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Effect of NPK fertilizers on the growth and yield components of two high yielding Mulberry (*Morus alba* L.) varieties in irrigated conditions

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ABSTRACT

A field experiment was conducted on a newly established mulberry garden at Pakani, Solapur (M.S). The experiment was conducted during 2016- 2017 and 2017-2018. To investigate the effect of NPK (300:120:120 kg/ha/year) fertilizers on the different growth components like Leaf weight (3rd, 6th, Average 5 leaves), Average height of shoots per plant, Average number of shoots per plant and Average weight of shoots per plant of two high yielded V1 and S1635 mulberry varieties. Soil of the experimental plot is Block cotton and irrigation is supplied twice per month. The present investigation shows V1 mulberry variety performs better than S1635 besides all components.

Keywords: V1 and S1635 Mulberry Varieties, NPK fertilizers, Growth and Yield parameters.

INTRODUCTION

Man is always inquisitive for Silk products. Silk – The Queen of textiles spells luxury, elegance, class and comfort. Mankind has always loved this shimmering fiber of unparalleled grandeur from the moment. Chinese Empress Shilling Ti discovered it in her tea cup. It withstood many a daunting challenges from other natural and artificial fibers and yet, remained the undisputed "Queen of Textiles" since centuries. (https://cmerti.res.in/?page_id=2456)

Chemically speaking, silk is made of proteins secreted in the fluid state by a caterpillar, popularly known as "Silkworm". These Silkworms fed on the selected food plants and spin cocoons as a "protective shell" to perpetuate the life. Silkworm has four stages in its life cycle viz., egg, caterpillar, pupa and moth. Man interferes this life cycle at the cocoon stage to obtain the silk, a continuous filament of commercial importance, used in weaving of the dream fabric.

Mulberry foliage is the only food for the silkworm (*Bombyx mori L.)* and is grown under varied climatic conditions ranging from temperate to tropics. Mulberry leaf is a major economic component in sericulture since the quality and quantity of leaf produced per unit area has a direct bearing on cocoon harvest. In India, most states have taken up sericulture as an important agro-industry with excellent results. (*Datta*, *Mulberry Cultivation and Utilization in India, https://www.fao.org/3/x9895E/x9895e04.htm*).

The quality of mulberry leaves plays an important role in the success of the sericulture industry and directs its economics (Choudhury *et al.* 1991), and hence much effort and research have been carried out to improve the quality and quantity of mulberry-leaf production for silkworm rearing and then cocoon production. Some varieties of mulberry leaves appeared to be superior to others (Raman *et al*. 1995). The nutritional status of mulberry leaves can be improved by enriching them with extra nutrients to increase larval growth and improve cocoon characteristics (Sengupta *et al.* 1992).

The *Bombyx mori* (L) is essentially monophagous and survives solely on mulberry leaves (*Morus* sp.) which play an important role in the nutrition of the Silkworms, in turn cocoon and silk production (Nagaraju, 2002). The nutritional elements of mulberry leaves determine the growth and development of the larvae and cocoon production (Sridevi *et al*., 2005). The quality of the leaves has a profound effect on the superiority of silk produced by the *B. mori* (L). In this regard, the production of good cocoon crop is totally dependent on the quality of leaves. Leaves of superior quality enhance the chances of good cocoon crop (Kumar, 1988). It has also been demonstrated that the dietary nutritional management has a direct influence on quality and quantity of silk production in *B. mori* (Murugan *et al*., 1998). In recent years, many attempts have been made to improve the quality and quantity of silk (Hiware, 2006), through enhancing the leaves with nutrients, spraying with antibiotics, juvenile hormone, plant products, with JH-mimic principles or using extracts of plants. Mulberry leaves have been supplemented with various nutrients for silkworm feeding to promote silk quality and quantity. The supplementation and fortification of mulberry leaves is a recent technique in sericulture research (Murugan *et. al.*, 1998).

MATERIAL AND METHODS

A present study was carried out on a newly established mulberry garden at Pakani, Sholapur (MS), India. The experiment was conducted during 2016-2017 and 2017-2018. To investigate the effect of NPK (300:120:120 kg/ha/year) fertilizers on the different growth components like Leaf weight (3rd, 6th, Average 5 leaves), Average height of shoots per plant, Average number of shoots per plant and Average weight of shoots per plant of two high yielded V1 and S1635 mulberry varieties. Plantation method is 3' x 1' spacing type. Soil of the experimental plot is Block cotton and irrigation is supplied twice per month. The fertilizer doses are supplied as recommended by Dandin *et al*., (2001).

RESULTS AND DISCUSSION:

Table 1: Basic Difference between V1 and S1635 Mulberry verities.

