OF (POTTASIN-P)^{TM} UNDER TWO LEVELS OF NITROGEN FERTILIZER

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Abstract

The effects of (Pottasin-P) ^{TM} as a potassium fertilizer under two levels of N fertilizer were studied on some chemical constituents of the plant and the productivity of Giza 77, cultivar during two successive seasons; 1997 and 1998, at Sakha Agricultural Research Station.

Spraying cotton plants by (Pottasin-P) ^{TM} tended to increase chlorophyll (a) and (b) as well as reducing sugars, total soluble sugars, nitrogen %, phosphorous %, total amino nitrogen % in leaves and protein% in seeds, but had no significant effect on oil % in seeds. N. fertilizer led to a significant increase in total soluble sugars, N%, P%, total amino nitrogen in leaves and oil % in seeds.

Spraying (Pottasin)^{TM} on cotton plant caused an increase in plant height at harvest and number of open bolls per plant, and reduced boll weight and seed index (in one season), significantly increased seed cotton yield per plant (gm), seed cotton yield (in Kentars/feddan), and a slight increase in earliness percentage of yield. Lint micronaire reading and Pressley index were not significantly affected by any treatment.

INTRODUCTION

Potassium (K) deficiency, that occurs in mid-to late season, was reported to occur across the cotton areas, with its deficiency symptoms occuring on young leaves at the top of the plant (Azab *et al.*, 1993).

Potassium is known to affects many of the cotton plant's growth factors and lint fiber Properties. Potassium enhances many nutrients uptake especially N, improving many physiological growth processes, increasing plant tolerance to salinity as it decreases water stress and activates the enzyme system under saline conditions. (Mengel and Kirby, 1987).

Merdith (1992), found that potash fertilization enhanced fiber maturity, increased lint yields and significantly reduced "white speck" or dead fiber. Gamalat *et al.* (1994) and Oosterhuis (1995), reported that foliar application of k have helped to overcome cotton K deficiency, and are useful until soil K can be built up through broadcast applications to supply the plant's needs.

Concerning the effect of N fertilization, Ewieda *et al.* (1979 b), Shahine (1980); Makram et al. (1994) and El-Kalla et al. (1994), found that increasing N levels up to 75 kg N/fed. increased boll weight boll number per plant, seed cotton yield per feddan and earliness. On the other hand, El-Debaby and Hammam (1987), found that high N application had insignificant effect on number of open bolls/plant, seed cotton yield /plant and fiber properties.

MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station during 1997 and 1998 seasons, to study the effect of K application under different Levels of nitrogen fertilizer on the productivity of Giza 77 Egyptian cotton cultivar (*G.barbadence* L.) and some chemical constituents of the cotton plant.

The physical and chemical characters of the soil before sowing are presented in Table (1) as follows:

Table 1. The physical and chemical characters of the soil before sowing.

Physical analysis components	1997	1998
Mechanical analysis		
Sand %	21.8	23.0
Silt %	36.6	34.9
Clay %	41.6	37.1
Textural class	clay loam	clay loam
Chemical analysis		
pH	7.9	7.6
available N (ppm)	17.7	20.1
P (ppm)	13.3	14.2
K (ppm)	240.0	251.0

This analysis showed that this soil suffered from N deficiency (>20 ppm; very low level) and has a model level of K (200-400 ppm available K).

The other normal cultural practices were followed. Seeds were sown on April 1st in both seasons and seedling were thinned to two plants per hill. The experimental design was complete randomized block in factorial arrangment with four replications. Each plot (12 m^2) consisted of five rows, four meters long, and 60 cm apart, with 20 cm distance between hills.

Foliar spraying with (Pottasin-P)^{TM} at the levels of 0,800, 1000 and 1200 cm^3/

fed. were used twice, at the thinning and at the beginning of flowering, under two levels of nitrogen fertilizer, i.e. 60 kg/fed. and 90 kg/fed.

