Research Article

EFFECT OF GRADED LEVELS OF WATER SOLUBLE FERTILIZERS ON GROWTH, YIELD OF MULBERRY AND COCOON QUALITY

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KEYWORDS:
Mulberry, Silk worm, Water soluble fertilizers.

ARTICLE INFO
Received on:
09.09.2019
Revised on:
25.10.2019
Accepted on:
27.10.2019

ABSTRACT

A field experiment was conducted at College of Sericulture, Chintamani, Karnataka, in randomized block design with seven treatments replicated thrice with drip irrigation. The treatments comprises of two sources of fertilizers *viz.*, water soluble fertilizers (WSF) and conventional fertilizers (CF) at four levels (25, 50, 75 and 100% RD of WSF through fertigation) as per the schedule used for application of fertilizers. The type of soil is sandy clay loam in texture with neutral pH, EC of 0.24 dS m^{-1}, 0.62% organic carbon, medium in available N, low in P and high in K content. Shoot height (m), Number of branches (No./plant) and Total number of leaves (No./plant) were higher in the treatment with 100 % RD with water soluble fertilizers against control and CF. Similar trends were observed for leaf yield/plant and leaf yield/ha. The uptake of N, P & K was higher in fertigation with 100% RDF through water soluble fertilizes + FYM (RD). But the performance of Silkworm, *Bombyx mori* L. in terms of cocoon weight (g/10 cocoons), Shell weight (g/10 cocoons) and Shell ratio (%) was higher in the treatment receiving 75% NPK through water soluble fertilizes (Fertigation) + FYM (RD). These findings indicated that inverse relationship between the nutrient accumulation in mulberry leaves and cocoon parameters in the silkworm *B. mori* that may be attributed to the increased accumulation of nutrients (particularly nitrogen) leads to decreased production of chlorogenic acid, Flavonal, and increased concentration of 1-deoxynojirimycine might have affected leaf quality and performance of silkworms.

INTRODUCTION

Mulberry is one of the most important commercial crops grown extensively as food plant for silkworm. Mulberry (*Morus* spp.) is a perennial and high biomass producing plant, continues to grow throughout the year in tropics. Continuous production of mulberry for a long time results in gradual reduction in leaf yield and quality (Rashmi *et al*., 2009). In India, mulberry is cultivated in 282,244 ha (Dutta, 2014) in different agro climatic conditions varying from temperate to tropical. Silkworm, *Bombyx mori* L. being monophagous insect, derives almost all nutrients for growth and development from the mulberry leaf. It has been estimated that, nearly 70% of the silk proteins are derived from mulberry leaves. Hence, silkworms should be fed with good quality mulberry leaves in abundant quantity for the successful cocoon production (Vijaya *et al*., 2009).

Leaf yield and quality of mulberry depends on the soil type, plant variety, and availability of plant nutrients and agro-ecological conditions, which reflects on quality of silk production. In India, mulberry is largely cultivated for leaf production and contributes to an extent of 38.20% for successful cocoon crop production (Miyashita, 1986). Sizeable area under mulberry is cultivated with flood irrigation with exclusive soil application of fertilizers. Use of flood irrigation with soil application of fertilizers leads to considerable loss of water and consequent leaching of nutrients from the soil.

So, it is essential to standardize the agro – techniques for mulberry cultivation and technological innovations are also to be exploited to achieve the objective of higher mulberry productivity and better water and nutrient use efficiency. In this regard, drip fertigation is the one of the best alternative in delivering water and nutrients to plant. Surface irrigation methods are utilized in more than 80% of the world's irrigated lands yet the field level application efficiency is

often only 40–50%. In contrast, drip irrigation may have field level application efficiencies of 70–90%, as surface runoff and deep percolation losses are minimized. Drip irrigation may allow more crops per unit water and to allow crop cultivation in areas where insufficient water exists to irrigate by surface method.

Fertigation a technique of application of both water and fertilizers through drip irrigation system during the recent years was shown to be very effective in achieving higher water and fertilizer use efficiencies. In this method, both water and fertilizer are delivered precisely in the effective crop root zone as per the crop needs and crop developmental phases. Increased growth and yield with drip irrigation has been reported in several crops and the yield increase ranged between 7–112% depending on the crops/varieties and method of irrigation. The water and fertilizer saving through drip fertigation system have been reported to be 40– 70% and 30–50% respectively (Rekha *et al.*, 2008).

