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Growth And Yield Response Of Maize To Nitrogen Application at Different Growth Stages

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Abstract

The present study was undertaken to determine a suitable growth stage of maize crop for the application of nitrogen fertilizer for maximising yield and yield components of maize under agro-climatic conditions of Faisalabad. Maximum grain yield (5.27 t ha^{-1}) alongwith highest harvest index (37.00%) per hectare was obtained for the crop raised by split N fertilization i.e. 1/3 at sowing + 1/3 at lst irrigation + 1/3 at flowering and lowest grain yield (2.93 t ha^{-1}) and harvest index (23.50%) in control.

Introduction

Maize (*Zea mays* L.) is one of the leading cereals in the world. It ranks third in the worid production of cereals next to wheat and rice. It contributes a lot to Pakistan's economy, as it is a source of food, feed and fodder. It provides a valuable raw material for the preparation of many industrial products like corn, oil, flakes, custard, glucose, jelly, energile etc. In view of its increasing importance as an attractive food and cash crop, its demand is enhancing day by day in the agro-based industries. Maize (*Zea mays* L.) occupies a key place in the existing cropping systems of the country because it is a short duration crop and provides good economic return to the growers. Maize crop has higher yield potential but its average yield in Pakistan is 1.45 t ha^{-1} which is far low as compared to that of other maize growing countries in the world (Anonymous, 1997). The yield is below the production potential of maize varieties under cultivation. Many factors are responsible for this low yield but astute use of fertilizers and potent cultivars to utilize the nutrient elements efficiently, are of major importance.

A valuable success has already been acquired as regards management practices and evolution of new varieties to realize a bumper crop, which cannot yield to their inherent capacity unless a suitable growth stage for the application of fertilizer is traced out. Undoubtedly, application of fertilizer has rather become popular among the farming community but its judicious and timely application is still a matter of grave concern, both for economic and industrial point of view. Moreover, a substantial amount (40-50%) of applied nitrogen is lost through volatilization, nitrification and leaching as nitrates (Gill, 1978) Thereby, the fertilizer nitrogen, being an expensive input, needs special attention in its use to assume maximum yield efficiency.

The present study was, therefore, undertaken to determine a suitable growth stage of maize crop for the application of nitrogen fertilizer for maximizing yield and yield components of maize under agro-climatic conditions of Faisalabad.

Materials and Methods

An experiment to determine the growth and yield response of maize to nitrogen application at different growth stages was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad. The experiment was laid out in a randomized complete block design with four replications. Maize variety "Golden-95" was sown in the lst week of August. Net plot size was 3 x 5 m. Whole of the phosphorus (75 kg ha^{-1}) was applied as follows, F_0 (control), F_1 (150 kg N at stem elongation), F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation), F_3 (150 kg N at tasseling), F_4 (1/2 dose of N at sowing + 1/2 dose of N at tasseling), F_5 (150 kg N at silking), F_6 (1/2 dose of N at sowing + 1/2 dose of N at silking) and F_7 (1/3 at sowing + 1/3 at lst irrigation + 1/3 at flowering). The crop was sown in 60 cm apart single rows and plant to plant distance was maintained 22 cm by thinning. The crop was sown on a well prepared seed bed using seed rate of 30 kg ha^{-1} Following observations were recorded during the course of study, plant height (cm), number of cob bearing plant/plot, number of grains per cob, 1000-grain weight (g), grain yield (t ha^{-1}) and harvest index (%). Data collected on growth and yield parameters were analyzed statistically and differences among treatment means were compared by using least significant difference (LSD) test at 5 percent probability level (Steel and Torrie, 1984).

Results and Discussion

Maximum plant height was recorded (236.9 cm) from the plots where treatments F_7 (1/3 at sowing 1/3 at 1st irrigation + 1/3 at flowering) was applied. Minimum plant height was recorded (1.88.8 cm) in the treatment F_0 (control). Treatments F_1 (150 kg N at stem elongation) and F_5 (150 kg N at silking) were statistically at par with each other. Treatments F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation) and F_3 (150 kg N at tasseling)

Table 1: Effect of different nitrogen levels on the growth and yield of maize at different growth stages

Treatments	Plant height (cm)	Cob bearing Plant Plot	No. of grains cob^{-1}	1000-grain weight (g)	Grain yield t ha^{-1}	Harvest Index (%)
F_0 (0 Kg N)	188.8f	74.47d	262.9e	226.1d	2.932e	3.5f
F_1 (150 Kg N at stem elongation)	208.9d	90.30bc	374.9d	235.9c	3.600d	28.00de
F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation)	211.1e	94.43bc	379.7d	212.4e	3.750d	29.5Ocd
F_3 (150 Kg N at tasseling)	209.9e	86.10c	370.8d	229.8d	3.700d	27.00e
F_4 (1/2 dose of N at sowing + 1/2 dose of N at tasseling)	224.6c	100.1b	454.9c	235.8c	4.375bc	30.75c
F_5 (150 Kg N at silking)	221.1d	90.1b	473.0bc	229.8d	4.000cd	29.25cd
F_6 (1/2 dose of N at sowing + 1/2 dose of N at silking)	228.8b	101.2a	497.5b	241.3b	4.725b	34.50b
F_7 (1/3 at sowing + 1/3 at 1st irrigation)	236.9a	1 17.87a	611.7a	247.2a	5.275a	37.00a

Any two means in a column not sharing a letter differ significantly at 0.05 p

irrigation + 1/3 at flowering) were also statistically similar, while F_4 (1/2 dose of N at sowing 1/2 dose of N at tasseling) and F_6 (1/2 dose of N at sowing + 1/2 dose of at silking) were statistically different from each other and rest of the treatments. More plant height in F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) could be referred to the timely availability and split doses of N.

