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**Effect of fly ash, farm yard manure and soil  
amendments to maize crop on morphological and yield  
contributing characters of *Kharif* maize (*Zea mays* L.)**

**Kulveer Kaur, Karampal Singh and Navdeep Gandhi**

**Abstract**

An experiment was conducted at farm of Mr. Gurmail Singh at Village Kiker Khera, Teh. Abohar, District Fazilka, Punjab in *kharif* season of year 2018 to study the effect of fly ash, farm yard manure and soil amendments to maize crop on morphological and yield contributing characters of *kharif* maize. The treatments were fly ash, fly ash + FYM, FYM + Lime, FYM + Gypsum, FYM, Control. The effect of these factors on plant height, number of leaves per plant, stem girth, days to cob maturity, number of cobs per plant, average cob length, number of seeds per cob, test weight and grain yield were observed. Fly ash treatment gives highest plant height (181.4 cm) and stem girth (5.94 cm) than other treatments. Maximum test weight (250.00 g) and average cob length (22.2 cm) were obtained in combined application of fly ash and farm yard manure. Average numbers of cobs were found maximum in combined application of farm yard manure and gypsum. For yield purpose fly ash treated plot gives maximum grain yield (23.73 q/acre) of maize, thus it can be stated that fly ash gives better growth and yield of maize crop as compare to other treatments.

**Keywords:** Maize crop, morphological, *Kharif* maize, *Zea mays* L.

**Introduction**

Maize (*Zea mays* L.) is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. It is one of the most versatile emerging crops having wider adaptability. Globally, maize is known as queen of cereals because of its highest genetic yield potential. Globally, it is cultivated on more than 160 million ha area across 166 countries having wider diversity of soil, climate, biodiversity and management practices. Maize contributes maximum among the food cereal crops i.e. 40 % annually (>800 metric tonnes) in the global food production. Among the world maize growing countries, USA is the largest producer of contributes nearly 35% of the total maize produced, followed by China with more than 20% production with same acreage as of USA. Maize is the driver of US with highest productivity > 10 t/ha whereas; productivity of India is just half than the world productivity (Kumar *et al.* 2012) <sup>[1]</sup>. In India, maize is the third important food crop after rice and wheat. Production of maize crop during *kharif* 2017-18 is 18.73 million tonnes. Nine states *viz.* Karnataka, Andhra Pradesh, Tamil Nadu, Rajasthan, Maharashtra, Bihar, Uttar Pradesh, Madhya Pradesh and Gujarat account for 85 per cent of India's maize production and 80 per cent of area under cultivation.(www.ficci.in) <sup>[2]</sup> Maize is primarily used for feed (60%) followed by human food (24%), industrial (starch) products (14%) beverages and seed (1%) each. Maize can be grown successfully in variety of soils ranging from loamy sand to clay loam with neutral pH, proper drainage should be selected for cultivation of maize <sup>[3]</sup> (www.farmer.gov.in). Fly ash is a resultant waste produced form the combustion of coal in thermal power plants. Presence of essential plant nutrients such as N, P, K, Ca, Mg, S and micronutrients (Pandey and Singh, 2010) <sup>[4]</sup> and increases yield of several crops by its application. Apart from nutrition, fly ash generation is increased to 300 million tonnes per annum in 2017 and is suspected to increase 900 million tonnes per annum by 2031-32.

## Material and Methods

The experiment was carried out at the farm of Mr. Gurmail Singh at Village Kiker Khera, Teh. Abohar, District Fazilka, Punjab, India. The location coordinates are 30.1453° N, 74.1993° E. The crop was grown in *kharif* season of 2017-18. The experiment was conducted in six plots, with each plot having dimensions 21× 12 ft. Hence each plot with an area of 252 sq.ft. The treatments were fly ash, fly ash + FYM, FYM + Lime, FYM + Gypsum, FYM, Control. The field was prepared after pre-sowing irrigation by two ploughings followed by planking. Seed rate @ 10 kg per acre at spacing of 60×20 cm on southern face of east west ridges was sown on 10<sup>th</sup> June, 2018. Fly ash from Guru nanak Dev Thermal power plant, Bathinda was used for incorporation in the soil @25 tonnes/ha and Farm yard manure @25 tonnes/ha were used. Lime and Gypsum were used for amendment i.e. Lime @5 qt/ha and Gypsum @ 8 qt/ha. Plant height was measured with the help of measuring tape from ground level to top of the plant at the interval of 15 days from selected 5 plants from each plot. Number of leaves per plant, number of cobs per plant and number of seeds per cob were counted manually. Stem girth was measured with the help of measuring tape at 30 days interval. Test weight was obtained from counting 1000 seeds and weighed with the help of electronic weighing balance.

