Research Article

Yield and nutrient uptake of *Bt cotton* as influenced by composted waste, organic and inorganic fertilizers

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Abstract

Urban waste management is a major environmental issue in India. The growing rate of urban wastes has caused a serious problem and threatening the health of society. Mismanagement of urban wastes can cause adverse environmental impacts, public health risk and other socio-economic problems. Composting is considered to be the best option to deal with the urban wastes for converting into valuable source of plant nutrients. Cotton is an exhaustive crop requiring huge amount of nutrients for realising potential yields. Scarcity of organic manures especially in dry lands forces the need for alternate organic sources. Keeping these points in view a study was carried out to determine the effect of combined application of municipal city waste with inorganic fertilisers on the performance of *Bt* cotton at College Farm, College of Agriculture, PJTSAU, Hyderabad, India during *kharif*, 2014. The experiment was laid out in randomised block design replicated thrice with eleven treatments that comprised of 100 % NPK alone (150: 60: 60 kg NPK ha^{-1}), 100% NPK + FYM @10 tonnes ha^{-1} (farmers practice) and 100 %, 75%, 50% NPK integrated with 3 levels of Godavari Gold compost (GG) @ 1.25, 1.875 and 2.5 tonnes ha^{-1} respectively.

Results of the study revealed that Bt cotton registered significantly higher growth parameters, yield attributes, yield and nutrient uptake (N, P and K kg ha-1) with the integrated application of 100 % NPK + 2.5 t ha^{-1} of Godavari Gold compost as compared to 100% NPK alone, 100% NPK + FYM @10 tonnes ha^{-1} (farmers practice) and 75 % RDF and 50 % RDF integrated with Godavari gold compost @ 1.25, 1.875 and 2.5 tonnes ha^{-1}.

Keywords: Composted waste, FYM, inorganic fertilisers, *Bt* cotton, dry matter production, yield and nutrient uptake

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Introduction

Urban waste management is one of the major environmental problems of Indian cities. Various studies reveal that about 90% of urban wastes disposed off unscientifically in open dumps and landfills, creating problems to public health and the environment [1]. With the ever increasing demographic pressure the garbage quantity increases, which, in turn, exhaust the landfill sites. Landfills are also becoming increasingly expensive because of the rising costs of construction operations.

Unlike western countries, the urban waste of Asian cities is often comprised of 70–80% organic matter, dirt and dust. Composting is considered to be the best option to deal with the waste generated [2] besides helps to reduce the transport of wastes and disposal in landfills.

Cotton is an important commercial crop of India often referred as “white gold” the most versatile cash crop which plays a distinguishable role in national economy in terms of foreign exchange and employment generation.The productivity of cotton in India is significantly lower (568 kg ha^{-1}) as compared to the four major cotton growing countries *viz;* China (1300 kg ha^{-1}), USA (900 kg ha^{-1}), Pakistan (700 kg ha^{-1}) and Brazil (2027 kg ha^{-1}) though India ranks first in area with 11.88 m ha^{-1}, accounting 30 per cent of world coverage and 22 per cent (351 lakh bales of lint) of the world cotton production (second rank) with a productivity of 568 kg ha^{-1}. Telangana ranked third in area (1.65 m. ha) with a production of 5 million bales and productivity of 515 kg ha^{-1} [3].

The special features of *Bt* cotton are shorter crop duration, compact crop canopy, synchronized boll bursting, capable of accommodating a higher plant population per unit area and to withstand high fertility condition [4].

Today the coverage under *Bt* hybrids in India is saturated, and trends of high nitrogen requirement by fast expanding *Bt.* hybrids on one hand, rapid depletion of soil nutrients, warrants improvement in cotton yield through agronomic management by integrated nutrient management to restore the soil fertility and sustain crop productivity and fully harness its economic benefits [5].

Integrated use of chemical fertilizers and organic manures is not only essential for achieving higher yields but also plays crucial role in improving soil health. Although FYM is the commonly recommended organic manure, its availability is becoming scarce on account of low or negligible maintenance of cattle population especially in dry lands. In this context, alternate organic sources like compost are one of the sound options on account of its rich nutrient content [6].

