

INFLUNCE OF CULTIVAR, POTASSIUM FERTILIZER AND BORON FOLIAR APPLICATION ON GROWTH, YIELD AND QUALITY OF CAULIFLOWER.

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ABSTRACT

Response of two cauliflower cultivars i.e. Snowball and Sultany to potassium fertilizer rates (24,48,72 and 96 kg. K₂O /fed.) and boron foliar application (0,25.50 and 75 ppm) as single or in combination were studied during the period from 2001-2003 at Kaha Farm of Horticulture Research Institute. Results showed that plants of Sultany cv. had longer stems as well as length of leaf blade, while those of Snowball cv. produced higher values of curd (weight, height and width) and N content of leaves. On the other hand, there were no significant differences between the two cultivars regarding number of outer leaves, width of leaf blade, fresh weight of plant, total yield /fed., compactness of curd, dry matter percentage of curd and P, K percentages in leaves.

Regarding potassium fertilizer levels, the highest values of stem length, width and length of leaf blade, curd width and height as well as all yield parameters and N and P percentages in leaves were given by using 72 kg K₂O/fed. Moreover, dry matter percentage of curd and K percentage in leaves were gradually increased by increasing potassium levels up to 96kgK₂O/fed. Number of outer leaves and curd compactness were not affected by potassium application.

Obtained results also showed that length and width of leaf blade, all yield parameters, curd (height, compactness and dry matter percentage) and N and P percentages in leaves were increased with increasing boron levels up to 50 ppm, while this factor had no significant effect on stem length, number of outer leaves and curd width.

The interaction between all factors under study had marked influence on leaf blade length and width. However, the highest values of those traits were given by plants of Sultany cv. sprayed by boron at 50 ppm and fertilized with 72kg K₂O/fed. All yield parameters, curd height and width effected significantly by the interaction between cultivars x potassium application, while the interaction between cultivars x potassium levels x boron application had no significant effect on yield parameters, curd characteristics and P and K percentages in leaves.

INTRODUCTION

Uniformity in growth, development and maturation among cauliflower plants is necessary to obtain optimum yield and quality from a high percentage of plants at a single harvest date. Genetics of the plants, the environment and cultural practices including fertilization may affect the uniformity among plants, the yield and quality of cauliflower Salter, (1973). Early work indicated that growth of plants, yield and quality are strongly affected by cultivars, potassium fertilization and boron foliar spray. Potassium is necessary to improve plant yield and quality, since it is known to be linked with carbohydrate metabolism, sugar translocation and helps to maintain the osmotic concentration to keep the cell turgid (Louis and Frederick, 1980).

The effect of potassium application on growth, yield and quality has been studied by many investigators. For instance, Peck and Macdonald (1986) reported that potassium supply hastened growth, maturity, increasing yield of cauliflower, broccoli and Brussels sprouts crops in harvest sequences and increased concentrations of P and K in leaf blades of them.

Moreover, Demchak and Smith (1990) showed that K treatments increased total yield, terminal weight, plant weight of broccoli and increased N and K in leaf blades but leaf P was not affected. On the other hand, Cszinszky (1996) reported that K rates had no significant effect on yield of cauliflower. However, Sharma and Singh (1992) mentioned that cauliflower cv. Pusi grown in sand with 0.01 normal K supply had lower dry matter. Working on cabbage, Harrison and Bergman (1981) reported that significant differences did occur among cabbage cultivars for total yield in all K treatments and as K levels increased, leaf K concentrations increased but leaf N and K had affected little. Similar results of leaf analysis were obtained by Gibson and Whipker (2003) on ornamental cabbage. Many researchers reported also that increasing potassium fertilization rates increased vegetative growth and yield of some vegetable crops (El-Gazzar et al. (1990) on carrot. Working on common bean Farrago and Bad El-Megeed (1993) showed that potassium application increased number of leaves/plant and dry matter content of plant but El-Mansi (1968) reported that potassium fertilizer application had no effect on number of leaves/plant of pepper plant. Shahin et al. (1999) during his study on pepper plant showed that weights of fruit/plant, total yield/fed. and dry matter content of curd was increased with increasing potassium level up to 72 kg K_2O /fed.

Under the application of potassium fertilization we can induce promotion on growth and yield of cauliflower by spraying plants with boron. In this respect, Bidwell (1979) reported that the addition of boron increase the translocation of radioactive products of photosynthesis and Molgarred and Hardman (1980) concluded that boron may be needed for cell wall formation and the metabolism of pectin compounds. Moreover, the effect of boron application on IAA development and formation and increasing cell elongation and development as well as flowering bud formation (Duggar, 1984 and Marchener, 1986). In this connection, spraying cauliflower plants with B significantly increased vegetative growth expressed as plant height, stem length and number of leaves/ plant (Mishra and Singh, 1986 and Mustafa et al., 1991) Parasad and Singh (1988) reported that treating cauliflower plants with boron promote growth and increased curd height and diameter. In addition, Abd El-Ail (1994) working on cauliflower plant showed that there was significant increase in number of leaves/plant and curd size in plants sprayed with boron at 50 ppm. But curd compactness had increased only at one season. In this respect, Shelp and Shattuck(1987) observed that supplied cauliflower plant with boron at 1.0mg/liter increased fresh weight of cauliflower while, the highest level of boron 12.5 mg B/ liter as foliar spray did not affect head quality. However, greatest fresh weight of cauliflower plant and highest total yield were obtained from plants sprayed by boron foliar application (Parasad and Singh, 1988; Moustafa et al., 1991 and Abd El-Ail, 1994) Moreover, Vinay et al., (1994) found that total and curd yield of

cauliflower increased linearly with increasing boron application rate up to 0.5mg/kg soil but decreased at higher rates. The same result was obtained by Francois (1986) working on cauliflower, broccoli and radish observed that excess boron significantly reduced plant size, total and trimmed weight of cauliflower and broccoli.

