Effect of nitrogen and growth regulator applications on seed cotton (*G. hirsutum* L.) yield under ecological conditions of the Harran Plain in the GAP region

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ABSTRACT

This study was carried out to determine the effects of varying rates of nitrogen fertilizer and growth regulator applications on yield and agronomical and technological characteristics of cotton (Gossypium hirsutum L.). Split plot experiments with three replications were conducted during the period 1998-2000. Sizes of the plots were 50.4 m² (4.2 m by 12.0 m) in planting, and 28 m² (2.8 m x 10.0 m) in harvesting. Sayar 314 cotton variety (Gossypium hirsutum L.) was used as the material. Between and within the row spacings of the plants were 70 cm and 20 cm, respectively. Nitrogen rates (0, 60, 120 and180 kg ha^{-1}) were the main plots and the growth regulators, Pix™ (1000 ml ha^{-1}), Pix™ (2000 ml ha^{-1}), Atonic™ (1500 ml ha^{-1}), Atonic™ (3000 ml ha^{-1}) were the sub plots in the trials. Experimental results suggest that the effects of the treatments of nitrogen and growth regulators on seed-cotton yield were significant while nitrogen x growth regulator interaction was insignificant. The highest seed-cotton yield was obtained from the 180 kg ha^{-1} nitrogen and 3000 ml ha^{-1} Atonic™ applications. Result of regression analysis indicate that the relationship between the nitrogen fertilizer and seed-cotton yield was highly significant (r= 0.985), fitting to the quadratic yield equation $Y= 2660 + 21.58X - 0.0625X^2$. Using this equation, 170 kg ha^{-1} and 164 kg ha^{-1} nitrogen rates were found as the natural and economic optimums for seed-cotton yield, respectively

Introduction

Turkey is the 6th largest cotton producing country in the world with average yield of 1160 kg ha^{-1}, twice as high as that of world (Anonymous, 1998, 1999, 2000, 2001, 2002). Currently, cotton production areas in Turkey are located particularly in Western (Aegean), Southern (Antalya – Cukurova) and South Eastern (GAP) Anatolia regions.

The South Eastern Anatolia, also known as the Upper Mesopotamia, receives a very limited amount of precipitation thus irrigation is mandatory for profitable cotton production. The South-Eastern Anatolia energy and irrigation project launched in 1976 and to be completed in the next decade contains 22 dams and 19 hydroelectric power plants on the Euphrates and Tigris rivers. This huge project will permit the irrigation of 1 657 447 ha of arable land (Anonymous, 1989). This irrigation potential will significantly change the cropping pattern within this region. Consequently, it is expected that the size of the cotton planted area will reach, within this pattern to no less than 58,0000 ha, which is about 35% of the total arable land in the region. Within this scheme, the overall cotton harvested area in Turkey will reach to 1.2 million hectares with a predicted production of more than 1.3 MT tons of cotton fiber.

Extension of irrigated cotton production in the region will increase the risk of creating detrimental effects on soil and environment, especially due to water and increased fertilizer applications. It is thus necessary to incorporate some practices in cotton cultivation to alleviate this impact. Among such practices, applications of nitrogen fertilizer and growth regulators may be one of the most convenient and effective ones.

This study was carried out to determine the effects of varying rates of nitrogen fertilizer and growth regulator applications on yield and agronomical and technological characteristics of irrigated cotton (*Gossypium hirsutum* L.).

Experimental procedure

Pix™ (dimethyl pipendium chloride) and Atonic™ (Sodium 2-methoxy-5-nitrophenol), along with nitrogen was tested on Sayar 314 variety of Cotton (*Gossypium hirsutum* L.) in a three-year field trial under the ecological conditions of the Harran plain in the Sanlýurfa province of the GAP area in Turkey on the type of red-brown alluvial soil. The experiments were split plot design, with three replications, nitrogen main plots and of Pix™ and Atonic™ sub plots. Size of the plots was 50.4 m² (4.2 m by 12 m) and 28 m² (2.8 m x 10 m) was harvesting. Between and within row, plant spacing was 70 cm and 20 cm, respectively. Planting dates were 7 May 1998; 27 April 1999 and 4 May 2000. Nitrogen was split applied, one half at planting and the remainder just before the first irrigation at 0, 60, 120 and 180 kg ha^{-1} rates. Pix™ at 1000 and 2000 ml ha^{-1}, and Atonic™ at 1500 and 3000 ml ha^{-1} rates were applied to split nitrogen plots. All plots received uniform pre plant 60 kg ha^{-1} P_2O_5 as triple super phosphate. Growth regulators were sprayed with a knapsack sprayer at 10% of squaring, 10% flowering and 10 days after the second treatment. Irrigation schedule was initiated at flowering and terminated when boll opening was 10% complete, resulting in total eight irrigations.