## Treatments

- T<sub>1</sub> - Fly-Ash
- T<sub>2</sub> - Fly-Ash + FYM
- T<sub>3</sub> - FYM + Lime
- T<sub>4</sub> - FYM + Gypsum
- T<sub>5</sub> - FYM
- T<sub>6</sub> - Control

## Results and Discussions

### Plant height (cm)

As from the experiment maximum plant height was achieved by T<sub>1</sub> (181.4 cm) and minimum plant height was in T<sub>3</sub> (134 cm). So Aggarwal *et al.* [5] concluded that growth characteristics of sorghum were influenced significantly by increasing levels of fly ash and nitrogen. Highest average plants of 162 cm were recorded with 40 kg N + 20 t/ha flyash. Similarly Memon *et al.* [6] observed highly significant increase in plant height, dry matter yields and NPK contents with the application of fertilizers, particularly nitrogen. Highest plant height was obtained in NPK treated plots i.e. (86.4 cm) followed by treated compost press mud (67.7 cm) and treated compost farmyard manure (66.0).

### Average number of leaves per plant

It is observed that maximum numbers of leaves were found in the treatment T<sub>5</sub> (14.6) and minimum in T<sub>4</sub> (13.2). Similarly Geetanjali *et al.* [7] observed that that a significant higher number of leaves (13.30) with the treatment (T<sub>7</sub>: Fly ash @ 15 t/ha + Municipal compost @ 15 t/ha along with RDF recorded at harvest. It was at par with (T<sub>6</sub>) and (T<sub>8</sub>) over control and rest of the treatments was due to balanced supply of plant nutrients through application of FA and organic manures along with RDF it will help in promoting plant growth. Gautam *et al.* [8] observed that Leaves (19.75 mg) and pods (65.85 mg) were observed highest in T<sub>4</sub> (3:2 fly ash to soil) at the end of the experimental period.

### Average number of cobs per plant

As from the experiment the results showed that crop receiving

farm yard manure and gypsum in combination have good growth as compared to other treatment combinations. Such that average number of cobs per plant obtained from T<sub>4</sub> is 1.4 which is higher than other treatments. Similarly Shah *et al.* [9] observed that the maximum number of cobs per plant (1.127) was recorded in treatment where Urea + FYM (T<sub>3</sub>) were applied. Rahman *et al.* [10] observed that higher number of cobs at harvest was recorded by inorganic fertilizer but was not significantly different from number of cobs recorded under combined manure and inorganic fertilizer at half rates.

### Test weight (gm)

As from the experiment maximum test weight was 250.00 g in treatment T<sub>2</sub> i.e. fly ash and farm yard manure in combination and minimum was 226.64 g in T<sub>6</sub> i.e. control. Sharma *et al.* [11] observed that highest test weight (1000 grain weight) i.e. (188 gm) was obtained in the treatment receiving fly ash @ 10 t/ha. Similarly Yavarzadeh and Shamsadini [12] observed that the treatment RDF + FYM 10 t/ha recorded significantly higher 1000 grain weight (48.12 gm).

