



## RESEARCH PAPER

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## Effect of different application rates of organic, inorganic and farmyard manure fertilizer on *Zea mays* L., growth and yield production

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### Abstract

Maize is highly cultivated cereal crop in the world, due to its nutritional value it use as a staple food for human and fodder for livestock. The research was carried out by sowing of maize under the natural conditions by using four treatments (Control, Urea, FYM and NPK) in Randomized Complete Block Design. The NPK treated plot showed the maximum average height 188.27cm and the minimum average height 139.26cm was observed in control plants. Growth and yield parameters showed significant results by the use of Nitrogen, Phosphorus and Potash, i.e. average 2.3 cobs/plant and average 450.8 seeds/cob followed by Urea and Farm Yard Manure while control plots showed average 1.5 cobs/plant and average 359.75 seeds/cob were the minimal numbers of cobs and grains.

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## Introduction

*Zea mays* L. (maize) is the most important cereal crop next to wheat and rice in the Pakistan. While in India, it ranks fourth after rice, wheat and sorghum. In the world it is grown over an area of 130 million hectares with an annual production of 506 million tons with productivity of 3890 kg ha<sup>-1</sup>. It is called "King of Cereals" because of its productive potential compared to any other cereal crop. Being an exhaustive crop and it has very high nutrient requirements, so the productivity is closely depends on nutrient management system (Serna-Saldivar 2010).

It is widely grown in irrigated and rain fed areas. Maize is multiuse crop and provides food for human beings, fodder for livestock and feed for poultry. It has great nutritional value as it contain about 66.70% starch, 10% protein, 4.8% oil, 8.5% fiber, 3% sugar and 7% ash. The average yield production of maize crop is 3427 kg ha<sup>-1</sup> in Pakistan. It is also third quick growing crop after wheat and rice grain production in Pakistan (Bibi *et al.*, 2010). The average yield production of maize crop is 3427 kg ha<sup>-1</sup> in Pakistan. It is also third quick growing crop after wheat and rice grain production in Pakistan.

Inorganic fertilizers generally in excessive amount are applied to vegetables in order to achieve a better yield and maximum value of growth. So, the use of inorganic fertilizer without adding any other fertilizer may cause problems for human health. However, inorganic fertilizers play a major role in plant nutrition's (Adediran *et al.*, 2005; Ayoola and Makinde, 2007).

Farmyard manure is rich in micronutrients. The word farmyard manure refers to the urine of farm animals along with litter (leftover material from roughages and faded fed by cattle) and decomposed mixture of drugs. An average well decomposed FYM contains 0.5%N, 0.2% P<sub>2</sub>N<sub>5</sub>, and K<sub>2</sub>O, 0.5 % Nitrogen is very important element for crop growth production. It is normally available in organic form in animal manure (Nasir *et al.*, 2010).

The aim of this study was to examine the effects of different amounts of inorganic and organic fertilizers for the growth and yield production of *Zea mays* L., crop.

## Materials and methods

A field experiment was conducted to compare the effect of Urea, Farm-yard manure (FYM), and Nitrogen, Phosphorus, Potassium, (NPK) (N120, P30 and K60 kg ha<sup>-1</sup> Fertilizer) on the germination, growth and yield of Maize (*Zea* in the nursery of University of Balochistan Quetta, during summer 2012).

### Description of Experimental Site

Present experiment was carried out in the nursery of University of Balochistan, Quetta. Experimental site was comparable to the natural agricultural field of Quetta region. The texture of the soil used was sandy loam. Experiment was carried out in the natural sunlight and other environmental conditions.

The experiment consists of four treatments i.e Control, Urea, FYM and NPK. 250gms of each fertilizer treatment was applied before sowing and another 250 gms of each fertilizer was applied at the stage of flowering in the respective treatment plot of each crop.

### Source of Seeds

Certified seeds of Maize (*Zea mays* L.) were collected from Federal Seed Certification Department, Quetta. Seed were provided from fresh lot because of their viability. They were screened for empty looking and shriveled ones. Healthier looking seeds were selected for the experiment.

