

EFFECT OF VERNALIZATION PERIODS AND PLANTING DATE ON PLANT SURVIVAL, EARLINESS, AND YIELD COMPONENTS OF GLOBE ARTICHOKE

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ABSTRACT

This study was carried out at El-Kanater Research Station, El-Kaluobia Governorate during the two successive seasons of 2012-2013 and 2013-2014, to investigate the effect of two combination, between two vernalization periods (30 and 45 days at 5 °C and 85% R.H.) and two planting dates (August 15th and September 1st) in addition to control (without vernalization) on growth, yield and its components as well as inulin contents of Globe Artichoke. The experimental design was complete randomized block design with three replications.

Results show clearly that plants vernalized for 30 or 45 days and planted on September 1st gave the highest plant survival percentage followed by those vernalized for 45 days and planted on August 15th in the two tested seasons. The lowest survival percent was shown in non vernalized plants planted on August 15th or on Sept. 1st. Also vernalization for 30 days then planting on September 1st and vernalization for 45 days and planting on Aug. 15th gave the highest leaf number and head dry matter content. Number of early heads per plant and per feddan increased significantly with vernalization than control. Vernalization for 30 days then planting in Sept. 1st showed significantly the highest weight of early yield per plant as well as weight and diameter of receptacle in the two tested years. Plants received vernalization for 30 days and planted on Sept. 1st gave the highest number of total heads / plant and per feddan in the two tested years. Plants vernalized for 45 days then planted in Aug. 15th produced the highest significant total yield / plant and inulin contents in the two tested years. Late planting showed significant decrement in the diameter of flower heads of total yield regardless vernalization.

The study recommends that vernalization of Globe Artichoke plant materials at 5 °C and 85% RH in peat moss layers for 30 days before early planting on Aug. 15th is very needed to enhance plant survival, yield and quality as well as inulin content in Globe Artichoke heads

Keywords: Globe Artichoke, vernalization, planting date, Yield and quality

INTRODUCTION

The Globe Artichoke, (*Cynara scolymus* L.) is one of the most important traditional vegetatively propagated crops grown well in the Mediterranean environment. Nowadays in Egypt, more attention is given for promoting the Globe Artichoke production to satisfy the increased demands of the local production as well as exportation and processing purposes. The early production of flower heads during the period from December to February is the major importance for promoting artichoke exportation. Among the used treatments to induce earliness of production is the vernalization of the plants either through cold treatment of plants or from natural temperature conditions in the spring in the cold areas. Globe Artichoke is generally planted from August to September and propagated vegetatively by offshoots

and stumps, or dried shoots harvested from commercial field at the end of production cycle. This method during that time does not guarantee the uniformity and plants survival in the field. Also, earliness, quality and quantity of production is low. In order to improve the survival percentage of Globe Artichoke, some field trials were conducted for evaluating the effect of planting dates and vernalization periods. Vernalization has been induced in Globe Artichoke by exposing transplant to cold treatments in controlled environment or cold frame (Hussain and Stewart, 1996). In this respect, Lopezet *et al* (2007) found, that cooling stumps before planting differentiated buds that grow after 8-10 days of such storage, while if the stumps are planted directly without cooling, sprouting started 13-15 days after planting since the planting months are during the time of extremely high temperature. Concerning cold storage periods, Salisbury and Ross (1999) found that vernalization is promoting the flowering. In this respect, Stella and Cointry (2010) indicated that in Artichoke, the change from vegetative to reproduction stage requires an exposure to certain amount of cold hours. Vernalization increased plant survival percent as reported by El-Abagy (1993) and Mariateresa *et al* (2005). Also plant height increased by vernalization treatment as found by El-Abagy (1993) and Abd El-Hamid *et al* (2008) while it was not affected as reported by chun *et al* (2013). Moreover, number of leaves was increased as mentioned by El-Abagy(1993) while it was not affected as found by abd El-Hamid *et al* (2008) and Chun *et al* (2013). There were significant increases in flower head weight and diameter due to vernalization as reported by El-Abagy (1993), Anusuya (2000), Pesti *et al* (2004), Abd El-Hamid *et al* (2008) and Chun (2013). In addition, vernalization strategies enhanced early and total yield of Globe Artichoke as mentioned by Anusuya *et al* (2000), Pesti *et al* (2006), Abd El-Hamid *et al* (2008) and Chun *et al* (2013). On the other hand, Stella and Enrique (2010) found that vernalization of Globe Artichoke plantlets did not affect first harvest but increased number of buds and total yield. The study of Anusuya *et al* (2000) showed that vernalization was not effective particularly in late plantings. As for planting date effect, Elia *et al* (1991) found that 30th August date gave the highest yield compared with 16th of October and March. Moreover, Mauromical and lerna (1995) found that 1st and 10th of July planting increased head production than August planting. Generally, Pesti *et al* (2004) and Morteza *et al* (2013) indicated that early sowing date (May) produces higher crop yield at the time when the demand at the markets is high but the late date produces buds with higher quality. Anusuya *et al* (2000) found that the effect of vernalization on Artichoke yield varied with planting date whereas at later planting with vernalizing the transplants increased the number of plants producing apical buds by about 20%.

