

Allelopathic Effects of *Jatropha curcas* Linn. Aqueous Extract on Some Intercropped Food Crops

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Received 25 June 2017 ; Accepted 28 July 2017 ; Published online 14 August 2017

Abstract Laboratory bioassay was conducted to find out the allelopathic effects of *Jatropha curcas* Linn. on selected intercropping food crops, viz., *Triticum aestivum* (wheat) and *Zea mays* (maize) and their varieties. Aqueous extracts from leaves of *Jatropha curcas* were prepared at different concentrations of 5, 10, 15, 20% and applied to the varieties of test crops. All the crops were affected by the different concentrations of aqueous extracts. The maximum seed germination reduction was observed for wheat in variety UP-2338 (40.50%) and for maize the maximum seed germination reduction was in variety Pragati. Maximum radicle length reduction (52.62%) was recorded in wheat variety UP-2526 and for maize in Pragati (58.57%). The plumule length reduction was maximum in wheat variety UP-2526 (52.62%) and maize variety Pragati (58.87%). Higher concentrations of *Jatropha curcas* had a strong inhibitory effect on germination, radicle and plumule length of both the crops. The level of inhibition of aqueous leaf extract of *Jatropha curcas* varied with the concentration and type of tested crops and their varieties.

Keywords Allelopathy, Food crops, Intercropping, *Jatropha curcas*, Leaf aqueous extract.

Introduction

Jatropha, an agro-fuel plant, has been rapidly introduced in many areas of the world in recent decades. A number of food crops are also being raised along with *Jatropha* and new intercropping systems are being evolved to promote and popularize the introduced species amongst farmers. The *Jatropha* is competing with food crops in the countries / regions where cultivated land area is a critical constraint to food security. The agro-fuel species is also reported to cause allelopathic effects on some food crops [1], which appears to be another stress on food production. As an oil producing, succulent, drought resistant and poisonous shrub or small tree belonging to Euphorbiaceae family and mainly grown in tropical and subtropical regions [2], *Jatropha curcas* is being increasingly adopted by farmers, institutions and oil industries and being propagated through government policies without much concern to its long-term ecological impacts on food crops.

Allelopathy has a great significance in plant succession and food production. Many pioneer species in the early stages produce chemical substances which are inhibitory to other species. There is quite an impressive body of literature relating to *Jatropha* allelopathic influences on the performance of other plants or field crops [1, 3—6] ; however, there is some information gap about various *Jatropha*-based intercropped systems recently adopted in the Tarai area of the Himalayas.

A domination of certain plant species hinders

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Table 1. Effect of different concentrations of leaf extract of *Jatropha curcas* on seed germination (%) and per cent reduction (–) or increase (+) over control on different crops varieties (mean ± SE).

Crops and varieties		T ₀	Concentration of leaf extract				
			T ₁	T ₂	T ₃	T ₄	
Wheat	UP–2526	97.03 ± 0.612	87.47 ± 0.284 (–9.86)	87.27 ± 1.202 (–10.06)	69.40 ± 1.822 (–28.48)	62.30 ± 0.878 (–35.79)	
	UP–2338	100 ± 00.00	87.23 ± 1.420 (–12.77)	85.23 ± 1.030 (–14.77)	65.7 ± 1.208 (–34.30)	59.5 ± 0.962 (–40.50)	
Maize	Gourav	85.77 ± 0.788	79.70 ± 2.814 (–7.07)	68.40 ± 0.982 (–20.25)	61.37 ± 1.020 (–28.45)	44.80 ± 1.909 (–47.77)	
	Pragati	87.63 ± 1.551	85.70 ± 1.217 (–2.21)	69.87 ± 0.338 (–20.27)	60.00 ± 1.398 (–31.53)	42.56 ± 1.396 (–51.43)	

productivity thanks to the release of secondary metabolites. Released from various plant parts (e.g., leaves, roots, shoots), these phytoactive compounds may exert their effects on their own species (auto-allelopathy) as well as on other plants growing in the surroundings (allele-allelopathy) [7, 8]. In case of allele-allelopathy, a particular plant species becomes competitor for the adjacent plants influencing various stages of their growth as well as productivity performance.

Alkaloids, phenolics and other allelochemicals are produced and stored by certain plants preferably as part of a defence mechanism to protect the plants [9]. Many of such allelochemicals are secondary substances not occurring in all living matter but appear sporadically.

