J. Agric. Sci. Mansoura Univ., 28(1): 493 - 512, 2003

EFFECT OF CULTIVAR AND POTASSIUM FERTILIZATION RATE ON TOTAL YIELD, CHEMICAL CONSTITUENT AND STORABILITY OF JERUSALEM ARTICHOKE TUBERS

Tawfik[1], A. A.; R. S. Bekhit[2], M. R. Emara[1], A. H. Khereba[2] and Z. A. El-Sharkawy[1]

[1]Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

[2]Vegetable Crops Department, Faculty of Agriculture, Cairo University, Giza, Egypt.

ABSTRACT

The interactive effect of potassium application rate and Jerusalem artichoke Local and Fuseau cultivars on plant growth, tuber yield, tuber chemical constituent and storability was studied during 1995 and 1996. Potassium levels of 24, 48 and 72 kg K_2O. Fed^{-1} were used in both years. In addition, 96 kg K_2O. Fed $^{-1}$ was investigated during 1996. Local cultivar showed higher foliage FW than Fuseau, in contrast to plant height. Local cultivar growth parameters responded positively with the increased levels of potassium application up to 96 kg K_2O. Fed^{-1}, during 1996. Tuber yield of the Fuseau cultivar was 50 and 27% higher than that of the Local one, during 1995 and 1996, respectively.

The respective increases in tuber dry matter of Local cultivar than Fuseau were 1.5 and 3%, respectively. At 180 DAP, the highest potassium rate during 1995 and 1996 significantly ($P \leq 0.05$) enhanced tuber yield and dry matter, than other rates. Results also indicated that Local cultivar tuber yield increased as potassium level was elevated from 24 to 48 and 72 kg K_2O. Fed^{-1} as compared with Fuseau, during 1995. In contrast to inulin content, Local cultivar tubers showed greater total carbohydrate and total protein than those of Fuseau.

The application of 96 kg K_2O. Fed^{-1} increased tuber inulin and total carbohydrate, whereas that of 24 kg K_2O. Fed^{-1} enhanced total protein only. In contrast to tuber protein, inulin and total carbohydrate were increased as harvest was delayed to 180 DAP.

As storage period was prolonged, percentage of sprouted tubers, decay loss, weight loss and total weight loss were increased. In contrast to room temperature (24°C), tuber sprouting, weight loss and total weight loss were retarded under cold storage (10°C). Heedless of storage conditions, Local cultivar showed higher percentage of sprouted tubers and different losses than Fuseau. On the contrary to those of 96 kg K_2O. Fed^{-1}, tubers of 24 kg K_2O. Fed^{-1} exhibited higher sprouting but lower percentage of different losses.

Tubers stored with moistened peat moss, under room temperature, demonstrated higher percentage of sprouted tubers but lower decay, weight and total weight loss than their corresponding without peat moss. Under cold storage, tubers stored with moistened peat moss in polyethylene bags displayed lower decay, weight and total weight loss than those with peat moss in carton boxes. For fresh market, it is recommended to apply 96 kg K_2O. Fed^{-1}, to enhance tuber yield and quality. If tubers have to be stored for a period of time, it is advisable to use Fuseau tubers of 48 kg K_2O. Fed^{-1} packed in polyethylene bags with moistened peat moss and stored at 10°C cold storage.

Keywords*:* Jerusalem artichoke, *Helianthus tuberosus* L., Potassium, Storage.

INTRODUCTION

Jerusalem artichoke (*Helianthus tuberosus* L.) is a non-traditional tuberous crop recently introduced to Egypt for its high nutritional and medicinal values. The tubers are known with its high content of fructose (Spitters, 1987) that made the crop one of the sugar crops (Zonin, 1987). In addition, the tubers contain 8-18% carbohydrates with high inulin content (Khereba, 1979) and about 9 g proteins. $100g^{-1}$ FW (Mansour *et al.*, 2001). Therefore, promising directions for the use of Jerusalem artichoke in food industry are expected. The crop also produces a large top growth that can be used as an animal fodder and as a source of protein production.

Potassium is one of the important macro-elements that plays major physiological and biochemical roles in plant growth (Beringer *et al.*, 1990). Potassium application has been shown to improve vegetative growth, yield and quality of the Jerusalem artichoke Local and Fuseau cultivars, under Egyptian conditions (Mansour *et al.*, 2001). Moreover, the element was shown to influence tuber inulin content (Mansour *et al.*, 2001) and to enhance photosynthate transport from leaves to other plant parts (Nelson, 1970). In potatoes, potassium was reported by El-Gamal (1980) to improve storability of tubers, even under ambient temperature storage conditions.

One of the problems associated with storage of Jerusalem artichoke at ambient temperatures is tuber shrinkage, deterioration, and loss of quality shortly after harvest (Tindall, 1986). When stored at 0°C and 90-95% RH, tubers may successfully be reserved for 90 to 150 days without major losses. The use of polyethylene bags or storage containers with polyethylene wrapping reduced weight loss and shrinkage of tubers allowing for longer period of storage (Stepanets *et al.*, 1992). Likewise, moistened peat moss is mixed with immature tubers to lessen water loss and shrinkage and maintain good appearance of exported potatoes.

The objective of the present work, therefore, was to study the interactive effect of cultivar and potassium fertilization level on plant growth, tuber yield and chemical constituent of tubers. Moreover, to investigate the effect of cultivar, potassium level during growth and type of storage container on the keeping quality of tubers, under room temperature and cold storage conditions.

MATERIALS AND METHODS

The present study was conducted during summer seasons of 1995 and 1996 using Local and imported cultivars of Jerusalem artichoke (*Helianthus tuberosus*, L.). The Department of vegetable crops, Faculty of Agriculture, Cairo University, Egypt, supplied the Local cultivar, while Fuseau was imported from the United Kingdom by the Horticulture Research Institute, Agricultural Research Center, Egypt. Tubers of the Local cultivar are irregular with yellow skin and white flesh, whereas those of the Fuseau are spindle with white-yellow skin and yellow flesh. Field experiments were carried out at the Barrage Horticulture Research Station, Ministry of Agriculture.

Soil physical analysis revealed that the experimental soil contained 31.5% clay, 22.7% silt, 41% fine sand and 1.35% coarse sand. Chemical analysis resulted in a pH of 7.5 and 7.4, total N (%) of 0.12 and 0.10, available N (ppm) of 38 and 35, available P_2O_5 (ppm) of 6.6 and 6.9 and available K_2O (ppm) of 75 and 78, during 1995 and 1996, respectively.

Tubers were planted in rows of 1 m width and 0.5 m plant distance within the row on May 27th and May 12th of 1995 and 1996 summer seasons, respectively. The area of each sub-plot (experimental unit) was 45 m^2 comprising 9 rows; each of 5 m in length. Tuber yield was determined using the middle five rows (25 m^2) of each experimental unit while the other 4 rows (20 m^2) were assigned to measure different growth parameters.

All experimental units received identical levels of nitrogen and phosphorus fertilizers. Calcium super phosphate (15% P_2O_5) was base dressed during soil preparation with a rate of 150 kg per Feddan (22.5 kg P_2O_5. Fed^{-1}). Ammonium sulfate (20.6% N) was used as nitrogen source where 200 kg per Feddan (41.2 kg N. Fed^{-1}) were equally divided and side-dressed at 30 and 60 days after planting (DAP). For conversion, one Feddan (Fed.) is equivalent to o.42 ha.

Levels of potassium (K) fertilization under the study were 24, 48 and 72 kg K_2O. Fed^{-1} applied as sulfate of potash (48% K_2O) during 1995 and 1996 summer seasons. An additional level of 96 Kg K_2O. Fed^{-1} was investigated during 1996 season using the same type of fertilizer. Each potassium level was equally divided and side dressed at 30 and 60 DAP. The experimental design was a split plot with three replications, in both years. The Local and Fuseau cultivars resembled the main plots, while potassium levels represented the sub-ones.

At 120 DAP, three plants from each experimental unit were randomly selected to calculate fresh weight (FW) of foliage and plant height. At harvest (180 DAP), fresh weight of tubers (t. Fed^{-1}) was determined. Percentage of tuber dry matter (DM) was found out after harvest where tubers were washed with distilled water, dried at ambient temperature, grated, weighed and oven-dried at 105^{o}C for 24 hr.

