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EFFECT OF DIFFERENT LEVELS OF NPK FERTILIZERS AND IRRIGATION ON YIELD AND NUTRITIVE QUALITY OF MULBERRY LEAF

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Abstract

Experiment was conducted at the research field of Bangladesh Sericulture Research and Training Institute, Rajshahi in 2001-2002 and 2002-2003 to investigate the effect of NPK fertilizers and frequency of irrigation on leaf yield, yield components and leaf quality characters of three mulberry varieties. Four levels of NPK fertilizers and three levels of irrigation were adopted. The treatments comprising 300 kg N, 150 kg P, and 100 kg K/ha/yr along with two irrigations in a month was found to be the best for higher leaf yield, leaf moisture and leaf nutrient contents of mulberry plants (var. BM-3).

Key Words: Mulberry, NPK fertilizers, irrigation, nutritive quality.

Introduction

Mulberry leaf production is often limited by the amount of available soil moisture and it can be increased by supplemental irrigation (Jolly, 1986). Kasiviswanathan and lyengar (1965) observed that irrigation increased leaf yield of mulberry plants by about 68%. The irrigation given during November-April (drought period) about 15 days interval outyielded monthly irrigation (Mukherjee *et al.*, 1972; Rangaswami *et al.*, 1976).

The importance of NPK fertilizers for both increased productivity and improved quality of mulberry leaves has been well recognized. The yield of mulberry is influenced more by the amount of nitrogenous fertilizer than phosphorus and potassim (Pain, 1965; Kasiviswanathan *et al.*, 1979; Islam *et al.*, 1982 and 1985).

In Bangladesh, a balanced dose of NPK fertilizers with appropriate frequency of irrigation should be fixed up to achieve the maximum yield potential of mulberry leaves. The present piece of experiment was undertaken in an attempt to find out the optimum doses of NPK fertilizers with an irrigational frequency that would give maximum leaf yield with least of cost.

Materials and Method

The experiment was conducted at the experimental field of Bangladesh Sericulture Research and Training Institute, Rajshahi, Bangladesh. The soil of the

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experimental field was sandy clay loam with pH 7.2. The total nitrogen was 0.08%, phosphorus 0.36%, potassium 30.30%, organic matter 0.77% and C.E.C. (cation exchange capacity) 18.30 me/100 g.

Three improved mulberry varieties viz., BM-1, BM-2 and BM-3 were used. NPK fertilizers were applied in the form of urea, TSP, and MP, respectively. Four doses (treatment) were as follows (kg/ha/yr) (Quader *et al.*, 1992):

Treatments	N	P	K
T ₀	0	0	0
T ₁	200	100	75
T ₂	300	150	100
T ₃	400	200	125

Fertilizer doses were applied in two splits following the two seasons of irrigation during the drought period (November-April) of 2001-02 and 2002-03. There were 3 levels of irrigation as I₀ = No irrigation, I₁ One irrigation at the middle of the month and I₂ = Two irrigations in a month (15 days interval). On each occasion, 2 acre-inch irrigation water was applied. The experimental design was split split plot with three replications.

The irrigation practice was done during the drought period of the year and as experimental schedule, season 1 (February-April) of 2002 and season 2 (November-January) of 2002-03. There were two harvests for two seasons. Each harvest was done at 90 days after planting (DAP) and the following characters were recorded:

- A. For leaf yield and its components: plant height, number of branches/plant, number of leaves/branch and leaf yield/plant.
- B. For leaf quality: Moisture (%), protein (%), reducing sugar (%), total sugar (%), soluble carbohydrate (%), minerals (%) and N(%).
- C. Data were analyzed statistically.

The meteorological data were collected from the regional Meteorological Station, Shympur, Rajshahi, which is about 2 km from the experimental field. Information like average monthly temperature, rainfall, and relative humidity (RH) are shown below:

		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Tem. (°C)	2001	17	21	26	29	30	29	30	30	29	27	22	19
	2002	17	19	25	30	30	29	29	29	27	27	23	18
	2003	17	21	24	28	29	29	29	29	29	28	24	18
Rain fall (mm)	2001	6	24	10	25	129	245	304	92	310	223	24	22
	2002	--	--	33	12	122	85	249	186	124	132	10	--
	2003	--	5	55	70	156	343	241	177	316	157	54	--
RH (%)	2001	84	66	58	57	77	84	84	85	89	87.6	72	70
	2002	83	73	55	48	67	84	86	82	78	80	78	75
	2003	81	74	62	49	59	74	81	84	86	87	83	82

Results and Discussion

Leaf yield and its components

Mean values of leaf yield and the components of three mulberry varieties as influenced by NPK fertilizers and irrigation over seasons and years are presented in Table 1.