Sr. No.	Characteristics	Mulberry Varieties	
		V1	S1635
1	Colors of leaves	Faint Green	Dark Green
2	Branches	Comparatively Less	More
3	Sprouting	Good	Very Good
4	Height Of Plant	Satisfactory	Satisfactory
5	Leaf Size	Large	Bigger
6	Leaf Fallen Rate	Less	High
7	Disease And Pest Resistance	Good	Weak

Table 2: Growth and Yield Parameters of Mulberry Verities

Sr. No.	Growth and Yield Parameters		V1		S1635	
			2016 – 2017	2017 - 2018	2016 - 2017	2017 – 2018
1	3rd no. Leaf Weight (gm)	Mean	1.93	1.97	1.06	1.89
		SE ±	0.05	0.05	0.03	0.01
		CD %	0.12	0.09	0.08	0.03
2	6th no. Leaf Weight (gm)	Mean	5.86	6.96	4.85	5.68
		SE ±	0.04	0.03	0.02	0.02
		CD %	0.09	0.08	0.06	0.04
3	Average 5 leaves Weight (gm)	Mean	21.15	23.18	19.03	18.71
		SE ±	0.67	0.02	0.08	0.02
		CD %	1.71	0.04	0.20	0.05
4	Average Height of Shoot (cm)	Mean	286	337.8	215.6	286.1
		SE ±	4.27	11.44	3.74	4.27
		CD %	10.98	29.40	9.60	10.98
5	Average No. of Branches/Shoots Per Plant	Mean	17.4	20.8	19.2	21.4
		SE ±	1.21	1.02	1.93	1.75
		CD %	3.11	2.62	4.97	4.50
6	Average Weights Per Plant (kg)	Mean	4.423	15.485	3.752	14.621
		SE ±	0.21	0.21	0.07	0.24
		CD %	0.54	0.54	0.19	0.61

1. Weight of 3rd number leaf of Mulberry varieties (gm):

The 3rd leaf of the plant is usually used for the Chawaki rearing or at initial stage of rearing. Hence, their productions play a crucial role in sericulture. The fresh weight of 3rd no. leaf of V1 mulberry plant was maximum (1.93) among S1635 plant (1.06), during the year 2016-2017. During the year 20117-2018 also V1 variety shows maximum (1.97) than S1635 variety (1.89) due to 3'X1' spacing and NPK fertilizers among the plants.

This finding are in conformity with results obtained by Shivaprakash *et al.* (2000) he got higher leaf yield and better quality leaf (nitrogen) using 300:120:120 kg NPK per hector per year under irrigated condition in S-36 variety at 60 × 60 cm spacing.

Jolly (1986) concluded that under irrigated condition application of 20 tons of FYM/ha/year as basal and 255 kg each of nitrogen and phosphorus and potassium per hectare per year was better for harvesting higher quality leaves required for chawki worms.

2. Weight of 6th number leaf of Mulberry varieties (gm):

The 6th leaf of the mulberry plant is usually used for the rearing of late age or mature stage worms. Hence, their productions play a vital role in sericulture industry. The fresh weight of 6th leaf of V1 mulberry variety was higher during the year 2016-2017. It increased from 5.86 among S1635 variety 4.85 gm, during the year 2017-2018 weight ranges from 5.68 gm (S1635 variety) as high as 6.96 gm (V1 variety) for 3'x1' spacing's and NPK fertilizer doses.

Similar results were correlated with, Patil *et al.* (2002), reported that application of NPK @ 150:75:100 or 200:100:150 kg per hector per year with 5 tone

Vermicompost resulted in higher leaf yield than 300 kg N and 2.5 t vermicompost in V-1 mulberry.

Sinha *et al.* (2001) reported that 150:50:50 kg NPK per hector per year + 10 t FYM combination gave significantly higher leaf yield in S1 mulberry under partially irrigated conditions when compared to control (without FYM + NPK).

3. Average Weight of 5 leaves of Mulberry varieties (gm).

The average weight of 5 leaves of both the mulberry varieties V1 and S1635 were randomly selected from top to bottom. For shoot feeding methods these leaves were fed to mature silkworms. During the year 2016-2017, V1 Mulberry variety shows maximum 21.15 gm than S1635 variety 19.03 gm. During the year 2017-2018 V1 mulberry variety shows higher leaf weight than S1635 (23.18 – 18.71).

Similar results were reported by Kasiviswanathan and Iyengar (1965), obtained significantly more leaf yield in M-5 variety with application of 100 kg N per hector per year over no nitrogen under irrigated conditions. Kasiviswanathan and Iyengar (1970) studied the effect of different treatment combinations *viz.,* M1 (30 × 10 cm plant spacing, whole shoot harvest), M2 (90 × 90 cm spacing, leaf picking), M3 (plant density same as M1) and 100, 200 kg N per hector per year in M5 variety of mulberry. Split application of 200 kg N per hector per year was significantly superior with respect to leaf yield (31,450 kg) over 100 kg N per hector per year in combination of 30 × 10 cm spacing, leaf harvest and pruning once in a year under irrigated conditions.
Ghosh *et al*. (1997). Studied that the variety S 36 with spacing of 60 x 60 cm and fertilizer doses of NPK @ 300:180:120 kg/ha/year which maximum leaf yielded with higher NPK contents to be better package for irrigated conditions of southern tropics.

