

**EFFECT OF CULTIVARS AND HARVESTING DATES
ON THE PRODUCTIVITY AND ROOTS QUALITY
OF SWEET POTATO UNDER SANDY SOIL
CONDITIONS AND DRIP
IRRIGATION SYSTEM**

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ABSTRACT: This work was carried out during the two summer seasons of 2003 and 2004 at El-Khattara Experimental Farm, Fac. Agric., Zagazig University, to study the effect of cultivars and harvesting dates on plant growth, chemical composition, yield and tuber root quality of sweet potato under sandy soil conditions and drip irrigation system.

Abise cv. recorded maximum values of number of branches and leaves / plant, dry weight of branches, leaves and dry weight of vine / plant, chlorophyll b, total chlorophyll (a+b) and carotenoides, average tuber root, N contents in leaves total carbohydrates, sugars and N and K contents in roots, whereas Beauregard cv. recorded maximum values of P content in branches, number of roots/ plant, yield / plant, marketable and total yield/*fed*, carotene, DM (%) and P in roots.

Harvesting date at 90 days after transplanting gave the highest values of number of leaves/ plant, TSS % and P contents in roots, whereas harvesting date at 120 days gave the highest values of vine length, dry weight of branches, leaves and vine, chlorophyll a, b and total (a+b), carotenoides, N and K contents in leaves, yield/ plant, marketable and total yield /*fed*, whereas harvesting date at 150 days gave the highest P and K in leaves, carotene, DM(%), carbohydrate, sugars and K contents in roots.

Abies cv. recorded maximum values of vine length, number of both leaves and branches / plant , dry weight of leaves , branches and vine, chlorophyll a, b and total (a+b) when harvested at 120 days after transplanting , whereas *Beauregard* cv. recorded maximum values of yield/ plant, oversized, marketable and total yield/feddan. *Abies* and *Beauregard* cvs. recorded maximum values of N,P and K contents in leaves and branches, DM %, carbohydrate, sugar , carotene and N and K in roots when harvested at 150 days after transplanting.

Key words: Sweet potato, harvesting dates, cultivars, growth, yield and root quality.

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam.) is a popular vegetable crop in Egypt. It has been cultivated for both human food consumption and starch production , moreover the foliage are used for animal feed. For increasing its total productivity to meet the increment in the human population, that could be achieved through increasing cultivated area especially on sandy soils or through improved cultivars or through determining the suitable time for harvesting.

There are significant differences among sweet potato cultivars for plant growth, plant chemical composition and yield and its components (Shalaby *et al.*, 1993; El-Shimi 1996; Hewedy *et al.*, 1999, Shalaby *et al.*, 2001; Al-Esaily, 2002; Wanas, 2002).

Under sandy soil conditions, Ayoub (2005) found that *Beauregard* cv. recorded superior effect on stem length , dry weight/ plant, NPK uptake of storage root, number and weight of tuber roots/ plant and yield than *Mabrouka* and *Abies* cultivars, whereas *Abies* cv. recorded maximum number of branches/ plant and dry weight of both leaves and branches. *Mabrouka* cv. gained more uptake of N and P by vines, N,P and K by leaves and total uptake of N,P and K and average fresh weight of root and oversized tuber yield/ *fed* than *Abies* and *Beauregard* cultivars.

Dry weight of different plant parts and total dry weight/ plant of sweet potato were increased by delaying harvesting date Shamsuddin and Poul, 1988; Yang and Lui, 1991; Reynodles *et al.*, 1994).

Under sandy soil conditions, Al-Esaily (2002) found that vine length, number of both leaves, branches and storage roots/ plant N,P and K content in leaves and branches, average fresh weight of root and marketable, unmarketable as well as total yield /fed were at least values specially at the earliest harvesting date (110 days), then progressively increased by delaying harvesting up to the last harvesting date (170 days). Vine length, number of both leaves and branches / plant, dry weight of leaves, branches and total dry weight/ plant and storage roots and vines were of higher values in Mabrouka cv. comparing with Beauregard cv. at different harvesting dates (110,130,150 and 170 days) and N,P and K contents in leaves and branches. Yield / plant and per feddan in Mabrouka and Beauregard cvs. were increased by delaying harvesting date until 170 days (Al-Esaily, 2002).