Therefore, the aim of this study was to investigate the effect of vernalization period and planting date on plant survival, growth, yield and quality of Globe Artichoke,

MATERIALS AND METHODS

The present work was carried out at El-Kanater Research Station, El-Kaluobia Governorate during the two successive seasons of 2012-2013 and 2013-2014, to evaluate the effect of two combinations between two vernalization periods (30 and 45 days at 5 °C and 85%RH) and two planting dates (August 15th and September 1st) in addition to control (without vernalization) on growth, yield and its components as well as inulin contents of Globe Artichoke. Stumps were obtained from a private farm of globe Artichoke from Kafer Al Dwar, Behera Governorate (Herous cultivar) was used. Similar stumps in diameter (5-6cm) were taken then, divided and disinfected with fungicides. Stumps were subjected to vernalization process (cold storage in plastic box with wet peat moss layers at 5°C in refrigerator at postharvest Dept., Horticulture Research Institute, Giza for two periods of storage i.e., 30 and 45 days before planting. During cold storage period, plant parts were sprayed with water once a week. The field experimental unit area was 25m². It contained five rows with 5m in length and 1 m width. The stored stumps were sown on one side of the row at distance of 1m² apart. Planting dates were August 15th and September 1st in the two seasons. Soil type was loamy clay soil. All agricultural practices were carried out as commonly followed in the district. The experiment included 6 treatments, which were the combinations between Three vernalization treatments and two planting dates as follows

- 1- Vernalization for 30 days then planting in August 15th.
- 2- Vernalization for 30 days then planting in September 1st.
- 3- Vernalization for 45 days then planting in August 15th.
- 4- Vernalization for 45 days then planting in September 1st.
- 5- No vernalization and planting in August 15th.
- 6- No vernalization and planting in September 1st.

The experimental design was completely randomized block design with three replications.

Data recorded:- The following data were recorded

1- Plant survived:-

It was expressed as the percentage of well survived plants based on number of plant parts grown in each plot. Survival percentage was calculated when more than 50% of the plants developed additional two new leaves, i.e., at 40 days after planting in the field.

2-Vegetative growth:-

Five plants from each plot were chosen randomly from each treatment at 120 days after planting for measuring the following vegetative growth characters of Globe Artichoke plants expressed as plant height (cm) and number of leaves / plant.

3- Yield and its components

Harvesting started from December 15th till the end of April in both seasons.

4-Early yield:- Early yield was considered as flower heads by weight (kg) and number which were harvested from the first five pickings, ended at the

end of February. It was calculated as yield / plant in Kg and ton /Fadden calculated from plot yield and number of plants in plot. Also, random samples of five flower heads were taken from each plot to determine flower head weight (g), flower head diameter (cm), fresh weight of receptacle (g) and its diameter (cm) as early yield characters.