Guaranteed analysis of (Pottasin-P)^{TM} was as follows: 30% K_2O and 8% P_2O_5, as mentioned by the producer (General Organization for Agric. Balance Fund).

The plant characters studied were:

1. Chemical constituents:

The determinations were done during (1997) only on leaves on the fourth node from the apex were taken at random at the peak of flowering, i.e. after 15 days from the second spraying of (Pottasin-P)^{TM}. Chlorophyll (a) and (b) were determined as described by Arnon (1949), and carotenoids as reported by Rolbelen (1957). Total soluble sugars were determined using enthrone method (Cerning, 1975), and reducing sugars were determined also according to the method described by A.O.A.C (1965). Nitrogen percentage was determined according to A.O.A.C. (1975). Phosphorous percentage was determined according to the method described by Troug and Mayer (1929). Total amino nitrogen was determined according to the method described by Rosen (1957). Oil content (in seed) was determined according to A.O.A.C. (1975) method. Protein content (in seed) was determined using the method described by A.O.A.C. (1965). .

2. Agronomical characters:

Plant height was measured in cm, at harvest, from the ground to the apex. Number of open bolls per plant was determined as the mean number of open bolls for ten guarded plants. Boll weight was determined as the average boll weight in gramms of seed cotton picked from ten selected plants per plot. Seed cotton yield per plant was estimated by picking the seed cotton of ten guarded plants and then divided by their number .

Yield of seed cotton in kentars per feddan

Sum of the two picks was considered as the final yield of seed cotton and was reported in kenters. Earliness percentage was calculated from the percentage yield of the first pick to total yield. Lint percentage the percentage of the lint from fixed weight of seed cotton. Seed index as the weight of 100 seeds in gramms.

3. Fiber properties:

Micronaire reading and Pressley index, were determined on repesentative samples.

Analysis of variance was performed on all data according to Snedecor and Cochran (1981), and treatment averages were compared at 0.05 level of probability using L.S.D.

RESULTS AND DISCUSSION

Chemical constituents :

Chlorophyll and carotenoid contents in leaves:

Results in Table (2) indicate that (Pottasin) ^{TM} application and nitrogen level significantly affected chlorophyll contents (chl. (a), chl. (b), and total chlorophyll (a+b)) of cotton leaves. Pottasin application at al level of 800 cm^3/fed. increased slightly chl. (a), chl. (b). and carotenoids compared with the control plants.

Spraying 800 cm^3/fed. of (Pottasin) ^{TM} under the level of 60 Kg N/fed. was better than higher level of N/fed. In this respect Azab et al. (1993), reported that spraying application of (K) on cotton plants exerted a significant effect on chlorophyll b and carotenoid contents. The application of K increased chlorophyll (a), however decreased the total carotenoid content of Leaves. Gamalat *et al.* (1994) found that spraying potassium led to a slight increase in total chlorophyll content while the reveres was true with carotenoids where its contents decreased at the same time.

Carbohydrate contents in leaves:

The data given in Table (2) show that (Pottasin)^{TM} application under different levels of N fertitization significantly affected total soluble sugars as mg/g dry weight of leaves. Lower concentration of (Pottasin)^{TM} i.e. 800 cm^3/fed. tended to increase reducing sugars and total soluble sugars. While increasing the level of N application significantly increased total soluble sugars, it gave insignificant effect on reducing sugars content in leaves. Concerning T.S.S., spraying 800 cm^3/fed. (Pottasin)^{TM} under the level of 90 kg N/fed . was better than 60 kg N/fed. In this connection Gamalat *et al.* (1994) rported that low potassium level tended to increase carbohydrate with low molecular weight (total soluble sugars). Azab *et al.* (1993) showed that k-treatments significantly decreased all components of carbohydrates i.e. reducing, non reducing and total soluble sugars. This reduction may be due to the increase in translocation level from leaves to the active growing plant organs.

Table 2. Effect of (K) and (N) applications on some chemical constituents in 1998 season.

