



## QUALITY, UPTAKE OF NUTRIENTS AND ECONOMICS OF IRRIGATED BT COTTON (*GOSSYPIMUM HIRSUTUM* L.) AS INFLUENCED BY MACRO NUTRIENTS AND LIQUID FERTILIZERS

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### Abstract

A field experiment was conducted during *kharif*, 2011 at Agricultural College Farm, Raichur to study the effect of macro nutrients and liquid fertilizers on growth and yield of irrigated Bt cotton (*Gossypium hirsutum* L.). The results revealed that application of 125 per cent RDF recorded the highest lint index (5.60) ginning percentage (36.17), harvest index (0.34), uptake of nitrogen (107.81 kg ha<sup>-1</sup>), phosphorus (109.25 kg ha<sup>-1</sup>), potassium (30.08 kg ha<sup>-1</sup>), gross returns (Rs. 79,718 ha<sup>-1</sup>) and net returns (Rs.56,740 ha<sup>-1</sup>) over 100 per cent RDF (5.51,35.62,0.28, 9.88, 103.00 kg ha<sup>-1</sup> 26.80 kg ha<sup>-1</sup>,104.53 kg ha<sup>-1</sup> and Rs. 70,505 ha<sup>-1</sup> and Rs.48,723 ha<sup>-1</sup>, respectively). Among foliar spray of liquid fertilizers foliar spray of Bio 20 @ 3 ml/l recorded the highest lint index (6.00),ginning percentage (37.00), harvest index (0.33), seed index (10.13), uptake of nitrogen (110.80 kg ha<sup>-1</sup>), phosphorus (112.25 kg ha<sup>-1</sup>), potassium (30.16 kg ha<sup>-1</sup>), gross returns (Rs. 75,022 ha<sup>-1</sup>) and net returns (Rs.51,964 ha<sup>-1</sup>).

**Key words:** RDF, liquid fertilizers, Bio 20.

### Introduction

India is historically considered as the native home of cotton and center of finest textile industry in the world. About 60 million people in India are involved in cotton cultivation, textile industry and trade. Cotton ‘the king of apparel fibres’ is an important cash crop and it supplies a major share of raw material for the textile industry. India is the third largest producer of cotton in the world with 8.96 m ha area, 242.5 lakhs bales of production with 467 kg/ha productivity. India ranks first in area and productivity is far below the world average of over 600kg/ha (Anonymous, 2010). In Karnataka, cotton occupies an area of 5.40 lakh ha with a production of 14.0 lakh bales and with productivity of 434 kg lint per ha (CAB, 2011). The Northern dry zone of the state (Zone 2 and 3) cover partly the Tungabhadra and Upper Krishna Command areas (TBP & UKP). The area under Bt cotton in these command areas is increasing over the years. However, actual yield levels are low due to poor agronomic practices especially fertilization. Fertilization is adopted to exploit the maximum yield potential of the yield potent of Bt cotton which could be exploited by applying optimum dose of fertilizers at proper time. The nutrient management in cotton is a complex phenomenon due to its simultaneous production of vegetative and reproductive structures during the active growth phase. Cotton requires sufficient quantity of macro and micro nutrients to achieve the maximum seed cotton yield. Micronutrients deficiency in cotton increases abscission of boll and finally affects the yield of cotton and are directly related to physiological process in plant and helps in increasing the production by improving the reproduction phase (Dubey *et al.*, 2000). In this direction, a detailed research on combined effect of macro nutrients and foliar spray of liquid fertilizers was conducted to study its effect on growth, yield, Quality economics and uptake of nutrients of irrigated Bt cotton (*Gossypium hirsutum* L.) under irrigation.

