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EFFECT OF PLANTING DATES AND CHELATED CALCIUM FOLIAR APPLICATION ON TIPBURN OF HEAD LETTUCE

Abou EL-Yazied, A.; A. M. El-Gizawy; M. I. Ragab and E. S. Hamed

Horticulture Dep., Faculty of Agric., Ain Shams Univ., Shoubra Elkheima, Cairo, Egypt.

ABSTRACT

This work was carried out at Nikla village, Giza governorate, during 2002 /2003 and 2003/2004 seasons to evaluate the effect of three planting dates (the first of October, November and December), and applying of 0 , 200 , 400 and 600 ppm chelated calcium as foliar application on vegetative characteristics (.i.e., fresh and dry weight, head size and number of leaves per plant) and percentage of tipburn injury of head lettuce cv. Limor .The results indicated that seed sown on the first of December increased head size and Ca concentration in leaves compared to other sowing dates. But there were no significant diffrance among planting dates in head fresh and dry weight, number of leaves per plant and percentage of tipburn. Whereas foliar spray with chelated calcium reduced and prevented tipburn injury and increased percentage of Ca concentration in leaves but had no significant effect on fresh and dry weight and number of leaves per plant. Thus, foliar spray with 600 ppm chelated Ca in the three planting dates gave the best results and prevented tipburn incidence.

Keywords: Head lettuce, *Lactuca sativa* var., capitata. L., Chelated Calcium, foliar application, planting dates, Tipburn.

INTRODUCTION

Lettuce (*Lactuca sativa* var., capitata. L.) is one of the most popular salad vegetable crops in Egypt, and considered as an important crop for exportation in the future (Edrees, 2001). Tipburn of lettuce is a serious problem confronting most growers. Tipburn is Ca-related physiological disorder (Sonneveld and Mook, 1983). The collapse and necrosis that occur at the apex and margin of leaves are associated with a localized Ca-deficiency (Thibodeau and Minotti, 1969). Calcium is an important nutrient determining the keeping quality of fruit and vegetables. It is present in cell walls and appears to be involved in ion uptake and the maintenance of membrane permeability (Buike and Alisna, 2003).

Beraha and Kwolek (1975) reported that tipburn incidence can range from 0 to 100% depending upon the weather condition at the time of head development, high incidence has been observed during the summer months. Most workers had believed it is caused by calcium deficiency (Thibodeau and Minotti, 1969; Ashkar and Ries, 1971). In addition, Yanagi *et al* (1983) showed that tipburn incidence was positively correlated with mean monthly maximum, average and minimum temperature and was negatively correlated with calcium levels in the inner head sections. In addition, Collier and Tibbitts (1982) and Barta and Tibbitts (1991) showed that the very low Ca levels of lettuce exhibited Ca-deficiency injury and termed in Tipburn. Moreover, Collier and Tibbitts (1982) reported that tipburn is usually found later in plant development when the head is well formed and close to maturity and then the increased severity of tipburn is attributed to accelerated plant growth with

young leaves which are more sensitive due to their rapid growth increasing the demand for calcium. The objective of the present study was, therefore, to study the effect of different planting dates and different concentrations of chelated calcium foliar application aiming to reduce tipburn incidence of head lettuce grown in Giza governorate.

MATERIAL AND METHODS

This work was carried out at the Zein El-Din farm, Nikla, Giza, Egypt during the two successive seasons of 2002/2003 and 2003/2004, to evaluate the effect of planting dates and chelated calcium foliar application on tipburn of head lettuce (*Lactuca sativa* var capitata L.) under drip irrigation system in a sandy soil . Table (1) show the chemical and physical analyses of the soil.
Seeds of crisphead lettuce cv. "Limor" classified as crisp-heading cultivar, large and vigorous in plant growth, and with somewhat crumpled leaves that have a slightly ashy cast in the green color, under favorable conditions heads are large and solid, seeds were obtained from Agri seed Co., Holland. Seeds were sown in the nursery at three dates (the first of October, November and December) in the two seasons.
The meteorological data during the growing seasons including maximum and minimum monthly temperatures as well as relative humidity (RH) are shown in Table (2).