The data were evaluated with TARIST computer software. The relationship between nitrogen rates (X) and seed-cotton yield (Y) was obtained by fitting the data into the quadratic equation $Y=a+bX+cX^2$. The economic rate of the nitrogen fertilizer (Eg) was calculated by the equation Eg=Fg-Fm.b/2 Fm.c, where Fg is the price of nitrogen fertilizer in terms of pure nitrogen and Fm is the sale price of seed-cotton, whereas b and c are the coefficients taken from the quadratic yield equation.

Results and Discussion

In the trials, beside seed cotton yield, plant height, number of monopodia and sympodia, and number of bolls, seed cotton weight of bolls, earliness, ginning percentage, 100 seed weight, fiber length, fineness, strength and uniformity were investigated. In this paper only the results of seed-cotton yields are reported.

Analysis of Variance (Table 1) suggests that both fertilizer and growth regulator applications significantly (0.001) effected seed cotton yield, where as their interaction was significant only in year 2000. The mean values of the seed cotton yield related to rates of fertilizer and growth regulators and the groups formed by LSD control throughout the three-year experimental period are given in Figures 1 and 2. In Figure 1 it is obvious that the highest seed cotton yields were obtained from the applications of 120 and 180 kg ha^{-1} nitrogen in all years. Effects of growth regulators (Figure 2) however, were not consistent throughout the years. It can be suggested that Pix™ was not effective at all under conditions of high solar intensity, low relative humidity and large differences between day and night temperatures, while Atonic™ might have a questionably small positive effect on yield.

It can be recalled from Table 1 that the nitrogen x growth regulator interaction is significant only in year 2000, a possible outcome of the inconsistent effects of growth regulators. The combined effects of nitrogen and growth regulators on yield are given on Figure 3. Although it is not possible to draw solid conclusions from one-year results, there seems to be a tendency towards a positive relation between nitrogen and Atonic™ especially at 120 kg $ha^{-1}$and 180 kg ha^{-1} nitrogen rates.

Three-year averages (Figure 4) demonstrate a significant ($p<0.01$) relation ship between the seed-cotton yield and nitrogen rates with the quadratic equation $y=2660 + 21.58X - 0.0625 X^2$.

It can be predicted that seed cotton yield can be increased by nitrogen applications up to 170 kg ha^{-1} and the economical nitrogen rate is 164 kg ha^{-1} under the experimental conditions and at market prices of nitrogen and seed cotton.

Conclusion

The present study has shown that the effects of the treatments of nitrogen and growth regulators (Atonic™ and Pix™) on seed-cotton yield of cotton (*Gossypium hirsutum* L.) were significant in each year (1998-1999-2000) while nitrogen x growth regulator interactions were insignificant expect the year of 2000.

The highest seed-cotton yield was obtain from the 180 kg ha^{-1} nitrogen while the 170 kg ha^{-1} and 164 kg ha^{-1} nitrogen rates were found as the natural and economic optimums for seed-cotton yield, respectively. Each year the Atonic™ treatments increased seed-cotton yield while the Pix™ treatments didn't effect. So, 165 kg ha^{-1} nitrogen rate and Atonic™ treatment were recommended for cotton production in the South Eastern Anatolia Project Area to obtain high seed-cotton yield.

References

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Table 1. *Analysis of variance (mean square of seed cotton yield and their significance).*

Variation Source	D.F	1998 M.S	1999 M.S	2000 M.S
Replications	2	12362.178	4820.040	198.733
Fertilizer (F)	3	93527.272***	99129.550***	133107.612***
Eror-1	6	586.892	507.630	173.536
Growth Regulators (G)	4	6238.490***	3550.892***	5385.914***
F x G Interactions	12	362.980	420.720	623.776**
Error	32	684.859	366.591	215.096
Sum	59	6102.588	5780.638	7401.247

