

Timing of nitrogen fertilizer application influences on seed cotton yield

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Abstract

To find out the optimum timing of N application on seed cotton yield, two years field experiment was conducted at Adaptive research Farm Sargodha, Pakistan during summer seasons of year 2011 and 2012. Cotton variety MNH 886 was sown. Five treatments were applied as full nitrogen at first irrigation, ½ nitrogen at first irrigation + ½ nitrogen at 2nd irrigation, ½ nitrogen at sowing + ½ nitrogen with 2nd irrigation, ½ nitrogen at sowing + ½ nitrogen at flowering stage, ten split applications of N with each irrigation. Randomized complete block design was used for layout using three replications. Significantly the highest seed cotton yields (1559 kg ha⁻¹ and 1135.7 kg ha⁻¹ during years 2011 and 2012, respectively) were observed with ten split applications of N with each irrigation. The maximum seed cotton yield in response to split N application seems due to the highest number of bolls plant⁻¹ and boll weight in that treatment. Regression analysis also showed the significant strong positive relationship of seed cotton yield with number of boll plant⁻¹ (R²=0.867) and boll weight (R²=0.895).

Keywords: Boll weight, MNH 886, split application, seed cotton yield

1. Introduction

Cotton (*Gossypium hirsutum* L.) is the most important cash crop in Pakistan. It is mainly grown for the purpose of oil and fiber in the world. Pakistan is ranked at fifth position regarding its production and at third position with respect to export of cotton lint among producing countries of the world. Cotton has share of 1.4 percent in gross domestic product and 7.6 percent in agricultural value addition. It contributes US\$ 10.4 billion to foreign exchange earnings of the country. This crop covers about 2.8 million hectares area of Pakistan which produces 12.8 million bales annually. The average yield of cotton lies around 773 kg ha⁻¹ in Pakistan Economic Survey of Pakistan [1], which is quite lower than that of other cotton producers like China whose annual production is 1380 kg ha⁻¹. The agronomic factors responsible for low yield in the country are numerous among which inappropriate fertilizer management is considered major one. Nitrogen is the most limiting essential plant nutrient in the world and it needs to be supplied in proper quantities and time. Nitrogen requirement of crops is usually more than those of P and K. yet N has higher losses, lower use efficiency and greater potential to pollute the environment. Jan *et al.*, [2]. There are several factors which effect plant use efficiency of added nitrogen. These factors include application rate and timing, cultivar and climatic conditions. Research has shown that N and K uptake efficiency was increased when N was applied in splits Bhatiand Manpreet [3], Ali [4], and N application 187 kg ha⁻¹ gave the highest seed cotton yield Khan *et al.* [5]. Inappropriate application delays cotton maturity Rochester *et al.*, [6]. It is essential to use N efficiently as possible to increase the farmers profit and reduce losses of nitrogen.

Little work has been carried out to optimize the best timing of nitrogen fertilizer application for getting higher seed cotton

yield. The objective of present study was to determine the best timing of N fertilizer application on seed cotton yield under agro-ecological conditions of Sargodha.

2. Materials and Methods

Two year field study was carried out during summer seasons of 2011 and 2012 at Adaptive Research Farm Sargodha, Pakistan. The experimental site was located at 32.08° N latitude, 72.67° E longitude and 193m altitude. Soil of experimental site was clay loam having pH 8.5.

Different N fertilizer treatments were: full nitrogen at first irrigation, ½ nitrogen at first irrigation + ½ nitrogen at 2nd irrigation, ½ nitrogen at sowing + ½ nitrogen with 2nd irrigation, ½ nitrogen at sowing + ½ nitrogen at flowering stage, 10 split N application with each irrigation. Nitrogen was applied by side dressing method. Experiment was laid out in randomized complete block design with three replications. The net plot size was 37.5 × 255cm.