(Table 1): Chemical and physical analyses of the soil at Zein El-Din farm, Nikla village, Giza, during 2002/2003 and 2003/2004 seasons

Chemical analysis of the soil									
Seasons	EC		Cations (Meq. L^{-1})				Anions (Meq. L^{-1})		
	m. mhos/cm	pH	Ca^{++}	Mg^{++}	K^{+}	Na^{+}	Cl^{-}	$Hco3^{-}$	$SO4^{-}$
2002/2003	0.8	7.34	2.43	4.05	0.66	2.41	1.52	1.5	1.3
2003/2004	0.8	7.20	2.78	3.65	0.45	2.10	1.33	1.5	1.3
Physical analysis of the soil									
Sand %	**Silt %**	**Clay %**	**Organic matter %**			**Texture**			
89.4	4.6	5.7	0.3			Sand			

Soil samples were analyzed by Soil Water and Environment Res. Inst. Agric. Res. Center.

Table (2): Monthly average of daily temperature and relative humidity (RH %) of Nikla village, Giza. during 2002/2003 and 2003/2004 seasons.

Month	2002/2003				2003/2004			
	RH%		Temperature ºC		RH %		Temperature ºC	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
October	77.8	37.71	28.92	21.08	81.12	33.56	29.57	19.8
November	80.12	36.52	25.12	16.38	82.34	41.72	24.4	15.87
December	80.76	37.87	20.34	11.27	77.32	38.76	19.45	10.58
January	73.54	32.91	20.8	10.73	68.71	34.28	18.45	9.92
February	66.96	27.84	19.35	9.82	73.14	35.58	20.52	10.4
March	73.87	29.74	19.41	10.63	73.89	34	23.55	12.9

Data were obtained from the central meteorological laboratory, Dokki, Giza, Ministry of Agriculture, A.R.E.

The seeds of head lettuce were sown in the nursery in foam trays (108 eyes) at the three sowing dates using mixture of peat moss and vermiculite 1:1 (v/v) (according to the recommended transplant production media for protected cultivation by the Egyptian Ministry of Agriculture).

A split plot design with four replicates was used where the planting dates were assigned in the main plots and the foliar chelated calcium spray treatments were located in the subplots.

The experimental unit area was 25 m^2 consisted of 5 ridges; each of 5 m length, 1 m width.

Transplants were set out in the field after thirty days from seed sowing (at 3-4 leaf stage) seedlings were transplanted at 15 cm apart in the two seasons.

Calcium foliar spray treatments were applied as foliar applications by using chelated calcium (14% Ca^{++}) by EDTA produced by U.A.D. Co. Egypt., to reduce tipburn incidence. The powder of chelated calcium was dissolved in clean water to prepare the following concentrations: 0 (check), 200, 400 and 600 ppm. The first spray of chelated calcium was at the10-leaf stage and was repeated every 15 days until the plants were harvested as recommended by Thibodeau and Minotti (1969).

Before planting all treatments plots were supplied with 20 m^3 chicken manure + 100kg sulpher + 20kg magnesium sulfate + 20kg N (as ammonium sulfate 20.5 %) + 30kg P_2O_5 (as super phosphate 15.5 %) and 20kg K_2o (as potassium sulfate 50 %).

After planting N, P and K were applied twice a week through the drip irrigation system at a rate of 70, 30 and 40kg /fed., respectively divided through all season as the plant growth. On the other hand, all treatments were sprayed with chelated micro element fertilizer (1 Fe: 0.5 Zn: 0.5 Mn at rate of 50 g/ 100 L water) at two and five weeks after planting.