(N) Fertilizer rates	(K) application conc.	In Leaves								In Seeds	
		Chlorophyll			Carbohydrate						
		Chl (a)	Chl (b)	Carotenoids	R.s	T.s.s	N%	P%	T.amino N.	oil %	Protein %
60 kg/fed.	0	2.10	1.68	0.59	14.42	26.11	2.6	1.18	4.38	19.22	19.53
	800 cm^3/fed.	2.40	1.40	0.38	15.64	30.91	2.6	1.57	5.17	21.87	20.34
	1000 cm^3/fed.	1.54	1.07	0.48	11.80	20.12	3.1	1.25	5.41	20.33	18.71
	1200 cm^3/fed.	1.54	1.01	0.37	12.85	16.07	4.0	1.20	4.17	21.37	21.07
90 kg/fed.	0	1.71	0.70	0.64	14.61	44.53	3.0	1.36	5.31	22.90	19.87
	800 cm^3/fed.	2.17	1.97	0.42	13.56	45.35	3.5	1.69	6.44	22.67	19.55
	1000 cm^3/fed.	1.40	0.69	0.47	14.64	39.19	3.5	1.28	5.10	21.68	19.18
	1200 cm^3/fed.	1.70	0.96	0.62	10.86	23.92	3.6	1.12	7.71	23.90	18.60
L.S.D.		N.S.	0.50	0.11	2.37	2.79	0.2	0.05	0.43	N.S.	0.43
(K)	0	1.91	1.19	0.62	14.52	35.32	2.8	1.27	4.84	21.56	19.70
	800 cm^3/fed.	2.27	1.69	0.40	14.60	38.13	3.1	1.63	5.81	22.27	19.95
	1000 cm^3/fed.	1.47	0.88	0.47	13.22	28.66	3.4	1.26	5.26	21.01	18.95
	1200 cm^3/fed.	1.62	0.98	0.49	11.85	20.00	3.8	1.16	5.94	22.63	19.83
L.S.D.		0.28	0.35	0.08	1.67	1.97	0.1	0.04	0.30	N.S.	0.30
(N)											
	60 kg/fed.	1.90	1.29	0.45	13.68	23.30	3.1	1.30	4.78	20.70	19.91
	90 kg/fed.	1.75	1.08	0.54	13.42	38.25	3.4	1.36	6.14	23.04	19.30
L.S.D.		N.S.	N.S.	0.06	N.S.	1.40	0.1	0.03	0.22	1.50	0.22

Nitrogen% in leaves:

It is clear from data obtained in Table (2) that nitrogen percentage in leaves was dramatically affected by (Pottasin)^{TM} or nitrogen fertilizer. Pottasin applications increased nitrogen % in leaves. Increasing nitrogen level/ fed also increased thi content. The highest value was obtained from spraying 1200 cm^3/fed (pottasin)^{TM} under the level of 60 kg /fed. This character seemed to be related to protein level in the seeds. (Mengel and Kirby, 1987).

Phosphorous % in leaves:

(Pottasin)^{TM} applications and nitrogen levels/fed. significantly affected phosphorous% in leaves. Spraying 800 cm^3/fed. (Pottasin)^{TM} had a better effect than the other concentrations, while increasing nitrogen fertilizer up to 90 kg N/fed increased this content in leaves. The highest value was obtained from using of 800 cm^3/fed. of (Pottasin)^{TM} under the level of 90 kg N/fed. as nitrogen fertilizer. Mengel and Kirby (1987), reported that K application may enhance many nutrients uptake.

Total amino nitrogen in leaves:

Data in Table 2 shows that (Pottasin)^{TM} and N applications had significant effects on this character. It is clear that sprying (Pottasin)^{TM} at the level of 1200 cm^3/ fed. increased the total amino nitrogen in leaves. In the same trend, increasing the level of nitrogen/fed. increased this constituent. The highest value was obtained from spraying 1200 cm^3/fed. of (Pottasin)^{TM} under the level of 90 kg N/fed. These results confirmed the relationships between leaf potassium, gas exchange, ATP simulation, soluble protein and sugar. Leaf photosynthesis was lower in the no (K) treatments, as mentioned by Oosterhuis *et al.* (1995). Such results also confirmed the catalytical effect of potassium on the formation of sugar and starch, (Gamalat *et al.* 1994).

