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RESPONSE OF GIZA 90 COTTON CULTIVAR TO PHOSPHORUS FERTILIZATION LEVELS AND FOLIAR SPRAY WITH BORON AND CALCIUM

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ABSTRACT

The present work was carried at Shandaweel Agricultural Research Station during 2005 and 2006 seasons to study the effect of phosphorus fertilization levels, foliar spraying with boron and/or calcium on growth, seed cotton yield and its components of Giza 90 cotton cultivar (*gossypium barbadense* L.).

A spilt-plot design with four replications was used, the main plots were assigned to phosphorus fertilization levels. 15, 22.5 and 30 kg P_2O_5/Fed. Foliar spray with boron and calcium i.e. control, three foliar spraying by boron and/or calcium (at budding stage beginning of flowering stage and 15 days after the flowering) were arranged in the sub-plots.

The results indicated that increasing phosphorus levels up to 30 kg P_2O_5/Fed. caused an increase in the number of fruiting branches/plant, number of open bolls/plant, bolls weight and seed cotton yield per plant and Fed., but decreased plant height at harvest in both seasons. While, number of plants at harvest/Fed. (in 2005 season only) was significantly affected by phosphorus levels of 30 kg P_2O_5/fed. Meanwhile, position of first fruiting node was not significantly affected by phosphorus levels in both seasons. With respect to foliar spraying with boron and calcium, the result revealed a significant effect on plant height at harvest, number of fruiting branches/plant, number of open bolls/plant, boll weight and seed cotton yield per plant and fed. in both seasons. While, number of plants at harvest per Fed. was significantly affected by foliar spraying with boron and calcium. in 2005 season only Meanwhile, position of first fruiting node was not significantly affected by foliar spraying with boron and calcium in both seasons.

The interaction between phosphorus levels and foliar spray (boron and/or calcium) was significant on plant height at harvest, number of fruiting branches/plant, number of open bolls/plant, boll weight, seed cotton yield per plant and fed. in both seasons. While, number of plants at harvest/Fed.; in 2005season only; was significantly affected by interaction between phosphorus fertilization and spraying with boron and/or calcium. On the other hand, position of the first fruiting node was not significantly affected by interaction between phosphorus fertilization and spraying with boron and/or calcium in both seasons. The greatest values of these traits were obtained from the phosphorus levels of 22.5 or 30 kg P_2O_5/fed. with the three foliar spraying by boron and calcium.

INTRODUCTION

Phosphorus is important for various metabolic processes, being a component of the co-enzyme and energy carrier adenosine triphosphate (ATP), which is responsible for active ion uptake and synthesis of various organic compounds. An inadequate p supply causes a reduction of the synthetic activities of the plant and development of the crop. Phosphorus effect was discussed by many investigators Amer (1964) reported that phosphorus fertilization increased plant height, number of bolls plant and seed cotton yield. Abd El–Aal, *et al.* (1990), Balbaa (1995), El. Kashlan, *et al.* (1992), Girgis, *et al.* (1993) and El Sayed (1996) found that foliar spraying with phosphorus significantly affected number of open bolls/plant, boll weight, seed cotton yield per plant and fed. While, El-Sayed & Abd Alla (2002) found that, plant height at harvest, number of fruiting branches /plant, number of open bolls, boll weight, seed cotton yield per plant and fed. increased significantly by Phosphorus application up to 46.5 P_2O_5/fed.

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 splits 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 0.3% 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 per plant when the high level was used as compared with 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 0.3% at each spray significantly increased plant height at harvest, number of fruiting branches/plant, boll weight, number of open bolls/plant, seed cotton yield per plant and fed. in both seasons as compared with control treatment.

