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EFFECT OF PLANTING DATES AND SEED TUBER SOURCES ON PRODUCTIVITY OF POTATO IN SIWA OASIS

Gomaa,S.S.
Department of Plant Production, Desert Research Center, Matariya, Cairo, Egypt.

ABSTRACT

An experiment was conducted at Siwa Oasis Research Station, Matrooh Governorate, Desert Research Center in two consecutive winter seasons, 2012 and 2013 to determine the effects of four planting dates (1st of Jan., mid of Jan., 1st of Feb. and mid. of Feb.) and three potato seed tuber sources of spunta cultivar (imported certified seed tubers, local seed tubers and recently harvested seed tubers which treated with GA_3) on growth and yield under Siwa conditions. The results showed that planting on mid. of Jan. (date2) and 1st of Feb. (date 3) , generally, produced the highest growth and total yield and its components values. On the other hand, 1st of Jan. (date 1) and mid. of Feb. (date 4) gave the lowest values. Base temperature calculation for potato revealed that it was 5.99 ^{o}C and accumulated heat units above base temperature were 191.56 ± 12.4 degree-days during emergence period.

The results showed , also, that Imported seed tubers (source 1) showed superiority in most studied characters of vegetative growth and yield parameters , followed by local seed tubers (source 2) as compared with recently harvested seed tubers (source 3). Generally, satisfactory characters were obtained when imported seed tubers were planted on mid. of Jan. (date 2) or first of Feb. (date 3) in both two seasons. Highly significant positive correlations were found between yield/fe d. and either yield/plant or average tuber weight. On the contrary, significant negative correlation was found between yield/fed. and number of tuber /plant. Correlation and regression revealed ,also, that increasing number of plant leaves led to increasing of plant fresh weight and average of tuber weight. While increasing number of plant shoots led to increasing number of tubers and decreasing tuber weight.

Keywords: potato, seed tuber sources, planting dates, GA_3, emergence, growth, yield, heat units.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the world's most economically crop It ranks the fourth in production after wheat, maize and rice, with annual production of 365365376 tons (FAO, 2012). In Egypt potato is an important vegetable crop, planted on about 200000 feddan with a production of about 4758040 ton in 2010 (FAO, 2012).

The average annual quantity of potato seed required for summer, autumn and winter plantings is about 200000 tons; of which 50000 tons are imported from Western Europe for use in the summer season and the rest is locally which produced in previous summer season and stored in refrigerators till planting date , whether produced by individual farmers (homegrown self produced) or through the government program for producing improved seeds (homegrown certified seed) (Crissman *et al.,* 1991).

Due to the bulky, perishable characteristics of seed tubers and the low multiplication rate of potatoes, seed of potatoes represent a high portion of production costs for potato farmers. Reducing the cost and improving the

quality of planting material for potato production can have an important favorable effect on the productivity and profitability of potato production (Crissman *et al.,* 1991).

In order to optimize potato productivity and quality, various aspects of production chain should be considered in an integrated way such as potato seed quality (Loebenstein, 2007), chronological and physiological age of seed tubers and sprouting before planting (Caldiz *et al.*, 2001). Also, Rykaczewska (2001) reported that physiological age of mother tubers and sprouting before planting affected plant development and yield, while non-sprouting before planting caused significant adverse effect on yield.

The impact of climate characters affects crop productivity, especially with differences between regions. So, determining the optimum planting date has been considered an important production aspect. Kalbarczyk (2001) reported that plant development was significantly related to meteorological factors, and equations were developed for predicting the time taken to reach different growth stages based on weather data. Analysis of complete variance showed that there were significant effect of planting date on plant emergence, plant height, yield of tubers and total numbers of tubers/ha. (Dubey *et al.,* 2011). Moreover, the longest duration between planting date and 50% emergence was 51.83 days belonged to planting date of 22 December. Delaying planting date, number of days to 50% emergence was decreased at 1% probability level (Darabi ,2013). Tuber sprouting before planting accelerated the emergence of plants for 12 days, moving the vegetation to an earlier period (Sawicka and Marczak, 2011) .

Opoku and Harris, (2001) stated that delaying planting reduced potato yield, while early planting increased radiation use efficiency which confirmed results of Kamla (1999) who found that potato yield was decreased with transplanting delay. The environmental and physiological factors that promote tuber formation have been investigated by many researchers. Short day length and low temperatures, especially at night enhanced tuber initiation and increased the number of tuber formed, (Cutter,1992; Struik and Ewing,1995 and Kawakami *et al*.2005).

Yenagi *et al*.(2004), under India conditions, reported that tuber dry matter content and tubers number and weight per plant showed significant variations in response to planting dates. It was due to an advantage of favorable environmental factors. The highest tuber yield recorded by early planting of potato on June 18th, but delayed planting till June 25th and July10th decreased the tuber yield by 10.03 and 20.45 per cent, respectively. The higher tuber yield obtained with early planting on June 18th was mainly due to increased yield components such as number of tubers and tuber weight per plant. The higher yield with early planting could be also attributed to higher plant height, increased leaf area index (LAI) and increased total dry matter production compared with late plantings. Opposite results were found by Darabi (2013) who showed that total and marketable yield, yield components and tuber dry matter (%) was not significant .