So, the present work was under taken to determine the suitable maturity stage at which sweet potato should be harvested to obtain high yield with good quality of storage roots under sand soil condition.

MATERIALS AND METHODS

Two field experiments were conducted during the two successive summer seasons of 2003 and 2004 at El-Khattara Experimental Farm, Fac. of Agric., Zagazig University , to study the effect of cultivars and harvesting dates on the growth, plant chemical composition , yield and its components as well as tuber roots quality of sweet potato plants under sandy soil conditions and drip irrigation system..

The physical and chemical properties of experimental soil field are presented in Table 1:

This experiment included six treatments which were the combinations of two cultivars; i.e., Abies and Beauregard and three harvesting dates, i.e., 90, 120 and 150 days after transplanting. These treatments were arranged in a split plot design with four replicates. Cultivars were randomly distributed in the main plots and the harvesting dates were randomly assigned in the sub-plots.

The area of experimental unit was 12.6 m². It contains three dripper irrigation lines with 6 m long and 70 cm wide. One dripper

line was used for measuring the vegetative growth characters, while the other two lines were used for measuring the yield and its components. The selected transplants (15-20 cm length) were transplanted with irrigation water at 25 cm apart on May 7th, during summer seasons of 2003 and 2004, just beside the dripper lines, immediately after dipping in fungicide solution of Benlate at a rate of 1 gm/ liter. The source of both sweet potato cultivars was El-Kanater El-Khairia Research Station, Agric. Res. Center, Egypt.

All experimental units received equal amounts of farmyard manure (FYM at 20 m³/fed) at soil preparation and received also equal amounts of ammonium sulphate (20.5% N), potassium sulphate (48-50% K₂O) and calcium superphosphate (15.5 % P₂O₅) at the rates of 400, 400 and 200 kg/fed., respectively. One third of both ammonium sulphate and potassium sulphate were added with FYM at soil preparation time in the center of rows and covered with sand and the two thirds were splitted and

Table 1: The physical and chemical properties of the experimental soil field

| Soil properties | 2003season | 2004season |
|--------------------------------|------------|------------|
| Physical properties (%) | | |
| Sand | 95.72 | 96.23 |
| Silt | 2.15 | 2.46 |
| Clay | 2.13 | 1.31 |
| Texture | Sand | Sand |
| Chemical properties | | |
| pH | 8.01 | 7.96 |
| E.C. (dsm ⁻¹) | 1.99 | 2.11 |
| Organic matter (%) | 0.06 | 0.04 |
| Total N (%) | 0.12 | 0.13 |
| available N (ppm) | 14.98 | 13.13 |
| available P (ppm) | 13.90 | 12.30 |
| available K (ppm) | 67.00 | 64.00 |

Samples of the soil was obtained from 25cm soil surface.

applied in eight portions weekly, beginning 15 days after transplanting. Calcium super-phosphate was added at soil preparation with FYM.

Drip irrigation system was used as a modified method of irrigation. The dripper lines with discharge of 2.1 liter /h. for each dripper at 1 bar. The plants were irrigated at transplanting time, and then 2 days by intervals. The total amounts of water applied to sweet potato plants from transplanting to harvesting date was 3000m³/ feddan. Irrigation was continued till 15 days before harvesting.

The other normal agricultural treatments for growing sweet potato plants were practiced.

