Scholars Academic Journal of Biosciences
Abbreviated Key Title: Sch Acad J Biosci
ISSN 2347-9515 (Print) | ISSN 2321-6883 (Online)
Journal homepage: https://saspublishers.com/sajb/

OPEN ACCESS

Botany

Influence of Pond Deposit Soil on Growth of *Cassia tora* L and Mycorrhizal Status

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DOI: 10.36347/sajb.2020.v08i03.001 | **Received:** 12.03.2020 | **Accepted:** 20.03.2020 | **Published:** 24.03.2020

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Abstract **Original Research Article**

Cassia tora L. is a dicot legume which is considered as weed. The plant was collected from the region of which grown on Bori dam deposited soil and compared with natural growth plant. Physicochemical parameters, root colonization percentage, spore density and biomass productivity was investigated. The growth and productivity of treated plant was compared with normal plant. In physiochemical parameters, it was observed the difference in pH, EC and mineral contents & slight varying as per the slandered values. But phosphorous, calcium, magnesium and copper content was found high in deposited soil. The percent root colonization (81%) and spore density (1542±3.11) was found to be considerably high in treated *C. tora* than normal plant (28%). The type of AMF spores i.e *Acaulospora* and *Glomus* were found dominant. Due to the high percentage of AMF root colonization and high spore density. The biomass productivity was found to be more than normal plant.

Keywords: Physicochemical parameters, *Cassia tora,* AMF root colonization, AMF spores and biomass productivity.

INTRODUCTION

Cassia tora is grows wild in most of the tropics and is considered a weed in many places. Heat extract of some *Cassia* species showed antimicrobial property against a few gram negative bacteria as well as against a few fungi which are mostly dermatophytes causing skin infection in human beings [1]. Since, *Cassia tora* has an external germicide and antiseptic character, it has been used for treating skin diseases such as leprosy, ringworm, itching and also for snakebites. It contains the organic compound anthraquinone. AMF are responsible for enhanced uptake of mineral nutrients especially phosphorus [2].

Mycorrhizas are mutually beneficial fungi with much plants.AM fungihave ability to increase plant for uptake of elements like phosphorous (P) and several other non-mobile soil nutrients. Mycorrhizas are helpful to plants for their growth, disease protection and increasing soilquality [3].The P deficiency is mostly observed in tropical soils and under drought conditions. AM are useful in these type of plants for such growth and development problems [4]. AMF improve plant growth by better uptake of nutrients and tolerance to drought and salinity condition [5]. Nowadays AM fungi are extensively used in various crop fields as source of fertilizers.

MATERIALS AND METHODS

Study Site

The study was investigated on *Cassia tora* L. plant in monsoon season (September- 2019) from agricultural landside of Naldurg (17.820N 76.300 E) Osmanabad districts of Maharashtra. Naldurg is located at an altitude of 566 m and receives an average annual rainfall of 760 mm.

Physico-chemical Characterization

Physico-chemical analyses of both types of soil were collected from study area. The samples were then oven-dried at a temperature of 110°C for 24 hours and reweighed. Electrical conductivity and pH of compost were measured [6]. Nitrogen content was determined by the Kjeldahl method [7]. Organic Carbon [8] and Phosphorus in soil was determined by Olsens method by using spectrophotometer [9, 10]. Potassium was evaluated by Ammonium acetate method [11] using Flame photometer. Sodium, Calcium and Magnesium cations were estimated by EDTA titration [12]. Analysis of Ferrous, Mangenese, Copper,Boron, Sulphur, Zinc and Molybdenum were done by acid digestion of soil [13].

