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Effect of Different Level of Potassium on Early Growth of Maize (Zea mays L.) Genotypes

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Abstract

Nitrogen, phosphorus and potassium are the major nutrients required for the proper growth and development of the maize crop. Among N P K, Potassium (K) is an essential nutrient for plant growth which cannot be replaced by other nutrients. An experiment was carried out at Sundarbazar, Lamjung during May-June 2015 in diffused light condition to find the effect of K on two varieties of maize viz. RatoMakai and QPM. Maize genotypes were grown under four treatment combinations of K (control, 17kgha^{-1}, 22 kgha^{-1} and 27 kgha^{-1}). Four replications of treatment were arranged in Randomized Complete Block Design. QPM showed 13% and 9% more plant height than RatoMakai under control and 27 kgha^{-1} treatment respectively. Similarly, 16% more height was observed in QPM at 27 kgha^{-1} over control and 19% more height in RatoMakai in same case. The biomass accumulation (root and shoot) in both maize genotypes were found greater in case of 27 kgha^{-1} than control. But, in comparison between these two genotype QPM variety showed higher biomass accumulation than RatoMakai variety in all level of treatments. QPM seemed to be suitable genotype over RatoMakai in this environmental condition, that showed good results towards all parameters at various level of treatment.

Key Words: biomass; plant height; potassium; qpm; ratomakai

Introduction:

Maize (Zea mays, L.) is a monocot plant and it can be grown from Terai to Hilly areas and almost all maize growing areas of Nepal (NMRP, 2012). In Nepal, maize is the principle food crop in hilly region and the second most staple food crop of the country after rice in terms of production and productivity. In fiscal year 2012/2013 (AICC, 2071B.S) the total production of maize was 19,99,010 MT, which occupies about 8,49,635 ha of land. More than 69% of mid hills area is occupied by maize. It can be used as food, feed, fodder and raw materials for industrial purpose.Maize plant shows good response towards fertilizer application. Among N P K, Potassium (K) is an essential nutrient for plant growth which cannot be replaced by other nutrients.The function of K is associated with increased root growth and tolerance to drought, cellulose formation, enzyme activity, photosynthesis, transportation of sugar and starch, increase protein content of plants, maintain turgor, reduce water loss, and to protect plants against diseases and nematodes (Thomson, 2008).

Plants absorb potassium in its ionic form, K+. The high mobility of K results in its loss through leaching due to heavy rainfall. According to study conducted by Brady (1992), most potassium added to the soil will be fixed in the spaces between clay lattice and plants can utilize only 1-2%.The amount of slowly available potassium varies according to the type of clay that dominates the soil. Later, on the next growing season the slowly available K acts as readily available K for the plant. Potassium uptake by plant is affected by several factors thus those factors should be taken in consideration for the optimum utilization of potassium. Some of the factors associated with K uptake are soil moisture, soil aeration and oxygen level, soil temperature, tillage system.

Area under hybrid genotypes is increasing in Nepal. The hybrid genotypes replacing local and other various indigenous genotypes of maize. Hybrid varieties show good response towards fertilizer application and gives good yield than the local genotypes. Local genotypes of Nepal can also give good production in various environmental conditions. For the better production of maize, effective fertilizer management i.e.

effective dose of fertilizer should be applied.

Potassium deficiency in most soil in Nepal has been reported. Recently, depleting K pool has been reported in Nepal (Regmi, et al 2003). Managing K, therefore, is emerging as key concern. And the required fertilizers for cultivation is not timely available. Thus, for managing the appropriate dose of potassium for the early growth and development of plant, the research has been conducted. So that which appropriate level of k could be determined for the efficient growth and development of maize plant in early phase.

Materials and Method:

A pot experiment was conducted under diffused light condition under a roof of under construction library of Lamjung Campus, Sundarbazar, Lamjung (800masl) during May-June 2015. The experimental area lies in mid hills region of Nepal with subtropical climate. Our experiment was carried under a roof so precipitation and direct sunlight had very less effectRandomized complete block design (RCBD) with four replication, four treatments (potassium dose of 0, 17, 22, 27 $kgha^{-1}$) for two varieties of maize (one local and one hybrid). Red maize (RatoMakai) and Quality protein maize (QPM) are local and hybrid variety of maize respectively. All the required nutrients solution (micro and macro) were prepared in the soil science laboratory. At first stock solution of definite strength was prepared and working solution prepared at the time of sowing by diluting with required amount of water. Soil required for this experiment was collected from the farmland near the experimental area. The topsoil was dug out and left it for two days to dry up. Then the polypots (4L) were filled with 3kg soil in each pot after making it smooth. Each pot was applied with nutrient solution. All the required seeds for this experiment were pre-germinated in the petri dishes in the laboratory by soaking in water for 24 hours. Then the pre-germinated seedlings were sown in the pot by using forceps without damaging the radicle and plumule. Three seeds were sown in each pot and depth of sowing is 3cm. Thinning was done after seven days of sowing and one plant was removed from each pot. Plant height were taken after 7 DAS at two days interval till 30^{th} days and plant biomass (root and shoot) were taken after 42 DAS. Weeding was done 20 days after sowing and staking was provided for the plant. Insecticide (Nuvan) was applied @1ml L^{-1} of water to prevent from insect.

Results and Discussion:

In the treatments of potassium in QPM variety of maize, the treatment with 27 $kgha^{-1}$ showed 16% more plant height than 0 $kgha^{-1}$ treatment fig.1.