5-Total yield:- Total flower heads harvested all over the season were calculated by weight (kg) and number in each plot and calculated per plant (kg) and per fedden (ton). Average flower head weight (g), average flower head diameter (cm), receptacle fresh weight (g) and average receptacle diameter (cm) were recorded as yield components for total yield. Also dry mater of flower heads was calculated by drying the heads in an oven at 70°C until constant weight.

6- Inulin contents:- Inulin contents was determined in heads of early and total yield according to the method of Winton and Winton (1958).

7- Statistical analysis:

Data were statistically analyzed and means were compared by using Duncan's multiple range tests as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1-Plant survival percent:-

Vernalization increased significantly the survival percent as compared with control plants (Table 1) in the two tested seasons .Results in Table (1) show clearly that plants vernalizaed for 30 or 45 days and planted on September 1st gave the highest plant survival percent followed by those vernalized for 45 days and planted on August 15th in the two tested seasons. The lowest survival percent was shown in non-vernalized plants planted in August 15th or in September 1st. Results confirm those of El abagy (1993) and Lopezat *et al* (2007) Moreover late planting in Sep.1st increased survival percentage than August 15th planting because of the high temperature in August(37-40⁰C)

2- Vegetative growth:-

Plant height:-

It is clear from data presented in Table (1) that generally vernalization of stumps before planting increased significantly plant height except the vernalization for 30 days and planting in August 15th in the first season. Control plants gave the lowest values in the two tested years. However, no significant differences were detected among early planting (Aug 15th) and late planting (Sept 1st). Similar results were found by El-Abagy (1993) and Abd El-Hamid *et al* (2008).

Number of leaves /plant:-

Vernalization for 30 day then planting on September 1st and vernalization for 45 days and planting on Aug.15th gave the highest leaf number without significant difference between them in the first season (Table1). On the other hand, plants planted on Aug.15th without Vernalization (control) showed the lowest number of leaves in addition to those vernalized for 30 days and planted in the same date. The high number of leaves produced from late planting and vernalization may by due to the high survival

percent (Table1) which correlated to low temperature during planting time (30-33°C) and cooling the plants before planting as mentioned by El-Abagy (1993). On the other said, the results are not agree with those reported by Abd El-Hamid *et al* (2008) and Chun *et al* (2013).

Table 1 : Influence of vernalization period and planting date on survival percent, plant length and No. of leaves/plant during 2012/2013 and 2013/2014 seasons.

Treatments	Survival (%)		Plant length (cm)		No. of leaves/plant	
	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Ver. For 30 days + pla. at Aug.15 th	75.32c	72.34c	98.94a	87.89ab	16.50b	11.33cd
Ver. For 30 days+ pla. at Sept.1 st	92.87a	91.79a	90.78c	85.89b	24.33a	21.00a
Ver. For 45days + pla. at Aug.15 th	85.91b	80.25b	95.20b	89.17a	17.45b	12.11c
Ver. For 45 days + pla. at Sept.1 st	95.48a	94.53a	98.33a	89.78a	23.22a	16.00b
Control + planting at Aug.15 th	52.73e	57.68e	89.14c	78.40c	14.34c	10.79d
Control + planting at Sept.1 st	63.11d	65.13d	79.27d	79.38c	17.40b	15.56b

Vern:- Vernalization pla :- planting

Values within the columns or rows followed by the same small or capital letter(s) do not significantly differ from each other according to Duncan's multiple range test at 5 % level.

3- Early yield and its components

Number of early heads/ plant:-

In Table 2 number of early heads per plant and per feddan increased significantly with vernalization than control. However the lowest values were detected to vernalization for 45 days and planting on August 15th in the two tested seasons. On the other side, non vernalized stumps which planted on August 15th gave the lowest values. Such increment in early yield by number of heads may be due to vernalization enhanced the plant growth and initiation as well as the differentiation of flower buds as found by Pesti *et al* (2004), Stella and Cointry(2010) and Morteza *et al* (2013).

