Full Length Research

Optimization of Fertilizer Application Rate for Maize Crop Grown With Untreated Waste Water

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Field experiment was conducted to study the effect of waste water with basal dose of NPK on the morphological traits of maize during 2014. This research was carried out according to randomized complete block (RCB)design with five replications. The characters studied including germination percentage, plant height, leaf area, plant wet weight and plant dry weight were measured. The germination percentage and plant height decreased with reduction in the recommended doses of N, P and K with application of wastewater. The maximum value were recorded for seed emergence percentage, leaf area, fresh and dry weight in T1(Full N + Full P + ½ K + waste water),while minimum value were recorded for seed emergence percentage, leaf area and fresh weight in T9 (Full N, Full P and full K).It was recommended that application of waste water with NPK could be favorable effects on the maize crop.

Key words: NPK, waste water, morphological traits, maize.

INTRODUCTION

Maize (Zea mays L.) is the world leading cereal crop. It belongs to grass family, Poaceae. It is native to America and was cultivated about 8, 000 years ago. Because of the highly cross pollinated nature, maize does not survive probably in its wild form. It is monoecious i.e. the staminate and pistillate flowers are borne in isolated inflorescence on the same plant. It is grown at altitude from sea level to 3300 meters above sea level and from 50oN to 40oS latitude as a multi-use crop in temperate, sub-tropical and tropical regions of the world (Ihsan et al., 2005).Maize is one of the most widely distributed crops of the world. This crop being the highest yielding cereal crop in the world is of significant importance for countries like Pakistan, where rapidly increasing population has already out stripped the available food supplies. In Pakistan, maize is the third important cereal after wheat and rice (Bukhsh et al., 2011). Intensive cropping system requires highly fertilized soils and those soils should be maintained through integrated plant nutrient management system. The fertilization can affect enzymatic activities inside the soil profile. Proper applications of waste water with inorganic fertilizers can increase the activities of soil

micro- organisms and enzymes and soil available nutrient contents (He and Li, 2004). He and Li, (2004) indicated that combined application of organic and inorganic fertilizers with waste water can increase the activities of soil invertase and available nutrient content. Furthermore, the application of waste water with chemical fertilizer can prove to be an excellent procedure in maintaining and improving the soil fertility, and increasing fertilizer use efficiency. For this reason, it could be helpful to study the effect of application of waste water with chemical fertilizer by using integrated nutrient management system, which has been the research focus all over the world. The influence of different nutrients applied to soil on farmland ecosystem was different. Therefore, the present study was carried out to evaluate the effect of different corn variety under the integrated use of inorganic fertilizers with waste water under the agro-climatic conditions of Faisalabad, Pakistan.

MATERIALS AND METHODS

The experiment was conducted at the University College of Agriculture, University of Sargodha, Pakistan during the year 2014. This research was carried out according to randomized complete block (RCB) design with five replications. To study the effect of different does of NPK with waste water on maize crop, pot culture experiment was carried out under field conditions. Different pots were used for the sowing of the seed and each pot was carried 10 kg of the soil. Six seed were sown in each pot. With a daily observation, emergence date was recorded for each treatment after start of the experiment. Seed germination was noted daily up to day 7. A seed was considered germinated when radical emerged by about 2 mm in length. Then the mean germination rate was calculated according to the following equation:
R= ∑ n / ∑ D.n
Where,
R is mean germination rate
n is the number of seeds germinated on day
D is the number of days from the start of test

Germination percentage was also determined at the end of the test. Plant height was taken with meter rod after 25 and 50 days. Five plant were randomly selected from each treatment and leaf area of three leaves (Upper, Lower, Middle) from each plant were measured with the help of leaf area machine and average was worked out. Fresh weight was calculated by weighing the thinned plant sample on electric balance and dry weight of thinned plants was calculated after drying in oven at 105° C by weighing through electric balance. Four numbers of irrigations were applied during the growing season. Different doses of fertilizers with waste water were applied in the plots. All cultural practices were followed

from sowing till harvest. The data collected during the maize crop season were statistically analyzed by using the computer statistical program Mstat-C. Analysis of variance technique was employed to test the overall significance of the data, while the least significance difference (LSD) test at P = 0.05 was used to compare the differences among treatment means (Steel et al., 1997).

