day was from 32-55°C. Maximum hot air temperature was recorded during 14.00 h. The drying characteristics curve is shown in figure 3.

Drying Bajra

The dehydration pattern of bajra earheads in solar cabinet drier with energy collector is shown in Table 5. From the table and drying characteristics curve figure 3, it was observed that bajra earheads with initial moisture content of 23.2% was dried to 11.8% in 9 h. The hot air temperature recorded during the day, varied from 32-56°C. Maximum hot air temperature of 56°C was observed at 14.00 h.

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EFFICACY OF VESICULAR ARBUSCULAR MYCORRHIZAL FUNGI ON THE MANAGEMENT OF ROOT ROT DISEASE OF *Casuarina equisetifolia* Forst

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ABSTRACT

Efficacy of four Vesicular Arbuscular Mycorrhizal (VAM) fungi on the management of root rot disease of *Casuarina equisetifolia* Frost caused by *Rhizoctonia bataticola* (Taub Butler) was evaluated. All the four VAM fungi when applied to soil significantly reduced the root rot incidence in the nursery. VAM fungi treated plants showed significant increase in dry weight when compared to pathogen inoculated plants. Among the VAM fungi *Glomus fasiculatum* recorded the least disease incidence with maximum dry weight.

KEY WORDS: *Casuarina equisetifolia*, VAM, Root rot disease, Management

INTRODUCTION

Root rot disease caused by *Rhizoctonia bataticola* is the most serious soil borne disease in the nurseries of forest trees. The pathogen is known to attack more than 500 species of plant. Drenching the plants with chemical fungicides is prohibited because of the problem of residual toxicity, acquired resistance and high cost of chemical application. Seedling root rot in *Casuarina* is known to cause serious damage and have been reported from Karnataka and Maharashtra states in India (Qurshi, 1956). Mycorrhizal fungi are known to reduce the incidence of disease (Zak, 1964). In green house studies VAM fungi reduced the effects of several pathogens on their hosts. The disease caused by *Thielaviopis basicola* on tobbaco and alfalfa, *Fusarium oxysfporum* f. sp. *lycopersici* on tomato, *Phytophthora megaspora* var. *sojae* on soybean and *Pyrenochaeta terrestris* on onion and *Rhizocotonia solani* and *Pythium ultimum* on poinsettia were reduced by different species of VAM fungi (Schenck and Kellam, 1978). Hence with a view to investigate the effect of VAM fungi on the management of diseases in *Casuarina* seedlings in the nursery, studies were conducted at the Forest College and Research Institute, Mettupalayam - 641 301, Tamil Nadu, India and the results are discussed hereunder.

MATERIALS AND METHODS

Fifteen days old sterile grown *Casuarina* seedlings were transplanted into pots after filling with three kilograms of red loam soil (7.5 pH ; 0.15 dSm^{-1} electrical conductivity ; 53 ppm ; 10 ppm and 94 ppm available N, P, and K respectively) presterilized at 1 kg/m^2 for 1 hour at 2 successive days. The four different VAM fungi *viz., Glomus mossae* (Nicol & Gerd) Gerd Trappe, *Glomus fasiculatum* (*Thaxter seneu* Gerd, *Glomus etinicatum* Berker Gerd. *Gigaspora margarita* Becker and Hall obtained from Department of Microbiology, University of Agricultural Sciences, Bangalore were applied 2 cm below the soil surface at 20 g/pot containing 40 viable VAM fungal spores/g of soil. The number of viable spores in VAM fungal inoculum was determined using the Most Probable Number Method (Porter, 1979). The pathogen *Rhizoctonia bataticola* (Taub Butler) was isolated from the infected roots of *Casuarina* from the nursery of Forest College campus, Mettupalayam. Seven days after planting, 15 ml of the purified culture of the fungus (7 days old) containing mycelia and young developing sclerotia were applied around the seedlings. The following treatments were set up in completely randomised design with three replications, i) *Rhizoctonia bataticola* inoculated, ii) *R. bataticola* and *G. mossae* inoculated, iii) *R. bataticola* and *G. fasiculatum* inoculated, iv) *G. etinicatum* inoculated v) *R. bataticola* and *Gigaspora margarita* inoculated, vi) *G. mossae* inoculated, vii) *G. fasiculatum* inoculated, viii) *G. etinicatum* inoculated, ix) *G. margarita* inoculated, x) control. The observations on per cent root rot disease incidence, spore count of VAM fungi in the rhizosphere (Gerdemann and Nicolson, 1963), per cent infection of VAM fungi in roots (Phillips and Hayman, 1970) and dry weight (g/plant) at 45th day and 90th day after planting were recorded.