In *Jatropha* leaf-fall in the fall season produces a thick layer of litter that could influence productive performance of a food crop. Leaves, therefore, appear to be the main agent of allelopathy. In the experi-

ment attempt has been made to study the allelopathic effect of *Jatropha curcas* aqueous leaf extracts on seed germination and seedling growth of some important crop cultivars which is commonly cultivated along with *Jatropha* in an intercropping system.

(This paper is part of the research work under PhD Degree Program carried out by the first author under the supervision of the second author at GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India. All facilities provided by the University are gratefully acknowledged).

Materials and Methods

Mature fresh leaves of *Jatropha curcas* Linn. were collected from the *Jatropha* plantation and dried in an oven at 60°C ± 20°C for two days and the dried leaves were ground to a fine powder in Wiley Mill (40 mesh). Seeds of two different crops, viz. *Triticum aestivum* (wheat) and *Zea mays* (maize), were collected from the department of Plant Breeding and

Table 2. Effect of different concentrations of leaf extract of *Jatropha curcas* on radicle length and per cent reduction (% of control) on different crops varieties (mean ± SE).

Crops and varieties		T ₀	Concentration of leaf extract			
			T ₁	T ₂	T ₃	T ₄
Wheat	UP–2526	15.53 ± 0.204	14.47 ± 0.226 (–6.85)	9.53 ± 0.291 (–38.65)	7.36 ± 0.214 (–52.62)	6.98 ± 0.280 (–55.06)
	UP–2338	15.74 ± 0.123	14.67 ± 0.233 (–6.82)	9.93 ± 0.146 (–36.89)	7.27 ± 0.120 (–53.83)	6.37 ± 0.081 (–59.53)
Maize	Gourav	18.30 ± 0.153	15.89 ± 0.468 (–13.17)	15.10 ± 0.667 (–17.49)	11.98 ± 0.567 (–34.54)	6.27 ± 0.123 (–65.74)
	Pragati	18.13 ± 0.333	16.83 ± 0.348 (–7.17)	15.50 ± 0.265 (–14.52)	12.84 ± 0.273 (–20.77)	6.50 ± 0.253 (–63.82)

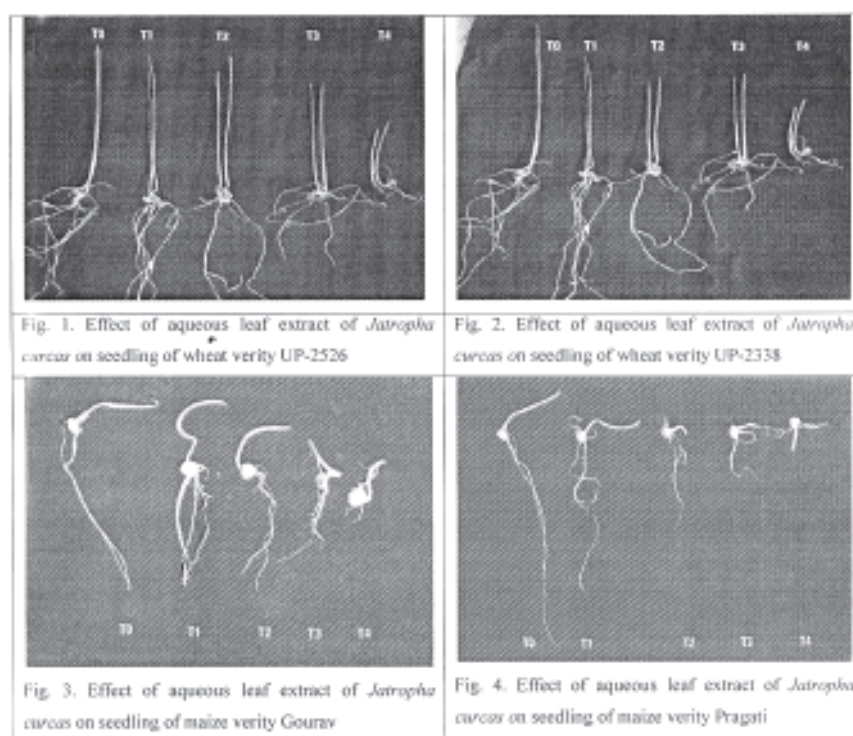


Fig. 1. Effect of aqueous leaf extract of *Jatropha curcas* on seedling of wheat variety UP-2526. **Fig. 2.** Effect of aqueous leaf extract of *Jatropha curcas* on seedling of wheat variety UP-2338. **Fig. 3.** Effect of aqueous leaf extract of *Jatropha curcas* on seedling of maize variety Gourav. **Fig. 4.** Effect of aqueous leaf extract of *Jatropha curcas* on seedling of maize variety Pragati.

