http://www.pjbs.org

PJBS

ISSN 1028-8880

# Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (12): 1994-1995, 2000


# Determination of Optimum Level of Potash and its Effects on Yield and Quality of Maize

Aman Ullah Chaudhry and Javeed Khalid Malik
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

**Abstract:** A field experiment was conducted to determine the optimum level of potassium on maize (*Zea mays* L.) growth, yield and quality. The potash level comprised 0, 50, 100, 150, 200, 250, 300 and 350 Kg $K_2O$ $ha^{-1}$ while the maize hybrid was 922 single supper cross. Amongst the eight potash treatments 150 kg $ha^{-1}$ gave the highest yield of 7.74 t $ha^{-1}$, but the overall effects of all treatments were non-significant. The yield components like cob length, 1000-grain weight and number of grains per cob remained unaffected but cob yield was significant by potash application. Similarly the parameters like plant height at maturity, number of grain rows per cob, days taken to tasseling and silking remained unaffected, however, stalk yield and protein contents were significantly affected. The optimum level lies between the range of 150-200 Kg $K_2O$ $ha^{-1}$, beyond this level the application of potash is not profitable.

**Key words:** Maize, potash, quality, yield

## Introduction

Maize is an important cereal crop of the world as well as of Pakistan and it ranks third in cereals next to wheat and rice in respect of area and production. Though the existing varieties have a high potential, soil and climatic conditions of Pakistan are also ideal for maize production, but yield per hectare in Pakistan is very low as compared to many maize growing countries of the world. The causes of this gap in yield include injudicious use of inputs and lack of adoption of modern production technology. Among the various yield determining factors, application of fertilizer is an important one. The intensive cropping pattern at present has deprived the soil of essential plant nutrients such as nitrogen, phosphorus and potassium. This has resulted in lowering the yield of crops especially fast growing crops like maize. Uptil now, the use of chemical fertilizer has been mainly confined to the application of nitrogen and phosphorus, but no attention has been paid to potassium.

Potassium is an essential element for all living organisms. Potassium is of utmost importance for water status of plant and is involved in the growth of meristematic tissues. Potassium is also indispensable for the maintenance of cell turgor pressure, which is required for cell expansion. Potassium plays a significant role in osmoregulation of plant cell and regulates opening and closing of stomata. Potassium is not a constituent of organic structure but regulates enzymatic activities and translocation of photosynthates (Mengel and Kirby, 1987). Potassium is not deficient in our soils because soils of Pakistan, in general, made of such minerals, which have large capacity to provide K to crops under normal conditions because of dominance of illite minerals (Ranjha *et al.,* 1990).

In the literature there is lot of controversy over the application of potash. Many authors respond positive effect of K on maize yield and quality. However, there are number of authors who reported non-significant effect on yield (Chudhry and Ahmad, 2000). At present Punjab Agriculture Department recommend K at the rate of 100 Kg $ha^{-1}$. In order to solve the controversy the following study was conducted. The effect of varying Levels of potassium ranging from 0 to 350 Kg $K_2O$ $ha^{-1}$, on yield and quality of maize genotype 922 single supper cross hybrid, was studied under Faisalabad conditions.

## Materials and Methods

The study was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad in autumn season during the year 1997. The experiment was laid out in randomized complete block design with three replications keeping a net plot size of 7.4 m. Potash treatments included in this study were 0, 50, 100, 150, 200, 250, 300 and 350 Kg $K_2O$ $ha^{-1}$. A uniform dose of 250 and 150 Kg nitrogen and phosphorus $ha^{-1}$ was used respectively and $ZnSO_4$ was also used at the rate of 15 Kg $ha^{-1}$. Urea, diammonium phosphate and potassium sulphate were used as the sources of N, $P_2O_5$ and $K_2O$, respectively. Nitrogen was applied in two equal doses, one along with whole dose of $P_2O_5$ and $K_2O$ at the sowing time by side dressing with the single row hand drill, while the remaining dose of nitrogen was top dressed before tasseling stage.

Maize CV 922 single supper cross hybrid was sown on August 18, 1997 using a seed rate of 15 Kg $ha^{-1}$. The sowing was done with dibbler and plant to plant distance was maintained 25 cm and row to row distance used was 75 cm. The insecticide Fenvalrate was applied at the rate of 600 ml $ha^{-1}$ to check the attack of stem borer. irrigation was given when needed and the field was kept weed free throughout the season. All other possible plant production and agronomic practices were applied uniformly to the crop during the study period.

Observations on desired parameters were recorded using standard procedures. Data obtained were analyzed statistically by using Fisher's analysis of variance technique, while significance of treatment means were tested by using least significance difference (LSD) at five percent level of probability (Steel and Torrie, 1980). Before the conduct of experiment, soil analysis was done which showed 0.038% N, 8.17 ppm available $P_2O_5$ and 166.6 ppm available $K_2O$. The pH of the soil was 7.63. At the time of harvest, climatic data of the crop growing season were taken and compared with last five growing seasons. Data showed there was no fluctuation with previous crop growing seasons, except low rainfall during the experiment of crop growing season.