RESULTS AND DISCUSSION

The incidence of root rot was significantly reduced by the four VAM fungi treatment when compared to *R. bataticola* alone (Table 1). The highest reduction in disease incidence (60.9 and 54.6% at 45 and 90 DAS) was observed in *G. fasiculatum* inoculated seedlings. VAM spore was more in *G. fasiculatum* inoculated seedlings than the combined inoculation of *R. bataticola* and *G. fasiculatum*. The same trend was also observed in the other three VAM fungi inoculated with *R. bataticola* but the effect was next only to *G. fasiculatum*. The VAM fungi infection in *C. equisetifolia* root was higher in *G. fasiculatum* inoculated seedlings than those inoculated with both *R. bataticola* and *G. fasiculatum* (Table 2). Seedlings inoculated with VAM fungi recorded more dry weight than the pathogen inoculated seedlings (Table 3).

Table 1. Effect of different VAM fungi on the root rot incidence *Rhizoctonia bataticola* on *Casuarina equisetifolia*

Treatments	Disease incidence (%)		Percent reduction over control	
	45th day	90th day	45th day	90th day
R. bataticola (Rb)	66.37 (54.56)^a	40.42 (39.47)^a	-	-
Rb + *G. mossae*	31.48 (34.13)^c	20.34 (26.81)^d	52.56	49.67
Rb + *G. fasiculatum*	25.97 (30.63)^e	18.34 (25.35)^e	60.87	54.62
Rb + *G. etinicatum*	32.87 (34.98)^b	25.37 (30.25)^b	50.47	37.23
Rb + *G. margarita*	30.23 (33.35)^c	24.10 (29.40)^c	54.45	40 37
G. mossae	0(0.99)^f	0(0.99)^f	-	-
G fasiculatum	0(0.99)^f	0(0.99)^f	-	-
G etinicatum	0(0.99)^f	0(0.99)^f	-	-
G. margarita	0(0.99)^f	0(0.99)^f	-	-
Control	0(0.99)^f	0(0.99)f	-	-

In a column means followed by a common letter are not significantly different at the 5% level by DMRT.
Values in parantheses are arc sine transformed values.

Table 2. Effect of VAM fungi and *R. bataticola* on spore number and VAM infection in *C. equisetifolia*

Treatments	VAM population (spore no/50g of soil)		VAM infection (%)	
	45th day	90th day	45th day	90th day
R. bataticola (Rb)	0(1.41)d	0(1.41)d	0(0.99)f	0(0.99)f
Rb + *G. mossae*	134.33(11.63)b	253.33(15.86)ab	50.22(45.13)f	51.73(45.99)e
Rb + *G. fasiculatum*	142.33(11.97)ab	214.67(14.69)cd	57.00(49.02)e	53.63(47.08)d
Rb + *G. etinicatum*	106.33(10.36)c	203.33(14.29)d	58.27(49.76)d	60.77(51.22)c
Rb + *G. margarita*	136.00(11.70)b	211.00(14.56)d	58.67(49.99)d	61.53(51.67)b
G. mossae	135.67(11.69)b	240.33(15.53)b	60.77(51.22)b	60.80(51.24)c
G. fasiculatum	158.67(12.64)a	276.67(16.66)a	65.22(58.86)a	70.14(56.88)a
G. etinicatum	143.00(12.00)ab	237.33(15.44)bc	50.23(45.13)f	60.85(51.27)c
G. margarita	139.00(11.86)ab	242.67(15.61)b	60.00(50.77)c	61.37(51.57)b
Control	0(1.41)d	0(1.41)d	0(0.99)f	0(0.99)f

In a column means followed by a common letter are not significantly differed at the 5% level by DMRT. Values in parantheses are transformed values.

