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## Effect of water-soluble fertilizers through fertigation on quality, nutrient content and nutrient uptake of Bt cotton

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### Abstract

Field experiment was conducted at research farm, Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* season of 2013-14 to study the effect of water soluble fertilizers through fertigation on quality, nutrient content and uptake of Bt cotton. The quality parameters like lint index, ginning percentage and test weight of cotton significantly improved with application of 100 per cent RDF through soluble fertilizers by fertigation over 100 per cent RDF through conventional fertilizers. Application of 100 per cent RDF through soluble fertilizers by fertigation significantly increased nitrogen, phosphorus and potassium content and their uptake in stalk of cotton over the application of RDF through conventional fertilizers.

**Keywords:** Fertigation, quality, nutrient content, nutrient uptake, Bt cotton

### Introduction

Cotton (*Gossypium* sp) is one of the most important textile fibers in the world, accounting for around 35 per cent of total world fiber use. It is a major cash crop in the world and is grown commercially in more than 52 countries. World cotton area is almost stagnant from last five decades but production has been markedly increased because of steep rise in productivity due to introduction of Bt cotton varieties. Intensive agriculture with very high nutrient turnover in the soil-plant system coupled with low and imbalanced fertilizer use resulted in deterioration of native soil fertility and poses a serious threat to long term sustainability of crop production. In India, short supply of indigenous fertilizer and their exorbitant costs mainly for P and K have further aggravated the problem. Due to continuous use of unbalanced chemical fertilizers, resulted in adverse effect on the productivity of land and high cost of the fertilizers enforced to farmers to search alternatives to fertilizer. Injection of fertilizers into irrigation water gives a better crop response than either band or broadcasting. Fertigation gives flexibility of fertilization, which enables the specific nutritional requirement of the crop to be met at different stages of its growth. Split application of fertilizers ensures required nutrients in right time and in right quantity for getting higher yield with minimum loss of nutrients. For effective fertigation, the fertilizers used should be 100 per cent water soluble so as to leave no residues in the micro irrigation system that might clog the system. Soluble fertilizer that dissolved easily in water and are immediately available for plant species. The water soluble nitrogen, phosphorus and potassium fertilizers play major role in growth and development of cotton. Keeping these facts in view a field experiment was conducted to study the effect of water soluble fertilizers through fertigation on quality, nutrient content and nutrient uptake of Bt cotton.

### Materials and Methods

Field experiment was conducted at research farm, Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* season of 2013-14. The soil of the experimental site was clay in texture with pH 7.85, EC-0.18 dSm<sup>-1</sup>, organic carbon- 5.50 g kg<sup>-1</sup>, available nitrogen-156.00 kg ha<sup>-1</sup>, phosphorus - 8.90 kg ha<sup>-1</sup>, and potassium-744.20 kg ha<sup>-1</sup>. The experiment was laid out in randomized block design with three replications and five treatments comprising T<sub>1</sub>- Recommended dose of fertilizers through soil

application, T<sub>2</sub>- Recommended dose of fertilizers through fertigation (conventional), T<sub>3</sub>-100% RDF through soluble fertilizers by fertigation, T<sub>4</sub>- 80% RDF through soluble fertilizers by fertigation and T<sub>5</sub>- 60% RDF through soluble fertilizers by fertigation. The cotton variety Rashi-2 was sown on 4<sup>th</sup> June, 2013 at 180 cm row to row and 30 cm plant to plant spacing with recommended seed rate.

All other agronomic practices were adopted as per need of crop. The quality parameters were measured as per the standard procedures. Nutrient content in stalk samples were determined as nitrogen by Microkjeldahl method (AOAC, 1975) <sup>[1]</sup>, P by Vanadomolybdo phosphoric acid yellow method and K by Flame Photometer method (Jackson, 1973) <sup>[4]</sup>.

## Results and Discussion

### Lint index

The lint index was in the range of 3.01 to 3.88 with a mean of 2.5. The highest and lowest lint index was noticed in T<sub>3</sub> (3.38) and T<sub>1</sub> (3.01) treatments. Fertigation with different fertilizer doses and their split application did not influence the lint index significantly during the study. More or less similar trend in respect of lint index was also registered by Reddy and Aruna (2010) <sup>[7]</sup>.

### Ginning percentage

The data regarding ginning percentage are presented in Table 1. The maximum ginning percentage (33.07%) was noticed in treatment T<sub>3</sub> (100% RDF through soluble fertilizer) and minimum in treatment T<sub>1</sub> (100% RDF through soil application).

However, data regarding ginning percentage did not reach to the level of significance as affected by the different treatments.