### Material and Methods

The field experiment was conducted during *kharif*, 2011 at Agricultural College Farm, Raichur situated in North Eastern Dry Zone (Zone-2) of Karnataka at 16° 12' N latitude and 77° 20' E longitude with an altitude of 389 meters above the mean sea level. The experiment was laid out in split plot design with RDF (75, 100 and 125 %) in main plots and liquid fertilizers {control, foliar application of nutroplus @ 2 ml/lit, foliar application of Bio 20 @ 3 ml/lit, foliar application of 1% MgSO<sub>4</sub> + 0.5% ZnSO<sub>4</sub> and Foliar application of 2% KNO<sub>3</sub>} as sub plot treatments with three replications. In main plot treatments *i.e.*, half of the nitrogen dose, entire dose of phosphorus and potassium in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP) was applied as basal dose and remaining half of the nitrogen in the form of urea was top dressed in three equal splits at 50, 80 and 110 days after sowing in the ring formed 5 cm away from the plant. The sub plot treatments *i.e.*, foliar spray of liquid fertilizers was imposed at flowering (90 DAS), boll formation stage (110 DAS) and boll bursting (125 DAS) of the cotton crop. The experimental field was clayey (56.05 % clay) in texture with the available nitrogen (218.00 kg ha<sup>-1</sup>), phosphorus (32.00kg ha<sup>-1</sup>), potassium (180.67 kg ha<sup>-1</sup>) and organic carbon content (0.60 %). Sowing was done by hand dibbling as per the treatments on 08-07-2011.

## Results and Discussion

### Effect of fertilizer levels:

Application of 125 per cent RDF produced significantly higher lint index (5.60) over 75 per cent RDF (5.34). Application of 100 per cent RDF (5.51) and 125 per cent RDF (5.51) recorded on par. Application of 125 per cent RDF recorded significantly higher ginning percentage (36.17) compared to 75 per cent RDF (34.87) which intum was on par with 100 per cent RDF (35.62). Macro-nutrition with 125 per cent RDF recorded significantly higher harvest index (0.34) when compared to 100 per cent RDF (0.28) and 75 per cent RDF (0.25). Conspicuous difference in the uptake of nitrogen was noticed due to application of RDF. Significantly higher nitrogen uptake (107.81 kg/ha) was recorded with 125 per cent RDF when compared to 100 per cent RDF (103.00 kg/ha) and 75 per cent RDF (98.38 kg/ha). Significantly higher phosphorus uptake (30.08 kg/ha) was recorded with the application of 125 per cent RDF when compared to 100 per cent RDF (26.80 kg/ha) and 75 per cent RDF (23.39 kg/ha). Higher potassium uptake (109.25 kg/ha) was recorded with the application of 125 per cent RDF when compared to 100 per cent RDF (104.53 kg/ha) and 75 per cent RDF (100.67 kg/ha). Higher cost (Rs. 22,720 ha<sup>-1</sup>) was incurred due to application of 125 per cent RDF when compared to 100 per cent RDF (Rs. 21,851 ha<sup>-1</sup>) and 75 per cent RDF (Rs. 20,658 ha<sup>-1</sup>).

Significantly higher gross return was obtained due to the application of 125 per cent RDF (Rs. 79,718 ha<sup>-1</sup>) compared to 100 per cent RDF (Rs. 70,505 ha<sup>-1</sup>) and 75 per cent RDF (Rs. 57,231 ha<sup>-1</sup>). Net returns recorded due to the application of 125 per cent RDF were maximum (Rs.56,740 ha<sup>-1</sup>) and significantly higher when compared to 100 per cent RDF (Rs. 48,723 ha<sup>-1</sup>) and 75 per cent RDF (Rs. 36,572 ha<sup>-1</sup>). B C ratio of (3.51) was recorded due to the application of 125 per cent RDF when compared to 100 per cent RDF (3.24) and 75 per cent RDF (2.77). The increase in the quality, uptake of nutrients and economics higher with 125 per cent RDF might be due to significantly higher number of good opened bolls per plant, total number of bolls harvested per plant, mean boll weight, amount of dry matter accumulation in reproductive parts and leaf area upto the harvest. These results are in compliance with the findings of Anil Kumar (2004), Bastia (2000), Dev Raj *et al.* (2011), Krishnamurthy *et al.* (1973), Krishnegowda (2004), Manjappa (1997) and Satyanarayana Rao and Setty (2002) who reported significantly higher cotton yield due to application of higher level of RDF.