These results are supported by the findings of Tiwary *et al*. (1970), who obtained increased plant height with a split application of nitrogen.

Cob Bearing Plant Plot^{-1}: Data showed that maximum cob bearing plants (117.8) were recorded in case of treatment F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) and minimum (74.47) with respect to F_0 (control). Treatments F_6 (1/2 dose of N at sowing + 1/2 dose of N at silking) and F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) were statistically at par with each other. Similarly F_1 (1/2 kg N at stem elongation), F_2 (1/2 dose of at sowing + 1/2 dose of N at stem elongation), F_4 (1/2 dose of N at sowing + 1/2 dose of N at tasseling) and F_5 (150 kg N at silking) were statistically similar with one another. Similarly, F_3 (150 kg N at tasseling) and F_5 (150 kg at silking) were statistically similar with one another. Similarly, F_3 (150 kg N at tasseling) and F_5 (150 kg N at silking) were statistically similar with one another. Similarly, F_3 (150 kg N at tasseling), F_1 (1/2 kg N at stem elongation), F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation) and F_5 (150 kg N at silking) were also statistically similar with one another. More number of cob bearing plants in treatment F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) may be attributed to split doses of nitrogen.

Number of Grains Cob^{-1}: Results showed the highly significantly effect of N application on number of grains per cob at various growth stages. Table 1 showed the difference among the treatment means. Treatment F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) gave the maximum (611.7) number of grains per cob while minimum number of grains per cob (262.9) was observed in case of control. The treatment F_5 (150 kg N at silking) and F_6 (1/2 dose of N at sowing + 112 dose of N at silking) were statistically at par. Treatment F_1 (150 kg N at stem elongation), F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation) and F_3 (150 kg N at tasseling) were statistically similar with one another. Similar, treatments F_4 (1/2 dose of N at sowing + 1/2 dose of N at tasseling) and F_5 (150 kg N at silking) were statistically at par with each other. These results are in confirmation with the results of Bangarwa *et al*. (1998). They concluded that three equal splits of N i.e., at sowing, 100 days after sowing and at tassel initiation increased number of grains per cob, 1000-grain weight and grain yield.

1000-grain Weight: The highest 1000-grain weight (247.29) was obtained from the treatment F_7 (1/3 at sowing + 113 at 1st irrigation + 1/3 at flowering) and lowest 1000-grain weight (226.1 g) was obtained from the control. Treatment F_0 (control), F_3 (150 kg N at tasseling) and F_5 (150 kg N at silking) were statistically at par with one another. Similarly, F_1 (150 kg N at stem elongation) and F_4 (1/2 dose of N at sowing + 1/2 dose of N at tasseling) were also statistically similar with each other. While treatment F_5 (1/2 dose of N at sowing + 1/2 dose of N at silking) and F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation) were statistically different from all other treatments. It could be due to timely application of N and minimum losses of N because of applying in splits, which ensured the maximum availability. These results are in confirmation with the results of Hussain (1991). They concluded that split application of N increased 1000-grain

weight and grain yield of maize crop.

Grain yield: Showed the analysis of variance of the grain yield, which revealed that results were highly significant for N application at different growth stages. Maximum (5.28 t ha^{-1}) in case of treatment F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering). Treatment F_7 gave significantly maximum yield over all other treatments. Treatments F_4 (1/2 dose of N at sowing + 1/2 dose of N at tasseling) and F_6 (1/2 dose of N at sowing + 1/2 dose of N at silking) were statistically at par with each other. Similarly, treatments F_3 (150 kg N at stem elongation), F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation), F_3 (150 kg N at tasseling) and F_5 (150 kg N at silking) were statistically similar with one another. While treatments F_0 (control) and F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) were not only different from each other, but also from rest of the treatments. These results are similar to the findings of Schmitt and Beck (1991). These concluded the grain yield increases with nitrogen. Gaur *et al*. (1992) and Gautam *et al*. (1964) who reported that N application in splits gave better results.

Harvest index: Maximum harvest index (37.00%) was attained by the F_7 (1/3 at sowing + 1/3 at lst irrigation + 1/3 at flowering) and minimum (23.50) was observed with F_0 (control). The harvest index value ranged from 23.5 to 37 percent. Results remained statistically at par in case of F_2 (1/2 dose of N at sowing + 1/2 dose of N at stem elongation) and F_5 (150 kg N at silking). Similarly, F_1 (1/2 kg N stem elongation) and F_5 (150 kg N at silking) were also statistically similar with one another. While treatment F_0 (control), F_6 (1/2 dose of N at sowing + 1/2 dose of N at silking) and F_7 (1/3 at sowing + 1/3 at 1st irrigation + 1/3 at flowering) were statistically differ from one another and from all other treatments. These results are supported by the findings of Bangarwa *et al*. (1998). They concluded that split application of nitrogen increases the harvest index.

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