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Effect of Fly Ash and Nitrogen on Growth and Productivity of Bt Cotton (*Gossypium hirsutum* L.)

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A B S T R A C T

A field experiment entitled "Effect of fly ash and nitrogen on the growth and yield of Bt cotton (*Gossypium hirustum* L.)" was conducted during the *kharif* season of 2018 at Research Farm of Guru Kashi University, Talwandi Sabo, Bathinda (Punjab). The soil of the experimental field was loamy sand, low in organic carbon and available nitrogen, medium in available potassium and phosphorus. The trail was laid out in split plot design with two levels of fly ash *viz.* 0 and 10 t ha^{-1} in main plots and four levels of Nitrogen (0,125,150 and 175kg ha^{-1}) in sub plots. The results showed that the fly ash 10t ha^{-1} gave significantly higher growth and yield attributes over control. Application of nitrogen 175 kg ha^{-1} gave significantly higher plant height, dry matter accumulation, leaf area index, number of sympodial branches per plant, number of bolls per plant, boll weight, seed cotton yield ,stalk yield and biological yield as compared to 0, 125, 150kg N ha^{-1}. The results showed that application of nitrogen 175kg N ha^{-1} gave significantly higher seed cotton yield (104, 23.8, 3.9%) over 0, 125, 150kg N ha^{-1} respectively. On the basis of present investigation, it can be concluded that 175 kg N ha^{-1} gave higher growth and yield attributes but at par with the application of 150 kg N ha^{-1}.

Introduction

American cotton (*Gossypium hirustum* L.) also known as "upland cotton" originated in South America, is most widely cultivated fibre crop of the world and contributes abbot 95% of the approximately 110 Million bales of cotton produced throughout the world. It is an important cash crop known as white gold and is also known as the king of fibre crops. Major cotton growing countries are USA, Russia, India, Brazil, Mexico and Sudan. India ranks first in the world with respect to area under cultivation. This being the important cash crop of the country benefits several million people by providing employment opportunities i.e. cultivation, trade, manufacturing, processing. It is not a source of fiber only, but also a good source of edible oil, which play an important role to

meet the demand of ever increasing population of India. Besides this, this crop also provides fuel for different purposes. Four species of the genus *gossypium* viz. *hirustum, barbadense, arboreum* and *harbaceum* are cultivated, *hirustum* occupies the first place.

Major cotton growing states in the country are Maharashtra, Gujarat, Karnataka, Madhya Pradesh, Punjab, Rajasthan, TamilNadu and Uttar Pradesh. Maharashtra is the largest producer and is followed by Gujarat. In Punjab, Bt Cotton (*Gossypium hirustum* L.) and *gossypium arboreum* L.) are cultivated, however, the area under the cotton is decreasing. During the year 2017-18 cotton was grown on area of 2.87 lakh ha with production of 12.71 lakh bales. Whereas desi cotton (*Gossypium arboreum* L.) was cultivated on an area of 4 thousand ha with the production of 12 thousands bales. Desi cotton relatively lower yielding species then the Bt cotton (*hirsutum*). The present study was, therefore, undertaken on Bt cotton.

Nitrogen is the key limiting nutrient for cotton production under irrigated conditions. Nitrogen management practices under cotton cultivation in India are 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 in 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 (Mahmood-ul-Hasan *et al.,* 2003).

The mineralogical, physical and chemical properties of fly ash depend on the nature of the parent coal, condition of the combustion, type of emission control devices and storage and handling methods. Formation of fly ash depends on the ash content of coal and Indian coal used in power plants generally has very high ash content (30-45%) and is of lower quality (Mathur *et al.,* 2003). Presence of essential plant nutrients such as N, P, K, Ca, Mg, S and micronutrients make it a source of plant nutrients and increase the yield of several crops by 20-25% and found beneficial for soil and crop when it was applied in optimum quantity (Kohli *et al.,* 2010). Addition of fly ash improved the workability of the soil. The effect of the addition of fly ash is to significantly improve the physical properties of the black cotton soil. Fly ash contains oxides, hydroxides, carbonates, silicates and sulfates of calcium, iron, aluminium and other metal, in trace amount.

Materials and Methods

The present investigation entitled "Effect of different fly ash and nitrogen levels on the growth and yield attributes of Bt cotton" carried out in experimental area of agriculture research farm of Guru Kashi University, Talwandi Sabo (Bathinda) during kharif 2018-19. The soil of the experimental field was loamy sand, low in organic carbon and available nitrogen, medium in available potassium and phosphorus. The trail was laid out in split plot design with two levels of fly ash *viz.* 0 and 10 t ha^{-1} in main plots and four levels of Nitrogen (0,125,150 and 175kg ha^{-1}) in sub plots. Proper field preparation was done in the experimental field. Application of nitrogen according to the treatment but other nutrient, weed management, plant protection applied as per the recommended package of practice. The observations were on plant height at maturity, dry matter accumulation, leaf area index, number of sympodial branches/plant, number of bolls/plant, boll weight, seed cotton yield, stalk yield, biological yield and harvest index.

