

NITROGEN MANAGEMENT STUDIES IN AUTUMN PLANTED MAIZE (*ZEA MAYS L.*) HYBRIDS

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ABSTRACT

A field experiment was conducted at Agronomic Research Area, University of Agriculture, Faisalabad, during autumn 2006 to evaluate the performance of two maize hybrids (R-2315, R-2331) under split dose of N application at different growth stages of crop plants (full N at sowing, half N at sowing + half N 25 DAS; 1/3 N at sowing + 1/3 N 25 DAS + 1/3 N at 55 DAS) and different methods of fertilizer application (broadcast and side placement/side dressing) to improve its efficiency. The experiment was laid out in randomized complete block design with split-split plot arrangement; keeping maize hybrids in main plot, time of N application in sub-plot and method of N application (M) in sub-sub plots. It was observed that maize hybrids were statistically similar for number of days taken to mature, number of grains per cob, 1000-grain weight, and grain yield while the timing and method of N application significantly affected the same parameters. The more number of days taken to mature (102.38), maximum number of grains per cob (519.00), 1000-grain weight (297.64 g) and grain yield (6.42 t ha⁻¹) were recorded when 1/3 N was applied at sowing + 1/3 N at 25 DAS and 1/3 N 55 DAS as compared to other timings of N application at different growth stages of crop. Likewise, the higher number of days taken to mature (99.58), and higher number of grains per cob (514.17), 1000-grain weight (286.22 g) and grain yield (6.07 t ha⁻¹) were recorded, when N was side dressed/side placed as compared to N application through broadcast in the same parameters. It was concluded that 1/3 N application at the time of sowing, 1/3 N application 25 DAS + 1/3 N application 55 DAS by side dressing/side placement was the best efficient methodology for N management, irrespective of the type of maize hybrid.

Key Words: Maize hybrids, time and method of N application, yield and its attributes

INTRODUCTION

Maize (*Zea mays L.*) is an important food and feed crop of the world and is often referred as “the king of grain crops”. It ranks third in world production after wheat and rice and is important cereal crop of Pakistan. It is grown extensively with equal success in temperate, subtropical and tropical regions of the world. It forms major dietary part of the millions of the people in the form of bread, cake and porridge in many parts of the world in Asia, Africa and America. Besides being an important food grain for human consumption, maize has also become a major component of livestock and poultry feed (Witt and Pasuquin, 2007).

Pakistan grows about 1.01 million hectares of maize with annual production of 3.31 million tonnes of grain with average yield of 3.21 t ha⁻¹ (Govt. of Pakistan, 2008). This per unit area yield is alarmingly low as compared to the biological potential of the existing cultivars. Several factors contribute to the low yields of maize obtained in Pakistan and different strategies have been proposed to improve maize productivity (Hussain *et al.*, 2003). There is need to develop a site specific agro technology to enhance productivity of maize by making improvement in some basic components of the existing maize production technology in Pakistan. Among different agro management practices, nutrient

management is of special significance to realize maximum potential of maize.

Nitrogen (N) plays an important role in photosynthesis and is an integral part of protein. It is essential for enzymatic biochemical and physiological reactions in plant metabolism (Balasubramaniyan and Palaniappan, 2001). Nitrogen availability in soil for optimum plant growth and development is very low in Pakistan because of high temperature and very low organic matter. So, it is quite impossible to think to grow a crop without application of N fertilizer. No doubt nitrogenous fertilizer use has now become incumbent in bumper crop harvest (Tisdale *et al.*, 1997), but the indiscriminate use and high cost of nitrogenous fertilizers have drawn the attention of the agronomists to re-think its utilization to improve its efficiency. Selection of genotypes/hybrids, methods and time of N fertilizer application at different growth stages of plant has urged upon the agronomists to devise again a comprehensive picture for its efficient utilization (Lehrsch *et al.*, 2000). Maize hybrids respond differently to nitrogen (N) fertilizers because of their different genetic ability to uptake, utilize it and translocate it in their metabolism (Paponov and Engels, 2003), but some times maize hybrids remain unable to express their genetic potential because of improper management practices (Katalin, 2000).

Time and method of N application play more important role in N efficient utilization at different growth stages of crop plants (Pearson, 1994). N application in split doses in different times of plant growth stages increases grain yield (Sangoi *et al.*, 2007) of maize hybrids due to increase in number of grains per cob (Cooke, 2006) and 1000- grain weight (Khan *et al.*, 1999) as the number of days taken for maturity are also lengthened (Amanullah, 2004). Correspondingly, side dressing/side placement of N fertilizer increases grain yield of maize hybrids (Chaudhary and Pirhar, 2002) than broadcast due to increase in number of grains per cob (Ceretta *et al.*, 2002) and 1000- grain weight (Lehrsch *et al.*, 2000).

