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Effect of fly ash and micronutrients (Zn and Fe) on Stover and seed yield of maize crop

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Abstract: A field experiment was conducted at the main Field Station, Department of Agriculture, Lovely Professional University, Phagwara, Punjab during session 2018-2019 on sandy loam soil with ph 7.41 and Ec 0.35(ds m^{-1}). The study was done to evaluate the "Effect of Fly ash and micronutrients (Zn and Fe) on yield of maize crop." Pioneer 3401 hybrid variety was used. The experiment has seven treatments T_1 (RDF), T_2(Fly ash 10 t ha^{-1}), T_3(RDF + Zn EDTA 12%), T_4(RDF + Fe EDTA 12%), T5(RDF + Fly ash 10 t ha^{-1}+ Zn EDTA 12%), T6(RDF + Fly ash 10 t ha^{-1}+ Fe EDTA 12%) and T7(RDF + Fly ash 10 t ha^{-1} + Zn EDTA 12% + Fe EDTA 12%) and was arranged in RBD design. The different parameters of growth and yield were evaluated. It was reported that T_7 shows the maximum records of Number of cobs per plant (1.73), cob length (18.17 cm), cob weight (141.57 g), grains per cob (339.86), cob girth (14.03 cm), grain rows per cob (13.26), 100 seed weight (26 g) and seed yield (70.27q/ha).The least was recorded from T_1 treatment. The yield of a crop has shown more responses to the combine application of RDF, Fly ash and foliar spray of Zn and Fe. The combination of fertilizers has an anticipated command on maize cultivar.

Keywords: Fly ash, Foliar spray, Maize cultivar, Micronutrients

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most important grain crops after rice and wheat overall. Maize is an annual plant which belongs to the family Poaceae and *Zea* as Genus. *Zea mays* L. has 10 pairs of chromosomes. Maize is the very essential crop for fodder and grains in rainfed and irrigated systems of agriculture in regions of arid and semi arid. United states of America, Brazil, China, India and Mexico are major countries which contribute in maize production. It is popularly grown in Punjab, 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 (ChitraMani & Kumar, P. (2020); Sharma, M., & Kumar, P. (2020); Chand, J., & Kumar, P. (2020); Naik, M., & Kumar, P. (2020); Kumar, P., & Naik, M. (2020); Kumar, P., & Dwivedi, P. (2020); Devi, P., & Kumar, P. (2020); Kumari, P., & Kumar, P. (2020); Kaur, S., & Kumar, P. (2020); Devi, P., & Kumar, P. (2020); Sharma, K., & Kumar, P. (2020); Kumar, S. B. P. (2020); Devi, P., & Kumar, P. (2020); Chand, J., & Kumar, P. (2020). In Punjab, it is mostly sown in the districts of Hoshiarpur, Ropar, ShaheedBhagat Singh Nagar, Amritsar, Gurdaspur, Jalandhar, Kapurthala, Patiala, Ludhiana, SAS Nagar and Fatehgarh Sahib. It is the very essential crop among the cereals in the agricultural economy, in food and fodder crop. Maize is increasing popularity between the farmers of india because it adapt and survive in all agro-climatic zones of india, the quality to grow in all seasons makes popular.

Due to its high yielding and all other qualities it is also called as "Queen of Cereals"Maize occupied an important place as food for human (25%), poultry feed (52%), animal food (11%), starch (10%) and brewery (2%). Maize is also cheap source of home heating furnaces have been developed which uses maize kernels or wood pellets or cherry pits as a fuel. They feature a large hopper that feeds the uniformly sized maize kernels into fire. Maize is also used for gaining feed stock for the production of ethanol fuel. Ethanol is mixed with gasoline to decrease the amount of pollutants emitted when used to fuel in the motor vehicles .In India, maize contributes about 9% for the basket of national food and about Rs.100 billion to the GDP of agriculture and it also create employment for the more than 100 million man days at the farms and in industrial and agricultural sector **(Mahajhan V, 2016;** Kumar, P. (2019); Kumar, D., Rameshwar, S. D., & Kumar, P. (2019); Dey, S. R., & Kumar, P. (2019); Kumar et al. (2019); Dey, S. R., & Kumar, P. (2019); Kumar, P., & Pathak, S. (2018); Kumar, P., & Dwivedi, P. (2018); Kumar, P., & Pathak, S. (2018); Kumar et al.,2018; Kumar, P., & Hemantaranjan, A. (2017); Dwivedi, P., & Prasann, K. (2016). Kumar, P. (2014); Kumar, P. (2013); Kumar et al. (2013); Prasann, K. (2012); Kumar et al. (2011); Kumar et al. (2014**).**In the recent time of progressive or sustainable agriculture farmers creates a big interest in the use of fly ash in agricultural fields for gaining a crop production, soil health and regenerating wastelands **(Pathan et al. 2003)**.

