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BROCCOLI *(BRASSICA OLERACEA VAR. ITALICA)* GROWTH AND YIELD UNDER ASSIUT CONDITIONS

II-YIELD AND ITS COMPONENTS

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Abstract: This experiment was carried out at the Vegetable Experimental Farm of the Faculty of Agriculture, Assiut University, Assiut during the two successive winter seasons of 2002-2003 and 2003-2004 to study the effect of five sowing dates (July 15, Aug. 15, Sept. 15, Oct. 15 and Nov. 15) on yield and quality characteristics of broccoli heads of three genotypes under Assiut conditions. Results showed that there were significant differences among the five planting dates. The latest planting date Nov.15 gave the highest value for the duration of harvest period, sulfur % and vitamin C %. There was a consistent significant decrease in number of secondary heads with each delay in planting date. Significant differences were also found among the tested cultivars. Assiut -1 cultivar gave the heaviest head weight and the highest value of sulphur % while recorded the lowest value of vitamin C %. . Southern Star cultivar gave the lowest number of secondary head during both seasons and the lowest value of sulphur %..Italyan cultivar had the lowest duration of harvest period and total yield in both seasons but recorded the highest value of vitamin C%.The interaction effect between planting date × cultivar was significant for most of studied traits. Results of this study indicated that Assiut-1 cultivar gave the highest head quality on July, 15 and high sulfur % on Nov.,15. While the Italyan cultivar gave the highest value of vitamin C % on Nov., 15.

Key words: broccoli, growth, yield.

Introduction

Broccoli (*Brassica oleracea* var. *italica*) is a minor vegetable crop cultivated in a very small area over all Egypt. No statistics were found to determine such area in Egypt not even in F.A.O. statistics data base.

Broccoli is highly nutritious, and has been deemed as a vegetable with potential anti-cancer activity due to high levels of glucoraphanin, which can hydrolyses to form sulphoraphane, an isothiocyanate, broccoli sprouts have been reported to have 20–50 times the glucoraphanin concentration of mature broccoli heads (Fahey et al., 1997). Moreover, dietary antioxidants, vitamins and non-nutrient

components such as flavonoids, are present in crucifers and may decrease the risk for certain cancers (Lindsay & Astley, 2002). The highest concentration of cancer-protective compounds, such as aliphatic and indole GLS, were found in Brussels sprouts (sinigrin and glucobrassicin) and in broccoli (glucoraphanin). (Ewa Cies'lik *et. al.*, 2007 and Sonja Winkler et. Al., 2007).

The content of vitamin C in fresh broccoli was almost twice that in cauliflower (Lisiewskaz and Kmiecik 1996). In Egypt, Aboul-Nasr and Ragab (2000) stated that broccoli is a good source of vitamin A, calcium and vitamin B_2. Temperature had a strong influence on the ascorbic acid content, as when broccoli grown at 15–20 C, the ascorbic acid content decreased by up to 38% as compared to broccoli grown at 7–12 C. In addition to the lower temperatures moderate radiation led to accumulation of ascorbic acid in broccoli heads (Schonhof *.et. al.*, 2007)

In broccoli, the content of both glucosinolates and theirbioactive hydrolysis , antioxidant , vitamins and flavonoid contents varies with genotype, environment and processing. (Jeffery *et. al.*2003). Daniela Heimler *et. al.* (2005) reported that the Brassicaceae have a low caloric value depending on the low content of protein, fat and an moderate content of fiber. On the contrary, the contents of minerals, vitamins and other phytochemicals such as polyphenols and glucosinolates, sulphur containing compounds, are notable. Pirjo Mattila and Jarkko Hellstrom (2007) considered broccoli as one of the best vegetable sources of total phenolic acids which have attracted considerable interest in the past few years due to their many potential health benefits.

Successful broccoli production requires proper timing of planting dates, and well-developed transplants (MaryPeet,1998). This experiment aimed to find out the most suitable sowing date to produce the highest concentration of this subject.In addition, the yield and its quality was our big aim in this study.

Materials and Methods

This investigation was carried out in a clay soil at the Experimental Farm of the Faculty of Agriculture, Assiut University, Assiut in two successive winter seasons of 2002/2003 and 2003/2004.

