



Evaluation of Physiological Responses of Maize Hybrids to different Nitrogen levels in Kerman Province, Iran

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Introduction: Nitrogen is one of the most abundant elements on earth and major essential for crop growth and development that is heavily used in modern agriculture to maximize yields. Among cereals, maize (*Zea mays* L.) is an important food and feed crop which ranks third after wheat and rice in the world. As N fertilizer costs remain relatively high and environmental concerns over excessive N application increase, the objectives of the present study were: (i) to compare maize hybrids growth and yield responses to N rates, (ii) to determine optimum N rate for maize grain yield production, (iii) to explore the physiological functions controlling maize growth and yield and (iv) to identify more effective physiological indices in maize grain production under N stress as well as potential condition.

Materials and Methods: Two field experiments were conducted in 2014 and 2015 at the Experimental Field of Kerman Agricultural and Natural Resources Research Center, Kerman, Iran. The experiment was laid out as a randomized complete block design with factorial arrangement of treatments and three replications. Four nitrogen rates (0, 92, 220 and 368 kg N ha⁻¹) were applied to three maize hybrids (KSC 704, Maxima and TWC 604). Statistical analysis was done using SAS software (version 9.4).

Results and Discussion: Due to a significant lack of homogeneity of variance across the two years, data from the two years were treated as independent experiments and analyzed separately. Results showed that both N rates and hybrids had significant effect on growth indices and maize grain yield. The interaction between genotype and N rate was significant for grain yield in 2015 ($P < 0.01$). Thus, physical slicing was used to do mean comparison. Results showed that KSC 704 and Maxima had quite similar responses to N rates and with an increase in N fertilization, their grain yield also increased. This response, however, was different in case of TWC 604 so that 92 kg N ha⁻¹ showed maximum grain yield. The hybrids grain yield was lower notably in 2015 than 2014. As N rate reduced from 368 to 0 kg N ha⁻¹, the mean grain yield of hybrids reduced by 41 % (5082.5 kg ha⁻¹) in 2014 and 93 % (8824.6 kg ha⁻¹) in 2015. The highest and lowest values of grain yield were belonged to 368 kg N ha⁻¹ in 2014 (12359.3 kg ha⁻¹) and Zero kg N ha⁻¹ in 2015 (640 kg ha⁻¹), respectively. Since there were not found sensible differences between weather data during growing seasons in 2014 and 2015, it can be concluded that sharp reduction of grain yield especially in 0kg ha⁻¹ plots in second year was due to nitrogen depletion from the soil. Two previous cropping seasons were fallow, so in first year of experiment, the amount of initial nitrogen in the soil was notable (about 415 kg ha⁻¹ in 0–60 cm soil depth); while in second year soil depletion of initial nitrogen occurred by both maize crop and existence of high sand percentage in soil texture (about 85 %) that led to high nitrogen leaching from the soil. Among the indices, Leaf area index (LAI) and leaf area index duration (LAID) were known as key indices in maize grain yield. Net assimilation rate (NAR) of hybrid TWC 604 was higher than hybrids KSC 704 and Maxima throughout growing seasons in two years; while the hybrids KSC 704 and Maxima showed higher grain yield with compared to TWC 604. The reason for this is the higher LAI and LAID in hybrids KSC 704 and Maxima that resulted in higher CGR and consequently higher grain yield in these hybrids than TWC 604. Our results showed that lack of nitrogen fertilizer significantly limited LAI and LAID.

Conclusions: In this study, maize grain yield increased with N application up to 368 kg ha⁻¹. However an

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economic evaluation is essential in order to optimum N fertilizer recommendation. LAI and LAID were known as key indices in maize grain yield formation. Nitrogen stress decreased maize grain yield mainly by reduction in LAI and LAID. Significant yield benefits were observed in KSC 704 and maxima compared to TWC 604 in both N stress and potential conditions.

Keywords: Grain yield, Growth indices, Nitrogen stress