Mulberry is one of the major commercial crop in Chickkaballapur and Kolar districts during field visit to different mulberry growing areas, farmers applying large quantities of water soluble fertilizers based on POP of chemical fertilizers to reduce the dose of water soluble fertilizers and its use efficiency to address the farmers problem in producing quality leaves and its effect on cocoon productivity the present experiment is planned with objective effect of graded levels of water soluble fertilizers on growth, yield of mulberry and cocoon quality.

MATERIALS AND METHODS

An experiment was conducted at College of Sericulture, Chintamani in V-1 mulberry garden geographically located in eastern dry zone (Zone-5) of Karnataka state during *kharif* 2018. The mulberry variety used in study was V-1 cultivated under irrigated conditions with wider spacing. The commercial multi-bivoltine hybrid PM X CSR2 was used for the study. Experiment was laid in a completely randomized block design with 7 treatments with 3 replications each *viz.*, T_1: Control, T_2: Recommended dose of fertilizers + FYM, T_3: Recommended dose of fertilizers + no FYM, T_4: 100 % NPK through water soluble fertilizes + FYM (Fertigation), T_5: 75 % NPK through water soluble fertilizes + FYM (Fertigation), T_6: 50 % NPK through water soluble fertilizes + FYM (Fertigation), T_7: 25 % NPK through water soluble fertilizes + FYM (Fertigation). Package of practices was followed as per the recommended standards. Growth and yield parameters of mulberry *viz.*, shoot height (cm), number of branches per plant, number of leaves per plant, leaf yield (g/plant) and leaf yield/ha/crop (tons) were recorded at 45 day after pruning as per the standards suggested and analyzed statistically. The chawki worms were reared by feeding tender leaves whereas late age worms were fed with matured leaves harvested from the V-1 mulberry garden treated with different levels of application of conventional and water soluble fertilizers. During rearing optimum spacing was provided according to age of worms. Lime powder and bed disinfectant were dusted on silkworms before settling for each moult to keep the bed dry and facilitate easy moulting. Ripe worms were handpicked and mounted on bamboo mountage at the rate of 50 worms per sq ft as per the treatment and cocoons were harvested manually on the 5th day of mounting. Silkworm growth and cocoon parameters *viz.*, moulting duration (h), instar duration (5th instar duration in days), larval weight of 5th instar on 5th day (g/10 larvae), per cent effective rate of rearing (ERR), cocoon weight (g/10 cocoon), shell weight (g/10 cocoon), shell ratio (%), single cocoon filament length (m) and filament denier were recorded treatment-wise as per the standard procedure and analyzed statistically.

RESULTS AND DISCUSSION

Effect of graded levels of water soluble fertilizers on growth and yield attributes of Mulberry

Among the different treatments, 100 % NPK through water soluble fertilizes + FYM (Fertigation) recorded significantly

Table 1. Effect of graded levels of water soluble fertilizers on growth and yield parameters of mulberry leaves in field experiment

Treatment	Shoot height (m)	Number of branches	Number of leaves/ plant	Leaf area ($cm^{2)}$	Leaf yield/plant (kg)	Leaf yield / ha/ crop (tons)
T_1	1.05	15.00	176.33	69.19	0.30	3.10
T_2	1.30	17.67	186.33	86.89	0.40	4.33
T_3	1.17	17.40	195.33	78.34	0.41	4.17
T_4	1.38	19.33	207.33	96.42	0.43	4.50
T_5	1.07	16.60	189.20	85.78	0.38	4.11
T_6	1.15	15.73	179.67	83.52	0.36	3.89
T_7	1.20	15.27	194.67	84.90	0.32	3.20
SEm ±	**0.07**	**0.48**	**6.63**	**7.47**	**0.05**	**1.12**
CD @ 0.05	**0.21**	**1.48**	**20.44**	**23.03**	**0.17**	**3.45**