Seed bed was prepared with three cultivations and two rotavations. Beds were made with the help of bed-shaper. Cotton variety MNH 886 was sown on margins of 75cm wide beds manually after irrigation. Sowing was carried out 22nd May during 2011 and 20th May during 2012. Pendimethalin 330EC at 825 g a.i. ha⁻¹ was applied 1 day after sowing (DAS) for weed control. First irrigation was applied 40 DAS and remaining irrigation with 12-15 days interval. A total of 10 irrigations were applied. Nitrogen, P and K at 153, 57 and 62 kg ha⁻¹ were applied as urea, diammonium phosphate and sulfate of potash, respectively. Full dose of P and K were applied at time of sowing whereas N was applied according to treatments plan. Three pickings were done during Nov-Dec in both years of study.

Data regarding various plant growth and yield parameters of cotton viz., plant population (m⁻²), plant height (cm), number

of bolls plant⁻¹, boll weight (g) and seed cotton yield (kg ha⁻¹) were recorded at maturity and harvest using their standard procedures. Data collected were statistically analyzed using Fisher's analysis of variance techniques and mean separation was carried out by least significant difference test at 5% probability Steel *et al.* [7].

3. Results and Discussion

3.1 Plant height (cm)

Plant height reflects the vegetative growth performance of a crop. Data related to plant height of cotton as influence by different N application treatments have been shown in table 1. Data indicated that significantly the highest plant height (147 cm) of cotton was recorded with ½ N at sowing + ½ N with 2nd irrigation during year 2011. However, during year 2012, split N application at each irrigation resulted in the highest plant height (129 cm) of cotton which remained statistically similar to that observed with ½ N application at sowing + ½ N application at flowering stage. Contrastingly, the lowest plant heights (110.3 and 117 cm) of cotton in year 2011 and 2012 were noted with split N application at each irrigation and whole N application with first irrigation, respectively. Differential response of plant height to different application of N in year 2011 and 2012 seem due to the variation in the total rain fall during the growing seasons of that year (Figure 1). Hallikeri *et al.* [8] noted the highest plant height at the highest N application rate (120kg ha⁻¹).

3.2 Number of bolls plant⁻¹

Number of bolls per plant is an important yield component of cotton. Although this is considered to be varietal character, the prevailing environmental condition may have a greater influence on this trait. Data given in table 1 showed that number of bolls per plant of cotton was significantly affected by various N application treatments. The split application of N with each irrigation produced significantly the highest number of bolls per plant (19 and 21) during year 2011 and 2012, respectively. However the lowest number of bolls (13 and 15 plant⁻¹ in year 2011 and 2012, respectively) of cotton was achieved by full dose of N with first irrigation (Table 1). The highest availability of N application at sympodial and flowering stage may be resulted to highest number of boll

plant-1. Bhati *et al.* [3] also reported that split application of N gave maximum number of boll plant⁻¹ in cotton. Rashidi *et al.* [9] observed that the application of 200kg ha⁻¹ N rate increased the boll number (19.8) as compared to low rates.

3.3 Bollweight (g)

The bolls weight significantly contributed to seed cotton yield and it is influence by different environmental conditions. Data given in table 1 revealed that bolls weight of cotton was affected by different N application treatments. The highest boll weight (2.9 and 2.91 g) of cotton was noted with split N application with each irrigation during year 2011 and 2012, respectively. However the lowest boll weight (2.77 and 2.78 g in year 2011 and 2012, respectively) of cotton was observed by full dose of N with first irrigation (Table 1). This is might be due to highest availability of N at boll development stages in cotton increased the boll weight. These results agree with those of Hallikeri *et al.* [8] who reported that split application with different N levels significantly increased boll weight in cotton. Saleem *et al.* [10] recorded the maximum boll weight (2.9g) with the application of 120kg ha⁻¹ N.

