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EFFECT OF NITROGEN DOSES AND IRRIGATION FREQUENCIES ON COB YIELD OF BARI HYBRID MAIZE-7

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ABSTRACT

A field study was conducted to assess the interaction effects of irrigation and nitrogen rates on hybrid maize yield. The research was conducted during December 2013 to April 2014 at the farmer field Tabaria area of Natore District in Bangladesh. The experiment consists of (i) two irrigation treatments viz. no irrigation and three irrigation and (ii) two nitrogen levels viz. no nitrogen use and 230 kg Nha^{-1}.The experiment was laid out in a split plot design with three replications having 12 unit plots with 20 m^2 sized. The interaction effect of irrigations and nitrogen levels significantly influenced the yield attributes of BARI hybrid maize-7 except cob grain free and harvest index, where the yield and yield attributes increased with increasing irrigation and nitrogen levels in all cases.

Key words: Nitrogen, irrigation, yield, maize.

Introduction

Maize occupies an important position in the existing cropping systems of Bangladesh due to source of good economic return in a short duration and diversified products such as corn oil, glucose-D, starch etc. The average grain yield of maize is not only substantially lower compared with other important maize growing countries but also less than the production potential of existing genotypes. Thus there is a need to develop a site specific agro technology to increase productivity of maize by making improvement in some basic components of the existing maize production technology in Bangladesh. The method and extent of fertilization should be determined not on the basis of maximum yield, but solely on the basis of profitability (Ipperisil, 2009). According to Debreczeni (2010) the upper limit of fertilizer application has to be determined on the basis of optimal level of economic cultivation originating from surplus yield. Accurate precipitation forecasts can only be given with the knowledge of precipitation and ground water conditions regarding a specific plot (Balasubramanian, 2009). If precipitation and the easily accessible water supply of the soil do not satisfy the needs of the plant, then the deficiency has to be compensated with irrigation (Petrasovit *et al*., 2008). Irrigation also improves the efficiency of fertilizer utilization by the crop. Increases in irrigation frequency increased N, P and K uptake by maize (Prasad and Prasad, 2008). Maximum grain yield and greater water use efficiency were achieved when irrigating to 100% of field capacity (Mbagwu and Hamblin, 2010). Management of crop nutrition includes correct manure application at right time, optimum level and appropriate method of application. Nitrogen, being an integral part of structural and functional proteins, chlorophyll and nucleic acids such as RNA and DNA as well as essential for proper carbohydrate utilization, plays a vital role in crop development (Tisdale *et al.*, 2010). Both nitrogen deficiency and excess affects assimilate partitioning between vegetative and reproductive organs (Mbagwu and Hamblin, 2010). The present study was therefore, undertaken to determine the optimum level of irrigation schedules and nitrogen rates for optimum cob yield of maize in Bangladesh.

Materials and Methods

A field study was conducted to assess the interaction effects of irrigation and nitrogen rates on hybrid maize yield. The research was conducted during December 2013 to April 2014 at the farmer field Tabaria area of Natore District in Bangladesh. The experiment consists of (i) two irrigation treatments viz. no irrigation and three irrigation and (ii) two nitrogen levels viz. no nitrogen use and 230 kg Nha^{-1}.The experiment was laid out in a split plot design with three replications having 12 unit plots with 20 m^2 sized.

The soil was sandy loam in texture with organic matter 0.57%. The recommended cultural practices, except irrigation and nitrogen levels, were adopted to raise the crop. Irrespective of doses, one third quantity of nitrogen was given as recommended basal dose, at the time of final land preparation and remaining urea applied as top dressing in two equal splits at 40 and 80 DAS. The crop was also fertilized with 200 $kgha^{-1}$ TSP, 140 $kgha^{-1}$ MP, 13 $kgha^{-1}$ Zinc sulphate, 7 $kgha^{-1}$ Boric acid, 160 $kgha^{-1}$ Gypsum at the time of final land preparation. The crop was harvested at full maturity. Data on different yield parameters such as cob length, cob grain free length, cob girth, grain line cob^{-1}, grain number $line^{-1}$, total grain cob^{-1}, grain weight cob^{-1}, 1000 grain weight cob^{-1}, grains yield tha^{-1}, straw yield tha^{-1}, biological yield tha^{-1} and harvest index (%) were investigated in this study. The data were analyzed statistically using the analysis of variance (ANOVA) technique with the help of MSTAT-C and Microsoft excel program, and mean differences were adjusted by Duncan's Multiple Range Test.