Tuber concentration of inulin (Whistler, 1962), total carbohydrate (Montgomery, 1961) and total protein (Pregl, 1945) were determined following oven-dry at 65-70^{o}C for 48 h in an air-forced ventilated oven, at 120, 150 and 180 DAP.

During 1996, the storage experiment was conducted to study the effect of cultivars, different potassium levels applied during growth and type of storage container on percentage of sprouted tubers, decay loss, weight loss and total weight loss, under room temperature (Average of 24^{o}C) and cold storage (10^{o}C and 85% RH) conditions. Percentage of sprouted tubers was recorded at two weeks interval starting at 15 and 75 days of storage at room temperature and cold storage, respectively.

Percentage of decay, weight and total weight losses were calculated starting at 15 days of storage with two weeks interval, and at 30 days with one month interval, for room temperature and cold storage conditions, respectively. Polyethylene bags and carton boxes with and without moistened peat moss were used to study the effect of storage containers on different losses.

Tubers used to study the effect of cultivars and potassium levels were placed in wide-mesh cotton sacks.

Tuber samples of 30 kg representing each treatment, under the study, were equally divided into two parts and each was placed under room temperature and cold storage (10°C) conditions. Furthermore, every part was split into three replications; each of five kg of tubers. The storage period lasted 60 and 150 days for room temperature and cold storage studies, respectively.

Data were statistically analyzed according to Snedecor and Cochran (1980), where the least significant difference (LSD) at $P \leq 0.05$ was employed to test the treatment means.

RESULTS AND DISCUSSION

Fresh weight of foliage

During 1995, foliage fresh weight of the Local cultivar was 34% significantly ($P \leq 0.05$) higher than that of Fuseau indicating a wide range of variation on growth between the two cultivars, regardless of the potassium level (Table 1). Differences in FW of foliage could be due to higher adaptation of the Local cultivar to the Egyptian environmental conditions as compared with Fuseau. Similar conclusion was pointed out by Hamed (2001).

At 120 DAP, plants fertilized with 72 kg K_2O. Fed^{-1} had 54 and 52% higher foliage FW than those of 48 kg K_2O. Fed^{-1}, during 1995 and 1996 studies, respectively. Similar positive effect of high potassium rate on FW of potato foliage were reported (Tawfik, 2001).

The interaction between rate of potassium and cultivars was significant ($P \leq 0.05$), in 1996, indicating that application of 24, 48 and 72 kg K_2O. Fed^{-1} increased foliage FW of Fuseau plants by 24, 3.5 and 40% as compared with Local ones (Table 1), respectively. However, the application of 96 kg K_2O. Fed^{-1} significantly diminished foliage FW of Fuseau by 30% in comparison to the Local cultivar.

Plant height

In general, plant height of Fuseau cultivar surpassed that of the Local by 6 and 4% , during 1995 and 1996 (Table 1), respectively. However, differences were only significant ($P \leq 0.05$) during 1996 study. Measurements of plant height in the present study were within the 28-350 cm range that previously reported by Khereba (1979) for Jerusalem artichoke clones evaluated in Egypt.

Regardless of cultivars, stimulation of plant height was positively influenced by rate of potassium application (Table 1). In 1995, soil application of 48 and 72 kg K_2O. Fed^{-1} significantly increased plant height by 14 and 15% as compared with 24 kg K_2O. Fed^{-1}, respectively. In 1996, plants subjected to 48 kg K_2O. Fed^{-1} showed 7% more plant height than those of 24 kg K_2O. Fed^{-1}. Similarly, soil application of 72 kg K_2O. Fed^{-1} elevated plant height by 8 and 16% over that of 48 and 24 kg K_2O. Fed^{-1}, respectively. In addition, plants treated with 96 kg K_2O. Fed^{-1} showed 11, 20 and 29% more plant height than those fertilized with 72, 48 and 24 kg K_2O. Fed^{-1}, respectively. Similar results were reported by Mansour et al (2001) where plant height of Jerusalem artichoke cultivars was increased as potassium application rate was elevated from 24 to 48 or 96 kg K_2O. Fed^{-1}.

The effect of interaction between potassium application rate and cultivars on plant height was significant during 1996 only indicating that plant height of the Local cultivar was significantly stimulated as rate of potassium fertilization elevated from 24 to 48, 72 and 96 kg K_2O. Fed^{-1}.

Table 1: Interactive effect of Jerusalem artichoke cultivars and potassium level on fresh weight of foliage (kg. $plant^{-1}$) and plant height (cm) at 120 days after planting during 1995 and 1996.

		FW of foliage (Kg)					Plant height (cm)				
	Cultivar	Potassium level (kg K_2O. Fed^{-1})					Potassium level (kg K_2O. Fed^{-1})				
		24	48	72	96	Mean	24	48	72	96	Mean
1995	Fuseau	2.23	1.70	2.88	---	2.27	154.00	188.00	195.00	---	179.00
	Local	3.07	2.48	3.57	---	3.04	163.00	174.00	170.00	---	169.00
Mean		2.65	2.09	3.23			158.50	181.00	182.50		
1996	Fuseau	3.53	5.10	8.73	4.87	5.56	235.00	215.00	233.33	265.00	237.08
	Local	2.83	4.93	6.20	7.00	5.24	175.67	225.67	241.67	265.33	227.08
Mean		3.18	5.02	7.66	5.93		205.33	220.33	238.50	265.17	

LSD $_{\leq 0.05}$:	FW of foliage		Plant height	
	1995	1996	1995	1996
Cultivars	0.19	NS	NS	4.15
K_2O level	0.78	0.80	13.74	8.32
K_2O level at the same cultivar	NS	1.14	NS	11.77
Cultivar at the same K_2O level	NS	1.15	NS	8.63

Total yield of tubers

Tuber yield (180 DAP) of Jerusalem artichoke cultivars was not significant ($P \leq 0.05$), in both years (Table 2). However, productivity of Fuseau cultivar surpassed that of the Local by 50 and 27%, during 1995 and 1996, respectively. Total yield of Fuseau cultivar was 45.9 and 41.5, while that of the Local reached 30.6 and 32.6 t. Fed^{-1}, during 1995 and 1996, respectively. Opposite results were indicated by Hamed (2001). This could be related to the differences in the prevailing environmental conditions at the time of each study.

Also, differences in productivity between the Local and Fuseau cultivars could be explained based on the genetic differences between the two cultivars. Similar findings among Jerusalem artichoke cultivars and clones had been previously reported by Khereba (1979) and Spitters (1987).

The increase of potassium application rate to 48 and 72 kg K_2O. Fed^{-1} during 1995, and to 96 kg K_2O. Fed^{-1} in 1996 significantly ($P \leq 0.05$) increased total yield of tubers at harvest (Table 2). In 1995, plants fertilized with 48 kg K_2O. Fed^{-1} had 15% higher tuber yield than those treated with 24 kg K_2O. Fed^{-1}. When potassium rate was elevated to 72 kg K_2O. Fed^{-1}, total yield was correspondingly enhanced by 14 and 32% as compared with 24 and 48 kg K_2O. Fed^{-1}, respectively. In 1996, the application of 72 kg K_2O. Fed^{-1} increased tuber yield by 20 and 25% as compared with 24 and 48 kg K_2O. Fed^{-1}, respectively.

Plants fertilized with 96 kg K_2O. Fed^{-1} produced 66, 59 and 32% higher tuber yield than those of 24, 48 and 72 kg K_2O. Fed^{-1}, respectively. Our results reflected the importance of potassium fertilization level to obtain high tuber yield of Jerusalem artichoke (Soja *et al.*, 1990). In the present investigation, soil analysis revealed low available K concentration (75-78 ppm). Therefore, soil application with high K rate probably increased soil exchangeable K (Mercik, 1989) and, consequently, stimulated phloem loading and translocation of assimilates to tubers (Beringer *et al.*, 1990). Hence, physiological processes such as stomatal regulation and photosynthesis (Marschner, 1986) as well as carbohydrate synthesis and translocation (Nelson, 1970) were ideally performed resulting in high tuber yield as indicated in Table (2). The present findings, in this regard, agreed with those of Tawfik (2001) on potatoes.