3.4 Seed cotton yield kg ha⁻¹

The term seed cotton is the un-ginned cottonseed with attached lint. The yield components such as number of boll plant⁻¹ and boll weight strongly influence the seed cotton yield. Data of seed cotton yield was shown in table-1 which revealed that significantly the highest (1559 kg ha⁻¹ and 1135.7 kg ha⁻¹ during years 2011 and 2012, respectively) seed cotton yield was observed with ten split application of N at each irrigation. The maximum seed cotton yield in response to split N application seems due to the highest number of boll and boll weight in that treatment. Regression analysis also showed the strong relationship of seed cotton yield with number of boll plant⁻¹ (R²=0.867) and boll weight (R²=0.895) (Figure 2). Yang *et al.* (2011) also reported that highest biomass and yield was obtained when the N was applied (225kg ha⁻¹) in three split at pre-plant application, a first bloom application and a peak bloom application in cotton. The similar result was found by Tang *et al.* [11] that maximum yield was obtained by application of 225kg ha⁻¹ N in three splits.

Table 1: Yield and yield related traits of cotton as influenced by various N application treatments

N application treatments	Plant population m ⁻²		Plant height (cm)		Number of boll plant ⁻¹		Boll weight (g)		Seed cotton yield (kg ha ⁻¹)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
T ₁	4.5	4.7	120.0 bc	117.0 c	13.0 c	15.0 d	2.77 d	2.78 d	1204.0 e	773.7 e
T ₂	4.6	4.8	128.3 b	125.0 ab	18.0 a	20.0 ab	2.87b	2.88 c	1448.0 b	1094.3 b
T ₃	4.6	4.6	147.0 a	122.0 b	15.0 b	17.0 cd	2.79 cd	2.8 c	1279.0 d	876.3 d
T ₄	4.5	4.8	120.7 bc	127.0 a	16.0 b	18.0 bc	2.8 c	2.81 c	1371.0 c	961.3c
T ₅	4.6	4.7	110.3 c	129.0 a	19.0 a	21.0 a	2.9 a	2.91 a	1559.0 a	1135.7a
LSD (P _≤ 0.05)	NS	NS	14.8	4.1	1.8	2.1	0.02	0.01	9.8	6.0