* = 0.05, ** = 0.01 and *** = 0.001 level of significance

Figure 1. *Effect of nitrogen rates on seed cotton yield through the years.*

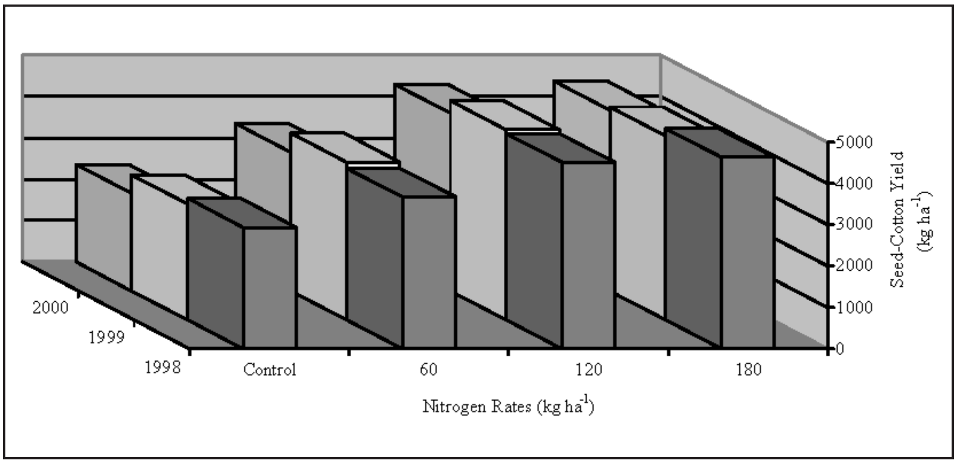

Figure 2. *Effect of growth regulators on seed-cotton yield through the years.*

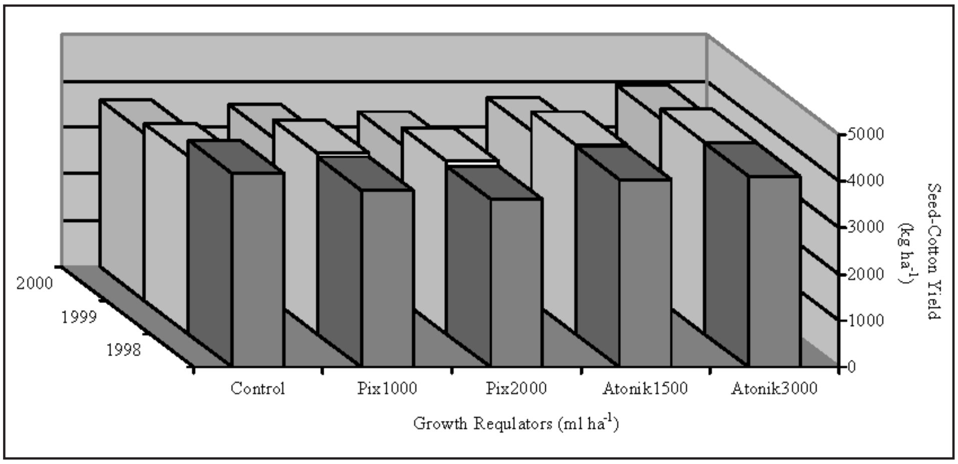

Figure 3. *Seed-cotton yield related to rates of nitrogen and growth regulators in year 2000.*

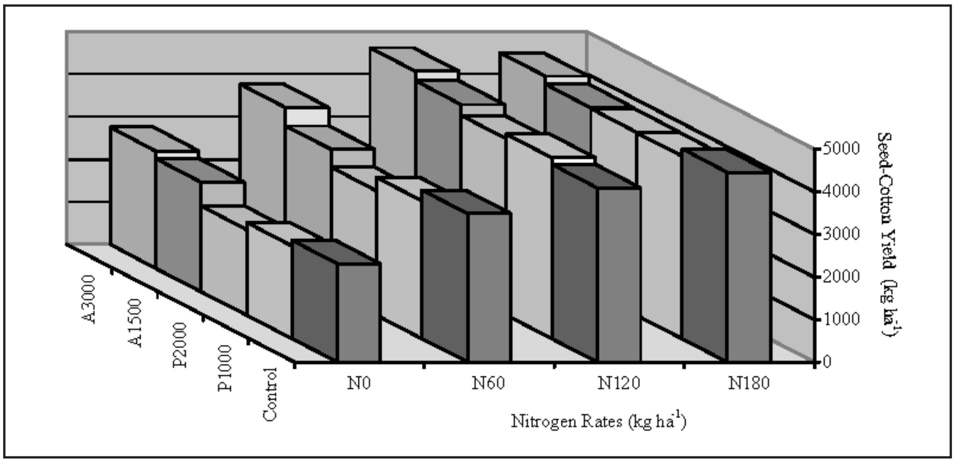

Figure 4. *The relationship between three-year average seed cotton yield and nitrogen rates.*