Kawakami *et al*. (2005), under Japan conditions, studied the effect of planting date on the growth and yield of potato plants grown from conventional seed tubers (CT) and micro tubers (MT). They found that tuber

formation was later with MT plants than with CT plants, but this difference was smaller on the last planting date. The linear increase in tuber dry weight started later with MT plants than in CT plants, but the rate of increase was similar with both MT and CT plants on all planting dates. Delaying planting reduced tuber yield, mainly because of shortening growing period with both MT and CT plants.

Under Egyptian conditions, EL-Helaly (2012) studied the effect of potato propagation by seedlings compared to traditional method of potato planting (tuber seeds) on growth and tuber yield. The treatments consisted of the combination of two planting methods (tuber seeds and seedlings) and two planting dates (November 4th and December 4 th). He found that seedlings in the second planting date had lower stem length, above ground dry weight and tuber number per plant and tuber yield than earlier planting. The method of tuber seeds had highest tubers number per plant than transplanting method with differences between planting dates in tuber number per plant.

Depending on temperature regime and location, potato yield was decreased due to increased development rates and higher respiration (Ropert, 2003). Therefore, the aim of present the study was to investigate the effect of seed tuber sources and planting dates on potato growth, yield and quality under Siwa oasis conditions.

MATERIALS AND METHODS

An experiment was conducted at Siwa Oasis Research Station, Desert Research Center (Khimisa Farm) during two consecutive winter seasons of 2012 and 2013. Siwa Oasis is located at latitude 29^{o} 12' N, longitude 25^{o} 29'E and 18 meters below sea level, to study the effect of seed tuber sources and planting dates on potato growth, yield and quality under Siwa oasis conditions.

Three potato seed tuber sources of early mature cultivar Spunta were used which were: I-imported seed tubers from Europe during December which were available for the summer season, 2- local seed tubers saved by the farmers from the previous summer harvest, and 3- seed tubers recently produced from autumn planting and harvested during December. Potato seed tubers recently harvested, (the third source) were soaked in GA_3 at the concentration of 5 ppm for about 10 minutes two weeks before planting to break its dormancy (EL-Asdoudi and Ouf,1994). Four planting dates were investigated, i.e., 1st of January (first planting date), mid. of January (second planting date), 1st of February (third planting date) and mid. of February (fourth planting date). Split-plot design with three replicates was applied where planting dates arranged in the main plot and seed tubers sources occupied the subplots. Experimental plots were consisted of five ridges each of 3 meters long and 0.7 meter wide forming a plot area of 10.5 m^2. The distance between hills within the row was about 30 cm. Recommended cultural practices, i.e., fertilization, irrigation, weeds and pest control were applied.

Average maximum and minimum temperature were recorded as shown in Table (1).

Table(1) Maximum and minimum monthly temperature during 2012 and 2013 growing seasons

Temperature	First season						Second season					
	Jan.	Feb.	Mar.	Apr.	May	June	Jan.	Feb.	Mar.	Apr.	May	June
Maximum	19.3	21.5	24.5	29.9	34.0	37.5	20.4	21.8	25.8	30.5	34.2	37.7
Minimum	5.6	7.1	10.1	13.7	17.8	20.4	6.6	8.2	11.0	15.1	18.5	21.5
Mean	12.5	14.3	17.3	21.8	25.9	28.9	13.5	15.0	18.4	22.8	26.4	29.6

Studied traits:

1- Emergence %:- It was recorded as follow: (number of plants present in plot/ standard number of plants in plot) x 100.

2- Emergence period: - Number of days required for about 70% potato seed emerged.

3- Base temperature: - Base temperature of potato during emergence was determined according to intercept method proposed by Arnold (1959) using mean temperature and rate of growth as follows: Rate of growth = 100/ Number of days from planting to emergence. Then regression equation in which mean temperature is X axis and rate of growth is Y axis. Base temperature was obtained as the value of X and Y equal zero.

4- Heat units:- Heat unit required for potato emergence was calculated according to the following formula: ((minimum temperature + maximum temperature) /2) – base temperature during emergence period.

5- Growth paramerters :- It were expressed as shoot length, shoots umber, shoot fresh weight and leaves number were recorded at 60 days from emergence.

6- Yield and its components:

- Average yield/plant.
- Average yield/fed.
- Average tuber number.
- Average tuber weight.
- Dry matter content.
- Specific gravity of potato tuber was determined according to Burton (1948).
- Starch content of potato tuber was determined according to Burton (1948).

7- Statistical analysis:

Data were subjected to statistical analysis by M-STAT C (Russel, 1991). The differences among means were performed using least significant difference (LSD) at 5% level.