2. MATERIALS AND METHODS

The present investigation was carried out at the departmental farms of Lovely Professional University, Punjab. The experimental site is located at a latitude of 31.24 º and longitude of 75.70º as map coordinates along with altitude of 232 m above sea level. The soil experimental field was sandy loam in texture, well fertile and free from weeds. Initial nutrient evaluation of soil revealed medium level of organic carbon, available nitrogen and available P and K. The experiment was divided in to seven treatments replicated thrice and laid out in a Randomized Block design. Maize variety P- 3401 was used at a recommended seed rate of 20 kg/ha. Treatments comprised of T_1 (RDF),T_2(Fly ash 10 t ha^{-1}), T_3(RDF + Zn EDTA 12%), T_4(RDF + Fe EDTA 12%), T5(RDF + Fly ash 10 t ha^{-1}+ Zn EDTA 12%), T6(RDF + Fly ash 10 t ha^{-1}+ Fe EDTA 12%) and T7(RDF + Fly ash 10 t ha^{-1} + Zn EDTA 12% + Fe EDTA 12%).Seed rate, fertilizer doze and cultural practices followed were as per the recommended package of practices for maize (**Anonymous, 2013**). Observations were recorded on plant growth, seed yield and nutrient uptake by plant.

Statistical analysis

The treatments were subjected to statistical analysis using SPSS v.21 software and Duncan Multiple Range Test was applied to derive the homogenous sets.

3. RESULTS AND DISCUSSION

Yield parameters

Data pertaining to No. of Cobs of maize under effect of flyash and micronutrients is expressed in Tables of yield parameters. From the perusal of the data, it is evident that maximum no. of cobs (1.73) was recorded with the application of RDF + fly ash + Zn + Fe (T_7) whereas no. of cobs (1.20) was recorded under control. Maximum cob length (18.17 cm) were recorded under the treatment T_7 whereas minimum cob length (15.16cm) was recorded under control. Both number of cobs and cob length were recorded maximum where RDF + fly ash + Zn + Fe was applied. **Qadir *et al.* (2013)** resulted highest result with combination of three micronutrients. **Mahmoud *et al.* (2006)** also reported that micronutrients when applied in foliar spray show maximum results. Zn plays major role when applied in combination with

others.Maximum cob weight (141.57 g) was recorded with the application of RDF + fly ash + Zn + Fe (T_7). Maximum grains /cob(339.86) was recorded with the application of RDF + fly ash + Zn + Fe (T_7) whereas minimum grains/cob (304.93) were recorded under control (T_1).

An inquisition of the data reveals that maximum cob girth (14.03 cm) of maize crop under different treatments was recorded with the application of RDF + fly ash + Zn + Fe (T_7) whereas minimum cob girth (12.23) was recorded under treatment (T_1). Maximum grain rows per cob (13.26) was recorded with the application of RDF + fly ash + Zn + Fe. Whereas minimum grain rows per cob (11.20) was recorded under control treatment. Maximum Test weight of 100 seeds (26.00 gm) was recorded with the application of RDF + fly ash + Zn + Fe T_7 whereas minimum test weight (23.02) of maize crop treatments was recorded under control treatment. Maximum seed yield (70.27 q/ha.) was recorded with the application of RDF + fly ash + Zn + Fe(T_7) whereas minimum seed yield was recorded under treatment (T_1). It is noteworthy to mention here that, with use of micronutrients yield of maize plant get increased **Tariq *et al.***(2014)Stover yield (75.57 q/ha) was obtained maximum under the application RDF + fly ash + Zn + Fe (T_7) whereas Lowest stover yield (69.28 q/ha) was recorded under control (T_1)**. Arune *et al.***(2006) also resulted that with foliar spray of $ZnSO_4$ (0.5%) and urea (2%) gave higher results of growth and yield Maximum harvest index (48.70) was recorded with the application of RDF (T_1) whereas minimum harvest index (48.18) was recorded under treatment (T_7).

Test weight (g)

Table: 1 Effect of fly ash and micro nutrient on test weight of maize

Treatments	Test weight (100 seeds)
T1	$23.02^{f}\pm0.078$
T2	$23.56^{e}\pm0.070$
T3	$24.40^{cd}\pm0.239$
T4	$24.12^{d}\pm0.064$
T5	$25.32^{b}\pm0.130$
T6	$24.73^{c}\pm0.033$

T7	26.00^{a}±0.058
C D	0.31
S.E(M)	0.10

According to DMRT (Duncan's multiple range test) the mean followed by different letters are significantly different at $p< 0.05$, for separation of means.

