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INFLUENCE OF SPLIT NPK APPLICATION ON MACRONUTRIENT STATUS OF MULBERRY (*MORUS ALBA*) LEAVES DURING SUMMER/AUTUMN IN KASHMIR

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ABSTRACT
A study was taken to assess nutrient status of mulberry after spring pruning corresponding to summer/ autumn cocoon crop as influenced by split application of NPK under Kashmir climatic conditions. Basal dose of fertiliser was applied in the first week of April and second in last week of June. Nitrogen was applied in three levels *viz*., N1, N2 and N3 (150+150; 180+120 and 120+180 kg/ha), phosphorus in two levels, *viz*., P1 and P2 (120+000 and 60+60 kg/ha) and potassium also applied in two levels K1 and K2 (120+000 and 60+60 kg/ha) respectively. Leaf samples were analysed fortnightly from August 1 to October 1. It was found that fertiliser levels during 2nd application exhibited significant influence on the respective nutrient contents in the leaves. Higher content of nitrogen was recorded in treatments with higher levels of soil application during 2nd dose *viz*., N3 (3.690 %). Maximum phosphorus content was registered in P2 (0.225 %) while as highest potassium content (1.460 %) in leaves was recorded with K2. Split application of P and K along with N exhibited quality improvement in mulberry leaf suggesting the need for rescheduling the existing fertiliser schedule under Kashmir climatic conditions. This will render second silkworm rearing commercially viable.

KEY WORDS: Foliar analysis, Fertiliser levels, Silkworm rearing, Phase, Split application, Mulberry.

INTRODUCTION

Mulberry belonging to family Moraceae is primarily cultivated for rearing of silkworms and its contribution towards successful rearing is 38.2% (Miyashita, 1986). There is a close relationship between fertiliser and leaf quality, particularly the quality of organic fertiliser applied, the ratio of organic fertiliser and chemical fertiliser and the ratio of the three nutrients- nitrogen, phosphorus and potassium. Quality of leaf influences the healthy growth of silkworm larvae and thereby the quality of cocoons (Hajare *et al*., 2008). Among the three elements, P deficiency affects the cocoon crop badly because deficiency of P affects the uptake of other elements as well (Radha *et al*., 1988). Time as well as dosage of fertiliser application plays an important role in the growth and development of mulberry. Nutrient balance ensures efficient use of both applied and native nutrients in soil. Significant and positive correlations have been reported between cocoon yield component traits with that of foliar constituents (Sannappa *et al*., 2002). Jammu and Kashmir state is bestowed with a climate well suited for the production of bivoltine silk of international quality having scope for taking 2 crops in a year from May to September from same plantation but farmers are reluctant to take second cocoon rearing mainly because of poor quality of leaf available during summer/autumn seasons that obviously affects the health of silkworms and cocoon crop. Various fertiliser dosages have been recommended for mulberry trees based on the agro climatic conditions under which mulberry tree is cultivated. Under irrigated conditions in tropical areas, fertilisers (NPK) are applied @300: 120: 120 kg/ha/yr in 5 split doses after each leaf harvest. For established plantations under irrigated Kashmir climatic conditions NPK is applied @300:120:120 kg/ha/yr in two splits, first dose comprising of half of N and entire P& K applied in March/April and second dose comprising of remaining N applied in June (Anonymous, 2003). However, this recommendation has been observed to give good leaf yield and quality in spring alone. Further for the improvement in cocoon production during summer/autumn seasons it is necessary to produce mulberry leaves of good quality (Minamizawa, 1997).

Although considerable work has been done in India on the nutrient uptake of the mulberry leaves in response to fertiliser levels and on split application of fertilisers under tropical conditions, very little work has been done on these aspects under temperate climatic conditions of Kashmir where introduction of multiple rearing on large scale is demand of the hour. But poor quality of mulberry leaf during summer / autumn seasons comes in the way of popularising second commercial rearing. Therefore, present investigation was taken up to study the impact of split application of NPK on nutrient status of leaves during summer / autumn seasons.

