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Phytochemical Effects of Aqueous Leaves Extract of Tree Species as a Seed Priming Agent on Growth and Yield Attributes of Chickpea Crop

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ABSTRACT

A field trial was carried out to investigate the phytochemical effects of aqueous leaves extract of tree species as a seed priming agent on growth and yield attributes of chickpea (NIFA-2005) crop; grown at AZRC-Arid Zone Research Centre, Dera Ismail Khan, Pakistan during winter season. The study was laid in complete randomized block design with seven treatments including control (tap water), leaf extract of Moringa (Moringa oleifera), Thorn mimosa (Acacia nilotica), Rose wood (Dalbergia sissoo), Pongam (Pongamia piñata), Conocarpus (Conocarpus lancifolius) and River red gum (Eucalyptus camaldulensis) and replicated thrice. Results revealed that control plots, where hydro priming was practiced, had comparable fallouts in almost all studied parameters to other treatments used. However, moringa extract had significantly higher effect on growth rate (8.03 g m-2 day-1), net assimilation rate (2.30 g m-2 day-1), plant height, weight of nodules (3.60 g), and grain yield 1875 (kg ha-1). Thus, the practice of moringa leaves extract is recommended to get the maximum yield of chickpea crop.

INTRODUCTION

Chickpea (Cicer arietinum L.) is ranked third utmost pulse crop fallowed by peas and soybean, and approximately 15% of total world pulse production belong to this crop (FAO, 2019). Having high protein content, it is vital component of human diet and livestock in the developing countries. In Pakistan, 995 thousand hectares is under cultivation which contributed the 700 thousand tones production (Economic survey of Pakistan, 2020-21); and is generally grown in rain-fed areas in Punjab and Kyber Pakhtunkhwa provinces of Pakistan. However, in Sindh and Baluchistan, the crop is usually grown on utilizing residual moisture after rice harvest. Drought is one of the main limiting factor in chickpea crop grown in rain-fed condition (Reddy *et al*., 2004; Yu and Setter, 2003).

Seed priming have significant impact on activation of several biochemical changes in seed (i.e. dormancy breaking, hydrolysis or metabolism of inhibitors, imbibition and enzyme activation). The primed seed can speedily imbibe, accelerates the seed metabolism and causing an early and higher crop growth rate and thus increased the yield of chickpea and other rain-fed crops in drought condition (Shankar et al.,2014)

In Pakistan, chickpea yield on farmers' field's usually remains below one t ha^{-1} and the prime limiting factor is drought. Seed priming is simple procedure that expands vigor and subsequently performance of crop in field. Each priming technique has varying effects depending on specie of plant, stage of plant development, concentration/dose of priming agent, and incubation period (Oraon, S., & Mondal, S. 2020)..

The application of allelopathic extract is low cost, environment friendly and provide the key prospective for seed priming (Thakur et al., 2017; Bhardwaj et al., 2021). Seedling emergence is one of the foremost

constraints in chickpea production because of its thin seed coat and susceptibility to soil borne pathogens under rain-fed condition (Oraon & Mondal, 2022.). The present study was conducted to investigate phytochemical effects of aqueous leaves extract of tree species as a seed priming agent on growth and yield attributes of chickpea crop.

MATERIALS AND METHODS

The experiment was undertaken at AZRC, Dera Ismail Khan during winter season to examine the impact of leaves extract of different trees as seed priming and it was comprised of seven treatments; Control, Moringa (*Moringa oleifera*), Thorn mimosa (*Acacia nilotica*), Rose wood (*Dalbergia sissoo*), Pongam (*Pongamia piñata*), Conocarpus (*Conocarpus lancifolius*), River red gum (*Eucalyptus camaldulensis*) replicated thrice in a randomized complete block design. High yielding, well adopted chickpea variety "NIFA- 2005" was seeded by hand driven hand drill @ 65 kg seed ha^{-1}. Fertilizers and irrigations were scheduled as per recommendations for chickpea crop.