The effect of five planting dates and three broccoli genotypes on growth and yield of broccoli were studied. The five sowing dates were July 15th, August 15th, September15th, October15th and November15th. The tested broccoli genotypes were Assiut-1 (synthetic variety), Italian genotype and hybrid Southern star(Table 1).

Table (1): Source of the genotypes used in this work .

Genotypes no.	Genotypes	Source
1	Assiut-1	Damarany and Aboul-Nasr *
2	Italian	Battistini Sementi s.n.c.
3	Southern star (hybrid)	TAKII,S

*Assiut-1 is a synthetic cultivar that was produced at the Department of Horticulture, Assiut University by Damarany and Aboul-Nasr (2000). The original parents of this genotype were namely Parma, Atlantic, Walthon-29 and Toro. A mass selection was conducted for eight years to get a late flowering broccoli genotype under Assiut conditions.

A complete block design with split plot arrangement that have four replicates used in this study. Planting dates were assigned to the main plots and genotypes were distributed at random in the sub plots. Planting was practiced in rows 3.5 m long and 75 cm wide and transplants were planted at 45 cm apart between hills in the rows, Each plot consisted of four rows and the plot area was 10.5 m^2. Harvesting was done when maturity was attained.

Normal cultural practices for as recomended were applied (irrigation, fertilization, weed and pest controls).

The following data were recorded: for all the plants/plot.

A- Yield characters

1-Head weight (g). The curd was cut and weighed.

2- Number of secondary heads per plant .Data of this treatment were transformed before analysis while, the showed data in the table (3) are the original data.

3-Total yield (ton/fed): Weight of all curd/plot and transformed to ton/fed.

4- Harvest period duration: Number of days from the start to the end of harvesting season.

5-Number of days from transplanting to harvest time.

B-Chemical composition

A random samples of broccoli heads at harvesting were used for the following chemical analysis:

1- Sulphur concentration in heads, assayed on fresh weight basis, A.O.A.C. (1984).

2- Ascorbic acid (v.c.%) in heads.

Ascorbic acid was determined titrimetrically using 2.6-dichlorophenol indophenol

procedure as described in the A.O.A.C. (1984).

Statistical analysis

All data of were statistically analyzed using F test and means of treatments were compared using Duncin Multiple Range Test (DMRT) at 5% level according to Gomes and Gomes (1984).

Results and Discussion

Head weight (g):

Data for head weight are presented in Table 2. All studied factors (planting date , genotypes and the interaction) significantlay affect head weight. The latest planting date Nov.15 gave significantly lower head weight, than the earliest planting date July 15. Which might be related to higher accumulation of assimilates storage with high temperature at the beginning of season rather than low temperature at the end of season. May be this due to low temperature and therefore, in order to induce flowering the plants should pass a good vegetative growth period until they reach reasonable size sufficient to form a marketable curd. While at the latest planting dates low temperature prevailed during early stages of growth stimulated curd initiation and stopped emergence of more leaves which is the source of food storage and this resulted in plants with small heads in both seasons.Yacoub, (2001) showed that the earliest planting date (July 12) of cauliflower grown under Assiut conditions gave significantly the highest values for marketable and net curd weights Most researchers who investigated the effects of planting dates on broccoli and cauliflower growth and development have shown that earlier planting dates significantly increased yield and yield component (Yacoub, 2001 and Mihov and Antonova, 2002).

Assiut-1 cv. gave the heaviest head weight during the two seasons, while cultivar Italyan gave the lightest head.However, Aboul-Nasr and Ragab (2000) found that Parma cv. Exceeded Assiut-1.in forming heavier and larger sized heads. Waltert and Theiler (2003) stated that the growth of curd showed higher cultivar variation and was more sensitive to environmental factors than the growth of stem. Consequently, there was a higher variation between curds of one crop, which differs between cultivars.

