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

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A B S T R A C T

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, P_2O_5 and K_2O through briquettes. Besides, the addition of 20 kg $ZnSO_4$ in NPK briquette proved its superiority over all treatment except fertigation.

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 $76^{0}46^{'}$, east longitude and $19^{0}16^{'}$ North latitude, having elevation of 423.46 m above the mean sea level. The mean temperature ranges from 20.9 (minimum) to 34.2ºC (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 $30cm^2$ with the gross plot size $7.2x5.4cm^2$. The experiment was laid out in randomized block design comprising of five treatments with four replications.

Treatment details

T_1: Absolute Control (No fertilizer application)

T_2: Soil application of 120:60:60 by N, P_2O_5, K_2O kg ha^{-1} and Drip irrigation

T_3: RDF through fertigation (soluble fertilizer: 80:40:40 NPK kg ha^{-1})

T_4: 120: 60: 60 kg NPK ha^{-1} through briquettes with drip irrigation

T_5: Application of NPK + micronutrient briquettes (120:60: 60 NPK kg ha^{-1} +20kg ha^{-1} $ZnSO_4$) these are applied in three split dose, 24 N, 36 P_2O_5, 36 K_2O and 10 Zn kg ha^{-1} at basal dose, 48 N, 24 P_2O_5, 24 K_2O 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 85.51cm at 90 DAS and 84.05 to 101.50 cm at last picking stage. Application of soluble fertilizers through fertigation (T_3) 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), Veerputhirum *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 T_1 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 T_3 (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 (T_2) and control (T_1). These findings are in accordance with Mussaddak (2001), Patke *et al.,* (2003), Veerpurthiran *et al.,* (2005) (Table 3).

T_3: RDF through fertigation (soluble fertilizer: 80:40:40 NPK kg ha^{-1})

Application	N (Kgha^{-1})	P (Kgha^{-1})	K (Kgha^{-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

T_4: 120: 60: 60 kg NPK ha^{-1} through briquettes with drip irrigation

Application	**N**(Kgha^{-1})	**P**(Kgha^{-1})	**K**(Kgha^{-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	Plant height (cm)			
		30 DAS	60 DAS	Boll formation	Last picking
T_1	Absolute Control(Drip irrigation)	21.80	58.10	65.28	84.05
T_2	RDF(Soil)	31.68	59.55	70.47	86.65
T_3	Soluble(fertigation) Fertilizers	35.50	70.0	85.51	101.50
T_4	NPK Briquetes with Drip	33.15	69.55	76.86	95.15
T_5	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**

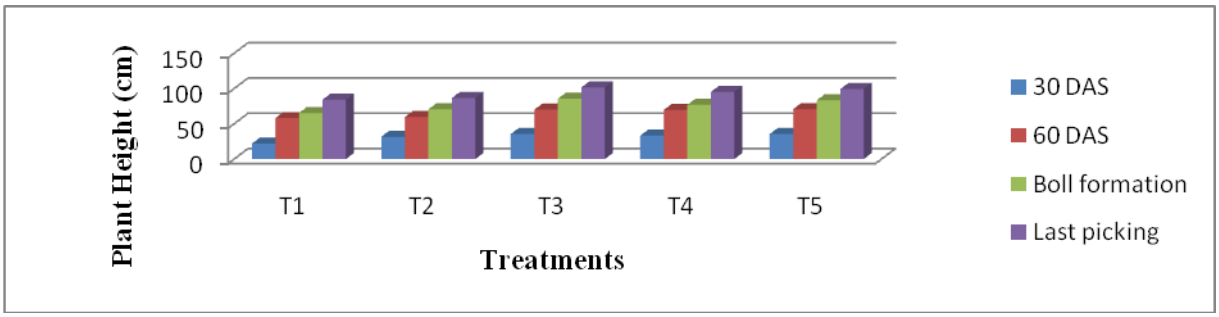


Table.2 Effects of treatments on number of leaves at various growth stages of Bt-cotton

Treatments	Treatment details	Number of leaves			
		30 DAS	60 DAS	Boll formation	Last picking
T_1	Absolute Control	29.05	52.55	79.35	84.25
T_2	RDF	29.10	62.09	84.25	122.16
T_3	Soluble Fertilizers	34.86	75.50	97.10	143.65
T_4	NPK Briquettes	31.38	67.63	88.60	126.78
T_5	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**

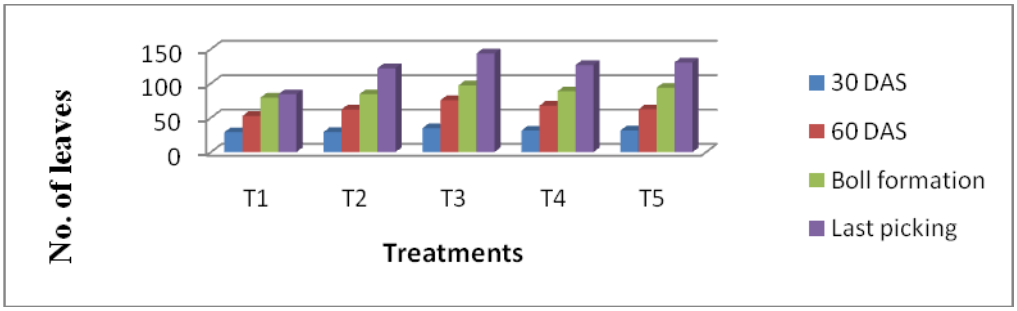


Table.3 Effects of treatments on dry matter (gm plant^{-1}) at various growth stages of Bt-cotton