### Effect of liquid fertilizers spray:

Bio 20 @ 3 ml/lit produced significantly higher lint index (6.00) and lower lint index (5.24) in absence of foliar spray. Foliar spray of nutroplus 2 ml/lit (5.31), 2 per cent KNO<sub>3</sub> (5.42) and 1 per cent MgSO<sub>4</sub> + 0.5 per cent ZnSO<sub>4</sub> (5.48) recorded on par results. Ginning percentage was influenced significantly due to application of liquid fertilizers. Foliar spray of Bio 20 @ 3 ml/lit recorded significantly higher ginning percentage (37.00) as compared to other treatments. Significantly higher nitrogen uptake (110.80 kg/ha) was recorded with Bio 20 @ 3 ml/lit over control (93.36 kg/ha) which intum was on par with 2 per cent KNO<sub>3</sub> (106.14 kg/ha). Higher phosphorus uptake (30.16 kg/ha) was recorded with the foliar spray of Bio 20 @ 3 ml/lit over control (22.67 kg/ha). Foliar spray of nutroplus 2 ml/lit of H<sub>2</sub>O, 1 per cent MgSO<sub>4</sub> + 0.5 per cent ZnSO<sub>4</sub> and 2 per cent KNO<sub>3</sub> recorded on par results (26.64, 26.87 and 27.45 kg/ha, respectively). Significantly higher potassium uptake (112.25 kg/ha) was recorded with the foliar spray of Bio 20 @ 3 ml/lit and lower uptake (91.42 kg/ha) without foliar spray of liquid fertilizers. The treatments 1 per cent MgSO<sub>4</sub> + 0.5 per cent ZnSO<sub>4</sub> and 2 per cent KNO<sub>3</sub> recorded on par results (107.50 and 108.63 kg/ha, respectively). Higher cost of cultivation was incurred due to foliar spray of liquid fertilizer nutroplus 2 ml/lit (Rs. 23,117 ha<sup>-1</sup>) while lower cost of cultivation was recorded in control (Rs. 19,357 ha<sup>-1</sup>). Significantly higher gross returns (Rs. 75,022 ha<sup>-1</sup>) were obtained with the application of 3 ml/lit Bio 20 when compared to other foliar sprays. While lower gross return (Rs. 63,762 ha<sup>-1</sup>) was recorded in control. Foliar spray with Bio 20 @ 3 ml/lit recorded higher net returns (Rs. 51,964 ha<sup>-1</sup>) as compared to 2 per cent KNO<sub>3</sub> (Rs. 48,578 ha<sup>-1</sup>), 1 per cent MgSO<sub>4</sub> + 0.5 per cent ZnSO<sub>4</sub> (47,924 ha<sup>-1</sup>) and 2 ml/lit nutroplus (Rs. 44,186 ha<sup>-1</sup>). The factors which have a direct influence on quality of cotton, nutrient uptake and economics are yield components *viz.*, total number of bolls harvested per plant, number of good opened bolls per plant, mean boll weight, lint index, harvest index and ginning percentage. In the present investigation, all these yield attributing characters increased significantly due to foliar spray of Bio 20, which is a liquid fertilizer containing macro nutrients along with micronutrients, which are directly related to physiological process in plant and helps in increasing the production by improving the reproduction phase and might have contributed for increased yield, which were noticed with the foliar spray of Bio 20.

## References:

- Anil Kumar, 2004, Nutrient management studies in Bt and non Bt cotton (*Gossypium hirsutum* L.) hybrids in TBP command area. *M.Sc.(Agri.) Thesis*, Univ. Agric. Sci., Dharwad .
- Anonymous, 2010, Annual report. All India Coordinated Cotton Improvement Project. .
- Bastia, D.K., 2000, Integrated nutrient management in rainfed hybrid cotton. *Madras Agric. J.*, **87**(7-9): 442-443.
- Cotton Advisory Board (CAB), 2011
- Dev Raj, M. S, Bhattoo, B. S., Duhan, B. S., Promila Kumari and Jain, P. P., 2011, Effect of crop geometry and fertilizer levels on seed cotton yield and nutrient uptake of *Bt- Cotton* under irrigated condition. *J. Cotton Res. Dev.*, **25**(2): 176-180.
- Dubey, B.K., Gupta, Jyoti, Chaterji. C. and Gupta, J. 2000. Micronutrients in cotton (*Gossypium hirsutum*). *Indian J.agric.Sci.*,**70**: 253-254.

