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# RESPONSE OF GIZA 90 COTTON CULTIVAR TO WATER STRESS AND NITROGEN LEVELS WITH BORON FLOIAR APPLICATION

**Hamed, F.S.**
**Cotton Research Institute, Agric. Res. Cent. Giza, Egypt.**

## ABSTRACT

The present study was carried out at Shandaweel Agricultural Research Station during 2009 and 2010 seasons to study the effect of water stress and nitrogen fertilization levels with boron foliar application on growth, seed cotton yield and its components of Giza 90 (*Gossypium barbadense* L.). A split-plot design with four replications was used. The main plots were assigned to water stress treatments (irrigation every two weeks and three weeks). Nitrogen fertilization levels with boron foliar application i.e., 60 kg N/fed, 60 kg N/fed + foliar spraying by boron (at budding stage beginning), 60 kg N/fed + foliar spraying by boron (at flowering stage), 60 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage), 75 kg N/fed, 75 kg N/fed + foliar spraying by boron (at budding stage beginning), 75 kg N/fed + foliar spraying by boron (at flowering stage) and 75 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage) were assigned in the sub-plots. The results indicated that irrigation every two weeks significantly increased plant height at harvest, number of fruiting branches/plant, number of open bolls/plant, boll weight and seed cotton yield/plant in both seasons, while, days to first open boll, seed cotton yield/fed, days to first flower appearance and location of first fruiting node (in one season only). However, number of plants at harvest was not significantly affected by water stress in both seasons. With respect to nitrogen fertilization levels and foliar spraying with boron treatments, the results indicated that, plant height at harvest, number of fruiting branches/plant and seed cotton yield/feddan were significantly increased by 75 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage) in both seasons, while, boll weight (in 2009 season only), meanwhile, boll weight (in 2010 season only) by 75 kg N/fed + foliar spraying by boron (at budding stage beginning). However, number of open bolls/plant and seed cotton yield/plant (in 2009 season only) by 75 kg N/fed + foliar spraying by boron (at flowering stage), while, number of open bolls/plant and seed cotton yield/plant (in 2010 season only) by 75 kg N/fed. Meanwhile, location of first fruiting node and number of plants at harvest/fed were not affected by nitrogen fertilization levels + foliar spraying with boron in both seasons. It could be concluded that using regular irrigation intervals every two weeks along the whole plant life and nitrogen application 75 kg N/fed + foliar spraying with boron (at budding stage beginning and flowering stage).

## INTRODUCTION

Irrigation and fertilizers application are the most important aspects of cotton production. In Egypt, the reduction of cotton yield is the first problem facing the cotton producers, possibly due to many factors such as water supply, fertilizers application and pest control management. Several studies were carried out in this field but the problem was more difficult because it concerned with social and economic behavior of Egyptian farmers. Chaudhry (1969) found that irrigation intervals (8, 15, 22 and 29 days) influenced plant height, numbers of branches/plant and node of the first sympodium, Gomaa *et al.,* (1981) indicated that decreasing irrigation intervals significantly increased both boll number and weight, number of sympodia and seed cotton yield. Guinn *et al.,* (1981) indicated that water deficit decreased plant height and number of branches per plant. Ali (1990) found that the irrigation every 15 days produced the highest seed cotton yield per feddan, number of open bolls per plant and boll weight more than the irrigation every 10 or 20 days. Radin *et al.,* (1992) indicated that plant height, boll weight and seed cotton yield were significantly increased in favour of reducing irrigation intervals. Ibrahim and Moftah (1997) indicated that plant height, numbers of branches and bolls per plant were significantly decreased by extending the irrigation frequency intervals to 28 days, while, the position of first sympodium and number of fruiting branches/plant were not significantly affected. El-Shahawy and Abd El-Malik (1999) found that the close irrigation intervals (every two weeks) resulted in higher number of sympodia, number of open bolls, boll weight and seed cotton yield. Final plant height reached its maximum with the intermediate interval (irrigation every three weeks). Close irrigation intervals delayed maturation in terms of raising nodel position of the first sympodium. El-Shahawy *et al.,* (2000) found that irrigation intervals every two weeks increased plant height, number of sympodial branches, number of open bolls/plant, boll weight and seed cotton yield. They added that node location of the first sympodium was not affected by irrigation intervals. Ziadah *et al.,* (2000) found that irrigation intervals 15/15 days during vegetative and fruiting stages significantly increased plant height at harvest, number of fruiting branches/plant, boll weight, number of open bolls/plant, seed cotton yield/plant and seed cotton yield/fed in both seasons compared to the other tested irrigation treatments. Ali (2002) found that plant height, number of sympodium/plant, number of open bolls/plant, boll weight and seed cotton yield/plant and per feddan were significantly influenced by irrigation intervals in favour of the close irrigation (every two weeks). El-Sayed (2005) and Hamed (2007) found that irrigation every two weeks increased final plant height, number of fruiting branches, number open bolls/plant, boll weight and seed cotton yield/plant and per feddan, while, position of the first sympodium was not affected by irrigation intervals. Nitrogen is an important factor limiting plant growth. The response of cotton plants to nitrogen fertilization depends mainly on soil fertility level and cotton variety. Therefore, it is suitable to apply nitrogen fertilizer in an adequate amount necessary for plant nutrition to produce higher yield with good quality. Several studies were carried out in this respect, Darwish *et al.,* (1995), Abdel-Malik and El-Shahawi (1999), Darwish (2001), Hamed (2002), Saleh *et al.,* (2004), El-Sayed and El-Menshawi (2005), El-Hindi *et al.,* (2006), Hamed (2006) and El-Sayed (2011) t found that plant height at harvest and number of fruiting branches/plant significantly increased by nitrogen application. While, Abdel-Malik and El-Shahawi (1999), Ali and El-Sayed (2001), El-Sayed and El-Menshawi (2005), Hamed (2006) and El-Sayed (2011) found that first fruiting node, number of days to first flower appearance and number of days to first open boll significantly increased by nitrogen application. Meanwhile, Hamissa *et al.,* (2000), Saleh *et al.,* (2004), El-Sayed and El-Menshawi (2005), El-Hindi *et* *al.,* (2006), Hamed (2006) Ghaly *et al.,* (2007), Mahdi (2007), Ibrahim (2008), El-Sayed (2011) and Rashidi and Gholami (2011) found that number of open bolls/plant, boll weight, seed cotton yield/plant and per feddan were significantly increased by nitrogen application.

