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# Relationship Between Leaf Extension Rate and Extension Duration for Determining the Final Leaf Length in Maize under Various Phosphorus Levels

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**Abstract:** The investigation to see the effect of different phosphorus levels viz., 0,50,75,100 and 125 kg $P_2O_5$ $ha^{-1}$ with a recommended constant dose of nitrogen @ 150 kg $ha^{-1}$ on the leaf growth of two maize varieties was carried out. The experiment was laid out in Randomized Complete Block Design (factorial) with four replications. The maize cultivars included were Composite-17 against a standard variety Akbar. Leaf extension rate (LER) was calculated as the slope of a linear regression fitted to the points along the A-B position of the graph. Final leaf length (FLL) was measured as lamina plus sheath when the individual leaf was fully expanded. Using data for final leaf length and the calculated LER, the duration of leaf extension rate (LED) was calculated. Phosphorus levels increased FLL in both the maize varieties due to increase in LER. In the present study LED was negatively correlated with FLL and LER, indicating that phosphorus applications decreased the duration for leaf expansion due to increases in LER.

**Key words:** Maize, leaf extension rate, leaf extension duration, final leaf length, phosphorus levels

## Introduction

Maize is sown in almost all the provinces of Pakistan, but Punjab and N.W.F.P. are main areas of production. Maize contributes 6.4 per cent to the total food grain production in Pakistan. Soil and climatic conditions of Pakistan are ideal for maize production but in spite of favourable conditions and high yielding varieties, the yield recovery at farmers fields in Pakistan is very low as compared to other maize growing countries. The reason for low yield may be the injudicious use of inputs, lack of quality seed, plant protection measures and unavailability of irrigation water at critical growth stages. However, the use of suitable fertilizers in appropriate doses to fertilizers responsive varieties of maize greatly affects the crop yield. Although considerable work to determine a suitable dose of fertilizer for different maize cultivars has been done in the past. The newly evolved maize genotypes with different growth behavior for exploring their yield potential necessitate readjustment of their growth fertilizer for their requirements.

Phosphorus is essential nutrient for plant growth and development. It plays a fundamental role in metabolism and energy producing reaction in plants. It is an integral part of nucleic acid, phytin and phospholipids and is essential for cellular respiration in the metabolism of the starch, protein and fats. Phosphorus application also stimulates blooming and seed formation of maize. Barreto and Fernandes (2002) conducted a study in Brazil to evaluate the effects of different prates an placement on pupate, leaf P use efficiency (PUE) and grain yield of maize. Phosphorus was applied at 0.45,90,135 and 180 Kg $ha^{-1}$ either in rows or broadcast. Phosphorus broadcasting resulted in higher leaf P concentration compared with row P Fertilizer application. PUE was affected by the P rates but not by P placement. Ernani *et al.* (2001) studied the effect of the application method of phosphate fertilizers at to pH values on maize. There was no difference between the application methods and the best yields were obtained with the soluble phosphate sources. Addition of phosphate fertilizers on the soil surface increased P in the soil upto 3 cm depth. In the absence of water deficit, maize plants could obtain enough P fro soluble phosphate added to the soil surface, despite their low mobility. Berardo *et al.* (2001) investigated the effect of P application in sols of varying P levels on the yield of maize. Yield responses to P were dependent on soil P levels. The results suggested that maize yield and yield responses to P application were highly correlated with soil P and water availability during the growing season. Plenet *et al.* (2000a) studied growth analysis of maize crops and phosphorus deficiency of Leaf elongation rates during the quasi- linear phase of leaf expansion were significantly reduced for lower leaves of P0 plants. Leaf elongation duration was not greatly affected by P treatments.

