

Original Research Article

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Influence of Farmyard Manure and Nitrogen on Performance of Bt Cotton (*Gossypium hirsutum* L.)

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ABSTRACT

A field experiment entitled influence of farmyard manure and nitrogen on growth and yield of Bt cotton (*Gossypium hirsutum* L.) was conducted at Research Farm of University College of Agriculture, Guru Kashi University, Talwandi Sabo, Bathinda to study the effect of different levels of farmyard manure (FYM) and nitrogen on growth and yield of Bt cotton during kharif season in 2019. The trial was laid out in split plot design with three levels of FYM (0, 15 and 30 t ha⁻¹) in main plots and four nitrogen levels (0, 75, 100 and 125% of recommended dose of Nitrogen) in sub plots, replicated thrice. Farmyard manure @ 30 t ha⁻¹ recorded significantly higher plant height (181.1 cm), dry matter accumulation plant⁻¹ (306.1 g), number of monopodial branches plant⁻¹ (2.4), number of sympodial branches plant⁻¹ (35.2), number of bolls plant⁻¹ (54.6), boll weight (15.4 g), seed cotton yield (36.8 q ha⁻¹), stick yield (55.7 q ha⁻¹) and biological yield (92.5 q ha⁻¹) than other control and 15 t ha⁻¹. FYM @ 30 t ha⁻¹ (36.8 q ha⁻¹) resulted in 15.0 and 5.4% higher seed cotton yield than 0 and 15 t ha⁻¹, respectively. Plant height (181.3 cm), dry matter accumulation plant⁻¹ (321.1 g), number of monopodial branches plant⁻¹ (2.6), number of sympodial branches plant⁻¹ (38.3), number of bolls plant⁻¹ (56.4), boll weight (16 g), seed cotton yield (37.5 q ha⁻¹), stick yield (57 q ha⁻¹) and biological yield (94.5 q ha⁻¹) was recorded significantly higher in 125% RDN but it was statistically at par with the application of 100% RDN. The application of 125% RDN resulted in 21.8, 10.3 and 3.9% higher seed cotton yield than 0, 75 and 100% RDN, respectively.

Keywords

Bt cotton, farmyard manure, Monopodial, nitrogen, Seed cotton yield and Sympodial

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Introduction

American cotton (*Gossypium hirsutum* L.) is an important fibre crop of global significance and cultivated in tropical and subtropical regions of more than seventy countries in the world of which the top five producers are China, USA, India, Pakistan and Uzbekistan. It is a cash crop of India and the most important foreign exchange earner through

export of raw cotton, garments and cotton seed by products in the form of edible oils and oilcakes. It plays a key role in national economy in terms of both employment generation and foreign exchange earnings. Cotton impacts the lives of estimated 60 million people in India. The area under cotton in India was 122.4 lakh ha with an annual production of 361 lakh bales (1 bale =170 kg) and the productivity was 501.5 kg lint ha⁻¹. It

is grown in almost all the states but Gujarat, Maharashtra, Andhra Pradesh, Madhya Pradesh, Punjab, Haryana, Karnataka, Rajasthan and Tamil Nadu contribute major in area and production. In Punjab, cotton is a crop of great economic value, playing a significant role in the socio economic status of the farmers. It occupies an area of about 2.8 lakh ha with an annual production of 11.5 lakh bales and the productivity was 688.4 kg lint ha⁻¹ (Anonymous, 2019).

Nitrogen is the key limiting nutrient for cotton production in irrigated condition. Nitrogen management practices under cotton cultivation in India is highly inefficient but can be substantially improved through better fertilizer management (Kienzler, 2010). This is because of the fact that the cotton performance is greatly influenced by slight change in the prevailing environment like rainfall, fertility etc.

The nitrogen fertilization has contributed greatly to cotton production, because it plays a vital role to cotton growth and yield (Chaudhry, 2007). Among the many strategies to improve the cotton productivity, split application of fertilizers especially nitrogen has proven more productive and profitable. Therefore there is always a scope for testing the performance of American cotton by changing the fertilizer especially N under the north-west zone of Punjab.

Organic manures can play an important role in sustaining the productivity by not only acting as a source of nutrients but also through modifying soil physical behavior as well as increasing the efficiency of applied nutrients (Reddy and Aruna, 2008). Farmyard manure has always been an important organic source of nutrients due to its significant influence in increasing yield through its influence on physical, chemical and biological properties of the soil. The plant

nutrients contained in FYM are not immediately available to plant as compared to fertilizers but become slowly available upon its mineralization. However, its residual effects are more than fertilizers.