Mycorrhizal Study

Rhizospheric soil and roots of treated *Cassia tora* were collected from deposited soil of Bori dam region and rhizospheric soil and roots of normal plant soil was collected from roadside of Naldurg. (17.82° N 76.30° E). The soil type of both the samples is brown and black. Two plants of each were collected. Roots were dug out & washed to remove soil and stored in FAA (Formalin Aceto Alcohol. (5:5:90) prior to staining [14]. Rhizospheric soil sample of each plant was enumerated for AM fungal spores. Root bits (size 1 cm or 2 cm) were boiled in 10% of KOH for 15-20 min; washed in tap water and stained in 0.05% Trypan blue in lacto phenol [15]. And percentage of Mycorrhizal colonization was estimated by magnified intersection. The percent root colonization was measured by using formula [16].

$$\% \text{ Colonization} = \frac{\text{Total number of root segments colonized}}{\text{Total number of root segments examined}} \times 100$$

AM fungal spores were improved by the wet sieving and decanting technique [17]. Spores were mounted in polyvinyl alcohol lacto phenol. Identification of AM fungal spores was carried out based on morphotaxonomic criteria using INVAM International collection of Vesicular Arbuscular Mycorrhizal (http://invam.wvu.edu/the-fungi) and available manual [18,19]. The specimens of AM fungi ndeposited in Department of Botany, Arts , Science and Commerce College, Naldurg, Maharashtra, India.

Biomass Production

Three plants were harvested 8 weeks after planting for soybean. At harvest, the soil from the roots was washed off carefully and the nodule number was counted visually. Fresh weight of root and shoot samples were recorded. Shoots (including fruit & flowers) and roots were separated and oven dried at 60°C for 48 h for the determination of dry mass after recording their lengths [3]. Leaf area was measured at harvest by disc method. Fifty leaf disc of known size were taken from randomly selected leaves of plant, discs and remaining leaf blades were oven dried and leaf area was calculated by using formula suggested by [20].

All data were statistically analyzed the significance of differences was determined by using book [21].

RESULTS AND DISCUSSION

Physico-chemical Characterization

The soil samples of treated and normal *Cassia tora* plants were observed that, the colour of both the soils was nearly black and brown texture and sandy to loamy. The results depicted much difference in its pH, electrical conductivity and mineral contents of both the soils which was slight varying as per the slandered values. pH, electrical conductivity, nitrogen, potassium, zinc and boron content of both treated and normal soils was appropriate as per the standard norms. Phoshorous, calcium, magnesium and copper content was high in treated soil than in normal soil which was as per the expected as AM fungi increases these minerals absorbing capacity and which were found too much less in normal soil (Table 1).

Mycorrhizal status

Arbuscular mycorrhizal fungal (AMF) assessment of % of root colonization and spore density was studied in treated and normal *Cassia tora*. Among the two plants, treated *Cassia tora* showed maximum root colonization (81%) than non-treated (28%). The highest spore density (1542 /100g soil) was found in deposited soil treated than normal (520/100g soil). In root colonization, hyphal & vesicles types of colonization were found. Distinct vesicles inside the root tissue, globular vesicles inside the ortical tissue with branhed hyphae, distinct vesicles with bulbous suspensor & appresoria , Arbuscles inside the cortical tissue were found. Arbuscular types of colonization were found very least in both the types of plants. Among AMF genera *Acaulospora* and *Glomus* were found to be dominant (Table 2; Fig 1).

Biomass Production

In the present study, ten parameters were studied in *Cassia tora*. Pond deposited soil treated plant data was observed significantly compared to normal. The deposited soil treated plant having stem height (80cm), width of stem (3.8 cm), length of root (35cm), number of leaves (69) with leaflets (117), fresh weight of shoot (21g),dry weight of root (4g) with total leaf area (39950 cm^2) was found to be much more high than in normal as stem height (50 cm), width of stem (2 cm) , length of root (12.5 cm), number of leaves (17) with leaflets (136) ,fresh weight of shoot (20 g) & dry weight of root (0.76 g) with total leaf area (1223 cm^2). In biomass productivity of the treated plant was found to be more than normal plant. It is clear from the current data that AMF association can increase the biomass (Table 3 Fig.2).