RESULTS AND DISCUSSION

1-The influence of planting dates and seed tubers sources on emergence:

The influence of planting dates, seed tuber sources and their interaction on emergence % and period presented in Table (2) indicated that planting on mid Jan. and 1st of Feb. (date,2 and 3) produced, generally, the highest emergence % compared with other planting dates; generally, no significant differences were found among other plantings. As for emergence period, Table (2) and fig. (1) revealed that it was significantly decreased as planting was delayed. Regarding seed tuber sources, Table (2) cleared that local seed tubers (second source) and imported seed tubers (first source) gave the highest emergence percent and the second source gave shorter period, while seeds recently harvested gave the lowest emergence percent and the longest period. Concerning the interaction effect, obtained data showed that imported seeds whether planted on the first, second date or third date gave the highest emergence percent.

Table: (2) Effect of planting date and potato seed tuber sources on emergence percent and period

parameters		Emergence percent %		Emergence period (days)	
Seasons / Planting dates		1St Season	2ndSeason	1St Season	2ndSeason
Date 1	(1st of jan.)	73.38	83.06	30.56	27.44
Date 2	(mid of jan.)	82.26	80.78	25.8	23.67
Date 3	(1st of Feb.)	76.30	78.33	21.67	20.89
Date 4	(mid of Feb.)	74.07	75.56	19.89	19.33
LSD at 0.05		4.32	3.93	1.04	1.01
Seed tuber sources					
Source 1	(imported)	89.76	89.79	19.75	18.83
Source 2	(local)	73.98	82.88	17.67	16.00
Source 3	(recently harvested)*	65.76	65.63	36.08	33.67
LSD at 0.05		3.39	2.44	0.95	0.45
Interaction dates x sources					
Date 1	Source 1	92.37	94.17	24.00	22.67
	Source 2	85.67	94.17	22.33	18.67
	Source 3	48.61	60.83	45.33	41.00
Date 2	Source 1	97.78	90.83	21.33	18.33
	Source 2	80.00	86.50	18.67	15.67
	Source 3	65.55	65.00	37.67	37.00
Date 3	Source 1	86.67	88.33	17.33	17.67
	Source 2	83.33	78.33	15.33	14.67
	Source 3	72.22	68.33	32.33	30.33
Date 4	Source 1	82.22	85.83	16.33	16.67
	Source 2	73.67	72.50	14.33	15.00
	Source 3	76.67	68.33	29.00	26.33
LSD at 0.05		6.77	4.88	1.90	0.89

*Treated with GA_3

The longest emergence period was recorded with the recently harvested seeds (third source) planted on the first date or the second date followed by the third date which may be to some extent due to its dormancy. Obtained results were in agreement with those of (Dubey *et al.,* 2011; Sawicka and Marczak, 2011 and Darabi, 2013).

It may be worth to mention that point of temperature above which accumulated temperature for the summations are called base temperature. Accumulated temperature above base temperature is effective for plant growth and expressed as degree-day. Calculated base temperature for the investigated potato cultivar grown in Siwa was 5.99 ^{o}C (42.8 ^{o}F). Accumulated heat units above base temperature illustrated in Fig (2) showed that it was ranged from 184.2 to 202.5 degree-days with mean of 191.56 ± 12.4 degree-days .This indicated that emergence period depended upon accumulated heat units above base temperature since there were no significant differences among accumulated heat units of different planting dates.

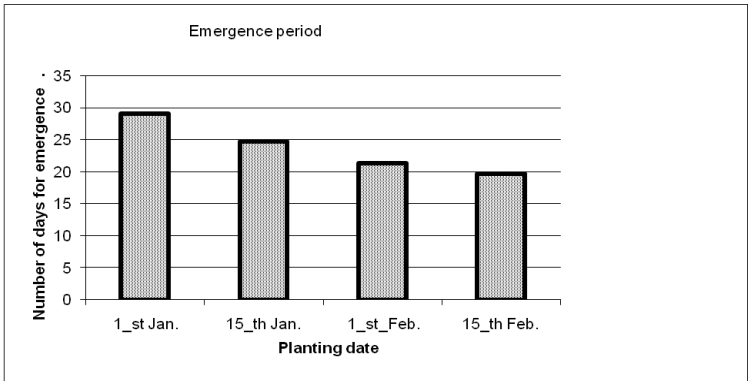

Fig (1) : Effect of planting dates on average emergence period (No. of days) required for potato emergence (Spunta cultivar) grown in Siwa oasis.