Calcium also plays an important role in plant growth as a major component of the middle lamella (calcium pectate). This explains the possible role of calcium deficiency in abscission. Addicott and Lyon, (1973) listed Ca deficiency as one of the causes of abscission and suggested this improvement. Also, Ca deficiency affected translocation of carbohydrates, causing accumulation in the leaves and a decline in stems and roots. it seems probable that young bolls abscised because of starvation (Guinn, 1984). Calcium deficiency may also decrease the basi–petal translocation of auxin (Dela Fuent and Leopold 1973). Swan (1985), reported that the number of opened bolls /plant, boll weight, seed cotton yield per plant and seed cotton yield /Fed. were increased with application of calcium in both seasons. Sawan, *et al.* (1997) found that spraying plants with Ca at 60 ppm produce the highest number of opened bolls per plant and boll weight. Calcium also significantly increased seed cotton yield per plant and per hectare, while no insignificant difference was noticed in earliness due to Ca application as compared with the control. Darwish (2001) reported that foliar application of Ca significantly increased seed cotton yield per plant and/or per fed., number of open bolls/plant, final plant height and number of sympodia/plant in both seasons. Boll weight was significantly increased in the first season only.

The present work was designed to study the effect of phosphorus fertilization level, foliar spraying with boron or/and Calcium on growth, seed cotton yield and its components of Giza 90 cotton cultivar. .

MATERIALS AND METHODS

Two field experiments were carried out at Shandweel Agricultural Research Station in 2005 and 2006 seasons. Cotton seeds in hill spaced 20 cm apart were sown at the last week of March in both seasons. Thinning was done at 30 days after sowing to two plants per hill. Mechanical and chemicals analysis of soil are presented in Table 1.

Table 1: Mechanical and chemicals analysis of soil samples at 0-30 cm depth from the surface in 2005 and 2006 seasons.

Soil characteristics	2005	2006
Texture	Clay loam	Loam
Calcium carbonate %	1.49	1.24
Organic matter %	0.938	1.02
pH (1 : 2 : 5 suspension NPK)	7.4	7.20
Total N (ppm)	681	702
Available p (ppm)	8.1	9.4
Available k (ppm)	410	448
Cations mg /100gm soil		
Ca ++	1.12	1.2
Mg +	0.83	0.88
Na +	0.83	0.51
K +	0.10	0.33
Available B (ppm)	0.45	0.55

The experimental design was split – plot with four replications. The main plots were assigned randomly for the three phosphorus fertilization levels, i.e., 15, 22.5 and 30 kg P_2O_5/fed. While, foliar spraying with boron and/or Calcium , i.e., control, three foliar sprays by boron and/or calcium (at budding stage, beginning of flowering stage and 15days after the flowering), were attributed randomly in the sub-plots .The area of experimental plot was 19.5 m^2 (5m. length and 3.9 m. width) and included 6 rows of 65 cm apart. Phosphorus fertilizer was added in the form of calcium super-phosphate (15.5% P_2O_5) before the first irrigation in each season. Five guarded hills (every hill contains two plants) were randomly chosen from the three inner rows to study the following characters:

A - Growth traits, which included:

Plant height at harvest (cm). ; Number of fruiting branches /plant. and Position of first fruiting node.

B-yield and yield components:

Number of open bolls/plant ; Boll weight in grams; Seed cotton yield per plant in grams ; Number of plants/fed. at harvest 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).

The collected data were subjected to proper analysis of variance outlined by Snedecor and Cochran (1967) and the treatment means were compared using least significance test (L.S.D) at 5% level.

RESULTS AND DISCUSSION

Growth traits:

The result in Tables 2, 3 and 4 show that number of fruiting branches/plant increased significantly with increasing phosphorus application level up to 30 kg P_2O_5/fed., but decreased plant height at harvest in both seasons. The position of first fruiting node was not significantly affected by phosphorus levels in both seasons. Such results could be attributed to the role of phosphorus on plant metabolism and consequently enhancing growth habits. These results are in agreement with those obtained by El–Sayed & Abd alla (2002).

With respect to foliar spraying with boron and calcium, the results presented in Tables 2, 3 and 4 show that plant height at harvest and number of fruiting branches/plant were significantly affected by foliar spraying with boron and calcium as compared with the control treatment in both seasons. While, position of first fruiting node was not significantly affected by foliar spraying of boron and calcium in both seasons. Such results may be attributed to the role of boron and calcium on plant metabolism and consequently enhancing growth habits. These results are in agreement with those obtained by Darwish, (2001), El-Shazly, *et al.* (2003) and El–Masri, *et al.* (2005).

The interaction between phosphorus fertilization and spraying with boron and/or calcium significantly affected plant height at harvest and number of fruiting branches/plant in both seasons, while position of first fruiting node was not significantly affected in both seasons.