Table 2:Interactive effect of Jerusalem artichoke cultivars and potassium level on total yield of tubers (t. Fed^{-1}) and tuber dry matter (%) at 180 days after planting during 1995 and 1996.

		Total tuber yield(t. Fed^{-1})					Dry matter of tubers (%)				
	Cultivar	Potassium level (kg K_2O. fed^{-1})					Potassium level (kg K_2O. fed^{-1})				
		24	48	72	96	Mean	24	48	72	96	Mean
1995	Fuseau	44.19	45.41	48.21	---	45.94	21.10	29.16	31.88	---	27.38
	Local	21.79	30.85	39.09	---	30.58	24.89	26.10	26.54	---	25.84
Mean		32.99	38.13	43.65			22.99	27.63	29.21		
1996	Fuseau	33.92	34.56	42.21	55.36	41.51	24.55	26.24	26.96	30.77	27.13
	Local	25.75	27.87	32.85	43.87	32.59	21.63	22.91	23.66	28.19	24.10
Mean		29.84	31.21	37.53	49.62		23.08	24.57	25.13	29.48	

$LSD_{\leq 0.05}$:	Yield (t. Fed^{-1})		Tuber DM%	
	1995	1996	1995	1996
Cultivars	NS	NS	0.60	0.93
K_2O level	3.09	3.50	1.32	1.07
K_2O level at the same cultivar	4.37	NS	1.60	NS
Cultivar at the same K_2O level	9.47	NS	1.45	NS

In 1995, the interaction between rate of potassium and Jerusalem artichoke cultivars was significant indicating that tuber yield of the Local cultivar was increased as potassium fertilizer elevated from 24 to 48 and 72 kg K_2O. Fed^{-1} (Table 2). In this regard, Local plants received 48 kg K_2O. Fed^{-1} had 42% more tuber yield than those of 24 kg K_2O. Fed^{-1}. Moreover, the productivity of plants subjected to 72 kg

K_2O. Fed^{-1} were 79 and 26% higher than that when 24 and 48 kg K_2O. Fed^{-1} were applied, respectively. Differences between the response of the Local and Fuseau cultivars to the increasing rate of potassium fertilization could be due to the higher productivity of Fuseau cultivar (Table 2) that was observed under all levels of potassium than Local one.

Percentage of tuber dry matter

Fuseau cultivar produced tubers with significantly ($P \leq 0.05$) higher percentage of DM than Local one, in both years, (Table 2). Dry matter of Fuseau tubers were 27.38 and 27.13% in comparison to 25.84 and 24.1% for the Local one, during 1995 and 1996, respectively. Differences in tuber DM might be due to genetic differences among Jerusalem artichoke cultivars (Zubr *et al.*, 1993, Joshi *et al.*, 1994 and Mansour *et al.*, 2001).

Results indicated a significant increase of tuber DM percentage as potassium level elevated to 72 kg K_2O. Fed^{-1}, in 1995, and 96 kg K_2O. Fed^{-1}, during 1996, (Table 2). In 1995, the increase of potassium application from 24 to 48 and 72 kg K_2O. Fed^{-1} resulted in 4.6 and 6.2% higher tuber DM, respectively. The corresponding increases as potassium rate elevated from 24 to 48, 72 and 96 kg K_2O. Fed^{-1}, during 1996, were 1.5, 2.1 and 6.4%, respectively. Plants received 96 kg K_2O. Fed^{-1} had 4.9 and 4.4% higher tuber DM than those of 48 and 72 kg K_2O. Fed^{-1}, respectively. The positive effect of high rate of potassium on tuber DM might be attributed to the role of potassium in assimilation and translocation of carbohydrates as well as their conversion into starch (Nelson, 1970). Similar potassium promoting effects of Jerusalem artichoke tuber DM were previously reported by Soja *et al.* (1990), Zubr *et al.* (1993), Joshi *et al.* (1994) and Mansour *et al.* (2001).

Results also indicated that the interaction effect between potassium rate and cultivars on tuber DM was significant during 1995 (Table 2). Increasing potassium level from 24 to 48 and 72 kg K_2O. Fed^{-1} elevated tuber DM of Fuseau cultivar by 8 and 10.8%, respectively. Moreover, Fuseau plants fertilized with 72 kg K_2O. Fed^{-1} had 2.7% higher tuber DM than those of 48 kg K_2O. Fed^{-1}, during 1995 study. On the other hand, tuber dry matter of the Local cultivar significantly ($P \leq 0.05$) enhanced by the application of 72 kg K_2O. Fed^{-1} where those of 24 and 48 kg K_2O. Fed^{-1} showed comparable tuber DM. In addition, Local cultivar responded better than Fuseau to the 24 kg K_2O. Fed^{-1} potassium level where 3.8% higher DM was produced. On the contrary, higher levels of potassium application, i.e., 48 and 72 kg K_2O. Fed^{-1} favored tuber DM production and accumulation of the Fuseau cultivar where 3.1 and 5.3% more DM were formed as compared with the Local one (Table 2), respectively.

Inulin content of tubers

Regardless treatments, percentage of tuber inulin was progressively increased as time of harvest was delayed from 120 to 150 and 180 DAP for both cultivars, (Fig. 1A). Fuseau tubers harvested at 150 and 180 DAP showed 1.4 and 3.2% higher inulin than those harvested at 120 DAP, respectively. The corresponding increases of Local cultivar tuber inulin were 1.2 and 2.6%, respectively. Results also indicated that Fuseau tubers contained 0.5, 0.7 and 1.1% higher inulin than Local ones, at 120, 150 and 180 DAP (Fig. 1A), respectively. However, differences between the two cultivars were not significant ($P \leq 0.05$) as previously reported (Hamed, 2001).

Data revealed a positive effect of potassium level on percentage of tuber inulin (Fig. 1B). Results indicated that the application of 96 kg K_2O. Fed^{-1} showed the highest percentage of tuber inulin at all sampling dates, in contrast to 24 kg K_2O. Fed^{-1}. The highest range of differences, however, was observed at 180 DAP. In this respect, the application of 96 kg K_2O. Fed^{-1} resulted in 4.9, 3.5 and 2.6% higher tuber inulin as compared with 24, 48 and 72 kg K_2O. Fed^{-1}, respectively.

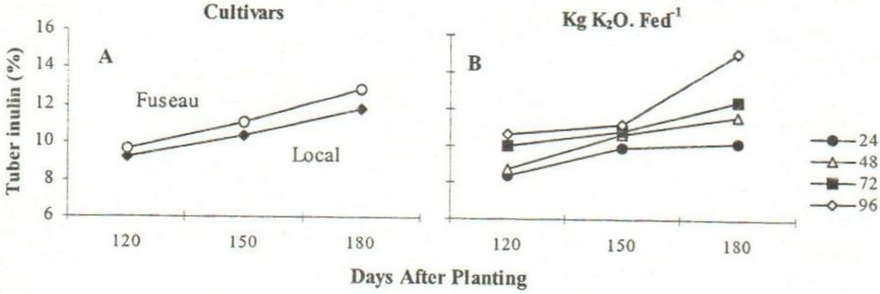

Figure 1: Effect of cultivar (A) and potassium application rate (B) on percentage of Jerusalem artichoke tuber inulin, at 120, 150 and 180 days after planting.

Carbohydrate content of tubers

Regardless of treatments, total tuber carbohydrate was increased as harvest was delayed (Fig. 2). In general, Local cultivar exhibited 0.9, 0.6 and.1.1% higher total carbohydrate than Fuseau, at 120, 150 and 180 DAP (Fig. 2A), respectively. The delay of harvest from 120 to 180 DAP of the Local cultivar slightly increased tuber total carbohydrate by 0.7%. The respective increase of Fuseau tuber carbohydrate was about 0.6%. The positive effect of late harvest on increasing tuber carbohydrate could be due to allowing more carbohydrate synthesis and translocation of the assimilates from the vegetative growth to tubers (Soja *et al.*, 1990). Differences of tuber total carbohydrate among Jerusalem artichoke cultivars were reported by Zubr *et al* (1993).