Therefore, this study aimed to investigate the effect of potassium fertilizer levels and boron foliar application on growth, yield and quality of Snowball and Sultany cultivars.

MATERIALS AND METHODS

These experiments were carried out at kaha farm of Horticulture Research Institute, Qualubia Governorate during two successive seasons of 2001/2002 and 2002/2003. Seeds of cauliflower cultivars i.e. Snowball and Sultany were sown in the nursery on the 13th and 18th of August 2001 and 2002, respectively. Healthy and uniform transplants were chosen for transplanting 5 weeks from seed sowing in each season. The soil was clay loam in texture with pH of 7.8, organic matter was 2.3%, available nitrogen was 22.4 ppm, 37 ppm soluble P and 142 ppm K. The experiment included 32 treatments which were the combination of two genotypes i.e. Snowball and Sultany, four rates of potassium fertilization (24, 48, 72, and 96 kg K₂O/fed.) and four levels of boron solution 0, 25, 50 and 75 ppm, whereas the control plants were sprayed with distilled water. A split plot design with three replicates was adopted. The two cauliflower cultivars were randomly assigned as main plots and potassium fertilizer levels at sub-plots, whereas boron foliar spray were distributed in the sub-sub-plots. The area of the experimental plot was about 12 m² consisted of three rows. Each row was 5 m length and 80 cm width. Transplants of the two cultivars were cultivated 50 cm apart on one ridge of the row. Potassium fertilizer was applied as potassium sulphate (48 % K₂O). The amount of potassium fertilizer was divided in two equal doses and applied at 4 weeks and 6 weeks after transplanting.

The source used for boron was boric acid. Plants were sprayed with boron as foliar spray, three times at 15 days intervals starting 20 days after transplanting. Soil preparation and the agricultural practices were done as commonly followed in the district. At the marketable stage (about 12 weeks from transplanting) cauliflower plants were harvested. A random sample of 10 plants was taken to determine the following parameters:

1-Vegetative growth:

- a- Stem length (cm). b- Number of outer leaves/plant.
c, d- Leaf blade length and width (cm).

2-Yield parameters:

- a- Fresh weight/plant. (whole plant without outer leaves)
b- Curd weight.
c- Total yield /fed. (whole plant without outer leaves)

3-Curd characteristics:

- a, b- Curd height and width.

c- Curd compactness: it was measured using a score from 1-5 whereas:

1 = very poor compactness.

2 = poor compactness.

3 to 4 = medium compactness. 4 to 5 = good compactness.

d- Curd dry matter %.

4-leaves chemical analysis:

Plants leaves were dried at 70 °C then grounded and digested with sulphoric – perchloric acids mixture. Nitrogen was estimated by microkjeldahl method (Piper, 1997). Phosphorus was estimated colourmetrically by the method described by (Jackson, 1958). Potassium was estimated using flame photometer (Jackson, 1967)

All obtained data were subjected to statistical analysis according to Snedecor and Cochran (1971).

RESULTS AND DISCUSION

1-Vegetative growth:-

a- Effect of cultivars:

Data presented in Table (1) show significant differences between the two cultivars for length of both stem and leaf blade in the two seasons. However, Sultany cv. had longer stems as well as length of leaf blade as compared with Snowball cv. On the other hand, Snowball cv. produced larger number of outer leaves than Sultany cv. without significant differences in both seasons.

As for width of leaf blade, the same table shows that values of leaf blade width of the two cultivars were approximately equal in both seasons.

b- Effect of potassium fertilizer level :

It is evident from data in Table (1) reveal that increasing potassium fertilizer levels up to 72 kg K₂O/fed significantly increased length of both stem and leaf blade ,while the highest level of potassium fertilization (96 kg K₂O/fed.) caused reduction in those traits. This effect was true in the two seasons of study. Results in this concern agree with those reported by El-Gazzar et al. (1990) on carrot plants. On the other hand, plants grown under different levels of potassium fertilization had similar number of outer leaves. In this respect, El-Mansi (1968) found that potassium application had no effect on number of leaves/plant of pepper, while Farag and Abd El-Megeed (1993) found that potassium supply increased number of leaves/plant of common bean.

Concerning width of leaf blade, it is clear from Table (1) that the same trend noticed in case of stem length and leaf blade length was also noticed for width of leaf blade in the second season only but in the first one this effect was not significant.

C-Effect of boron application :

Data listed in Table (1) illustrated that boron foliar application had no significant effect on stem length and number of outer leaves/ plant in the two seasons. However, values of each trait were approximately equal. On the other hand, plants sprayed with boron at 50 ppm. had the highest record of leaf blade length, while the lowest one was given by unsprayed plants with significant differences between them, whereas excess boron supply (75ppm.) had significant reduction in this trait. Data had the same trend in both seasons.

Regarding width of leaf blade, data in the same table indicated that increasing boron foliar level up to 50 ppm significantly increased width of leaf blade in the two seasons. Similar results on those traits have been found by (Mishra and Singh, 1986; Parasad and Singh, 1988; Mustafa et al., 1991 and Abd El-All, 1994 on cauliflower plants). In this respect, Bidwell (1979) reported that the addition of boron increase the translocation of radioactive products of photosynthesis and Molgarred and Hardman (1980) concluded that boron may be needed for cell wall formation and the metabolism of pectin compounds. Moreover, boron deficiency caused rosetting of terminal buds and small leaves.

d- Effect of interaction between cultivars, potassium levels and boron foliar application :

It is clear from Tables (2, 3) that the interaction between cultivars x potassium fertilizer levels x boron foliar application was not effective on stem length and number of outer leaves/plant. These results were true in the two seasons.