Weight of early yield:-

It is clear from Table 2 that vernalization for 30 days then planting in Sept.1st showed significantly the highest early yield per plant in the two tested years in addition to vernalization of stumps for 45 days then planting on Aug.15th in the second season. However, control plants showed the lowest values when planted in Aug.15th or Sept.1st. Also, vernalizing plants for 30 days then planting on Sept.1st and vernalizaing for 45days then planting on Aug.15th indicated the highest early yield/feddan with significant difference between them. On the other side, the lowest early yield/feddan was obtained from those non vernalized plants with significant difference between them in

the second season. These results are similar to those of Salisbury and Ross (1999) and Stella and Cointry(2010) who reported that vernalization or cooling the plant stumps before planting increased earliness in globe artichoke plants.

Table 2: Influence of vernalization period and planting date on number of heads of early /plant and feddan and average weight of heads \ plant and feddan. during 2012/2013 and 2013/2014 seasons.

Treatments	Number of early heads /plant		Number of early heads /feddan		Early weight of heads /plant (g)		weight of early heads / feddan(ton)	
	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Ver. For 30 days + pla. at Aug.15 th	0.89c	1.20de	3880d	4787e	250.1b	426.2cd	1.00b	1.700d
Ver. For 30 days+ pla. at Sept.1 st	1.13b	2.00b	4507b	7987b	299.8a	697.6a	1.200a	2.790b
Ver. For 45 days + pla. at Aug.15 th	1.37a	2.31a	5493a	9227a	252.1b	718.7a	1.010b	2.880a
Ver. For 45 days + pla. at Sept.1 st	1.01bc	1.54c	4053c	6120c	238.1bc	504.3b	0.950bc	2.020c
Control planting at Aug.15 th	0.92c	1.08e	3653e	4307f	227.1c	412.4d	0.910c	1.640e
Control planting at Sept.1 st	1.01bc	1.25d	4053c	5000d	223.4c	435.4c	0.890c	1.740d

Vern:- Vernalization pla :- planting

Values within the columns or rows followed by the same small or capital letter(s) do not significantly differ from each other according to Duncan's multiple range test at 5 % level.

Weight of receptacle of early head:-

It is obvious from results shown in Table 3 that vernalization for 30 days and planting on Sept.1st showed the highest weight of receptacle in the two tested seasons in addition to those vernalized for 45 days in the second year as compared with all tested treatments. On the other hand, the lowest values were detected to those plants planted early (Aug.15th) with or without vernalization in the two experimental years. This increase in average receptacle weight due to plants vernalized for 30 days and planted on Sept.1st and those planted in Sept1st after vernalizing the plants for 45 days in the second season may be due to the low number of heads / plant as shown in Table 2 produced from the late planting. Such results agree with those of Pesti *et al* (2004), Abd El-Hamid *et al* (2008) and Chun *et al* (2013).

Receptacle diameter of early head:-

Data in Table 3 show clearly that stumps vernalized for 30 days and planted in Sept. 1st gave significantly the highest values of receptacle diameter in addition to those vernalized for 45days or non-vernalized and planted in Sept.1st Also these results may be due to the low number of heads / plant produced from late planting (Sept. 1st). Such results agree with those of Pesti *et al* (2004), Abd El-Hamiad *et al* (2008) and Chun *et al* (2013).

Average weight of early head.

Results in Table 3 clearly indicate that there were significant increment in weight of inflorescence in plants vernalized for 30 days then planted on Aug.15th and those vernalized for 45days and planted on August 15th or on Sept.1st as compared with the other tested treatments. This increment may be due to long vernalization period (45days) when planting late (Sept.1st) or early planting (Aug.15th) combined with 30 days of vernalization period. Our results agree with those of Anusuya *et al* (2000), Pesti *et al* (2004), Abd El-Hamid *et al* (2008) and Chun *et al* (2013)who reported that vernalization enhanced early and total yield.

Average diameter of early head.