### Experimental design

The experiment was conducted in randomized complete block design with 4 replicates. Plots sizes were 5.00 m x 10.00 m. Soil used in the experiment was dug up to one feet depth in the fertile field of experimental area. Soil lumps were broken into small soil fragments thoroughly mixed and pebbles were also removed.

### Sowing of Seeds

The seeds of all selected crops were sown manually on 21<sup>st</sup> May 2012. A distance of 1 ft was maintained between rows and each seed was sown at a depth of 1.5 inch in the soil. A total of 20 seeds were sown in each treatment plot including control plots of each crop.

### Growth and yield Parameters

Several growth and yield parameters were recorded to assess the impact of various fertilizer treatments on the selected experimental crops Table 1.

## Results

### Growth Parameters

The results for the mean plant height, leaves size/plant (cm<sup>2</sup>), fresh weight of shoot/plant (g) and oven dry weight of shoot/plant (g) of *Zea mays* affected by different fertilizer treatments represented in the Table 1.

**Table 1.** Growth and yield parameters of *Zea mays*.

SN.	Growth parameters for <i>Zea mays</i>	Yield parameters for <i>Zea mays</i>
1	Plant height (cm)	Cob length/ plant (cm)
2	Leaf size/plant (cm <sup>2</sup> )	Number of Cob/plant
3	Number of leaves/plant	Number of seeds /cobs
4	Root length/plant	100 seeds weight/plant (g)
5	Fresh weight of shoot/plant (g)	Fresh weight of cob/plant.
6	Oven dry weight of shoot/plant/(g)	Oven dry weight of cobs/plant (g)

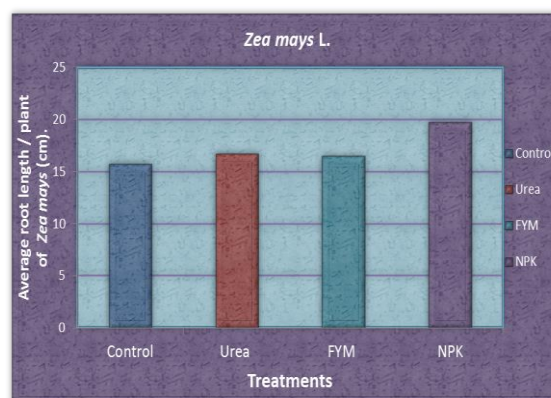
The results shown that mean plant height is significantly affected by the fertilizer treatment. The maximum mean plant height was observed in the plants of NPK plots (188.27 cm) followed by the plant of Urea plots 159.75 cm & FYM plot 145.15 cm. Minimum average plant height in *Zea mays* was observed in the control plant (139.26 cm).

Results exposed that leaf area is the significantly affected by the application of fertilizer. Maximum leaf area/plant was observed in the plant of NPK plot (333.76 cm<sup>2</sup>) followed by the urea and FYM plot plants i.e. 321.92 cm<sup>2</sup> & 252.88 cm<sup>2</sup> respectively. The minimum/smallest leaf/plant was observed in the plant of control plants (224.21 cm<sup>2</sup>).

The result revealed that various fertilizer treatments had significant effect on the average Shoot fresh weight of the plant. Maximum average shoot fresh weight was observed in the plant of NPK plot (309.13g) followed by the plant of Urea & FYM plot with 266.30g & 265.34g respectively. Minimum average shoot fresh weight was observed in the control plant (255.34g).

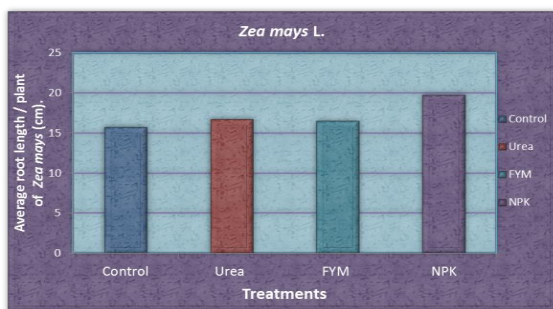
We observed that maximum average oven dry weight of shoot was observed in the plant of NPK plot (140.25g) followed by the plant of Urea & FYM plot with 134.77gm & 122.56g respectively. And minimum average oven dry weight of shoot / plant was observed in the control plant of *Zea mays* (110.86g).