Further, growing concerns about the environmental consequences of mineral N use and its future cost perspectives emphasize the need to develop new production technologies that are sustainable both economically and ecologically. There are concerted efforts worldwide to use recycled plant residues, agro-industrial wastes, municipal wastes, compost and animal manures to complement the N availability and reduce dependence on mineral N fertilizer. If production residues were used in agriculture, they would no longer be called wastes but would become economically valuable soil amendments by balancing soil organic matter and increasing yield.

Godavari gold is compost fortified with major nutrients. The organic N fraction gradually becomes available for crop uptake as the manure decomposes (mineralizes) while mineral N fraction becomes immediately available to the crop. So organic compost helps for both instant and sustained release of nitrogen to the crop. Hence for exhaustive crop like Bt. cotton hybrids, which draw plenty of soil nutrients and deplete the soil fertility when grown with such organic products will enhance the soil fertility and sustain crop production levels. Thus, taking into considerations the above facts, a field experiment was initiated to evaluate the response of *Bt* cotton to compost, organic and inorganic chemicals.

Materials and Methods

The experiment was conducted during *kharif*, 2014 at the College Farm, Professor Jaya Shankar Telangana State Agricultural University (PJTSAU), College of Agriculture, Rajendranagar, Hyderabad. The farm is located at 17^0 18' 49" North Latitude and 78^0 24' 42" East Longitude.The soil of the experimental site was sandy clay loam with soil p*H* (7.4), EC (0.32 dS m^{-1}) and OC (0.41 %). The soil was low in available nitrogen (226.0 kg ha^{-1}), high in available phosphorus (36.0 kg ha^{-1}) and medium in available potassium (224.0 kg ha^{-1}). This experiment was laid out in a randomized block design with eleven treatments and replicated thrice (**Figure 1**). The size of gross and net plots were 7.2 m X 6.0 m (43.2 m^2).The eleven treatments comprised of T_1: 100% NPK- Recommended dose of fertilizers (150: 60: 60 kg NPK ha^{-1}), T_2: 100% NPK+ FYM @ 10 tonnes/ ha (Farmers Practice), T_3: 100% NPK + Godavari Gold (GG) @ 1.25 tonnes/ ha, T_4:100% NPK + Godavari Gold @ 1.875 tonnes / ha, T_5:100% NPK+ Godavari Gold @ 2.5 tonnes/ ha, T_6:75% NPK + Godavari Gold @ 1.25 tonnes/ ha, T_7:75% NPK + Godavari Gold @ 1.875 tonnes/ ha, T_8:75% NPK + Godavari Gold @ 2. 5 tonnes/ ha, T_9: 50% NPK + Godavari Gold @ 1.25 tonnes/ ha, T_{10}: 50% NPK + Godavari Gold @ 1.875 tons/ ha and T_{11}: 50% NPK + Godavari Gold @ 2.5 tonnes/ ha. Well rotten farmyard manure (FYM) and composted waste (Godavari gold) was applied 15-20 days before sowing. The chemical properties of the composted waste are detailed in **Table 1**.

Figure 1 An overview of the experiment

Table 1 Physico-chemical properties and nutrient content of the composted waste (Godavari gold).

Parameters	Value
Moisture content (%)	15.0-25.0
Color	Dark brown to Black
C/N ratio	<20
Nitrogen (%)	0.8
Phosphorus (%)	0.4
Potassium (%)	0.4
p*H*	6.5-7.5
Conductivity (dsm^{-1})	4.0
Arsenic (mg kg^{-1})	10.0
Cadmium (mg kg^{-1})	5.0
Chromium (mg kg^{-1})	50.0
Copper (mg kg^{-1})	300.0
Lead (mg kg^{-1})	100.0
Mercury (mg kg^{-1})	0.15
Nickel (mg kg^{-1})	50.0
Cadmium (mg kg^{-1})	5.0
Zinc (mg kg^{-1})	1000.0

Two seeds $hill^{-1}$ of cotton hybrid Jaadoo were dibbled at a spacing of 90 cm x 60 cm during second fortnight of August and fertilizers were applied as per treatments. Crop was kept weed free by using power weeder (**Figure 2**).