Boron (B) is involved in the uptake and metabolism of $Ca^{++}$ by the plant and is essential for fruiting (Hearn, 1981). A deficiency in B may cause shedding of young bolls and deforming of flowers. In extreme cases the plant is stunted the main stem and leaves are deformed (Hearn, 1981). Boron (B) deficiency decreased leaf size and length of sympodial branches and hence increased shedding of ovaries and buds of cotton (Pak, 1976). Boron (B) shortages are usually found in alkaline soils with a pH of about 8 to 8.5 (Cardozier, 1957). El-Shazly, *et al.,* (2003) found that two foliar feedings of boron as boric acid (17% boron) at two levels i.e., 0.15 and 0.30% at each spray significantly increased plant height in two seasons and number of fruiting branches/plant in one season as compared with the control treatment. Moreover, these treatments significantly increased seed cotton yield/plant when the high level was used as compared with the control treatment. In addition, the high level of boron significantly increased boll weight and seed cotton yield/fed in two seasons as well as number of open bolls/plant in one season as compared with the control. El-Masri, *et al.,* (2005) found that two foliar feeding of boron as boric acid (17% boron) at two levels i.e., 0.15 and 0.030% at each spray significantly increased plant height at harvest, number of fruiting branches/plant, boll weight, number of open bolls/plants, seed cotton yield/plant as well as per fed in both seasons as compared with the control treatment. Abd El-Aal, *et al.,* (2007) found that plant height at harvest, number of fruiting branches/plant number of open bolls/plant, boll weight, seed cotton yield/plant and per feddan were significantly affected by foliar spraying with boron and calcium in both seasons, while, number of plants at harvest/fed (in 2005 season only). Meanwhile, position of first fruiting node was not significantly affected by foliar spraying with boron and calcium in both seasons. Rashidi and Gholami (2011) found that foliar allocation of boron significantly increased boll number, boll weight, seed cotton yield and lint yield.