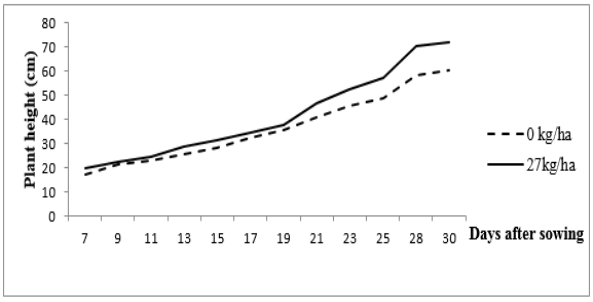

Figure 1: Comparison of different level of potassium on plant height of QPM variety

Hybrid maize shows good response towards fertilizer application. Potassium helps in the closing and opening of leaf stomata which considerably increases the leaf area index and also positively increases the plant height as well (Uchida, 2000). Chemmaet al., (1999) has also found similar result on the application of 150 $kgKha^{-1}$ over control.

Plant height of RatoMakai variety in the treatment of potassium, the treatment with 27 $kgha^{-1}$ showed 19% more plant height than 0 $kgha^{-1}$ fig.2.

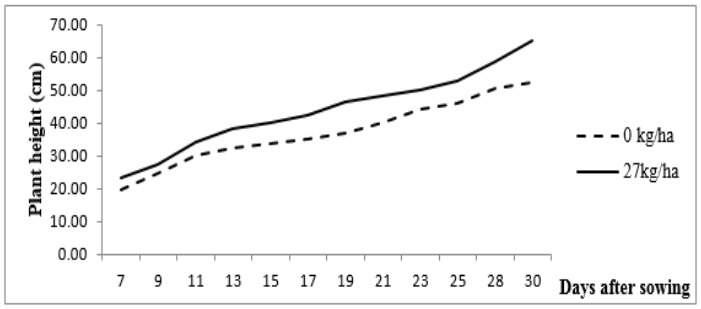

Figure 2: comparison of different level of potassium on plant height of RatoMakai variety

Potassium helps plant in the uptake of nutrient from the soil and thus, that might be the reason for the increment of plant height of RatoMakai variety over control treatment. The previous observed result on QPM showed the increase in height of plant on the application of higher level of potassium. Thus, the significant result has been obtained in the case of RatoMakai as well.
Shoot dry weight of both QPM and RatoMakai variety showed difference among the various level of treatment. The increasing dose of potassium caused the shoot dry matter to increase both in QPM and RatoMakai variety fig.3.

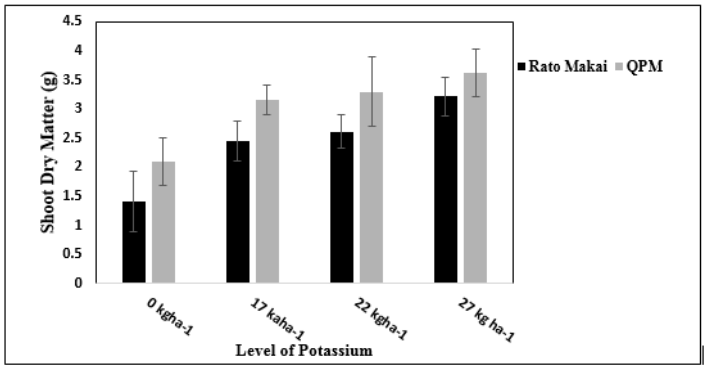

Figure 3: Effect of application of different level of K on shoot dry weight of both genotype

Application of potassium fertilizer significantly increased the dry matter and the increase on dose increased the dry matter in maize (Al Zubaidi and Al Semak 1992). Whereas, comparing the effect of same level of potassium between two varieties, QPM was found to be superior in terms of shoot dry matter in all potassium level. Hybrid variety of maize has good response on potassium application for dry matter accumulation.Further, Jiaet. al., (2008), reported increased root dry matter due to potassium uptake in

early growth of rice which correlated positively with the increase in shoot dry weight in early growth caused by the upward translocation of k absorbed by root.

On comparison on the different level of treatment of potassium, on increment on the dose of potassium the root dry matter was found to be increased fig.4. Same result was obtained by Aldana, Manuel Estuardo (2005), where higher dose of potassium (3.75 mM) had higher root dry weight than lowest k rate (0.75 mM).

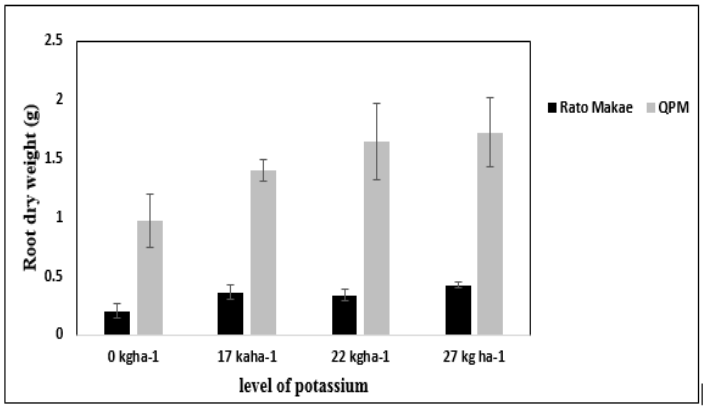

Figure 4: Effect of application of different level of K on root dry weight of both genotype

Among two varieties QPM variety showed higher accumulation of root dry matter after 42 days compared to RatoMakai. It might be due to high absorption capacity of hybrid maize over locally adapted maize variety and as well good response of hybrid maize towards nutrient application.

Conclusion:

QPM was found to be better responsive variety than RatoMakai to the different levels of potassium where the treatments of all level of potassium were superior between and within two varieties in terms of plant height, shoot biomass and root biomass accumulation in the research area. Since, this experiment was conducted just for a month. Thus, for a better result a complete growth season research for maize should be conducted.

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