The heaviest head was obtained when Assiut-1 cv. was cultivated at July 15th and the lowest head weight was obtaind when the hybrid Southern star was cultivated at Nov. 15th. These results are in agreement with those obtained by Chung and Strickland (1986) who suggested that the lower growing

Table (2): Plant head weight (g) as affected by five planting dates in three broccoli genotypes grown in two successive winter seasons of 2002-2003 and 2003-2004 under Assiut conditions. 2002-2003 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	2130.2 a	1970.8 b	561.2 f	405 fg	112.6 h	1035.9 A
Italian	1335.0 c	1444.8 c	763.3 e	379.9 g	105.7 h	805.8 A
Hybrid Southern Star	1444.8 c	1430.8 c	997.1 d	457.7 fg	101.4h	886.4 A
Average	1636.7 A	1615.5 A	773.9 B	414.2 C	106.6 D	

2003-2004 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	1463.2 a	1323.5 b	416.8 gh	313.9 i	94.7 j	722.4 A
Italian	816.7 e	900.2 d	462.5 fg	304.2 i	112.6 j	519.2 B
Hybrid Southern Star	1143.8 c	923.1 d	491.8 f	365.4 hi	81.8 j	601.2 B
Average	1141.2 A	1048.9 A	457.0 B	327.8 B	96.4 C	

Means followed by the same letter or letters within rows are non-significantly differed at P = 0.05

Table (3): Number of secondary heads per plant as affected by five planting dates and three broccoli genotypes grown in two successive winter seasons of 2002-2003 and 2003-2004 under Assiut conditions.

2002-2003 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	6.14 a	5.06 b	0.77 ef	0.72 efg	0.07 g	2.55 A
Italian	6.08 a	3.35 c	0.9 e	0.52 efg	0.09 fg	2.19 A
Hybrid Southern Star	2.13 d	3.32 c	0.45 efg	2.44 d	0.22 efg	1.71 A
Average	4.78 A	3.91 A	0.71 BC	1.22 B	0.12 C	

2003-2004 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	0.9 b	0.29 cde	0.7 bcd	0.32 cde	0.00 e	0.44 A
Italian	3 a	1.18 b	1.04 b	0.3 cde	0.00 e	1.1 A
Hybrid Southern Star	0.12 e	0.19 de	0.74 bc	0.7 bcd	0.00 e	0.35 A
Average	1.34 A	0.55 BC	0.83 AB	0.44 BC	0 C	

Means followed by the same letter or letters within rows are non-significantly differed at P = 0.05

temperatures of later sowings might cause floral initiation at a younger physiological age. Plants therefore develop heads before reaching full size and the spears are small and take a longer time to reach maturity. Benoit and Ceustermans (1986) and Dufault (1996) stated that the earliest planting dates gave the highest total average head weight and diameter, and the highest percentage of large sized heads. Trotta *et al.* (2000) showed that yield in all tested cultivars was decreased when sowing was delayed from 6 August to 16 September.

Number of secondary heads per plant:

As shown in Table 3,all studied factors (planting date, genotypes and the interaction) were significantlay affect number of secondary heads per plant in both seasons. The highest number of secondary heads was obtained from the first planting date, and the lowest number of secondary heads was obtained from the latest one. There was a consistent significant decrease in number of secondary heads with each delay in planting time.The same findings were recorded by Ahmed and Wajid-Siddique (2004) they showed that early sowing of broccoli seeds (5th of May) produced higher number of secondary heads compared with later dates.

The three genotypes had no significant effect with respect to this character in spit of cultivar Assiut-1 gave the highest value of number of secondary heads in the first season of study, and Italyan cv. gave the highest in the second season. Southern Star hybrid gave the lowest number of secondary head during both seasons The highest number of secondary heads was obtained when Italyan cv. was cultivated at July 15 th . On the other hand , the lowest value was obtained when Assiut-1 cv. was cultivated at Nov. 15 th .

Total yield (ton/fed.):

Results for this character are presented in Table 4. Total yield was significantly affected by planting date in both seasons. Results of all tested genotypes, revealed that the highest total yield was obtained from the second planting dates in both seasons, while the lowest was obtained from the latest one in both seasons. Salter *et al.* (1984) showed that yield, maturity and quality of broccoli heads were significantly affected by planting dates. They also found that, late-sown crop, gave a lower yield with a lower harvest index, smaller and shallower heads and a greater plant-to-plant variability compared with crops from the earlier sowings. Moreover, Chung (1985) and Chung and Strickland (1986) revealed that delays in the sowing date after