The data on plant height, dry matter and monopodial and sympodial branches was recorded from randomly selected five representative plants from each plot and seed cotton yield was recorded on per plot basis. Adequate plant protection measures were taken as per recommendations. The nutrient analysis was carried out following standard procedures.

Figure 2 Weeding with power weeder at 30 days after sowing

Results and Discussion

Data on the dry matter production indicated that it increased progressively with advancement of the age of the crop from 30 DAS up to harvest (**Figures 3-5** and **Table 2**). Similar to the plant height, there was a gradual increase in dry matter accumulation with conjunctive application of 50 % RDF up to 100 % RDF with graded levels of Godavari gold compost and plots applied with 2.5 t ha^{-1} of compost registered higher dry matter accumulation over graded lower levels of 1.875 and 1.25 tha^{-1} respectively.

Figure 3 An overview of the crop at 60 days after sowing

Figure 4 An overview of the crop at flowering stage

Figure 5 An overview of crop at boll formation stage

Table 2 Dry matter production (kg ha^{-1}) of *Bt* cotton as influenced by organic and inorganic fertilizers

Treatments	**30DAS**	**60DAS**	**90 DAS**	**120 DAS**	**150 DAS**	**At harvest**
T_1 (100% NPK)	682.57	1817.85	3398.21	4997.92	6331.98	6736.60
T_2 (100% NPK + FYM 10 t/ha- (Farmers Practice)	757.62	1887.63	3594.07	5281.15	6537.22	7038.01
T_3 (100% NPK + 1.25 t GG/ha)	824.48	1846.00	3500.24	5145.69	6419.36	6969.99
T_4 (100% NPK + 1.875 t GG/ha)	978.71	2028.96	3752.39	5488.74	6723.11	7223.90
T_5 (100% NPK + 2.5 t GG/ha)	1060.80	2163.83	3970.54	5635.92	6957.68	7571.64
T_6 (75 % NPK + 1.25 t GG/ha)	508.41	1410.89	2697.46	3347.19	4850.74	5231.89
T_7 (75 % NPK + 1.875 t GG/ha)	576.43	1568.63	2858.72	3699.62	5072.98	5562.04
T_8 (75 % NPK + 2.5 t GG/ha)	679.06	1677.70	3053.40	4311.24	5313.40	5807.15
T_9 (50% NPK + 1.25 t GG/ha)	320.18	960.53	2187.89	3024.67	3906.88	4352.19
T_{10} (50% NPK + 1.875 t GG/ha)	418.11	1101.27	2462.89	3246.33	4161.05	4598.27
T_{11} (50% NPK + 2.5 t GG/ha)	497.86	1239.07	2627.09	3442.19	4403.89	4844.28
SEm ±	16.16	42.80	53.60	64.60	71.35	84.80
CD (P=0.05)	47.66	123.6	152.49	183.78	206.15	246.76

A close perusal of data indicated that at all the crop growth stages the crop fertilized with 100 % NPK + 2.5 t GG/ha (T_5) maintained its superiority and accumulated significantly higher dry matter production over all other treatments and it was followed by 100 % NPK + 1.875 t GG/ha (T_4), 100 % NPK + FYM @ 10 t/ha (T_2- Farmers practice) and 100 % NPK alone (T_1). The crop fertilized with 75 % NPK with graded levels of Godavari Gold (T_6- T_8) registerd significantly higher dry matter production over 50 % NPK in combination with Godavari gold (T_9 - T_{11}). The lowest dry matter production was recorded with 50% NPK + 1.25 t GG/ha (T_{11}).

Higher dry matter production in plots fertilised with 100 % NPK + 2.5 t GG/ha could be ascribed to the higher and consistent nutrient availability from organics and inorganics up to maturity that resulted in improved leaf area, branching and photosynthetic activity that reflected in higher dry matter accumulation [7].