All replicates received similar treatments as regard to cultivation, irrigation, pest and disease control, and other agricultural practices as commonly followed in the district.

Harvesting date, were after 69, 57; 78, 65; 72 and 69 days from transplanting for the first, second and third planting dates, in the two seasons, respectively, these dates were on 8 and 6 January, 18 and 13 February and 12 and 10 March, respectively.

Heads were harvested at marketable stage (head maturity is as soon as heads become firm, as described by Kader *et al*., 1973). Data on vegetative characteristics including fresh and dry weight, head size, number of leaves per plant and percentage of tipburn in plants were recorded after harvest. In this regard, fresh weight was an average of 12 heads and dry weight averaged from 8 heads (100g head fresh weight were dried after drying at 70 ºC until constant weight). The number of leaves per head averaged from 10 plants of each treatment. Head size averaged from 8 plants of each treatment and was calculated using a measuring cylinder. Tipburn was calculated as a percentage of burned heads to the total heads of each treatment.

Chemical analysis was conducted after harvest to determine the percentage of calcium in the dry mater of head due to the procedures

described by Piper (1974). The obtained data were statistically analyzed using Duncan's multiple rang test at 5 % level to verify the differences among means of the treatments according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

1. **Vegetative characteristics**:

1-1- **Head fresh weight:**

Data presented in Table (3) show that the highest fresh weight per head was achieved when seeds were sown in December and October during 2002/ 2003 seasons and by December sowing date during 2003/2004 season. On the contrary, November planting date recorded the lowest fresh weight during the two seasons of the present study. The obtained results are in agreement with those reported by Ibrahim (1982) who found that the fresh weight, dry weight and height of plants were increased significantly when lettuce was sown in December. This disagree with Abak *et al.* (2000) who reported that head weight of plants transplanted late in season gave the lowest weight compared to early planting dates. This result may be due to that early planting date may be associated with high temperature and long days as shown in Table (2) which may enhance plant growth. In this respect, Scafie (1973) mentioned that the relative growth rate increased with increasing air temperature between 10 and 18ºC, since during this temperature range the relative growth rate was linear, whereas, above 18ºC the increase in relative growth rate was more gradual.

No significant differences were achieved among the four tested levels of chelated calcium during 2002/2003 seasons. Whereas, during 2003/2004 season spraying lettuce plants with 600 ppm chelated Ca recorded the highest fresh weight compared to other levels without any differences among 0, 200 and 400 ppm Ca. This result agrees with that obtained by Abd El-Hady (1995). The obtained result can be explained as calcium plays an important role in cell wall, protein, and other constituents of the organic materials in plant cell. Calcium also involved in cell division and elongation (Hepler and Wayne, 1985).

Regarding the interaction between planting dates and Ca levels, data in Table (3) show that the highest fresh weight was recorded by the plants sown in October and subjected to the four levels of chelated calcium and by that sown in December and sprayed with 200, 400 and 600 ppm chelated calcium during 2002/ 2003 season, While, during 2003/2004 season no significant differences were recorded among the four levels of chelated calcium sprayed in December planting date and those sprayed with 200 and 600 ppm chelated Ca in October planting date. On the other hand, the plants sprayed with any of chelated Ca tested levels and planted in November gave the lowest head fresh weight during the two seasons of the study. This result agrees with Abak *et al.* (2000), who reported that head weight of plants transplanted late in season gave the lowest weight compared to early planting dates and the spring planting gave lower yields than the autumn ones.

Table (3): Effect of planting dates and chelated calcium foliar application on head fresh weight/plant (g) lettuce cv. Limor, during 2002 / 2003 and 2003/2004 seasons.