MATERIALS & METHODS

The present investigation was carried out at the experimental farm of Temperate Sericulture Research Institute Mirgund during 2009 and 2010. Established mulberry plantation of

Goshoerami (the most popular variety of mulberry used for commercial rearing in the region) with uniform growth and vigour was used for the study. The plantation was maintained as dwarf at 6' x 6' spacing. Cultural operations were followed as per the package of practices recommended by the Temperate Sericulture Research Institute Mirgund. Experiment was laid down in RBD comprising of thirteen fertiliser combinations including control (control 1&2). Three replications were maintained per treatment and number of plants per treatment/ replication was uniformly kept as five. Soil characteristics of the experimental plot prior to application of 2nd dose of NPK are presented in Table 1. Fertiliser (basal dose) was applied in the first week of April where nitrogen was applied in three levels *viz*., N1, N2 and N3 (150; 180 and 120 kg/ha), phosphorus in two levels *viz*., P1 and P2 (120 and 60 kg/ha) and potassium also applied in two levels, K1 and K2 (120 and 60 kg/ha) respectively. 2nd dose of fertiliser was applied in last week of June where nitrogen was applied in three levels *viz*., N1, N2 and N3 (150; 120 and 180 kg/ha), phosphorus in two levels *viz*., P1 and P2 (00 and 60 kg/ha) and potassium also applied in two levels, K1 and K2 (00 and 60 kg/ha) respectively. Fertiliser combinations are furnished in table 2.

TABLE 1: Fertility status of soil prior to application of 2nd split dose

Parameters	Depth	
	(0-30 cm)	(30-60 cm)
Soil reaction pH (1:2.5)	7.34	7.86
Electrical conductivity (dSm^{-1})	0.22	0.34
Organic carbon (%)	1.59	0.97
Available nitrogen (ppm)	106.33	69.74
Available phosphorus (ppm)	8.08	5.80
Available potassium (ppm)	114.62	61.64
Exchangeable calcium (ppm)	2197.78	2837.29
Exchangeable magnesium (ppm)	798.85	826.83
Available sulphur (ppm)	9.89	8.36

TABLE 2: Fertiliser combinations

T_1	$N_0P_0K_0$	T_2	$N_1P_1K_1$	T_3	$N_1P_1K_2$	T_4	$N_1P_2K_1$	T_5	$N_1P_2K_2$
T_6	$N_2P_1K_1$	T_7	$N_2P_1K_2$	T_8	$N_2P_2K_1$	T_9	$N_2P_2K_2$	T_{10}	$N_3P_1K_1$
T_{11}	$N_3P_1K_2$	T_{12}	$N_3P_2K_1$	T_{13}	$N_3P_2K_2$				

T1 - No Fertiliser (control 1); T2 – Recommended 1st dose (control 2) *Viz*., Basal dose of 150:120:120 kg/ha in April & 2nd dose of 150:00:00 kg/ha in June.

Leaf analysis

Composite leaf samples as described by Nakashima (1931) were collected on August 1, August 15, September 1, September 15 and October 1, during both the years of study. Leaf samples after collection were washed with tap water and then dipped in 0.1% HCl. The samples were then washed with single and double distilled water. These samples were air dried on filter papers and then oven dried at 60 ±5ºC (Chapman, 1964) till constant weight was obtained. The samples were crushed in stainless steel blender and sieved through 0.2 mm mesh. For estimation of nitrogen, samples were digested in conc. H_2SO_4 in presence of digestion mixture comprising of potassium sulphate, iron sulphate, copper sulphate and salicylic acid in the ratio of 10:1:05:1. For determination of phosphorus, potassium, calcium, magnesium and sulphur the samples were digested in di acid (nine parts of HNO_3 and four parts of $HClO_4$). Distillation of the digested samples for determining nitrogen was carried out on kjelteck apparatus by collecting ammonia on boric acid forming ammonium borate which was later titrated with N/50 H_2SO_4 following the procedure given by Jackson (1973). Phosphorus was determined by vanadomolybdo phosphoric acid yellow colour method, potassium was estimated on flame photometer, while as calcium and magnesium were estimated by versenate method as described by Jackson (1973). Sulphur was determined by turbidimetric method given by Chesnin and Yien (1951).