Krishnamurthy, K., Bommegouda, A., Rajashekara, B.G., Jaganath, M.K., Raghunath, G., Venugopal, N. and Jayaram, G., 1973, Investigation of structure of cereals (Maize and Sorghum). *Final Technical Report of PL- 480 Projects*, p. 374.

Krishnegowda, 2004, Response of Bt cotton hybrids (*Gossypium hirsutum* L.) to fertilizer levels under irrigated condition in Tungabhadra Project (TBP) area. *M.Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad.

Manjappa, K., Guggari, A.K., Palled, Y.B. and Kubsad, V.S., 1997, Effect of spacing and fertilizers on yield of cotton (*Gossypium hirsutum* L.) under irrigated condition. *Indian J. Agron.*, **42**(1): 184-187.

Satyanarayana Rao and Setty, R.A., 2002, Response of hybrid cotton to levels and times of nitrogen and potash application under irrigated condition. *J. Cotton Res. Dev.*, **16**(2): 188-189.

## Annexure

**Table 1. Lint index, ginning percentage harvest index and economics of Bt cotton as influenced by macro-nutrients and liquid fertilizers.**

| Treatments                                 | Lint index  | Ginning percentage | Harvest index | Cost of cultivation (Rs./ha) | Gross returns (Rs./ha) | Net returns (Rs./ha) |
|--|-------------|--------------------|---------------|------------------------------|------------------------|----------------------|
| <b>Main plots</b>                          |             |                    |               |                              |                        |                      |
| F <sub>1</sub>                             | 5.34        | 34.87              | 0.25          | 20,658                       | 57,231                 | 36,572               |
| F <sub>2</sub>                             | 5.51        | 35.62              | 0.28          | 21,851                       | 70,505                 | 48,723               |
| F <sub>3</sub>                             | 5.60        | 36.17              | 0.34          | 22,720                       | 79,718                 | 56,740               |
| <b>Mean</b>                                | <b>5.48</b> | <b>35.55</b>       | <b>0.29</b>   | <b>21,743</b>                | <b>69,151</b>          | <b>47,345</b>        |
| S.E.m±                                     | 0.05        | 0.21               | 0.006         |                              | 212.98                 | 266.42               |
| C.D. at 5%                                 | 0.15        | 0.60               | 0.02          |                              | 601.50                 | 752.43               |
| <b>Sub plots</b>                           |             |                    |               |                              |                        |                      |
| S <sub>1</sub>                             | 5.24        | 34.31              | 0.25          | 19,357                       | 63,762                 | 44,072               |
| S <sub>2</sub>                             | 5.31        | 35.35              | 0.29          | 23,117                       | 67,304                 | 44,186               |
| S <sub>3</sub>                             | 6.00        | 37.00              | 0.33          | 23,057                       | 75,022                 | 51,964               |
| S <sub>4</sub>                             | 5.48        | 35.67              | 0.29          | 20,683                       | 68,608                 | 47,924               |
| S <sub>5</sub>                             | 5.42        | 35.48              | 0.30          | 22,485                       | 71,064                 | 48,578               |
| <b>Mean</b>                                | <b>5.48</b> | <b>35.55</b>       | <b>0.29</b>   | <b>21,743</b>                | <b>69,151</b>          | <b>47,345</b>        |
| S.E.m±                                     | 0.07        | 0.27               | 0.01          | --                           | 274.96                 | 343.95               |
| C.D. at 5%                                 | 0.20        | 0.77               | NS            | --                           | 776.53                 | 971.38               |
| <b>S at the same F level</b>               |             |                    |               |                              |                        |                      |
| S.E.m±                                     | 0.17        | 0.67               | 0.02          | --                           | 673.50                 | 842.50               |
| C.D. at 5%                                 | NS          | NS                 | NS            | --                           | NS                     | NS                   |
| <b>F at the same or different S levels</b> |             |                    |               |                              |                        |                      |
| S.E.m±                                     | 0.07        | 0.28               | 0.02          | --                           | 399.86                 | 635.03               |
| C.D. at 5%                                 | NS          | NS                 | NS            | --                           | NS                     | NS                   |