As for length of leaf blade, the interaction between all studied factors had markedly influence on this trait in both seasons. However, the highest values of leaf blade length were given by Sultany cv. fertilized with 72 Kg K₂O/fed. and sprayed with boron at 50 ppm. in the two seasons.

Table (1): Effect of cultivars, potassium fertilizer levels and boron foliar application on some vegetative characteristics of Snowball and Sultany cultivars during 2001/2002 & 2002/2003 seasons.

Treatments		2001/2002 season				2002/2003 season			
		Stem length (cm)	No. of outer leaves	Leaf blade length (cm)	Leaf blade width (cm)	Stem length (cm)	No. of outer leaves	Leaf blade length (cm)	Leaf blade width (cm)
Cultivars	Snowball	25.44	33.34	59.22	27.37	26.41	34.52	60.85	27.95
	Sultany	50.39	30.42	64.15	27.28	51.57	31.41	65.37	28.28
	L.S.D at 0.05	1.17	N.S	3.03	N.S	1.32	N.S	3.52	N.S
K- levels Kg k ₂ O/fed.	24	36.42	30.06	60.29	26.94	37.69	31.58	61.67	26.80
	48	38.39	31.93	62.01	24.00	39.32	33.73	63.24	28.93
	72	40.85	33.30	63.01	28.74	41.99	34.72	65.15	29.42
	96	36.00	32.23	61.42	26.57	36.95	31.83	62.38	27.31
	L.S.D at 0.05	3.91	N.S	1.69	N.S	3.41	N.S	2.07	1.75
Boron levels ppm	0	37.54	31.13	59.20	27.15	38.56	32.80	60.95	27.81
	25	37.55	32.30	59.46	26.31	38.97	33.59	60.85	27.00
	50	38.65	32.23	65.03	29.35	39.66	33.70	66.33	30.01
	75	37.92	31.86	63.04	26.50	38.76	32.77	64.29	27.64
	L.S.D at 0.05	N.S	N.S	0.10	1.43	N.S	N.S	1.52	1.34

Width of leaf blade was significantly affected by the interaction between cultivars x boron foliar application, between potassium levels x boron foliar application and between cultivars x potassium levels x boron foliar application, while the interaction between cultivars x potassium levels had no significant effect on this character in the two seasons.

Table (2) : Effect of the Interaction between cultivars, Potassium fertilizer levels and boron foliar application on vegetative characteristics of Snowball and Sultany cauliflower cultivars during season 2001/2002.

Treatment		Cultivars							
K-levels kg k ₂ O/fed.	Boron levels ppm	Stem length (cm)		No. of outer leaves		Leaf blade length (cm)		Leaf blade Width (cm)	
		Snow ball	Sultany	Snow ball	Sultany	Snow Ball	Sultany	Snow Ball	Sultany
24	0	24.50	47.00	30.00	24.00.	57.33	57.00	28.83	27.83
	25	24.00	41.67	32.67	27.00	57.50	55.33	21.83	25.17
	50	24.33	51.50	33.33	29.33	62.67	58.83	28.33	31.17
	75	24.33	54.00	33.67	30.33	64.83	70.83	27.50	25.83
48	0	24.83	51.00	34.00	28.00	54.08	55.67	26.33	25.83
	25	25.33	52.67	36.67	29.33	55.00	64.17	23.66	28.50
	50	24.63	50.67	32.33	33.00	54.07	76.50	25.83	28.00
	75	26.00	52.00	34.40	27.67	62.50	74.00	30.17	27.17
72	0	25.33	52.63	35.03	33.00	61.67	62.00	27.17	26.83
	25	26.00	54.00	33.90	33.50	62.33	63.67	29.00	30.33
	50	27.43	55.67	33.50	33.00	59.92	75.67	30.74	34.83
	75	27.67	58.00	31.17	32.83	60.83	58.00	30.50	20.50
96	0	25.00	50.00	34.83	29.50	57.83	68.00	28.50	25.83
	25	26.33	50.33	33.33	32.00	56.67	63.00	23.50	28.50
	50	26.00	49.00	31.33	32.00	62.50	70.00	27.92	28.00
	75	25.33	36.00	33.33	31.50	59.67	53.67	28.17	22.17
L.S.D.at 0.05									
Cvs x K		N.S		N.S		2.38		N.S	
Cvs x B		N.S		N.S		3.35		2.02	
k x B		N.S		N.S		4.74		2.86	
Cvs x K x B		N.S		N.S		6.71		4.04	

Table(3): Effect of the interaction between cultivars, potassium fertilizer levels and boron foliar application on vegetative characteristics of Snowball and Sultany cauliflower cultivars during season (2002/2003).