Table (4): Total yield (ton/fed) as affected by five planting dates and three broccoli genotypes grown in two successive winter seasons of 2002-2003 and 2003-2004 under Assiut conditions

2002-2003 season

Genotypes	Transplanting date					
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	Average
Assiut-1	5.63 def	10.06 a	6.52 cd	4.74 ef	1.00 h	5.59 A
Italian	2.76 g	8.54 b	7.62 bc	4.26 f	0.53 h	4.74 A
Hybrid Southern Star	5.75 def	6.23 cde	10.00 a	5.02 def	0.79 h	5.56 A
Average	4.71 B	8.28 A	8.05 A	4.67 B	0.77 C	

2003-2004 season

Genotypes	Transplanting date					
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	Average
Assiut-1	3.88 cde	10.00 a	4.59 bcd	2.93 ef	0.88 h	4.46 A
Italian	1.73 gh	4.71 bc	4.86 bc	2.61 fg	1.03 h	2.99 A
Hybrid Southern Star	3.62 de	4.52 bcd	5.51 b	3.64 de	0.92 h	3.64 A
Average	3.08 C	6.41 A	4.99 B	3.06 C	0.94 D	

Means followed by the same letter or letters within rows are non-significantly differed at P = 0.05

December considerably reduced marketable spear yield. The potential marketable spear yield was reduced from 15.6 t/ha for the December sowing to 10.5 t/ha for the January sowing and 5.7 t/ha for the March sowing. Also, Bianco *et al.* (1996) found that yield generally decreased as sowing date was delayed. Rooster and De-Rooster (1997) found that harvesting was not advanced but yields were increased by earlier sowing. In Assiut, Yacoub (2001) showed that the earliest planting date (July 12) of cauliflower grown under Assiut conditions gave significantly the highest values of total yield per feddan. Ahmed and Wajid-Siddique (2004) showed that early sowing of broccoli seeds (5^{th} of May) resulted in higher yield per plant compared with later dates.Differences among genotypes were not significant in both seasons at all tested planting dates. Cultivar Assiut-1 cv. gave the highest value in both seasons and Italyan cultivar gave the lowest yield during both seasons. However, Trotta *et al.* (2000) showed that broccoli yield in all tested cultivars decreased when sowing delayed from 6 August to 19 September.

The interaction effect of planting date x genotype was significant in both seasons. The highest total yield was obtained when Assiut-1 cv. was cultivated at Aug., 15^{th} . On the other hand , the lowest value was obtaind when genotypes were cultivated at Nov.15^{th}. The presented results is in agreement with the findings of Kahn and Motes (1988) they found that cultivar and planting date effects were often more important than effects of stand establishment methods in these studies.

Harvest period duration:

The harvest period duration is presented in Table 5. Planting date, genotypes and the interaction significantlay affected the harvest period duration in both season. Results of the second season of all tested genotypes, revealed that the highest duration of the harvest period was obtained from the latest planting date, and the lowest was obtained from the fourth date. Whereas in the first season the early and the fourth date had a superiority values than the moderate dates.

Significant differences were found among the tested genotypes regarding duration of the harvest period as an average of all tested planting dates. Genotypes Southern Star and Assiut-1 recorded the highest values of harvest period duration in 2002-2003 season. However, in the second season Assiut-1 cv. gave the highest values. Italyan cv. was the lowest duration of harvest period in both season.

Table (5): Harvest period as affected by five planting dates and three broccoli genotypes grown in two successive winter seasons of 2002-2003 and 2003-2004 under Assiut conditions

2002-2003 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	52 b	48.50 bc	29.50 de	24.25 ef	54.25 b	41.70 A
Italian	31.50 d	11.25 g	22.25 f	18 f	49 bc	26.40 B
Hybrid Southern Star	63.75 a	43 c	30.25 de	18.50 f	53.75 b	41.85 A
Average	49.08 A	34.25 B	27.33 BC	20.75 C	52.33 A	

2003-2004 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	34 c	46.25 b	33 c	18 e	65.50 a	39.35 A
Italian	3.25 f	21 de	26.75 cd	8.25 f	60.00 a	23.85 B
Hybrid Southern Star	3.75 f	28.25 c	28.75 c	8 f	61.25 a	26 B
Average	13.67 C	31.83 B	29.50 B	11.42 C	62.25 A	

Means followed by the same letter or letters within rows are non-significantly differed at P = 0.05

The interaction effect of planting date x genotype was significant. Although, in most cases highest values of harvest period were found in the latest planting date and Assiut-1 cv. Chung and Strickland (1986) found that sowing after February(later date) increased the length of the growing period and reduced the spear yields for all cultivars, compared with earlier sowings.