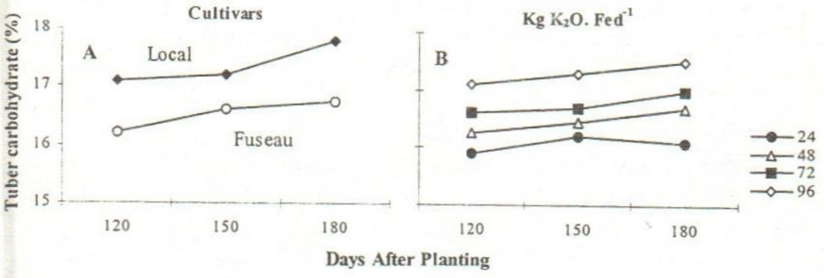

Figure 2: Effect of cultivar (A) and potassium application rate (B) on percentage of Jerusalem artichoke tuber total carbohydrate, at 120, 150 and 180 days after planting.

The increase of tuber carbohydrate as harvest was delayed from 120 to 180 DAP reached 0.2, 0.5, 0.4 and 0.4%, for 24, 48, 72 and 96 kg K_2O. Fed^{-1} (Fig. 2B), respectively. The increase of potassium rate consistently elevated tuber concentration of total carbohydrate, at 120, 150 and 180 DAP (Fig. 2B). In contrast to 24 kg K_2O. Fed^{-1}, the application of 96 kg K_2O. Fed^{-1} resulted in the highest tuber total carbohydrate. Whereas those of 48 and 72 kg K_2O. Fed^{-1} displayed intermediate values. Tubers of 96 kg K_2O. Fed^{-1} revealed 1.2, 1.1 and 1.4% higher total carbohydrate than those of 24 kg K_2O. Fed^{-1}, at 120, 150 and 180 DAP, respectively. At 180 DAP, the application of 72 and 48 kg K_2O. Fed^{-1} increased total carbohydrate of tubers by 0.9 and 0.6% as compared with 24 kg K_2O. Fed^{-1}, respectively. Similar potassium increasing effect of storage roots total carbohydrate was reported on sweetpotato by Wanas (1987).

Total protein of tubers

Regardless of cultivar and potassium treatments, percentage of tuber total protein decreased as harvest was delayed to 150 and 180 DAP (Fig. 3). Total protein of the Local tubers was declined by 0.15 and 0.27% (Fig. 3A) with the delay of harvest to 150 and .180 DAP, respectively. The corresponding reductions of Fuseau tuber total protein were 0.37 and 0.45%, respectively. Local cultivar tubers exhibited about 0.13, 0.35 and 0.31% higher total protein than Fuseau when was determined, at 120, 150 and 180 DAP, respectively.

The application of 24 kg K_2O. Fed^{-1} promoted tuber total protein as compared with the higher levels (Fig. 3B). More reduction in tuber protein of 24 and 48 than 72 and 96 kg K_2O. Fed^{-1} treatments was true, as harvest was delayed from 120 to 150 and 180 DAP (Fig. 5B). Tubers of 24 kg K_2O. Fed^{-1} showed 0.2 and 0.7% total protein reduction as harvest was delayed to 150 and 180 DAP, respectively. The corresponding protein reduction of 48 kg K_2O. Fed^{-1} tubers were 0.46 and 0.55%, respectively. At 120 DAP, the application of 24 kg K_2O. Fed^{-1} increased tuber total protein by 0.4, 0.9 and 0.9% as compared with 48, 72 and 96 kg K_2O. Fed^{-1}, respectively. The respective enhancement of tuber total protein were 0.9, 0.8 and 0.7% at 150 DAP, and 0.5, 0.4 and 0.3%, at 180 DAP (Fig. 3B), respectively.

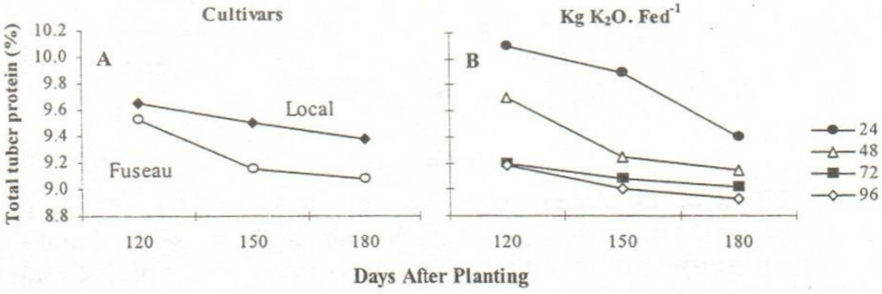

Figure 3: Effect of cultivar (A) and potassium application rate (B) on percentage of Jerusalem artichoke tuber total protein, at 120, 150 and 180 days after planting.

Tuber quality during storage

Percentage of sprouted tubers

Sprouting started for all treatments after 15 and 75 days, at room temperature and cold storage conditions (Fig. 4), respectively. That cold storage delayed sprouting compared with room temperature coincided with the findings of Modler *et al.* (1993) where sprouting of Jerusalem artichoke tubers was delayed by cold storage temperature. That sprouting was at a slower rate at cold storage than room temperature might be attributed to the low temperature retarding effect of the onset of sprouting. A tendency towards the shortening of the rest period of potato tubers as the storage temperature increased was reported by Stalin and Enzmann (1992).

The Local cultivar showed consistent higher percentage of sprouted tubers than Fuseau, regardless of storage conditions. Under room temperature (Fig. 4A), Local cultivar tubers showed 19, 32 and 59% sprouted tubers in comparison to 15, 23 and 40% for Fuseau, at 30, 45 and 60 days of storage, respectively.

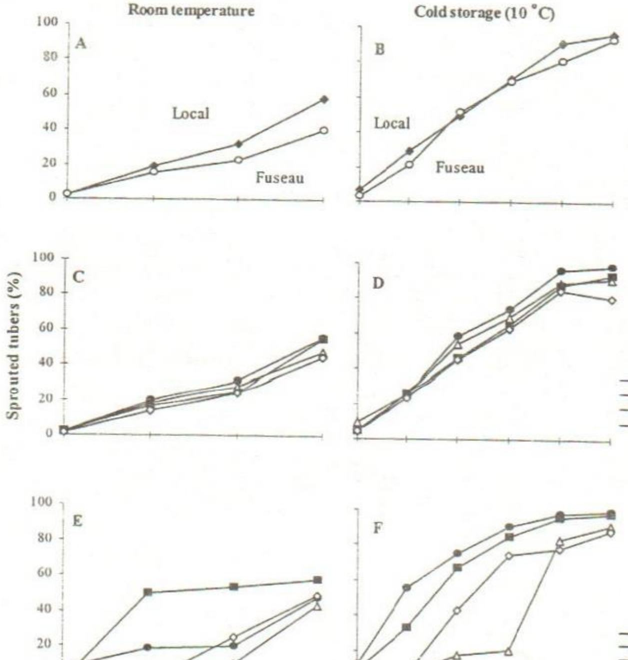

Figure 4: Effect of Jerusalem artichoke cultivar (A and B), potassium level (C and D; kg K_2O. Fed^{-1}) and storage container (E and F) on sprouting of tubers (%) under room and cold storage conditions.

Storage containers: PP: Polyethylene bags + Peat moss CP: Carton boxes + Peat moss

P : Polyethylene bags C : Carton boxes

Under cold storage (Fig. 4B), percentage of sprouted tubers for both cultivars reached about 50% at 105 days. Thereafter, percentage of Local cultivar sprouted tubers recorded 71, 91, and 96% as compared with 69, 81, and 93% for the Fuseau, at 120, 135, and 150 days, respectively.

Potassium application of 96 kg K_2O. Fed^{-1} during growth resulted in lower percentage of sprouted tubers than the lower levels, at room temperature (Fig. 4C). At the end of storage, tubers of 96 kg K_2O. Fed^{-1} exhibited 45% of sprouted tubers as compared with 55, 47 and 56% for those of 72, 48 and 24 kg K_2O. Fed^{-1}, respectively. The discourage effect of high potassium levels on tuber sprouting at room temperature might be due to the reducing amounts of tuber amino-acids and sugar content that retarded sprouting of tubers as concluded by El-Gamal (1980) on potatoes.