Results and Discussion

Yield parameters of experimental maize varieties with performance of irrigation and nitrogen

Cob length: The cob length graphs irrespective irrigation and nitrogen treatment resulted in a usual graph of different irrigation and nitrogen treatments with replication in yield level i.e. cob length values increased with increasing irrigation and nitrogen levels. Afterwards advancement of irrigation and nitrogen levels stared to decline cob length (Fig. 1). The cob length probably due to irrigation and nitrogen level increased on optimum levels. Irrigation also improved the efficiency of fertilizer utilization by the cob length. Increases in irrigation frequency increased N, P and K uptake by maize (Prasad and Prasad, 2008). Kar *et al.* (2006) recorded that increased N application from 20 to 80 Kg Nha^{-1} significantly increased the cob length from 14.6 cm to 17.5 cm and cob girth from 13.8 to 16.7 cm.

Cob grain free: Cob grain free length had not significant effect influenced among the interaction effect of irrigation and nitrogen treatments in BARI hybrid maize-7 (Table 1). The highest grain free length 1.50 cm found in rainfall irrigation with no nitrogen use and the lowest 0.75 cm was obtained three irrigation with 230 kg/ha nitrogen levels. The cob grain free length might probably due to more irrigation and nitrogen supply non-significantly affected. Increased application of irrigation and nitrogen gives faster rate of leaf expansion and cob development (Wright, 2012), increased LAI, leaf area duration, photosynthetic rate and increased radiation interception and radiation use efficiency.

Cob girth: The cob girth curves respective of different irrigation and nitrogen treatments with replication in yield level i.e. cob girth curve values increased with increasing irrigation and nitrogen levels (Fig. 1). Cob girth might probably due to sufficient irrigation and nitrogen supply increased yield production. Nath *et al.*(2009) reported that in sweet corn an increase of 11.6% and 16.9 n cob length and cob girth were recorded when the fertility level was raised from 50 to 70 kg Nha^{-1} and an application of 110 kg Nha^{-1} accounted for significant increase (10.1%) over 70 kg Nha^{-1} in cob girth. Nitrogen and irrigation being an integral part of structural and functional proteins, chlorophyll and nucleic acids as well as essential for proper carbohydrate utilization, plays a vital role in crop development (Tisdale *et al.,* 2010).

Grain number line/cob: The grain number line/cob graphs of different irrigation and nitrogen treatments within yield level i.e. grain number line/cob values respective increasing irrigation and nitrogen levels significantly increased the production (Fig. 1). It was conformed increasing irrigations and nitrogen levels increased yield in an optimum level and significantly differs with the treatments apply. Greater number of grains/cob by adequate application of N is in accordance with the findings of others who also reported similar effects of N application proper irrigation on the number of grains/cob (Rasheed, 2012).

Grain number/line: Grain number/line showed significant effect among interaction effect of irrigation and nitrogen treatments in BARI hybrid maize-7 (Table 1). The maximum number/line 50.33 counted in three irrigations with 230 kg/ha nitrogen level which was differs from any others treatments. The lowest grain number $line^{-1}$ obtained rainfall irrigation with no nitrogen use which also differs from all others treatments.

