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Economics of using biofertilisers and their influence on certain quantitative traits of mulberry

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Significant variation was recorded in various quantitative parameters of the mulberry with the application of various bio-inoculants like phosphate solubilising microorganisms, nitrogen fixing bacteria and arbuscular mycorrhizal fungi. The longest shoot length was recorded in T_4 (175.43 cm) receiving 350: 140 kg/ha/year N and P along with co-inoculation followed by T_6 (172.78 cm) receiving 175: 70 kg/ha/year N and P along with co-inoculation respectively. The treatment T_8 receiving 175 kg nitrogen and 70 kg phosphorus/ha/year (with rock phosphate as a source of P) has indicated significantly higher number of shoots per plant (6.43) as compared to T_0 control recording only (5.64) number of shoots per plant. Significantly higher number of leaves per shoot was recorded in treatment T_8 (27.53) as compared to the rest of the treatments including T_0 (26.37) as control. The study also clearly indicated that it is possible to curtail the application of nitrogenous and phosphatic fertilizers in mulberry cultivation to an extent of 25 to 50% without any adverse effect on leaf yield and quality by supplementing nitrogen and phosphorus through the use of nitrogen fixing bacteria *Azotobacter*, phosphate solubilizing bacteria, fungi and VA-mycorrhiza. The studies on economics of using bio-inoculants in mulberry also indicated that approximately Rs 2000 to 4500 /ha/year can be saved only on the input cost of nitrogen and phosphorus in mulberry cultivation.

Key words: Mulberry, biofertilisers, economics.

INTRODUCTION

With the increase in scientific knowledge regarding the negative effects of using various inorganic fertilizers, the application of alternative source viz., biofertilisers, in various agricultural cropping systems has gained more and more popularity. Frequent use of chemical fertilizers for a prolonged period deteriorates the surface soil characteristics and affects the availability and uptake of nutrients by the plants (Subbaswamy et al., 1994). The biofertilisers have been proved to enhance crop yield both, if applied singly or in combination with other inoculants. The role of VAM in the nutrition of agricultural and horticultural crops has received much attention (Tinker, 1978; Menge et al., 1977). Mycorrhizal plants of mulberry are found to be superior in survivability, plant growth, biomass production and leaf quality in comparison to non-mycorrhizal plants (Fatima et al., 1996). Umakant and Bagyaraj (1998) working on the response of mulberry saplings to inoculation with VAM and *Azotobacter* reported that dual inoculation of nursery bed with *Glomus fasciculatum* and *Azotobacter chroococum* considerably increased the plant growth and mulberry sapling development. Further, inoculation of soil

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with these organisms enriches rhizosphere microflora which can have a vital influence on plant growth through mineral uptake (Sukhada, 1988). The available information on the combined use (co-inoculation) of vesicular arbuscular mycorrhiza, nitrogen fixing bacteria, phosphate solubilizing bacteria and fungi have indicated their use as enhancement in soil fertility and thereby improved plant growth through their increased biological activity in the rhizosphere Subba Rao (1998). Mulberry plants, whose leaf is exclusively used for rearing silkworms (*Bombyx mori* L.) for subsequent cocoon production, have indicated their positive response towards the application of biofertilisers. The beneficial effect of inoculation of mulberry plants with *Azotobacter* bio-fertilizer and Vesicular Arbuscular mycorrhiza have been well documented by Das et al. (1994a, b), Katiyar et al. (1995) and Baqual et al. (2005).

In India, the mulberry is grown in abundance, mostly in the tropical belt where most of the regions are dominated by soils that are low in available nutrients and moisture Osonubi et al. (1991). Therefore, it becomes imperative to use low cost biofertilisers with added advantages in terms of crop production and sustainability of sericulture. With this background, the present, study involving combined use of Vesicular Arbuscular mycorrhiza fungi viz., *Glomus fasciculatum* and *Glomus mosseae,* nitrogen fixing bacteria viz., *Azotobacter* and phosphate solubilizing micro-organisms viz., *Bacillus megaterium* and *Aspergillus awamori* was taken in order to generate some information about their influence on quantitative traits of mulberry and to work out the economics of using biofertilisers viz-a-viz inorganic fertilizers in mulberry cultivation.