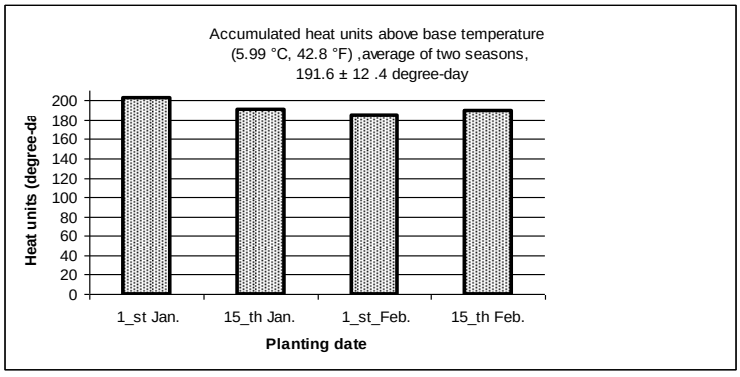

Fig (2) : Effect of planting dates on accumulated heat units (degree-day) required for potato emergence (Spunta cultivar) grown in Siwa Oasis.

2-Influence of planting dates and seed sources on vegetative growth characteristics:

Data in Table (3) indicated that planting date affected positively on potato growth features expressed as shoot length and shoot fresh weight as well as both No. of shoot and leaves per plant except shoot fresh weight in the second season. Generally, planting on mid and 1st of Feb.

Table: (3) Effect of planting dates and seed tuber sources on shoot length, shoot fresh weight and No. of both shoot leaves 60 days from emergence during the two seasons.

parameters		Shoot length (cm)		shoot fresh weight (g/plant)		Shoots number/plant		Leaves number/plant	
Seasons / Planting dates		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Date 1 (1st of jan.)		30.22	34.15	71.13	84.30	2.48	2.56	11.56	11.54
Date 2 (mid of jan.)		33.30	33.91	100.83	84.19	2.53	2.83	13.36	12.79
Date 3 (1st of Feb.)		36.88	36.38	103.56	85.11	2.53	2.83	12.56	13.54
Date 4 (mid of Feb.)		37.19	39.24	105.85	84.64	2.94	3.17	12.50	12.82
LSD at 0.05		3.16	1.77	8.53	NS	0.22	0.29	0.53	0.84
Seed tuber sources									
Source 1 (imported)		46.30	46.47	127.42	115.45	1.88	1.94	16.21	16.00
Source 2 (local)		31.32	34.03	86.37	81.05	2.08	2.58	12.10	13.04
Source 3 (recently harvested)		25.58	27.27	69.41	57.18	3.90	4.02	9.17	8.97
LSD at 0.05		2.02	1.41	5.94	2.75	0.17	0.20	0.59	0.67
Interaction dates x sources									
Date 1	Source 1	36.50	42.22	95.92	112.64	1.60	1.67	15.25	14.83
	Source 2	29.67	35.94	66.58	91.69	2.25	2.67	12.75	13.00
	Source 3	24.50	24.28	41.08	48.56	3.58	3.33	6.67	6.78
Date 2	Source 1	46.45	44.93	149.56	119.35	1.67	1.92	18.17	16.89
	Source 2	33.89	34.26	96.67	84.92	2.08	2.58	13.92	14.08
	Source 3	19.56	22.54	54.78	48.31	3.83	4.00	8.00	7.39
Date 3	Source 1	50.37	48.98	144.33	118.56	1.83	1.92	16.25	17.22
	Source 2	32.34	32.66	89.56	75.00	1.92	2.33	11.00	13.33
	Source 3	27.93	27.51	76.78	61.78	3.83	4.25	10.42	10.05
Date 4	Source 1	51.87	49.73	119.89	111.25	2.42	2.25	15.17	15.06
	Source 2	29.37	33.25	92.67	72.58	2.08	2.75	10.75	11.72
	Source 3	30.32	34.75	105.00	70.08	4.33	4.50	11.58	11.67
LSD at 0.05		4.05	2.82	11.87	5.5	0.33	0.39	1.18	1.35

***treated with GA_3**

(date, 4) followed by the second or third date gave the highest values of shoot parameters. On the contrary, the first date gave the lowest values of all growth parameters. Obtained results were in agreement with those of (Kamla, 1999; Opoku and Harris, 2001 and EL-Helaly, 2012).

Also, data in Table (3) stated that imported seed tubers (source, 1) produced the longest shoot, heaviest shoot fresh weight and highest leaves number, followed by (source, 2) compared with (source, 3). On the contrary, newly potato seed tuber recently harvested (source, 3) produced the highest shoots number, followed by (source, 2) compared with (source 1) in both of two seasons .this results agreement with those obtained by Mikaitzel (1993) and Barani *et al*.(2013).

Table: (4) Effect of planting dates and seed tuber sources on yield, average tuber number per plant and tuber weight during the two seasons.