Oil percentage in seeds:

It is clear from data in Table (2) that there were no significant effects on seed oil percentage, with reference to (K) application, while there was a significant effect due to N fertilizer on seed oil percentage. The highest values were obtained from using 1200 cm^3/fed (Pottasin)^{TM} under the level of 90 kg N/fed. Gamalat *et al.* (1994) found results.

Protein percentage in seeds

Table (2) illustrated that (Pottasin)^{TM} application and N fertilizer had a significant effect on seed protein %. In general increasing the level of (Pottasin)^{TM} application increased seed protein %, while increasing the level of nitrogen fertilizer reduced seed protein %. (as a result for the high vegetative growth, accompanied by reducing in fruiting growth). The highest value was obtained from spraying 1200 cm^3/fed. of (Pottasin)^{TM} under the level of 60 kg N/fed. These results are in agreement with the results obtained by Azab *et al.* (1993).

The productivity of cotton plants

Results obtained cleared that the influence of (Pottasin)^{TM} application under different levels of N fertilizer on the chemical constituents of the plants makes it at least partly responsible for the effects on the reproduction characters and yield components.

Growth and production characters:

The results given (in Tables 3 and 4) can be summarized as follows:

Plant height was significantly affected by Pottasin spraying or different levels of nitrogen fertilizer. The tallest plants were obtained from spraying 1200 cm^3 of pottasin per feddan and using 90 kg of N/fed. Chang and Oosterhuis (1995) reported that the growth of upper canopy was affected by K treatments.

Open bolls per plant were considerably increased by K treatments under different levels of nitrogen fertilizer. All the foliar - application K treatments increased the number of open bolls per plant. The highest number of open bolls per plant was obtained from using 1200 cm^3 of pottasin and using 90 kg of N/fed. as nitrogen fertilizer. Therefore, boll number appears to be an important component of increasing yield due to foliar application of K treatment as illustrated by Oosterhuis (1993). Also high level of N/fed. caused a significant increase in number of open bolls/plant in both seasons. Eweida *et al.* (1979), Shahine (1980), Makram *et al.* (1994), and El-Kalla et al. (1994) found that increasing N levels to 75 kg N/fed. increased boll number per plant.

Application of (Pottasin)^{TM} as a foliar fertilizer produced the lightest bolls compared with the untreated treatment, only in the first season. The lightest bolls were obtained from spraying 1200 cm^3/fed. of pottasin and using 60 kg N/fed. as nitrogen fertilizer. Chang and Oosterhius (1995), found that K applications caused an increase

in boll weight. N fertilizer had a significant effect on boll weight only in the first season. The heaviest bolls were obtained from using 90 kg N/fed. Eweida *et al.* (1979), Shahine (1980), Makram *et al.* (1994), and El-Kalla *et al.* (1994) found that increasing N levels up to 75 N./fed. increased boll weight.

Yield components:

With respect to seed cotton yield per plant, the results revealed a strong response to foliar application of K and apositive relation between K concentration and seed cotton yield per plant, as the level of K foliar application increased the seed cotton yield per plant increased. Azab *et al.*, (1993), came to the same conclusion. High level of N/fed. application significantly increased seed cotton yield per plant. Azab *et al.* (1987) and Makram et al. (1994) reported similar results.

Yield of seed cotton (in kentars) per feddan also was significantly affected in a similar way to seed cotton yield per plant. Oosterhuis. (1990), and Azab *et al.* (1993) obtained the same results.

Foliar spraying with (Pottasin)^{TM} slightly increased the earliness percentage as compared with the control but in favour of the use of 60 kg N/fed. as nitrogen fertilizer. High level of N/fed. significantly decreased earliness. Azab *et al.* (1987) and Makram *et al.* (1994) found that high N level decreased earliness.