Mycorrhizal association with soil borne fungal pathogen known to cause reduction in disease incidence (Schenck and Kellam, 1978 ; Schoenbeck, 1980 ; Schoenbeck and Dehne, 1981). In the present study all the four VAM fungi reduced the root rot disease incidence in *Casuarina* seedlings of more than fifty per cent when compared to control. Mycorrhizal fungi are also to retard pathogen development in the root system because the mycorrhizal roots are more lignified than non mycorrhizal and especially in the stelar tissue (Schenck *et al.*, 1977). Roots colonised by mycorrhizal fungi exhibit high chitinolytic activities. These enzymes can be effective against invading fungal pathogen (Dehne and Schonbeck, 1978).

Table 3. Effect of VAM fungi and *R. bataticola* treatment on the dry weight of the *C. equisetifolia*

Treatments	Dry weight (g/plant)	
	45th Day	90th Day
R. bataticola (Rb)	0.49(f)	1.22(g)
Rb + *G. mossae*	0.65(c)	1.58(c)
Rb + *G. fasiculatum*	0.73(b)	1.66(b)
Rb + *G. etinicatum*	0.55(e)	1.40(ef)
Rb + *G. margarita*	0.60(d)	1.56(c)
G. mossae	0.70(b)	1.59(c)
G. fasiculatum	0.84(a)	1.83(a)
G. etinicatum	0.64(c)	1.42(e)
G. margarita	0.64(c)	1.46(d)
Control	0.52(ef)	1.37(f)

In a column means followed by a common letter are not significantly different at the 5% level by DMRT.

In this study both mycorrhizal infection and spore number were higher in VAM fungi inoculated seedlings alone than the combined inoculation of VAM fungi and the pathogen. Damage to the root from outside (eg. by the action of toxins or by the development of root rot fungi in the cortex) will destroy the food base for the mycorrhizal fungi in the living root tissue (Davis *et al.*, 1978; Ross, 1972). From the present study, it was evident that dry matter production was higher in VAM inoculated seedlings than the pathogen inoculated seedlings. Mycorrhizae inoculated plants grew better because of increased uptake of nutrients such as phosphorus, enhanced water transport (Safir *et al.*, 1971) and reduce the effect of root infecting fungi (Schenck and Kellam, 1978).

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SEASONAL VARIATION IN PROLINE CONTENT IN CERTAIN BANANA VARIETIES

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ABSTRACT

The seasonal fluctuation in proline content in 11 banana varieties belonging to three genomic groups were studied. The proline content increased from March to June and the started declining irrespective of the varieties. Among the three genomic groups ABB record higher amount of proline accumulation during June than the other two groups (AAA and AAB). Drought was observed during the months of April, May and June in the crop growing period of March to August. During this period, the accumulation of proline occurred and there was variation in proline accumulation among the varieties studied. The highest accumulation of 265 ug/g of proline was recorded in Karpooravalli followed by 260 ug/g in Monthan suggesting that the ABB types have better tolerance to drought than AAA or AAB. The number of functional leaves, height and girth of pseudostem were also high in Karpooravalli and Monthan than in other varieties. The decline in proline content immediately on receipt of monsoon was more pronounced in Karpooravalli and Monthan indicating the better diversification of the accumulated proline for protein synthesis.

KEY WORDS: Proline accumulation, Banana, Karpooravalli, Monthan

Banana is an important choice fruit for all occations. The area under this crop in Tamil Nadu has been estimated to be 62.5 thousand hectares with a production of 1104.7 thousand tonnes (Anon. 1981). The choice of varieties for a particular region is decided by numerous factors like profitability, disease prevalance and marketability. Sometimes, polyclonal cultivation is also practiced. The varieties differ in their reaction to varied agro-climatic conditions. The variation is attributed to be due to bispecific origion from the combination of parental species *Musa acuminata* colla and *Musa balbisiana* (colla Simmonds, 1962). Accumulation of proline is often attributed to