Treatment		Cultivars							
k-levels kg K ₂ O/fed.	Boron Levels ppm	Stem length (cm)		No. of outer leaves		Leaf blade length (cm)		Leaf blade Width (cm)	
		Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany
24	0	25.87	48.67	32.00	26.17	59.00	58.00	27.83	29.33
	25	26.00	43.57	34.33	29.17	57.83	57.00	22.92	23.00
	50	26.43	52.33	33.67	30.00	63.50	61.00	26.67	29.67
	75	24.67	54.00	35.67	31.62	63.67	73.33	28.33	26.67
48	0	25.83	52.00	36.00	30.23	56.58	56.00	27.17	28.33
	25	28.43	54.37	37.67	31.57	57.50	64.50	25.17	32.00
	50	25.50	51.73	33.67	34.83	55.67	78.33	26.92	31.00
	75	25.67	53.00	36.67	29.17	63.00	74.33	31.17	29.67
72	0	27.33	53.77	37.00	34.67	65.83	64.17	27.17	27.67
	25	27.70	55.00	35.00	35.33	64.17	65.00	30.17	28.33
	50	28.40	56.33	34.67	34.73	62.33	76.33	32.00	36.17
	75	29.67	58.70	32.33	34.00	61.83	61.50	31.50	22.33
96	0	24.00	51.00	36.00	30.33	59.67	68.33	28.67	26.33
	25	27.00	51.67	35.00	30.66	58.17	62.67	24.42	30.00
	50	26.83	50.71	29.67	30.33	63.50	70.00	28.67	29.00
	75	26.17	38.23	33.00	29.67	61.33	55.33	28.42	23.00
L.S.D.at0.05									
Cvs x K		N.S		N.S		2.92		N.S	
Cvs x B		N.S		N.S		3.56		1.89	
k x B		N.S		N.S		5.04		2.68	
Cvs x K x B		N.S		N.S		7.12		3.79	

Generally, the widest leaf blade was produced by plants of both cultivars fertilized with 72Kg K₂O/fed. and sprayed with boron at 50 ppm in the two seasons.

2-Yield parameters:

a-Effect of cultivars:

Data in Table (4) show clearly that Snowball cv. had higher values of curd weight than Sultany cv. with significant differences between them in the two seasons, while there were no significant differences between the two cultivars regarding fresh weight of plant and total yield /fed. in both seasons.

b-Effect of potassium fertilizer levels:

Data in Table (4) show that increasing potassium fertilizer level up to the highest level of potassium 96kg K₂O/fed. significantly increased curd weight and fresh weight of plant. The maximum increase was obtained by using 72kg K₂O/fed. in the two seasons. These results are in the same line with those obtained by Peck and Macdonald (1986) on cauliflower and broccoli and Demchak and Smith (1990) on broccoli and Harrison and Bergman (1981) on cabbage Shahin et al. (1999) on pepper. On the other hand, Cszinzsky (1996) reported that K rates 98,196and294kg/ha. had no significant effect on yield of cauliflower. As for total yield/fed., it is evident from Table (4) that the best treatment which caused a significant enhancement for total yield/fed. was 72kg K₂O /fed during the two seasons of study, followed by 96kg K₂O /fed. with significant differences between them. These results explained on the base that potassium is necessary to improve plant yield, since it is known to be linked with carbohydrate metabolism, sugar translocation and helps to maintain the osmotic concentration to keep the cell turgid (Louis and Frederick, 1980).

c- Effect of boron foliar application :

As shown from data in Table (4) fresh weight of plant and weight of curd were significantly increased by increasing boron level up to 50 ppm in both seasons, whereas spraying plants with boron at 75 ppm caused reduction in those traits.

Concerning total yield/fed., it could be noticed from the same table that boron foliar spray effect significantly on total yield /fed. in both seasons. However, plants sprayed with boron at the level of 50ppm showed the highest values of total yield/fed. , while the lowest values were obtained with the highest level of boron (75ppm) with significant difference between them. These results may be due to the role of boron in plant physiology, especially the effect of boron application on IAA development and formation (Duggar, 1984 and Marschener, 1986) and consequently increasing plant cell elongation and development as well as flowering bud formation. Such results are in harmony with those reported by Francois (1986); Parasad and Singh (1988); Mustafa et al. (1991); Abd El-All (1994) and Vinay et al. (1994) on broccoli and cauliflower.

d- Effect of the interaction between cultivars , potassium fertilizer levels and boron foliar application:

As shown in Table (5) there was significant effect for the interaction between cultivars x potassium fertilizer levels on fresh weight of plant as well as total yield /fed. in the two seasons, while curd weight was affected

significantly by this interaction in the second season only. On the other hand, the interaction between cultivars x boron application, potassium fertilizer levels x boron application and cultivars x potassium fertilizer levels x boron application had no remarkable effect on fresh weight of plant; curd weight and total yield/fed. in both seasons.

Table (4): Effect of cultivars, potassium fertilizer levels and boron foliar application on yield parameters of Snowball and Sultany cultivars during 2001/2002 & 2002/2003 seasons.

Treatments		2001/2002 season			2002/2003 season		
		*Fresh weight (kg)	Curd weight (kg)	Total yield Ton/fed.	*Fresh weight (kg)	Curd weight (kg)	Total yield ton/fed.
Cultivars	Snowball	3.38	2.66	29.951	3.52	2.83	31.332
	Sultany	2.85	1.99	25.412	3.02	2.27	26.865
	L.S.D at 0.05	N.S	0.25	N.S	N.S	0.24	N.S
K- levels Kg K ₂ O/fed.	24	2.77	2.03	24.653	2.94	2.23	26.197
	48	3.00	2.27	26.665	3.11	2.39	27.631
	72	3.50	2.59	31.182	3.73	2.92	33.157
	96	3.17	2.42	28.225	3.30	2.66	29.408
	L.S.D at 0.05	0.22	0.22	1.82	0.21	0.24	1.88
Boron levels ppm	0	2.99	2.21	26.618	3.15	2.40	28.073
	25	3.26	2.42	28.841	3.39	2.71	30.134
	50	3.31	2.59	29.444	3.48	2.73	31.018
	75	2.89	2.09	25.822	3.05	2.35	27.176
	L.S.D at 0.05	0.32	0.27	2.83	0.31	0.27	2.73

* The whole plant without outer leaves

In general, the highest values of those traits were obtained by plants of the two cultivars fertilized with potassium at 72kg K₂O/fed. and sprayed with boron at 50 ppm. without significant differences. Genetics of the plants, the environment and cultural practices including fertilization may affect the uniformity among plants, yield and quality of cauliflower Salter, (1973).