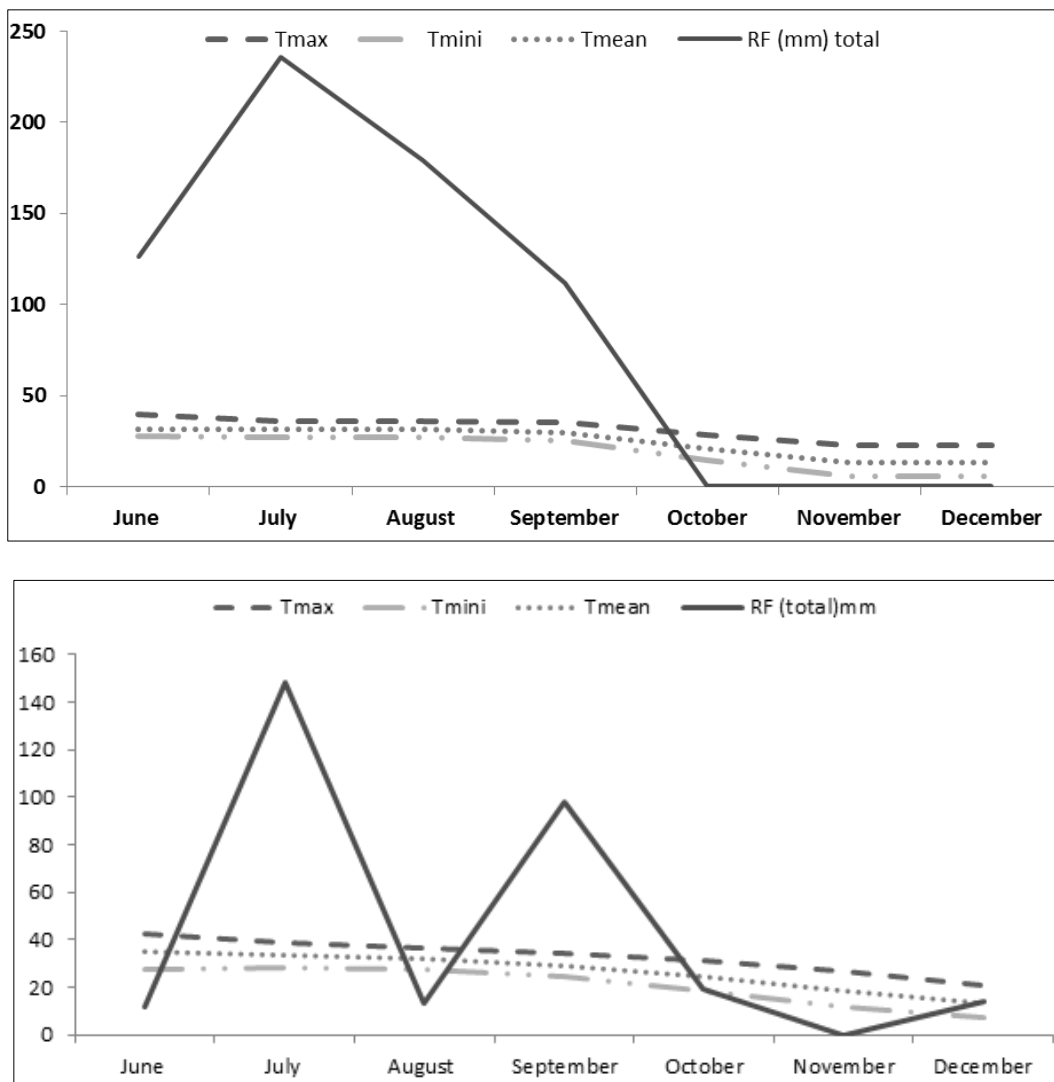
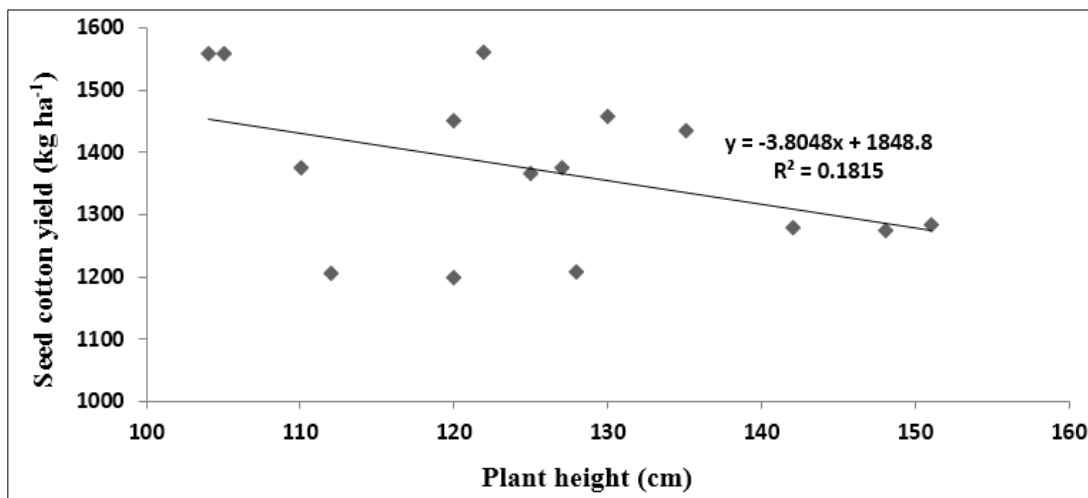


Fig 1: Metrological data of the experimental site (Sargodha) during crop growing seasons of years (a) 2011 and (b) 2012