Data Recorded

1. Plant growth: A random sample of three plants from every experimental unit were taken at harvesting time (90, 120 or 150 days after transplanting) to determine vine length, number of both branches and leaves, and number of tuber roots/ plant were determined. The different plant parts; i.e., branches and leaves were oven dried at 70°C till constant weight, and the following data were recorded: Dry weight of

branches, leaves and total dry weight of whole plant.

2. Leaf pigments: A random sample from the fourth upper leaf on the main stem was taken at harvest time to determine both chlorophyll a and b, as well as carotenoides according to the method described by Wettstein (1957).

3. Nitrogen, phosphorus and potassium contents: The dry weight of branches, leaves and tuber roots at harvesting time (in the second season), were finely ground and wet digested using sulphuric acid and perchloric acid (3:1). N, P and K were determined on the base of dry weight according to the methods described by Bremner and Mulvaney (1982), Olsen and Sommers (1982), and Jackson (1970), respectively.

4. Yield and Its components: At harvest time the tuber roots of every experimental unit were harvested and weighed, then separated into three grades; i.e., oversized, marketable and culls according to their sizes, as specification down by the Ministry of Economic for sweet potato exportation (1963), and the following data were recorded:

1. Average number of tuber roots/ plant,
2. Average weight of tuber roots/ plant (gm),
3. Total weight of oversized tuber roots (ton/fed): Tuber roots with diameter over 6 cm,
4. Total weight of marketable tuber roots (ton/fed): Tuber roots with diameter between 3-6 cm.,
5. Total weight of culls tuber roots (ton/fed): Tuber roots with diameter less than 3 cm, and
6. Total weight of tuber roots (ton/ fed.) = oversized + marketable + culls tuber roots.

5. Tuber root quality: Dry matter was determined at harvesting and TSS was determined in tuber juice by Carle Zeis refractometer, carotene was determined according to the method by A.O.A.C. (1970), N, P and K by Bremner and Mulvaney (1982), Olsen and Sommers (1982), and Jackson (1970), respectively. While carbohydrate and sugar were determined by Dubois *et al.* (1956) and Forsee (1938) methods, respectively.

Statistical analysis: The obtained data were statistically analysed according to Snedecor and

Cochran (1967) Means separation was done using LSD at 5 % level of probability.

RESULTS AND DISCUSSION

I. Plant Growth

a. Effect of cultivars

Data in Table 2 show that there were significant differences between Abies and Beauregard with respect to vine length, number of both branches and leaves, dry weight of branches, leaves and vine dry weight and number of storage roots in both seasons. Abies cv. exhibited the tallest plants and gave the highest number of branches and leaves, dry weight of branches and leaves as well as vine dry weight compared with Beauregard cultivar, while Beauregard gave the highest number of storage roots. The differences between the two cultivars in this respect might be due to the heredity differences among them. These results agree with those reported by Ayoub (2005) who found that Abies cv. recorded maximum number of branches / plant and dry weight of both leaves and branches than Mabrouka and Beauregard cultivars. Similarly, Shalaby *et al.*

Table 2: Effect of cultivars and harvesting dates on the growth characters of sweet potato plants