Monopodial branches

It could be observed from the data (**Table 3**) that number of monopodial branches varied significantly among different nutrient management treatments. A significant improvement in the number of monopodial branches was observed with an increase in the fertiliser dose from 50 % to 100 % RDF in conjunction with Godavari gold compost at varying rate from 1.25 to 2.0 t ha^{-1}. Among the treatments crop fertilised with 100 % NPK + 2.5 t GG / ha recorded highest monopodial branches (3.20) and was followed by 100 % NPK + 1.875 t GG/ha (2.93), 100 % NPK + FYM @ 10 t/ha - Farmers practice (2.64) and 100 % NPK alone (2.61). Conjunctive application of 75 % RDF with varying levels of Godavari Gold compost was significantly superior over 50 % RDF in combination with Godavari Gold compost and the lowest number of monopodial branches were registered with 50% NPK + 1.25 t GG/ha (1.57).

Higher monopodial branches registered with 100 % NPK + 2.5 t GG / ha could be due to the reason that organic manures play important role in sustaining the productivity by not only acting as source of nutrients but also by modifying soil physical behavior as well as increased efficiency of applied nutrients [8].

Sympodial branches

An overview of data on sympodial branches indicated an increase in number of sympodia from 120 Days after sowing (DAS) to harvest, with a steep rise from 120 DAS to 150 DAS and it was gradual till harvest (Table 3). There was a significant increase in sympodial branches with an increase in fertiliser application from 50 % to 100 % RDF along with conjunctive use of Godavari Gold compost from 1.25 to 2.0 t ha $^{-1}$. At all the crop growth stages conjunctive use of 100 % NPK + 2.5 t GG / ha recorded highest number of sympodial branches and it was followed by the treatments 100 % NPK + 1.875 t GG/ha, 100 % NPK + FYM @ 10 t/ha - Farmers practice and 100 % NPK alone.

Higher sympodia with the application of 100 % NPK + 2.5 t GG / ha could be due to adequate and steady supply of nutrients from compost throughout crop growth period through organics owing to slow release of mineralisable N coupled with reduced losses [9] and [10].

Number of squares at flowering

The nutrient management treatments exerted significant influence on number of squares at flowering stage (Figure 4 and Table 3). There was a gradual and significant improvement in number of squares from 50 % to 100 % RDF in conjunction with varying levels of Godavari gold from 1.25 to 2.0 t ha^{-1}. Among the treatments significantly higher number of squares at flowering stage were recorded in the plots that received 100 % NPK + 2.5 t GG / ha (40.1) followed by the treatments 100 % NPK + 1.875 t GG/ha (37.1), 100 % NPK + FYM @ 10 t/ha - Farmers practice (35.4) and 100 % NPK alone (32.1). Crop fertilised with 50% NPK + 1.25 t GG/ha produced lowest number of squares (18.0).

Table 3 Yield attributes and seed cotton yield (kg ha^{-1}) of *Bt* cotton as influenced by organic and inorganic fertilizers

Treatments	Monopodial branches at harvest	Sympodial branches			No. of squares (At flowering)	No. of bolls	Seed cotton yield (kg ha^{-1})
		120 DAS	150 DAS	At harvest			
T_1 (100% NPK)	2.61	12.07	20.57	21.50	32.1	32.5	1708.47
T_2 (100% NPK + FYM @10 t/ha Farmers Practice)	2.64	14.73	23.50	25.50	35.4	35.7	1938.90
T_3 (100% NPK + 1.25 t GG/ha)	2.51	13.23	21.50	24.03	33.8	33.0	2078.00
T_4 (100% NPK + 1.875 t GG/ha)	2.93	17.60	24.43	26.03	37.1	36.6	2239.17
T_5 (100% NPK + 2.5 t GG/ha)	3.20	18.90	26.23	28.43	40.1	38.2	2398.87
T_6 (75 % NPK + 1.25 t GG/ha)	1.90	11.70	12.27	15.37	23.6	22.7	1361.80
T_7 (75 % NPK + 1.875 t GG/ha)	2.00	12.20	15.53	18.87	25.7	24.5	1501.90
T_8 (75 % NPK + 2.5 t GG/ha)	2.20	13.47	18.70	20.30	29.0	28.6	1683.93
T_9 (50% NPK + 1.25 t GG/ha)	1.57	9.23	10.33	10.40	18.0	17.8	949.37
T_{10} (50% NPK + 1.875 t GG/ha)	1.63	9.80	11.30	12.17	21.6	18.8	1089.83
T_{11} (50% NPK + 2.5 t GG/ha)	1.85	10.50	12.00	14.57	23.1	20.7	1262.60
SEm ±	0.08	0.60	0.68	0.74	0.44	0.87	46.45
CD (P=0.05)	0.22	1.71	1.93	2.10	1.25	2.58	137.04