Ca levels ppm	Planting dates							
	2002/2003				2003/2004			
	Oct.	Nov.	Dec	Mean Ca level	Oct.	Nov.	Dec.	Mean Ca level
0 (Check)	550.6a	452.0de	494.4bcd	499.0A'	564.9b	532.9b	636.4a	578.1AB'
200	550.2a	467.0cde	511.5abc	509.6A'	621.8a	524.5b	669.6a	605.3AB'
400	516.1ab	453.0de	527.8ab	499.0A'	513.7b	510.7b	675.0a	566.5B'
600	522.2ab	437.2e	534.7ab	498.0A'	658.9a	552.0b	676.1a	629.0A'
Mean dates	534.8A	452.3B	517.0A		589.8B	530.0C	664.3A	

Values at the same column followed by the same letter(s) are not significantly different at 0.05 level, Duncan's multiple range test, small letter(s) refer to interaction.

1-2- Head dry weight:

Data in Table (4) show that during 2002/2003 seasons no significant differences were achieved among the three planting dates regarding head dry weight. While, in 2003/2004 season the October and December planting dates gave higher values compared to that of November planting date. Our results disagree with Walworth *et al*. (1992), who reported that the head dry weight of plants transplanted in mid seasons was higher than that transplanted either early or late in the season and the poor growth of the late can be explained largely by the declining in temperature in August and September. Contra results, were recorded by Ibrahim (1982), who found that plant dry weight and total yield increased significantly by transplanting lettuce in December. The obtained result may be due to the declining in minimum temperature (Table 1) in December which may decrease the plant respiration and as result more assimilation will be stored.

Table (4): Effect of planting dates and chelated calcium foliar application on dry weight (g/100g head fresh weight) of head lettuce cv. Limor, during 2002/2003 and 2003/2004 seasons.

Ca levels ppm	Planting dates							
	2002/2003				2003/2004			
	Oct.	Nov.	Dec.	Mean Ca level	Oct.	Nov.	Dec.	Mean Ca level
0(Check)	6.3a	6.41a	5.9a	6.2A'	6.4a	5.5b	6.4a	6.1A'
200	6.2a	5.9a	5.8a	5.9A'	6.5a	5.9ab	6.4a	6.3A'
400	6.3a	6.11a	5.7a	6.0A'	6.0b	5.6b	6.2a	6.0A'
600	6.2a	6.4a	5.7a	6.1A'	6.4a	6.1a	6.2a	6.2A'
Mean dates	6.3A	6.2A	5.7A		6.3A	5.7B	6.3A	

Values at the same column followed by the same letter(s) are not significantly different at 0.05 level, Duncan's multiple range test, small letter(s) refer to interaction.

No significant differences were recorded among the four chelated calcium concentrations under the study in relation to head dry weight during the two seasons. This result disagrees with Collier and Tibbitts (1984), who mentioned that by decreasing the relative humidity the chelated calcium concentration increased in the leaf and give high dry weight, the time taken to

the onset of tipburn was correlated with dry weight but was unrelated to ontogenetic age.

The interaction between planting dates and chelated calcium levels was not significant in most cases during the two seasons of study. With exception of the plant received 200 ppm and those received 0 and 400 ppm chelated Ca in November planting date during 2002/2003 and 2003/2004 seasons, respectively, which recorded the lowest dry weight per head.

1-3-Number of leaves per plant:

There were no significant differences in number of leaves per plant among the three planting dates during the two seasons of the present investigation (Table 5). Similar results are reported by Ibrahim (1982), who found no significant difference in number of leaves per lettuce plants planted in December and January. Also, no significant differences were recorded among the four tested concentrations of chelated calcium during the two seasons under the study. In addition, the interaction between the two studied factors showed slight significant differences in the first season and was not significant in the second one.

Table (5): Effect of planting dates and chelated calcium foliar application on number of leaves /plant of head lettuce cv. Limor, during 2002/2003 and 2003/2004 seasons.