### Average grain yield (kg/ha)

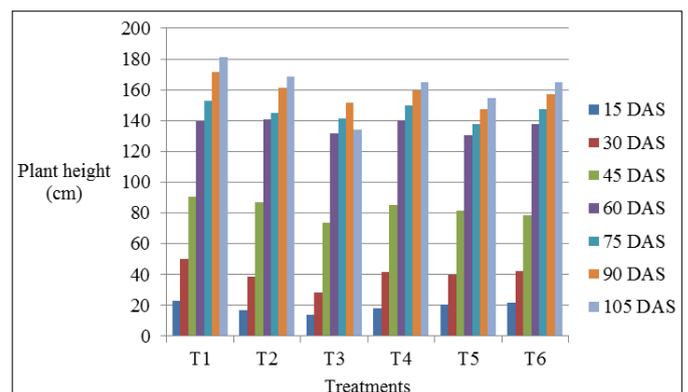
It was observed that maximum yield (23.73 q/acre) was obtained in T<sub>1</sub> followed by T<sub>4</sub> (21.15 q/acre), T<sub>2</sub> (18.18 q/acre), T<sub>3</sub> (16.52 q/acre), T<sub>5</sub> (14.74 q/acre) and minimum yield (14.44 q/acre) was observed in T<sub>6</sub> i.e. control. Chandrakar and Jena [13] observed that maize grain yield was increased over control (38.6 q/ha) by 27% when lime was applied. Conjunctive application of Lime + Fly ash + FYM recorded maximum grain yield (57.72 q/ha) among all treatment combinations. Yeledhalli *et al.* [14] observed that the total yield of 35.7 q/ha was recorded in treatment receiving pond ash @ 40 t/ha along with FYM @ 20 t/ha followed by flyash @ 30 t/ha. The yield in control was 53.3 and 45.00 respectively.

## Observations and Tables

### Plant height (cm)

**Table 1:** Plant height of maize as affected by use of fly ash, farm yard manure and soil amendments.

Treatment	Plant height (cm)						
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS
T <sub>1</sub>	22.6	49.8	90.4	139.4	152.8	171.4	181.4
T <sub>2</sub>	16.8	38.5	86.8	140.8	145.2	161.4	168.6
T <sub>3</sub>	13.8	28	73.8	131.6	141.6	151.4	134
T <sub>4</sub>	18	41.4	85.4	140.2	149.6	159.4	164.8
T <sub>5</sub>	20.4	39.8	81.4	130.2	137.4	147.2	154.4
T <sub>6</sub>	21.8	42	78.4	137.8	147.6	157	164.6

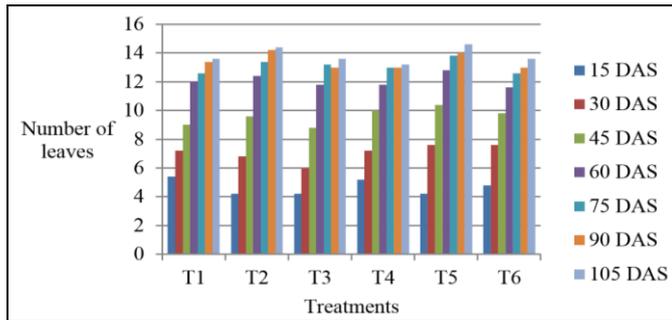


**Fig 1:** Comparison between plant heights of 6 treatments.

**Average number of leaves per plant**

**Table 2:** Periodic number of leaves of maize plant as affected by use of farmyard manure, fly ash and soil amendments.

Treatment	Average number of leaves						
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS
T <sub>1</sub>	5.4	7.2	9	12	12.6	13.4	13.6
T <sub>2</sub>	4.2	6.8	9.6	13.4	13.4	14.2	14.4
T <sub>3</sub>	4.2	6	8.8	13.2	13.2	13	13.6
T <sub>4</sub>	5.2	7.2	10	13	13	13	13.2
T <sub>5</sub>	4.2	7.6	10.4	13.8	13.8	14	14.6
T <sub>6</sub>	4.8	7.6	9.8	11.6	12.6	13	13.6

