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RESPONSE OF MULBERRY TO INOCULATION OF POTASH MOBILIZING BACTERIAL ISOLATE AND OTHER BIO-INOCULANTS

S. D. Padma & J. Sukumar
Plant Pathology & Microbiology Section, Moriculture Division, Karnataka State Sericulture Research & Development Institute, Thalaghattapura, Bangalore-560062.

ABSTRACT
Potassium is the third major element required by plants for its metabolism. The requirement of the plant for this element is quite high, if the potassium ion is in short supply deficiency symptoms appears on the plant and reduces the crop yield. Mulberry is no exception as its annual requirement is 120-140 kg/ha. The present investigation aims at evaluating the potash mobilizing bacterial isolate on mulberry. Potash mobilizing bacterial isolates were isolated from mulberry rhizosphere and evaluated for their efficacy under *in vitro* and *in vivo* conditions, this isolate along with nitrogen fixing, phosphate solubilizing bacterial isolates and phosphate mobilizing vesicular arbuscular mycorrhizal isolate (*Glomus mosseae*) were evaluated for their synergistic action on growth, yield and K uptake in V1 mulberry genotype. Significant increase in growth, leaf yield, root volume and K uptake were recorded in treatments receiving combined inoculations as compared to uninoculated and individually inoculated treatments. Increased leaf yield was also recorded in treatment with combined inoculation in presence of reduced dose of NPK (75%) fertilizers indicating the beneficial effects of bioinoculants.

KEY WORDS: Mulberry, Potash, Potash mobilizing bacteria.

INTRODUCTION

Potassium is a major essential nutrient required by the plants for its growth and is taken in large quantities similar to nitrogen. It is absorbed as potassium ion and is found in soils in varying amounts, but the fraction of the total potassium in the exchangeable form is usually small (Tisdale & Nelson, 1975). Plant requirements for this element is quite high. It is absorbed as Potassium ion and is found in soils in varying amounts, but the exchangeable form is small. It is involved in all the biological reactions in crop plants (Sedaghathoor *et al.*, 2009). It is also involved in numerous biochemical and physiological processes and plays a pivotal role in plant growth, yield, quality and stress (Cakmak, 2005). Potash mobilizing bacteria are also known to produce aminoacids, vitamins and growth promoting substances like Indole acetic acids nd Gibberellins (Ponmurugan and Gopi, 2006). The beneficial role of nitrogen fixing *Azotobacter* and *Azospirillum* and phosphate solubilizing bacteria are well established in mulberry cultivation (Sukumar *et al.*, 2001). Potash mobilizing bacterium *Frateuria aurentia* has been isolated by Chandra *et al.* (1999 & 2000) and recommended for some agricultural crops. However, such studies are lacking in mulberry cultivation. Currently information on effect of Potash mobilizing bacterial isolate on mulberry is lacking, therefore a study was undertaken to evaluate its effect along with nitrogen fixing, phosphate solubilizing bacterial isolates and phosphate mobilizing vesicular arbuscular mycorrhizal isolate (*Glomus mosseae*) for their synergistic action on growth, yield and K uptake in V1 mulberry genotype.

MATERIALS & METHODS

Isolation of bacterial cultures from mulberry rhizosphere soil

The potash mobilizing bacteria were isolated from mulberry garden soils on Glucose Yeast Calcium Agar medium (GYCA) and confirmed on Mannitol Peptone yeast agar medium (MPYA).The isolated bacteria exhibited clear zones and were maintained on agar slants.The bacteria were gram negative bacilli,rod shaped and motile (Table-1). Among the four isolates one was found to be good in solubilizing potash and this bacterial culture was stored at 4^0C in refrigerator and was used in the experiment as inoculant.

To study the response of mulberry to co-inoculation with potash mobilizing, nitrogen fixing, phosphate solubilizing and phosphate mobilizing isolates

The experiment was conducted in pots of 12 kg capacity. The pots were filled with sand: soil: FYM in the ratio of 1:1:1. V-1 cuttings were planted and after establishment the treatments were imposed as given in Table-2. The amount of potash present in the soil was determined using flame photometer before the imposition of treatments and also after the harvest. The inoculants used were potash mobilizing bacteria (KMB-1) @ of 20kg/hectare, nitrogen fixer *Azotobacter chroococcum* @ of 20kg/hectare, phosphate solubilizer *Bacillus sp* @ 25 kg/acre and vesicular arbuscular mycorrhiza *Glomus mosseae* @ 100 kg/acre. Data of ten harvests that is growth, fresh weight, moisture content and root volume were recorded and is given in Table-2.

