Effect of Multinutrient (N, P, K and Zn) Briquettes on Growth and Yield of Bt Cotton

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Abstract

An experiment was conducted at experimental farm of Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during kharif season, 2015-16. The effect of multinutrient briquettes was studied on growth, yield and yield attributing character of Bt cotton. The experiment was laid out in a Randomized Block Design with five treatments and four replications. The results of the investigation revealed that height of Bt cotton plant at square formation, flowering, boll bursting and harvest was continuously increasing in all the treatments. Maximum increase in height was observed with the treatment receiving RDF through a fertigation in six splits followed by multi nutrient NPK+ Zn briquette application. The maximum number of leaves was observed with treatment RDF through a fertigation at square formation, flowering, boll bursting and at last picking and next best treatment was application of NPK+ Zn through briquette. The highest dry matter was recorded with RDF through a fertigation and NPK + Zn briquette application at last picking and there was almost two fold increase in dry matter from boll formation to last picking whereas the maximum number of bolls was recorded in treatment RDF applied in six splits through soluble fertilizers by fertigation. The application of 80:40:40 kg NPK kg ha⁻¹ through soluble fertilizers by fertigation in six splits have produced more seed cotton yield which was at par with application of 120:60:60 N, P₂O₅ and K₂O through briquettes. Besides, the addition of 20 kg ZnSO₄ in NPK briquette proved its superiority over all treatment except fertigation.

Keywords
Multinutrient (N, P, K and Zn) briquettes, Bt cotton, Yield.

Introduction

Generally, farmers of the country nearly 15 million spread across 10 states are engaged in cotton production. It is grown on an area of 11.76 million hectares. This area of 11.76 million hectares constitutes around 38% of the world area under cotton cultivation. Several reports studies indicated that positive correlation between vegetative growth and the number of fruiting points produced by cotton is well known. N supplement therefore by split application becomes important as it is supplied ideally in a time when crop critically requires. Bt-cotton differs in its requirement either by total or part of it in the different stages of crop. Thus, nitrogen use efficiency can be increased and better used to attain the
objective of higher production (Hallikari et al., 2010). Phosphorus is another important nutrient in cotton production. It is essential for vigorous root and shoot growth, promotes early boll development, hastens maturity, helps to overcome the effects of compaction, increases water use efficiency, and is necessary for energy storage and transfer in plants. The function of potassium in plant metabolism is different from that of other major nutrients. The later become part of the plant structure, whereas potassium largely remains as an ion in the cells and sap and helps to control the water intake and metabolism of the plant.

Patil et al., (2001) reported that the soil potassium reserves are depleted and crop yields found to be reduced. It is reported that high clay Vertisol once upon a time suppose to be having very high potassium content now responding for K application, which shows that the K content has been depleted. On the other hand, zinc is one of the plant micronutrients, involved in many enzymatic activities of plants. It functions generally as a metal activator of enzymes. Patil (2013) reported that zinc improves crop productivity almost as much as major nutrients do. It ranks the third most important limiting nutrient element, next to nitrogen and phosphorus in crop production. Besides increasing crop yield it increases the crude protein content, amino acids, energy value and total lipid in chickpea, soybean, black gram etc. with zinc application.

**Materials and Methods**

A field experiment was conducted at the Research Farm of Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during 2015-16. The location of experiment lies between 76°46', east longitude and 19°16' North latitude, having elevation of 423.46 m above the mean sea level. The mean temperature ranges from 20.9 (minimum) to 34.2°C (maximum) and relative humidity was 79.0 per cent throughout the wet seasons. The experimental soil belongs to taxonomic class Parbhani series of mixed montmorillonite hyperthermic Typic haplusterts. The soils were analyzed by following standard analytical procedure as outlined by Jackson (1973). The soil pH was 7.73; EC 046 dSm⁻¹, available nitrogen 140 kg ha⁻¹, available phosphorus 8.5 kg ha⁻¹ and available potassium 699.26 kg ha⁻¹ and available zinc 0.53 mg kg⁻¹. Bt cotton were grown on field at a spacing of 180 x 30cm² with the gross plot size 7.2x5.4cm². The experiment was laid out in randomized block design comprising of five treatments with four replications.

**Treatment details**

T₁: Absolute Control (No fertilizer application)

T₂: Soil application of 120:60:60 by N, P₂O₅, K₂O kg ha⁻¹ and Drip irrigation

T₃: RDF through fertigation (soluble fertilizer: 80:40:40 NPK kg ha⁻¹)

T₄: 120: 60 kg NPK ha⁻¹ through briquettes with drip irrigation

T₅: Application of NPK + micronutrient briquettes (120:60: 60 NPK kg ha⁻¹ +20kg ha⁻¹ ZnSO₄) these are applied in three split dose, 24 N, 36 P₂O₅, 36 K₂O and 10 Zn kg ha⁻¹ at basal dose, 48 N, 24 P₂O₅, 24 K₂O and 10 Zn kg ha⁻¹ at square formation and 48 N at flower formation stage.