Plenet *et al.* (2000b) conducted the growth analysis of maize under phosphorus deficiency. The results obtained in the field crop conditions strengthen the idea that P

deficiency affects plant growth earlier and to a greater extent than photosynthesis per unit leaf area. Bos *et al.* (2000) studied the mechanisms involved in leaf area expansion in maize. Leaf elongation rate increased and leaf elongation duration decreased with temperature. Leaf length decreased with photosynthetic photon flux density (PPFD), caused by a shorter leaf elongation duration. Leaf with closely associated with specific leaf weight. Sorensen and Stone (1999) examined the relationship between growth duration, leaf area and yield of maize hybrids. There were clear relationships between leaf area, leaf number, crop duration and yield. Leaf extension rate determines the final leaf length which is responsible for determining the leaf area for photosynthesis. The role of leaf area for determining the yield of any crop is well known. Under stress conditions both of these factors are seriously affected, thus reducing the crop yields (Iqbal, 1992) The present study was, therefore, undertaken to find out leaf growth of a maize variety "Compsite-17" to varying phosphorus levels against a standard variety "Akbar" grown in irrigated conditions at Faisalabad.

## Materials and Methods

The investigation to see the effect of different phosphorus levels viz., 0, 50, 75, 100 and 125 kg $P_2O_5$ $ha^{-1}$ with a recommended constant dose of nitrogen @ 150kg $ha^{-1}$ on the leaf growth of two maize varieties was carried out at Agronomic Research Area , University of Agriculture, Faisalabad. The experiment was conducted on a sandy clay loam soil, having initial NPK level of 0.05% of nitrogen, 7.51 ppm of phosphorus and 246.6 ppm of potash, respectively. The experiment was laid out in Randomized Complete Block Design (factorial) with four replications and the net plot size measured 3.6 x 7.0 m. The maize cultivars included were Composite-17 against a standard variety Akbar.

**Leaf extension rate (cm $day^{-1}$):** Leaf extension growth was measured every day with ruler from ligules of the one position down of the top leaf. The data was then plotted using " MINITAB" statistical package. Leaf extension rate (LER) was calculated as the slope of a linear regression fitted to the points along the A-B position of the graph.

**Final leaf length (cm):** Final leaf length (FLL) was measured as lamina plus sheath when the individual leaf was fully expanded.

**Leaf extension duration (days):** Using data for final leaf length and the calculated LER, the duration of leaf extension rate (LED) was calculated as follows:

$$\text{Leaf extension duration} = \frac{\text{Final leaf length}}{\text{Leaf extension rate}}$$

The data collected was subjected to Fisher's analysis of Variance Technique at 5% probability. (Steel and Torrie, 1984). Pairwise comparisons were made by Tukey's method as given below: Least Significant Difference (LSD) = S.E. of means X Q (K, df). Q (K. df) was obtained from tables of the studentized range, where K = the number of means to be compared and d.f. = errors degree of freedom.

## Results and Discussion

Plant dry matter depends on the accumulation of carbon products in photosynthesis. This in turn is determined by two main components: the rate of photosynthesis per unit leaf area and the area of leaf surface available for photosynthesis. One of the objectives of the present study was to investigate the effects of different phosphorus levels on the later parameter and the relationship of this with growth and yield of two maize varieties. Variation in leaf size due to these factors can be analyzed in terms of effects on leaf extension rate (LER) and leaf extension duration (LED) (*Maan et al.,* 1989). To determine the relative importance of LER and LED in determining the final leaf length (FLL) of each leaf, data for various phosphorus levels tested in two maize varieties were combined and correlations between FLL, LER and LED were determined, first for individual leaves, then for group of leaves. Phosphorus levels increased FLL in both the maize varieties due to increase in LER (Tables 1 and 2). There was a positive correlation relationship between leaf extension rate (LER) and Final leaf length (FLL) of different leaf insertion in maize grown under different phosphorus levels.. Whereas the leaf extension duration (LED) was negatively correlation with (FLL) and (LER). These results indicated that LER was the main factor determining the final length of various leaves of maize grown under different phosphorus levels.