4. Average height of shoots per plant of Mulberry varieties (cm):

Total number of leaves depends on the height of shoots per plant. For commercial sericulture Shoot feeding method plays very important role for saving labour cost. V1 mulberry variety shows maximum height of shoots among S1635 mulberry variety both during 2009-2010 (286 cm and 215.6 cm), similarly during the year 2010-2011 (337.8 cm and 286.1 cm).
Studies conducted by Bhaskar *et al.* (2003) with M-5 mulberry under irrigated condition with varied levels of N (200-280 kg per hector per year), P (80-140 kg per hector per year) and K (80-140 kg per hector per year) indicated that application of 280:80:80 kg NPK per hector per year significantly improved plant height, number of shoots, number of leaves per plant, leaf area and moisture content as compared to control. Response of mulberry varieties like K-2, S-13 and S-34 was positive on growth parameters, except plant height, leaf yield and biomass production (Singhvi *et al*., 2006).

Satyanarayana (2000) reported that V-1 was superior to S-36 in all growth and yield parameters *viz.,* plant height, number of branches per plant, number of leaves per plant, leaf area, leaf area index and leaf yield. He further reported that CSR18 x CSR19 per cent better with respect to total larval duration, weight of 10 larvae just before setting for third moult, pupal duration, single cocoon bave length, renditta while PM x NB4D2 for ERR (%), cocoon yield by number, incidence of flacharie and muscardine and NB4D2 for maximum fifth instar larval weight, cocoon weight, pupal weight, silk filament length on V-1 variety.

5. Average number of shoots per plant of Mulberry varieties (No.):

Mulberry leaf production depends on the quality and quantity of shoots per plant. The quality and quantity of shoots depends on different factors like application of fertilizers, plantation methods (spacing's) and seasons. The average number of shoots for the S1635 mulberry variety was maximum (19.2) among V1 mulberry variety (17.4) during the year 2016-2017. Similarly during the year 2017-2018, S1635 variety (20.8) shows higher number of shoots than V1 variety (20.8) due to 3' x 1' spacing and NPK fertilizer dose.

Effect of foliar spray of urea (*Gooding and Davies*, 1992; *Readman et al*., 1997) along with different doses of NPK fertilizers significantly increase leaf yield and nutrients like moisture content, protein, sugar, reducing sugar and starch in both tender and mature leaves (Quader *et al*., 1989).

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duration, single cocoon bave length, renditta while PM x NB4D2 for ERR (%), cocoon yield by number, incidence of flacharie and muscardine and NB4D2 for maximum fifth instar larval weight, cocoon weight, pupal weight, silk filament length on V-1 variety.

6. Average weight of shoots per plant of Mulberry varieties (kgs):

The leaf yield was significantly influenced due to application of fertilizers like NPK. V1 variety shows maximum shoot yield (4.423 kg) than S1635 variety (3.752 kg) during the year 2016-2017. During the year 2017-2018 V1 varieties shows maximum yield (15.485 kg) among S1635 variety (14.621 kg).

Similar results were obtained by Ramakant *et al.* (2001) studied combination effects of different spacings (90 × 90 cm (Indian), 90 + 180 × 60 cm (Indo Japanese), (90 + 90 + 90 + 270) × 60 cm (Brazilian), 60 × 60 cm (control), fertilizer (300:120:120 kg NPK per hector per year (control), 350:140:140 kg NPK per hector per year with urea as a source of nitrogen), 350:140:140 kg NPK per hector per year (with ammonium sulphate as a source of nitrogen). It was observed that the Indo Japanese system of planting with 350 kg N per hector per year (with ammonium sulphate as a source of nitrogen): 140 kg P per hector per year (SSP): 140 kg K per hector per year (MOP) produced significantly higher leaf yield of 56.9 t per hector per year in S-36 as compared to 48.5 t in control (300:120:200 kg NPK kg-1 per year).

Bongale *et al.* (2000) studied the influence of different mulberry varieties (M-5, S-36, and Viswa), spacings (60 × 60 cm, 90 × 90 cm) and nitrogen levels (300, 400 kg N per hector per year). S-36 with closer spacing and 400 kg N gave significantly higher leaf yield compared to 300 kg N per hector per year.

Conflict of Interest: None of the authors have any conflicts of interest to disclose. All the authors approved the final version of the manuscript.

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