**Results and Discussion**

**Growth and yield attributes**

The plant height of Bt Cotton increased gradually within the treatments of various
stages of crop i.e. 21.80 to 35.50 cm at 30 DAS, 58.10 to 70.0 cm at 60 DAS, 65.28 to 85.51 cm at 90 DAS and 84.05 to 101.50 cm at last picking stage. Application of soluble fertilizers through fertigation (T3) found better amongst all treatments in improving the height of cotton. Fertigation treatments recorded significantly higher plant height at all growing stages of cotton as compared to briquettes application. The next best treatment was application of fertilizer through NPKZn briquette. Similar findings were also reported by Wadtkar et al., (2001), Raskar et al., (2001), Patke et al., (2003), Veerpurthiran et al., (2005), Reddy and Aruna (2010), Mussaddak et al., (2011) and Tekale (2000) (Table 1).

The number of leaves plant\(^{-1}\) was recorded from square formation (30 DAS) stage to last picking i.e. harvest of cotton crop. In grand mean number of leaves were varied from 31.18 to 123.48 leaves per plant, this clearly indicates that number of leaves goes on increasing as crop proceeds towards maturity (Table 2). At square formation (30 DAS) stage the number of leaves plant\(^{-1}\) in treatment T1 was 29.05 which were increased to 34.86, flowering (60 DAS) stage and boll formation stage (90 DAS) number of leaves were increased from 52.55 to 75.50 and 79.35 to 97.10 and respectively due to application of recommended dose of soluble fertilizer through fertigation over soil application. Last picking stages it was observed that number of leaves increased from 84.25 to 143.65 and 130.50 due to fertigation and NPK+Zn briquette application. The maximum number of leaves was recorded with T3 (RDF fertilizer through fertigation) followed by multinutrient briquette over conventional fertilizer application and control at all growth stages. These results resembled with the results that were reported by Mussaddak et al., (2001), Patke et al., (2003).

In depth scrutiny of data revealed that the dry matter (stalk) yield of Bt cotton at boll formation and at harvest varied from 84.45 to 120.09 and 297.40 to 409.48 g plant\(^{-1}\), respectively due to application of soluble fertilizers through drip irrigation i.e. fertigation, which showed distinct superiority, followed by the briquette application proved superiority over conventional fertilizer application (T2) and control (T1). These findings are in accordance with Mussaddak (2001), Patke et al., (2003), Veerpurthiran et al., (2005) (Table 3).

### T3: RDF through fertigation (soluble fertilizer: 80:40:40 NPK kg ha\(^{-1}\))

| Application  | N (Kg ha\(^{-1}\)) | P (Kg ha\(^{-1}\)) | K (Kg ha\(^{-1}\)) |
|--------------|-------------------|-------------------|-------------------|
| Sowing       | 12                | 8                 | 8                 |
| 20 DAS       | 16                | 8                 | 8                 |
| 40 DAS       | 16                | 8                 | 8                 |
| 60 DAS       | 12                | 8                 | 8                 |
| 80 DAS       | 12                | 8                 | 8                 |
| 100 DAS      | 12                | -                 | -                 |
|              | 80                | 40                | 40                |

### T4: 120: 60: 60 kg NPK ha\(^{-1}\) through briquettes with drip irrigation

| Application          | N(Kg ha\(^{-1}\)) | P(Kg ha\(^{-1}\)) | K(Kg ha\(^{-1}\)) |
|----------------------|-------------------|-------------------|-------------------|
| Basal application    | 24                | 36                | 36                |
| Square formation     | 48                | 24                | 24                |
| Boll formation       | 48                | 00                | 00                |
**Table 1.** Effects of treatments on plant height (cm) at various growth stages of Bt-cotton

| Treatments | Treatment details | 30 DAS  | 60 DAS  | Boll formation | Last picking |
|------------|-------------------|---------|---------|----------------|--------------|
| T<sub>1</sub> | Absolute Control (Drip irrigation) | 21.80  | 58.10  | 65.28 | 84.05 |
| T<sub>2</sub> | RDF (Soil) | 31.68  | 59.55  | 70.47 | 86.65 |
| T<sub>3</sub> | Soluble (fertigation) Fertilizers | 35.50  | 70.00  | 85.51 | 101.50 |
| T<sub>4</sub> | NPK Briquettes with Drip | 33.15  | 69.55  | 76.86 | 95.15 |
| T<sub>5</sub> | NPK + Zn Briquettes with Drip | 35.45  | 70.80  | 83.33 | 99.25 |
| Grand mean | | 31.51  | 65.60  | 76.29 | 93.32 |
| S.Em (±) | | 0.334  | 0.278  | 0.223 | 0.563 |
| CD at 5% | | 1.042  | 0.865  | 0.696 | 1.754 |