Number of days from transplanting to harvest time:

As shown in Table 6, number of days from transplanting to the harvest time was significantly affected by all studied factors (planting date , genotypes and the interaction) in both seasons. Data of the two seasons indicated that the earliest planting date (July 15th) gave the highest number of days, while the latest date gave the lowest value in both seasons.

Cultivar Italyan gave the highest number of days, while, hybrid Southern Star was the lowest in this respect.The interaction effect of planting date x genotypes was significant in both seasons. There was a trend for decrease in number of days of the three genotypes with the delay in planting date from July, 15 to Aug., 15.

Chemical composition of head:

Sulphur percentage at harvest time:

As shown in Table 7, All studied factors (planting date, genotypes and the interaction) were significantlay affected sulphur percentage of broccoli plants at harvest time.

The highest sulphur percentage at harvest time was obtained from the latest planting date, and the lowest sulphur percentage was obtained from the third planting date. Regard to genotypes Assiut-1 cv. gave the highest value of sulphur percentage, while Southern Star hybrid gave the lowest value of sulphur percentage. Assiut-1 cultivar on July, 15 was the highest value and the lowest was obtained from Southern Star hybrid on Oct., 15. These results are in agreemint with those obtained by Rosa *et al* (2002) they determined the sulphur (S) content in the primary and secondary inflorescences of 11 broccoli cultivars grown in early and late seasons. Results showed that sulphur was higher ($P < 0.05$) in summer/winter than in spring/summer. Rangkadilok *et al*.(2004) stated that there were significant genotypic differences for the content of both S (sulphur) and glucoraphanin in all broccoli plant organs at different growth stages.

Table (6): Number of days from transplanting to harvest as affected by five planting dates and three broccoli genotypes grown in two successive winter seasons of 2002-2003 and 2003-2004 under Assiut conditions

2002-2003 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	103.3 c	91.5 de	97 d	89.3 e	77 f	91.6 B
Italian	125.5 a	114.5 b	104.3 c	95.8 d	79.5 f	103.9 A
Hybrid Southern Star	86.0 e	89 e	97 d	91.5 de	79.3 f	88.6 B
Average	104.9 A	98.3 A	99.4 A	92.2 A	78.6 B	

2003-2004 season

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	120.5 bc	98.8 d	91.0 ef	86.0 g	63.0 h	91.9 B
Italian	133.5 a	124.2 b	99.3 d	95.8 de	63.0 h	103.2 A
Hybrid Southern Star	117 c	95.5 de	86.5 fg	92.0 e	63.0 h	90.8 B
Average	123.7 A	106.2 B	92.3 C	91.3 C	63.0 D	

Means followed by the same letter or letters within rows are non-significantly differed at P = 0.05

Table (7): Whole plant sulphur percentage as affected by five planting dates and three broccoli genotypes grown in successive winter seasons of 2003-2004 under Assiut conditions

Genotypes	Transplanting date					Average
	15th of	15th of	15th of	15th of	15th of	
Assiut-1	1.34 a	1.26 b	1.24 e	1.13 i	1.25 c	1.25 A
Italian	1.17 g	1.09 l	1.08 m	1.07 n	1.25 d	1.13 B
Hybrid Southern Star	1.14 h	1.1 j	1.09 k	1.06 o	1.2 f	1.12 C
Average	1.22 B	1.15 C	1.14 D	1.09 E	1.23 A	

Means of cultivars, planting dates or their interactions followed by the same letter or letters are not significantly different at the P = 0.05

Ascorbic acid (Vitamin C percentage) at harvest time:

Ascorbic acid percentage at harvest time was significantly affected by all studied factors (planting date, genotypes and the interaction) in 2003-2004 season Table 8. Results as an average of all tested genotypes, revealed that the highest ascorbic acid percentage at harvest time was obtained from the latest planting date, and the lowest Vitamin C percentage was obtained from the earliest planting date. These results agree with Leja *et al.* (2003) and Vallejo *et al.* (2003) they revealed that broccoli grown in spring has higher contents of ascorbic acid and total antioxidant activity compared with those grown in autumn.