MATERIALS AND METHODS

The experiment which was laid in randomized block design was conducted under field conditions in one year old established irrigated mulberry garden of V1 variety, situated at Central Sericultural Research and Training Institute (CSR and TI farm) Mysore, India. The experiment comprised of twelve treatments and three replications for each treatment. The treatments comprised of two levels of inoculation (I_0: No inoculation and I_1: inoculation), two sources of phosphorus (S_1: Single super phosphate and S_2: Rock phosphate) and three fertilizer doses (F_1, F_2, F_3 as recommended, $3/4^{th}$ of recommended and ½ the recommended doses of nitrogen and phosphorus respectively). The recommended doses of nitrogen and phosphorus are 350 and 140 kg /ha/year respectively. The plots were inoculated with a mixed culture of mycorrhiza containing spores of *G. fasciculatum* and *G. mosseae* by intercropping technique with maize as mycorrhizal host (Katiyar et al., 1998).

For this purpose small furrows were dug in between the rows of mulberry and maize grains were evenly placed in these furrows enabling them to germinate and aid in colonization after establishing root system. All the plots which were inoculated with arbuscular mycorrhiza were then subsequently inoculated with *Azotobacter* at 20 kg/ha/year and phosphate solubilizing bacteria (*Bacillus megaterium*) at 5 kg /ha/year, phosphate solubilizing fungi (*Aspergillus awamori*) at 5 kg /ha/year in five equal splits corresponding to five crop harvests. The bacterial biofertilizer and fungi were used by mixing with 200 kg of powdered farm yard manure and applied near the rhizosphere of mulberry by making furrows. The chemical fertilizers nitrogen and phosphorus were applied in five split doses as per the doses mentioned in the treatments above. However, potassium was applied at 140 kg /ha/year in the form of muriate of potash as common dose irrespective of treatments. The fertilizers were applied after a gap of 10 to 12 days of the application of bio-fertilizers. The various parameters were estimated and the economics of using biofertilisers was worked out.

RESULTS AND DISCUSSION

Effect on longest shoot length

The data revealed a significant variation in longest shoot length due to different treatments. Among different treatments, the treatments T_4 (175.43 cm), T_6 (172.78 cm) and T_9 (174.65) have indicated prominent effect of co-inoculation with different micro-organisms. All these treatments were found to be statistically at par with T_0 (173.27 cm) as control (Table 1). However, treatment T_6 received half the recommended dose of nitrogen and phosphorus where phosphorus was applied as single super phosphate while the treatment T_9 received full dose of nitrogen and phosphorus where phosphorus was applied in the form of rock phosphate. These indicate that the application of fertilizer nitrogen and phosphorus in mulberry cultivation can be reduced by 50% of the recommended dose through the use of beneficial microbes like phosphate solubilizing micro-organisms, VA-mycorrhiza and nitrogen fixing bacteria without any adverse effect on the growth of the plants. Further, the use of rock phosphate can also bring down the cost of mulberry cultivation, as it is much cheaper than the single super phosphate. Almost similar trend was recorded in the second year also. Among different treatments, the treatments T_6 (182.15 cm) and T_9 (182.38 cm) have indicated most prominent effect of co-inoculation. However, unlike first year all these treatments were found to be highly significant over T_0 (174.74 cm) as control (Table 1). Thus the data of the second year in respect of shoot growth confirms the beneficial effect and higher efficacy of co-inoculation of mulberry as compared to the first year.

Effect on number of shoots per plant

Regarding number of shoots per plant, in general the co-inoculation of mulberry has resulted significant increase over un-inoculated treatments. In the first year, the treatment T_8 has indicated significantly higher number of shoots per plant (6.43) as compared to all other treatments including T_0 (5.64) as control except the treatment T_4. Almost similar result was also recorded in the second year in respect of number of shoot per plant. Maximum number of shoots per plant was recorded in the

Table 1. Effect of microbial co-inoculation on various growth parameters of V_1 variety under different levels and sources of phosphorus and nitrogen.

