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A comparative study on the effect of seagrass (*Syringodium isoetifolium* Ascherson) and biofertilizer (*Azolla pinnata* Brown) on *Sorghum bicolor*, Willd.

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Abstract

The present paper deals with the comparative study of seagrass- *Syringodium isoetifolium* and biofertilizer- *Azolla pinnata* on *Sorghum bicolor*. 1% extract on seagrass favours percentage of germination, increased rates of morphological characters like shoot and root length, length and breadth of lamina whereas in the earlier stages and biochemical characters like carbohydrate, protein, enzyme activities like polyphenol, peroxidase and catalase were more in *Azolla* treated plants earlier flowering, numbers of spikelets, number of seeds were also increased than control and seagrass.

Keywords

Syringodium isoetifolium, *Azolla pinnata, Sorghum bicolor*

Introduction

India is an agriculture country utilizing organic and inorganic fertilizers for most of the crops. The total requirements of fertilizer would be 23 million tones and 13 million tones using all sources such as mineral fertilizer, organic manure and inorganic fertilizers. Biofertilizers and seaweed liquid fertilizers are the alternate sources for importing soil fertility which reduces environmental pollution (Solanke *et al.,* 2006).

The genus *Azolla,* a coherent group of aquatic freshwater fern that float freely and fixes atmospheric nitrogen in association with bluegreen algae the *Anabaena* and hence named as *Anabaena azollae*, the biofertilizer (Kannaiyan, 1990). It also helps in detoxifoliation of heavy metals (Singh, 2002).

Seagrasses are Angiosperms growing abundantly in the tidal and intertidal zones of sea functioning as the main trappers of sediment and provides shelter to many thousands of protozoan and small fishes (Kannan *et al.,* 1999). The utilization of seaweeds and seagrasses rich in potassium, nitrogen and found superior to conventional organic manures and noted as seagrass liguid fertilizers (SGLF). Growth regulators such as auxins, cytikinins and gibberlins were also reported (Mollar and Smith, 1999). The seagrass *Syringodium isoetifolium* is used as SGLF to observe the morphological, biochemical and yield responses of *Sorghum bicolor* a common cereal of Tamilnadu.

Materials and Methods

Sorghum bicolor, a common cereal is selected to carry out the experiment. Seeds were purchased from Agriculture College, Coimbatore. *Syringodium isoetifolium* the seagrass and *Azolla pinnata* the biofertilizer were freshly collected from the coastal and freshwater area of this district. 1% *Syringodium* extracts (MF_1), 1% *Azolla* extracts (MF_2) and controls (water) were prepared and germination percentage was observed on the 7th day. Morphological characters such

as shoot length, root length, biochemical analysis of carbohydrate (Dubois *et al.,* 1956), protein (Lowry *et al.,* 1951), peroxidase, polyphenol oxidase and catalase (Kumar and Khan, 1952) activities were estimated on the 7th day. The plants were transplanted to pots (3:1 ratio of garden soil). On the 21st day 1% extract were added again with respect to the treatment. Growth and biochemical characters were reported on 35th day. Reproductive characters such as appearence of spike, number of spikelets, number of seeds and their average weights were reported.

Results and Discussion

Growth studies of *Sorghum bicolor* in *Syringodium* and *Azolla* extracts showed great variation. Maximum of (100%) germination rate was observed in SGLF than *Azolla* (90%) and control (80%) extract treated seeds. The mean values of shoot length (13.6 cm), root length (3.33 cm), length of lamina (5.99 cm) and breath of lamina (0.55 cm) were observed on the 7th day as maximum growth in 1% seagrass extract than the control and *Azolla* extract (Table 1). In several reports similar to seagrass also function as potential marine resources of the world and in several coastal areas they were utilized as good manures (Booth, 1969). Seagrasses are rich in growth promoting substances like vitamines and aminoacids (Venkataramankumar and Mohan, 1997). Germination percentages, seedling growth rates were enhanced by the influence of seagrass (Imanuel and Subramaniam, 1999). Kumar *et al.,* (2007) also pointed the increased effects of morphological growth rates in *Abelmoschus esculentus.* On the 35th day also morphological growth rates reached maximum iin MF_1 treatment than MF_2 and control.

Biochemical analysis (Table 2) revealed the concentration of carbohydrates (12 mg/g) and proteins (5.55 mg/g) were increased enormously in MF_2 medium in which the plants were provided with *Azolla* extracts. *Azolla,* by its endosymbiont with *Anabaena* fixes atmospheric nitrogen which increases the yield in rice and other crop plants (Venkataraman, 1986; Singh and Singh, 1997; Mandal, 1999). On dry weight basis *Azolla* contains the following chemical composition: Nitrogen – 5%, Phosphorus – 0.5%, Potassium – 2 to 4.5%, Calcium – 0.1 to 1%, Magnesium – 0.65%, Manganese – 0 – 1.6% and Iron – 0.26% (Mary, 2007). In the present investigation polyphenol, peroxidase and catalase activities were more in MF_2 medium (Table 3). Sharma and Sharma (1998) observed that polyphenol oxidase activity increased invitro cultures and in germinating Wheat seeds (Teneja and Sacaar, 1975). In *Cucumis sativus* (Mary, 2007) and *Capsicum annum var frutescens* (Jalaja, 2008) previously reported the influence of *Azolla* promotes the growth rates and high activites of enzymes.

