	5.0	4.7
1%	22.9	22.3	5.6	6.2	4.7	5.0
2%	22.3	25.0	5.0	7.1	5.0	5.0
3%	22.0	23.7	5.7	6.7	4.7	5.3
4%	24.0	25.9	7.3	7.0	5.7	5.7
5%	27.6	24.5	7.2	6.9	5.7	5.7
Mean	23.8	23.8	6.2	6.6	5.1	5.2
SE	±0.93		± 0.29		± 0.11	
CV	17%		19.2%		9.4%	

present in the leaves of *Prosopis juliflora*. *Nat. Inst. Sci. India* 35B:60-71.

Habit, M.A. and Saavedra, J.C 1988. The current stage of knowledge on *Prosopis juliflora*. II International Conference on Prosopis, Recife, Brazil, 25 – 29 August, 1986. 553 pp.

Saffan, S.E. and Salma, H.M. 2005. Influence of allelopathic of *Acacia raddiana* leaf extract on germination and some metabolites seedling of *Lupinus termis*. *Egypt. J. Biotechnol.* 21: 32-43.

Sen, D.N. and Chawan, D.D. 1970. Ecology of desert plants and observations on their Seedlings III: The influence of aqueous extracts of *Prosopis juliflora* (DC) on *Uphorbia caducifolia* Haines. *Vegetation* 21:277-298.

Sola, N. H., Juliani, H.R. and Cabrera, J.L. 1992. Determination of some soil components under *Prosopis ruscifolia*. *Agrochemical* 36:148-153.

Steel, R.G. D. and Torrie, J.H. 1992. Principles and procedures of statistics. McGraw Hill Book Company Inc., New York. 622 pp.

Sundramoorthy, S., Kalra, N. and Chawan, D.D. 1995. Allelopathy and *Prosopis juliflora* provenance Israel in semi-arid agroforestry system. *India J. Forest* 18(3):214 – 220.

Wunder, W.G. 1966. *Prosopis juliflora* in the arid zone of Sudan. Forestry Research and Education Project. Pamphlet No. 26. Department of Forestry, Khartoum, Sudan. 23 p.