higher values for the growth and yield parameters *viz.*, shoot height (1.38 m), number of branches/plant (19.33), number of leaves/ plant (207.33), leaf area (96.42 cm^2) and leaf yield (0.43 kg/plant and 4.50 t/ha/crop) at 45th days after pruning (Table 1) followed by Recommended dose of fertilizers + FYM. Lower growth and yield attributes of shoot height (1.05 m), number of branches/plant (15.00), number of leaves/ plant (176.33), leaf area (69.19 cm^2) and leaf yield (0.30 kg/plant and 3.10 t/ha/crop) in the control. The present research findings clearly indicated that significantly higher growth and leaf yield parameters were recorded in 100 % NPK through water soluble fertilizes + FYM (Fertigation) applied treatment compared to rest of the treatments which might be due to significant increase in growth and yield attributes to adequate supply of water soluble fertilizers may increases the nutrient use efficiency due to complete solubility and reduce the losses by leaching and volatilization. These results were in agreement with the findings of (Mohanaramya *et al.,* 2010). Similar results were reported in chillies by Muralikrishnasamy *et al*. (2006) in capsicum by Sanchita *et al*. (2010) and in cauliflower by Ilakiyanila (2012).

Effect of graded levels of water soluble fertilizers on larval and cocoon parameters of silkworm

There were significant differences among the treatments with the application of graded levels of water soluble fertilizers applied with respect to larval parameters of silkworm (PM X CSR2) (Table 2). Significantly less moulting duration (91.25 h), fifth instar duration (7.24 days) and more larval weight of 5th instar on 5th day (22.89 g/10 larvae), ERR (94.00%), cocoon weight (18.91 g/10 cocoons), shell weight (2.48 g/10 cocoons), filament length (823.83m) and finer denier (2.72) were noticed in treatment which received 75 % NPK through water soluble fertilizes + FYM (Fertigation) (T_5) which is on par with T_6 which received 50 % NPK through water soluble fertilizes + FYM (Fertigation). Whereas significantly lower cocoon characters were observed in control treatment *viz.*, longer moulting duration (92.92 h), 5th instar duration (7.52 days), lower larval weight of 5th instar on 5th day (22.76 g/10 larvae), ERR (79.33%), cocoon weight (14.92 g/10 cocoons), shell weight (2.13 g/10 cocoons), shell ratio (16.95%), filament length (740.58 m) and coarser denier (2.65). there is a inverse relationship between nutrient content in terms of mulberry leaf yield and cocoon parameters this might be due differences in water soluble fertilizers application levels affected each functional component in mulberry leaves. For instance, with increased nitrogen levels, the chlorogenic acid and flavonol contents significantly decreased, but the 1-deoxynojirimycin content significantly increased. Selection of the optimal nitrogen application level is necessary to obtain the desired functional components from mulberry leaves (Sugiyama *et al.,* 2016).

Table 2. Larval parameters of silkworm, *Bombyx mori* L (PM×CSR2) as influenced by feeding mulberry treated with water soluble fertilizers

Treatment	Moulting duration (hrs)	Instar duration (days)	Larval weight at 5th instar 5th day (g/larvae)	ERR (%)	Cocoon weight (g/ 10 larvae)	Shell weight (g/ 10 larvae)	Shell ratio (%)	Filament length (m)	Filament denier
T_1	92.92	7.52	22.76	79.33	14.92	2.13	16.95	740.58	2.65
T_2	91.57	7.49	22.69	81.33	15.71	2.13	17.68	757.33	2.65
T_3	92.52	7.45	22.84	81.33	15.33	2.37	17.24	768.34	2.68
T_4	91.83	7.36	22.60	85.33	15.61	2.38	17.06	806.31	2.74
T_5	91.25	7.24	22.89	94.00	18.91	2.48	17.94	823.83	2.72
T_6	91.33	7.22	23.37	89.33	14.98	2.39	17.68	818.53	2.45
T_7	92.22	7.28	22.93	88.67	15.68	2.30	17.96	772.34	2.65
SEm ±	**0.43**	**0.08**	**0.19**	**2.56**	**0.73**	**0.05**	**0.42**	**15.03**	**0.15**
CD @ 0.05	**1.34**	**0.21**	**0.59**	**7.89**	**2.25**	**0.14**	**1.29**	**46.33**	**0.45**

CONCLUSIONS

This study has shown that application of 50 to 75% recommended doses of water soluble fertilizers + FYM are optimum for mulberry leaf yield and cocoon productivity, there is an inverse relationship between cocoon parameters and yield (Nutrient content) of mulberry leaves.

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How to cite this article?
Naveen, D.V., Venkatachlapathi, V., Vinoda, K.S., Bharathi, V.P., Ramakrishna Naika and Venkataravana, P. 2019. Effect of graded levels of water soluble fertilizers on growth, yield of mulberry and cocoon quality. *Innovative Farming*, **4**(4): 185-188.