## MATERIALS AND METHODS

Two field experiments were conducted at Shandaweel Agricultural Research Station, Sohag Governorate during 2009 and 2010 seasons. Using Egyptian cotton cultivar Giza 90 (*Gossypium barbadense* L.). It is classified as along staple variety grown in Upper Egypt which was developed from across between Giza 83 and Dandara. The experimental design was split-plot with four replications. The main plots were allocated for the water stress treatments (irrigation every two weeks and three weeks), which resulted 11 and 8 number of irrigations in each season, while the sub-plots were assigned for the nitrogen fertilization levels with boron foliar application i.e., 60 kg N/fed, 60 kg N/fed + foliar spraying by boron (at budding stage beginning), 60 kg N/fed + foliar spraying by boron (at flowering stage), 60 kg

N/fed + foliar spraying by boron (at budding stage beginning and flowering stage), 75 kg N/fed, 75 kg N/fed + foliar spraying by boron (at budding stage beginning), 75 kg N/fed + foliar spraying by boron (at flowering stage) and 75 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage). The sub-plots size was 17.55 $m^2$ (4.5 m length and 3.9 m width) and included 6 ridges of 65 cm apart. Cotton seed were sown in hills spaced 20 cm apart leaving two vigorous seedlings per hill at thinning time. Nitrogen fertilizer was added in bands and divided in two equal portions, the first one was applied of ten thinning just before the second irrigation and the second part before the third irrigation. Other practices were done as recommended in cotton production that is involved a basic dose of 150 kg calcium super phosphate (15.5% $P_2O_5$) at land preparation besides 50 kg potassium sulphate (48% $K_2O$) per feddan before the fourth irrigation for all sub-plots. Soil samples were taken in the two seasons before planting cotton to estimate the soil characters using the standard methods as deseribed by Chapman and Perker (1981). The results are shown in Table (1). Five guarded hill (every hill contains two plants) were randomly chosen from the three inner rows to study the following characters.

**Table (1): Mechanical and chemical analysis of soil samples at 0-30 cm depth from the surface in 2009 and 2010 seasons.**

| Soil characteristics | 2009 | 2010 |
|---|---|---|
| Texture | **Clay loam** | **Loam** |
| Calcium carbonate % | **1.41** | **1.36** |
| Organic matter % | **0.984** | **1.02** |
| pH (1:2:5 suspension NPK) | **7.25** | **7.30** |
| Total N (ppm) | **748** | **691** |
| Available P (ppm) | **9.65** | **8.75** |
| Available B (ppm) | **0.40** | **0.50** |
| **Cations mg/100gm soil :** | | |
| Ca++ | **1.16** | **1.20** |
| Mg++ | **0.85** | **0.77** |
| Na++ | **0.67** | **0.57** |
| K+ | **0.30** | **0.20** |

**Table (2): Number of irrigation over all the growing seasons.**

| Irrigation intervals | 2 weeks | 3 weeks |
|---|---|---|
| Number of irrigation | **11** | **8** |

A- Plant growth: final plant hight at harvest in cm and number of fruiting branches/plant.

B- Earliness measurements: location of first fruiting node, number of days from planting to first flower, number of days to the first open boll.

C- Yield and yield components: number of open bolls/plant, boll weight in grams, seed cotton yield/plant in grams, number of plant/feddan at harvest in thousand and seed cotton yield in kentars/fed. Seed cotton yield/plot in kilograms was recorded and transformed to kentars/fed (one kentar = 157.5 kg). Statistical analysis was performed according to

Snedecor and Cochran (1981) and means were compared by the L.S.D. at 5% level.

## RESULTS AND DISCUSSION

**A- Growth and earliness traits:**

The results in Tables (3, 4, 5, 6 and 7) show that plant height at harvest and number of fruiting branches/plant increased significantly as irrigation intervals decreased in both seasons, while, days to first open bolls/plant (in 2010 seasons only). Meanwhile, days to first flower appearance and location of first fruiting node (in 2009 season only). The irrigation every two weeks intervals gave the tallest plants due to higher node number. The reverse trend was detected with prolonging irrigation intervals up to three weeks intervals. These results may be due to the sufficient water irrigation supply which was necessary to provide the cotton plants with its requirement of water to activate vital processes such as metabolism which reflected on growth and earliness. Similar results were obtained by Chandhry (1969), Gomaa *et al.,* (1981, Guinn *et al.,* (1981), Radin *et al.,* (1992), Ibrahim and Moftah (1997), El-Shahawy and Abd El-Malik (1999), El-Shahawy *et al.,* (2000), Ziadah *et al.,* (2000), Ali (2002), El-Sayed (2005) and Hamed (2007). With respect to nitrogen fertilization levels and foliar spray with boron,the data show that plant height at harvest and number of fruiting branches/plant significantly increased by increasing nitrogen fertilizer level and boron up to 75 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage) in both seasons. While, days to first open boll and days to first open boll significantly increased due to applying 75 kg N/fed + foliar spraying by boron (at flowering stage) in both seasons. Such results may be attributed to the role of N fertilizer level with boron on plant metabolism consequently enhancing growth habits. These results are agreement with those obtained by Darwish *et al.,* (1995), Abdel-Malak and El-Shahawi (1999), Darwish (2001), Hamed (2002), El-Shazly *et al.,* (2003), Saleh *et al.,* (2004), El-Masri *et al.,* (2005), El-Sayed and El-Menshawi (2005), El-Hindi *et al.,* (2006), Abd El-Aal *et al.,* (2007) and El-Sayed (2011). found that plant height at harvest and number of fruiting branches/plant significantly increased by nitrogen application. While, Abdel-MalAk and El-Shahawi (1999), Ali and El-Sayed (2001), El-Sayed and El-Menshawi (2005), Hamed (2006) and El-Sayed (2011). The interaction between water stress (irrigation intervals) and nitrogen fertilizer level with boron significantly affected plant height at harvest, number of fruiting branches/plant and days of first open bolls/plant in both seasons. While, days of first flower (in 2009 season only). Meanwhile, location of first fruiting node was not significantly affected in both seasons.