| Treatments | Morphological characters / plant | | | Dry weight (gm/ organ) | | | |
|-----------------------------------|----------------------------------|-----------|-------------|------------------------|--------|--------|--------|
| | Vine length (cm) | Number of | | Branches | leaves | Vine | |
| | Branches | leaves | Tuber roots | | | | |
| Effect of cultivars | 2003 season | | | | | | |
| Abies | 93.66 | 45.33 | 454.00 | 2.63 | 90.14 | 87.56 | 177.70 |
| Beauregard | 102.50 | 12.94 | 162.10 | 4.52 | 62.04 | 61.28 | 123.32 |
| LSD at 0.05 level | NS | 08.54 | 30.51 | 1.63 | 17.02 | 16.15 | 17.78 |
| Effect of harvesting dates | | | | | | | |
| 90 days | 83.08 | 26.91 | 336.33 | 4.05 | 59.20 | 60.72 | 119.92 |
| 120 days | 109.33 | 34.08 | 323.33 | 3.32 | 87.08 | 93.18 | 180.26 |
| 150 days | 101.83 | 26.41 | 265.10 | 3.35 | 82.00 | 69.35 | 151.35 |
| LSD at 0.05 level | 9.27 | 3.93 | 58.60 | NS | 10.93 | 10.03 | 12.08 |
| Effect of cultivars | 2004 season | | | | | | |
| Abies | 105.55 | 31.27 | 458.94 | 2.64 | 121.54 | 105.95 | 227.49 |
| Beauregard | 79.50 | 15.44 | 197.88 | 4.33 | 81.82 | 85.71 | 167.54 |
| LSD at 0.05 level | 12.67 | 2.58 | 62.11 | 1.59 | 16.81 | 16.53 | 5.73 |
| Effect of harvesting dates | | | | | | | |
| 90 days | 83.66 | 27.08 | 398.75 | 3.72 | 87.59 | 95.83 | 183.43 |
| 120 days | 102.33 | 24.33 | 370.00 | 3.29 | 104.04 | 109.16 | 213.21 |
| 150 days | 91.58 | 18.66 | 216.50 | 3.27 | 113.41 | 82.50 | 195.91 |
| LSD at 0.05 level | NS | 4.34 | 47.38 | NS | 15.45 | 9.95 | 23.82 |

(1993), El-Shimi(1996), Hewedy *et al.* (1999), Shalaby *et al.* (2001), Al-Esaily (2002) and Wanas (2002) found that there were significant differences among sweet potato cultivars for growth characters.

b. Effect of harvesting dates

Data in Table 2 indicate that harvesting date had significant effect on plant growth, expressed as vine length, number of both leaves and branches / plant and dry weight of leaves, branches and vine/ plant, except number of storage roots/ plant. Delaying harvesting date till 120 days after transplanting gave the tallest plants, and the highest number of branches, dry weight of branches and vine dry weight/ plant, with no significant differences between 90 and 120 with respect to number of leaves/ plant. The increases in vine dry weight were about 50 and 16 % for the harvesting date at 120 days after transplanting over the harvesting date at 90 days in the first and second seasons ,respectively. In this connection, it could be suggested that plants at the earliest stage (90 days) did not reach the full development yet, so they showed the least values of dry

weight of leaves, branches and vine dry weight / plant.

These results agree with those reported by Shamsuddin and Poul (1988) Yang and Lui (1991), Reynolds *et al.* (1994) and Al-Esaily (2002) on sweet potato.

c. Effect of interaction between cultivars and harvesting dates

Results in Table 3 illustrate that the interaction between cultivars and harvesting date had significant effect on vine length, number of both leaves and branches / plant, dry weight of leaves, branches and vine dry weight / plant. In general, vine length, number of both leaves and branches / plant, number of tuber roots/ plant, dry weight of branches, leaves and vine / plant decreased with delaying harvesting date till 150 days after transplanting for both Abies and Beauregard .Abies cv. at 120 days after transplanting gave the tallest plants and recorded maximum values of number of branches and dry weight of leaves and branches and vine dry weight, while Abies at 90 days after transplanting recorded maximum number of leaves / plant. Beauregard at 120 days after transplanting gave the highest values of tuber roots / plant. These results may be due to