Table 2: Effect of Phosphorus fertilizer levels, boron and/or calcium foliar application and their interaction on plant height at harvest in 2005 and 2006 seasons

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+Ca	Mean	Control	B	Ca	B+Ca	mean
15 kg P_2O_5	115.50	112.50	107.25	112.00	111.81	153.25	146.25	156.00	144.00	149.87
22.5 kg P_2O_5	116.75	118.25	103.50	106.75	111.31	141.75	154.00	135.50	157.00	147.06
30 kg P_2O_5	108.50	109.25	106.50	116.25	110.12	155.75	134.75	133.00	140.50	140.94
Mean	113.58	113.33	105.75	111.67		150.25	145.00	141.50	147.08	

L .S. D for application	2005	2006
Phosphorus levels (P)	1.64	3.68
Boron and calcium foliar (F)	1.01	1.76
Interaction (P×F)	1.47	3.04

Table 3: Effect of Phosphorus fertilizer levels, boron and/or calcium foliar application and their interaction on number of fruiting branches/plant in 2005 and 2006 seasons

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+Ca	Mean	Control	B	Ca	B+Ca	mean
15 kg P_2O_5	14.70	15.20	14.55	15.40	14.46	18.45	19.95	20.05	20.95	19.85
22.5 kg P_2O_5	13.30	15.50	16.80	15.45	15.26	19.00	20.55	20.70	21.00	20.31
30 kg P_2O_5	16.00	15.80	15.50	16.65	15.99	20.30	20.15	21.45	21.00	20.72
Mean	14.67	15.80	15.62	15.83		19.25	20.22	20.73	20.98	

L.S.D for application	2005	2006
Phosphorus levels (P)	0.19	0.36
Boron and calcium foliar (F)	0.51	0.45
Interaction (P×F)	0.89	0.78

Table 4: Effect of Phosphorus fertilizer levels, boron and/or calcium foliar application and their interaction on position of first fruiting node in 2005 and 2006 seasons:

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+Ca	Mean	Control	B	Ca	B+Ca	Mean
15 kg P_2O_5	6.75	6.95	6.90	6.70	6.82	6.50	6.75	6.85	6.45	6.64
22.5 kg P_2O_5	6.70	7.05	6.95	6.72	6.86	6.85	6.75	6.95	7.35	6.97
30 kg P_2O_5	6.95	6.95	6.80	6.35	6.76	6.60	6.70	7.05	6.95	6.82
Mean	6.80	6.98	6.88	6.59		6.65	6.73	6.95	6.92	

L.S.D for application		
Phosphorus levels (P)	NS	NS
Boron and calcium foliar (F)	NS	NS
Interaction (P×F)	NS	NS

Yield and yield components:

Data in Tables 5, 6, 7, 8 and 9 show that number of open bolls/plant, bolls weight, seed cotton yield per plant and fed., increased significantly by phosphorus application up to 30 kg P_2O_5 /fed. in both seasons. While, number of plants at harvest/fed. in 2005 season increased significantly with increasing phosphorus levels up to 30 kg p205 /fed. These results may be due to the role of phosphorus in encouraging early appearance of bolls of cotton plants. Similar results were obtained by Amer (1964), Abd El–Aal, *et al.* (1995), Balbaa (1995), El– Kashlan, *et al.* (1992), Girgis, *et al.* (1993) and El-sayed (1996). With respect to foliar spray with boron and/or calcium, (Tables 5, 6, 7, 8 and 9) number of open bolls/plant, boll weight and seed cotton yield per plant and fed. were significantly affected by foliar spray with boron and/or calcium in both seasons and number of plants at harvest/fed. in 2005 season only as compared with the control treatment. Such results may be attributed to the role of boron and calcium in reducing shedding of ovaries and buds of cotton. Similar results were obtained by Sawan *et al.* (1997), Darwish (2001) El-Shazly *et al.*(2003) and EL-Masri, *et al.* (2005).