**Table (3): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on plant height at harvest in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | Irrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 172.25 | 141.50 | **156.87** | 151.75 | 152.50 | **152.12** |
| ) kg N/fed+ boron foli raying at budding stag eginning | 174.75 | 153.00 | **163.87** | 150.25 | 157.25 | **153.75** |
| ) kg N/fed+ boron foli raying at flowering stage | 174.75 | 140.00 | **157.37** | 148.25 | 147.75 | **148.00** |
| ) kg N/fed+ boron foli raying at budding stag eginning and flowering stage | 166.5 | 144.50 | **155.50** | 159.00 | 146.25 | **152.62** |
| kg N/fed | 170.50 | 142.50 | **156.50** | 163.50 | 145.00 | **154.25** |
| kg N/fed+ boron foli raying at budding stag eginning | 175.75 | 148.50 | **162.12** | 156.25 | 144.25 | **150.25** |
| 75 kg N/fed+ boron foli spraying at flowering stage | 179.00 | 137.00 | **158.00** | 159.00 | 152.50 | **155.75** |
| kg N/fed+ boron foli raying at budding stag eginning and flowering stage | 178.25 | 152.25 | **165.25** | 158.00 | 154.25 | **156.12** |
| Mean | **173.97** | **144.91** | | **155.75** | **149.97** | |
| **LSD $_{0.05}$ A** | | | * | | | * |
| **B** | | | **3.01** | | | **0.53** |
| **AB** | | | **4.26** | | | **0.75** |

**Table (4): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on number of fruiting branches/plant in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | rrigation intervals(A | | Mean | Irrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 23.35 | 19.00 | **21.17** | 21.70 | 23.35 | **22.52** |
| 60 kg N/fed+ boron foli spraying at budding stag beginning | 22.75 | 21.20 | **21.97** | 24.65 | 20.75 | **22.70** |
| 60 kg N/fed+ boron foli spraying at flowering stage | 24.10 | 20.45 | **22.57** | 22.05 | 20.00 | **21.02** |
| 60 kg N/fed+ boron foli spraying at budding stag beginning and flowering stage | 21.45 | 20.60 | **21.02** | 21.85 | 23.60 | **22.72** |
| 75 kg N/fed | 22.50 | 20.90 | **21.70** | 22.90 | 23.40 | **23.15** |
| 75 kg N/fed+ boron foli spraying at budding stag beginning | 24.10 | 20.10 | **22.10** | 21.95 | 21.80 | **21.87** |
| 75 kg N/fed+ boron foli spraying at flowering stage | 24.00 | 19.15 | **21.57** | 24.65 | 21.80 | **23.22** |
| 75 kg N/fed+ boron foli spraying at budding stag beginning and flowering stage | 23.35 | 23.15 | **23.25** | 25.15 | 24.45 | **24.80** |
| Mean | **23.20** | **20.57** | | **23.11** | **22.40** | |
| LSD $_{0.05}$ A | | | * | | | * |
| **B** | | | **1.07** | | | **0.88** |
| **AB** | | | **1.52** | | | **1.24** |

**Table (5): Effect of application and their interaction on location of first fruiting node in 2009 and 2010 water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar** seasons.