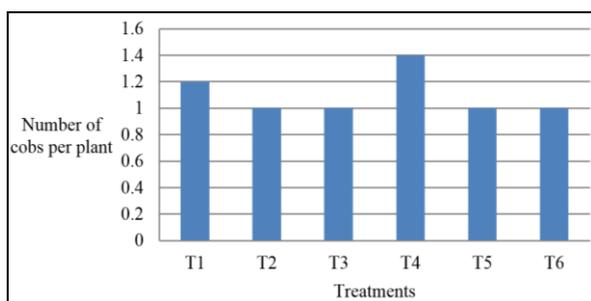


**Fig 2:** Periodic number of leaves of maize.

**Average number of cobs per plant**

**Table 3:** Average number of cobs per plant as affected by use of farmyard manure, fly ash and soil amendments.

Treatments	Average number of cobs per plant
T <sub>1</sub>	1.2
T <sub>2</sub>	1
T <sub>3</sub>	1
T <sub>4</sub>	1.4
T <sub>5</sub>	1
T <sub>6</sub>	1

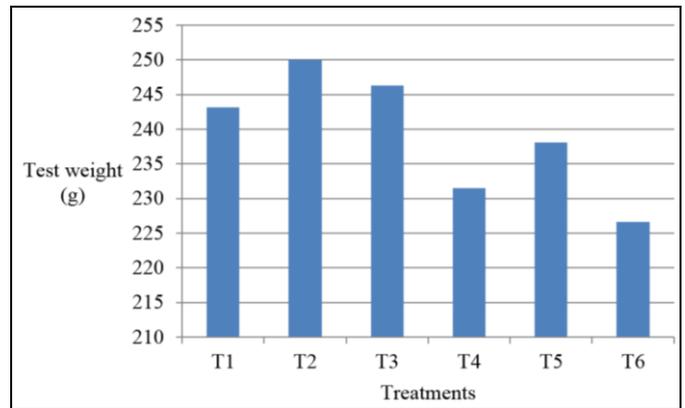


**Fig 3:** Average number of cobs per plant as affected by use of farmyard manures fly ash and soil amendments

**Test weight (g)**

**Table 4:** Test weight as affected by use of farm yard manure, fly ash and soil amendments.

Treatments	Test weight (g)
T <sub>1</sub>	243.20
T <sub>2</sub>	250.00
T <sub>3</sub>	246.34
T <sub>4</sub>	231.50
T <sub>5</sub>	238.14
T <sub>6</sub>	226.64

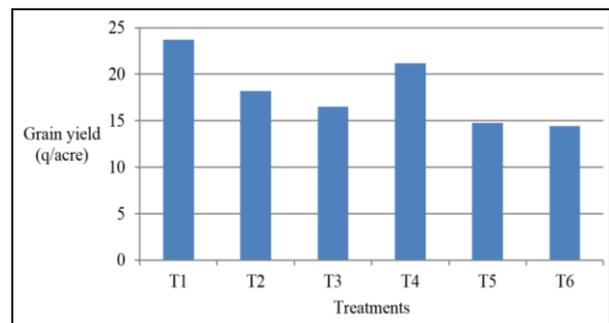


**Fig 4:** Test weight as affected by use of farm yard manure, fly ash and soil amendments

**Average grain yield (q/acre)**

**Table 5:** Grain yield as affected by use of farm yard manure, fly ash and soil amendments.

Treatments	Average grain yield (q/acre)
T <sub>1</sub>	23.73
T <sub>2</sub>	18.18
T <sub>3</sub>	16.52
T <sub>4</sub>	21.15
T <sub>5</sub>	14.74
T <sub>6</sub>	14.44



**Fig 5:** Grain yield as affected by use of farm yard manure, fly ash and soil amendments.

**Conclusion**

It was concluded that the fly ash, farm yard manure and soil amendments influenced most of the growth factors i.e. plant height, number of leaves and stem girth. As a result they were recorded maximum with the sole application of fly ash and farm yard manure. Fly ash treatment gives highest plant height (181.4 cm), and stem girth (5.94 cm) than other treatments. Maximum test weight (250.00 g) and average cob length (22.2 cm) were obtained in combined application of fly ash and farm yard manure. Average numbers of cobs were found maximum in combined application of farm yard manure and gypsum.

For yield purpose fly ash treated plot gives maximum grain yield (23.73 q/acre) of maize, thus it can be stated that fly ash gives better growth and yield of maize crop as compare to other treatments.

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