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

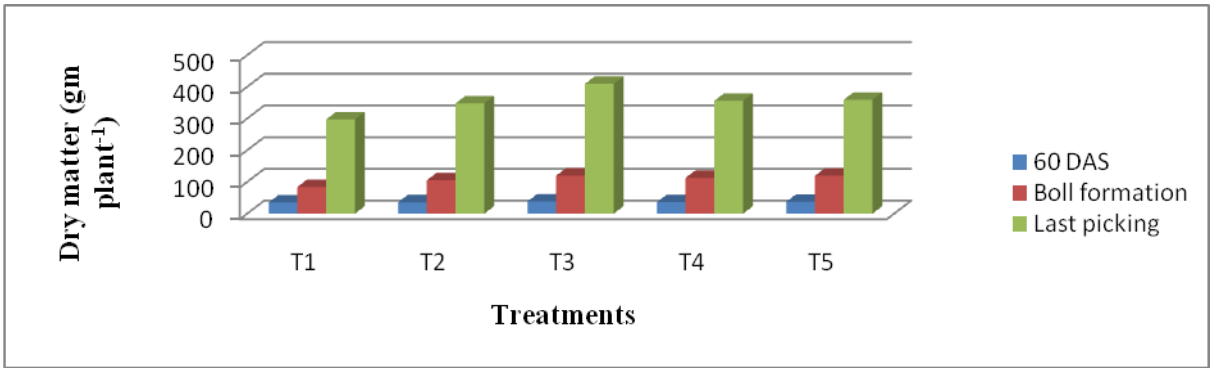


Table.4 Effects of treatments on total no of boll/plant (No.) and boll weight (gm) at various growth stages of Bt-cotton

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

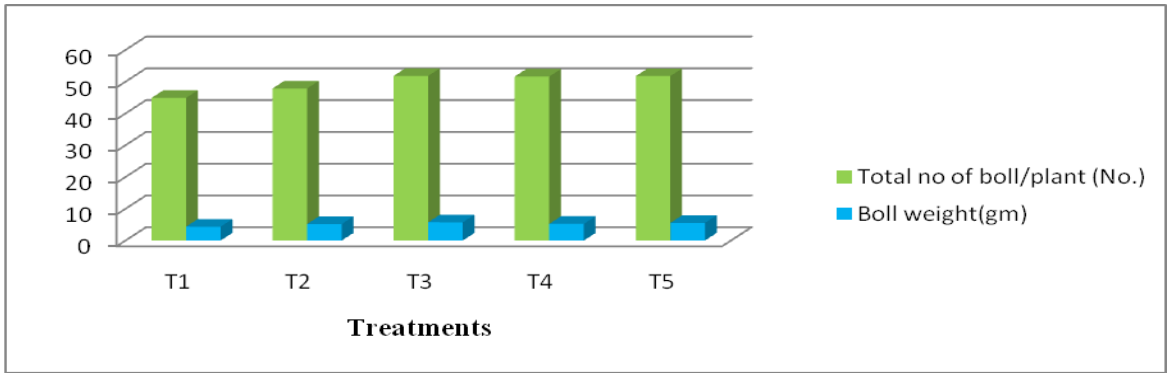
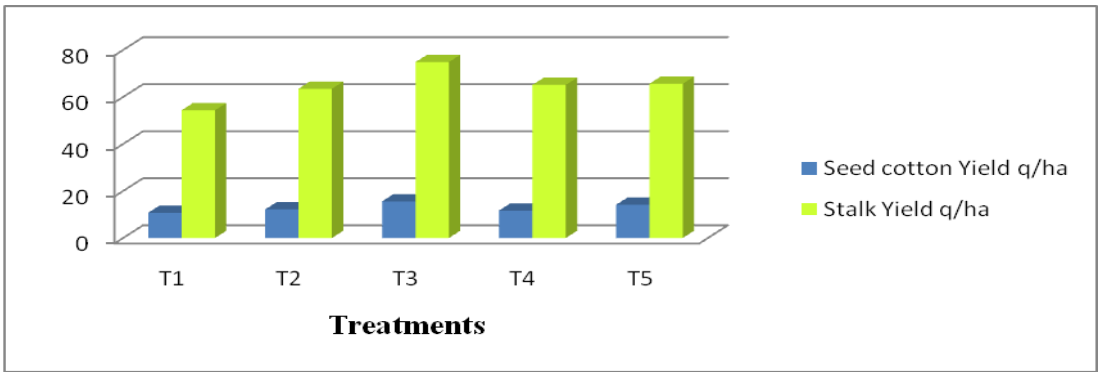


Table.5 Effects of treatments on seed cotton yield (q ha^{-1}) and Stalk yield (q ha^{-1}) at various growth stages of Bt-cotton

Treatments	Treatment details	Seed cotton Yield q/ha	Stalk Yield q/ha
T_1	Absolute Control	10.74	54.35
T_2	RDF	12.15	63.50
T_3	Soluble Fertilizers	15.59	74.84
T_4	NPK Briquettes	11.670	65.14
T_5	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



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 T_3 (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 T_3, T_4 and T_5 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).

The yield of cotton regarding effect of multi-nutrient briquettes, conventional fertilizer application and fertigation are presented in Table 5, The application of soluble fertilizers have significantly produces maximum cotton yield (15.59 q ha^{-1}) compared to other treatments. The Dry matter (Stalk) yield recorded under same set of treatment followed the trend of seed cotton yield. From the above results, it can be inferred that due to application of soluble fertilizer through fertigation improved the seed cotton and stalk yield these are reported by Bharambe *et al.*, (1997), Tumbare *et al.*, (1999), Thind *et al.*, (2008).

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 $ZnSO_4$ Kg ha^{-1}.

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