| Fertilization treatments (B) | 2009 season Irrigation intervals(A) | | | 2010 season Irrigation intervals(A) | | |
|---|---|---|---|---|---|---|
| | 2 weeks | 3 weeks | Mean | 2 weeks | 3 weeks | Mean |
| 60 kg N/fed | 7.67 | 6.75 | 7.21 | 7.60 | 6.95 | 7.27 |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 7.45 | 7.52 | 7.49 | 6.80 | 7.75 | 7.27 |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 7.65 | 7.10 | 7.37 | 7.50 | 7.60 | 7.55 |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 7.52 | 7.07 | 7.30 | 7.40 | 7.15 | 7.27 |
| 75 kg N/fed | 7.62 | 7.10 | 7.36 | 7.10 | 6.90 | 7.00 |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 7.50 | 7.35 | 7.42 | 7.90 | 7.20 | 7.55 |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 7.62 | 7.47 | 7.55 | 7.50 | 6.55 | 7.02 |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 7.97 | 7.35 | 7.66 | 6.65 | 7.50 | 7.07 |
| Mean | 7.63 | 7.22 | | 7.31 | 7.20 | |
| LSD $_{0.05}$ A | | | * | | | NS |
| B | | | NS | | | NS |
| AB | | | NS | | | NS |

**Table (6): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on days to first flower appearance in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season Irrigation intervals(A) | | | 2010 season Irrigation intervals(A) | | |
|---|---|---|---|---|---|---|
| | 2 weeks | 3 weeks | Mean | 2 weeks | 3 weeks | Mean |
| 60 kg N/fed | 85.55 | 79.60 | **82.57** | 79.12 | 81.40 | **80.26** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 85.85 | 80.95 | **83.40** | 74.80 | 76.75 | **75.77** |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 83.25 | 82.45 | **82.85** | 78.75 | 74.55 | **76.65** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 82.30 | 79.70 | **81.00** | 78.65 | 75.90 | **77.27** |
| 75 kg N/fed | 85.95 | 81.75 | **83.85** | 78.35 | 81.30 | **79.82** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 84.65 | 80.65 | **82.65** | 79.35 | 77.00 | **78.17** |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 88.35 | 82.25 | **85.30** | 81.60 | 80.65 | **81.12** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 83.00 | 83.15 | **83.07** | 78.40 | 76.45 | **77.42** |
| Mean | **84.86** | **81.31** | | **78.63** | **78.00** | |
| **LSD $_{0.05}$ A** | | | ***** | | | **NS** |
| **B** | | | **2.29** | | | **0.50** |
| **AB** | | | **NS** | | | **0.71** |

**Table (7): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on days yo first open boll/plant in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | rrigation intervals(A | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 136.47 | 139.30 | **137.89** | 126.95 | 134.70 | **130.82** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 138.05 | 139.85 | **138.95** | 129.25 | 128.80 | **129.12** |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 137.10 | 142.90 | **140.00** | 140.15 | 131.85 | **136.00** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 135.10 | 134.10 | **134.60** | 132.75 | 137.00 | **134.87** |
| 75 kg N/fed | 139.65 | 138.05 | **138.85** | 136.30 | 128.50 | **132.40** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 140.65 | 136.20 | **138.42** | 137.35 | 132.40 | **134.87** |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 143.90 | 136.50 | **140.20** | 137.15 | 135.60 | **136.40** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 137.75 | 140.00 | **138.87** | 132.60 | 129.65 | **131.12** |
| Mean | **138.58** | **138.36** | | **134.09** | **132.32** | |
| **LSD $_{0.05}$ A** | | | **NS** | | | ***** |
| **B** | | | **0.94** | | | **0.59** |
| **AB** | | | **1.33** | | | **0.84** |