The result or the average No. of leaves/plant affected by different fertilizer treatments are graphically represented in Fig. No 1. Maximum average number of leaves/plant in *Zea mays* was observed in the plants of NPK plot (17.5) followed by the plant of urea and FYM with 15.7 & 15.3cm respectively. Minimum average number of leaves/plant was observed in the control plants (13.5).



**Fig. 1.** Average no. of leaves/plant of *Zea mays* as affected by various fertilizer treatments.

The result of average root length/plant of *Zea mays* affected by different fertilizer treatments are graphically represented in Fig. no 2. Maximum average root length was observed in the plants of NPK plot (19.72 cm) followed by the plant of Urea & FYM plot i.e. 16.72 cm & 16.47 cm respectively. Minimum root length was observed in the control plant (15.47 cm).



**Fig. 2.** Average root length/plant of *Zea mays* as affected by various fertilizer treatments.

**Table 2.** Growth parameter of *Zea mays* L. is affected by different fertilizer treatments.

S. No	Growth parameters for Zea Mayas	Control	Urea	FYM	NPK
1	Plant height (cm).	139.26 ± 22.17	159.75 ± 29.60	145.15 ± 26.12	188.27 ± 21.29
2	Leave size/plant (cm <sup>2</sup> )	224.21 ± 3.20	321.92 ± 2.26	252.88 ± 2.37	333.76 ± 3.23
3	Fresh weight of shoot/plant(g)	255.34 ± 75.89	266.30 ± 83.24	265.34 ± 75.89	309.13 ± 01.53
4	Oven dry weight of shoot/plant(g)	110.86 ± 50.40	134.77 ± 58.44	122.56 ± 53.64	140.25 ± 51.92

**Table 3.** Yield parameter of *Zea mays* L. is affected by different fertilizer treatments.

S. No	Zeas Mayas	Control	Urea	FYM	NPK
1	Cob Length / plant(cm)	14.92 ± 1.97	16.62 ± 2.30	15.82 ± 2.08	18.25 ± 2.46
2	100 seeds weight / plant(g)	17.01 ± 3.08	19.03 ± 2.84	17.70 ± 2.59	19.81 ± 3.34
3	Fresh weight of cobs / plant(g)	96.18 ± 25.20	112.69 ± 8.38	104.68 ± 26.82	133.72 ± 17.31
4	Oven dry weight of cobs / plant(g)	32.47 ± 16.10	42.23 ± 18.12	35.26 ± 16.65	57.87 ± 19.39

The result of table 01 shows that cob length is significantly affected by the fertilizer treatment. The maximum mean cob length was observed in the plants of NPK plots (18.25 cm) followed by the plant of Urea plots (16.72 cm) and FYM plot (16.47 cm). Minimum average plant height was observed in the control plant (15.47 cm).

The result revealed that NPK fertilizer treatment produced the maximum average 100 seeds weight/cob i.e. 19.81g followed by Urea and FYM plot plants with 19.03g and 17.70g respectively. Minimum average 100 seeds weight /cob was observed in control plants of *Zea mays* which had an average 100 seeds weight /cob of 17.01g.

Table no 02 also shows that Maximum fresh weight of cob/plant was observed in the plant of NPK plot (133.72g) followed by Urea & FYM plot with an average weight of 112.69g & 104.68g respectively. Minimum average fresh weight of cob/plant was observed in control plant with an average weight of 96.18 g.

### Yield Parameters

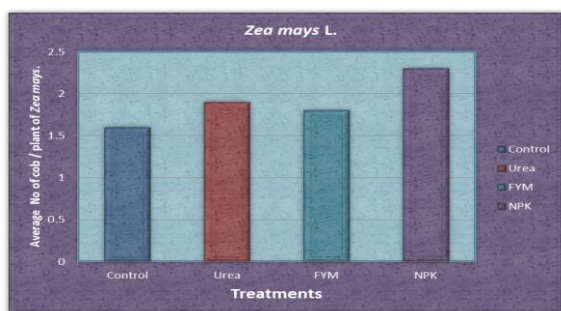
#### Average Cob Length

The results of the cob length/plant (cm), 100 seeds weight/plant (g), fresh weight o cobs/plant (g) and oven dry weight of cobs/plant (g) of *Zea mays* are increased by different fertilizer treatments represented in the Table 02.