Table 5: Effect of Phosphorus fertilizer levels, boron and/or calcium foliar application and their introduction on number of open polls/plant in 2005 and 2006 seasons:

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+ Ca	Mean	Control	B	Ca	B+Ca	Mean
15 kg P_2O_5	10.45	12.35	11.35	12.95	11.77	10.60	10.45	11.00	11.55	10.90
22.5 kg P_2O_5	11.40	13.10	13.65	13.60	12.94	12.50	11.65	10.55	11.50	11.55
30 kg P_2O_5	12.90	13.00	13.40	12.20	12.95	10.60	12.85	12.40	13.30	12.29
Mean	11.58	12.92	12.80	12.92		11.23	11.65	11.32	12.12	

L.S. D for application of		
Phosphorus levels (P)	0.26	0.29
Boron and calcium foliar (F)	0.38	0.24
Interaction (P×F)	0.66	0.41

Table 6: Effect of Phosphorus fertilizer levels, boron and/or calcium foliar application and their interaction on boll weight (gm) in 2005 and 2006 seasons:

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+ Ca	Mean	Control	B	Ca	B+Ca	Mean
15 kg P_2O_5	1.74	1.94	1.85	1.26	1.82	1.65	1.75	1.75	2.07	1.80
22.5 kg P_2O_5	1.74	1.76	1.95	1.96	1.86	1.71	1.73	1.93	2.24	1.91
30 kg P_2O_5	1.85	1.75	1.86	1.96	1.86	2.15	1.83	1.84	1.95	1.94
Mean	1.78	1.82	1.89	1.90		1.84	1.77	1.84	2.09	

L.S. D for application of		
Phosphorus levels (P)	0.01	0.02
Boron and calcium foliar (F)	0.02	0.02
Interaction (P×F)	0.04	0.04

Table 7: effect of Phosphorus levels, boron and/or calcium foliar application and their interaction on seed cotton yield (gm/plant) in 2005 and 2006 seasons:

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+ Ca	Mean	Control	B	Ca	B+Ca	Mean
15 kg P_2O_5	18.18	23.96	20.99	22.79	21.48	17.49	18.29	19.25	23.91	19.73
22.5 kg P_2O_5	19.84	23.06	26.62	26.66	24.04	21.37	20.15	20.36	25.76	21.91
30 kg P_2O_5	23.86	22.75	24.92	23.91	23.86	22.79	23.51	22.82	25.93	23.76
Mean	20.54	23.30	24.17	24.50		20.49	20.65	20.81	25.20	

L.S. D for application of		
Phosphorus levels (P)	0.46	0.47
Boron and calcium foliar (F)	0.71	0.49
Interaction (P×F)	1.22	0.85

Table 8: effect of Phosphorus levels, boron and/or calcium foliar application and their interaction on number of plants at harvest /fed. in 2005 and 2006 seasons:

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+ Ca	Mean	Control	B	Ca	B+Ca	Mean
15 kg P_2O_5	45837	50205	48919	49592	48626	42730	45672	43518	44249	44042
22.5 kg P_2O_5	50619	53841	50893	50411	51441	46268	45057	44018	46095	45360
30 kg P_2O_5	50706	51245	52622	49494	51017	46478	45557	44345	42672	44763
Mean	49054	51764	50811	49816		45159	45428	43961	44339	

L.S. D for application of		
Phosphorus levels (P)	1449	NS
Boron and calcium foliar (F)	1773	NS
Interaction (P×F)	NS	NS

Table 9: effect of Phosphorus levels, boron and/or calcium foliar application and their interaction on seed cotton yield (kentar /fed). in 2005 and 2006 seasons:

Phosphorus levels	2005					2006				
	boron and/or calcium foliar application					boron and/or calcium foliar application				
	Control	B	Ca	B+ Ca	Mean	Control	B	Ca	B+Ca	Mean
15 kg P_2O_5	4.63	5.97	5.72	7.04	5.84	4.38	4.54	4.39	4.46	4.44
22.5 kg P_2O_5	7.5	6.54	6.61	6.43	6.66	5.28	4.86	6.01	6.44	5.65
30 kg P_2O_5	6.21	5.90	6.58	7.51	6.55	4.75	5.90	4.46	4.98	5.02
Mean	5.96	6.14	6.31	6.99		4.80	5.10	4.95	5.30	

L.S.D for	2005	2006
Phosphorus levels (P)	0.53	0.31
Boron and calcium foliar (F)	0.56	0.37
Application interaction (P×F)	0.98	0.64