At cold-storage (Fig. 4D), tubers of the lowest potassium rate showed the highest percentage of sprouted tubers started at 105 until the end of storage. At 150 days, the application of 96 kg K_2O. Fed^{-1} during plant growth demonstrated the lowest percentage of sprouted tubers (80%) as compared with the lowest potassium level (99%). Potassium treatments of 48 and 72 kg K_2O.Fed^{-1} showed intermediate values of 92 and 94% of sprouted tubers (Fig. 4D), respectively.

The presence of peat moss as a storage medium markedly enhanced tuber sprouting under room temperature (Fig. 4E) and cold storage (Fig. 4F). However, at the end of the storage, all storage treatments showed comparable percentage of sprouted tubers.

Under room temperature, tubers of polyethylene bags and carton boxes without peat moss started sprouting at 30 days of storage and maintained lower percentage of sprouting than their respective with peat moss (Fig. 4E). The lowest percentage of sprouted tubers was demonstrated by polyethylene bags without peat moss during the term of storage. By using polyethylene bags, tubers stored without peat moss showed 0, 10 and 44% sprouting as compared with 19, 20 and 48% for their respective with peat moss, at 30, 45 and 60 days, respectively. When carton boxes were used, percentage of sprouted tubers without peat moss were 0, 25 and 49% as compared with 50, 53and 58% when peat moss was present, at 30, 45 and 60 days, respectively. Tubers stored with peat moss using carton boxes showed the highest percentage of sprouting, starting at 30 days of storage (Fig. 4E). In this regard, carton boxes with peat moss exhibited 31, 33 and 10% more sprouted tubers than their respective polyethylene bags, at 30, 45 and 60 days, respectively

Under cold storage, polyethylene bags and carton boxes without peat moss showed sprouted tubers at 90 days of storage (Fig. 4F). At this stage, both treatments exhibited 27 and 50% lower sprouted tubers than their respective ones with peat moss, respectively. Moreover, polyethylene bags without peat moss maintained lowest percentage of sprouted tubers at 105 and 120 days. Thereafter, tubers of polyethylene bags and carton boxes without peat moss showed comparable percentage of sprouted tubers at 135 and 150 days of storage. At 105 days, polyethylene bags without peat moss demonstrated 25, 49 and 58% less sprouted tubers than carton boxes without peat moss, carton boxes with peat moss and polyethylene bags with peat moss, respectively. The respective reduction of sprouted tubers at 120 days were 55, 65 and 70%, respectively.

Percentage of decay loss

The Fuseau cultivar showed no decay loss until 30 days of storage, in contrast to the Local one (Fig. 5A), under room temperature. The Local cultivar showed 5% higher decay loss than Fuseau at 45 days of storage. However, percentage of decayed tubers were analogous for both cultivars at the end of storage period reaching 14% (Fig. 5A).

Both cultivars showed comparable levels of decay loss during different storage periods, until 120 days of storage. Afterwards, Local cultivar recorded 4% higher decay loss than Fuseau, at the end of storage.

Level of potassium application during growth showed comparable decay loss percentage until 45 days, under room temperature (Fig. 5C). At 60 days, tubers of the 24 kg K_2O. Fed^{-1} potassium application showed 7% of decay loss as compared with 18, 11 and 14% for those of the 48, 72 and 96 kg K_2O. Fed^{-1} potassium levels, respectively.

Under cold storage (10 ^{o}C), tubers of 24 and 48 kg K_2O. Fed^{-1} exhibited no decay loss until 90 days of storage, as compared with 60 days for the other treatments (Fig. 5D). At 120 days of storage, all treatments showed comparable values of decay loss ranged from 3-5%. However, at the end of storage, tubers of 48 kg K_2O. Fed^{-1} gave the lowest decay loss (15%) where those of 96 kg K_2O. Fed^{-1} exhibited the highest values (19%).

Under room temperature, no marked differences on percentage of tuber decay loss were observed among storage container treatments until 60 days of storage (Fig. 5E). The addition of peat moss resulted in a pronounced reduction of decay loss, at 60 days of storage. In this regard, polyethylene bags and carton boxes with peat moss showed 16 and 18% less decay loss than their respective ones without peat moss (Fig. 5E), respectively. At 60 days, tubers of polyethylene bags had 3.2% decay loss, as compared with 9.5% for those of carton boxes, when peat moss was used (Fig. 5E)

At cold storage, carton boxes showed earlier tuber decay loss (at 120 days) as compared with polyethylene bags (at 150 days), regardless of peat moss usage (Fig. 5F). At 120 days, carton boxes with and without peat moss showed about 6 and 9% tuber decay loss, respectively. At the end of storage, tubers stored in polyethylene bags with and without peat moss showed comparable low decay loss. The highest percentage of decay loss (25%) was presented by carton boxes with no peat moss, at the end of the storage period.

The reduction of decay loss as moistened peat moss was added specially under room temperature conditions (Fig. 5E) was not expected, theoretically, since high water content in the presence of high temperature would encourage decay by different micro-organisms. It seems that the observed decay loss was due to deterioration and shriveling brought about by water loss through the fragile membrane (skin) of Jerusalem artichoke tubers (Zonin, 1987).

Similar trend was reported by Tindall (1986) who claimed that Jerusalem artichoke tubers rapidly shrunk and deteriorated when was kept at ambient temperature. When tubers were stored at 0 ^{o}C and a relative humidity of 90-95%, they successfully stored for 90 to 150 days without major weight loss. However, a significant loss due to decay and shriveling of tubers occurred when storage was prolonged, even when tubers were initially sound and disease free (Tindall, 1986).

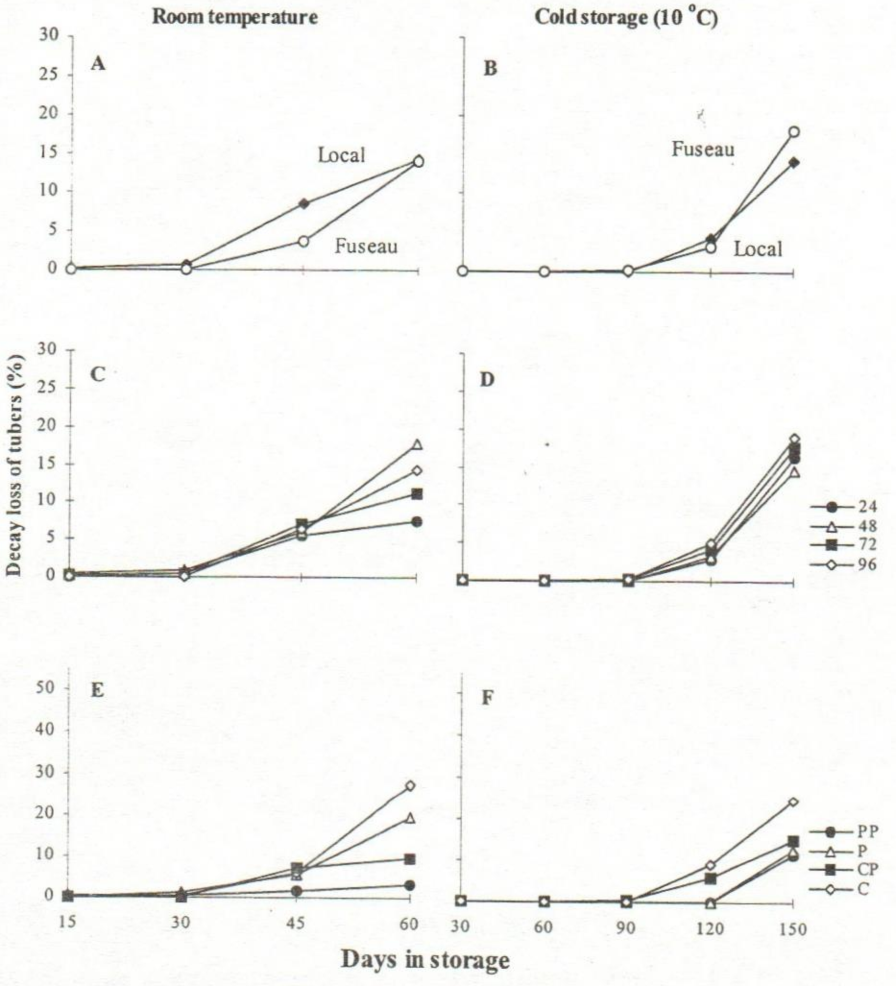

Figure 5 : Effect of Jerusalem artichoke cultivar (A and B), potassium level (C and D; kg K_2O. Fed^{-1}) and storage container (E and F) on decay loss of tubers (%) under room and cold storage conditions.