RESULTS & DISCUSSION

The isolated bacterium used for the study exhibited clear zones. The bacteria were gram negative bacilli, rod shaped and motile (Table-1). Significant improvement in plant height, leaf yield and root volume were recorded in treatments with combined inoculation of all microorganisms but maximum growth and yield was noticed in treatment with $N_{75}P_{75}K_{75}$ + nitrogen fixers +phosphate solubilizers +phosphate mobilizers + potash mobilizing bacterium. Growth and yield was on par in treatments with $N_{100}P_{100}K_{100}$ + NFB+PSM+VAM+KMB & $N_{50}P_{50}K_{50+}$NFB+PSM+VAM+KMB Root growth was found to be maximum in treatments with $N_{100}P_{100}K_{75}$ $_{+}$KMB and $N_{100}P_{100}K_{50}$ +KMB. Least growth and yield was observed in uninoculated treatment.

K influences the total chlorophyll and carotenoid contents of the leaves it may also directly or indirectly improve crop yield through increased photosynthesis. Similar kind of result has been reported by Jayaganesh *et al.,* 2011. Bagyalakshmi *et al*., 2012 have reported that application of indigenous KSB formulation with various doses of potash fertilizers with N & P enhanced green leaf yield and productivity in tea. The increase in yield might be due to the solubilization and fixation of nutrients in the soil through solubilzation by producing organic acids by KMB. Sheng *et al.* (2002) have reported that KSB namely *Bacillus mucilaginosus* is able to solubilize inorganic source of K like muriate of potash and sulphate by means of production of organic acids in order to improve yield. The plants which received the highest level of K gave the highest yield in all the years (Natesan *et al*., 1984).

CONCLUSION

The present research findings provide information that sustained growth and leaf yield can be achieved with 75% of NPK fertilizers with combined inoculation of all the beneficial microorganisms. Thus the application of reduced chemical fertilizers with consortium of all microorganisms can be recommended for mulberry to increase the yield and to maintain soil health in the ecosystem.

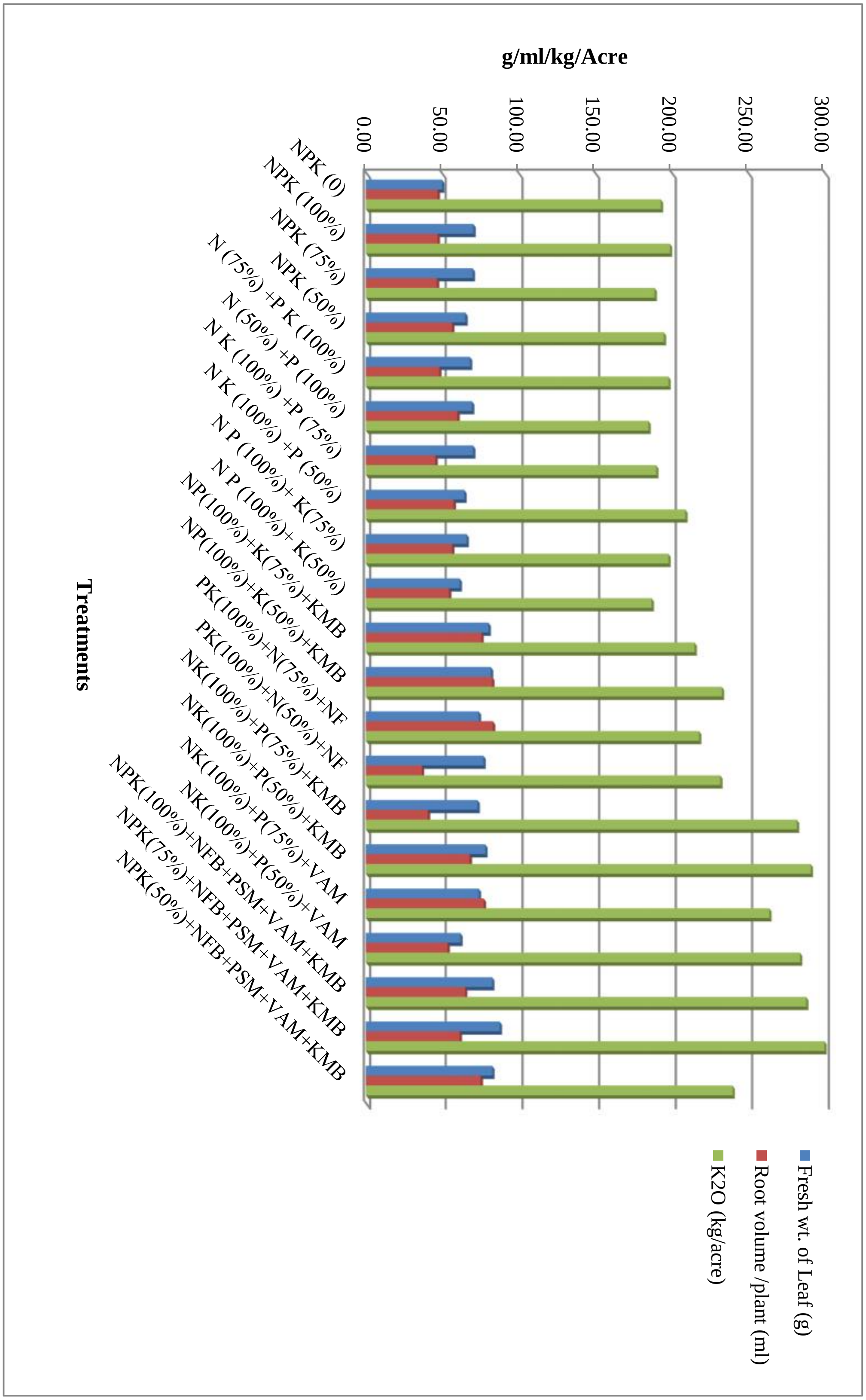
TABLE 1: Characteristics of KMB isolated from mulberry rhizosphere soils