The data were recorded on crop growth rate (g m^{-2} day^{-1}), net assimilation rate (g m^{-2} day^{-1}), plant height at maturity (cm), number of fruit bearing branches (plant^{-1}), number of pods (plant^{-1}), number of nodules (plant^{-1}), weight of nodules (g), 1000-grain weight (g), grain yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index (%). The obtained results were statistically analysed using analysis of variance techniques as proposed by Steel *et al*. (1997) and comparison of individual treatment values were tested through $LSD_{0.05}$ using Computer software "Statistic ver. 8.1".

RESULTS AND DISCUSSION

Crop growth rate (g m^{-2} day^{-1})

Phytochemical effects of aqueous leaves extract of tree species revealed significant impact on (Table 1). Higher CGR of 8.03 g m^{-2} day^{-1} was observed in moringa leaf extract followed by Conocarpus, Pongam and control treatments (5.70, 5.50 and 5.40 g m^{-2} day^{-1}) respectively. In this connection, Yasmeen *et al*. (2011) indicated that Moringa leaf extract enhances relative water contents and the plants antioxidants during stress conditions. Fite et al., (2018) and Vashishth et al., (2023) showed that the application of leaf extracts of various species significantly improves crop growth rate of chickpea. Lower crop growth rate in hydro priming might be due to no supplementation of nutrients to the crop plants.

Table 1

Phytochemical Effects of Aqueous Leaves Extract of Tree Species as a Seed Priming Agent on different Growth and Yield Attributes of Chickpea.

Plant Extracts	Parameters							
	Crop growth rate	Net assimilation rate	Plant height	Number of pod bearing branches	Number of nodules	Weight of nodules	Grain yield	Biological yield
Control	5.40 c	1.50 b	25.87 abc	2.78 abc	37.33 b	2.70 d	1536 e	4770 c
Moringa (Moringa oleifera)	8.03 a	2.30 a	24.97 abc	3.00 abc	35.00 b	3.60 a	1875 a	6000 a
Thorn mimosa (Acacia nilotica)	5.80 bc	1.50 b	23.23 bc	3.22 a	40.33 b	3.10 c	1628 cd	4812 c
Rose wood (Dalbergia sisso)	6.80 b	2.20 a	20.07 c	2.22 c	60.33 a	3.50 ab	1797 ab	5555 ab
Pongam (Pongamia piñata)	5.50 c	1.50 b	27.77 ab	2.33 bc	35.33 b	3.20 bc	1649 c	5264 bc
Conocarpus (Conocarpus lancifolius)	5.70 c	1.70 ab	29.33 a	3.56 a	35.00 b	3.20 bc	1734 b	4965 c
River red gum (Eucalyptus camaldulensis)	6.03 bc	1.70 ab	23.30 bc	3.11 ab	35.67 b	3.40 abc	1555 de	5249 bc
LSD0.05	1.028	0.630	5.832	0.785	19.294	0.395	83.25	547.15

Net Assimilation Rate (g m^{-2} day^{-1})

Aqueous leaf extracts of various tree species significantly improved NAR (Table 1). Maximum NAR (2.30 g m^{-2} day^{-1}) was observed in Moringa leaf extract followed by the and Rose wood (2.20 g m^{-2} day^{-1}) Conocarpus and River red gum (1.70 g m^{-2} day^{-1}) repectively. Phiri, (2010) stated Moringa leaf extract has positive effects on various plants growth. Prasade et al. (2016) noted higher net assimilation rate by applying Moringa leaf extract. Williams and Frausto da Silva (2002) also found positive impact of Moringa leaf extract on chickpea seed imbibition.

Plant Height at Maturity (cm)

Plant height of chickpea showed significant impact on application various aqueous extract of different tree leaves (Table 1). Plant height (29.33 cm) was recorded in Conocarpus and Pongam leaf extract (27.77 cm) and Rose wood (20.07 cm) respectively. Beside this, Moringa and control treatments had statistically at par plant height. Sangeetha at el. (2023) studied that height of chickpea plant was linearly increased by applying extracts of different species. Similar findings were also reported by Amin and Javaid (2013).

Number of Pod Bearing Branches (plant^{-1})

Fruit bearing branches of chickpea were influenced significantly by leaves extract of tree species (Table 1).

