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Evaluation for allelopathic impact of *Acacia auriculiformis* A. Cunn. ex Benth on Seed germination and Seedling growth of Rice (*Oryza sativa* L), a widely cultivated Indian crop species

Vishal Vijayan
College of Forestry, Kerala Agricultural University, Vellanikkara, Kerala – 680656, INDIA

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Abstract

A field examination was directed at the trial field of Kerala Agricultural University during March to May 2014; this study explored the Allelopathic possibilities of Acacia auriculiformis on the seed germination and seedling development of rice (Oryza sativa L.). This trial examination was led in 2 × 3 × 5 factorial arrangement based on CRD with five treatments. Rhizosphere soil and top soil were gathered from the woodlots and 3-5 year old Acacia stand separately, though, fresh acacia leaves were utilized for inundating field soil with cold extract and field soil mulched with dry leaves of acacia embrace five treatments. Statistical analysis (ANOVA, P = 0.05) uncovered that the treatments brought a respectable inhibition in the germination of rice seeds, the seedling shoot lengths and vigor indexas compared to the control. However, there were no significant differences in the root length and dry matter weight of rice. The maximum inhibitory effect was observed in field soil mulched with dry leaves of acacia with inhibition on the germination, seedling length, dry matter production and vigor index. Root length was more delicate to the treatments than seedling length. The results from this study firmly recommend that allelopathy may be a conceivable technique controlling the timing of rice germination and seedling formation.

Keywords: *Acacia auriculiformis*, Rice, Allelopathy, seed germination.

Introduction

Agroforestry is recognized as one of the supreme strategy to attain ideal multiple benefits, through interactive and intentional land use system and technologies where trees are deliberately planted with agricultural crops or with animals. Agroforestry, other than the beneficial components also involves harmful properties on the agricultural crops because of numerous aspects like light, space competition, nutrients and organic chemicals discharged as leachates or leaf extract which influence plant crops also cause root exudation, residue decomposition[1]. In Agroforestry, trees and plant crops strive each other depend upon the climatic factors, the manner in which they are grown and the nature of the species for growth resource and competitive effects[2]. Rice is one of the most important commercial nutritious food crops, providing 13 percent calories from protein and 90% calories from carbohydrates[3]. More than two billion people in Asia and many millions in Latin America and Africa aid rice as a major source of sustenance. India at present have average productivity of rice is 2.2 tons/ha, wide below the global average which is 2.7 tons/ha. Rice is grown under diverse soil and different climatic conditions that it is said that there is barely any kind of soil in which it cannot be grown including alkaline and acidic soils. Rice crop has likewise got wide physical versatility; it is developed from underneath ocean level regions up to higher rise range. In terms ofarea, consumer preference and production rice is one of the most important cereal food crops of India, on the other hand *Acacia auriculiformis* A. Cunn. ex Benth is a leguminous species (Mimosoideae). It is an agroforestry species which is fast growing,nitrogen-fixing, adaptable to different environments[4], which attain a great demand among farmers. So, acacia based agroforestry model is required to meet food and fuel dilemmas. It is naturally distributed in Australia, Papua New Guinea and Indonesia[5]. It was introduced in India, China and other Asian countries for timber, firewood and for high quality chemical pulp[6]. Since 1980's *Acacia auriculiformis* has been used as a major component in Social Forestry Programmes in Kerala.

Allelopathy is a biological sensation by which a living being createsone or more biochemicals that influence the growth, survival, development and reproduction of other organisms[7], these biochemicals enter the environment and create immediate or aberrant impacts on the development and improvement of the same or other species[8]. It is a natural and environmentally friendly technique that might helpful in controlling weeds, expanding crop yields, and decreasing the use of synthetic pesticides[9]. Allelochemicals which may be present in every plant tissues, including roots, stems, rhizomes, leaves, fruits and seeds of a plant which can inhibit the germination production of other species[10], which is generally refer to the secondary metabolites disseminatedby flawless living plants into their surrounding which may substantially differ in allelopathic activity[11,12]. Chemicals released can be advantageous of receptor

plants or growth detrimental[13]. Different techniques have been suggested by several researches to find allelopathic potential through extensive activities, which reveal the significance of allelopathy in the productivity of weeds and crops[14,15]. The purpose of the present study was to reveal the allelopathic potential of diff con of *A. auriculiformis* leaf ex on the major commercial food crop rice. A separate section on review of literature is not included here but past works are referred to in appropriate places in the text.

Material and Methods

Collection of soil and seed samples: For present study, the grains of rice (*Oryza* sativa L) were procured from Department of Agronomy, KAU, Vellanikkara. The grains were surface sterilized by socking in 1% Sodium hypochlorite solution for 15 minutes, then washed with distilled water several times.The top soil and Rhizosphere soil from the root zone was evacuated from regenerated vegetation of five year and eight year old Acacia plantation in Kerala Agricultural University main campus, Vellanikkara to the depth of 5 cm. Field soil collected from a nearby site was mulched with dry Acacia leaves from seven year old stand and without mulching was used for control treatment. To destroy all buried and unwanted seeds, the soil was autoclaved at 100°C for one hour, where it was used for filling up the trays of size 35cm×38cm×6cm.