### Test weight

The test weight of seed cotton varied in the range of 7.06 to 8.15 g with a mean 7.72 g. There was numerical increase in test weight of seed cotton due to fertigation treatments receiving 100 per cent RDF through soluble fertilizer in six splits but at par with 80 per cent RDF through soluble fertilizer and 100 per cent RDF through conventional fertilizers.

The lowest test weight (7.06 g) of seed was registered in treatment receiving 100 per cent RDF through soil application. The similar results were also recorded by Hosamani *et al.* (2013) <sup>[3]</sup> and Vinodkumar *et al.* (2013) <sup>[9]</sup>.

### Nitrogen concentration.

The results on nitrogen concentration in plant as influenced by soluble fertilizers through fertigation at various growth stages are reported in Table 2. Nitrogen concentration in plant varied from 3.32 to 3.56 at flowering, 2.66 to 3.26 at boll development and 1.80 to 1.98 per cent nitrogen at harvest stage of Bt cotton. It was also noticed that all the treatment receiving water soluble fertilizers recorded significantly higher nitrogen concentration in plant at all growth stages of Bt cotton as compared to T<sub>1</sub> (100% RDF through soil application). The maximum nitrogen content was recorded with T<sub>3</sub> treatments (100% RDF through soluble fertilizer) followed by T<sub>4</sub> treatments (80% RDF through soluble fertilizer) at all growth stages of Bt cotton. In general nitrogen concentration in plant increased up to flowering stage and it declined thereafter. Similar results were also reported by Kurwade *et al.* (2012) <sup>[5]</sup>.

### Phosphorus concentration

Results indicated that phosphorus concentration in cotton plant significantly affected by different treatments. Phosphorus content in plant was decreased with advancing growth stages of crop and maximum P concentration was observed at flowering stage and it declined there on. It was also noticed that the treatment T<sub>3</sub> (100 per cent soluble fertilizers) recorded highest phosphorus content at flowering (1.05%), boll development (0.85%) and at harvest (0.71%) stage over rest of the treatments during the year of the experimentation. The phosphorus content in plant varied from 0.91 to 1.05, 0.69 to 0.85 and 0.54 to 0.71 per cent at flowering, boll development and harvest stage of Bt cotton, respectively (Table 3). Similar observation was also noticed by Veeraputhiran *et al.* (2005) <sup>[8]</sup> and Kurwade *et al.* (2012) <sup>[5]</sup>.

### Potassium concentration

The results indicated that potassium content in cotton plant ranged from 2.77 to 3.03 per cent at flowering, 2.58 to 2.79 per cent at boll development and 2.12 to 2.27 per cent at harvest of Bt cotton (Table 4). There was maximum potassium content in cotton plant with treatment T<sub>3</sub> (100 per cent RDF through soluble fertilizer) and minimum potassium content in cotton plant with treatment T<sub>1</sub> (100 per cent RDF through soil application) at all the growth stages of Bt cotton. It was also noted that highest K concentration was at flowering stage of Bt cotton and thereafter it declined. This may be due to accumulation of these nutrients in floral parts and there has been a change within the plant due to translocation of K from leaves and stems to reproductive organs. These results are in conformity with the findings of Kurwade *et al.* (2012) <sup>[5]</sup> and Hosamani *et al.* (2013) <sup>[3]</sup>.

### NPK uptake

The results pertaining to NPK uptake by cotton stalk as influenced by soluble fertilizers through fertigation are given in Table 5. The NPK uptake by cotton stalk varied from 44.46 to 71.75, 13.33 to 25.73 and 52.36 to 82.26 kg ha<sup>-1</sup>, respectively. The maximum NPK uptake was recorded with T<sub>3</sub> followed by T<sub>4</sub> treatments during the year of experimentation. The treatment T<sub>1</sub> (100% RDF through soil application) recorded lowest plant nutrient uptake as compared to rest of the treatments. The uptake of NPK was significantly higher with all treatments receiving soluble fertilizer through fertigation as compared to soil application of fertilizer. The nitrogen uptake by cotton stalk was significantly higher under fertigation as compared to soil application. These results are in accordance with the line of Bharambe *et al.* (1997) <sup>[2]</sup>, Reddy and Aruna (2010) <sup>[7]</sup> and Nalayini *et al.* (2012) <sup>[6]</sup>.

Phosphorus plays a key role in the balanced nutrition of plants. It involved in energy transfer process in both photosynthesis and respiration. The phosphorus uptake significantly higher with all fertigation treatments over soil application. The results obtained in present investigation are also supported by Bharambe *et al.* (1997) <sup>[2]</sup> and Kurwade *et al.* (2012) <sup>[5]</sup>. Potassium is the most abundant free cation in plants and is not a constituent of any organic compound rather it is a factor activating a number of important enzymes which are involved in many processes in plant such as photosynthesis, respiration, carbohydrate metabolism, translocation and protein synthesis. A continuous supply of adequate K is needed during the entire period of cotton growth and development. In present investigation, it is achieved by fertigation. The results are also supported by Bharambe *et al.* (1997) <sup>[2]</sup>, and Kurwade *et al.* (2012) <sup>[5]</sup>.