## B- Yield and yield components:

The results in Tables (8, 9, 10, 11 and 12) show that number of open bolls/plant, boll weight and seed cotton yield/plant significantly affected by irrigation intervals,in favour of irrigation every two weeks in both seasons, while, seed cotton yield/fed (in 2010 seasons only). These results could be ascribed on the bases that plants grown with sufficient water supply produced, higher fruiting branches and higher fruiting forms. Similar results were obtained by Gomaa *et al.,* (1981, Guinn *et al.,* (1981), Ali (1990), El-Shahawy and Abd El-Malik (1999), El-Shahawy *et al.,* (2000), Ziadah *et al.,* (2000), Ali (2002), El-Sayed (2005) and Hamed (2007). However, number of plants at harvest/fed was not affectred by irrigation intervals in both seasons. With respect to nitrogen fertilization levels and foliar spray with boron, seed cotton yield/fed significantly increased by increasing nitrogen fertilizer level and boron up to 75 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage) in both seasons. While, boll weight (in 2009 season only) by 75 kg N/fed + foliar spraying by boron (at budding stage beginning). However, number of open bills/plant and seed cotton yield/plant (in 2009 season only) 75 kg N/fed + foliar spraying by boron (at flowering stage). While, number of open bolls/plant and seed cotton yield/plant (in 2010 season only) by 75 kg N/fed. These results might be explained on the basis that increasing nitrogen levels up to 75 kg N/fed with boron spraying gave cotton plants its requirements from nitrogen which provide the formed bolls with its requirements, resulting in more setting of bolls and decreased the shedding of fruiting organs/plant which reflected on seed cotton yield/plant and per feddan. Similar results were concluded by Sawan *et al.,* (1997), Howard *et al.,* (2000), Hamissa *et al.,* (2000), Darwish (2001), Soomro *et al.,* (2001), El-Shazly *et al.,* (2003), Saleh *et al.,* (2004), El-Sayed and El-Menshawi (2005), El-Hindi *et al.,* (2006), Hamed (2006), Abd El-Aal *et al.,* (2007), Abid *et al.,* (2007), Ghaly *et al.,* (2007), Mahdi (2007), Ibrahim (2008), Ali *et al.,* (2011) and Rashidi and Gholami (2011). While, number of plants at harvest/fed was not significantly affected in both seasons. The interaction between water stress (irrigation intervals) and nitrogen fertilizer level with boron significantly affected plant height at harvest, number of fruiting branches/plant, days to first open boll, boll weight, number of open bolls/plant and seed cotton yield/plant in both seasons ,days to first flower and seed cotton yield/fed in one season only. However, location of first fruiting node and number of plants at harvest/fed were not significantly affected in both seasons. It could be concluded that using regular irrigation interval every two weeks along the whole plant life and using nitrogen at the rate of 75 kg N/fed + foliar spraying by boron (at budding stage beginning and flowering stage), to obtain high yield under Shandaweel location.

**Table (8): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on number of open bolls/plant in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | Irrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| kg N/fed | 17.55 | 12.10 | **14.82** | 14.95 | 11.15 | **13.05** |
| kg N/fed+ boron foliar spraying dding stage beginning | 15.95 | 15.85 | **15.90** | 17.70 | 14.10 | **15.90** |
| kg N/fed+ boron foliar spraying wering stage | 14.75 | 16.10 | **15.42** | 15.05 | 13.60 | **14.32** |
| kg N/fed+ boron foliar spraying dding stage beginning and flowerin ge | 17.49 | 13.50 | **15.49** | 14.25 | 12.25 | **13.25** |
| kg N/fed | 16.35 | 12.95 | **14.65** | 17.35 | 14.75 | **16.05** |
| kg N/fed+ boron foliar spraying dding stage beginning | 18.35 | 12.45 | **15.40** | 14.80 | 12.40 | **13.60** |
| kg N/fed+ boron foliar spraying wering stage | 18.78 | 14.15 | **16.46** | 16.15 | 11.87 | **14.01** |
| kg N/fed+ boron foliar spraying dding stage beginning and flowerin ge | 12.80 | 16.05 | **14.42** | 15.95 | 15.15 | **15.55** |
| **Mean** | **16.50** | **14.14** | | **15.77** | **13.16** | |
| **LSD $_{0.05}$ A** | | | ***** | | | ***** |
| **B** | | | **0.61** | | | **0.79** |
| **AB** | | | **0.86** | | | **1.12** |

**Table (9): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on boll weight (gm) in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | rrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 1.66 | 1.59 | **1.62** | 1.57 | 1.64 | **1.61** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 1.76 | 1.77 | **1.77** | 1.78 | 1.62 | **1.70** |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 1.84 | 1.73 | **1.79** | 1.61 | 1.55 | **1.58** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 1.66 | 1.54 | **1.60** | 1.94 | 1.48 | **1.71** |
| 75 kg N/fed | 1.64 | 1.93 | **1.79** | 1.81 | 1.74 | **1.77** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 2.08 | 1.63 | **1.85** | 2.04 | 1.57 | **1.80** |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 1.86 | 1.80 | **1.83** | 1.84 | 1.50 | **1.67** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 2.07 | 1.82 | **1.94** | 1.79 | 1.52 | **1.65** |
| Mean | **1.82** | **1.73** | | **1.80** | **1.58** | |
| LSD $_{0.05}$ A | | | * | | | * |
| **B** | | | **0.06** | | | **NS** |
| **AB** | | | **0.06** | | | **0.26** |