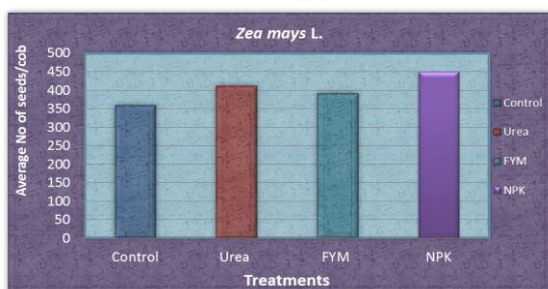
The result shown that average oven dry weight of cob/plant significantly affected by various fertilizer treatments. Maximum oven dry weight of cob/plant was observed in the plant of NPK plot (57.87g) followed by Urea & FYM plot with an average weight of 42.23g & 35.26g respectively. Minimum average oven dry weight of cob / plant was observed in control plants of *Zea mays* with an average weight of 32.47g.

Fig. no 3 showed the average number of cob/ plant affected by different fertilizer treatments. NPK fertilizer treatments had significant impact on the average number of cob/plant; NPK fertilizer treatment enhanced the production of cob. A maximum average of 2.3 cob/plant were observed in the plants of NPK plot followed by the plants of Urea & FYM plots with the 1.9 & 1.8 average number of cob/plant respectively. Minimum number of cob/plant was observed in plants of control plot.

Fig. no 04 showed that the average Number of seeds/cobs affected by various different fertilizer treatments. The result exposed that NPK fertilizer treatment produced average maximum number of seeds/cob i.e. 450.8 followed by Urea and FYM plot plants with 412.7 and 391.7 of average number of seeds/cob respectively. Minimum number of seeds/cob was observed in plants of control plot of *Zea mays* which had 359.75 average numbers of seeds/cob.



**Fig. 3.** Average no. of cobs/plant of *Zea mays* as affected by various fertilizer treatments.



**Fig. 4.** Average no. of seeds/cob of *Zea mays* as affected by various fertilizer treatments.

### Discussion

The result for the growth & yield parameters of *Zea mays* L. revealed that fertilizer treatment had significant effect; thus enhancing the yield of *Zea mays* significantly. NPK for *Zea mays* L. too proved to be highly effective, then Urea & FYM. Reduction in all growth and yield parameter was observed in the control plant of *Zea mays* L. The results are in accordance with the findings of Uwah *et al.*, (2011) who found that different PM ratios combined with different rates of N had significant effect on the plant height, leaf area index, number of grains/cob and also hastened tasselling of *Zea mays*.

Total dry matter (TDM), weight of grains/cob and total grain yield, peaked at 10t/ha PM and 80 kg N/ha fertilizer. At 10t/ha PM and 80 kg N/ha rates, TDM yield increased by 41 and 37% and grain yield by 42 and 39% respectively compared with the control treatments (Uwah *et al.* 2011).

Amujoyegbe *et al.*, (2007) reported effect of organic & inorganic fertilizer on yield & chlorophyll content of maize (*Zea mays* L.). There were significant variability & diversity observed on the crops due to treatments. Grain yield was 2.89 kg/ha under IF treatment for maize (2.33 kg/ha). Maize had the 72.3 g/plant dry matter. Maize had the highest LA (Leaf Area) (1969.5 cm<sup>2</sup>/plant) & total chlorophyll content of 2.63 mg/g under IFPM. In maize, the lowest chlorophyll content occurred in control plot. Drought tolerance measured as percentage chlorophyll stability index (CSI %) was highest under control plots (Amujoyegbe *et al.* 2007).

Walsh *et al.*, (2012) documented the effect of delayed nitrogen fertilization on maize (*Zea mays* L.) grain yields & nitrogen use efficiency. Several combinations of preplant & side dress N at various growth stages were evaluated. Maize grain yields were maximized with 90kg N ha<sup>-1</sup> preplant followed by 90 kg N ha<sup>-1</sup> side dress at V6 or V10 (8 of 9 site-years). Delaying N application until V10 growth stage when preplant N was applied did not result in lower yields. Mid-season N supplies fertilizer at the time when crop need & N uptake are at a maximum, & thus facilitates more efficient N use (Walsh *et al.* 2012).