Preparation of fresh leaf leachate: In order to prepare the fresh leaf leachate, 250 g of fresh senescent leaves of acacia were kept in a freezer for about four hours, which has been crumbled using an electric blender and rest to macerate in 500 ml distilled water for 72 hours in beakers individually at room temperature (22-25°C)[16]. After 24 hours the acquired brew was transferred and thereafter, the suspension was filtered through a double layered muslin cloth[17] pursued with Whatman No.1 filter paper, eventually it was stored in darkness at 4-5°C temperature until using it.

Germination, Seedling Growth and dry matter production: An observation for seed germination was recorded after 5th, 10th, 15th, 20th, 25th, 30thdays of sowing. Seeds were considered as germinated when the radicle emerged through the seed coat[18]. Analysis of germination and growth is considered to be a reliable index of evaluation of allelopathic action[19]. To analyze the allelopathic effect of Acacia, seedling growth, shoot length and root length were also measured. Shoot length measures the collar region to the tip of the longest leaf extending beyond the growing point and root length from collar region to the tip of the longest rootboth using a meter scale, mean height and mean length of each was also recorded. Total 05 treatments (03-formulations, 01- concentration and a control) were done, triplicates were maintained for each treatment and each replication is turn consisted of four trays. Vigor index was calculated for each treatment, 30 days after sowing[20].

Vigor index = (Root length + shoot length) × Germination percentage (1)

The seedlings were separated into shoot portion and root portion making crave at the collar region and the cut portion were kept in separate butter paper envelops, they were kept in hot air oven at 80°C for 48 hours. The dry weights of samples were determined using an electrical single pan balance.

Statistical analysis: Data obtained from each treatment and replication levels were analyzed using the analysis of variance (ANOVA) technique and least significant difference (LSD=0.05) tested by the method of Snedechor and Cochran[21].

Results and Discussion

Germination and Seedling Growth: Allelopathic effects of Acacialeaf litter, canopy soil and fresh leaf leachate clearly revealed that percentage germination of rice seeds were strongly inhibited (table-2). The presence of alkaloids and phenolic compounds like allelochemicals in the leaves of *Acacia* species has the potential to inhibit seed and seedling germination[22,23]. Allelopathic effects of different plant species reported have high inhibitory germination potential like *Eucalyptus,Parthenium, Pinus, Albizia*[24-26], The highest percentage germination in case of treatments was recorded in third observation 15thday; however, rhizosphere soil collected from woodlots of Acacia showed the maximum germination (91.33%) and top soil collected from 3-5 year old Acacia stands showed the least value (74.33%). Field soil mulched with dry leaves of Acacia (88.33%). Contrast (84%) and field soil irrigated with cold extract of fresh leaves of Acacia (82.67%) (table-2) were the order in which other treatments occurred. Towards the final phase, T3 and T2 registered very high germination and survival percentage and were marked by superior to other three treatments. T1 registered the least number of seedlings in all the observations after the 20th day, on the 30th day T1 did not have any rice seedlings at all. Field soil irrigated with cold extracts of fresh leave of Acacia showed 66% in 20days, 54.67% in 25th day and 16% in 30 days, 54.67%. On the 30th day, field soil mulched with dry leaves of Acacia showed the maximum germination percentage (88.33%). Rhizosphere soil collected from the woodlots of Acacia (84.33%) and control (63.33%).

The data of allelopathic effect on some morphologic characteristics such as shoot length, root length, shoot dry weight and root dry weight is presented in table-3. The highest value for shoot length was observed for the treatment field soil irrigated with cold extract of fresh leaves of Acacia (22.4cm), followed by field soil mulched with dry leaves (22.1cm), control (18.7cm) and the least value was observed in Rhizosphere soil collected from the woodlots of Acacia (18.5cm).

