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Effect of potassium on growth, yield and nutrient uptake of mulberry (*Morus alba* L.) in eastern ghat region of Orissa

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ABSTRACT

A field experiment was conducted at Regional Sericultural Research Station, Koraput, Orissa to study the effect of graded doses of potassium on mulberry (*Morus alba* L.). Graded doses of potash (0 to 60 kg K_2O $ha^{-1}yr^{-1}$) alongwith recommended doses of nitrogen and phosphorus were applied to a medium–K sandy loam red soil under rainfed condition. Analysis of three years' pooled data revealed that the growth attributes, yield, nutrient uptake, net return and benefit: cost ratio were influenced significantly due to potash application up to 60 kg K_2O $ha^{-1}yr^{-1}$.

Keywords : Graded doses of potash, mulberry, potassium and rainfed condition.

Mulberry is a deep-rooted perennial plant, which is cultivated for its leaves. The quality of mulberry silk is directly dependent on the nutrition of leaf which influences healthy growth of silkworm larvae and thereby the good cocoon crop (Bongale *et al*., 1996). Mulberry crop suffers from moisture and nutrient stress during the other than rainy season, which considerably reduces the leaf yield and quality under rainfed cultivation in the tropics. Leaf yield potential and quality of mulberry leaves are greatly influenced by the genotypes, cultivation practices adopted, soil moisture and nutrient status of the mulberry garden soils. In view of the depletion of soil moisture availability and irrigation resources of the tropics, the necessity for selecting of appropriate doses of nutrients has attained significance in recent years.

Potassium is essential for normal growth and development of mulberry plants. Due to its high requirement by plants and the important role in physiology, it has been termed as 'master cation' in plants (Yadav, 1983). Shortage of potassium results in soft branches and poor quality leaves in mulberry (Anonymous, 1988). To obtain optimum mulberry leaf yield, proper quantity of K fertilizer need to be supplied to plants along with nitrogen and phosphatic fertilizers. Therefore, studies were carried out to see the effect of different levels of potassium on growth attributes, yields, nutrients uptake, net return, benefit : cost ratio of mulberry and so also the nutrient status of soil and the results are presented in this paper.

MATERIALS AND METHODS

An experiment was conducted at Regional Sericultural Research Station, Koraput (Eastern Ghat, hot sub-humid eco-region with red and laterite soil) with mulberry (S_{1635}, the ruling variety of this eco-region) as the test crop planted at 90 x 90cm spacing in a randomized block design with four replications (66 sq. m plot size) under rainfed condition during 2001 - 2004 and the plantation was maintained following the recommended package of practices (Purohit and Pavankumar, 1996).

Mulberry crop received 150 kg N and 50 kg P_2O_5/ ha/ year along with FYM @ 10 ha/ year as per recommendation (Purohit and Pavankumar, 1996) in all the treatments. Graded doses of K_2O were applied as basal at the rate of 0, 15, 30, 45 and 60 kg. ha^{-1} $year^{-1}$. The NPK were applied in the form of urea, single super phosphate and muriate of potash. Growth attributes, namely, plant height, number of shoots/ plant, number of leaves/ plant and leaf along with leaf and shoot yield data were recorded crop wise. Annually three crops were harvested and the annual yield was computed by pooling three years data. Nitrogen, phosphorus and potassium contents in leaf were analysed as per the standard procedures (Piper, 1966) and ultimately the uptake of these nutrients was calculated. Initial (2001) and post-harvest (2004) soil samples were collected following the principle of 'composite soil sampling' and analysed as per standard procedures (Jackson, 1973; Black, 1965; Subbiah and Asija, 1956). Finally, the benefit : cost ratio has been calculated. Statistical analysis of the three years' pooled data had been done using the one-way ANOVA.

RESULTS AND DISCUSSION

Growth and yield attributes

Plant height increased significantly due to K application of 60 kg K_2O/ ha / year over control, whereas number of leaves/ plant and leaf area showed significant increase from 30 kg to 60 kg K_2O / ha/ year and 15 kg to 60 kg K_2O ha^{-1} $year^{-1}$ (follow this pattern throughout), respectively, over control, the maximum being with 60 kg K_2O (Table 2). Number of shoots. $plant^{-1}$ did not increase significantly due to K application. The mulberry leaf yield (pool of 3 years) increased significantly due to K application from 15 kg to 60 kg K_2O / ha/ year over control, the

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maximum being with 60 kg K_2O, whereas the mulberry shoot yield increased significantly due to K application from 30 kg to 60 kg K_2O / ha / year over control, the maximum being with 60 kg K_2O. Moisture contents of leaf and shoot increased significantly due to K application of 45 and 60 kg K_2O / ha / year over control, the maximum being with 60 kg K_2O (Table 3). The increase in growth and yield of mulberry may be due to the involvement of potassium in metabolic functions related to enzyme activation, water relations, energy transformations, translocation of a assimilates, nitrogen metabolism, protein and starch synthesis (Subbaswamy *et al*., 2001).