Parameters		Average tuber number/plant		Average tuber weight (g/tuber)		Average plant yield (g/plant)		Average potato yield (kg/fed.)	
Seasons / Planting dates		1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd season
Date 1 (1st of jan.)		6.22	7.12	79.89	69.77	454.01	462.51	5740.1	6615.4
Date 2 (mid of jan.)		7.34	7.68	91.66	68.22	606.25	484.59	8415.4	6578.2
Date 3 (1st of Feb.)		6.89	7.86	99.21	66.98	599.60	480.14	7496.1	6198.5
Date 4 (mid of Feb.)		7.37	7.68	89.84	62.24	577.73	452.90	6920.1	5540.5
LSD at 0.05		0.34	0.39	4.43	3.30	38.71	18.06	550.6	371.2
Seed tuber sources									
Source 1 (imported)		5.87	6.23	131.45	100.22	764.99	650.24	10952.5	9365.6
Source 2 (local)		5.50	6.48	101.20	69.89	553.21	454.80	6594.1	6088.4
Source 3 (recently harvested)*		9.50	10.04	37.80	30.29	359.99	305.06	3882.1	3245.3
LSD at 0.05		0.38	0.39	5.64	3.83	27.6	20.24	518.4	307.7
Interaction dates x sources									
Date 1	Source 1	5.37	5.23	110.93	104.90	423.85	423.85	8777.8	9999.9
	Source 2	5.30	6.23	96.76	84.32	40.48	40.48	6492.5	7906.3
	Source 3	8.00	9.90	31.97	20.08	423.85	423.85	1950.0	1939.9
Date 2	Source 1	5.97	6.70	144.31	109.06	40.48	40.48	13457.7	10616.7
	Source 2	6.47	6.73	93.00	68.39	423.85	423.85	8016.4	6368.5
	Source 3	9.60	9.60	37.66	27.21	40.48	40.48	3772.0	2749.3
Date 3	Source 1	5.97	6.33	149.96	106.50	423.85	423.85	11799.3	9521.4
	Source 2	5.23	6.67	107.32	62.59	40.48	40.48	6409.4	5414.9
	Source 3	9.47	10.57	40.35	31.84	423.85	423.85	4279.6	3659.1
Date 4	Source 1	6.17	6.67	120.59	80.44	40.48	40.48	9775.2	7324.4
	Source 2	5.00	6.27	107.73	64.26	423.85	423.85	5458.2	4664.0
	Source 3	10.93	10.10	41.21	42.01	451.02	423.85	5526.8	4632.9
LSD at 0.05		0.76	0.79	11.29	7.65	7.65	40.48	1036.9	615.4

***treated with GA_3**

Concerning interaction effects, all interactions between treatments showed significant positive effects on the most growth characteristics. Imported seed tubers (source, 1) recorded the highest values except shoot number when planted on mid. Jan. (date, 2) or 1st Feb. While recently potato seed tuber (source, 3) gave the highest shoots number with all plantings. It may be concluded from the forgoing results that, the superior effect of later planting dates on some growth characters such as, shoot length, shoot fresh weight and shoots number might be due to the favorable temperature degrees prevailed during this stage for potato growth. These results agreed with those of (Kalbarczyk, 2000). In addition, Yenagi *et al*.(2004) found significant variation between characters in response to planting dates due to an advantage of favorable environmental factors. While increasing of growth characters of imported potato seed tuber (source, 1) compared with other

sources especially, recently potato seed tubers may be due to potato seed quality (Loebenstein,2007) and chronological and physiological age of seed tubers and sprouting before planting (Caldiz *et al.,* 2001). Moreover, Rykaczewska (2001) reported that physiological age of mother tubers and sprouting before planting affected plant development, while, non sprouting before planting caused significant adverse effect.

3-Effect of planting dates and seed tuber sources on yield and its components:

Obtained date presented in Table (4) revealed that delaying planting from 1st Jan. (date, 1) to mid Jan.(date,2) or there after significantly increased the studied yield parameters. Generally, the highest values were recorded with mid Jan. and 1st Feb. plantings (dates 2 and 3).

As for the effect of potato seed sources, the imported seeds gave the highest yield and the heaviest tuber weight, while the greatest tubers number and the lowest tuber weight were obtained with the recently harvested seeds which treated with GA_3 . this results agreement with those obtained by Mikitzel (1993) and Barani *et al.(*2013).

Regarding the interaction effect, imported seeds whether planted on mid. Jan. or 1st Feb. (dates 2 and 3) produced the highest yield and the heaviest tuber weight, while recently harvested seeds (source, 3) whether planted on 1st or mid Feb. (dates 3 and 4) gave the greatest tuber number per plant. These results agreed with (Caldiz *et al.,* 2001; Kawakami *et al.,* 2005 and Loebenstein, 2007).

The higher tuber yield obtained with planting during Jan15th and Feb.1st was mainly due to matching convention environmental conditions, in particular, temperature and daylight length which reflected on increasing either vegetative growth, i.e., shoot length, shoot fresh weight and leaves number or increasing tuber weight per plant (Yenagi *et al.,* 2004).

In addition, delaying planting date further more led to reducing tuber yield, mainly because of shortening growing period (Kawakami *et al.,* 2005). Increasing temperature rabidly during spring under Siwa conditions may lead to increase vegetative growth but not yield. These results gree with (Ropert, 2003) who decided that depending on temperature regime and location can lead to low potato yields due to increased plant development and higher respiration rate.