Date presented in Table 3 show that head diameter increased in plants vernalized for 30 or 45 days then planted early in Aug 15th in the first season as well as plants received 30 days of vernalization and those non vernalized and planted also in the Aug 15th in the second season. Such results are true with those of Pesti *et al* (2004) and Morteza *et al* (2013) who found that early planting increase head diameter of globe artichoke.

Table 3 : Influence of vernalization period and planting date on average weight and diameter of receptacle and head for early heads during 2012/2013 and 2013/2014 seasons.

Treatments	Weight of receptacle(g)		Diameter of receptacle(cm)		Weight of early head (g)		Diameter of early head (cm)	
	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Ver. For 30 days + pla. at Aug.15 th	44.68c	32.42d	5.40c	4.64c	273.4a	258.1a	8.28ab	7.18ab
Ver. for 30 days+ pla. at Sept.1 st	77.04a	55.65a	6.41a	5.87a	244.0b	207.0b	8.08bc	6.91b
Ver. for 45days + pla. at Aug.15 th	46.40c	44.40c	5.50c	5.10b	280.7a	266.1a	8.49a	6.15c
Ver. for 45 days + pla. at Sept.1 st	66.09b	58.19a	5.93b	5.77a	287.1a	266.1a	8.10bc	5.78d
Control planting at Aug.15 th	42.95c	32.38d	5.40c	4.58c	235.6b	214.7b	7.80c	7.43a
Control planting at Sept.1 st	68.28b	50.84b	5.93b	5.76a	223.9b	208.2b	7.90bc	5.39e

Vern:- Vernalization pla :- planting

Values within the columns or rows followed by the same small or capital letter(s) do not significantly differ from each other according to Duncan's multiple range test at 5 % level.

4- Total yield and its components.

Number of total head yield.

It is clear from results presented in Table 4 that vernalization increased significantly the number of total flower heads / plant and/feddan, whereas plants planted in the two different planting dates without vernalization showed the lowest

total yield/plant and feddan. However plants received vernalization for 30 days and planted on Sept. 1st gave the highest number of total yield / plant and per feddan in the two tested years as found by Anusury *et al* (2000) in addition to those vernalized for 45days then planted on Aug.15th as reported by Pesti *et al* (2004) and Morteza *et al* (2013). Similar results were obtained by Salisbury and Ross(1999) and Stella and Cointry(2010).

Weight of total yield / plant:-

Data in Table 4 show clearly that plants vernalized for 45 days then planted in Aug. 15th produced the highest significant total yield /plants in the two tested years in addition to those vernalized for 30 days and planted in Aug. 15th or Sept.1st. Our results are in agreement with those of Anusuya *et al* (2000), Pesti *et al* (2006), Abd El-Hamid *et al* (2008) and Chun *et al* (2013). Similar results were obtained by Salisbury and Ross (1999) and Stella and Cointry (2010).

Table 4: Influence of vernalization period and planting date on number and weight of total heads /during 2012/2013 and 2013/2014 seasons.

Treatments	Number of total heads /plant		Number of total heads/feedan		Weight of total Heads / plant (kg)	
	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Ver. For 30 days + pla. at Aug.15 th	17.58b	12.83ab	70333c	51320c	6.53b	3.67ab
Ver. for 30 days+ pla. at Sept.1 st	20.56a	13.78a	82227a	55107a	5.69b	4.27a
Ver. for 45days + pla. at Aug.15 th	19.33a	13.67ab	77333b	54660b	8.22a	4.25a
Ver. for 45 days + pla. at Sept.1 st	17.56b	11.84b	70227d	47336d	5.50b	3.47b
Control planting at Aug.15 th	11.02c	9.19c	77067f	36773e	2.81d	2.04d
Control planting at Sept.1 st	11.27c	9.12c	45067e	36467f	4.07c	2.71c

Vern:- Vernalization pla :- planting

Values within the columns or rows followed by the same small or capital letter(s) do not significantly differ from each other according to Duncan’s multiple range test at 5 % level.

Average head weight in total yield.