### Main plot treatments

F<sub>1</sub> : 75% RDF  
F<sub>2</sub> : 100% RDF  
F<sub>3</sub> : 125% RDF

### Sub plot treatments

S<sub>1</sub> : Control  
S<sub>2</sub> : Foliar application of nutroplus @ 2 ml/lit  
S<sub>3</sub> : Foliar application of Bio 20 @ 3 ml/lit  
S<sub>4</sub> : Foliar application of 1% MgSO<sub>4</sub> + 0.5% ZnSO<sub>4</sub>  
S<sub>5</sub> : Foliar application of 2% KNO<sub>3</sub>

**Table 2. Uptake of nitrogen, phosphorus and potassium (kg ha<sup>-1</sup>) by Bt cotton as influenced by macro-nutrients and liquid fertilizers**

| Treatments                                 | Nutrient uptake                    |                                      |                                     |
|--|------------------------------------|--------------------------------------|-------------------------------------|
|  | Nitrogen<br>(kg ha <sup>-1</sup> ) | Phosphorus<br>(kg ha <sup>-1</sup> ) | Potassium<br>(kg ha <sup>-1</sup> ) |
| <b>Main plots</b>                          |                                    |                                      |                                     |
| F <sub>1</sub>                             | 98.38                              | 23.39                                | 100.67                              |
| F <sub>2</sub>                             | 103.00                             | 26.80                                | 104.53                              |
| F <sub>3</sub>                             | 107.81                             | 30.08                                | 109.25                              |
| <b>Mean</b>                                | <b>103.06</b>                      | <b>26.75</b>                         | <b>104.81</b>                       |
| S.E.m±                                     | 1.45                               | 0.67                                 | 0.90                                |
| C.D. at 5%                                 | 4.09                               | 1.90                                 | 2.53                                |
| <b>Sub plots</b>                           |                                    |                                      |                                     |
| S <sub>1</sub>                             | 93.36                              | 22.67                                | 91.42                               |
| S <sub>2</sub>                             | 102.00                             | 26.64                                | 104.30                              |
| S <sub>3</sub>                             | 110.80                             | 30.16                                | 112.25                              |
| S <sub>4</sub>                             | 103.00                             | 26.87                                | 107.50                              |
| S <sub>5</sub>                             | 106.14                             | 27.45                                | 108.63                              |
| <b>Mean</b>                                | <b>103.06</b>                      | <b>26.75</b>                         | <b>104.81</b>                       |
| S.E.m±                                     | 1.87                               | 0.87                                 | 1.16                                |
| C.D. at 5%                                 | 5.28                               | 2.46                                 | 3.27                                |
| <b>S at the same F level</b>               |                                    |                                      |                                     |
| S.E.m±                                     | 4.58                               | 2.13                                 | 2.84                                |
| C.D. at 5%                                 | NS                                 | NS                                   | NS                                  |
| <b>F at the same or different S levels</b> |                                    |                                      |                                     |
| S.E.m±                                     | 2.71                               | 1.53                                 | 2.33                                |
| C.D. at 5%                                 | NS                                 | NS                                   | NS                                  |

DAS – Days after sowing    NS – Non significant

**Main plot treatments**    **Sub plot treatments**F<sub>1</sub> : 75% RDFS<sub>1</sub> : ControlF<sub>2</sub> : 100% RDFS<sub>2</sub> : Foliar application of nutroplus @ 2 ml/litF<sub>3</sub> : 125% RDFS<sub>3</sub> : Foliar application of Bio 20 @ 3 ml/litS<sub>4</sub> : Foliar application of 1% MgSO<sub>4</sub> + 0.5% ZnSO<sub>4</sub>S<sub>5</sub> : Foliar application of 2% KNO<sub>3</sub>