Keeping in view the above findings, the present study was planned to find out the most efficient method and time of N fertilizer application in maize hybrids to obtain the maximum yield under the prevailing conditions of Faisalabad.

MATERIALS AND METHODS

The present study was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad, during autumn 2006. The experimental treatments comprised of two maize hybrids (R-2315, R-2331), different nitrogen application timings (full N at sowing (T_1), half N at sowing + half N 25 DAS (T_2), 1/3 N at sowing + 1/3 N 25 DAS + 1/3 N at 55 DAS (T_3) and two methods of fertilizer application (broadcast and side placement/side dressing). Experiment was laid out in a randomized complete block design with split-split arrangement, keeping maize hybrids (H) in main plots, whereas time of N application (T) in sub-plot and method of N application (M) in sub-sub plot. Experiment was replicated three times. Net plot size was 3 m x 5 m. Each plot had four rows and row to row distance was 75 cm. Crop was sown on 2nd August, 2006 with the help of single row hand drill using a seed rate of 30 kg ha⁻¹. Plant to plant distance was maintained 20 cm by thinning out the surplus plants at four leaf stage. A fertilizer dose of 175-100 kg NP ha⁻¹ was applied to all treatments. Whole of the P₂O₅ was applied at the time of sowing while N was applied as per treatment. All other agronomic practices were kept normal and uniform for all treatments. Crop was harvested on 6th November, 2006. As far as the observations concerned, ten plants were selected at random and used for counting number of days taken to mature. Similarly, number of grains per cob and means were calculated. Similarly, 1000-grain weight was worked out by counting the 1000-grain weight of 10 samples taken at random from grain produce of each plot and means were calculated. For grain yield, all the plants were taken from each plot, cobs were separated, unsheathed, shelled and weighed. Then yield was calculated on tons ha⁻¹ basis. Data recorded were

statistically analyzed using the Fisher's analysis of variance technique and treatments' means were compared by using the least significant difference (LSD) test at 5 % level of probability (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Hybrids differed non-significantly with respect to all the parameters under study (table 1) as observed by Katalin (2000). Crop took maximum duration (102.38 days) to mature when it received N in three splits (1/3 at sowing+ 1/3 at 25 DAS and 1/3 at 55 DAS) followed by the crop (97.25 days) where N was applied in two splits (half at sowing + half at 25 DAS). Similar trends were recorded by Amanullah (2004). Side placement/side dressing of N (M_2) significantly took more number of days to mature (99.58) than number of days taken to mature (94.75) in broadcast application of N (M_1). Similar trends were found by Lehrsch *et al.* (2000). Guatam *et al.*, (1994) while discussing on the similar grounds pointed out that side placement/side dressing of N in three splits resulted in the highest number of days to mature, which helped to synthesize more assimilates for grain production in different maize hybrids. Interactive effects of maize hybrids and time of N application (H x T), hybrids and method of N application (H x M), time and method of N application (T x M) and hybrids, time and method of N application (H x M x T) on number of days taken to maturity were non significant (table 1).

There was mark able variation in number of grains per cob due to different time of application of N. Application of N in three equal splits (T_3) significantly produced maximum number of grains per cob (519.00) followed by number of grains per cob (503.13), obtained when N was applied in two splits (half N at sowing + half N at 25 DAS). Side placement/side dressing of N (M_2) significantly produced more number of grains per cob (514.17) than number of grains per cob (492.17) in broadcast application of N (M_1). Similar trends were observed by Ceretta *et al.*, (2002). Interactive effect of time (T) and method (M) of N application on number of grains per cob was significant. Side placement/side dressing (M_2) of N with different timings *i.e* T_3 (1/3 N at sowing+ 1/3 N at 25 DAS+ 1/3 N at 55 DAS) produced significantly maximum number of grains per cob (539.75), whereas broadcast of full N at sowing produced minimum number of grains per cob (481.75). These results are in line with the findings of the Sojka *et al.* (1994) who stated that side placement/side dressing of N in three equal splits resulted in the highest number of grains per cob in different maize hybrids. Interactive effects of maize hybrids and time of N application (H x T), hybrids and method of N application (H x M) and hybrids, time and method of N application (H x M x T) on number of grains per cob were non significant (table 1).

There was significant variation among different time of application of N. Application of 1/3 N at sowing+ 1/3 N at 25 DAS and 1/3 N 55 DAS (T₃) significantly produced maximum 1000-grain weight (297.64 g)

Table 1: Influence of time and method of N application on days to maturity, grains per cob, 1000-grain weight and grain yield of two maize hybrids.