Storage containers: PP: Polyethylene bags + Peat moss CP: Carton boxes + Peat moss
P : Polyethylene bags C : Carton boxes

Percentage of weight loss

Regardless of the different treatments, increasing period of storage progressively increased percentage of weight loss (Fig. 6). Percentage of weight loss was markedly higher under room temperature than cold storage conditions, irrespective of the treatments. This is probably due to the higher higher temperature and lower relative humidity that increased evaporation, water loss and respiration rate (Bhandal and Naik, 1991), under room temperature conditions

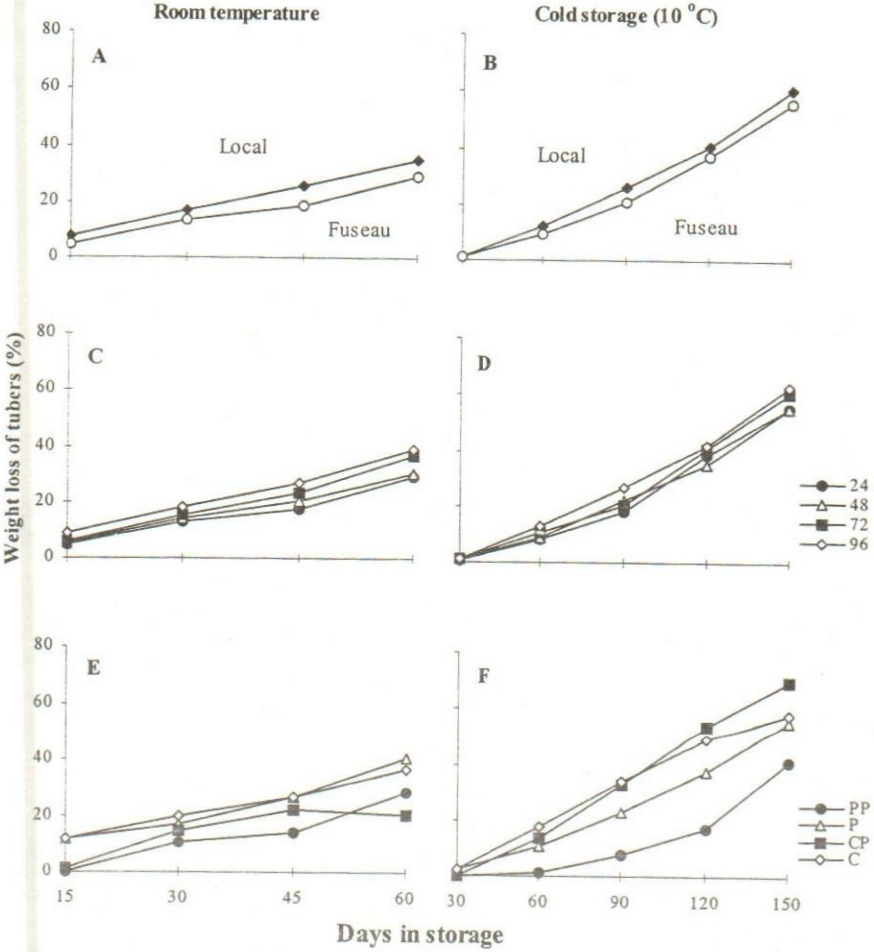

Figure 6: Effect of Jerusalem artichoke cultivar (A and B), potassium level (C and D; kg K_2O. Fed^{-1}) and storage container (E and F) on weight loss of tubers (%) under room and cold storage conditions.

Storage containers: PP: Polyethylene bags + Peat moss CP: Carton boxes + Peat moss
P : Polyethylene bags C : Carton boxes

Weight loss of the Local cultivar surpassed that of the Fuseau, at room temperature (Fig. 6A) and cold storage (Fig. 6B) conditions. Local cultivar weight loss was higher than that of the Fuseau by 2.9, 3.2, 7.3 and 6.1%, at 15, 30, 45 and 60 days of storage, under room temperature. Under cold storage, the respective higher percentage of weight loss were 3, 5.3, 3.2

Differences in weight loss between cultivars could be probably due to the higher percentage of sprouted tubers calculated for the Local cultivar than Fuseau (Fig. 4A).

Regardless of storage temperature, tubers of 24 and 48 kg K_2O. Fed^{-1} showed relatively lower percentage of weight loss, in contrast to those of 96 kg K_2O. Fed^{-1}.

Irrespective of storage containers, the use of peat moss decreased percentage of weight loss under room temperature conditions, as compared with non-peat moss treatments (Fig. 6E). The addition of peat moss to polyethylene bags reduced tuber weight loss by 11.6, 6.2, 12.9 and 12% as compared with their respective without peat moss, at 15, 30, 45 and 60 days of storage at room temperature, respectively. The corresponding reductions of tuber weight loss in carton boxes with peat moss were 10.9, 5.2, 5 and 16.6% as compared with those without peat moss, respectively.

Under cold storage, tubers stored with peat moss exhibited weight loss at 60 days of storage, in contrast to 30 days for those stored without peat moss (Fig. 6F). Heedless of peat moss, polyethylene bags showed lower tuber weight loss than carton boxes. Tubers stored in polyethylene bags with peat moss exhibited the lowest weight loss among treatments, during all storage periods. Polyethylene bags with peat moss showed 2.2, 9, 15.6, 20.5 and 14.7% lower weight loss than their respective without peat moss, at 30, 60, 90, 120 and 150 days, respectively. Moreover, it exhibited 12, 25.3, 36.5 and 28.5% lower tuber weight loss than their respective carton boxes with peat moss, at 60, 90, 120 and 150 days, respectively. Furthermore, tuber weight loss of polyethylene bags with peat moss were 2.3, 16.5, 26.3, 32 and 16.7% less than those of carton boxes without peat moss, at 30, 60, 90, 120 and 150 days of cold storage (Fig. 6F), respectively.

Percentage of total weight loss

In general, higher total weight loss was recorded under room temperature than cold storage conditions (Fig. 7). That could be attributed to the higher percentage of decay loss (Fig. 5) and weight loss (Fig. 6) observed under room temperature than cold storage of 10 °C.

At room temperature, Local cultivar showed 3.2, 3.9, 12.2 and 6.3% higher total weight loss than Fuseau, at 15, 30, 45 and 60 days of storage (Fig. 7A), respectively. This could be attributed to the higher percentage of decay (Fig. 5A) and weight loss (Fig. 6A) previously shown by the Local cultivar. At cold storage (Fig. 7B), less differences in total weight loss were observed between cultivars than at room temperature. In this respect, Local cultivar had 3, 5, 4.5 and 0.8% higher total weight loss than Fuseau, at 60, 90, 120 and 150 days of storage, respectively.

Tubers of 24 kg K_2O. Fed^{-1} showed the lowest total weight loss at 60 days than the rest of the potassium treatments, at room temperature conditions (Fig. 7C). This was expected since the same treatment showed the lowest tuber decay (Fig. 5C) and weight (Fig. 6C) losses. On the contrary, tubers of 96 kg K_2O. Fed^{-1} demonstrated relatively higher percentage of total weight loss at the end of the storage period probably due to their relatively higher decay (Fig. 5C) and weight (Fig. 6C) loss. The treatment of 48 and 72 kg K_2O. Fed^{-1} gave intermediate values of total weight loss during storage (Fig. 7C), at 60 days of storage. Moreover, the 24 kg K_2O. Fed^{-1} tubers exhibited 11, 11 and 17% lower total weight loss than those of 48, 72 and 96 kg K_2O. Fed^{-1} ones, at 60 days of storage, respectively.