Ca levels ppm	Planting dates							
	2002/2003				2003/2004			
	Oct.	Nov.	Dec.	Mean Ca level	Oct.	Nov.	Dec.	Mean Ca level
0(Check)	33.0ab	34.0ab	32.0ab	33.0A'	32.0a	32.0a	33.0a	32.33A'
200	32.0ab	33.0ab	33.0ab	32.67A'	33.0a	32.33a	34.67a	33.33A'
400	34.3ab	33.0ab	31.33b	32.89A'	32.67a	33.67a	34.67a	33.67A'
600	35.0a	31.67b	33.0ab	33.22A'	32.33a	34.33a	34.0a	33.56A'
Mean dates	33.58A	32.92A	32.33A		32.5A	33.08A	34.08A	

Values at the same column followed by the same letter(s) are not significantly different at 0.05 level, Duncan's multiple range test, small letter(s) refer to interaction.

1-4- Head size:

Data presented in Table (6) show that the highest head size was achieved from plants sown in December, October and December during 2002/2003 and 2003/2004 seasons, respectively. While the lowest head size was recorded by the plants sown in November during the two seasons. The obtained results agree with those reported by Kleinhenz and Wszelaki (2003) who found that planting dates affected cabbage head size and attributed that to the difference in air temperature during head development with smaller heads produced under high temperature conditions. This can be explained as the high temperature especially at night could exhaust large amounts of assimilates produced during a day and as a result no enough assimilates were left to produce new organs or tissues. Thus, the plant size will be small.

Concerning chelated calcium treatments, data in Table (6) show there were no significant differences among the four concentrations of chelated calcium during the two seasons of study. Regarding the interaction between planting dates and chelated calcium levels, data in Table (6) show that the highest head size was recorded by plants sown in December and

sprayed with 200 ppm chelated Ca during the first season. In the second season, plants of October planting and sprayed with 0 , 200 and 600 ppm chelated Ca and those of December planting date and sprayed with 0 , 200 and 400 chelated Ca had the highest heads. On the other hand, the lowest head size was obtained during the two tested seasons by the plants from seed sown in November and subjected to 200 ppm chelated calcium foliar application. This result agrees with Jones (1964), who found that the head size was below the optimum in the November and January planting dates. Contra results, were reported with Esch (1976) who found that the sowing in early September gave better results (yield/m^2 and head size) than October and January ones. These results might be due to the differences in plant behavior and responses to the climatic conditions.

Table (6): Effect of planting dates and chelated calcium foliar application on head size (cm^3) of head lettuce cv. Limor, during 2002 / 2003 and 2003/2004 seasons.

Ca levels ppm	Planting dates							
	2002/2003				2003/2004			
	Oct.	Nov	Dec.	Mean Ca level	Oct.	Nov.	Dec.	Mean Ca level
0(Check)	1683b	1266e	1641c	1530A'	1667a	1167c	1683a	1506A'
200	1636c	1181h	1773a	1530A'	1622ab	1067d	1617ab	1435A'
400	1650bc	1218g	1677b	1512A'	1600b	1133cd	1647ab	1460A'
600	1620c	1253f	1559d	1477A'	1650ab	1183c	1607b	1480A'
Mean dates	1647B	1230C	1660A		1635A	1137B	1638A	

Values at the same column followed by the same letter(s) are not significantly different at 0.05 level, Duncan's multiple range test, small letter(s) refer to interaction.

1-5- Tipburn percentage:

Data presented in Table (7) show that during the two tested seasons there were no significant differences among the three sowing dates in percentage of tipburned lettuce heads. Similar results were obtained by Beraha and kwolek (1975).

Table (7): Effect of planting dates and chelated calcium foliar application on percentage of tipburn of head lettuce cv. Limor, during 2002 /2003 and 2003/2004 seasons.