Table 1. Leaf yield and yield components of three mulberry varieties as influenced by NPK fertilizers and irrigation.

	Plant height (cm)	Branch number/plant	Leaf number/branch	Leaf yield/ plant (g)
Varietal effect				
BM-1	130.25	10.25	32.92	188.24
BM-2	95.92	9.41	25.18	162.36
BM-3	117.60	11.90	30.13	194.07
LSD 5%	2.15	0.56	0.72	2.06
NPK fertilizer effect				
T ₀	104.47	9.42	27.20	140.74
T ₁	113.24	10.49	29.18	177.28
T ₂	117.50	11.02	30.06	199.29
T ₃	123.06	11.68	31.19	210.11
LSI) 5%	1.86	0.48	0.68	1.88
Irrigation effect				
I ₀	96.89	8.98	26.46	119.17
I ₁	118.59	11.25	29.75	199.87
I ₂	178.27	11.71	32.03	225.60
LSD 5%	2.15	0.57	0.79	2.04

Effect of variety

There were significant differences between the varieties for all the characters studied. Among the varieties, BM-1 had significantly higher values for plant height, leaf number/branch followed by BM-3 and BM-2. But branch number/plant and leaf yield/plant were significantly higher in BM-3 followed by BM-1 and BM-2. Leaf yield/plant in BM-3 was 194.0 g and those of BM-1 and BM-2 were 188.24 g and 162.36 g, respectively (Table 1). This confirms the previous findings in mulberry (Miah, 1989).

Effect of NPK fertilizers

Application of NPK fertilizers significantly increased all the characters over the control (no NPK). Among the fertilizer treatments, T₃ (400 kg N, 200 kg P and 125 kg K/ha/yr) showed significantly the highest values for all these characters. On the other hand, T₀ had the lowest values. Such result was reported by Miah (1989) that by the application of N, P, and K fertilizers at the rate of 400 kg N, 200 kg P, and 150 kg K/ha/yr, leaf yield was increased by 77.92% over the control. Ray (1978) applied N fertilizer at the rate of 150, 300, 600, and 900 kg/ha/yr and observed that leaf yield increased by 88% in the highest dose. Compared to the control (T₀), leaf yield/plant of T₁, T₂, and T₃ was increased by 25.96, 41.60 and 49.29%, respectively. The importance of fertilizers on leaf yield of mulberry has also been reported by Ahmad (1986), Islam *et al.* (1982 and 1985), Kasiviswanathan and Iyengar (1965, 1966, 1969 and 1970), Subbarayappa *et al.* (1994), Mukherjee and Sengupta (1978) and Kasiviswanathan *et al.* (1977).

Effect of irrigation

There were significant effect of the frequency of irrigation treatments on leaf yield and its components (Table 1). Of the three irrigation treatments, I₂ had higher values for all the characters followed by I₁ and I₀. The leaf yield/plant was 225.60 g in I₂ and 199.87 gm, I₁, whereas I₀ showed 119.17g. The leaf yield increased by 89.3 1% and 67.72% in I₂ and I₁, respectively, over I₀ (Table 1). Mukherjee *et al.* (1972) reported that fortnightly irrigation in mulberry outyielded monthly irrigation, while the yield was least in the non-irrigated condition.

Leaf quality characters

Mean leaf nutrient values of the three mulberry varieties under the treatment of NPK fertilizers with frequency of irrigation are shown in Table 2.

Effect of variety

Among the varieties, BM-3 showed significantly highest leaf nutrients except for moisture, which is highest in BM-2.

Effect of NPK fertilizers

The nutritional components of mulberry leaf, such as leaf moisture, crude protein, reducing sugar, total sugar, starch, soluble carbohydrate and N increased significantly due to NPK fertilizers except for mineral content, which was decreased with the increased doses of NPK fertilizers.