3-Curd characteristics:

a- Effect of cultivars:

It is clear from Table (6) that there were significant differences between the two cultivars regarding curd height and width in the two seasons. On this regard, Snowball cv. showed higher values of curd height as well as curd width than values of Sultany cv. Genetic variances between cultivars are the main effective variables in this concern. On the other hand, no significant differences were noticed between the two cultivars regarding compactness and dry matter percentage of curd in both seasons.

b-Effect of potassium levels:

Results in Table (6) indicated that applying potassium fertilization at level of 72 kg K₂O /fed. significantly increased curd height and width compared with the lowest level 24 kg K₂O /fed. treatment in the two seasons. Whereas, curd compactness was insignificantly affected by all potassium levels under study in both seasons.

Table (5): Effect of the interaction between cultivars, potassium fertilizer levels and boron foliar application on curd characteristics of Snowball and Sultany cauliflower cultivars during 2001/2002 & 2002/2003 seasons.

Treatments		Cultivars											
		2001/2002 season						2002/2003 season					
		*Fresh weight (kg)		Curd weight (kg)		Total yield Ton/fed		*Fresh weight (kg)		Curd weight (kg)		Total yield ton/fed.	
k-levels kgk ₂ O/fed.	Boron-levels ppm	Snow Ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany
24	0	3.57	2.41	2.38	1.57	31.77	21.30	3.73	2.57	2.66	1.83	33.23	22.85
	25	3.61	2.32	2.70	1.61	32.10	20.65	3.76	2.48	3.23	1.73	33.49	22.10
	50	3.71	2.25	2.69	1.58	28.19	20.03	3.27	2.49	2.77	1.70	29.07	22.11
	75	2.80	2.05	2.15	1.38	24.95	18.25	2.95	2.3	2.27	1.63	26.26	20.47
48	0	2.76	2.51	2.20	1.92	24.59	22.34	2.93	2.67	2.19	1.97	26.05	23.73
	25	3.21	3.02	2.47	2.05	27.18	26.85	3.38	3.18	2.60	2.43	30.08	28.33
	50	3.32	3.08	2.59	2.18	29.53	27.44	3.47	3.22	2.68	2.56	30.91	28.63
	75	3.27	2.83	2.82	1.89	29.13	26.26	3.26	2.73	2.55	2.10	28.98	24.33
72	0	3.63	3.27	2.88	2.20	32.31	29.08	3.76	3.47	3.15	2.60	33.43	30.85
	25	3.78	3.60	3.08	2.40	33.67	32.04	3.94	3.77	3.27	2.90	35.10	33.52
	50	3.93	3.82	3.24	2.80	35.01	34.00	4.10	3.98	3.33	3.07	36.49	35.45
	75	3.16	2.83	2.43	1.64	28.12	25.22	3.79	3.00	2.88	2.15	33.71	26.70
96	0	2.82	2.97	2.31	2.02	25.09	26.46	2.98	3.13	2.41	2.37	26.55	27.89
	25	3.47	3.08	2.91	2.17	30.85	27.39	3.32	3.24	3.01	2.55	29.38	28.87
	50	3.76	3.13	3.03	2.59	33.46	27.89	3.92	3.43	3.11	2.60	34.86	30.56
	75	3.74	2.40	2.69	1.67	33.29	21.36	3.77	2.63	3.08	2.13	33.52	23.44
L.S.D.at0.05													
Cvs x K		0.31		N.S		2.57		0.30		0.33		2.66	
Cvs x B		N.S		N.S		N.S		N.S		N.S		N.S	
K x B		N.S		N.S		N.S		N.S		N.S		N.S	
Cvsx Kx B		N.S.		N.S		N.S.		N.S		N.S		N.S	

Regarding dry matter percentage of curd, data in the same table show that potassium fertilization had remarkable effect on dry matter percentage of curd. However, the highest rate of potassium 96 kg K₂O/fed. gave the highest dry matter percentage followed by using 72 kg K₂O/fed. , whereas the lowest percentage was obtained from plants fertilized with the lowest level 24 kg K₂O/fed. . These results were true in the two seasons. The present data agree with those obtained by Peck and Macdonald (1986) and Sharma and Singh (1992) on cauliflower and Gibson and Whipker (2003) on cabbage and Shahin et al. (1999) on pepper plant and Farag and Abd El- Megeed (1993) on common bean .

c-Effect of boron foliar application:

Data illustrated in Table (6) reveal that curd height showed significant response to boron spray in both seasons. In this connection, spraying plants with boron at 50 ppm showed higher values of curd height 17.10 and 17.56 cm as compared with control 14.46 and 15.01cm with significant differences between them in the two seasons, respectively. The favorable effect of boron on curd size have been reported by Mustafa et al. (1991) and Abd El-All (1994) using 50 -100 ppm boron as foliar application. On the other hand, no remarkable effect on curd width was noticed regarding this treatment where values were equal nearly under different levels of boron. The previous results were emphasized in both seasons. However, Francois (1986) reported that increasing boron foliar application from 1.0 to 4.0 mg B/liter significantly reduced head size of cauliflower and broccoli.

Concerning curd compactness, insignificant response to boron sprays was detected in the first season but this response became significant in the second one. However, sprayed plants with boron at 50ppm showed good curd compactness, while the highest level 72 ppm gave medium compactness with significant difference between them.

Table (6): Effect of cultivars, potassium fertilizer levels and boron foliar application on curd characteristics of Snowball and Sultany cultivars during 2001/2002 & 2002/2003 seasons.