Observation on reproductive characters such as appearence of spike, lemgth of spike, number of spikelets, number of seeds and their average weight were studied (Table 4). It revealed earlier flowering in MF_2 medium (in the 93rd day), length of the spike (43 cm), and maximum of 64 spikelets were reported in *Azolla* used (MF_2) medium. When compared the yield application of seagrass (MF_1) and *Azolla* (MF_2), MF_2 medium produced 704 seeds than control (380) and MF_1 (549). By the rich mineral sources *Azolla* influences the yield characters. Previous studies on Maize and *Sorghum* proved the production of high yield, when the plants were applied with nitrogenous fertilizers (Johnsy, 2005 and Chandra, 2010).

From this study it can be concluded that morphological characters were enormously increased by seagrass whereas *Azolla* indirectly influenced the yield. Moreover *Azolla* biofertilizer technology is eco-friendly, environmentally protected and create a natural boon to the farmers.

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Table 1: Morphological characters of *Sorghum bicolor* on 7th and 35th day in different treatments

Days	Treatments	Shoot length (cms)	Root length (cms)	Length of lamina (cms)	Breath of lamina (cms)
7th day	MF_1	13.6 ± 0.26	3.33 ± 0.61	5.99 ± 0.024	0.55 ± 0.04
	MF_2	9.6 ± 0.17	2.96 ± 1.07	3.68 ± 0.01	0.45 ± 0.02
	Control	8.1 ± 0.12	1.78 ± 0.03	3.2 ± 0.02	0.43 ± 0.01
35th day	MF_1	116.5 ± 0.38	31.62 ± 8.53	65.4 ± 0.29	4.7 ± 0.14
	MF_2	110.6 ± 0.35	28.24 ± 7.64	54.8 ± 0.21	3.9 ± 0.19
	control	69.4 ± 0.26	19.2 ± 5.89	38.4 ± 0.31	3.5 ± 0.10

Table 2: Biochemical analysis of *Sorghum bicolor* on 7th and 35th day in different treatments

Days	Treatments	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total chlorophyll (mg/g)	Carotenoid (mg/g)	Carbohydrate (mg/g)	Protein (mg/g)
7th day	MF_1	0.21 ± 0.01	0.32 ± 0.01	0.58 ± 0.01	1.28 ± 0.007	0.59 ± 0.01	0.31 ± 0.01
	MF_2	0.26 ± 0.001	0.39 ± 0.01	0.68 ± 0.04	1.20 ± 0.007	0.26 ± 0.007	0.02 ± 0.01
	Control	0.21 ± 0.003	0.08 ± 0.001	0.20 ± 0.01	0.34 ± 0.004	0.16 ± 0.006	0.90 ± 0.03
35th day	MF_1	0.75 ± 0.005	0.87 ± 0.11	1.62 ± 0.04	0.92 ± 0.03	84.2 ± 4	3.56 ± 0.16
	MF_2	0.81 ± 0.12	1.01 ± 0.10	1.82 ± 0.02	0.78 ± 0.02	11.2 ± 0.27	5.50 ± 0.30
	control	0.52 ± 0.002	0.78 ± 0.11	1.02 ± 0.01	0.71 ± 0.01	98.6 ± 0.27	4.46 ± 0.69

Table 3: Enzyme activities of *Sorghum bicolor* on 7th and 35th day in different treatments

Days	Treatments	Polyphenol oxidase	Peroxidase	Catalase
7th day	MF_1	0.030 ± 0.02	0.015 ± 0.002	0.477 ± 0.040
	MF_2	0.041 ± 0.008	0.025 ± 0.001	0.407 ± 0.023
	Control	0.020 ± 0.002	0.018 ± 0.001	0.313 ± 0.041
35th day	MF_1	0.067 ± 0.001	0.086 ± 0.007	1.223 ± 0.02
	MF_2	0.058 ± 0.002	0.052 ± 0.04	1.283 ± 0.029
	Control	0.016 ± 0.001	0.019 ± 0.001	1.23 ± 0.006

Table 4: Yield parameters of *Sorghum bicolor* under different treatments

Treatments	Appearance of spike (days)	Length of spike (cms)	No. of spikelets	No. of grains	Average weight (mg)
MF_1	98 ± 9.7	34.8 ± 5.8	43.5 ± 6	549 ± 18.7	38 ± 6.01
MF_2	93 ± 6.1	43 ± 5.4	64 ± 8	704 ± 65.7	40 ± 6.1
Control	94 ± 6.4	32.3 ± 5.8	23 ± 4.3	369 ± 16.9	36 ± 6

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