Table 2. Leaf nutritional characters of three mulberry varieties as influenced by NPK fertilizers and irrigation.

Treat.	Moisture (%)	Crude protein (%)	Reducing sugar (%)	Total sugar (%)	Starch (%)	Soluble carbohydrate (%)	Minerals (%)	Nitrogen (%)
Varietal effect								
BM-1	72.98	19.34	2.50	4.36	13.60	17.96	9.04	3.16
BM-2	73.16	19.74	2.72	4.45	13.65	18.11	8.89	3.16
BM-3	72.26	20.07	2.80	4.68	13.75	18.42	8.97	3.20
LSD 5%	0.10	0.10	0.06	0.06	0.12	0.06	0.26	0.06
NPK fertilizer effect								
T ₀	71.83	18.18	1.68	3.23	12.72	15.95	9.04	2.90
T ₁	72.79	19.17	2.56	4.60	13.50	18.11	8.99	3.08
T ₂	73.11	20.26	3.02	4.89	14.07	18.96	8.95	3.28
T ₃	73.45	21.30	3.34	5.26	14.38	19.63	8.88	3.44
LSD 5%	0.08	0.08	0.05	0.05	0.10	0.51	0.22	0.05
Irrigation effect								
I ₀	70.82	19.47	2.52	4.35	13.43	17.79	8.97	3.15
I ₁	73.64	19.75	2.69	4.52	13.66	18.19	9.00	3.18
I ₂	73.92	19.95	2.83	4.61	13.90	18.52	8.93	3.21
LSD 5%	0.10	0.10	0.06	0.06	0.12	0.06	0.26	0.06

Effect of irrigation

The irrigation treatment I₂ (two irrigations in a month) showed the highest values in respect of the all the nutritional components of mulberry leaf except for mineral content. On the other hand, control treatment (I₀) showed the least values for all the nutritional components except for mineral content, which was least in I₂ treatment.

Several workers have reported similar results. Miah (1989) observed that with the progressive increase of NPK fertilizers, leaf constituents like moisture, crude protein, total sugar, reducing sugar, starch and soluble carbohydrate contents increased gradually but mineral content decreased. It was also reported by Quader *et al.* (1972) that crude protein, sugar, and leaf moisture increased and mineral content decreased by the application of increased dose of fertilizer. Roy and Chi ya (1972) observed that fortnight irrigation increased moisture content, starch content and total carbohydrate, but not crude protein, which was slightly decreased in comparison to monthly irrigation.

Economics of NPK fertilizers with irrigation

From Table 1, it is observed that leaf yield increased significantly by the increasing doses of NPK fertilizers and frequency of irrigation, but the rate of increase gradually declined. This finding directed to evaluate a comparative performance of economic gain in leaf yield production against the different NPK fertilizer doses and frequency of irrigation. The costing of 1 kg leaf production reveals the fact that with the increase of NPK fertilizer doses and frequency of irrigation, leaf production cost decreased upto a certain limit and after that it increased upward. The costing was less when NPK fertilizers with two irrigations in a month in comparison to NPK fertilizers with one irrigation in a month except in T₀I₂ (data not shown). From the result, it is clear that T₂I₂ (300 kg N, 150 kg P and 100 kg K/ha/yr with two irrigations in a month) was the most economic dose. This result corroborates the findings of Islam *et al.* (1982) and Miah (1989), where the cost of leaf production per kg was lowest with 300 kg N, 150 kg P, and 100 kg K/ha under natural environment. Kasiviswanathan *et al.* (1977) obtained increased leaf yield against the increased doses of N fertilizer upto 900 kg N/ha, but economic evaluation confirmed that 300 kg N/ha was the most economic dose for mulberry leaf yield.

In the present experiment, though leaf yield was increased with the increased dose of NPK fertilizers upto 400 kg N, 200 kg P, and 159 kg K/ha with two irrigations in a month, but from the point of view of economics, application of 300 kg N, 150 kg P, and 100 kg K/ha with two irrigations in a month appeared to be the optimum dose of NPK fertilizers and frequency of irrigation.