The interactions between phosphorus fertilization and spraying with boron and/or calcium significantly affected number of open bolls/plant, boll weight and seed cotton yield per plant and fed. in both seasons and number of plants at harvest/fed. in 2005 season only. The greatest values of these traits were obtained from the application of phosphorus at level of 22.5 or 30 kg P_2O_5/fed. with foliar spraying by boron and calcium. It could be concluded that seed cotton yield of Giza 90 cotton cultivar grown in Shandaweel region could be increased by applying phosphorus at level of 22.5 or 30 kg P_2O_5/fed. with foliar spraying three times by boron plus calcium .

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Response of Giza 90 cotton to fertilization

استجابة صنف القطن جيزة ٩٠ للتسميد الفوسفاتي والرش بالبورون والكالسيوم .

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أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بشندويل فـي موسـمي ٢٠٠٥ و ٢٠٠٦ م لدراسة تأثير التسميد الفوسفاتي والـرش بـالبورون والكالـسيوم علـي النمـو والمحصول ومكوناته علي صنف القطن المصري جيزة ٩٠، تم تنفيذ التجارب في تصميم القطع المنشقة مرة واحدة في أربعة مكررات حيث خصصت القطـع الرئيـسية للتـسميد الفوسفاتي وهي (١٥ كجم فو ٢ أ ٥، ٢٢,٥ كجم فو ٢ أ ٥، ٣٠ كجم فو٢ أ٥ /فدان).

بينما خصصت القطع المنشقة للرش بالبورون والكالسيوم منفرداً أو معـا عنـد مرحلـة الوسواس، بداية التزهير، بعد التزهير بـ ١٥يوما إلى جانب معاملة الكنتـرول (الـرش بالماء) وكانت المتحصل عليها النتائج كالآتي:-

١. أدي التسميد الفوسفاتي حتى ٣٠ كجم فو٢ أ٥/فدان إلي زيادة معنوية لكل مـن عـدد الأفرع الثمرية، عدد اللوز المتفتح نبات، ووزن اللوزة، ومحصول النبات الفـردي ومحصول الفدان من القطن الزهر في كلا الموسمين، بينما تناقص طول النبات عند الحصاد معنوياً في كلا الموسمين، في حين تأثر عدد النباتات عند الجنـي معنويـاً بالتسميد الفوسفاتي في موسم ٢٠٠٥، بينما لم يكن للتسميد الفوسفاتي تأثيراً معنويـاً علي موقع أول فرع ثمري في كلا الموسمين.
٢. أدى الرش بالبورون والكالسيوم إلي زيادة معنوية فى كل من طـول النبـات عنـد الجني، عدد الأفرع الثمرية، عدد اللوز المتفتح/نبات ووزن اللوزة، ومحصول النبات الفردي والفدان من القطن الزهر في كلا الموسمين، بينما تأثرت عدد النباتات عنـد الجني في موسم ٢٠٠٥، ولم يكن هناك تأثير معنـوى لمعاملـة الـرش بـالبورون والكالسيوم علي موقع أول فرع ثمري في كلا الموسمين.

٣. كان للتداخل بين التسميد الفوسفاتي ومعاملة الرش بالبورون والكالسيوم تأثير معنوي علي طول النبات عند الجني ، عدد الأفرع الثمرية / نبات ، عدد اللوز المتفتح / بنات ووزن اللوزة ، ومحصول النبات الفردي والفدان من القطن الزهر في كلا الموسمين، بينما تأثر عدد النباتات عند الجني معنوياً في موسم ٢٠٠٥ بالتفاعل بين التسميد والرش بالبورون والكالسيوم، ولم يكن هناك تأثير للتفاعل بين التسميد الفوسفاتي ومعاملة الرش بالبورون والكالسيوم علي موقع أول فرع ثمري في كلا الموسمين.

وأمكن الحصول على أفضل النتائج في معظم الصفات بإضافة ٢٢,٥ أو ٣٠ كجم فو٢ أ٥/فدان مع الرش بالبورون والكالسيوم ثلاث مرات فى مرحلة الوسواس، بداية التزهير وبعد التزهير بـ ١٥ يوم.