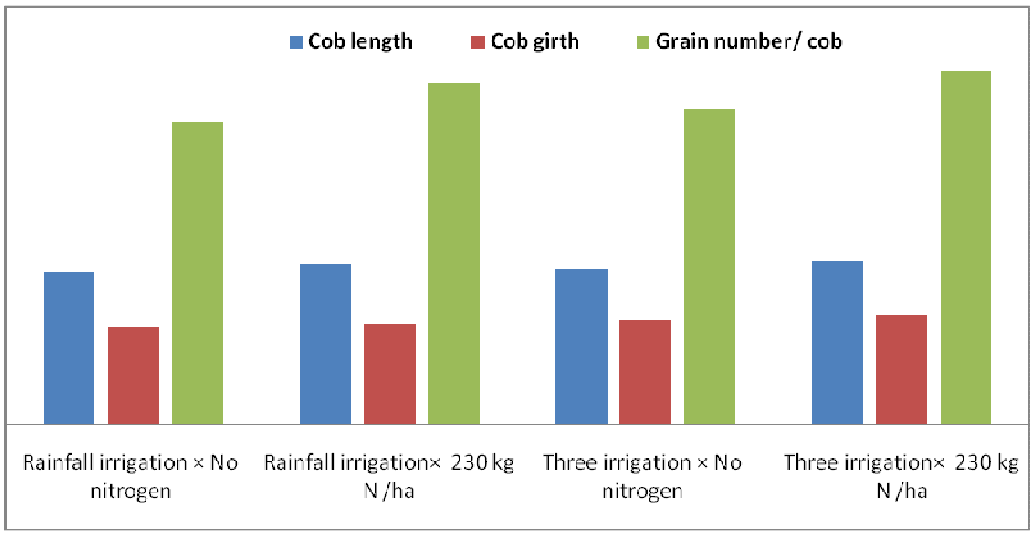

Fig. 1 Effect of irrigation and nitrogen on cob length, cob girth and grain number line/cob of maize

Table 1. Interaction effect of irrigation and nitrogen on the yield attributes of BARI hybrid maize-7

Treatments	Cob grain free (cm)	Grain number line^{-1} (no)	Grain yield (tha^{-1})	Straw yield (tha^{-1})	Biological yield (tha^{-1})	Harvest Index (%)
No irrigation and no nitrogen	1.50	41.50	6.40	45.33	51.75	0.13
No irrigation and 230 kg/ha nitrogen	1.17	46.50	8.46	55.58	63.88	0.13
Three irrigation and no nitrogen	1.25	45.33	8.25	54.24	62.32	0.13
Three irrigation and 230 kg/ha nitrogen	0.75	50.33	10.32	64.49	74.64	0.14
SD	0.32	3.63	1.60	7.84	9.36	0.005
CV (%)	28.68	7.91	19.17	14.27	14.83	3.77
Level of significance	NS	**	**	**	**	NS

In a column figures having common letters(s) do not differ significant as per DMRT
**Indicates 1 % and * indicates 5% level of probability
NS indicates not significant

Total grain/cob: Total grain/cob graphs respective in irrigation and nitrogen treatments resulted in a usual graphs of different irrigation and nitrogen treatments within yield level i.e. total grain/cob values increased with the increasing irrigation and nitrogen levels and afterwards inspect of irrigation level decline production (Fig. 2). It might be conformed due to irrigation and nitrogen uses a vitriol role in the BARI hybrid maize-7. Tisdale *et al*. (2010) found that the optimum level of irrigation schedules and nitrogen rates for enhanced grain yield and its components under semi arid irrigated conditions.

Grain weight/cob: Grain weight/cob graphs respective of irrigation and nitrogen treatment resulted in a usual curve of different irrigation and nitrogen treatments within yield level i.e. grain weight/cob values increased with the increasing of irrigation and nitrogen levels (Fig. 2). It was conformed that irrigation and nitrogen supply increased grain weight/cob. Cob weight increased with increase in nitrogen application and the heaviest cobs were obtained at 240 kg Nha^{-1} (Konuskan *et al.*, 2010).

1000 grain weight: The 1000 grain weight graphs respective of irrigation and nitrogen treatment resulted in a usual graphs of different irrigation and nitrogen treatments within yield level i.e. 1000 grain weight values increased with the increasing of irrigation and nitrogen levels (Fig. 2). It might be probably due to irrigation and nitrogen levels increased 1000 grain weight advanced. Yildirim and Kodal (2008) stated that applications of excessive irrigation water did not increase 1000 grain yields at the important level. The relationship between applied water and 1000 grain yield was quadratic.

Grain yield: Interaction effect of irrigation and nitrogen treatments had highly significant influenced with grain yield in BARI maize-7. The highest grain yield (10.32 tha^{-1}) produced in three irrigations with 230 kg/ha nitrogen which was dissimilar with any others treatments. The lowest grain yield (6.40 tha^{-1}) measured in rainfall irrigation with no nitrogen levels and statistically differs from any others treatments (Table 1). Maximum grain yield and greater water use efficiency were achieved when irrigating to 100% of field capacity (Mbagwu and Osuigwu, 2005).