References

- Ahmed, M. I. 1986. Effect of nitrogen fertilizer (urea) on *Morus alba* leaf yield. *Pak. J. For.* **36**: 19-22.
- Islam, R., M. A. Bari and Z. Ahsan. 1982. Effect of different levels of fertilizers on leaf yield of mulberry under the irrigated condition. *Bangladesh J. Agric.* **6-7**: 25- 30.

- Islam, R., M. A. Bari and R. Ali. 1985. Effect of nitrogen, phosphorus and potassium and their combination on the leaf yield of mulberry. *J. Asiatic Soc. Bangladesh (Sc.)*. **11**: 1-5.
- Jolly, M. S. 1986. Economics of sericulture under irrigated conditions. *CSRTI. Srirarnpuram*. 1-17.
- Kasiviswanathan, K. and M. N. Sitarama Iyengar. 1965. Preliminary observation on varietal cum irrigational response to different levels of N on the seasonal and total yield of mulberry leaf. *Indians J. Seric.* **4**: 4-10.
- Kasiviswanathan, K. and M. N. Sitarama Iyengar. 1966. Effect of NPK manuring on seasonal and total yield of mulberry. *Indian J. Seric.* **5**: 46-51.
- Kasiviswanathan, K. and M. N. Sitarama Iyengar. 1969. Varietal-cum irrigational response to different N levels on the seasonal and total yield of mulberry. *SIB*, **1**: 1-12.
- Kasiviswanathan, K. and M. N. Sitarama Iyengar. 1970. Effect of plant densities, methods of leaf harvest and nitrogen fertilization on the leaf yield of irrigated mulberry in Mysore State. *Indian J. Seric.* **9**: 43-48.
- Kasiviswanathan, K., S. Krishnaswami and C. V. Venkataraman. 1977. Studies on varietal-cum spacing and nitrogen fertilization on the leaf yield of mulberry under irrigated conditions in Karnataka. India. *Indian J. Seric.* **16**: 10-18.
- Kasiviswanathan, K., S. Krishnaswami and P. C. Chowdhury. 1979. Long-term studies on the variety, spacing and nitrogen fertilization for the improvement of yield potential of mulberry. *Indian J. Seric.* **18**: 23-29.
- Miah, M. A. B. 1989. Studies on the growth and yield of mulberry (*Morus alba* L.). Ph.D. Thesis. University of Rajshahi, Bangladesh.
- Mukherjee, S. K. and D. Sengupta. 1978. Studies on fertilizer, varieties, spacing, pruning and irrigation on mulberry leaf yield. *Annual Report. Central Sericulture Research and Training Institute, Berhampur, India*, 61-69.
- Mukherjee, S. K., D. Ray and A. K. Pain. 1972. Influence of different levels of irrigation on the yield of bush mulberry raised under Bengal and Mysore systems of plantation. *Indian J. Seric.* **11**: 33-38.
- Pain, A. K. 1965. Effect of NPK fertilizers and their combinations on the yield and nutritive value of mulberry. *Indian J. Seric.* **4**: 1-8.
- Quader, M. A., M. A. Qayyum, A. A. Sarkar, M. A. Rab and S. U. Ahmed. 1992. Varietal response to NPK-fertilizers in combination with foliar spray of urea on leaf yield and quality of mulberry. *Bull. Sericult. Res.* **3**: 54-66.
- Rangaswami, G. M., M. N. Naramahanna, K. Kasiviswanathan and C. R. Sastry. 1976. *Seiculture Manual. 1. Mulberry Cultivation*, FAO, Rome.
- Ray, D. 1978. Effect of different doses of ammonium sulphate and lime on soil composition, leaf yield and nutritive value of mulberry leaf. *Annual Report. Central Sericulture Research and Training Institute, Berhampur, India*. 5 I -55.

- Ray, D. and P. K. Chinya. 1972. Chemical composition of osage orange leaf (*Maclura pomifera Raf.*). *Indian J. Seric.* **11**:39-42.
- Subbarayappa, C. T., A. K. Sinha, P. Sandareswaran, N. R. Singhvi and R. K. Datta. 1994. Effect of split doses of fertilizers on yield of mulberry leaves. *Indian J. Seric.* **33**: 72-73.