Regular and balanced fertilization along with organic manures such as FYM will overcome the ill effects of these fertilizers and maintain the fertility status of the soil and improve the physical condition of soil. The value of organic manure is gradually building up soil fertility cannot be ignored and it bears sufficient testimony to the facts that manures and fertilizers to cotton is positively a paying concern.

Materials and Methods

The present investigation entitled “Influence of farmyard manure and nitrogen on growth and yield of Bt cotton (*Gossypium hirsutum* L.)” was conducted at Guru Kashi University, Talwandi Sabo (Bathinda). It is situated between 29.99^o N latitude and 75.08^o E longitude with an altitude of 252 meters above the mean sea level. The experimental site belongs to sub-tropical semi-arid climate having extreme winters and summers.

The experimental site belongs to semi-arid climate, where both summers and winters are acute. A maximum temperature of about 45^o is very common during summer, while freezing temperature accompany by frost happening may be in the months of December and January.

The monsoon season normally starts from the first week of July. However, a few showers received during winter season also. The temperature and rainfall both were found to be optimum for cotton crop.

The soil was slightly alkaline (pH 8.70) with normal electrical conductivity (0.42 dSm⁻¹).

The soil was medium in organic carbon content (0.40%). The available nitrogen (135.0 kg ha⁻¹) was low, whereas the available phosphorus (14.4 kg ha⁻¹) and available potassium (230 kg ha⁻¹) were both medium. The experiment was laid out in split plot design with three replications. The treatments comprised of three levels of FYM (0, 15 and 30 t ha⁻¹) and four levels of nitrogen (0, 75, 100 and 125% recommended dose of nitrogen).

The height (cm) of five randomly selected plants was measured at maturity. Dry matter accumulation was recorded from each plot, one plant was selected at random from a row ear marked for destructive sampling was uprooted and different plant parts viz. stem and leaves were separated. These samples were first air-dried and then oven dried to constant weight at 65⁰ C in hot air oven and their by weight was recorded. The monopodial branches, which were bearing at least one functional sympodial branch, were counted on five tagged plants and average value was recorded as number of monopodial branches plant⁻¹. The sympodial (reproductive) branches arising on the main stem were counted on five tagged plants.

The average value was recorded as number of sympodial branches plant⁻¹. Total number of bolls plant⁻¹ was counted on five randomly selected plants in each plot. Five randomly selected bolls were picked and weighed. Seed cotton boll was worked out by dividing the weight of five bolls with the number of bolls picked. Seed cotton from each picking was weighed separately and obtained by totaling these in kg plot⁻¹ was calculated and converted it into q ha⁻¹. The total weight of crop biomass from each plot was weighed separately and stick yield in kg plot⁻¹ was calculated and converted it into q ha⁻¹. The biological yield obtained from the addition of seed cotton yield and stick yield.

Results and Discussion

Growth parameters of Bt cotton

There was non-significant effect of farmyard manure (FYM) application on plant height at harvest (Table 1). However, the highest plant height (181.1 cm) was obtained with application of FYM @ 30 t ha⁻¹. The lowest plant height (174.7 cm) was observed with application of FYM @ 0 t ha⁻¹. Organics are known to have a favorable effect on soil structure, texture, tilth and thus facilitate quick and greater availability of plant nutrients and thus provides a better environment for root growth and proliferation, thereby creating more absorptive surface for uptake of nutrients. The higher nutrient uptake might have improved the photosynthetic activity of plants which in turn resulted in increased growth and yield attributes. Similarly increase in plant height (249.7 cm) was recorded with the application of FYM @ 10 t ha⁻¹ reported by Babaria *et al.*, (2009). The effect of nitrogen levels on plant height was found to be non-significant at harvest, however the highest plant height was observed with application of 125% RDN (181.3 cm). The lowest plant height was observed with application of 0% RDN (171.2 cm). Nitrogen stimulates plant growth and plays a key role in enhancing vegetative growth of plant including its height. Manjunatha *et al.*, (2017) said that application of 180 kg N ha⁻¹ recorded significantly higher plant height (151.5 cm) over other nitrogen levels. Similarly increase in plant height (169.6 cm) was recorded at 150% RDN reported by Rawal *et al.*, (2015).

The dry matter accumulation was significantly higher than other treatments at harvest (Table 1). The highest dry matter accumulation was obtained with application of FYM @ 30 t ha⁻¹ (306.1 g plant⁻¹). The lowest dry matter accumulation was observed

with application of FYM @ 0 t ha⁻¹ (266.3 g plant⁻¹). This could be ascribed to higher and continuous nutrient availability from combined source upto the maturity. Pagaria *et*

al., (1995), Padole (1998) revealed higher nutrient availability improved the growth attributes and photosynthetic activities of plant.