Table-1-
Germination of rice seeds as affected by different treatments

Treatments	Mean number of seedlings on:					
	5thday	10thday	15thday	20thday	25thday	30thday
T1 : Top soil collected from 3-5 year old Acacia stand	23.4	25.8	22.3	12.8	6.1	–
T2 : Rhizosphere soil collected from the woodlots of Acacia	23.1	26.8	27.4	26.8	24.8	25.3
T3 : Field soil mulched with dry leaves of Acacia	21.7	24.7	26.5	26.9	26.4	26.5
T4 : Field soil irrigated with cold extract of fresh leaves of Acacia	24.9	27.6	24.8	19.8	16.4	4.8
T5 : Control	18.9	25.2	25.2	23.2	22	19
CD(0.05)	NS	NS	0.0451	0.0936	0.1355	0.1195
SEM (±)	0.0059	0.0081	0.0043	0.0095	0.0136	0.0087

Table-2
Growth characters of rice seedlings as affected by the treatments at 30days after sowing

Treatments	Growth Characteristics of seedlings (mean)				
	Shoot length(cm)	Root length(cm)	Shoot dry weight(g)	Root dry weight(g)	Vigor index
T2 : Rhizosphere soil collected from the woodlots of Acacia	18.5	5.7	0.0097	0.0031	612.26
T3 : Field soil mulched with dry leaves of Acacia	22.1	4.9	0.0169	0.0044	715.5
T4 : Field soil irrigated with cold extract of fresh leaves of Acacia	22.4	5.5	0.0122	0.0055	133.92
T5 : Control	18.7	7.8	0.0096	0.0041	503.5

*T1 has no result

Table-3 depicts the mean root length of seedlings after the 30thday after sowing. The least value for root length were noticed for field soil mulched with dry leaves (4.9cm), whereas the maximum value reported (7.8cm) was for control, followed by Rhizosphere soil (5.7cm) and Field soil irrigated with cold extract of fresh leaves of Acacia (5.5cm). The difference was not significant for both the cases.

Vigor index exhibits health of plants and can be evaluate from more than one growth variables and it isestimated from germination, roots and shoots length to identify favorable environment for the output of good quality seeds. The effect of different treatment of *Acacia auriculiformis* on Vigor index in rice showed significance difference when compared to control (Table-1). The maximum value of Vigor index were recorded at T2(612.26)and minimum were at T4(133.92), studies show that seed vigor index decreases significantly with increase in concentration compared to that of control in Acacia leaf extract on Maize[28].

Mean root and shoot dry weight: It is clear from the present study that *Acacia auriculiformis* exhibit an inhibitory effect on dry matter production of *Oryza* sativa. Table 2 presents the mean root and shoots dry weight at 30 days after sowing. There was perceptible variation in the mean root dry weight among the treatments. Maximum root dry not per plant was observed in the treatment, field soil irrigated with cold extract of fresh leaves of Acacia (0.0055g) followed by field soil mulched with dry leaves (0.0044g) and control (0.0041g). Rhizosphere soil collected from woodlots of Acacia registered the lowest value (0.0031g). The results obtained from this study clearly revealed that among the different treatments field soil mulched with dry acacia leaves shows highest shoot dry weight of rice (0.0169g) while the other treatment exhibited decreased mean shoot dry weights (Table 2). *Acacia auriculiformis* leaf leachates shows decreased shoot and root dry weights of maize over control[28].

Conclusion

Allelopathy is a vital mechanism in which plants scatter toxic substances in nature as their competitive technique; it is a significant environmental favorable methodology to weeds control, to the diminishment of herbicide application and to yield increment. Allelopathy plays a major role in both natural and oversaw ecosystems which incorporates both positive and negative impact on plants each other. In the present investigation, the observation indicates that the treatments did not have any significant influence on germination behavior of rice seeds (table-1). However, the seedling number was statistically different towards the later stages. Probably the treatments exerted a profound control over the survival of

seedlings. The results clearly indicate that seedling growth was clearly inhibited when the top layer soil from a plantation was used on the growth medium. By the 30th day after sowing there was 100% mortality in the treatment, top soil collected from 3-5 year old acacia stands. The heavy mortality could be attributed to the fact that the top soil in the Acacia stand contained lot of inhibitory chemical substances. These inhibitory chemical substances present in the soil might have originated mainly from the leachates of fallen leaves, stem flow, leaf drip and root exudation. Similarly, irrigation with cold extract of fresh leaves of Acacia treatment also resulted in a sharp decrease in number of seedlings, especially during the later stages. It might be due to the allelopathic effect of leaf leachates, the length and dry matter accumulation in rice were severely affected by leaf leachates[29]. The inhibitory chemicals that were contained in the leachate might have led to the suppression of growth and lower survival of the rice seedlings. Seedling vigor index were highest under T3, field soil mulched with dry leaves of Acacia, followed by rhizosphere soil collected from the woodlots of Acacia. Maximum shoot length was observed in T4, field soil irrigated with cold extract of fresh leaves of Acacia (22.4 cm) followed by T3, field soil mulched with dry leaves of Acacia. Table 2 clearly indicates that there was only less number of seedlings in this treatment. Fewer seedlings present in a unit area might have resulted in the better growth of the survivors. Rhizosphere soil collected from woodlots of Acacia (84.3) and field soil mulched with dry leaves of Acacia (88.3) showed the maximum emergence of rice seedlings. Frommulched leaves most of the potent toxins were probably washed off. So they may not contain much allelopathic substances, hence high emergence here.

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