Increasing potato yield with imported potato seed tuber treatment may be due to the physiological age of mother tubers and sprouting before planting, while, non-sprouting before planting caused significant adverse effect on yield. In addition, Rykaczewska (2001) reported that decreasing yield with newly potato seed tuber may be due to that linear increase in growth started later than other potato seed tuber. Moreover, the environmental and physiological factors that promote tuber formation have been investigated by many researchers, in particular, short day length and low temperatures, especially at night, enhance tuber initiation and increased number of formed tuber (Cutter,1992; Struik and Ewing,1995 and Kawakami *etal.,*2005).

It may be worth to mention that yield of potato per fed. was highly significant positively correlated with either yield per plant or with average tuber weight Fig (3). A linear correlation coefficients (r) of 0.756 and 0.755 were obtained with yield per plant and average tuber weight, respectively. The corresponding coefficients of determination (r^2) were 0.571 and 0.570 ,which indicated that 57.1 % and 57 % of the variation in tuber yield per fed., were related to yield per plant and average tuber weight. On the other hand, the regression coefficients were 14.96 and 71.5 for yield per plant and average tuber weight, respectively. This indicated that for each increase of one gram yield per plant or one gram per tuber, yield per fed. correspondingly increased by 14.96 or 71.5 kg .Such increase of yield per fed. due to increasing average of tuber weight could be attributed to the high significant positive correlations found between average of tuber weight and either number of leaves /plant (r = 0.971) or average of above ground fresh weight/ plant (r = 0.846).The corresponding regression coefficients (b) were 8.19 and 1.15, respectively which indicated that for each increase of one leaf / plant or one gram of fresh weight /plant , average of tuber weight correspondingly increased by 8.19 gm or 1.15 gm ,respectively (fig , 3) . In conclusion , increasing number of plant leaves (assimilative plant system) led to increasing of plant fresh weight and average of tuber weight which , in turn , led to increase of yield / fed .

On the contrary, potato yield per fed. was negatively correlated with number of tubers per plant . A linear correlation coefficient (r) of - 0.564 was obtained with number of tubers per plant . The corresponding coefficient of determination (r^2) was 0.319 ,which indicated that 31.9 % of the variation in tuber yield per fed. were related to number of tubers per plant. On the other hand, the regression coefficient was -1012 which indicated that for each increase of one tuber per plant, yield per fed. correspondingly decreased by1012 kg

Such decrement of yield / fed. due mainly to average of tuber weight in spite of increasing number of tubers / plant. With this respect, number of shoots was correlated negatively with average tuber weight (r = 0. 912) in spite of it was positively correlated with number of tubers per plant (r = 0.959). The corresponding regression coefficients (b) were 34.36 and 1.908 ,respectively which indicated that for each increase of one shoot / plant, average of tuber weight correspondingly increased by 34.36 gm / tuber and number of tuber / plant decreased by 1.908 tuber (fig , 3) . In conclusion , increasing number of plant shoots led to increasing number of tubers which , in turn , led to a great decrease of tuber weight which reflected on decreasing yield / fed.