Statistical analysis

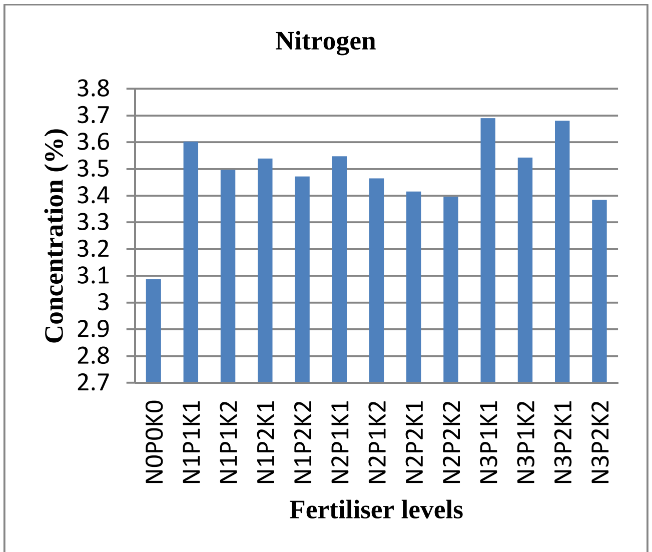
Data was compiled and analysed as per standard statistical procedure (Gomez and Gomez, 1984).

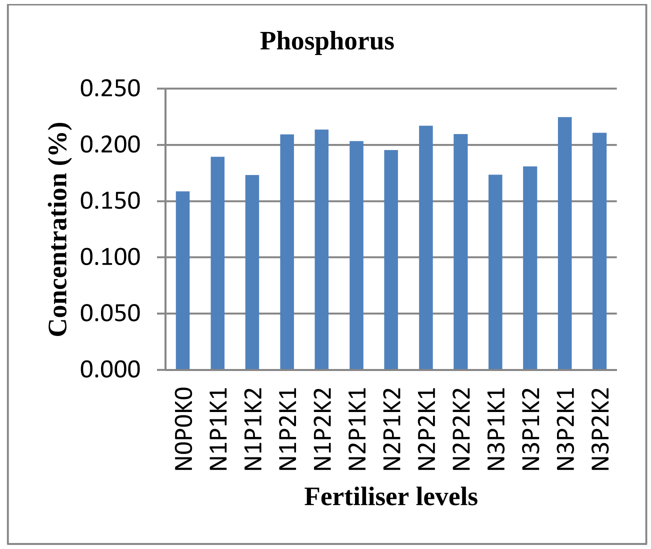
RESULTS & DISCUSSION

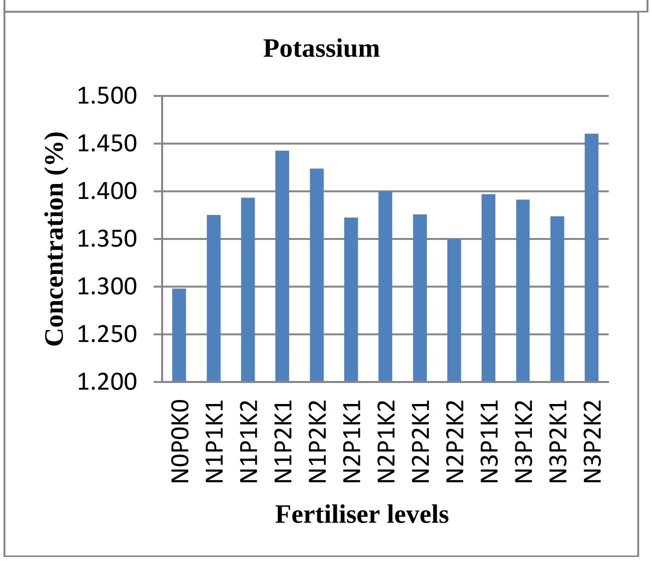
Data pertaining to the macronutrient content of mulberry leaf as influenced by the fertiliser levels is presented in Table 3 and illustrated in Fig. 1. Perusal of data pertaining to the nitrogen revealed that highest nitrogen content of 3.690 per cent was recorded in T10 which in turn was statistically at par with T12, T2, T6, T11 and T4 and significantly different from rest of the treatments. Higher contents of N were recorded in treatments having N3 and N1 levels of nitrogen application while as treatments having N2 levels of nitrogen application as 2nd dose recorded lower N concentration.