Average head weight increased significantly with vernalization and early planting (15th Aug) than early planting only (control) in the two tested seasons Moreover, non vernalized late plants (Sept.1st) resulted in the lowest significant values of early flower head weight. The results are in agreement with those of El-Abagy (1993) and Abd El-Hamied *et al* (2008)

Average receptacle diameter in total yield.

It is clear from results presented in (Table 5) that diameter of early heads increased significantly in early plantings (Aug.15th) with or without vernalization of the stumps before planting . There results may be due to the low number of early flowers on plant as found by Mouromical and Ierma(1995).

Average head weight in total yield :-

Non vernalized plants in the first season gave the highest values of average flower weight in total yield while in the second season, the highest values in average flower weight were detected to plants vernalized for 30 days and planted on Aug. 15th or Sept. 1st as well as those vernalized for 45 days and planted on Sept.1st Table 5. In this respect, the lowest values of average head weight were detected to plants vernalized for 45 days and planted on Aug.15th and those non vernalized and planted on Aug.15th in the first and second seasons respectively.

Average head diameter in total yield.

Data in reported by Table 5 indicate that late planting showed significant decrement in the diameter of flower heads regardless such plants were vernalized or not vernalized .Such decrement in diameter of head may be due to the high number of heads produced by late planting than those of early planting as reported by Elia *et al* (1991), Pestie *et al* (2004) and Morteza *et al* (2013).

Table 5: Influence of vernalization period and planting date on average head and receptacle weight and diameter of total yield during 2012/2013 and 2013/2014 seasons.

Treatments	Average head weight in total yield (g)		Average head diameter in total yield (cm)		Average receptacle weight in total yield (g)		Average receptacle diameter in total yield (cm)	
	2012 2013	2013 2014	2012 2013	2013 2014	2012 2013	2013 2014	2012 2013	2013 2014
Ver. For 30 days + pla. at Aug.15 th	371.0a	311.4a	7.50a	6.48bc	109.6b	95.32a	6.17ab	5.50bc
Ver. for 30 days+ pla. at Sept.1 st	276.5b	310.7a	6.17b	6.83ab	107.8b	91.21a	5.32c	5.91ab
Ver. for 45days + pla. at Aug.15 th	389.6a	317.9a	7.90a	7.13a	95.29c	80.05b	7.00a	6.11a
Ver. for 45 days + pla. at Sept.1 st	236.4c	263.3b	6.14b	6.23c	104.6b	92.44a	5.27c	5.22c
Control planting at Aug.15 th	299.5b	273.6b	7.47a	6.58bc	79.36d	68.22c	6.38b	5.84ab
Control planting at Sept.1 st	230.1c	224.9c	6.55b	5.24d	121.1a	82.63b	5.23c	5.43bc

Vern:- Vernalization pla :- planting

Values within the columns or rows followed by the same small or capital letter(s) do not significantly differ from each other according to Duncan's multiple range test at 5 % level.

5. Dry mater of head and Inulin contents in heads:-

As for dry mater contents ,results in Table 6 show clearly that stumps vernalized for 30 days and planted on August 15th gave plants with the highest significant head dry mater content as compared with all other tested treatments. On the other side, all plants planted on September 1st showed

significant decrease in head dry mater content regardless vernalization process. Such results could be due to the high vegetative growth produced from early planting which reflects the high values of dry mater of those early planting than those of late ones . Regarding inulin content in receptacle of early heads data in Table 6 indicate that vernlization for 45 days and planting in Aug.15th in the two tested seasons in addition to those vernalized for 45 days and planted in Sept.1st as well as those non vernalized and planted also in Aug 15th in the second season gave the highest significant values of inulin content in early flower heads. Concerning Inulin contents in heads of total yield, data in Table 6 show that the lowest significant values were detected to plants vernalized for 30 days and planted in Sept. 1st in the two experimental years in addition to those control plants planted in Aug. 15th in the second season. However all other tested treatments exhibited higher values as compared with the above mentioned treatments.