## Results and Discussion

**Yield and yield components:** The results showed that different potash levels did not significantly affect the grain

Table 1: Effect of levels of Potash on maize cob, stalk yield and protein contents

| Characters | Treatments $K_2O$ (Kg $ha^{-1}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 | 50 | 100 | 150 | 200 | 250 | 300 | 350 |
| Cob yield (t $ha^{-1}$) | 11.56bcd | 12.06abc | 12.25ab | 12.53a | 12.23ab | 12.10ab | 11.27cd | 11.23d |
| Stalk yield (t $ha^{-1}$) | 12.40cd | 14.28b | 14.05bc | 15.94a | 14.53ab | 13.80bc | 11.66d | 12.15d |
| Protein contents (%) | 5.54c | 7.24b | 7.72ab | 8.31ab | 8.45ab | 8.98a | 7.24b | 7.24b |

Table 2: Marginal product and inverse price ratio at different levels of potash application

| $K_2O$ applied Kg $ha^{-1}$ | Yield obtained Kg $ha^{-1}$ | Total product due to $K_2O$ | Maginal product | Inverse price ratio |
|---|---|---|---|---|
| 0 | 7100 | - | - | - |
| 50 | 7270 | 170 | 3.40 | 2.2 |
| 100 | 7460 | 360 | 0.20 | 2.2 |
| 150 | 7740 | 640 | 0.67 | 2.2 |
| 200 | 7600 | 500 | -1.77 | 2.2 |
| 250 | 7460 | 360 | -1.06 | 2.2 |
| 300 | 6910 | -190 | -2.07 | 2.2 |
| 350 | 7100 | 0 | 0.00 | 2.2 |

Price of maize per Kg = Rs.10, Price of fertilizer per Kg = Rs. 22

yield of maize. These results are in line with Parsad and Shrivastava (1992) however these results contradict with Ali *et al.* (1986). This may be due to, that soils of Pakistan are made up of 'Hite clay mineral, which have greater capacity to provide K (Ranjha *et al.,* 1990). Another reason is that initial K status 166.6 ppm of the soil is sufficient quantity. The yield components like cob length, 1000-grain weight and number of grains per cob remained unaffected but cob yield was significantly affected by potash application (Table 1). However this increase in cob yield was not reflected significantly in the final yield. Cob yield was significant by potash level of 150 kg $ha^{-1}$ and it was found at par with up to 250 Kg $K_2O$ $ha^{-1}$, but significantly different from control and highest treatment at 350 Kg $K_2O$ $ha^{-1}$ (Table 1).

**Photo biomass production:** The results showed that plants per plot and plant height were not significantly affected by potash application. However it was clear from Table 1 that potash at 150 kg $ha^{-1}$ significantly increased the stalk yield up to 15.94 t $ha^{-1}$ and remained at par with yield obtained by application of potash dose of 200 kg $ha^{-1}$. However, potash application of 150 kg $ha^{-1}$ gave significant different stalk yield from control and other potash treatment (Table 1). The increase in stalk yield is not significantly reflected in the final yield. These results are in agreement with Chaudhary and Roy (1992).

**Quality:** Protein is the major nutritive constituent of seed, which determines the ultimate quality of seed. The highest protein contents 8.98% were recorded under the treatment of 250 kg $ha^{-1}$ and *were* statistically at par with 150 kg $ha^{-1}$. However, 150 Kg $k_2O$ $ha^{-1}$ significantly produced more protein contents than control.

**Optimum level:** Optimum level of potash was determined by equating the inverse price ratio with marginal product (Table 2) which indicated that the potash application in the range of 150-200 Kg $K_2O$ $ha^{-1}$ is the optimum level. As the results showed that application of K had non-significant effect on the maize yield, but its application is profitable to farmers. Further research may be conducted at different locations on different types of soils and in different years keeping in view of initial potassium level in soil. The present recommendation of Punjab Agricultural Department at the rate of 100 Kg $ha^{-1}$ of $K_2O$ needs further investigation. Depending upon opportunity cost of capital if the farmer choose not to apply potassium to maize, he may save up to Rs. 3000 per hectare and as a result the cost of production may be reduced. Further there is need for research for efficient application such as in the form of sprays etc.

## References

Ali, A., M. Arshad and S. Ahmad, 1986. Response of maize to different fertilizer levels with different planting patterns. Pak. J. Agric. Res., 24: 289-293.

Chaudhary, S.K. and H.K. Roy, 1992. Effect of levels and methods of potash application on yield and K uptake by maize and forms of K in alfisols. J. Indian Soc. Soil Sci., 40: 868-870.

Chudhry, A.U. and A. Ahmad, 2000. Determination of optimum level of potash and its effect son yield and quality of sugarcane. Pak. J. Biol. Sci., 3: 1152-1153.

Mengel, K. and E.A. Kirby, 1987. Principles of Plant Nutrition. 4th Edn., International Potash Institute, Berne, Switzerland, pp: 100-115.

Parsad, B. and A.R. Shrivastava, 1992. Different responses of rabbi and kharif maize genotypes to K application in calcareous soil. Potassium Res., 8: 65-70.

Ranjha, A.M., A. Jabbar and R.H. Qureshi, 1990. Effect of amount and type of clay minerals on potassium fixation in some alluvial soils of Pakistan. Pak. J. Agric. Sci., 27: 187-192.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics. McGraw Hill Book Co. Inc., New York, pp: 232-251.