Treatments		2001/2002 season				2002/2003 season			
		Height (cm)	Width (cm)	Compactness	Dry matter %	Height (cm)	Width (cm)	Compactness	Dry matter %
Cultivars	Snowball	16.25	27.29	3.83	12.57	16.90	27.83	4.11	13.29
	Sultany	15.29	24.67	3.81	11.79	15.68	25.76	3.86	12.47
	L.S.D at 0.05	0.15	2.18	N.S	N.S	1.04	2.05	N.S	N.S
K- levels Kg k ₂ O/fed.	24	13.15	24.22	3.60	11.71	13.85	24.88	3.87	12.50
	48	15.98	25.28	3.77	11.92	16.38	25.98	3.93	12.59
	72	17.46	27.83	4.02	12.38	18.04	29.05	4.13	13.02
	96	16.48	26.59	3.90	12.71	16.89	27.28	4.00	13.42
	L.S.D at 0.05	3.01	1.78	N.S	0.93	2.73	1.80	N.S	0.84
Boron levels ppm	0	14.46	25.13	3.62	11.59	15.01	25.91	3.84	12.26
	25	16.18	26.40	3.92	12.18	16.60	27.58	3.99	12.83
	50	17.10	26.99	4.04	12.63	17.56	27.67	4.21	13.48
	75	15.33	25.40	3.75	12.33	16.00	26.02	3.88	12.95
	L.S.D at 0.05	1.32	N.S	N.S	0.64	1.31	N.S	0.28	0.63

As regard to dry matter percentage of curd, the highest values of dry matter percentage were resulted when 50 ppm boron foliar spray was used, while control plants gave the lowest one with significant differences between them in both seasons. These results of curd quality may be due to the physiological role of born on cell wall development (Marcher, 1986). Such results are similar to those of Abd El-All (1994) on cauliflower. On the other hand, Shelp and Shattuck (1987) studies on cauliflower supplied with excess boron 12.5 mg B / liter as foliar spray did not affect head quality.

d-Effect of the interaction between cultivars, potassium levels and boron foliar application:

Data in Table (7) reveal that the interaction between cultivars x potassium levels had a marked effect on width of curd in the two seasons.

As for curd height, this interaction had simulative influence in the second season only. Whereas, there were no significant effects on those traits due to the interaction between cultivars x potassium levels x boron application. These results were true in both seasons. Generally, plants of both cultivars fertilized with 72 kg K₂O /fed. and sprayed with boron foliar at 50 ppm produced the highest values of curd height and width.

Concerning compactness and dry matter percentage of curd, results in the same table cleared that there were no remarkable effect for the interaction between all treatments under study on those traits in the two seasons.

4-Leaf mineral content:

a -Effect of cultivars:

Data presented in Table (8) reveal that significant differences between the two cultivars for N concentration in leaves were found in the two seasons. Snowball. had higher N concentration in leaves 3.58 and 3.68% as compared with Sultany. 3.53and 3.57% in the first and second seasons, respectively. Such difference in N concentrations of leaves of the two cultivars under fixed N-fertilization levels could be attributed to genetic variation. On the other hand, data in the same table indicated that there were no significant effects for cultivars on P and K concentrations (%) in leaves in both seasons.

b -Effect of potassium fertilizer levels:

Data in Table (8) indicated that N and P concentrations in leaves were largely influenced by the rate of potassium application. These minerals considerably increased significantly with increasing potassium levels from 24kg k₂O/fed. up to 72 kg K₂O/fed., then decreased at 96kg K₂O/fed. level. This trend was true in the two seasons.

As regard to K percentage in leaves, significant differences among potassium treatments were observed in the two seasons. The percentage of K in leaves were 5.32 and 6.26 % with applying 96kg K₂O/fed. compared with 3.54 and 3.88with applying 24 kg K₂O/fed. in the first and second seasons, respectively.

Table (7): Effect of the interaction between cultivars, potassium fertilizer levels and boron foliar application on curd characteristics of Snowball and Sultany cauliflower cultivars during 2001/2002 & 2002/2003 seasons.

Treatment		Cultivars															
		2001/2002 season								2002/2003 season							
		Height (cm)		Width (cm)		Compactness		Dry matter %		Height (cm)		Width (cm)		Compactness		Dry matter %	
k-levels kg k ₂ O/fed.	Boron levels ppm	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany
		24	0	12.03	10.67	26.00	20.07	3.30	3.33	11.93	10.93	13.57	11.33	26.67	21.33	3.83	3.53
	25	14.83	11.83	28.83	19.67	3.67	3.33	12.19	11.53	15.90	12.33	29.33	21.33	4.17	3.67	12.77	12.17
	50	15.33	13.00	27.67	22.33	3.67	3.50	11.27	11.94	16.00	13.33	27.33	23.17	4.00	3.97	12.97	12.60
	75	16.50	11.00	28.83	20.33	4.00	4.00	12.07	11.83	17.00	11.33	27.67	21.67	3.77	4.00	12.75	12.50
48	0	15.50	15.33	23.33	23.67	3.67	3.83	11.99	10.13	15.33	14.00	23.83	24.67	4.13	3.67	12.66	10.90
	25	17.00	18.20	26.67	25.00	3.33	4.00	12.09	11.72	17.00	15.00	27.33	26.00	4.80	3.83	12.63	12.38
	50	16.50	18.33	27.10	25.00	4.00	4.30	12.21	12.60	18.33	16.33	27.67	25.67	4.53	4.00	12.87	13.37
	75	15.33	11.67	27.17	24.33	4.30	2.67	12.06	12.53	18.40	16.67	27.67	25.00	4.33	3.13	12.72	13.17
72	0	16.67	16.17	28.00	27.50	4.00	4.00	12.63	11.64	17.33	16.67	28.67	28.23	4.00	4.00	13.30	12.13
	25	17.17	18.67	28.67	28.50	4.33	4.33	13.12	11.83	17.66	19.17	29.33	29.53	4.17	4.33	13.80	12.67
	50	19.83	19.00	30.00	29.33	4.80	4.67	13.03	12.25	20.17	19.66	30.67	30.50	4.67	4.50	13.87	13.00
	75	16.83	15.33	27.33	23.33	3.33	3.00	13.38	11.17	17.67	16.00	28.00	25.50	3.80	3.57	13.73	11.67
96	0	15.00	14.33	26.00	26.50	3.50	3.67	12.45	10.98	16.00	15.83	26.67	27.20	3.77	3.77	13.20	11.63
	25	16.00	15.70	27.00	26.83	4.30	4.00	12.50	12.43	17.17	18.57	27.83	28.00	4.13	3.83	13.13	13.10
	50	17.83	17.00	27.17	27.33	4.00	4.30	14.69	13.04	17.33	19.33	27.67	28.17	4.13	3.90	15.37	13.80
	75	17.67	18.33	26.90	25.00	3.33	4.00	13.43	12.13	15.57	15.33	27.00	25.67	4.47	4.00	14.30	12.80
L.S.D.at 0.05																	
Cvs x K		N.S		2.55		N.S		N.S		3.86		2.51		N.S		N.S	
Cvs x B		N.S		N.S		N.S		N.S		N.S		N.S		N.S		N.S	
K x B		N.S		N.S		N.S		N.S		N.S		N.S		N.S		N.S	
Cvsx Kx B		N.S		N.S		N.S		N.S		N.S		N.S		N.S		N.S	