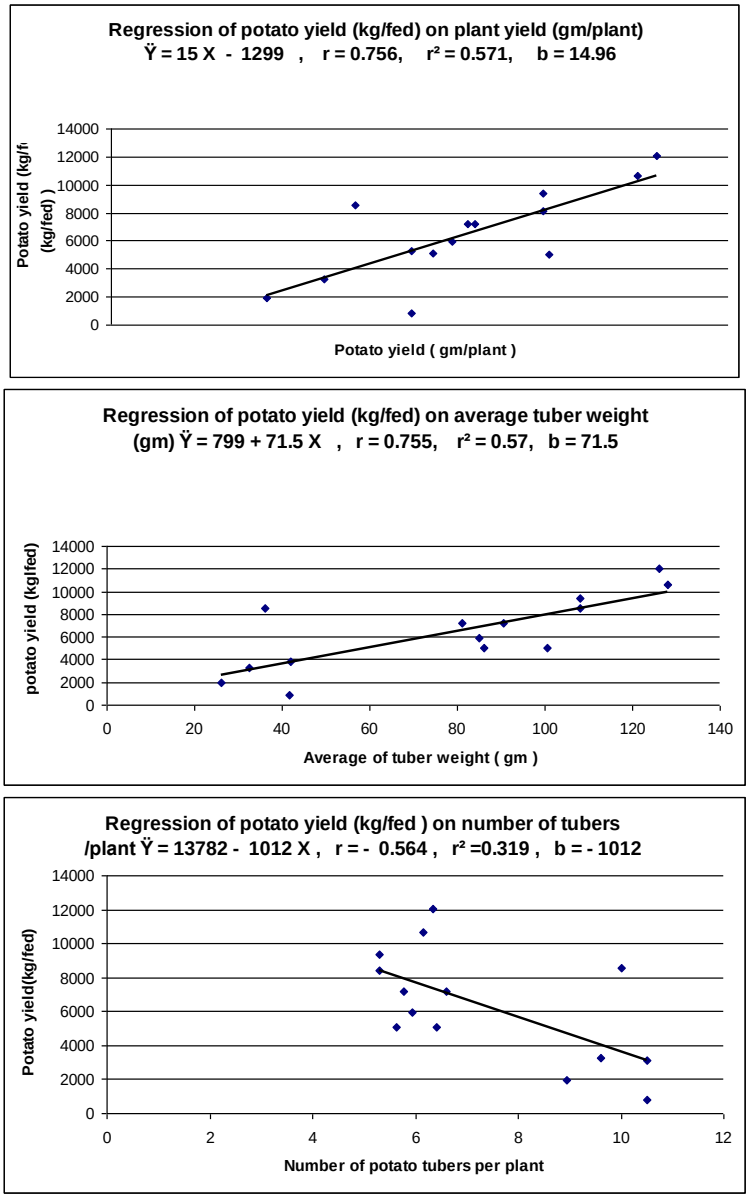

Fig.(3) Regression lines, coefficients of determination (r²) and regression coefficients (b) for either yield /plant , average of tuber weight , or number of tubers /plant vs. yield /fed .

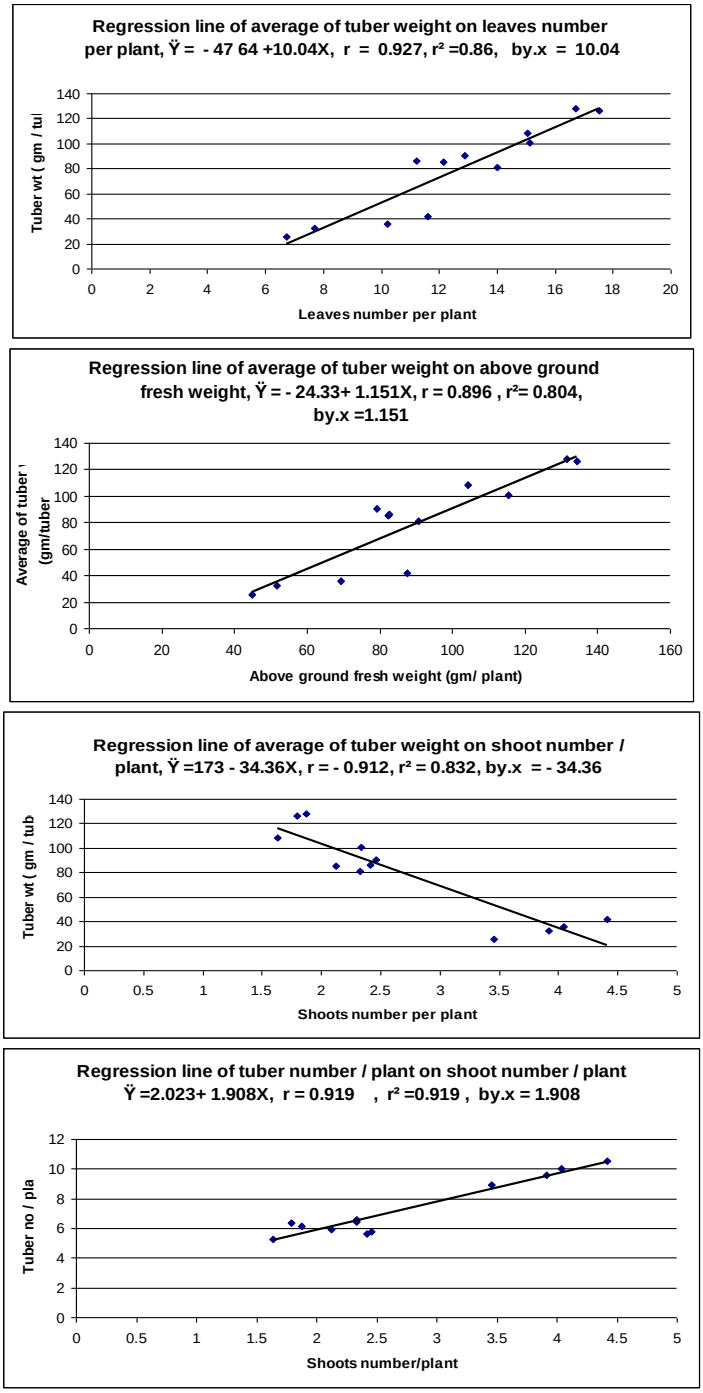

Fig.(4) Regression lines, coefficients of determination (r^2) and regression coefficients (b) for either average of tuber weight vs.leaves no., plant fresh weight or shoots no and tubers no vs. shoots no .

4-Effect of planting dates and seed tuber sources on quality of potato tuber:

Results of potato tuber quality expressed as dry mater and starch contents and specific gravity shown in Table (5) cleared that the effect of planting date on the investigated characters was insignificant . Regarding the effect of potato seed sources, data revealed that the highest values were obtained with imported potato seed treatment, while the lowest values were recorded with the newly produced seeds, i.e., recently harvested. Regarding the effect of the interaction, data in Table (5) showed insignificant effect for the interaction between planting dates and potato seed sources on tuber quality. Similar resulte were obtained by (Darabi, 2013) and dis-agree with Yenagi *et al*.(2004).