**Table 1:** Effect of soluble fertilizers through fertigation on quality parameters of Bt cotton

Treatment	Lint Index	Ginning percentage	Test weight (g)
T <sub>1</sub> - Recommended dose of fertilizers through soil application	3.01	31.90	7.06
T <sub>2</sub> - Recommended dose of fertilizers through fertigation (conventional)	3.31	32.25	7.74
T <sub>3</sub> - 100% RDF through soluble fertilizers by fertigation	3.38	33.07	8.15
T <sub>4</sub> - 80% RDF through soluble fertilizers by fertigation	3.33	32.52	8.11
T <sub>5</sub> - 60% RDF through soluble fertilizers by fertigation.	3.01	31.55	7.56
SE±	0.13	0.24	0.23
C.D.(P=0.05)	NS	NS	0.71
Grand mean	3.20	32.25	7.72

**Table 2:** Effect of soluble fertilizers through fertigation on nitrogen concentration (%) in plant at various growth stages of Bt cotton.

Treatment	Flowering	Boll development	At harvest
T <sub>1</sub> - Recommended dose of fertilizers through soil application	3.32	2.66	1.80
T <sub>2</sub> - Recommended dose of fertilizers through fertigation (conventional)	3.47	3.18	1.90
T <sub>3</sub> - 100% RDF through soluble fertilizers by fertigation	3.56	3.26	1.98
T <sub>4</sub> - 80% RDF through soluble fertilizers by fertigation	3.51	3.21	1.93
T <sub>5</sub> - 60% RDF through soluble fertilizers by fertigation	3.36	3.13	1.88
SE±	0.06	0.18	0.03
C.D.(P=0.05)	0.18	0.56	0.11
Grand mean	3.44	3.08	1.89

**Table 3:** Effect of soluble fertilizers through fertigation on Phosphorus concentration (%) in plant at various growth stages of Bt cotton

Treatment	Flowering	Boll development	At harvest
T <sub>1</sub> - Recommended dose of fertilizers through soil application	0.91	0.69	0.54
T <sub>2</sub> - Recommended dose of fertilizers through fertigation (conventional)	0.98	0.77	0.65
T <sub>3</sub> - 100% RDF through soluble fertilizers by fertigation	1.05	0.85	0.71
T <sub>4</sub> - 80% RDF through soluble fertilizers by fertigation	1.01	0.83	0.68
T <sub>5</sub> - 60% RDF through soluble fertilizers by fertigation	0.93	0.74	0.59
SE±	0.01	0.01	0.05
C.D.(P=0.05)	0.04	0.04	0.15
Grand mean	0.97	0.77	0.63

**Table 4:** Effect of water soluble fertilizers through fertigation on potassium concentration (%) in plant at various growth stages of Bt cotton.

Treatment	Flowering	Boll development	At harvest
T <sub>1</sub> - Recommended dose of fertilizers through soil application	2.77	2.58	2.12
T <sub>2</sub> - Recommended dose of fertilizers through fertigation (conventional)	2.90	2.66	2.16
T <sub>3</sub> - 100% RDF through soluble fertilizers by fertigation	3.03	2.79	2.27
T <sub>4</sub> - 80% RDF through soluble fertilizers by fertigation	2.96	2.76	2.24
T <sub>5</sub> - 60% RDF through soluble fertilizers by fertigation	2.86	2.72	2.17
SE±	0.06	0.04	0.03
C.D.(P=0.05)	0.19	0.12	0.10
Grand mean	2.90	2.70	2.19

**Table 5:** Effect of soluble fertilizers through fertigation on NPK uptake (kg ha<sup>-1</sup>) at harvest of Bt cotton.

Treatment	Nitrogen uptake	Phosphorus uptake	Potassium uptake
T <sub>1</sub> - Recommended dose of fertilizers through soil application	44.46	13.33	52.36
T <sub>2</sub> - Recommended dose of fertilizers through fertigation (conventional)	55.93	19.13	63.59
T <sub>3</sub> - 100% RDF through soluble fertilizers by fertigation	71.75	25.73	82.26
T <sub>4</sub> - 80% RDF through soluble fertilizers by fertigation	63.03	22.20	73.15
T <sub>5</sub> - 60% RDF through soluble fertilizers by fertigation	51.28	16.09	59.19
SE±	1.94	1.57	1.62
C.D.(P=0.05)	5.93	4.78	4.97
Grand mean	57.29	19.29	66.11

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