Table 3: Effect of interaction between cultivars and harvesting dates on the growth characters of sweet potato plants

| Treatments | | Morphological characters/ plant | | | Dry weight (gm/ organ) | | | |
|-------------------------------------|-----------------|---------------------------------|-----------|--------|------------------------|----------|--------|--------|
| | | Vine length (cm) | Number of | | | Branches | leaves | Vine |
| | | | Branches | leaves | Tuber roots | | | |
| Cultivars X Harvesting dates | | | | | | | | |
| Abies | 90 days | 79.83 | 43.66 | 515.00 | 3.33 | 71.24 | 65.17 | 136.41 |
| | 120 days | 108.16 | 50.83 | 452.00 | 2.25 | 100.98 | 99.76 | 200.74 |
| | 150 days | 93.00 | 41.50 | 395.00 | 2.32 | 98.22 | 97.75 | 195.97 |
| Beauregard | 90 days | 86.33 | 10.16 | 157.66 | 4.78 | 47.16 | 56.28 | 103.44 |
| | 120 days | 110.50 | 17.33 | 194.66 | 4.40 | 73.18 | 86.61 | 159.79 |
| | 150 days | 110.66 | 11.33 | 135.00 | 4.39 | 65.78 | 40.96 | 106.74 |
| LSD at 0.05 level | | 13.12 | 5.56 | 82.88 | 2.33 | 15.46 | 14.19 | 17.08 |
| Cultivars X Harvesting dates | | | | | | | | |
| Abies | 90 days | 104.33 | 38.50 | 647.33 | 3.56 | 98.58 | 105.95 | 204.53 |
| | 120 days | 114.66 | 31.16 | 409.50 | 2.11 | 127.08 | 118.86 | 245.94 |
| | 150 days | 97.66 | 24.16 | 320.00 | 2.25 | 138.96 | 93.04 | 232.01 |
| Beauregard | 90 days | 63.00 | 15.66 | 150.16 | 4.22 | 76.61 | 85.71 | 162.33 |
| | 120 days | 90.00 | 17.50 | 330.50 | 4.44 | 81.00 | 99.47 | 180.47 |
| | 150 days | 85.50 | 13.16 | 113.00 | 4.33 | 87.86 | 71.96 | 159.82 |
| LSD at 0.05 level | | 31.26 | 6.14 | 67.01 | 1.96 | 21.85 | 14.08 | 33.69 |

2003 season

2004 season

the genetical differences between two cultivars.

2. Leaf Pigments

a. Effect of cultivars

Data in Table 4 show that *Abies* and *Beauregard* cvs. Did not reflect significant effect on leaf pigments, chl. a, b, total (a+b) and carotenoides, in the first season, and chl. a in the second season, but had significant effect on chl. b, total (a+b) and carotenoides in the second season only. Whereas, *Abies* cv. was the superior one. Al-Easily (2002), under sandy soil conditions, found significant differences among sweet potato cultivars for chlorophyll a,b, total (a+b) and carotenoides in leaf tissues.

b. Effect of harvesting dates

Results in Table 4 illustrate that harvesting date had significant effect on concentration of chlorophylls a, b, total (a+b) and carotenoides in leaf tissues in both seasons. Harvesting date at 120 days after transplanting recorded, in general, maximum chlorophylls and carotenoides in leaf tissues. On the other hand, these pigments decreased with delaying harvesting date up to 150 days after transplanting.

c. Effect of interaction between cultivars and harvesting dates

Presented data in Table 5 indicate that the interaction between cultivars and harvesting dates had significant effect on concentration of chlorophyll a, b, total (a+b) and carotenoides in leaf tissues in both seasons. In general, chlorophylls a, b, total (a+b) and carotenoides increased with delaying harvesting date until 120 days for both cultivars. *Abies* cv. at harvesting date 120 days after transplanting recorded maximum values of chlorophylls and carotenoides in leaf tissues in both seasons, with no significant differences with *Beauregard* in the first seasons only. These results might be owe much to the differences heredity among cultivars.