Treatments	No. of leaves/shoot		Longest shoot length (cm)		No. of shoots/plant	
	I Year	II Year	I Year	II Year	I Year	II Year
T_0	26.37	26.42	173.27	174.74	5.64	5.54
T_1	25.29	24.23	172.78	175.88	5.72	5.76
T_2	25.17	26.59	164.23	167.92	5.83	5.58
T_3	24.73	25.31	167.72	173.35	5.57	5.56
T_4	27.31	28.07	175.43	175.25	6.14	6.33
T_5	25.50	26.13	168.36	173.01	5.36	5.78
T_6	25.47	26.62	172.78	182.15	5.59	6.39
T_7	24.61	26.14	167.62	172.60	5.62	6.19
T_8	27.53	28.70	163.76	166.07	6.43	6.58
T_9	25.66	27.75	174.65	182.38	5.53	6.48
T_{10}	23.40	24.35	161.18	172.41	5.56	5.63
T_{11}	23.78	27.42	173.35	182.67	5.60	5.63
Cd at 5%	0.657	0.906	2.56	5.25	0.304	0.409

Treatment details, T_0, $F_1S_1I_0$; T_1, $F_1S_2I_0$; T_2, $F_2S_1I_0$; T_3, $F_2S_2I_0$; T_4, $F_1S_1I_1$, T5, $F_2S_1I_1$; T_6, $F_3S_1I_1$; T_7, $F_3S_2I_1$; T_8, $F_2S_2I_1$; T_9, $F_1S_2I_1$; T_{10}, $F_3S_2I_0$; T_{11}, $F_3S_1I_0$; F_1, Recommended dose of nitrogen and phosphorus; F_2, 3/4th of recommended dose of nitrogen and phosphorus; F_3, ½ of recommended dose of nitrogen and phosphorus; I_0, no inoculation; I_1, inoculation; S_1, single super phosphate (SSP); S_2, rock phosphate (RP).

treatment T_8 (6.58) followed by T_9 (6.40), T_6 (6.39) and T_7 (6.19). All these treatments have received co-inoculation and different levels and sources of fertilizer. All these treatments were also significantly higher over treatment T_0 (5.54) as control. Thus from the analyzed data especially after perusing the treatments T_7 and T_8 it was clearly observed that use of different micro-organisms in association with reduced doses of nitrogen and phosphorus is highly useful in mulberry cultivation. The use of rock phosphate can bring down the cost of cultivation (Table 1). This confirms the observations of the first year.

Effect on number of leaves per shoot

First year data revealed that maximum number of leaves per shoot was recorded in treatment T_8 (27.53) which was significantly higher as compared to the rest of all the treatments including T_0 (26.37) as control (Table 1). The second year data also revealed a similar trend of the effect of co-inoculation of mulberry on leaf production. Higher number of leaves per shoot was recorded in almost all the treatments which received co-inoculation. However, maximum number of leaves per shoot was recorded in the treatment T_8 (28.70) which was significantly higher as compared to all the treatments including T_0 (26.42) as control except for T_4 (28.07) with which it was at par. Thus the second year's data also confirms the observation of the first year.

The overall observations have indicated that there has been a significant improvement in quantitative parameters of mulberry at a reduced cost which will in turn improve the productivity of cocoons thereby attracting more and more farmers towards the venture. More so, in view of tremendous pressure on agricultural land due to urbanization and heavy industrialization increasing vertical productivity is or high relevance and need of the hour.

Economics of co-inoculation of mulberry using beneficial micro-organisms

Although chemical fertilizers have played a better role in increasing the yield of agricultural crops, yet enormous increases in their prices has resulted in creating a distress for the farmers who are stuck with multi-pronged problems like marginal land holdings, erratic availability of these fertilisers and finally soil fertility degradation due to their excessive and constant use. Further sole dependence upon chemical fertilisers will only aggravate the situation in the coming future as such the need of hour is to integrate the use of chemical as well as biofertilisers for their effective and economic utilization for mulberry crop growth.

The economic potentiality of using beneficial micro-organisms as co-inoculants is tremendous. Since, the use of chemical fertilizers in mulberry cultivation is highly expensive the use of beneficial micro-organisms like *Azotobacter*, phosphate solubilizing bacteria, VA-mycorrhiza can reduce the application of nitrogen and phosphorus by 25 to 50% of the recommended dose. The economics of mulberry cultivation with or without using phosphate solubilizing micro-organisms, nitrogen fixing bacteria and VA- mycorrhiza was also calculated keeping

Table 2. Economics of using phosphate solubilizing microorganisms (PSM) Azotobacter, va-Mycorrhiza and rock phosphate in mulberry cultivation using 3/4th dose of nitrogen and phosphorus.