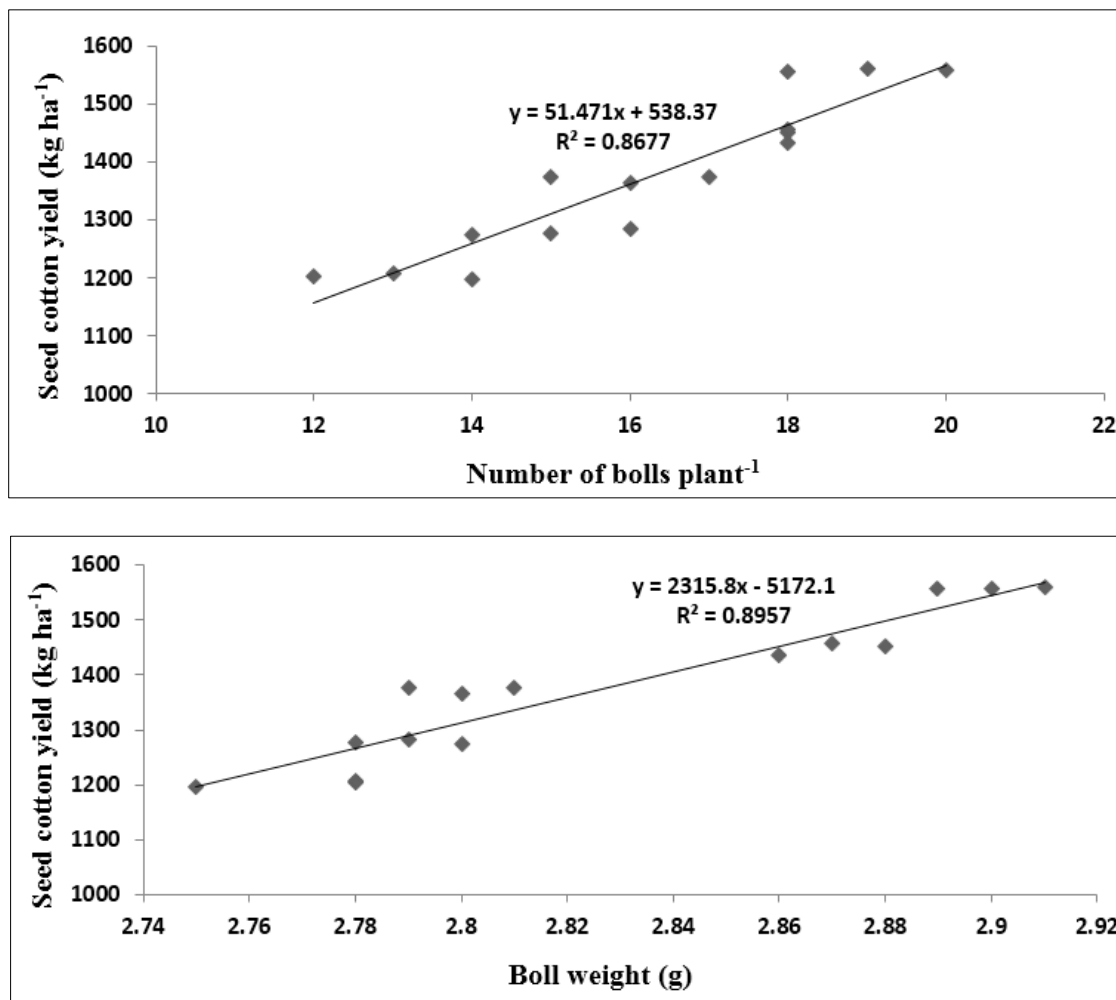


Fig 2: Relationship of seed cotton yield with its (a) plant height, (b) number of bolls plant⁻¹, and (c) boll weight plant⁻¹

4. Conclusion

The experiment concluded that ten split applications of N with each irrigation produced the maximum seed cotton yield and yield components such as number of boll plant⁻¹ and boll weight. Increase in seed cotton yield due to efficient N management was due to higher number of boll plant⁻¹ and boll weight.

5. References

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