Maximum number of pod bearing branches (3.56, 3.22 and 3.11) were observed in Conocarpus, Thorn mimosa and River red gum leaf extract treatments respectively, followed by Moringa (3.00) and control (2.78 plant^{-1}). The higher values in Conocarpus leaf extract could be due to presence of chemicals which accelerated pod bearing branches of chickpea (Babalola et al., 2013).

Number of Pods (plant^{-1})

A pod is a key component which contributes towards yield of chickpea (Mukhtar 2012). Aqueous leaves extract of various tree species non-significantly affected pods production of chickpea.

Number of Nodules (plant^{-1})

Legume crop has substantial impact on enhancing soil fertility via nodules formation and fixation of atmospheric nitrogen (Zia-Ul-Haq at el., 2007). Statistically significant influence was obtained on application of aqueous leaves extract of tree species on number of nodules of chickpea (Table 1). Higher number of nodules (60.33 plant^{-1}) was counted in Rose wood leaf extract than all other treatments. Increasing number of nodules with Rose wood leaves extract might be due to its functional role in nodules formation (Ahmad at el., 2010).

Weight of Nodules (g)

Phytochemical effect of aqueous leaves extracts of tree species as a seed priming agent on weight of nodules of chickpea is manifested in Table 1. Results showed significantly higher weight of nodules (3.60 g) in Moringa and in Rose wood (3.50 g) leaf extract treatments, followed by River red gum (3.40 g) treatment. The higher weight of nodules in Moringa leaf extract treatment was because of its internal ability to increase nodules weight on account of its chemical composition. Harris at el. (2008) also reported positive response of extracts on weight of nodules.

1000-grain weight (g)

Grain weight is a key feature that contributes towards the final yield (Anjum *et al*., 2006). Statistical analysis revealed non-significant variations among treatments (Table 1).

Grain yield (kg ha^{-1})

Significantly higher grain yield (1875 and 1797 kg ha^{-1}) in Moringa and Rose wood leaves extract treatments, followed by (1734 kg ha^{-1}) in Conocarpus. It might be due to greater nodules number, weight of nodules and grain weight in the corresponding treatments. Enhancement in grain yield observed in Moringa leaf extract treatment could be attributed to higher dry matter accumulation, CGR and net photosynthate in Moringa leave extract applied plots. These findings are in line with Zia-Ul-Haq at el. (2007) who obtained higher yield in snap bean crop with Moringa leaves extract application.

Biological yield (kg ha^{-1})

Aqueous leaves extract of tree species on biological yield is presented in Table 1. The mean values showed variations among the studied treatments. The higher biological yield (6000 and 5555 kg ha^{-1}) was noted in Moringa and Rose wood treatments followed by (5264 and 5249 kg ha^{-1}) Pongam and River red gum treatments. It might also be due to higher yield contributing parameters in Moringa leaf extract treated plots which enhanced grain as well as biomass production. Irshad at el. (2022) attained greater biological yield with Moringa leaf extract. Comparable results were also reported by Siddiqui at el. (2009).

Harvest index (%)

Aqueous extracts of different tree species showed significant impact on harvest index shown in Table 1. Maximum harvest index (34.94 and 33.88%) was recorded in Conocarpus and Thorn mimosa treatments, followed by 32.40 and 32.21% in Rose wood and River red gum treatments respectively.

CONCLUSION

The study demonstrated the significant impact of aqueous leaf extracts from various tree species on chickpea growth and yield. Among the treatments, Moringa and Rose wood leaf extracts exhibited the most promising results, enhancing key agronomic traits such as crop growth rate, net assimilation rate, and grain yield. The increased nodulation and nodule weight observed in these treatments suggest improved nitrogen fixation, contributing to overall plant vigor. While certain parameters like 1000-grain weight showed non-significant variations, the notable improvements in biological yield and harvest index highlight the potential of seed priming with allelopathic extracts as a cost-effective and environmentally friendly approach for improving chickpea productivity under rain-fed conditions. These findings align with previous research, reinforcing the efficacy of natural priming agents in mitigating drought stress and enhancing crop resilience. Future research should focus on optimizing concentration levels and exploring the long-term soil health impacts of these priming agents.

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