Ca levels ppm	Planting dates							
	2002/2003				2003/2004			
	Oct.	Nov.	Dec.	Mean Ca level	Oct.	Nov.	Dec.	Mean Ca level
0(Check)	24.97a	30.53a	33.30a	29.60A'	33.30a	27.77a	30.53a	30.53A'
200	5.53a	8.30a	11.07b	8.30B'	11.07b	8.30bc	8.30bc	9.22B'
400	2.76b	0.00c	2.767bc	1.84B'	2.76bc	2.76bc	0.00c	1.84B'
600	0.00c	0.00c	0.00c	0.00B'	0.00c	0.00c	0.00c	0.00B'
Mean dates	8.31A	9.70A	11.78A		11.78A	9.709A	9.707A	

Values at the same column followed by the same letter(s) are not significantly different at 0.05 level, Duncan's multiple range test, small letter(s) refer to interaction.

Regarding chelated calcium levels, data presented in Table (7) and Figure (1) show that when lettuce plants were foliary sprayed with chelated calcium, the percentage of tipburned plants were severely decreased as

compared to the check treatment during the two seasons of study, without any significant differences obtained among the three used concentrations of Ca in the two tested seasons. Moreover, the application of 600 ppm chelated calcium prevented the tipburn incidence compared to the check treatment. Similar results were recorded by several investigators (Ashkar and Ries, 1971; Collier and Tibbitts, 1984; Barta and Tibbitts, 1986; Buike and Alsina, 2003), who related tipburn incidence to the insufficient levels of Ca at leaf enlargement stage. However, the check treatment recorded the highest percentage of tipburned heads. This result can be explained on the basis of role of calcium in cell walls, cell division, regulation of metabolism, root development and its involvement in ion uptake.

Injuries may occur when there is inadequate supply of calcium to the root. This is because of calcium moves by mass flow with transpiration and therefore accumulates in the plants parts which transpire freely, the tissue which closed partially or totally by the outers leaves has lower net transpiration rate and consequently less calcium than outer leaves (Buike and Alsina, 2003). Data presented in Table (7) and illustrated in Figure (1) show that the interaction between planting dates and chelated calcium levels was significant. The lowest tipburn percentage was recorded when applying 600 ppm chelated calcium at the three planting dates during the two seasons of study, compared to the highest tipburn percentage recorded by the check treatment in October, November and December sowing dates. Indicating that applying foliar application of chelated calcium at any planting date decreased tipburn symptoms in head lettuce plants. This may be attributed to the highest chelated Ca concentration in tissues of the plants received 600 ppm Ca as shown in Table (8).

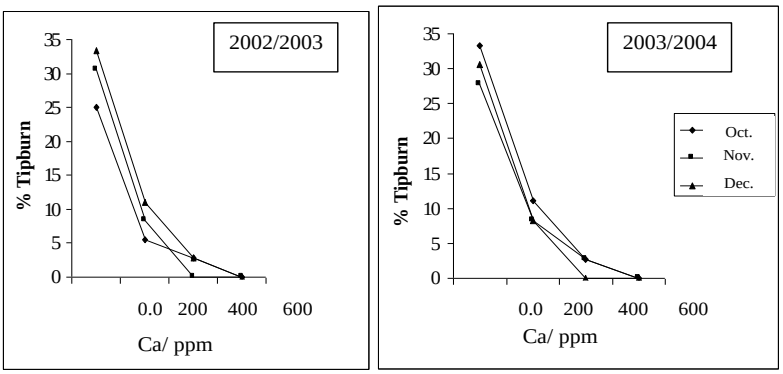

Fig (1): Percentage of tipburned head lettuce plants / plot as affected by chelated calcium foliar application during 2002/2003-2003/2004 seasons.

Concerning chelated calcium concentration, data presented in Table (8) show that chelated calcium concentration in head lettuce of October sowing date was the highest than those of other planting dates. This may be due to the low relative humidity with high temperature during this month

(Table2).This result agrees with Collier and Tibbitts (1984) who mentioned that the decreasing of the relative humidity increased calcium concentration in the leaf and give high dry weight. Barta and Tibbitts (1991), mentioned that tipburn development is associated with the environmental condition that encourage rapid dry matter accumulation and thus have a high daily requirement for calcium in expanding leaf tissue.