Potassium uptake by mulberry leaf was found to be statistically significant from 30 kg to 60 kg K_2O /ha/year (Table 4). Similar observations have been made by Sanjay Kumar *et al.* (2007). The K : N nutrient uptake ratio in mulberry leaf varied from 0.481 to 0.553 with the graded doses of K. A synergistic interaction effect coupled with a higher or preferential K uptake among these nutrients may be responsible for a gradual increase in these ratios (Table 4). The K : P nutrient uptake ratio in mulberry leaf varied from 5.224 to 6.034 for various doses of K.

Soil studies

The physicochemical characteristics of the initial and post harvest experimental soil are presented in tables 1 and 5. The pH, EC, organic carbon content of the soil did not show any significant change due to graded levels of potassium addition (Table 5). Available potassium content in the K – added plots increased significantly over control, which corroborates the findings of Yaduvanshi and Anand Swarup (2006). However, its status was statistically on par from 30 kg to 60 kg K_2O ha^{-1} $year^{-1}$. Mulberry, being a deep-rooted crop is capable of mining K from deeper layers of soil; besides leaching of K as well as limited soil moisture conditions prevalent in rainfed areas could be ascribed for such a phenomenon. Available N and P contents in the post-harvest soil showed non-significant change due to K levels. However, a marginal depletion from initial N status was recorded at 60 kg K_2O ha^{-1} $year^{-1}$ and P status was recorded at all the K levels. Depletion in soil N and P status may be (Yaduvanshi and Anand Swarup, 2006) attributed to crop utilization, volatilization and fixation loss (Table 5). With the application of increasing doses of potassium the C : K ratio decreased from 0.0190 to 0.0136 at 60 kg K_2O ha^{-1} $year^{-1}$ (Table 5). Moreover, K : N and K : P ratio increased with graded levels of K.

Economics

Results indicated that the graded levels of potassium increased both the gross and net economic returns of mulberry production (Table 6). The maximum gross and net incomes of Rs 2560.00 and Rs 2110.00 were obtained by the application of K_2O @ 60 kg. $ha^{-1}year^{-1}$ (Table 6). Though the benefit : cost ratio was maximum in case of 30 kg K_2O ha^{-1} $year^{-1}$ but the economic elasticity extends up to 60 kg K_2O ha^{-1} $year^{-1}$ (Table 6).

From the above studies, it may be inferred that potassium had significant influence on mulberry leaf production and nutrients uptake up to 60 kg K_2O / ha/ year in the medium K status sandy loam red soils under rainfed condition with the highest additional net income of Rs 2110.00 /ha/year. As such, 60 kg K_2O / ha/ year may be adopted in mulberry gardens existing under rainfed conditions of Eastern Ghat region of Orissa to get maximum economic return.

REFERENCES

Anonymous. 1988. *Mulberry Cultivation*. FAO, **73:**, pp.52.

Black, C. A. 1965. *Methods of Soil Analysis*. Part II, Ame. Soc. of Agron., Inc., Madison, Wisconsin, USA pp. 849-1378.

Bongale, U. D., Krishna, M. and Chaluvachari. 1996. Effect of multinutrient foliar spray on chlorosis in M5 variety of mulberry. *Indian J. Seric*., **35** : 9-12.

Jackson, M.L. 1973.*Soil Chemical Analysis*,Prentice Hall of India Pvt. Ltd., New Delhi, pp.53-81.

Piper, C. S. 1966. *Soil and Plant Analysis*, Hans Publishers, Bombay.

Rana, S. K., Ramesh, N.S., and Sandeep, Kumar. 2007. Effect of phosphorus and potassium doses and their application schedule on yield, juice quality and nutrient use efficiency of sugarcane – ratoon crop sequence. *J. Indian Soc. Soil Sci*., **55** : 505 – 508.

Subbaswamy, M. R., Singhvi, N. R., Vedavyasa, K., Srinivasan, E. B. and Sarkar, A. 2001. Non-exchangeable potassium source as a soil testing tool for potassium management in mulberry. *Proc. Nat. Sem. Mul. Seri. Res.* 26-28 November, 2001, Bangalore, pp. 208-12.

Subbiah, B. V. and Asija, G. L. 1956. A rapid procedure for the estimation of available nitrogen in soil. *Curr. Sci*., **25**: 259-61.