Fisher's ANOVA technique and least significant difference (LSD) test at 5% probability level was used to compare differences among treatment means (Steel *et al.*, 1997).

Results and Discussion

Growth parameters

Application of fly ash had influence on plant height, dry matter accumulation, leaf area index (Table 1). Application of fly ash 10t ha^{-1} recorded higher plant height (208.2cm), dry matter accumulation (25.86q/ha) and leaf area index (2.26) over the control. The data related to dry matter accumulation was in agreement with Matte and Kene (1995). Application of fly ash found to be non-significant on plant height. Among the nitrogen levels 175kg N ha^{-1} significantly influence the plant height, dry matter accumulation, leaf area index (Table 1). Application of 175kg N ha^{-1} recorded significantly higher plant height (217.9cm), dry matter accumulation (29.45q/ha), leaf area index (2.33). The present results on growth parameters were also agreed with Nehra and Kumawat (2007), Sagarka *et al.*, (2002) and Chimanshette *et al.*, (1990) respectively.

Yield attributing characteristics

The yield components namely number of sympodial branches/plant, number of bolls/plant, boll weight shows significant variation with application of fly ash 10t ha^{-1} (Table 2). Application of fly ash 10t ha^{-1} recorded higher number of sympodial branches/plant (29.3), number of bolls/plant (53.6), boll weight (4.94g). Data related to boll weight shows non-significant effect with application of fly ash. Among the nitrogen levels 175kg N ha^{-1} significantly influence number of sympodial branches/plant, number of bolls/plant, boll weight, seed cotton yield (Table 2). With application of 175 kg N ha^{-1} recorded significantly higher number of sympodial branches/plant (31.9), number of bolls/plant (55.4) and boll weight (5.06g) as compared to other nitrogen levels. The present study was in agreement with Nehra and Kumawat (2003), Bhaskar *et al.*, (1993) and Devi *et al.*, (1995) respectively.

Table.1 Effect of different fly ash and nitrogen levels on growth parameters of Bt cotton

Fly ash levels (t/ha)	Plant height (cm)	Dry matter accumulation (q/ha)	Leaf area index
Control	190.4	23.26	2.14
10	208.2	25.86	2.26
LSD (0.05%)	NS	1.80	0.03
Nitrogen levels (kg/ha)			
0	178.9	18.43	2.08
125	195.9	23.43	2.16
150	205.6	26.96	2.24
175	217.9	29.45	2.33
LSD (0.05%)	13.7	1.95	0.05

Table.2 Effect of different fly ash and nitrogen levels on yield parameters of Bt cotton

Fly ash levels (t/ha)	Number of sympodial branches/plant	Number of bolls/plant	Boll weight (g)
Control	26.0	44.6	4.78
10	29.3	53.6	4.94
LSD (0.05%)	1.2	2.0	NS
Nitrogen levels (kg/ha)			
0	22.1	41.1	4.65
125	27.8	47.7	4.81
150	28.7	52.1	4.93
175	31.9	55.4	5.06
LSD (0.05%)	3.5	7.0	0.04

Table.3 Effect of different fly ash and nitrogen levels on productivity of Bt cotton

Fly ash levels (t/ha)	Seed cotton yield (q/ha)	Stalk yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
Control	15.97	22.83	38.72	40.4
10 t/ha	16.98	25.00	41.90	39.8
LSD (0.05%)	0.51	1.74	2.14	NS
Nitrogen levels (kg/ha)				
0	9.86	17.62	27.48	35.8
125	16.25	23.98	39.74	40.8
150	19.36	25.98	45.34	42.6
175	20.12	28.57	48.69	41.3
LSD (0.05%)	1.26	1.91	3.29	NS

Productivity

Application of fly ash had influence on productivity of Bt cotton. With application of fly ash 10 t ha^{-1} significantly influence the seed cotton yield (16.98q/ha), stalk yield (25.00q/ha) and biological yield (41.90q/ha) (Table 3). Harvest index found to be non-significant with application of fly ash. Data related to seed cotton yield and stalk yield with application of fly ash was in agreement with Saini *et al.*, (2010). Among the nitrogen levels 175 kg N ha^{-1} recorded maximum seed cotton yield (20.12q/ha), stalk yield (28.57q/ha) and biological yield (48.69q/ha) as compared to other nitrogen levels (Table 3). Data related to stalk yield with application of nitrogen was in agreement with Siag and Verma (1994).

From the above findings, it can be concluded that the application of fly ash recorded significantly higher growth and yield parameters (dry matter accumulation, leaf area index, number of sympodial branches, number of bolls, seed cotton yield, stalk yield

and biological yield). Among the different nitrogen levels, application of 175kg N/ha recorded the higher growth parameters, yield attributes and seed cotton yield than the lower levels of nitrogen.

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