**Table (10): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on seed cotton yield (gm/plant) in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | Irrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 29.09 | 19.22 | **24.16** | 23.50 | 18.32 | **20.91** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 28.16 | 28.02 | **28.09** | 31.49 | 22.51 | **27.00** |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 27.17 | 27.94 | **27.56** | 24.35 | 21.04 | **22.70** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 29.13 | 20.76 | **24.95** | 27.72 | 18.08 | **22.90** |
| 75 kg N/fed | 26.89 | 25.07 | **25.98** | 31.39 | 25.64 | **28.52** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 38.11 | 20.97 | **29.54** | 30.20 | 19.60 | **24.90** |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 34.93 | 25.47 | **30.20** | 29.57 | 17.94 | **23.76** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 26.49 | 29.29 | **27.88** | 28.49 | 22.89 | **25.69** |
| Mean | **29.99** | **24.59** | | **28.34** | **20.75** | |
| LSD $_{0.05}$ A | | | * | | | * |
| **B** | | | **1.42** | | | **2.77** |
| **AB** | | | **2.01** | | | **3.92** |

**Table (11): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on seed cotton yield (kentar/fed) in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | Irrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 6.64 | 4.39 | **5.52** | 4.97 | 3.59 | **4.28** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 4.82 | 5.69 | **5.26** | 5.98 | 4.71 | **5.34** |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 4.89 | 6.55 | **5.72** | 5.09 | 4.72 | **4.91** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 5.11 | 6.09 | **5.60** | 4.97 | 3.77 | **4.37** |
| 75 kg N/fed | 5.17 | 5.50 | **5.34** | 5.26 | 4.29 | **4.78** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 6.44 | 5.85 | **6.15** | 4.85 | 3.92 | **4.39** |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 5.92 | 4.59 | **5.26** | 5.01 | 4.24 | **4.62** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 6.77 | 6.02 | **6.40** | 5.64 | 5.24 | **5.44** |
| Mean | **5.72** | **5.59** | | **5.22** | **4.31** | |
| LSD $_{0.05}$ A | | | **NS** | | | ***** |
| **B** | | | **0.55** | | | **0.71** |
| **AB** | | | **0.78** | | | **NS** |

**Table (12): Effect of water stress (irrigation intervals), nitrogen fertilizer levels with boron foliar application and their interaction on number of plants at harvest(1000 plant/fed) in 2009 and 2010 seasons.**

| Fertilization treatments (B) | 2009 season | | | 2010 season | | |
|---|---|---|---|---|---|---|
| | Irrigation intervals(A) | | Mean | Irrigation intervals(A) | | Mean |
| | 2 weeks | 3 weeks | | 2 weeks | 3 weeks | |
| 60 kg N/fed | 45.64 | 46.14 | **45.89** | 44.95 | 44.45 | **44.70** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning | 45.67 | 45.85 | **45.76** | 44.36 | 44.62 | **44.49** |
| 60 kg N/fed+ boron foliar spraying at flowering stage | 45.73 | 46.17 | **45.95** | 44.15 | 44.89 | **44.52** |
| 60 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 45.76 | 46.30 | **46.03** | 44.95 | 44.41 | **44.68** |
| 75 kg N/fed | 45.99 | 46.23 | **46.11** | 44.98 | 44.95 | **44.96** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning | 46.12 | 46.10 | **46.11** | 45.58 | 46.15 | **45.86** |
| 75 kg N/fed+ boron foliar spraying at flowering stage | 46.22 | 45.58 | **45.90** | 44.76 | 45.12 | **44.94** |
| 75 kg N/fed+ boron foliar spraying at budding stage beginning and flowering stage | 46.51 | 46.06 | **42.28** | 45.18 | 44.19 | **44.68** |
| Mean | **45.95** | **46.05** | | **44.86** | **44.85** | |
| **LSD $_{0.05}$ A** | | | **NS** | | | **NS** |
| **B** | | | **NS** | | | **NS** |
| **AB** | | | **NS** | | | **NS** |

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# استجابة صنف القطن جيزة 90 للإجهاد المائى ومستويات التسميد النتروجينى مع الرش بالبورون