Treatments	Number of days taken to maturity	Number of grains per cob	1000-grain weight (g)	Grain yield (t ha ⁻¹)
A- Hybrids (H)				
H ₁ : R-2315	97.06	500.5	274.1	5.73
H ₂ : R-2331	109.41	505.86	272.45	5.68
LSD (a)		N.S		
B- Time of N application (T)				
T ₁ : Full N at sowing	91.88c	487.38c	248.59c	4.89c
T ₂ : Half N at sowing+ Half N 25 DAS	97.25b	503.13b	273.55b	5.81b
T ₃ : 1/3 N at sowing+1/3 N 25 DAS+ 1/3 N 55 DAS	102.38a	519.00a	297.64a	6.42a
LSD (b)	4.865*	7.673*	4.332*	3.745*
H x T				
N.S				
(c) – Method of N application (M)				
M ₁ : Broadcasting	94.75b	492.17b	260.30b	5.34
M ₂ : side placement/side dressing	99.58a	514.17a	286.22a	6.07
LSD (c)	1.876*	20.156*	20.165*	0.712*
H x M				
N.S				
M x T				
M ₁ x T ₁	89.75	481.75d	248.00e	4.77e
M ₂ x T ₁	94.00	493.00c	249.18de	5.02de
M ₁ x T ₂	94.75	496.50c	259.04d	5.21d
M ₂ x T ₂	99.75	509.75b	288.07b	6.41b
M ₁ x T ₃	99.75	498.25c	273.85c	6.05c
M ₂ x T ₃	105.00	539.75a	321.42a	6.79a
LSD (d)	N.S	8.222*	10.10*	2.513*
H x M x T				
N.S				

Means not sharing a letter in common differ significantly at p < 0.05; N.S = Non significant; DAS= Days after sowing; * = Significant

followed by 1000-grain weight (273.55 g) obtained, when N was applied in two splits (half N at sowing + half N at 25 DAS). Side placement/side dressing of N (M₂) significantly produced heavier 1000-grain weight (286.22) than 1000-grain weight (260.30) in broadcast application of N (M₁). Similar findings were recorded by Lehrs *et al.* (2000). Interactive effects of time (T) and method (M) of N application on 1000-grain weight were significant. Side placement/side dressing (M₂) of N with

different timings *i.e* T₃ (1/3 N at sowing + 1/3 N at 25 DAS + 1/3 N at 55 DAS) produced significantly maximum 1000-grain weight (321.42 g), whereas broadcast of full N at sowing produced minimum 1000-grain weight (248.00 g). These results are in line with the findings of the Lehrs *et al.*, (2000) and Sangoi *et al.* (2007) who reported that side placement/side dressing of N in three splits resulted in the heaviest 1000-grain weight in different maize hybrids. Interactive effects of maize hybrids and time of N application (H x T), hybrids and method of N application (H x M) and hybrids, time and method of N application (H x M x T) on 1000-grain weight were non significant (table 1).

There was significant variation due to different time of N application on maize grain yield. Application of 1/3 N at sowing + 1/3 N at 25 DAS and 1/3 N at 55 DAS produced significantly maximum grain yield (6.42 t ha⁻¹) followed by grain yield (5.81 t ha⁻¹) obtained when N was applied in two splits (half N at sowing + half N at 25 DAS) and minimum grain yield (4.89 t ha⁻¹) was obtained when whole N was applied at sowing. Side placement/side dressing of N (M₂) produced significantly more grain yield (6.07 t ha⁻¹) than grain yield (5.34 t ha⁻¹) in broadcast application of N (M₁). Similar trends were reported by Chaudhary and Prihar (2002). Interactive effect of time (T) and method (M) of N application on grain yield was significant. Side placement/side dressing (M₂) of N in three splits (1/3 N at sowing + 1/3 N at 25 DAS + 1/3 N at 55 DAS) produced significantly maximum grain yield (6.79 t ha⁻¹), whereas broadcast of full N at sowing produced minimum grain yield (4.77 t ha⁻¹). Cooke (2006) and Lehrs *et al.* (2000) reported that application of N fertilizer in splits was better than its full application at the time of sowing. Interactive effects of maize hybrids and time of N application (H x T), hybrids and method of N application (H x M) and hybrids, time and method of N application (H x M x T) on grain yield were non significant (table 1).

CONCLUSION: Side placement/side dressing of N in split applications (1/3 N at sowing+ 1/3 N at 25 DAS+ 1/3 N at 55 DAS) resulted in the highest grain yield irrespective of maize hybrids.

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