At cold storage, tubers of 24 and 48 kg K_2O. Fed^{-1} maintained less total weight loss, at the end of storage than the rest of the treatments (Fig. 7D). Those of 96 kg K_2O. Fed^{-1} showed higher total weight loss, as under room temperature, than other treatments under the study. The comparatively lower total weigh loss exhibited by the 24 and 48 kg K_2O. Fed^{-1} could be due to their relatively lower decay (Fig. 5D) and weight (Fig. 6D) losses than other treatments. At the end of storage, tubers of 24 kg K_2O. Fed^{-1} exhibited less total weight loss of 7 and 10% as compared with those of 72 and 96 kg K_2O. Fed^{-1}, respectively. The respective reductions of total weight loss demonstrated by tubers of 48 kg K_2O. Fed^{-1} were 9 and 12% (Fig. 7D), respectively.

Total weight loss was greatly reduced by peat moss presence in the storage containers, at room temperature (Fig. 7E). Tubers of polyethylene bags and carton boxes with peat moss exhibited the lowest total weight loss as compared with their respective ones without peat moss. However, those of polyethylene bags with peat moss showed 0.94, 3.7 and 13.5% lower total weight loss than their respective of carton boxes, at 15, 30 and 45 days of storage at room temperature, respectively. At the end of storage, both treatments exhibited similar lower total weight loss than their respective containers without peat moss. Using peat moss as storage medium reduced total weight loss of tubers stored in polyethylene bags by 11.6, 7, 16.8 and 28.3% as compared with their corresponding without peat moss, at 15, 30, 45 and 60 days of storage, respectively. Similarly, carton boxes with peat moss showed 11.4, 5.7, 3.6 and 34.5% lower total tuber weight loss than their analogous without peat moss, at 15, 30, 45 and 60 days of storage, respectively.

At cold storage, polyethylene bags with peat moss showed the lowest tuber total weight loss followed by their similar ones without peat moss (Fig. 7F). On the other hand, carton boxes revealed the highest total loss, regardless of the peat moss treatment. The addition of peat moss to polyethylene bags reduced total weight loss of tubers by 2.2, 9, 15.5, 20.5 and 15.8% in comparison to their corresponding without peat moss, at 30, 60, 90, 120 and 150 days of cold storage, respectively. The respective reductions of total weight loss as compared with carton boxes with peat moss were 12.5, 25.8, 42.7 and 32.1%, at 60, 90, 120 and 150 days (Fig. 7F), respectively. Similarly, total weight loss of tubers stored with peat moss in polyethylene bags were lower by 2.3, 16.5, 26.3, 41.1 and 29.8% than those of carton boxes without peat moss, at 30, 60, 90, 120 and 150 days of cold storage, respectively.

That the addition of moistened peat moss to different storage containers decreased weight loss might be due to reducing water loss and shriveling through the tender skin of Jerusalem artichoke tubers. The polyethylene bags were not perforated, thus, maintained higher moisture and minimized shriveling and deterioration of Jerusalem artichoke tubers (Tindall, 1986). Consequently, allowed for longer period of storage than other treatments without peat moss. In this respect, Stepanets *et al.* (1992) reported that storage containers without polyethylene wrapping exhibited higher weight loss than their respective wrapped with polyethylene.

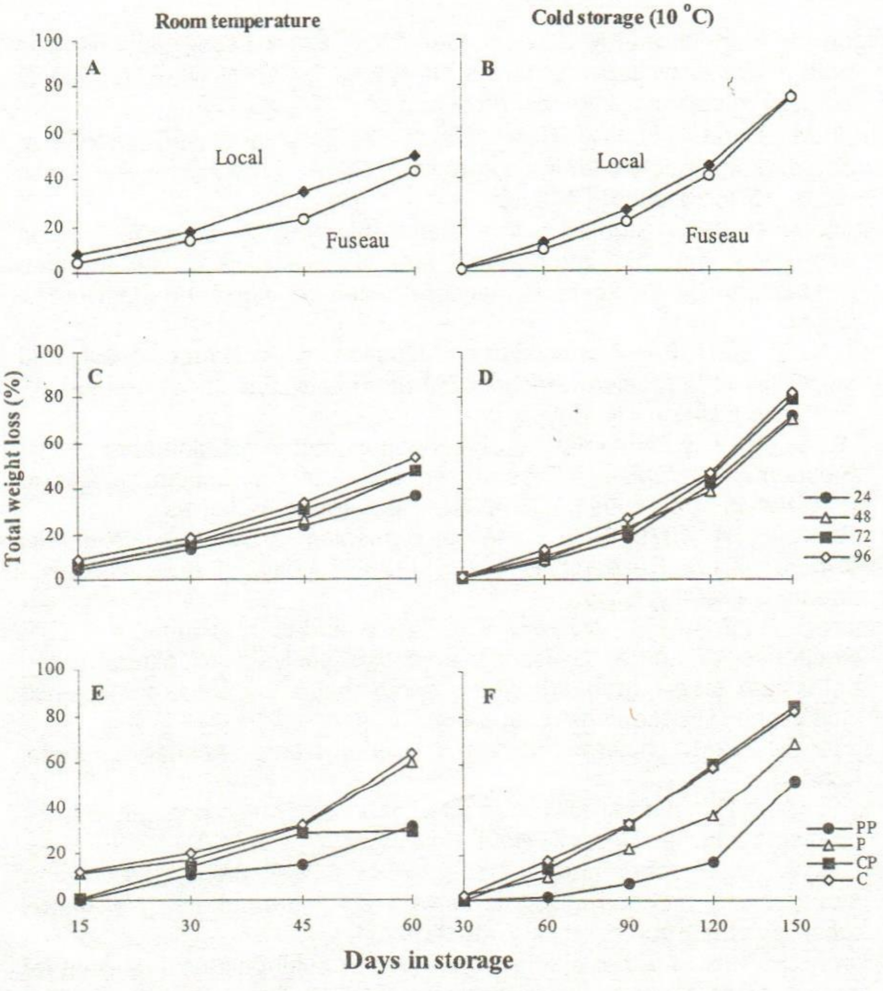

Figure 7 : Effect of Jerusalem artichoke cultivar (A and B), potassium level (C and D; kg K_2O. Fed^{-1}) and storage container (E and F) on total weight loss (%) under room and cold storage conditions.

Storage containers: PP: Polyethylene bags + Peat moss CP: Carton boxes + Peat moss
P : Polyethylene bags C : Carton boxes

It is concluded that, for fresh market production, the application of 96 kg K_2O. Fed^{-1} is an appropriate potassium rate enhancing tuber yield and quality. If tubers have to be reserved for a period of time it is preferable to use

Fuseau tubers of 48 kg K_2O. Fed^{-1} packed in polyethylene bags with peat moss and stored at 10 °C than room temperature.

REFERENCES

Beringer, H.; K. Koch and M.G. Lindhauer. 1990. Source:sink relationship in potato (*Solanum tuberosum*) as influenced by potassium chloride or potassium sulphate nutrition. Plant and soil, 124: 287-290.

Bhandal, M. S and P. S. Naik. 1991. Storage behavior and yield potential of potato genotypes stored in country and cold store. Journal of the Indian potato Association, 18: 100-101.

El-Gamal, A. M. 1980. Studies on the relationship between some fertilization treatments and the deterioration and improvement of seed potato production. Ph.D. Thesis, Faculty of Agriculture, Alexandria University, Egypt.

Hamed, N. M. 2001. Effect of cultivar and location on yield, tuber quality and storability of Jerusalem artichoke. M.Sc Thesis, Faculty of Agriculture, Ain Shams University, Egypt.

Joshi, S. S.; P. Knsumakumari; K. Biseenappa and A. Radhamani. 1994. Biochemical studies in some varieties of Jerusalem artichoke (*Helianthus Tuberosus* L.). Crop-Research Hisar, 8: 92 - 99.

Khereba, A. H. A. 1979. New clones of Jerusalem artichoke. (*Helianthus Tuberosus* L.). Research Bull. No. 1173. Faculty. of Agriculture, Ain shams University, Egypt.

Mansour, S. A.; Z. A. El-Sharkawy, A. A. Tawfik and H. M. Ramadan. 2001. Response of some Jerusalem artichoke cultivars to nitrogen and potassium levels in drip-irrigated sandy soil. African Crop Science Conference Proceedings, 5: 853-860.