Table:(5) Effect of planting date and potato seed tuber sources on tuber dry matter %, starch content and specific gravity.

Parameters		**Tuber dry matter %**		**Starch content %**		**Specific gravity**	
Seasons / Planting dates		**1st Season**	**2nd Season**	**1st Season**	**2nd Season**	**1st Season**	**2nd season**
Date 1 (1st of jan.)		18.48	17.97	12.47	12.01	1.072	1.069
Date 2 (mid of jan.)		18.32	17.92	12.33	11.97	1.070	1.069
Date 3 (1st of Feb.)		18.16	17.57	12.19	11.66	1.070	1.067
Date 4 (mid of Feb.)		17.91	17.64	11.96	11.74	1.069	1.068
LSD at 0.05		NS	NS	NS	NS	NS	NS
Seed tuber sources							
Source 1 (imported)		18.98	18.46	12.92	12.45	1.074	1.072
Source 2 (local)		18.35	17.76	12.36	11.84	1.071	1.068
Source 3 (recently harvested)*		17.32	17.10	11.44	11.24	1.066	1.065
LSD at 0.05		0.22	0.31	0.20	0.27	0.005	0.003
Interaction dates x sources							
Date 1	Source 1	19.13	18.46	13.06	12.45	1.075	1.072
	Source 2	18.85	18.31	12.80	12.32	1.073	1.071
	Source 3	17.44	17.13	11.54	11.26	1.067	1.065
Date 2	Source 1	19.13	18.66	13.05	12.63	1.072	1.073
	Source 2	18.46	17.79	12.45	11.85	1.072	1.068
	Source 3	17.36	17.31	11.48	11.43	1.066	1.066
Date 3	Source 1	19.12	18.19	13.04	12.21	1.075	1.070
	Source 2	18.11	17.44	12.14	11.54	1.070	1.067
	Source 3	17.27	17.09	11.39	11.23	1.066	1.065
Date 4	Source 1	18.53	18.53	12.51	12.51	1.072	1.072
	Source 2	17.98	17.49	12.03	11.64	1.070	1.068
	Source 3	17.21	16.89	11.34	11.06	1.066	1.064
LSD at 0.05		NS	NS	NS	NS	NS	NS

***treated with GA_3**

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تأثير ميعاد الزراعة ومصدر التقاوى على إنتاجية البطاطس بواحة سيوة

سيد سعد جمعة
قسم الانتاج النباتى- مركزبحوث الصحراء- المطرية – القاهرة – مصر

تم إجراء التجربة بمزرعة خميسة ، محطة بحوث سيوة، واحة سيوة، محافظة مطروح، وذلك لدراسة تأثيرأربعة مواعيد زراعة (أول يناير، منتصف يناير،أول فبراير،منتصف فبراير) وكذلك ثلاثة مصادر لتقاوى البطاطس (تقاوى مستوردة – تقاوى كسر محلى - تقاوى حديثة الحصاد معاملة بـ GA_3) على النمو والمحصول للبطاطس تحت ظروف سيوة. وقد أظهرت النتائج أن زراعة البطاطس فى منتصف يناير أو أول فبراير أعطى أفضل نمو للنباتات وأفضل محصول وعلى العكس فإن الزراعة فى أول يناير أو منتصف فبراير أعطى أقل النتائج.
تشير النتائج أن أقل درجه حرارة يبدأ عندها نمو البطاطس صنف سبونتا (صفر النمو) هى ٥.٩٩ درجة مئوية والوحدات الحرارية المتراكمة كانت ١٩١.٥٦ ± ١٢.٤ وحدة حرارية خلال فترة الانبات كما توضح النتائج أن تقاوى البطاطس المستوردة تفوقت تفوقا ملحوظا فى معظم الصفات المدروسة للنمو الخضرى والمحصول ، تلتها تقاوى البطاطس المنتجة محليا وذلك مقارنة بتقاوى البطاطس حديثة الحصاد.
وعموما أكثر النتائج المرضية تم الحصول عليها عند زراعة تقاوى البطاطس المستوردة فى منتصف يناير أو أول فبراير خلال موسمى الدراسة.
تشير النتائج الى وجود علاقة ارتباط معنوى موجبة بين محصول الفدان وكل من محصول النبات ومتوسط وزن الدرنة، وعلى العكس من ذلك وجدت علاقة ارتباط معنوى سالبة بين محصول الفدان ومتوسط عدد درنات النبات. كما وجد أن زيادة عدد الدرنات صاحبه زيادة فى الوزن الطازج للنبات ومتوسط وزن الدرنة ، بينما الزيادة فى عدد الفروع صاحبه زيادة فى عدد الدرنات ونقص فى متوسط وزن الدرنة.

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