Table.1 Effect of different levels of farmyard manure and nitrogen on growth parameters of Bt cotton

Treatment	Plant height (cm)	Dry matter accumulation (g plant ⁻¹)	Number of monopodial branches plant ⁻¹	Number of sympodial branches plant ⁻¹
Farmyard manure (t ha⁻¹)				
0	174.7	266.3	2.0	34.0
15	176.5	275.2	2.3	35.1
30	181.1	306.1	2.4	35.2
LSD (P=0.05)	NS	12.7	NS	NS
Nitrogen levels (% of RDN)				
0	171.2	248.9	1.8	31.2
75	177.3	267.1	2.1	32.6
100	180.0	292.9	2.3	37.1
125	181.3	321.1	2.6	38.3
LSD (P=0.05)	NS	7.9	0.4	1.0
Interaction	NS	NS	NS	1.8

Table.2 Effect of different levels of farmyard manure and nitrogen on yield attributes of Bt cotton

Treatment	Number of bolls plant ⁻¹	Boll weight (g)	Seed cotton yield (q ha ⁻¹)	Stick yield (q ha ⁻¹)	Biological yield (q ha ⁻¹)
Farmyard manure (t ha⁻¹)					
0	49.0	14.5	32.0	51.7	83.8
15	51.0	15.3	34.9	52.6	87.5
30	54.6	15.4	36.8	55.7	92.5
LSD (P=0.05)	3	0.6	1.3	0.9	1.7
Nitrogen levels (% of RDN)					
0	47.6	14.3	30.8	48.4	79.2
75	50.0	14.9	34.0	53.2	87.2
100	52.2	15.2	36.1	54.7	90.7
125	56.4	16.0	37.5	57.0	94.4
LSD (P=0.05)	1.3	0.4	1.5	1.9	2.5
Interaction	2.3	NS	NS	NS	NS

The results also corroborated the findings of Das and Prasad (2005). The dry matter accumulation was significantly higher than other treatments at harvest. The highest dry matter accumulation was obtained with application of 125% RDN (321.1 g plant⁻¹). The lowest dry matter accumulation was observed with application of 0% RDN (248.9 g plant⁻¹). Similar findings were also observed by Gangaiah *et al.*, (2013) and Hallikeri *et al.*, (2010). Providing the right nitrogen amount during the plant growth will provide healthy leaves with the photosynthetic capacity needed to support the growing of the reproductive components.

The effect of FYM on number of monopodial branches plant⁻¹ was observed non-significant at 120 DAS (Table 1). The highest number of monopodial branches plant⁻¹ was obtained with application of FYM @ 30 t ha⁻¹ (2.4). The lowest number of monopodial branches was observed with application of FYM @ 0 t ha⁻¹ (2). The effect of nitrogen levels on number of monopodial branches plant⁻¹ was significant at 120 DAS. The highest number of monopodial branches plant⁻¹ was obtained with application of 125% RDN (2.6) which was statistically at par with application of 100% RDN (2.3). The lowest number of monopodial branches plant⁻¹ was observed with application of 0% RDN (1.8). The increasing levels of nitrogen increased the monopodial branches plant⁻¹ also reported by Rawal *et al.*, (2015), this may be due to the fact that nitrogen helps in cell division and cell elongation leading to increased number of lateral branches. Nitrogen plays an accelerating role in the vegetative growth of the plant and monopodial branches shows a better response to higher nitrogen dose.

The effect of FYM on number of sympodial branches plant⁻¹ was non-significant at 120 DAS (Table 1). The highest number of sympodial branches was obtained with

application of FYM @ 30 t ha⁻¹ (35.3) and the lowest number of sympodial branches was observed with application of FYM @ 0 t ha⁻¹ (34). Blaise *et al.*, (2005) revealed that the control plot of the FYM treatment had significantly greater sympodial branches than the control plot where in FYM was not applied. This was because FYM meet a part of the phosphorus needs of cotton. Ushanandini *et al.*, (2017) also reported similar results. The effect of nitrogen levels on number of sympodial branches plant⁻¹ was significantly higher than other treatments at 120 DAS. The highest number of sympodial branches plant⁻¹ was obtained with application of 125% RDN (38.2). The lowest number of sympodial branches plant⁻¹ was observed with application of 0% RDN (31.2). This may be due to the fact that nitrogen helps in cell division and cell elongation leading to increased number of lateral branches. Nitrogen enhances vegetative growth of the plant and hence when its rate increases vegetative growth also increases. Liaqat *et al.*, (2018) reported highest number of sympodial branches at 165 kg N ha⁻¹. The results are similar to the findings of Meena *et al.*, (2017).