Table-1: Physico-chemical Characterization of Rhizosphere soil analysis of treated and normal *Cassia tora*

Sr. No.	Parameters	Standard value	Deposited soil Treated *Cassia tora*	Remarks	Normal soil of *Cassia tora*	Remarks
1.	pH	6.5 to 7.5	7.25	Appropriate	7.25	Appropriate
2.	EC (mS)	Less than 1.0	0.254	Appropriate	0.612	Appropriate
3.	Organic carbon %	0.41 to 0.60	0.40	Low	0.29	Low
4.	Nitrogen (kg/hector)	161 to 320	235.2	Appropriate	219.52	Appropriate
5.	Phosphorus (kg/hector)	31 to 50	72.38	High	29.64	Low
6.	Potassium (kg/hector)	181 to 240	229.90	Appropriate	27.01	Low
7.	Calcium (m.Eq.)	65 to 80	95.9	High	60.67	Low
8.	Magnesium (m.Eq.)	10 to 15	177.94	High	92.27	High
9.	Sodium (m.Eq.)	5 to 15	2.69	Low	1.90	Low
10	Zinc (ppm)	1.0 to 5.0	1.10	Appropriate	0.67	Low
11	Ferrous (ppm)	2.5 to 5.0	0.97	Low	0.58	Low
12	Manganese (ppm)	2.0 to 5.0	1.04	Low	0.71	Low
13	Copper (ppm)	0.2 to 0.5	3.23	High	3.09	High
14	Boron (ppm)	0.2 to 2.0	0.47	Appropriate	0.23	Appropriate
15	Sulfur (mg/kg)	10 to 20	3.25	Low	2.13	Low

Table-2: Mycorrhizal status in *Cassia tora* (*N=36)

Sr. No.	Parameters	Treated	Normal
1	Soil colour	Black	Brown
2	Soil type	Sandy to loamy	Sandy to loamy
3	Percentage of root colonization (%)*	81±1.02	28±2.33
4	% of Root length colonization*	32±2.0	10±2.19
5	Number of vesicles*	20±2.00	6±1.11
6	Number of hyphal *	13±3.11	5±0.11
7	Number of arbuscles*	04±2.11	01±1.01
8	Spore density /100g of soil	1542±3.11	520±4.00
9	Mycorrhizal Genera types	*Glomus, Acaulospora*	*Glomus, Acaulospora*

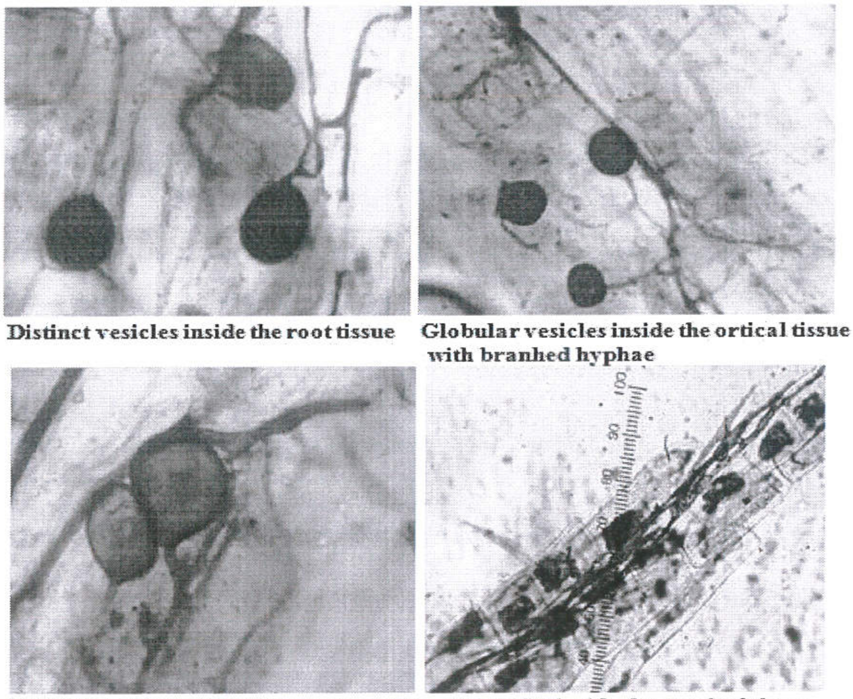
Values are Means of three replications, ± Standard Error

Table-3: Biomass production of treated and normal *Cassia tora*

Sr.no.	Parameters	Treated	Normal
1.	Height of stem (cm)	80±1.11	50±2.33
2.	weidth of stem (cm)	3.8±0.11	2±1.11
3.	Length of root (cm)	35±3.25	12.5±2.11
4.	No. of Leaves	69±3.11	17±3.22
5.	No. of Leaflet	117±3.11	77±4.21
6.	Fresh weight of shoot (g)	136±5.11	20±4.21
7.	Fresh weight of root (g)	7±1.21	1.14±0.11
8.	Dry weight of shoot (g)	21±2.22	4±0.31
9.	Dry weight of root (g)	4±1.11	0.76±0.33
10.	Total leaf area (cm^2)	39,950	1223

Values are Means of three replications, ± Standard Error

Fig.1 Mycorrhizal roots colonization in *Cassia tora* (200 X).