3. Plant Chemical Composition

a. Effect of cultivars

Data in Table 6 show that there were significant differences between *Abies* and *Beauregard* cultivars for P content in branches and N content in leaves. *Beauregard* cv. recorded maximum P contents in branches, whereas *Abies* cv. recorded maximum N contents in leaves. These results agree with those reported by Al-Esaily (2002) who found that N, P and K contents in leaves and branches were increased in

Table 4: Effect of cultivars and harvesting dates on the leaf pigments (mg/gm dry weight) of sweet potato leaves

| Treatments | Chlorophyll | | | Carotenoides |
|-----------------------------------|-------------|------|-------------|--------------|
| | a | b | Total (a+b) | |
| Effect of cultivars | 2003season | | | |
| Abies | 2.52 | 2.51 | 5.03 | 2.77 |
| Beauregard | 2.36 | 2.42 | 4.78 | 2.59 |
| LSD at 0.05 level | NS | NS | NS | NS |
| Effect of harvesting dates | | | | |
| 90 days | 1.96 | 2.11 | 4.07 | 2.34 |
| 120 days | 3.66 | 3.96 | 7.62 | 3.92 |
| 150 days | 1.71 | 1.33 | 3.04 | 1.79 |
| LSD at 0.05 level | 1.00 | 0.78 | 1.74 | 0.79 |
| Effect of cultivars | 2004 season | | | |
| Abies | 2.28 | 2.14 | 4.43 | 2.66 |
| Beauregard | 1.77 | 1.42 | 3.19 | 2.01 |
| LSD at 0.05 level | NS | 0.64 | 1.08 | 0.57 |
| Effect of harvesting dates | | | | |
| 90 days | 0.89 | 1.10 | 1.99 | 1.36 |
| 120 days | 2.77 | 2.49 | 5.26 | 3.17 |
| 150 days | 2.42 | 1.75 | 4.17 | 2.47 |
| LSD at 0.05 level | 0.60 | 0.41 | 0.95 | 0.55 |

Table 5: Effect of interaction between cultivars and harvesting dates on the leaf pigments (mg/gm/dry weight) of sweet potato leaves

| Treatments | | Chlorophyll | | | Carotenoides |
|------------------------------|----------|-------------|------|-------------|--------------|
| | | a | b | Total (a+b) | |
| Cultivars X Harvesting dates | | 2003season | | | |
| Abies | 90 days | 1.99 | 1.97 | 3.96 | 2.35 |
| | 120 days | 3.81 | 4.07 | 7.88 | 4.16 |
| | 150 days | 1.77 | 1.51 | 3.28 | 1.81 |
| Beauregard | 90 days | 1.93 | 2.26 | 4.19 | 2.33 |
| | 120 days | 3.52 | 3.84 | 7.36 | 3.68 |
| | 150 days | 1.65 | 1.16 | 2.81 | 1.77 |
| LSD at 0.05 level | | 1.42 | 1.11 | 2.49 | 1.13 |
| Cultivars X Harvesting dates | | 2004 season | | | |
| Abies | 90 days | 1.07 | 1.32 | 2.39 | 1.54 |
| | 120 days | 3.12 | 2.96 | 6.09 | 3.74 |
| | 150 days | 2.67 | 2.14 | 4.81 | 2.70 |
| Beauregard | 90 days | 0.72 | 0.88 | 1.60 | 1.18 |
| | 120 days | 2.42 | 2.02 | 4.44 | 2.60 |
| | 150 days | 2.18 | 1.36 | 3.54 | 2.24 |
| LSD at 0.05 level | | 0.84 | 0.58 | 1.34 | 0.78 |

Table 6: Effect of cultivars and harvesting dates on minerals content (%) of sweet potato plants in 2004 season

| Treatments | Minerals content (%) | | | | | |
|-----------------------------------|----------------------|-------|------|--------|-------|------|
| | Branches | | | Leaves | | |
| | N | P | K | N | P | K |
| Effect of cultivars | | | | | | |
| Abies | 3.61 | 0.330 | 1.71 | 4.51 | 0.311 | 3.60 |
| Beauregard | 2.55 | 0.486 | 1.63 | 3.87 | 0.327 | 3.02 |
| LSD at 0.05 level | NS | 0.092 | NS | 0.50 | NS | NS |
| Effect of harvesting dates | | | | | | |
| 90 | 3.01 | 0.373 | 0.81 | 4.54 | 0.300 | 2.74 |
| 120 | 3.38 | 0.395 | 1.71 | 4.70 | 0.295 | 3.87 |
| 150 | 2.85 | 0.456 | 2.50 | 3.34 | 0.363 | 3.33 |
| LSD at 0.05 level | NS | 0.032 | 0.24 | 0.33 | 0.032 | 0.32 |