T_1 : RDF, T_2 : RDF + fly ash, T_3 : RDF + Zn (EDTA), T_4 : RDF + Fe (EDTA), T_5 : RDF + fly ash +Zn , T_6 : RDF +fly ash +Fe and T_7 : RDF + fly ash + Zn + Fe

Table 1 showing Test weight is measured by weighing 100 seeds of maize cob to evaluate the crop seed yield and recorded the maximum test weight (26.00 g) under the treatment T7 (RDF+ fly ash+ Zn + Fe) which was followed by Treatment T5 (RDF + fly ash + Zn) having test weight (25.32 g) and the minimum test weight (23.02 g) was recorded under the treatment T1 (RDF). Mahmoud *et al.* (2006) also reported that micronutrients when applied in foliar spray show maximum results. Zn plays major role when applied in combination with others. Qadir *et al.* (2013) resulted highest result with combination of three micronutrients Seed yield (q ha^{-1})

Table: 2 Effect of fly ash and micro nutrient on seed yield of maize

Treatments	**Seed yield (q ha^{-1})**
T1	65.78^{g}±0.027
T2	66.57^{f}±0.026
T3	68.16^{d}±0.044
T4	67.73^{e}±0.32
T5	69.55^{b}±0.133

T6	68.63^{c}±0.216
T7	70.27^{a}±0.087
C D	0.252
S.E(M)	0.081

According to DMRT (Duncan's multiple range test) the mean followed by different letters are significantly different at $p< 0.05$, for separation of means.

T1 : RDF, T2 : RDF + fly ash, T3 : RDF + Zn (EDTA), T4 : RDF + Fe (EDTA), T5 : RDF + fly ash +Zn , T6 : RDF +fly ash +Fe and T7 : RDF + fly ash + Zn + Fe

Effect of fly ash and micro nutrient on the Yield (q ha^{-1})

The table 2 shows the maximum seed yield (70.27q ha^{-1}) under the treatment T7 (RDF+ fly ash+ Zn + Fe) which was followed by Treatment T5 (RDF + fly ash + Zn) having seed yield (69.55 q ha^{-1}) and the minimum seed yield (65.78 q ha^{-1}) was recorded under the treatment T1 (RDF). **Tariq *et al.* (2014)** concluded that with use of micronutrients yield of maize plant get increased. **Rakesh *et al.* (2015)** revealed that with zinc application results are better.

Stover yield (q ha^{-1})

Table: 3 Effect of fly ash and micro nutrient on Stover yield of maize

Treatments	**Stover yield (q ha^{-1})**
T1	69.28^{f}±0.13
T2	70.34^{e}±0.21
T3	71.81^{d}±0.07
T4	71.64^{d}±0.12

T5	$73.63^{b}\pm0.78$
T6	$72.63^{c}\pm0.05$
T7	$75.57^{a}\pm0.181$
C D	0.442
S.E(M)	0.142

According to DMRT (Duncan's multiple range test) the mean followed by different letters are significantly different at $p< 0.05$, for separation of means.

T_1 : RDF, T_2 : RDF + fly ash, T_3 : RDF + Zn (EDTA), T_4 : RDF + Fe (EDTA), T_5 : RDF + fly ash +Zn , T_6 : RDF +fly ash +Fe and T_7 : RDF + fly ash + Zn + Fe

Effect of fly ash and micro nutrient on the stover yield (q ha^{-1})

Table 3 show Data pertaining to Stover yield of maize under the effect of fly ash and micronutrient treatments is prescribed in the table 4.12. Which shows the highest Stover yield (75.57 q ha^{-1}) of maize under the treatment T7 (RDF + fly ash + Zn + Fe) which was followed by the treatment T5 (RDF + fly ash + Zn) having (73.63 q ha^{-1}) and the minimum stover yield (69.28 q ha^{-1}). **Ananda and Patil (2007)** shows that with application of micronutrients in combination results in increased straw and grain yield. . **Arune *et al.* (2006)** also resulted that with foliar spray of $ZnSO_4$ (0.5%) and urea (2%) gave higher results of growth and yield.

CONCLUSION-:

- The application of RDF with the combination of fly ash and foliar spray of Zn and Fe (EDTA) showed maximum results to growth, yield and economics of a maize crop.
- The study evaluated that foliar application of micronutrients in EDTA form showed quick results in maize crop growth and yield.
- Combination of micronutrient spray along with fly ash gives maximum yield and maximum profit to the farmer and less cost of cultivation of the maize crop.

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