Asghar *et al.*, (2010) reported the growth & yield of maize (*Zea mays* L.) cultivars affected by NPK application in different proportion. The plant height was significantly affected by different rates of NPK. Treatment F<sub>3</sub> (250-110-85) of NPK produced tallest plants than two other treatments. They found too low or high NPK levels reduced the yield & yield parameters of maize crop. Treatment F<sub>2</sub> (175-80-60) seems to be the most appropriate level to obtain maximum grain yield under the prevailing conditions (Asghar *et al.*, 2010).

Adekayode & Olojugba (2010) documented the utilization of wood ash as manure to reduce the use of mineral fertilizer for improved performance of maize (*Zea mays* L.) as measured in the chlorophyll. The four treatments investigated were 4 t/ha wood ash, 300 kg/ha NPK 15-15-15, 200 kg/ha NPK 15-15-15 plus 2t/ha wood ash mixture & a control plot without manure. Downy mildew resistant (DMR) open pollinated maize variety was planted at 60 × 30 cm in a randomized complete block experiment replicated four times, & the manure was applied in a ring at 10 cm from the maize plant. They found chlorophyll content & the grain yield were significantly high in 200kg/ha NPK 15-15-15 + 2t/ha wood ash mixture & in 300 kg/ha NPK 15-15-15 compared to other treatments (Adekayode and Olojugba 2010).

Sharifi & Taghizadeh (2009) reported the response of maize (*Zea mays* L.) cultivars to different levels of nitrogen fertilizer. N levels as urea (N 0, 80, 160 & 240 kg/ha) were in the main plots (control = N 0 kg/ha), & maize cultivars (SC-301, DC-370 & SC-404) was allocated at randomized in the sub-plots. Results indicated that nitrogen levels had significant effects on yield & yield components in maize hybrids. The highest grain yield was obtained from the highest levels of nitrogen fertilizer. They found maximum grain yield (7.76 ton/ha) was obtained in the plots with N 240 kg ha<sup>-1</sup> & SC-404 cultivar & minimum of it (5.12 ton/ha) was obtained in the plots with 0 kg nitrogen ha<sup>-1</sup> & SC-301 cultivar. They recommended that SC-404 hybrid can be applied with N 240 kg/ha in conditions of Ardabil Plain (Sharifi and Taghizadeh 2009).

Leslie *et al.*, (2009) reported the effect of organic nutrients on soil nutrient availability & maize (*Zea mays* L.) performance in Njoro, Kenya. The sub-plots were two residue management types; residue incorporation & residue removal with farm yard manure (FYM) incorporated in its place. Incorporation of LB, CR & GP residues resulted in higher concentrations of N & P in soil than NF residue & FYM incorporation in both cropping systems.

Under sole maize, grain yield following LB was significantly higher (51, 28.2 & 52%) than after CR, GP & NF, respectively. In the M/B intercrop, maize grain yield following LB was significantly higher (38.5 & 28.5%) than after GP & NF with no significant differences in yields following CR & LB. Maize dry matter (DM) yields followed a similar trend (Lelei *et al.* 2009).

Jaliya *et al.*, (2008) documented the effect of sowing date & NPK fertilizer rate on yield & yield components of quality protein maize (*Zea mays* L.). They observed effect of three dates of planting (10, 20 & 30 June) & four NPK levels (0:0:0, 120:18:33, 150:26:50 & 180:35:66 kg NPK/ha) on the yield & yield components (number of grains/cob, 100-grain weight, cob weight/plant, cob weight/ha, grain weight/plant & grain weight/ha) of quality protein maize. They found, cob weight/plant; cob yield/ha & grain weight/plant in 150:26:50 kg NPK/ha were significantly higher than the other rates except 180:35:66 in both years. Early sowing (June 10) & 150:26:50 kg NPK/ha were the best sowing date & fertilizer rate for growth & yield of Quality Protein Maize (QPM) variety GH110 - 5 in Northern Guinea Savanna ecological zone of Nigeria (Jaliya *et al.* 2008).

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