Yadav, R. C. 1983. Sulphate of potash - a quality fertilizer for quality crops. *Farmer Parliament*, **18 :** 14-15.

Yaduvanshi, N. P. S. and Anand Swarup. 2006. Effect of long term fertilization and manuring on potassium balance and non-exchangeable K release in a reclaimed sodic soil. *J. Indian Soc. Soil Sci*., **54** : 203 – 7.

Table 1. Initial physicochemical characteristics of experimental soil

Characteristics	Status
Texture	Sandy loam
pH (1:2.5)	5.64
EC (dS m^{-1})	0.23
Organic carbon (g kg^{-1})	3.4
Alkaline $KMnO_4$-N (mg.kg^{-1})	129.0
Bray-P (mg.kg^{-1})	4.5
NH_4OAC-K (mg.kg^{-1})	104.5
Total N (g kg^{-1})	0.46
C:N ratio	7.39

Table 2. Effect of different potassium levels on growth attributes of mulberry

Levels of K_2O (kg ha^{-1} $year^{-1}$)	Plant height (cm)	No. of shoots/ plant	No. of leaves/ plant	Leaf area (sq. cm/ leaf)
0	123.37	5.39	84.90	98.51
15	123.57	5.43	85.92	109.16
30	124.82	5.70	87.32	109.55
45	128.65	5.22	89.87	110.67
60	134.07	5.63	90.32	114.24
LSD (P=0.05)	**6.11**	**NS**	**2.08**	**1.37**

Table 3. Effect of different potassium levels on yields and moisture contents of mulberry

Levels of K_2O (kg ha^{-1} $year^{-1}$)	Leaf yield (t ha^{-1} $year^{-1)}$	Shoot yield (t ha^{-1} $year^{-1}$)	Leaf moisture (%)	Shoot moisture (%)
0	4.91	2.83	64.83	55.21
15	5.15	2.92	65.08	56.07
30	5.60	3.15	66.08	56.84
45	5.77	3.21	66.70	57.94
60	6.19	3.36	67.63	59.47
LSD (P=0.05)	**0.23**	**0.20**	**1.64**	**2.27**

Table 4. Effect of different potassium levels on nutrients contents and uptake of mulberry

Levels of K_2O (kg ha^{-1} year^{-1})	Nutrients concentrations (%)			Uptake of nutrients (kg ha^{-1} year^{-1})			Nutrient uptake ratio	
	N	P	K	N	P	K	K : N	K : P
0	3.44	0.29	1.68	59.40	5.00	28.90	0.481	5.710
15	3.61	0.29	1.75	64.92	5.22	31.50	0.485	6.034
30	3.57	0.31	1.82	67.81	5.89	34.58	0.510	5.871
45	3.66	0.36	1.88	70.32	6.91	36.10	0.513	5.224
60	3.74	0.38	2.07	74.80	7.60	41.40	0.553	5.447
LSD (P=0.05)	**NS**	**NS**	**0.11**	**NS**	**NS**	**4.52**	**-**	**-**

Table 5. Physicochemical properties of the post harvest soil

Levels of K_2O (kg ha^{-1} year^{-1})	pH	EC (dS m^{-1})	Organic carbon (g kg^{-1})	Available nutrient contents (kg ha^{-1})			C : K	K : N	K : P
				N	P	K			
0	5.70	0.24	3.81	291.0	14.72	200.22	0.019	0.688	13.60
15	5.55	0.22	3.67	282.0	13.64	210.31	0.017	0.746	15.42
30	6.00	0.21	3.64	270.0	13.01	219.63	0.016	0.813	16.88
45	6.10	0.25	3.45	264.0	13.23	229.55	0.015	0.869	18.77
60	5.35	0.26	3.22	252.0	11.51	237.18	0.013	0.941	20.61
LSD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**12.01**	**-**	**-**	**-**

Table 6. Economics of application of different potassium levels to mulberry

Levels of K_2O kg ha^{-1} year^{-1})	Increase in leaf yield over control (mt)	Increase in monetary return over control (Rs.)	Cost of treatments (Rs.)	Net profit/ return (Rs.)	Benefit: Cost ratio
0	-	-	-	-	-
15	0.24	480.00	112.50	367.50	3.27: 1.00
30	0.69	1380.00	225.00	1155.00	5.13: 1.00
45	0.86	1720.00	337.50	1382.50	4.10: 1.00
60	1.28	2560.00	450.00	2110.00	4.69: 1.00

Cost of 1.0 kg of mulberry leaf is Rs. 2.00/-, Cost of 1.0 kg of muriate of potash is Rs. 4.50/-