Concerning the effect of chelated calcium foliar spray, the concentration of Ca was increased significantly by increasing the sprayed Ca level. The interaction indicated that the highest Ca concentration in lettuce heads was achieved by sowing on the first of October and spraying with 600ppm chelated Ca concentration.

Table (8): Effect of planting dates and chelated calcium foliar application on Calcium concentration (ppm/100 g DM.) of head lettuce cv.Limor, during 2002 /2003 and 2003/2004 seasons.

Ca levels ppm	Planting dates							
	2002/2003				2003/2004			
	Oct.	Nov.	Dec.	Mean Ca level	Oct.	Nov.	Dec.	Mean Ca level
0.0(Check)	39.5f	39.6f	32.6g	37.23D'	32.6g	26.54h	26.51h	28.59D'
200	48.6e	49.6e	43.06f	47.09C'	43.4e	43.34e	40.14f	42.52C'
400	64.6b	55.8d	56.7cd	59.03B'	54.3c	53.30c	49.80d	52.47B'
600	69.5a	59.6c	58.9cd	62.67A'	58.3a	56.50b	59.20a	58.00A'
Mean dates	55.55A	51.65B	47.82C		47.15A	44.95B	44.08B	

Values at the same column followed by the same letter(s) are not significantly different at 0.05 level, Duncan's multiple range test, small letter(s) refer to interaction.

In summary, we can conclude from the present investigation that foliar application with 600 ppm chelated calcium on head lettuce plants at three planting dates under Nikla conditions gave the best results to prevent tipburn injury in head lettuce under this study.

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تأثير مواعيد الزراعة والرش بالكالسيوم المخلبي على احتراق حواف الأوراق في خس الرؤوس

أحمد ابو اليزيد –أحمد محمود الجيزاوى – محمد إمام رجب و إيهاب صلاح الدين حامد
قسم البساتين -كلية الزراعة -جامعة عين شمس -شبرا الخيمة - القاهرة – مصر.

أجريت هذه الدراسة في محافظة الجيزة بقرية نكلا (أرض رملية)وذلك خلال موسمي الدراسة 2004/2003 - 2003/2002 لدراسة تأثير ثلاثة مواعيد زراعة وهى الأول من كل من أكتوبر و نوفمبر وديسمبر وكذلك أربعة تركيزات من الرش بالكالسيوم المخلبي (14%) وهى صفر، ٢٠٠، ٤٠٠، ٦٠٠ جزء في المليون رشا على الأوراق لبيان أثرها على خصائص النمو الخضري (الوزن الطازج والجاف للرؤوس، حجم الرؤوس، عدد الأوراق بالنبات) ونسبة احتراق حواف الأوراق وذلك بخس الرؤوس صنف " ليمور" وأظهرت النتائج تحت ظروف الدراسة أن زراعة البذرة في الأول من ديسمبر أدت إلى زيادة حجم الرأس ونسبة الكالسيوم في الأوراق ولم يتأثر كل من الوزن الطازج والجاف للرؤوس وعدد الأوراق واحتراق حواف الأوراق باختلاف مواعيد الزراعة .بينما أدت المعاملة بالرش بالكالسيوم المخلبي إلى تقليل ومنع ظهور احتراق حواف الأوراق وأدت إلي زيادة نسبة الكالسيوم في الأوراق ولم يتأثر كل من الوزن الطازج والجاف للرؤوس وعدد الأوراق و حجم الرأس باختلاف تركيزات الرش بالكالسيوم المخلبي .لذلك فإن الرش بالكالسيوم المخلبي بتركيز 600 جزء في المليون خلال مواعيد الزراعة الثلاثة قد أعطت أفضل النتائج من ناحية منع ظهور احتراق حواف الأوراق بهذه الدراسة.

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