Lint percentage was slightly affected by the foliar application of K and N fertilizer but the differences between treatment means did not reach the level significance in 1997. These results are in agreement with those obtained by Mullins and Burmester (1995).

Concerning seed index, K foliar applications under the level of 90 kg N/fed. significantly reduced seed index. K foliar application reduced seed index compared with untreated control only in the second season (1998). On the other hand, application of high amounts of N/fed. reduced seed index in the two seasons. Gamalat et al. (1994) found that Potassium fertilizer enhanced seed index.

Fiber properties

Lint properties i.e. micronaire reading and Pressley index, were not significantly affected by any foliar treatments of K under the different levels of N fertilizer. The Same trend was obtained by Shahine (1980) and Mullins and Brumester (1995).

Table 3. Effect of (K) and (N) applications on yield, yield components and lint quality in 1997 season.

(N) Fertilizer rates	(K) application conc.	Plant height cm	Open bolls/plant	Boll weight gm	Seed cotton /plant gm	Seed cotton/ Fed.K/fed.	Earliness %	Lint %	Seed index gm	Mic. reading	Press. index
60 kg/fed.	0	107	11	3.04	25.83	7.77	73.17	35.30	9.52	3.10	11.13
	800 cm^3/fed.	112	14	3.08	33.00	8.70	76.75	34.45	9.07	2.95	11.43
	1000 cm^3/fed.	115	15	2.92	34.55	9.07	78.30	36.02	9.37	2.98	11.18
	1200 cm^3/fed.	116	16	2.87	38.15	9.26	78.49	35.69	9.38	3.00	11.23
90 kg/fed.	0	113	13	3.33	31.06	8.16	70.96	35.21	9.16	3.10	10.78
	800 cm^3/fed.	118	17	3.21	42.22	9.05	74.34	35.59	9.19	3.10	11.65
	1000 cm^3/fed.	120	18	3.28	44.06	9.25	75.96	35.27	8.89	2.95	10.85
	1200 cm^3/fed.	120	18	3.06	45.25	9.25	78.53	34.40	9.32	2.85	11.78
L.S.D.		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.25	N.S.	N.S.
(K)	0	110	11.75	3.19	28.44	7.97	72.06	35.25	9.34	3.10	10.95
	800 cm^3/fed.	115	15.50	3.14	37.61	8.87	75.54	35.02	9.13	3.03	11.54
	1000 cm^3/fed.	117.50	16.50	3.10	39.32	9.16	77.13	35.65	9.13	2.96	11.01
	1200 cm^3/fed.	118.00	17.25	2.97	41.70	9.26	78.51	35.05	9.35	2.93	11.50
L.S.D.		4.26	1.93	N.S.	4.13	0.33	1.38	N.S.	N.S.	N.S.	N.S.
(N)	60 kg/fed.	112.50	14.13	2.98	32.88	8.70	76.68	35.36	9.33	3.01	11.24
	90 kg/fed.	117.63	16.38	3.22	40.66	8.87	74.95	35.12	9.14	3.00	11.26
L.S.D.		3.01	1.36	0.24	2.92	N.S.	0.98	N.S.	0.13	N.S.	N.S.

* One Kentar =157.Kg

Table 4. Effect of (K) and (N) applications on yield, yield components and lint quality in 1998 season.