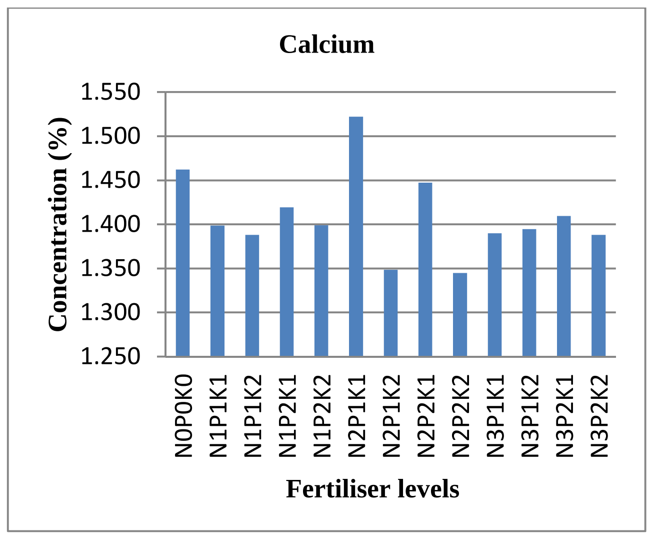
TABLE 3: Nutrient status of mulberry leaf as influenced by graded levels of NPK

Fertilizer levels	Nutrient content in leaf (Mean values)					
	N	P	K	Ca	Mg	S
$N_0P_0K_0$	3.087	0.159	1.298	1.462	0.583	0.200
$N_1P_1K_1$	3.602	0.189	1.375	1.399	0.632	0.221
$N_1P_1K_2$	3.497	0.173	1.393	1.388	0.586	0.192
$N_1P_2K_1$	3.539	0.209	1.443	1.419	0.592	0.207
$N_1P_2K_2$	3.472	0.214	1.424	1.399	0.531	0.207
$N_2P_1K_1$	3.547	0.203	1.372	1.522	0.555	0.205
$N_2P_1K_2$	3.464	0.195	1.400	1.348	0.592	0.206
$N_2P_2K_1$	3.415	0.217	1.376	1.447	0.592	0.199
$N_2P_2K_2$	3.397	0.210	1.350	1.345	0.634	0.205
$N_3P_1K_1$	3.690	0.174	1.397	1.390	0.593	0.206
$N_3P_1K_2$	3.542	0.181	1.391	1.395	0.619	0.190
$N_3P_2K_1$	3.680	0.225	1.374	1.410	0.621	0.227
$N_3P_2K_2$	3.384	0.211	1.460	1.388	0.539	0.186
$CD_{(0.05)}$	0.1650	0.0286	0.0488	0.0829	0.0456	NS