Yield attributes of Bt cotton

The different levels of FYM tested significantly influenced the boll weight (Table 2). The boll weight was highest with application of FYM @ 30 t ha⁻¹ (15.4 g) which was significantly at par with application of FYM @ 15 t ha⁻¹ (15.3 g). The lowest boll weight was observed with application of FYM @ 0 t ha⁻¹ (14.5g). Increased boll weight may be associated with more dry matter accumulation. The similar results were observed by Ushanandini *et al.*, (2017). The boll weight was significantly higher with application of 125% RDN (16 g) than other treatments. The lowest boll weight was observed with application of 0% RDN (14.3 g). Similar results were observed that

boll weight was significantly increased with 125% RDF as compared to the other nitrogen levels by Meena *et al.*, (2017). Increase in the availability of nitrogen might have increased the dry matter accumulation of plants and it acted as a source to supply nutrients to reproductive parts i.e. squares and bolls. Hallikeri *et al.*, (2010) recorded similar results and concluded that nitrogen levels were positively co-related with production of total number of bolls per plant and boll weight.

The different levels of FYM tested significantly influenced the seed cotton yield (Table 2). The seed cotton yield was observed significantly higher with application of FYM @ 30 t ha⁻¹ (36.8 q ha⁻¹) than other treatments. The lowest seed cotton yield was observed with application of FYM @ 0 t ha⁻¹ (32 q ha⁻¹). Number of cotton bolls plant⁻¹ and boll weight influenced the seed cotton yield. Furthermore, FYM also supplies nutrients and maintains a healthy positive nutrient balance besides a source of soil organic matter further emphasizing the need of integrated and balanced nutrient management. The similar results were observed by Mahavishnan *et al.*, (2005) and Blaise *et al.*, (2005). The highest seed cotton yield was observed with application of 125% RDN (37.5 q ha⁻¹), it was significantly higher than other treatments but it was at par with the application of 100% RDN (36.1 q ha⁻¹). The lowest seed cotton yield was observed with application of 0% RDN (30.8 q ha⁻¹). Rawal *et al.*, (2015) found that the increase in seed cotton yield may be attributed to favourable effect of nitrogen application of 125% RDN on yield attributing characters like plant height, monopodial branches, sympodial branches, boll weight and bolls plant⁻¹. Similar positive results were observed by Verma *et al.*, (2017), Manjunatha *et al* (2017), Hallikeri *et al.*, (2010) and Liaqat *et al.*, (2018).

The stick yield was observed highest with application of FYM @ 30 t ha⁻¹ (55.7 q ha⁻¹) which was significantly higher than other treatments (Table 2). The lowest stick yield was observed with application of FYM @ 0 t ha⁻¹(51.7 q ha⁻¹). The increase in stalk yield with organic sources treatments might have attributed to the higher photosynthetic activity leading to better supply of carbohydrates resulted in more number of branches and dry matter accumulation. Das *et al.*, (2005) and Babaria *et al.*, (2009) recorded similar results. The effect of different nitrogen levels on stick yield was significant. The stick yield was found significantly higher with application of 125% RDN (57 q ha⁻¹) than other treatments. The lowest stick was observed with application of 0% RDN (48.4 q ha⁻¹). Similar results were observed that stick yield was significantly increased (6.2 t ha⁻¹) with 180 kg nitrogen as compared to the other nitrogen levels by Gangaiah *et al.*, (2013). They also observed that the increase in cotton stick yield with nitrogen fertilization was ascribed to its impact on plant height and also on branching. Rawal *et al* (2015) also reveals similar results.

The biological yield was observed highest with application of FYM @ 30 t ha⁻¹ (92.5 q ha⁻¹) which was significant higher than other treatments. The lowest biological yield was observed with application of FYM @ 0 t ha⁻¹ (83.8 q ha⁻¹). Number of dry matter accumulation, cotton bolls plant⁻¹ and boll weight influenced the biological yield. Furthermore, FYM also supplies nutrients and maintains a healthy positive nutrient balance besides a source of soil organic matter further emphasizing the need of integrated and balanced nutrient management. The biological yield was found highest with application of 125% RDN (94.5 q ha⁻¹) which was significantly higher than other treatments. The lowest biological yield was observed with application of 0% RDN (79.2 q ha⁻¹).

It is clearly concluded that there is a good scope of increasing crop yields through the use of farmyard manure. It is extremely important for sustaining production and improving the fertility of soils. Application of FYM @ 30 t ha⁻¹ (36.8 q ha⁻¹) resulted in 15.0 and 5.4% higher seed cotton yield than 0 and 15 t ha⁻¹, respectively. The application of 125% RDN resulted in 21.8, 10.3 and 3.9% higher seed cotton yield than 0, 75 and 100% RDN, respectively.

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