Treatments			Control		
Inputs	**Quantity**	**Cost/ha/year (Rs)**	**Inputs**	**Quantity**	**Cost/ha/year (Rs)**
FYM	20 MT	9600.00	FYM	20 MT	9600.00
AMM. SUL.	1312.5 kg	6536.00	AMM. SUL.	1750 kg	8715.00
RP	525 kg	1365.00	SSP	875	2800.00
MOP	233 kg	962.00	MOP	233 kg	962.00
PSB	5 kg	275.00	-	-	-
VAM	1000 kg	200.00*	-	-	-
Azotobacter	23 kg	1265.00	-	-	-
Total		20,203.00			22,077.00

The economics are worked out for V -1 mulberry variety under 350: 140:140 fertilizer dosage. Difference (Control -Treatment) = 22,077 - 20,203 = 1874.00 net saving over control; FYM: Farm Yard Manure, Amm. Sul: Ammonium Sulphate,RP:Rock Phosphate, MOP: Muriate of Potash, PSB: Phosphate solubilising bacteria, VAM: Vesicular Arbuscular Mycorrhiza, *The depreciation cost of VAM for 15 years.

in view the prevailing cost of various fertilizers, manures and other inputs. The values arrived at indicated that with the use of these bio-fertilizers, an amount of Rs. 2000 to 4500 can be saved /ha/year on mulberry cultivation without adversely affecting the yield. The input cost on account of these fertilizers and manures in control is Rs. 22,077; it is only Rs. 20,203 (If 3/4th dose of recommended nitrogen and phosphorus is used) and Rs.17,570 only, using half of the recommended dose of N and P fertilizers (Tables 2).

Further, the fertilizer industry posses a major threat upon our fossil remains which demands major cut in their use for dual purpose of decreased health hazards associated with synthetic fertilizer use and for overall sustenance of natural resources.

REFRENCES

Baqual MF, Das PK, Katiyar RS (2005). Effect of arbuscular mycorrhizal fungi and other microbial inoculants on chlorophyll content of mulberry (Morus spp.). Mycorrhiza News. 17(3):12-14.

Das PK, Katiyar RS, Gowda MH, Choudhury PC, Datta RK (1994a). Effect of Vesicular arbuscular mycorrhizal inoculation on growth and development of mulberry (Morus spp.) saplings. Ind. J. Seric. 1:15-17.

Das PK, Choudhury PC, Gosh A, Katiyar RS, Mathur VB, Madhava Rao AR, Mazumder MK (1994b). Studies on the effect of bacterial biofertilizer in irrigated mulberry (*Morus alba*). Ind. J. Seric, 33(2):170-173.

Fatima PS, Das, PK, Katiyar, RS, Himantraj MT, Pallavi SN (1996). Effect of VAM inoculation in mulberry under different levels and sources of phosphorus on silkworm growth, cocoon yield and quality. Indian J. Seric. 35(2):99-103.

Katiyar RS, Das PK, Choudhury PC, Ghosh A, Singh GB, Datta, R.K (1995). Response of irrigated mulberry (*Morus alba* L.) to VA-mycorrhizal inoculation under graded doses of phosphorus. Plant. Soil 170:331-337.

Katiyar RS, Das PK, Choudhury PC (1998). VA-mycorrhizal inoculation of established mulberry garden through maize (*Zea maize*) intercropping. An effective technique. Abs: National Conference on Moriculture: Physiological, Biochemical and Molecular aspects of stress tolerance in mulberry (Trichy), Feb. 22-23 P. 54.

Menge JS, Lembright H, Johnson Elv (1977). Utilisation of mycorrhizal fungi in *Citrus* nurseries. Proc. Int. Soc. Citric. 1:129.

Osonubi O, Mulongoy K, Awotoye OO, Atyee MO, Okali DU (1991). Effect of ectomycorrhizal and vesicular arbuscular mycorrhizal fungi on drought tolerance of four leguminous woody seedlings. Plant Soil 136:131-143.

Subba Rao NS (1998). *Biofertilisers in Agriulture*. Oxford and IBH Publishing Co., New Delhi.

Subbaswamy MR, Reddy MM, Sinha AK (1994). Tank silt. A cheap name to manure mulberry. Indian Silk 32(10):10.

Sukhada K (1988). Response of papaya to inoculation with VA-mycorrhizal fungi. First Asian Conference on mycorrhizae, Madras, P. 34.

Umakant GC, Bagyaraj DJ (1998) Response of mulberry saplings to inoculation with VA mycorrhizal fungi and Azotobscter. Sericologia 38(4):669-675.

Tinker PB (1978). Effects of VAM in plant nutrition and Plant growth. Physiol. Veg. 16:743.