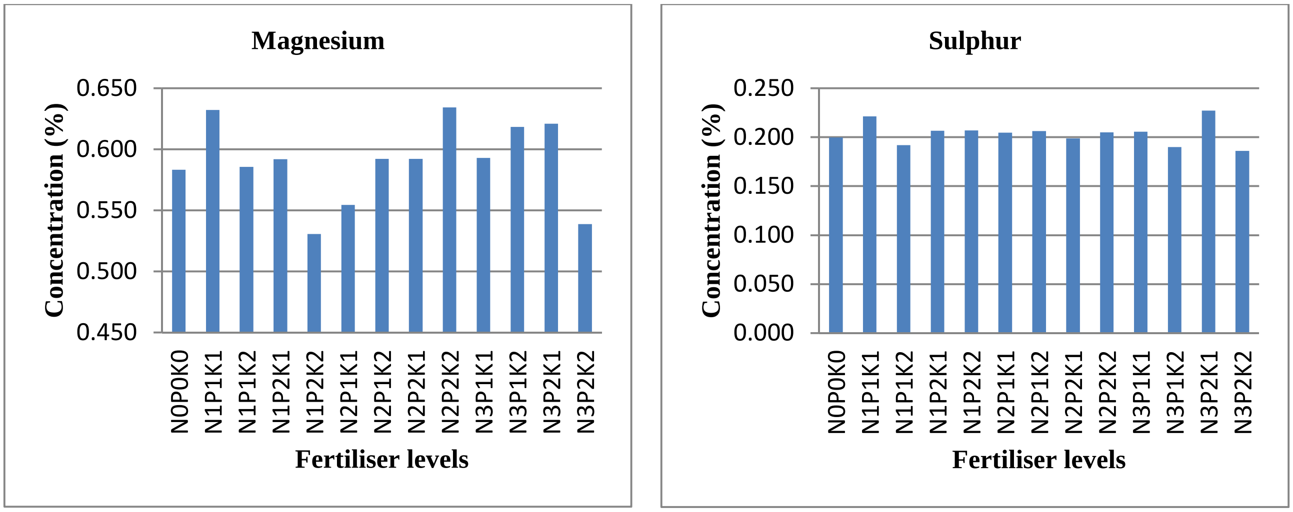


FIGURE 1

Highest P content of 0.225 percent was recorded in T12 which in turn was statistically at par with T8, T5, T13, T9, T4 and T6. T7 with P content of 0.195 was statistically at par with T2 and T11. Lowest P content of 0.159 percent was recorded in T1 which was in turn at par with T3 and T10. Higher content of phosphorus in leaf was recorded in treatments where phosphorus was applied in two split doses. Highest potassium content of 1.460 percent was recorded in T13 which in turn was statistically at par with T4 and T5. T7 with potassium content of 1.400 percent was statistically at par with T10, T3, T11, T8, T2, T12 and T6 respectively. Lowest K content of 1.298 per cent was recorded in T1 which was in turn at par with T9. Calcium content in mulberry leaf revealed that fertiliser levels did exhibit significant influence on it and highest calcium content of 1.522 percent was recorded in T6 which in turn was statistically at par with T1 and T8. Lowest Ca content of 1.345 per cent was recorded in T9 which was statistically at par with T7, T3, T13, T10, T11, T2, T5, T12 and T4 respectively. Highest Mg content of 0.634 percent was recorded in T9 which in turn was statistically at par with T2, T12, T11, T10, T7, T8 and T4. Magnesium content of 0.566 per cent was recorded in T3 which was statistically at par with T1 and T6. Lowest Mg content of 0.531 percent was recorded in T5 which was in turn at par with T13. Fertiliser levels did not exhibit any significant influence on foliar sulphur content. However highest mean S content of 0.227 percent was recorded in T12 and least S content of 0.186 per cent in T3.

DISCUSSION

Highest nitrogen content (3.690 %) was recorded in the treatment where nitrogen was applied in higher doses thus reflecting a clear dependence of foliar nitrogen on its input through soil. These results are in accordance with the findings of Fotedar *et al*. (1988); Kar *et al*. (1997); Subbarayappa and Bongale (1997); Bongale *et al*. (2000); Anupam *et al*. (2002) in mulberry and Purwanto *et al*. (2002) in Sago Palm. Splitting of phosphorus into two equal doses improved the status of phosphorus (0.225 %) in leaf. These findings are in agreement with those of Ghosh *et al*. (1997) and Subbaswamy *et al*. (2003a). Increase in leaf P content due to application of P @ 60 kg/ha after pruning as 2nd split dose can be attributed to the fact that P application increases cation exchange capacity of roots and causes better absorption of plant nutrients. Singh and Singh (1980) have also reported increase in cation exchange capacity of roots due to phosphorus application. Application of potassium @ 60 kg/ha after pruning as 2nd split dose depicted higher (1.460 %) leaf K content revealing that its application did have positive influence on K content of leaves during this phase. This could be attributed to the leaching of the element after basal application and upholds the recommendations for application of K fertilisers on crop basis in a split manner as envisaged by Sarkar *et al.* (2003), Subbaswamy *et al.* (2003b) and Shivaprakash *et al.* (2006). Various levels of NPK application as 2nd split dose also had significantly positive influence on the Ca and Mg content of leaves indicating that a shift from existing pattern of NPK application will result in overall improvement in mulberry leaf.

CONCLUSION

The study indicated that application of P and K after spring pruning as 2nd split dose along with N resulted in enhancement of these nutrients in leaf and its application in advance of scheduled date for 2nd rearing will not only improve the quality and yield of leaf but also growth of silkworms vis-à-vis cocoon yield during 2nd commercial rearing. So it is concluded that under irrigated conditions NPK application be done in two equal splits of 150:60:60 Kg/ha/yr. in the first week of April and last week of June respectively.

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