فكرى سيد حامد
معهد بحوث القطن - مركز البحوث الزراعية - جيزة - مصر

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بشندويل فى موسمى 2009، 2010م لدراسة تأثير الإجهاد المائى (فترات الرى) ومستويات التسميد النتروجينى مع الرش بالبورون على النمو والمحصول ومكوناته على صنف القطن المصرى جيزة 90 ، تم تصميم التجارب فى تصميم قطع منشقة مرة واحدة فى أربعة مكررات حيث خصصت القطع الرئيسية للإجهاد المائى ( فترات الرى ) (كل أسبوعين ، كل ثلاثة أسابيع) ، بينما خصصت القطع المنشقة لمستويات التسميد النتروجينىوالرش بالبورون وهى (60 كجم ن/فدان) ، (60 كجم ن/فدان + الرش بالبورون عند بداية مرحلة الوسواس) ، (60 كجم ن/فدان + الرش بالبورون عند بداية مرحلة التذهير) ، (60 كجم ن/فدان + الرش بالبورون عند بداية مرحلتى الوسواس والتزهير ) ، (75 كجم ن/فدان) ، (75 كجم ن/فدان + الرش بالبورون عند بداية مرحلة الوسواس) ، (75 كجم ن/فدان + الرش بالبورون عند بداية مرحلة التزهير ) و (75 كجم ن/فدان + الرش بالبورون عند بداية مرحلتى الوسواس والتزهير).

**وكانت النتائج المتحصل عليها كالآتى :-**

١ - ادى الرى كل أسبوعين أدى إلى زيادة معنوية لكل من طول النبات ،عدد الأفرع الثمرية/نبات ، عدد اللوز المتفتح /النبات ، وزن اللوزة ، محصول النبات الفردى فى كلا الموسمين ، بينما تأثر تاريخ تفتح أول لوزة ومحصول الفدان من القطن الزهر معنوياً فى موسم 2010م ، بينما تأثر تاريخ تفتح أول زهرة وموقع أول فرع ثمرى معنوياً فى موسم 2009م ، بينما لم يكم هناك تأثير معنوى للإجهاد المائى (فترات الرى) على عدد النباتات عند الجنى فى كلا الموسمين.

٢ - أدت المعاملة 75 كجم ن/فدان + الرش بالبورون عند بداية مرحلتى الوسواس والتزهيرإلى زيادة معنوية لكل من طول النبات ، عدد الأفرع الثمرية /نبات ، محصول الفدان من القطن الزهر فى كلا الموسمين ، بينما أدت المعاملة 75 كجم ن/فدان + الرش بالبورون عند بداية مرحلة التزهير إلى زيادة معنوية لكل من تاريخ تفتح أول زهرة وتاريخ تفتح أول لوزةا فى كلا الموسمين ، بينما أدت المعاملة (75 كجم ن/فدان + الرش بالبورون عند بداية مرحلتى الوسواس والتزهير ) إلى زيادة معنوية لصفة وزن اللوزة فى موسم 2010م ، بينما أدت المعاملة 75 كجم ن/فدان + الرش بالبورون عند بداية مرحلة التزهير غلى زيادة معنوية لكل من عدد اللوز المتفتح/نبات ومحصول النبات الفردى فى موسم 2009 ، بينما أدت المعاملة (75 كجم ن/فدان) إلى زيادة معنوية لكل من عدد اللوز المتفتح/نبات ومحصول النبات الفردى فى موسم 2010 ، بنما لم يكن هناك تأثير معنوى لمستويات التسميد للنتروجين + الرش بالبورون على كل من موقع أول فرع ثمرى وعدد النباتات عند الجنى فى كلا الموسمين.

٣ - كان التفاعل بين الإجهاد المائى (فترات الرى) ومستويات التسميد النتروجينى مع الرش بالبورون تأثير معنوي على طول النبات ، عدد الأفرع الثمرية ، تاريخ تفتح أول لوزة ، وزن اللوزة ، عدد اللوز المتفتح/النبات ، محصول النبات الفردى فى كلا الموسمين ، بينما تأثر تاريخ تفتح أول زهرة فى موسم 2010م ، محصول الفدان للقطن الزهر فى موسم 2009م ، لم يكن هناك تأثير معنوى للتفاعل بين الإجهاد المائى (فترات الرى) ومستويات التسميد النتروجينى مع الرش بالبورون على موقع أول فرع ثمرى ، عدد النباتات عند الجنى فى كلا الموسمين. وأمكن الحصول على أفضل النتائج بإضافة 75 كجم ن للفدان + الرش بالبورون فى بداية مرحلتى الوسواس والتزهير.

**قام بتحكيم البحث**

| | |
|---|---|
| **أ.د / احمد نادر السيد عطيه** | **كلية الزراعة – جامعة المنصورة** |
| **أ.د / وجدى محمد الشاذلى** | **مركز البحوث الزراعيه** |