RESULTS AND DISCUSSION

Data pertaining to germination percentage are presented in Table-3. As evident from the table, maximum values of germination % age (83.40) were recorded in Full N + Full P + ½ K + waste water treatments while the minimum values were recorded in T9(65.00). The result exhibited that all the treatments were statistically significant to each other for seed germination. The results indicated that application of waste water with the recommended fertilizer have a favorable effect on the germination of maize crop. These results are in opposite with those reported by Shahnaz and Sheikh (1980) who observed a decrease in % germination when the levels of waste water application were increased. Data in Table 3 showed that maximum plant height of 9.85 inches was obtained in case of T5 after 25 days of seed germination while after 50 days, maximum plant height of 16.25inches was taken in case of T1 followed by T2 (15.80 inch). Minimum plant height of 6.35 and 11.80 inches was recorded in control as T1 after 25 and 50 days, respectively. The results of T1, T2, T3 and T5 were significantly higher compared to other treatments but were statistically significant to each other. It was concluded from the results that the plant height increased by addition of waste water with the addition of recommended fertilizer for maize crops. These results also confirmed the findings carried out by Borin and Sartori (1989 and Tamayo et al. (1997).Data recorded for leaf area are presented in Table 4. Maximum leaf area (58.20) was recorded in T1 followed by T3, while minimum leaf area (48.00) was noted in control treatment as T9. It observed form the result that T1, T3, T5 and T2 had significant effect on leaf area of maize crop. The result exhibited that all the treatments were statistically significant to each other for leaf area. The results are in line with those reported by Pietz et al. (1982) who observed a decline in leaf area with higher rates of waste water application. The data in Table 4 exhibited that maximum fresh plant weight (8.40g) was noted in T1 followed by T2 and T4 (3.78g) while minimum fresh plant weight (3.40g) was showed in T9. The results of all treatments were significantly different to one another. It showed that application of waste water at the various fertilizer rate were having favorable effect on the fresh plant weight of maize crop, while further increase in the

Table1. Different doses of fertilizers with waste water

Treatments	Doses
T1	Full N + Full P + ½ K + waste water
T2	½ N + ½ P + ½ K + waste water
T3	½ N + Full P + full K + waste water
T4	Full N + ½ P + Full K + waste water
T5	Full N + Full P + nil K + waste water
T6	½ N + ½ P + Full K + waste water
T7	Full N + ½ P + ½ K + waste water
T8	Full N + nil P + Full K + waste water
T9 (Control)	Full N + Full P + Full k

Table 2. Mean Square values

Parameters	Replications (df-4)	Treatments (df-8)	Error (df-32)
Seed germination (%)	3.87	210.09**	5.80
Plant height after 25 days	1.32	5.22**	0.72
Plant height after 50 days	1.00	8.49**	1.11
Leaf Area	8.31	46.90**	12.82
Plant fresh weight	1.19	13.25**	0.51
Plant dry weight	0.52	0.99**	0.40

** = Highly significant at P≤0.01

rate of waste water application had negative effect on it. For dry plant weight the data are presented in Table 4. As showed from the table, maximum values of dry plant weight (2.00g) were recorded in T1 and T2 while the minimum values were recorded in T7 (0.80g). The result exhibited that all the treatments were statistically significant to each other for dry plant weight. The results indicated that application of waste water with the recommended fertilizer rate was having favorable effect on the germination of maize crop.

CONCLUSIONS

After studying the physical parameters i.e. Germination Percentage (GP), plan height, plant fresh and plant dry weight. On overall basis Pioneer-3062 genotype of maize was proved to be best with the recommended doses of N, P and K with waste water and it was most susceptible when K was not applied so its performance could be enhanced by apply more K fertilizers. The hybrid Pioneer-3062 gave excellent results with respect to morphological components as well as, Germination Percentage (GP), plan height, fresh plant weight, plant

Table 3. Effect of different fertilizer on various morphological components

Treatments	Seed germination (%)	Meansafter 25 days (inches)	Meansafter 50 days (inches)
T1	83.40f	9.71c	16.25d
T2	75.40c	9.14bc	15.80cd
T3	79.40cd	8.86bc	15.20bcd
T4	82.26ef	8.98bc	14.80bc
T5	82.46ef	9.85c	14.20b
T6	70.20b	8.60b	15.60cd
T7	70.20b	8.93bc	15.00bcd
T8	76.60cd	8.31b	15.40bcd
T9 (Control)	65.00a	6.35a	11.80a
LSD	3.11	1.10	1.36

Table 4. Effect of different fertilizer on various morphological components

Treatments	Leaf Area	Fresh weight (g)	Dry weight (g)
T1	58.20d	8.40e	2.00bc
T2	55.00bcd	6.80d	2.00c
T3	56.80cd	5.40c	1.60abc
T4	54.60bcd	6.80d	1.80bc
T5	56.00bcd	5.60c	1.20abc
T6	53.80bcd	4.80bc	1.60abc
T7	52.80bc	4.00ab	0.80a
T8	51.40ab	4.00ab	1.00ab
T9 (Control)	48.00a	3.40a	1.10ab
LSD	4.62	0.92	0.82

dry weight and leaf area. Among different fertilizer treatments, maximum value was observed for morphological components in the case of T1 (Full N + Full P + ½ K + waste water) gave outstanding results as compared to other treatments, in hybrid corn under agro-climatic conditions of Sargodha, Punjab Pakistan.

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