Sl. No	Tests	Colony characters
1	Gram’s reaction	--ve
2	Shape	Rods
3	Motility	Motile
4	Temperature (15 -35 C)	+ve
5	pH	5 - 8

TABLE-2: Response of mulberry to co-inoculation with potash mobilizing, phosphate solubilizing, nitrogen fixing isolates and VAM (Avg. of ten crops)

Sl. No.	Treatments	Growth (cm)	Fresh wt. of Leaf (g)	Moisture content (%)	Root volume /plant (ml)	pH	EC dsm-1	OC (%)	P2O5 (kg/acre)	K2O (kg/acre)
1	NPK (0)	42.64	50.40	62.34	47.50	7.20	0.27	1.60	231.00	193.00
2	NPK (100%)	52.20	70.94	62.70	47.50	7.20	0.55	1.77	313.00	199.00
3	NPK (75%)	47.58	70.46	62.80	47.00	7.30	0.63	1.93	298.00	189.00
4	NPK (50%)	50.28	65.70	63.10	57.00	7.30	0.65	1.47	177.00	195.00
5	N (75%) +P K (100%)	48.86	68.72	63.50	48.50	7.20	0.61	1.50	191.00	198.00
6	N (50%) +P (100%)	48.94	70.02	65.20	60.50	7.20	0.73	1.52	233.00	185.00
7	N K (100%) +P (75%)	51.64	70.76	64.00	46.00	7.30	0.73	1.73	130.00	190.00
8	N K (100%) +P (50%)	47.80	65.00	62.40	58.00	7.20	0.64	1.69	150.00	209.00
9	N P (100%)+ K(75%)	50.08	66.50	64.80	57.00	7.20	0.65	1.55	149.00	198.00
10	N P (100%)+ K(50%)	52.76	62.00	63.70	55.00	7.20	0.56	1.67	240.00	187.00
11	NP(100%)+K(75%)+KMB	54.04	80.68	62.20	76.00	7.10	0.78	1.90	180.00	215.00
12	NP(100%)+K(50%)+KMB	49.12	82.18	63.90	83.00	7.20	0.60	1.86	135.00	233.00
13	PK(100%)+N(75%)+NF	50.50	74.30	62.60	83.50	7.10	0.77	1.81	244.00	218.00
14	PK(100%)+N(50%)+NF	41.54	77.30	62.70	37.00	7.10	0.62	1.96	209.00	232.00
15	NK(100%)+P(75%)+KMB	43.16	73.50	63.00	41.00	7.10	0.54	1.94	208.00	282.00
16	NK(100%)+P(50%)+KMB	54.48	78.50	64.60	68.50	7.10	0.78	1.89	269.00	291.00
17	NK(100%)+P(75%)+VAM	54.02	74.30	63.50	77.50	7.10	0.68	2.05	312.00	264.00
18	NK(100%)+P(50%)+VAM	52.28	62.40	62.40	54.00	7.20	0.69	2.15	304.00	284.00
19	NPK(100%)+NFB+PSM+VAM+KMB	49.72	83.00	63.00	65.50	7.10	0.65	2.11	352.00	288.00
20	NPK(75%)+NFB+PSM+ VAM+KMB	49.14	87.95	61.50	62.00	7.00	0.96	2.10	369.00	300.00
21	NPK(50%)+NFB+PSM+ VAM+KMB	48.58	83.10	63.70	75.50	7.10	0.90	2.11	389.00	240.00
	CD @ 5%	21.08	30.80	--	25.30	--	--	0.77	103.10	97.20

FIGURE 1: Response of mulberry to co-inoculation with potash mobilizing, phosphate solubilizing, nitrogen fixing bacterial isolates and VAM (Avg. of ten crops)



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