Distinct vesicles inside the root tissue | **Globular vesicles inside the ortical tissue with branhed hyphae**

Distinct vesicles with bulbous suspensor & appresoria | **Arbuscles inside the cortical tissue**

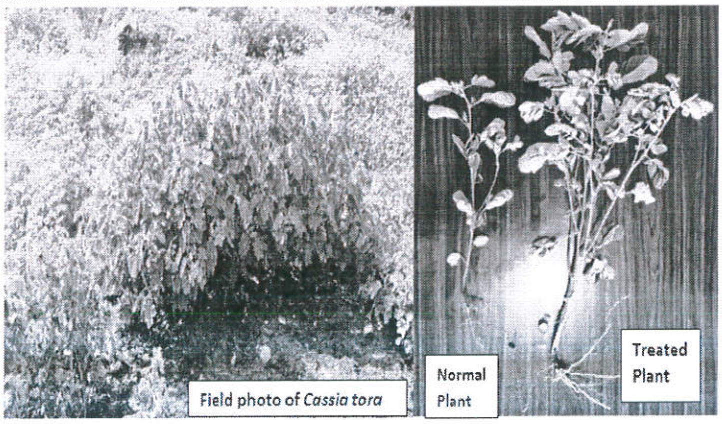


Fig.2. Studied area and impact of pond deposited soil on *C.tora*.

Our data was agreed with the previous literature, it was reported the pH of soil is one of the most important parameter and at basic or low acidic pH soils usually cultivated rice [22]. It was studied on the physicochemical parameters like pH, specific conductivity, chloride, total alkalinity, calcium, magnesium nitrate, sulphate, phosphate sodium and potassium from July 2008 to June 2009 and fluctuation were observed in several parameters [23]. It was reported that the salinity values above 2 dS/m begin to cause problems with salt sensitive plants, and values above 4 dS/m are problems for many garden and landscape plants [24]. Fungal diversity of any soil depends on a large number of factors of the soil such as pH, organic content and moisture [25].

It was studied the abundance of AMF propagules (colonized roots, spores, and hyphae) within sediments of Tagliamento River in Northeastern Italy; Root inoculums in fresh deposits were absent however; some viable spores and hyphae were available [26]. Pond deposited soil when amended with crop land soil, cropland soil showed significant growth rate and status of AMF in soybean field [27]. It was reported the AMF may play a role in the formation of stable soil aggregates, building up a macroporous structure of soil that allows penetration of water and air and prevents erosion, therefore, the application of AMF is of interest for the reclamation and re-vegetation of degraded lands [28]. It was studied the AMF has been taken into account and has had an impact in landscape regeneration, horticulture, alleviation of desertification and in the bioremediation of contaminated soils [29]. The AM colonization, spore population and diversity, altered with seasons as well as with plant species and maximum mycorrhization was noted in *Eclipta alba* (82%) followed by *Sida cordifolia* (80%) [30]. It was studied the AMF association on *Cassia tora* L. and found from different region of Marathwada and observed the % root length colonization (61.79 - 82.17%) and spore density (610 - 1038/100g soil) [31].

CONCLUSION

It is concluded that the biomass productivity was enhanced in deposited soil treated *Cassia tora* due to the presence of more AMF spores and high root colonization. Also, it is clear from the soil analysis that, plant growth and mycorrrhizal association depends on the level of soil fertility. The soil fertility is directly proportional to AMF spores and root colonization. The treated *C. tora* plant was having more fertile soil with high phosphorous, calcium, magnesium and copper elements as compared to normal plant and found basic pH of both the soils.

Conflicts of interest

There is no conflict of interest as regard to this work and publishing the article.

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