Marschner, H. 1986. Mineral nutrition of higher plants. Academic Press, London.

Mercik, S. 1989. Direct and residual effect of periodically high potassium rates on plants and soil. Roczniki Nauk Rolniczych, 108: 37-48.

Modler, H. W., J. D. Jones and G. Mazza. 1993. Observations on long-term storage and processing of Jerusalem artichoke tubers (*Helianthus tuberosus* L.). Food-chemistry, 48: 279-284.

Montgomry, R. 1961. Further studies of the phenol sulphonic acid reagent for carbohydrate. Biochemistry Biophysics Acta, 48: 591-593.

Nelson, D. C. 1970. Effect of planting date, spacing and potassium on hollow heart in Norgold Russet potatoes. American Potato Journal. 47: 130-135.

Pregl, F. 1945. Quantitative organic micro-analysis. Fourth Edition, Churchill, London.

Snedecor, G. W. And W. C. Cochran 1980. Statistical Methods. Seventh Edition. Iowa state University Press, Ames, Iowa, USA.

Soja, G., G. Dersch and W. Praznik. 1990. Harvest dates, fertilizer and varietal effects on yield, concentration and molecular distribution of fructan in Jerusalem artichoke (*Helianthus tuberosus* L.). Journal of Agronomy and crop science, 165: 181-189.

Spitters, G. J. 1987. Jerusalem artichoke, a new crop for the sweetener market. Prophyta, 41:259-261.

Stalin, P. and J. Enzmann 1992. Influence of N fertilizer rate and nitrification inhibitor on the storage behaviour of potatoes. Journal of Indian Potato Association, 19: 58-60.

Stepanets, L. F.; N. V. Remeslo, V. A. koltunov, L. D. Bobrovnik and M. G. Koval chuk. 1992. Methods of Jerusalem artichoke storage. Sakhharnaya-promysh lennast, 6, pp. 16-18.

Tawfik, A. A. 2001. Potassium and calcium nutrition improves potato production in drip-irrigated sandy soil. African Crop Science Journal, 9: 147-155.

Tindall, H. D. 1986. Vegetables in tropics. English tanguaye Book society. Macmillan Education ltd., Hong Kong, pp. 533.

Wanas, M. W. 1987. Some factors affecting productivity and quality of some sweetpotato cultivars. Ph.D. Thesis, Faculty of Agriculture, Menofeia University, Egypt.

Whistler, R.. L.; M. L. Woffrom, J. N. Bemiller and F. Shafizadeh. 1962. Methods in carbohydrate chemistry analysis and preparation of sugars. Published by Academic Press Inc. London,1: 116-117.

Zonin, G. 1987. Jerusalem artichoke: reality and hypotheses. Tnjormatore Agrario, 43: 67-70.

Zubr, J., H. S. Pedersen and A. Fuchs. 1993. Characteristics of growth and development of different Jerusalem artichoke cultivars. Inulin and Inulin containing crops, pp. 11-19.

تأثير الصنف ومعدل التسميد البوتاسى على المحصول الكلى، المحتوى الكيميائى والقدرة التخزينيه لدرنات الطرطوفه

أحمد عبد المنعم توفيق، *رأفت صادق نجيب، محمد رشاد عمارة، *احمد حسن خريبه، ظهره عبد المولى الشرقاوى

معهد بحوث البساتين ، مركز البحوث الزراعيه. الجيزة – جمهوريه مصر العربيه.

*قسم محاصيل الخضر – كليه الزراعه – جامعه القاهرة. الجيزة – جمهوريه مصر العربيه

أجرى هذا البحث خلال عامى ١٩٩٥، ١٩٩٦ لدراسه تأثير التفاعل بين معدل التسميد البوتاسى وصنفى الطرطوفه المحلى والفيوزا على بعض صفات نمو النبات ، المحصول الكلى ، المحتوى الكيميائى للدرنات والقدرة التخزينيه لها. إستخدمت معدلات التسميد ٢٤، ٤٨، ٧٢ كجم بو٢أ/فدان خلال عامى الدراسة بينما أضيف المعدل ٩٦ كجم بو٢أ/فدان الى المعدلات السابقه خلال عام ١٩٩٦ .

تفوق الوزن الطازج للمجموع الخضرى للصنف المحلى عن مثيله بالصنف فيوزا، على عكس إرتفاع النبات. وقد تلاحظ بصفه عامة فى الصنف المحلى تحسن صفات النمو تحت الدراسه بزيادة معدل التسميد البوتاسى حتى ٩٦ كجم بو٢أ/فدان خلال عام ١٩٩٦ مقارنه بالصنف فيوزا.

تفوق المحصول الكلى للصنف فيوزا بحوالى ٥٠ ، ٢٧ % عن مثيله للصنف المحلى خلال عامى ١٩٩٥ ، ١٩٩٦، على الترتيب. كذلك فقد كانت الزيادة فى محتوى درنات الصنف فيوزا من المادة الجافه حوالى ١,٥ ، ٣ % عن الصنف المحلى خلال العامين ، على الترتيب.

أدى التسميد بأقصى معدلات خلال عامى الدراسه إلى زيادة معنوية فى محصول الدرنات ومحتواها من المادة الجافه عند الحصاد على عمر ١٨٠ يوم بعد الزراعه. وقد كانت زيادة محصول الصنف المحلى نتيجه لزيادة معدلات التسميد البوتاسى من ٢٤ الى ٤٨ ، ٧٢ كجم بو٢أ/فدان أكثر منها فى الصنف فيوزا خلال عام ١٩٩٥. وقد كان محتوى درنات الصنف المحلى من الكربوهيدرات والبروتينات الكليه أعلى من مثيله فى درنات الصنف فيوزا ، بينما تفوق الأخير فى محتواه من الأنيولين. وقد زاد محتوى الدرنات من الأنيولين والكربوهيدرات الكليه بالتسميد بمعدل ٩٦ كجم بو٢أ/فدان وبتأخر موعد الحصاد إلى ١٨٠ يوم من الزراعه. وعلى العكس فقد زاد البروتين الكلى بالدرنات بالتسميد بمعدل ٢٤ كجم بو٢أ/فدان وبالحصاد المبكر على عمر ١٢٠ يوم.

أدى زيادة فترة تخزين الدرنات إلى إرتفاع كل من نسبة الإنبات ، نسبه التدهور بالدرنات ، زيادة الفقد بالوزن والفقد الكلى بالدرنات. وعلى عكس التخزين تحت ظروف درجه حرارة الغرفه (٢٤° م) فقد أدى التخزين على درجه حرارة ١٠° م إلى نقص نسبه التنبيت بالدرنات ، إنخفاض الفقد فى الوزن والفقد الكلى. وبغض النظر عن ظروف التخزين ، فقد إرتفعت نسبه إنبات الدرنات ونسب الفقد المختلفه بالصنف المحلى عن مثيلاتها بالصنف فيوزا .

أظهرت الدرنات الناتجه من نباتات تم تسميدها بمعدل ٢٤ كجم بو٢أ/فدان أعلى نسبة إنبات درنات وأقل نسب بأوجه الفقد المختلفه على عكس ما أظهرته تلك الناتجه من نباتات تمت معاملاتها بمعدل ٩٦ كجم بو٢أ/فدان .

أدى تخزين الدرنات مع بيت موس رطب تحت ظروف درجه حرارة الغرفه إلى زيادة نسبه إنبات الدرنات وإنخفاض نسب الفقد الأخرى. وتحت ظروف المخازن المبردة ، فقد أدى تخزين الدرنات مع بيت موس رطب فى أكياس بولى إثيلين إلى أقل إنخفاض فى نسبه تدهور الدرنات وأوجه الفقد الآخرى.

ويوصى بالتسميد بمعدل ٩٦ كجم بو٢أ/فدان لزيادة المحصول وجودة الدرنات بغرض الاستهلاك الطازج. وعند الرغبه فى التخزين، ينصح بإستخدام الصنف فيوزا مع التسميد بمعدل ٤٨ كجم بو٢أ/فدان وتخزين الدرنات مع بيت موس رطب فى أكياس بولى إثيلين على درجه ١٠°م.