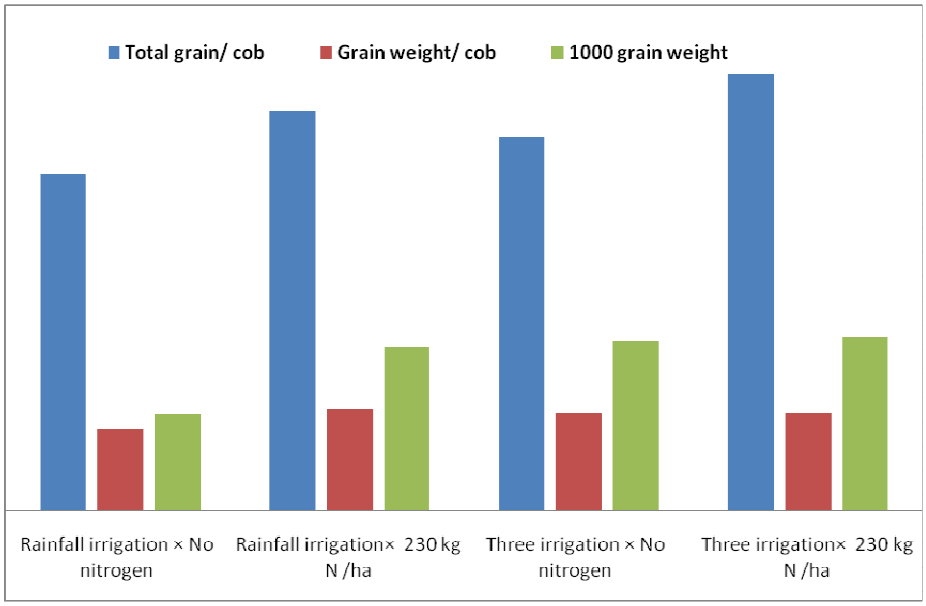

Fig. 2 Effect of irrigation and nitrogen on total grain/cob, grain wt. /cob and 1000 grain wt. of maize

Straw yield: Straw yield was showed positive effect positively among the interaction effect of irrigation and nitrogen treatments in BARI maize-7 (Table 1). The most vegetative yield (64.49 tha^{-1}) produced in three irrigations with 230 kg/ha nitrogen levels which was statistically dissimilar with others treatments. The lowest vegetative yield (45.33 tha^{-1}) counted in rainfall irrigation with no nitrogen levels and statistically differs from any others treatments. Tisdale *et al., (*2010) found the study was therefore, undertaken to determine the optimum level of irrigation schedules and nitrogen rates for enhanced straw yield and its components under semi arid irrigated conditions. Gaur (2011) reported higher stover yield at 60 kg "N" $ha^{-1.}$

Biological yield: Biological yield of BARI hybrid maize-7 showed significant effect on by interaction of irrigation and nitrogen treatments (Table 1).The maximum biological yield (74.64 tha^{-1}) obtained three irrigations with 230 kg/ha nitrogen levels which was statistically differs from any others treatments. The lowest vegetative yield (51.75 tha^{-1}) counted rainfall irrigation with no nitrogen use and differs from any others treatments. Maximum biological yield and greater water use efficiency were achieved when irrigating to 100% of field capacity (Mbagwu and Osuigwu, 2005).

Harvest index: Interaction effect of irrigation and nitrogen treatments harvest index showed insignificant effect in BARI hybrid maize-7 (Table 1). The maximum harvest index 0.14 obtained three irrigations with 230 kg/ha nitrogen levels. The minimum harvest index 0.13 found with all the treatments accept three irrigations with 230 kg/ha nitrogen levels and statistically differs from any others treatments. It's resulted due to irrigation and nitrogen levels increased with the harvest index not significantly increased. Results showed lower harvest index values in lower nitrogen and irrigation rates. Bindhani *et al.* (2007) reported that the nitrogen content both in baby corn and green fodder not increased significantly with increasing N levels up to 120 kg/ha.

Conclusion

Evaluating the results of the experiment, we found that N fertilizer significantly influenced on the efficiency of irrigated maize production. In irrigated cultivation, the condition of efficient farming is ensuring appropriate nutrient supply. Our experimental data have justified the results of previous researches results according to which, the amount of precipitation or the moisture stored in the soil modifies the fertilizer effect, meaning that less fertilizer is needed with lower water supply. According to the results of the experiment, 230 kg N/ha and three irrigations recommended in any condition, since compared to the no N-dose and rainfall irrigation, it did not increase the yield of maize considerably. In droughty years, it caused a significant yield decrease. From the above research work it could be concluded that application of N @ 230 kg/ha with three irrigations would be better for growth and yield of maize.

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