Higher number of squares at flowering with 100 % NPK + 2.5 t GG / ha could be attributed to the enhanced supply of readily available macro and micronutrients apart from availability of native soil nutrients coupled with the improved efficiency of the applied inorganic fertilisers [11].

Number of bolls

The data on number of bolls indicated that there was significant variation due to different nutrient management treatments and there was a linear increase with incremental dose of inorganic fertilisers from 50 to 100 % RDF in conjunction with godavari gold compost from 1.25 to 2.5 tha^{-1} (Table 3). Crop supplied with 100 % NPK + 2.5 t GG / ha Produced significantly higher number of bolls (38.2) followed by the treatments 100 % NPK + 1.875 t GG/ha (36.6), 100 % NPK + FYM @ 10 t/ha - Farmers practice (35.7) and 100 % NPK alone (32.5).While crop fertilised with 50% NPK + 1.25 t GG/ha produced lowest number of squares (17.8).

Application of 100% NPK + 2.5 t GG/ha over 100 % NPK + FYM @ 10 t/ha - Farmers practice and 100% RDF alone resulted in efficient translocation of photosynthates due to adequate amount of available nutrients that favoured higher number of sympodia, squares per plant and bolls These findings are in line with those reported by [12].

Seed cotton yield

Seed cotton yield varied significantly among various nutrient management treatments. It could be inferred from the data (**Figures 6** and **7** and Table 3) that there was a positive and significant improvement in the yield with increase in graded level of inorganic fertilisers from 50 to 100 % RDF in conjunction with varying levels of Godavari gold compost (1.25 to 2.0 t ha^{-1}).

Among the different nutrient management treatments, significantly higher seed cotton yield was recorded with the application of 100 % NPK + 2.5 t GG/ha (2398.87) followed by the application of 100 % NPK + 1.875 t GG/ha (2239.17),100 % NPK + 1.25 t GG/ha (2078.00) 100 % NPK + FYM @ 10 t/ha - Farmers practice (1938.90) and 100 % NPK alone (1708.47). Lowest seed cotton yield (949.37) was registered with 50% NPK + 1.25 t GG/ha.

Yield is a dependent variable and is the resultant of growth parameters, yield attributes and nutrient uptake. Higher yield in crop fertilised with 100 % NPK + 2.5 t GG / ha could be due to the greater and consistent nutrient availability throughout crop growth period due to conjunctive use of composted waste (ready source of macro and micronutrients) and 100 % inorganics that registered improved growth parameters (dry matter production) and yield attributes (monopodia, sympodia, number of squares at flowering and higher nutrient uptake (N, P and K) yield in comparision to rest of the treatments. These results are in line with those of [13].

The per cent increase in seed cotton yield was to the tune of 40.41, 31.06, 21.62 and 23.70, 15.48 and 7.17 % respectively with the application of 2.5 t, 1.875 t and 1.25 t GG/ha with 100% NPK as compared to 100 % RDF alone and 100 % NPK + FYM @ 10 t/ha -farmers practice.

Lower yield under 50 % RDF+ 1.25 t GG ha^{-1} could be attributed to the inadequate nutrient availability that resulted in lesser dry matter accumulation coupled with lesser number of monopodia, sympodia, squares at flowering and lower nutrient uptake as evident from the respective data (Tables 2-5).