(N) Fertilizer rates	(K) application conc.	Plant height cm	Open bolls/plant	Boll weight gm	Seed cotton/plant gm	Seed cotton/ Fed.K/fed.	Earliness %	Lint %	Seed index gm	Mic. readinn g	Press. index
60 kg/fed.	0	80.0	14.5	2.01	29.19	5.00	77.90	32.07	8.73	2.90	9.90
	800 cm^3/fed.	88.0	16.5	2.06	33.96	6.11	81.40	32.44	8.17	2.95	10.10
	1000 cm^3/fed.	90.0	17.0	2.07	35.23	6.24	83.10	32.72	8.66	3.05	9.95
	1200 cm^3/fed.	90.5	17.5	2.07	36.16	6.41	84.00	32.61	7.72	2.90	10.58
90 kg/fed.	0	95.0	18.0	2.05	34.39	6.56	75.20	32.95	7.97	2.80	10.28
	800 cm^3/fed.	102.5	19.5	2.10	40.98	7.61	79.60	33.67	9.96	2.85	9.90
	1000 cm^3/fed.	106.3	20.5	2.10	42.98	8.00	80.20	33.81	7.86	3.13	10.18
	1200 cm^3/fed.	110.0	20.5	2.13	43.56	8.22	81.10	33.66	8.32	3.15	10.60
L.S.D.		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.33	N.S.	N.S.
(K)	0	87.50	16.25	2.03	31.79	5.78	76.54	32.51	8.35	2.85	10.09
	800 cm^3/fed.	95.25	18.0	2.08	37.47	6.86	80.45	33.06	8.06	2.90	10.00
	1000 cm^3/fed.	98.13	18.75	2.08	39.11	7.12	81.65	33.27	8.26	3.09	10.06
	1200 cm^3/fed.	100.25	19.0	2.10	39.87	7.32	82.55	33.13	8.02	3.03	10.19
L.S.D.		6.03	0.97	N.S.	5.31	0.25	2.07	N.S.	0.23	N.S.	N.S.
(N)	60 kg/fed.	87.13	16.38	2.05	33.64	5.94	81.58	32.46	8.32	2.95	10.13
	90 kg/fed.	103.44	19.63	2.09	40.48	7.60	79.02	33.52	8.03	2.98	10.24
L.S.D.		4.26		N.S.	3.75			0.70	0.16	N.S.	N.S.

* One Kentar =157.Kg

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استجابة نباتات القطن للرش (بالبوتاسين-ف) تحت مستويين من التسميد الأزوتي

مصطفي حسن حسن غراب ، أسامه محمد محمد واصل ،
نبيل عبد الحفيظ عبد الشافي ريه

معهد بحوث القطن - مركز البحوث الزراعية بالجيزة.

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا-محافظة كفر الشيخ خلال موسمي ١٩٩٧ ، ١٩٩٨ لتقييم أثر الرش بالبوتاسين ـ ف بتركيزات صفر ، ٨٠٠ ، ١٠٠٠ ، ١٢٠٠ سم٣ / فدان تحت مستويين من التسميد الأزوتي (٦٠ ، ٩٠ كجم ن/فدان) علي إنتاجية القطن صنف جيزة ٧٧.

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

١ . أدي الرش بالبوتاسين إلي زيادة طفيفة في محتوي الكلوروفيل (أ ، ب) والسكريات المختزلة وكذلك السكريات الذائبة الكلية والنسبة المئوية للنتروجين والفوسفور والنيتروجين الأميني الكلي بالأوراق، وكذا النسبة المئوية للبروتين بالبذور . بينما لم يؤثر إضافة البوتاسين معنوياً علي النسبة المئوية للزيت بالبذور .

٢. أدي التسميد النيتروجيني إلي زيادة معنوية في السكرات الذائبة الكلية، والنسبة المئوية للنيتروجين والفوسفور والنيتروجين الأميني الكلي بالأوراق، وكذا النسبة المئوية للزيت بالبذور .

٣. أدي الرش بالبوتاسين إلي زيادة في طول النبات، وعدد اللوز المتفتح/نبات، ونقص في وزن اللوزة ووزن ١٠٠ بذرة بالجرام.

٤. أدي الرش بالبوتاسين إلي زيادة معنوية في محصول القطن الزهر بالجرام/نبات، وكذلك محصول القطن الزهر بالقنطار/فدان مع زيادة طفيفة في النسبة المئوية للتبكير .

٥. لم يؤثر الرش بالبوتاسين معنوياً علي خصائص الشعر (النعومة ، والمتانة).