Leaf analyses data agreed with previous reports by Peck and Macdonald (1986) on cauliflower, broccoli and Brussels sports crops also Harrison and Bergman (1981) and Gibson and Whipker (2003) on cabbage supported the same results. On the other hand, Demchak and Smith (1990) working on broccoli mentioned that addition of K increased leaf N and K but leaf P was not affected.

c- Effect of boron foliar application:

As shown from Table (8) that increasing boron foliar level up to 50 ppm significantly increased N, P and K percentages in leaves. Excess boron supply 75ppm. had significant reduction in this concern comparing with boron level 50ppm. This result is true in the two seasons. These results agree with those obtained by Shelp and Shattuck (1987) on cauliflower and Abd et al. (1987) on cabbage.

Table (8):Effect of the interaction between cultivars, potassium fertilizer levels and boron foliar application on N, P, K content of Snowball and Sultany cultivars leaves during 2001/2002 &2002/2003 seasons.

Treatments		2001/2002 season			2002/2003 season		
		N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
Cultivars	Snowball	3.58	0.624	4.41	3.68	0.708	5.24
	Sultany	3.53	0.606	4.32	3.57	0.702	5.04
	L.S.D at 0.05	0.04	N.S	N.S	0.02	N.S	N.S
K- levels Kg k ₂ O/fed.	24	3.52	0.407	3.54	3.49	0.506	3.88
	48	3.62	0.593	3.82	3.64	0.699	4.75
	72	3.69	0.780	4.77	3.80	0.854	5.68
	96	3.38	0.679	5.32	3.57	0.760	6.26
	L.S.D at 0.05	0.04	0.03	0.12	0.02	0.05	0.56
Boron - levels ppm	0	3.25	0.576	4.04	3.36	0.665	4.73
	25	3.60	0.605	4.36	3.47	0.695	5.16
	50	3.74	0.648	4.63	3.85	0.739	5.45
	75	3.62	0.631	4.42	3.82	0.719	5.22
	L.S.D at 0.05	0.03	0.02	0.11	0.02	0.03	0.39

d-Effect of the interaction between cultivars, potassium fertilizer levels and boron foliar application :

Data presented in Tables (9,10) showed that N content (%) in leaves differed significantly between the two studied cultivars as a result of the interaction between, potassium levels and boron foliar application. However, the highest values of leaf N content were given by plants of Snowball fertilized with 72kg K₂O/fed. and sprayed with boron at 50 ppm, whereas plants of Sultany supplied with 24 kg K₂O/fed. and unsprayed with boron gave the lowest values of N content %. These results were given in both seasons of study.

Concerning P and K concentrations in leaves, data in the same tables show that there were no significant differences for P and K percentages in leaves of both cultivars due to the interaction between factors under study in the two seasons.

Table (9) : Effect of the interaction between cultivars, potassium fertilizer levels and boron follar application on N,P and K contents of Snowball and Sultany cauliflower leaves during 2001/2002.

Treatment		Cultivars					
K-levels kgk ₂ O/fed.	Boron- levels ppm	N (%)		P (%)		K (%)	
		Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany
24	0	3.32	3.01	0.36	0.37	3.14	3.22
	25	3.47	3.36	0.39	0.42	3.60	3.53
	50	4.03	4.00	0.43	0.45	3.81	3.71
	75	3.43	3.50	0.41	0.43	3.70	3.57
48	0	3.11	3.02	0.55	0.54	3.51	3.55
	25	4.08	4.07	0.56	0.56	3.82	3.72
	50	3.40	3.30	0.66	0.62	4.11	4.17
	75	4.10	3.90	0.62	0.61	3.90	3.81
72	0	3.55	3.43	0.77	0.73	4.58	4.41
	25	3.76	3.65	0.80	0.74	4.81	4.63
	50	4.18	3.98	0.85	0.76	5.20	4.91
	75	3.54	3.45	0.84	0.75	4.90	4.72
96	0	3.34	3.23	0.65	0.63	5.10	4.80
	25	3.25	3.14	0.68	0.67	5.33	5.40
	50	3.56	3.45	0.70	0.71	5.60	5.53
	75	3.11	3.92	0.69	0.70	5.40	5.37
L.S.D.at 0.05							
Cvs x K		0.53		N.S		N.S	
Cvs x B		0.05		N.S		N.S	
K x B		0.07		N.S		N.S	
Cvs x K x B		0.09		N.S		N.S	

Table (10) : Effect of the interaction between cultivars, potassium fertilizer levels and boron follar application on N,P and K contents of Snowball and Sultany cauliflower leaves during 2002/2003 seasons.