**Table 2.** Effects of treatments on number of leaves at various growth stages of Bt-cotton

| Treatments | Treatment details | 30 DAS  | 60 DAS  | Boll formation | Last picking |
|------------|-------------------|---------|---------|----------------|--------------|
| T<sub>1</sub> | Absolute Control | 29.05  | 52.55  | 79.35 | 84.25 |
| T<sub>2</sub> | RDF | 29.10  | 62.09  | 84.25 | 122.16 |
| T<sub>3</sub> | Soluble Fertilizers | 34.86  | 75.50  | 97.10 | 143.65 |
| T<sub>4</sub> | NPK Briquettes | 31.38  | 67.63  | 88.60 | 126.78 |
| T<sub>5</sub> | NPK + Zn Briquettes | 31.55  | 62.24  | 93.65 | 130.60 |
| Grand mean | | 31.15  | 64.00  | 88.59 | 121.48 |
| SEm (±) | | 0.340  | 0.538  | 0.463 | 0.724 |
| CD at 5% | | 1.060  | 1.678  | 1.444 | 2.255 |
Table 3: Effects of treatments on dry matter (gm plant\(^{-1}\)) at various growth stages of Bt-cotton

| Treatments | Treatment details           | Dry matter (gm plant\(^{-1}\)) |
|------------|----------------------------|---------------------------------|
|            |                           | 60 DAS | Boll formation | Last picking |
| T\(_1\)    | Absolute Control          | 35.35  | 84.45          | 297.40       |
| T\(_2\)    | RDF                       | 35.99  | 105.34         | 347.94       |
| T\(_3\)    | Soluble Fertilizers       | 38.43  | 120.09         | 409.48       |
| T\(_4\)    | NPK Briquettes            | 36.22  | 113.13         | 356.26       |
| T\(_5\)    | NPK + Zn Briquettes       | 37.41  | 119.61         | 359.41       |
| Grand mean |                           | 36.68  | 108.52         | 354.13       |
| SEm (±)     |                           | 0.280  | 0.506          | 1.777        |
| CD at 5%    |                           | 0.871  | 1.576          | 5.537        |

Table 4: Effects of treatments on total no of boll/plant (No.) and boll weight (gm) at various growth stages of Bt-cotton

| Treatments | Treatment details           | Total no of boll/plant (No.) | Boll weight(gm) |
|------------|----------------------------|------------------------------|-----------------|
| T\(_1\)    | Absolute Control           | 44.88                        | 4.37            |
| T\(_2\)    | RDF                       | 47.87                        | 5.19            |
| T\(_3\)    | Soluble Fertilizers       | 51.83                        | 5.75            |
| T\(_4\)    | NPK Briquettes            | 51.63                        | 5.25            |
| T\(_5\)    | NPK + Zn Briquettes       | 51.77                        | 5.55            |
| Grand mean |                           | 49.59                        | 5.22            |
| SEm (±)     |                           | 0.432                        | 0.15            |
| CD at 5%    |                           | 1.345                        | 0.469           |
Yield attributes revealed that number of bolls per plant increased from 44.88 to 51.83, respectively. The maximum number of bolls per plant and boll weight was observed with treatment T₃ (RDF through fertigation with water soluble fertilizer). However the number of bolls produced under treatment NPK briquette and NPK +Zn briquette were almost same. Treatment T₃, T₄ and T₅ showed significant increase in number of bolls per plant over control and RDF (conventional fertilizer). These findings are achieved by application of nutrients by fertigation in conformation with earlier reported by Veerapurthiran and Chinnusamy (2005), Bharambe et al., (1997) (Table 4).

From the result and discussion of this study, it can be concluded that the growth and yield of Bt cotton showed significantly superior with the application of RDF through a fertigation (soluble fertilizer) @ 80:40:40 NPK kg ha⁻¹ followed by multinutrient NPK + Zn briquettes application @ 120:60:60 NPK +20 ZnSO₄ Kg ha⁻¹.

Table 5 Effects of treatments on seed cotton yield (q ha⁻¹) and Stalk yield (q ha⁻¹) at various growth stages of Bt-cotton

| Treatments | Treatment details | Seed cotton Yield q/ha | Stalk Yield q/ha |
|------------|-------------------|------------------------|-----------------|
| T₁         | Absolute Control  | 10.74                  | 54.35           |
| T₂         | RDF               | 12.15                  | 63.50           |
| T₃         | Soluble Fertilizers | 15.59              | 74.84           |
| T₄         | NPK Briquettes    | 11.670                 | 65.14           |
| T₅         | NPK + Zn Briquettes | 14.11              | 65.64           |
| Grand mean |                   | 12.85                  | 64.69           |

SEm (±) 0.173 0.51  
CD at 5% 0.539 1.54
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How to cite this article:

Sunil, B.H., V.D. Patil, M. Pushpalatha and Basavaprasad, V.M. 2017. Effect of Multinutrient (N, P, K and Zn) Briquettes on Growth and Yield of Bt Cotton. *Int.J.Curr.Microbiol.App.Sci.* 6(11): 717-723. doi: https://doi.org/10.20546/ijcemas.2017.611.084