Figure 6 Cotton picking

Figure 7 Cotton ginning

Nutrient Uptake

Nitrogen uptake

An overview of the data indicated that with the advancement of crop growth from 30 days, the uptake of nitrogen increased linearly up to harvest stage (**Table 4**). In general there was a gradual increase in N uptake with increase in graded level of fertiliser application from 50 % to 100 % RDF in conjunction with varying levels of Godavari Gold compost application (1.25 to 2.5 t ha^{-1}). At all the crop growth stages, crop fertilized with 100 % NPK + 2.5 tons GG /ha (T_5) removed significantly greater quantity of nitrogen and was followed by 100 % NPK + 1.875 t GG/ha (T_4) compared to 100 % NPK + FYM @ 10 t/ha (T_2) and 100 % NPK (T_1).

Table 4 Nitrogen uptake (kg ha^{-1}) of *Bt* cotton as influenced by organic and inorganic fertilizers

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	At harvest
T_1 (100% NPK)	5.75	24.00	65.92	93.20	120.54	123.97
T_2 (100% NPK + FYM @ 10 t/ha- (Farmers Practice)	6.80	25.83	70.45	101.33	126.19	130.51
T_3 (100% NPK + 1.25 t GG/ha)	7.17	25.01	68.16	98.20	123.49	126.97
T_4 (100% NPK + 1.875 t GG/ha)	9.21	28.57	73.94	108.10	131.34	136.36
T_5 (100% NPK + 2.5 t GG/ha)	10.25	31.26	79.01	115.17	137.10	144.60
T_6 (75 % NPK + 1.25 t GG/ha)	3.72	17.09	46.69	65.10	87.79	91.10
T_7 (75 % NPK + 1.875 t GG/ha)	4.35	19.38	50.72	73.23	91.83	98.12
T_8 (75 % NPK + 2.5 t GG/ha)	5.13	21.06	54.67	80.17	98.14	103.60
T_9 (50% NPK + 1.25 t GG/ha)	1.96	10.78	34.59	46.10	70.83	73.64
T_{10} (50% NPK + 1.875 t GG/ha)	2.69	12.83	38.61	51.83	74.69	79.34
T_{11} (50% NPK + 2.5 t GG/ha)	3.39	14.69	41.60	48.30	77.67	83.14
SEm ±	0.22	0.52	1.72	2.08	2.20	2.87
CD (P=0.05)	0.63	1.49	4.94	6.10	6.32	8.10

Phosphorus uptake

Data on Phosphorus uptake of crop (**Table 5**) clearly indicated a linear increase in Phosphorus uptake with the ontogeny of the crop (30 DAS to harvest stage). In general there was a gradual increase in P uptake with increase in graded level of fertiliser application from 50 % to 100 % RDF in conjunction with varying levels of Godavari Gold compost application (1.25 to 2.5 t ha^{-1}). At all the crop growth stages, crop fertilised with 100 % NPK + 2.5 t GG/ha (T_5) removed significantly higher quantity of phosphorous followed by 100% NPK + 1.875 t GG/ha (T_4) compared to 100 % NPK + FYM @ 10t/ha - Farmers practice (T_2) and 100 % NPK alone (T_1). While crop fertilised with 50% NPK + 1.25 t GG/ha (T_9) recorded significantly lower Phosphorus uptake at all the crop growth stages.

Potassium uptake

There were significant differences in Potassium uptake due to different nutrient management practices (**Table 6**). There was a linear and significant increase in K uptake with the crop age from 30 DAS to harvest stage. In general there was a gradual increase in K uptake with increase in graded level of fertiliser application from 50 % to 100 % RDF in conjunction with varying levels of Godavari Gold compost application (1.25 to 2.5 t ha^{-1}). Crop fertilised with100% NPK + 2.5 t GG/ha (T_5) removed significantly higher amount of potassium from 30 DAS up to harvest and was followed by 100% NPK + 1.875 t GG/ha (T_4) compared to 100 % NPK + FYM @ 10t/ha - Farmers practice (T_2) and 100 % NPK alone (T_1). Lowest K uptake was recorded with the application of 50% NPK + 1.25 t GG/ha (T_9).