Table 6 : Influence of vernalization period and planting date on head dry mater and inulin% during 2012/2013 and 2013/2 014 seasons.

Treatments	Dray mater/ head (g)		Inulin% in early yield		Inulin % in total yield	
	2012 2013	2013 2014	2012 2013	2013 2014	2012 2013	2013 2014
Ver. For 30 days + pla. at Aug.15 th	25.79a	20.93a	2.11b	1.49b	1.83a	1.84ab
Ver. for 30 days+ pla. at Sept.1 st	16.27bc	11.68c	1.31d	1.68b	1.08b	1.21d
Ver. for 45 days + pla. at Aug.15 th	18.21b	15.89b	2.89a	2.42a	1.77a	2.08a
Ver. for 45 days + pla. at Sept.1 st	13.58d	12.20c	2.17b	2.57a	1.53a	1.59c
Control planting at Aug.15 th	18.02b	16.79b	1.84bc	1.54b	1.52a	1.40cd
Control planting at Sept.1 st	15.11cd	12.53c	1.62cd	1.44a	1.49a	1.82ab

Vern: Vernalization pla :- planting

Values within the columns or rows followed by the same small or capital letter(s) do not significantly differ from each other according to Duncan's multiple range test at 5 % level.

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تأثير فترات الكمر البارد وميعاد الزراعة علي نسبة النجاح والتكبير ومكونات المحصول في الخرشوف

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اجريت هذه الدراسة في محطة بحوث البساتين بالقناطر الخيرية – محافظة القليوبية خلال موسمي ٢٠١٢/٢٠١٣ و ٢٠١٣/٢٠١٤ لبحث تأثير التداخل بين فترتين تبريد لتقاوي (السيقان القديمه) للخرشوف وهما ٣٠ و ٤٥ يوم قبل الزراعة في الثلجة علي درجة حرارة من ٥ م ورطوبة نسبية قدرها من ٨٥ % ثم الزراعة في ميعادين هما منتصف اغسطس واول سبتمبر بالاضافة الي الزراعة بدون تبريد في الميعادين (كنترول) وكان تصميم التجربه في قطاعات كاملة العشوائية بثلاث مكررات .

اوضحت النتائج ان اعلى نسبة نجاح للنباتات في الحقل بعد الزراعة تم الحصول عليها من معاملات الكمر البارد لمدة ٣٠ او ٤٥ يوم ثم الزراعة في اول سبتمبر بينما كانت اقل نسبة نجاح في النباتات التي لم تبرد وزرعت مبكرا في منتصف اغسطس وأدى الكمر البارد لمدة ٣٠ يوم قبل الزراعة في اول سبتمبر الي زيادة معنوية في عدد الاوراق / نبات ونسبة المادة الجافة في النوره وعموما زاد عدد النورات المبكرة /للنبات والفدان زيادة معنويه بالكمر البارد عن تلك التي زرعت بدون تبريد في ميعادى الزراعة .

وتوضح النتائج أيضا ان الكمر البارد لمدة ٣٠ يوم ثم الزراعة في اول سبتمبر ادى الي زيادة معنوية في كلا من المحصول المبكر والكلبي للنبات والفدان ومتوسط وزن وقطر التخت للنورات المبكره في موسمي الدراسة. وقد ادى الكمر البارد لمدة ٤٥ يوم ثم الزراعة في منتصف اغسطس الي زيادة معنوية في المحصول الكلي ومحتوى النورات من الانبولىين وعموما ادت الزراعة المتأخرة (اول سبتمبر) الي نقص قطر النورات الناتجة بغض النظر عن الكمر البارد قبل الزراعة.

توصى الدراسة بمعاملة الكمر البارد لتقاوي الخرشوف لمدة شهر علي درجة ٥م ورطوبة نسبيه ٨٥% في طبقات من البيت موس قبل الزراعة المبكرة في منتصف اغسطس لاهميتة في تحسين نسبة البقاء والمحصول المبكر والكلبي ومواصفات النورات ونسبة سكر الانبولىين بها.