Treatment		Cultivars					
K-levels kgk ₂ O/fed.	Boron- levels ppm.	N (%)		P (%)		K (%)	
		Snow ball	Sultany	Snow ball	Sultany	Snow ball	Sultany
24	0	3.22	3.11	0.48	0.45	3.56	3.20
	25	3.92	3.18	0.53	0.48	3.90	3.72
	50	4.11	4.10	0.55	0.53	4.33	4.10
	75	3.50	3.40	0.54	0.49	4.20	4.00
48	0	3.43	3.12	0.66	0.64	4.48	4.20
	25	3.58	4.47	0.68	0.67	4.78	4.72
	50	4.17	4.07	0.74	0.75	5.20	5.10
	75	3.70	3.61	0.73	0.72	5.00	4.50
72	0	3.66	3.54	0.81	0.82	5.62	5.20
	25	3.88	3.67	0.83	0.85	5.80	5.71
	50	4.21	4.10	0.85	0.93	5.91	5.82
	75	3.67	3.56	0.84	0.90	5.70	5.62
96	0	3.45	3.34	0.74	0.72	6.10	5.50
	25	3.36	3.25	0.78	0.75	6.41	6.20
	50	4.04	4.00	0.79	0.77	6.60	6.55
	75	3.67	3.46	0.77	0.76	6.30	6.41
L.S.D.at 0.05							
Cvs x K		0.03		N.S		N.S	
Cvs x B		0.03		N.S		N.S	
K x B		0.04		N.S		N.S	
Cvs x K x B		0.05		N.S		N.S	

Finally the obtained results may lead to that conclusion applying Snowball and Sultany cauliflower cultivars with potassium fertilization at level of 72 kg k₂O/fed. and spraying them with boron foliar application at 50 ppm achieved the maximum growth rate, promote compactness and dry matter percentage of curd and produced highest yield parameters.

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تأثير الصنف والتسميد البوتاسى والرش بالبورون على النمو والمحصول والجودة للقمييط

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- اجريت هذه الدراسة خلال الفترة من ٢٠٠١-٢٠٠٢ بمحطة التجارب الزراعية التابعة لمعهد بحوث البساتين بقها - لدراسة تأثير ٤ مستويات من التسميد البوتاسى (٢٤، ٤٨، ٧٢، ٩٦ كجم بو٢/فدان ، اربع مستويات من الرش بالبورون بمعدل صفر، ٢٥، ٥٠، ٧٥ جزء من المليون على النمو الخضري والإنتاج وجودة محصول القمييط لصنفي سنوبول والسلطاني ، قد أظهرت النتائج المتحصل عليها الأتي :
- أعطى الصنف السلطاني أطول ساق وأطول نصل ورقة بينما أنتج صنف سنوبول أعلى قيم لأوزان القرص وكذلك عرض وارتفاع القرص ومحتوى النتروجين بالأوراق .
 - عدم وجود فروق معنوية بين الصنفين بالنسبة لعدد الأوراق الخارجية - عرض نصل الورقة - الوزن الطازج للنبات - المحصول الكلى/ فدان كذلك انماج القرص والنسبة المئوية للمادة الجافة به ونسبة الفوسفور والبوتاسيوم بالأوراق.
 - بالنسبة لمستويات التسميد البوتاسي :- أدى استخدام ٧٢ كجم بو٢/١ فدان أعلى قيم لطول الساق ، عرض وطول نصل الورقة ، عرض وارتفاع القرص وكذلك كل مكونات المحصول ونسبة النتروجين والفوسفور بالأوراق .
 - الزيادة التدريجية للمواد الصلبة الذائبة بالقرص ونسبه البوتاسيوم بالأوراق بزيادة مستوى البوتاسيوم الى ٩٦ كجم بو٢/١ فدان.
 - لم يكن لمستويات التسميد البوتاسي تأثيراً معنوياً على عدد الأوراق الخارجية وأنماج القرص.
 - بالنسبة للرش بالبورون:- أظهرت النتائج زيادة طول وعرض نصل الورقة ومكونات المحصول وارتفاع القرص وأنماجه والنسبة المئوية للمادة الجافة بالقرص ونسبه النتروجين والفوسفور بالأوراق بزيادة مستوى البورون حتى ٥٠ جزء من المليون بينما لم يكن لهذا العامل تأثيراً معنوياً على طول الساق عدد الأوراق وعرض القرص.
 - كان للتفاعل بين عوامل الدراسة تأثير واضح على عرض وطول نصل الورقة حيث أعطت نباتات الصنف السلطاني المرشوشة بالبورون بتركيز ٥٠ جزء من المليون والمسمدة بـ ٧٢ كجم بو٢/١ فدان أعلى قيم لطول وعرض نصل الورقة .
 - كان هناك تأثير معنوي للتفاعل بين الأصناف ومستويات البوتاسيوم على مكونات المحصول وارتفاع وعرض القرص بينما لم يكن للتفاعل بين الأصناف ومستويات البوتاسيوم ومستويات البورون أى تأثير معنوي على مكونات المحصول وصفات القرص ونسبه الفوسفور والبوتاسيوم بالأوراق .