Genetics of the GB Pant University of Agriculture and Technology, India. Aqueous extract of *Jatropha* leaves was prepared by taking 10 g of powdered *Jatropha* leaf material in 100 ml sterilized distilled water and kept at room temperature (20–30°C) for 24 h. The extracts were filtered through three layers Whatmann No. 1 filter paper. This was considered as stock solution and a series of solution with different strengths (5%, 10%, 15% and 20%) was prepared by dilution method [10].

The seeds were sterilized by soaking in 0.01% HgCl_2 solution for 3 to 5 min and then washed thoroughly with sterilized distilled water and dried with an absorbent. Ten seeds were placed at equal distances for germination in each sterilized petri dish of 90 mm diameter and 15 mm height containing two blot-

ting papers in triplicates and moistened either with sterilized distilled water or control (T_0 treatment) or with aqueous extracts of different concentrations 5.00 (T_1), 10.00 (T_2), 15.00 (T_3) and 20.00% w/v (T_4) of *Jatropha* leaf extracts (treatments) and kept under laboratory conditions.

The emergence of radicle is considered as an index for seed germination. Number of germinated seeds was counted after ten days and radicle and plumule growth was recorded with the help of metered scale [10, 11].

Results and Discussion

In bioassay studies of leaf aqueous extract of *Jatropha curcas* on seeds of both varieties of wheat

Table 3. Effect of different concentrations of leaf extract of *Jatropha curcas* on plumule length and per cent reduction (% of control) on different crops varieties (mean $\pm$ SE).

Crops and varieties		T ₀	Concentration of leaf extract			
			T ₁	T ₂	T ₃	T ₄
Wheat	UP-2526	14.61 $\pm$ 0.271	10.63 $\pm$ 0.176 (-27.20)	10.6 $\pm$ 0.208 (-27.43)	9.39 $\pm$ 0.240 (-35.69)	6.92 $\pm$ 0.260 (-52.62)
	UP-2338	13.14 $\pm$ 0.275	10.50 $\pm$ 0.200 (-20.09)	9.43 $\pm$ 0.310 (25.19)	9.83 $\pm$ 0.203 (-28.21)	6.93 $\pm$ 0.240 (-47.26)
Maize	Gourav	6.44 $\pm$ 0.186	5.70 $\pm$ 0.265 (-11.86)	5.43 $\pm$ 0.203 (-15.98)	4.13 $\pm$ 0.123 (-36.13)	2.66 $\pm$ 0.185 (-58.65)
	Pragati	6.43 $\pm$ 0.022	5.91 $\pm$ 0.156 (-8.13)	5.27 $\pm$ 0.035 (-18.13)	3.66 $\pm$ 0.056 (-43.06)	2.66 $\pm$ 0.122 (-58.87)

showed a gradual inhibition in seed germination, root length and shoot length. The inhibitory effect was concentration dependent. In both the varieties of wheat the maximum seed germination reduction was observed in variety UP-2338 (40.50%) at T₄ treatment and for maize in variety Pragati (51.53%) at the same treatment (Table 1). Generally, there was a decrease in germination as the concentration of the extract increased. The reduction in germination could be attributable to inhibitory effect of allelopathic substances present in the extract. *Jatropha curcas* contains substances such as phenolic compounds, which succeeded to be used as natural anti-oxidant for the protection of oils and their corresponding biodiesel against oxidative deterioration [12].

The seedling growth was measured and compared amongst treatments. The reduction in radicle was gradual in leaf extract in both the crops at all the concentrations. In both the varieties of wheat the maximum reduction in radicle length was observed in UP-2338 (59.53%) at T₄ treatment and for the maize in variety Gourav (65.74%) at T₄ treatment (Table 2, Figs 1–4).

The plumule length was also reduced in all the treatments for both the crops. For wheat the maximum reduction was observed in variety UP-2526 (52.62%) at T₄ treatment and for the maize in variety Pragati (58.57%) (Table 3, Figs 1–4).

Similar inhibition of shoot length and root length as well as germination, radicle and plumule length by allelopathic extracts have been reported in various

agricultural crops, and it was also found that inhibition was more at higher concentrations [3, 8, 13].

Conclusion

Jatropha curcas provides a viable alternative to fossil fuels. However, the study revealed that higher concentrations of aqueous extract of *Jatropha* leaves have an inhibitory effect on germination, radicle and plumule length of wheat and maize. The presence of phenolic compounds could be the cause of reduction in germination and growth of seedlings in the food crops. The results obtained in this study would serve as a basis for further research under field conditions to confirm the allelopathic potential of *Jatropha curcas*.

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