Table 5 Phosphorus uptake (kg ha^{-1}) of *Bt* cotton as influenced by organic and inorganic fertilizers

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	At harvest
T_1 (100% NPK)	1.41	4.81	10.66	17.00	21.47	23.33
T_2 (100% NPK + FYM @ 10 t/ha- (Farmers Practice)	1.69	5.49	12.23	19.56	23.33	28.97
T_3 (100% NPK + 1.25 t GG/ha)	1.76	5.00	11.57	18.04	23.00	26.30
T_4 (100% NPK + 1.875 t GG/ha)	2.30	6.38	13.16	19.96	25.10	31.55
T_5 (100% NPK + 2.5 t GG/ha)	2.71	7.45	14.71	22.55	27.13	35.37
T_6 (75 % NPK + 1.25 t GG/ha)	0.61	2.28	6.58	9.06	13.83	16.57
T_7 (75 % NPK + 1.875 t GG/ha)	0.96	3.02	7.55	10.87	16.17	20.57
T_8 (75 % NPK + 2.5 t GG/ha)	1.24	3.38	8.88	13.53	19.70	22.93
T_9 (50% NPK + 1.25 t GG/ha)	0.19	0.82	3.18	5.57	9.10	11.87
T_{10} (50% NPK + 1.875 t GG/ha)	0.32	1.12	4.29	6.62	11.57	13.67
T_{11} (50% NPK + 2.5 t GG/ha)	0.46	1.53	5.08	7.59	12.20	15.27
SEm ±	0.09	0.19	0.34	0.43	0.66	0.83
CD (P=0.05)	0.27	0.56	1.01	1.26	1.81	2.28

Nutrient uptake is the product of dry matter production and nutrient content. Higher nutrient uptake (N, P and K) recorded by the crop fertilised with 100% NPK + 2.5 t GG/ha (T_5) could be ascribed to the higher dry matter accumulation as evident from the data (Table 1). Conjunctive application of 100 % inorganics with compost @ 2.5 t ha^{-1} resulted in adequate and steady availability of nutrients throughout the crop growth period due to mineralization and slow release of nutrients to cotton crop resulting in to higher uptake of nutrients with the increased dry matter production and seed cotton yield [14].

Table 6 Potassium uptake (kg ha^{-1}) of *Bt* cotton as influenced by organic and inorganic fertilizers

Treatments	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	At harvest
T_1 (100% NPK)	6.09	20.06	56.83	87.33	117.40	122.81
T_2 (100% NPK + FYM @ 10 t/ha- (Farmers Practice)	6.93	21.95	67.70	95.13	125.43	135.89
T_3 (100% NPK + 1.25 t GG/ha)	7.53	21.06	62.13	92.73	115.90	127.97
T_4 (100% NPK + 1.875 t GG/ha)	9.28	24.23	71.97	101.70	132.83	140.95
T_5 (100% NPK + 2.5 t GG/ha)	10.36	26.07	78.07	107.97	139.03	149.20
T_6 (75 % NPK + 1.25 t GG/ha)	3.12	12.86	35.83	60.83	79.53	87.07
T_7 (75 % NPK + 1.875 t GG/ha)	3.70	14.96	42.17	68.53	95.63	104.43
T_8 (75 % NPK + 2.5 t GG/ha)	4.72	15.89	48.63	75.43	108.20	115.17
T_9 (50% NPK + 1.25 t GG/ha)	1.46	5.35	18.13	44.23	61.67	70.80
T_{10} (50% NPK + 1.875 t GG/ha)	2.03	6.11	26.30	50.90	70.60	80.03
T_{11} (50% NPK + 2.5 t GG/ha)	2.18	7.26	32.00	55.67	79.07	88.63
SEm ±	0.24	0.59	1.58	1.74	2.32	2.70
CD (P=0.05)	0.72	1.5	4.66	5.00	6.80	7.92

Conclusion

The growth parameters (dry matter production), yield attributes (monopodial, sympodial branches, number of squares and bolls), seed cotton yield and nutrient uptake (N, P and K) of *Bt* cotton were significantly higher with the application of 100% NPK (150: 60: 60 kg NPK ha^{-1}) + 2.5 t ha^{-1} of Godavari Gold compost and the increase in yield was to the extent of 40.41 and 23.70 % respectively as compared to 100 % NPK + FYM @10 tha^{-1} - Farmers practice and 100 % NPK alone.

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