Cultivar Italyan gave the highest value of Vitamin C percentage , while Assiut-1 gave the lowest value of Vitamin C percentage . Farnham *et al.*2004 and Schreiner, 2005 found that the effect of genotype was greater than that of environmental factors on levels of glucoraphanin and quinine concentration of broccoli heads.More or less was recorded by Jagdish Singhet. et al. (2007) who reported that maximum vitamin C concentrations, b-carotene, lutein, DL-a-tocopherol content and phenol content was recorded in broccoli compared with the other Brassicaceae crops.

The interaction effect of planting date x genotypes was significant. The highest value of Vitamin C percentage was obtained from Italyan cultivar on the latest date Nov.,15, and the lowest value of Vitamin C percentage obtained from Italyan cultivar on July, 15.

Table (8): Vitamin C percentage in heads as affected by five planting dates and three broccoli genotypes grown in successive winter 2003-2004season under Assiut conditions

Genotypes	Transplanting date					Average
	15th of July	15th of Aug.	15th of Sept.	15th of Oct.	15th of Nov.	
Assiut-1	8.69 jk	17.35 i	116.27 h	155.52 e	400 c	139.57 C
Italian	6.87 k	17.85 i	160 e	186.67 d	733.33 a	220.94 A
Hybrid Southern Star	10.5 jk	14.27 ij	131.63 g	138.85 f	533.33 b	165.72 B
Average	8.69 E	16.49 D	135.97 C	160.35 B	555.55 A	

Means followed by the same letter or letters within rows are non-significantly differed at P = 0.05

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نمو و محصول البروكولى تحت ظروف أسيوط

١- المحصول و مكونات المحصول

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تم إجراء هذه التجارب بالمزرعة البحثية لفرع الخضر بكلية الزراعة جامعة أسيوط خلال موسمي شتاء (٢٠٠٢-٢٠٠٣) و (٢٠٠٣-٢٠٠٤). وقد استهدفت دراسة تأثير خمس مواعيد شتل (١٥ يوليو ، ١٥ أغسطس ، ١٥ سبتمبر ، ١٥ أكتوبر ، ١٥ نوفمبر) على المحصول والجودة لرؤوس ثلاث طرز وراثيه من البروكولي تحت ظروف أسيوط

أوضحت النتائج المتحصل عليها اختلافات معنوية بين مواعيد الزراعة الخمسة. الميعادالأخير١٥ نوفمبر أعطي أطول فترة حصاد.وأعلى نسبه مئوية لمحتوي كل من الكبريت وحمض الأسكوربيك .ظهر تناقص عدد الأقراص الجانبية على النبات مع التأخير في ميعاد الزراعة .

أشارت النتائج أيضا إلى اختلافات معنوية بين الطرز المختبرة وقد سجل الصنف (أسيوط -١) اعلي قيمة من وزن القرص و أعلى نسبةمئوية لمحتوي الكبريت بينما سجل أقل القيم من حيث فيتامين ج .الصنف (سوثيرن ستار) أعطي اقل عدد من الأقراص الجانبية و اقل نسبة كبريت خلال موسمي الدراسة. اظهر الصنف(الإيطالي) اقل فترة حصاد و اقل محصول كلى ولكن سجل اعلي القيم من حيث النسبة المئوية لفيتامين ج .

تأثير التفاعل بين ميعاد الزراعة × الأصناف كان معنويا لمعظم الصفات المدروسة .

ويستخلص من نتائج هذه الدراسة أن شتل الصنف (أسيوط -١) فى منتصف شهر يوليو قد أدى إلى تكوين رؤوس أفضل جودة و أعطى عند زراعته فى منتصف نوفمبر أعلى نسبة من الكبريت . أما الصنف الإيطالي فقد أعطى أعلى مستوى من حمض الأسكوربيك عند زراعته فى منتصف نوفمبر.