Sorensen and stone (1999) also clearly observed relationship between leaf size, leaf number, crop duration and yield and it was possible to estimate maize yield using sample measures of the area of the largest leaf. Similarly planet *et al.* (2000) also observed that leaf elongation duration was not greatly affected by P treatments. Kemal-ur-Rahim (1988) and Iqbal (1992) observed that FLL in wheat was mainly affected by LER, whereas LED was relatively unaffected. LER has also been shown to be

Table 1: Values of linear correlation coefficient ( r ) between final leaf length (FLL in cm) different leaf insertions of maize and leaf extension rate (LER in cm per day) and leaf extension duration (LED in days)

| | FLL in cm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameters | Leaf 4 | Leaf 5 | Leaf 6 | Leaf 7 | Leaf 8 | Leaf 9 | Leaf 10 | Leaf 11 | Leaf 12 | Leaf 13 | All leaves |
| LER | 0.69* | 0.90** | 0.91** | 0.82** | 0.81** | 0.91** | 0.93** | 0.99** | 0.94** | 0.87** | 0.98** |
| LED | -0.51NS | -0.57 NS | -0.46NS | -0.19NS | -0.65* | -0.81** | -0.92** | -0.97** | -0.79** | -0.62** | -0.94** |

Table 2: Values of linear correlation coefficient (r) between leaf extension rate (LER in cm per day) and leaf extension duration (LED in days)

| | FLL in cm | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameters | Leaf 4 | Leaf 5 | Leaf 6 | Leaf 7 | Leaf 8 | Leaf 9 | Leaf 10 | Leaf 11 | Leaf 12 | Leaf 13 | All leaves |
| LED | -0.92** | -0.85** | -0.77** | -0.70** | -0.94** | -0.96** | -0.96** | -0.98** | -0.94** | -0.89** | -0.98** |

*, ** = Significant at 5% & probability level
NS = Non Significant

more important than LED in determining the FLL in barely (Maan *et al.,* 1989). In the present study LED was negatively correlated with FLL and LER, indicating that phosphorus applications decreased the duration for leaf expansion due to increases in LER.

**References**


Barreto, A.C. and M.F. Fernandes, 2002. Yield and phosphorus uptake by corn plants as affected by phosphorus fertilizer rates and placement in a coastal tableland soil. Revista- Brasileira-de-ciencia-do- solo, 26: 151-156.

Berardo, A., S. Ehrt, F.D. Grattone and F.O. Garcia, 2001. Corn yield response to phosphrous fertilization in the southeastern Pampas. Better crops International.

Bos, H.J., H. Tijani-Eniola and P.C. Struik, 2000. Morphological analysis of leaf growth of maize: responses to temperature and light intensity. Netherlands. J. Agril. Sci. 48: 181-198.

Ernani, P.R.,C. Steckling and C. Bayer, 2001. Soil chemical characteristics and corn dry mass yield as affected by application methods of phosphate fertilizers, at two levels of acidity . Bovista-Brasileira-de-ciencia-do-solo, 24: 939-946.

Iqbal, R.M., 1992. Growth and physiology of spring wheat under saline conditions. Ph.D. Thesis, University of Wales, U.K.

Kemal-ur-Rahim, K., 1988. The effects of salinity on photosynthesis and other physiological processes in spring wheat varieties. Ph.D. Thesis. University of Wales, U.K.

Maan, A.A.S., D. Wright and M.B. Alcock, 1989. Effect of sowing dates, sowing density and nitrogen supply on leaf extension in spring barley. J. Agric. Sci., Cambridge, 113: 305-315.

Plenet, D., S. Etehebest, A. Mollier and S. Pellerin, 2000a. Growth analysis of maize field crops under phosphorus deficiency. I. Leaf growth. Plant and Soil, 223: 117-130

Plenets, D., A. Mollier and S.I. Pellerin, 2000b. Growth analysis of maize field crops under phosphorus deficiency-II. Radiation use efficiency, biomass accumulation land yield components. Plant and soil, 224: 259-272.

Sorensen, I. and P. Stone, 1999. Relationships between growth duration, leaf area and yield of maize hybrids. Agronomy-New Zealand, 29: 83-85.

Steel, R.G.D. and J.H. Torrie, 1984. Principles and Procedures of Statistics. McGraw Hill International Book Company, London, pp: 172-176.