Mabrouka compared with Beauregard .

b. Effect of harvesting dates

Data in Table 6 indicate that harvesting date had significant effect on N, P and K contents in leaves and branches, except N content in branches. P and K contents in branches and P contents in leaves were significantly increased by delaying harvesting date till 150 days, whereas N and K contents in leaves were significantly increased by delaying harvesting date till 120 days. These results agree with those reported by Al-Esaily (2002) who found that N, P and K content in leaves and branches were progressively increased by delaying harvesting date. These results suggested that delaying harvesting of sweet potato gave chance to plants to more absorb minerals in different plant organs.

c. Effect of interaction between cultivars and harvesting dates

Data in Table 7 indicate that the interaction between cultivars and harvesting dates had significant effect on N, P and K contents in branches and leaves. In general, N, P and K contents were increased by delaying harvesting dates in both cultivars. cv Abies gave

higher N contents in branches and N and K contents in leaves when harvested at 120 days after transplanting, whereas cv Beauregard gave higher P and K contents in branches and P contents in leaves when harvested at 150 days after transplanting with no significant differences between the two cultivars.

4. Yield and its Components

4.1 Yield of oversized, marketable and culls

a. Effect of cultivars

Data in Table 8 show that there were significant differences between Abies and Beauregard cultivars for number of storage roots/ plant, average storage root weight, yield / plant, weight of oversized, marketable, culls and total yield/ *fed* in both seasons, except yield of oversized in the second season and yield of culls/ *fed* in both seasons. In general, Beauregard cv. gave the highest values of number of storage roots/ plant, yield/ plant, and weight of marketable and total yield / *fed*, whereas Abies cv. gave the highest average storage root weight and yield of culls/*feddan*. These results agree with those reported by Shalaby *et al.* (1993), El-Shimi (1996), Hewedy *et al.* (1999), Shalaby *et al.* (2001), Al-Esaily *et*

Table 7: Effect of interaction between cultivars and harvesting dates on minerals content (%) of sweet potato plants in 2004 season

| Treatments | | Minerals content (%) | | | | | |
|--------------------------|------------------|----------------------|-------|------|--------|-------|------|
| | | Branches | | | Leaves | | |
| Cultivars | Harvesting dates | N | P | K | N | P | K |
| Abies | 90 | 3.43 | 0.297 | 0.86 | 4.90 | 0.307 | 3.05 |
| | 120 | 4.26 | 0.293 | 1.87 | 5.09 | 0.290 | 4.15 |
| | 150 | 3.15 | 0.400 | 2.42 | 3.56 | 0.337 | 3.62 |
| Beauregard | 90 | 2.60 | 0.450 | 0.76 | 4.19 | 0.293 | 2.43 |
| | 120 | 2.51 | 0.497 | 1.56 | 4.32 | 0.300 | 3.60 |
| | 150 | 2.55 | 0.513 | 2.58 | 3.12 | 0.390 | 3.04 |
| LSD at 0.05 level | | 1.36 | 0.045 | 0.34 | 0.47 | 0.046 | 0.45 |

Table 8: Effect of cultivars and harvesting dates on yield and its components of sweet potato

| Chara Treatments | No. of roots /plant | Average root weight (gm) | Yield / plant (kg) | Yield of tuber roots (ton/fed.) | | | |
|-----------------------------------|---------------------------|-----------------------------------|-----------------------|---------------------------------|-------|-------|--------|
| | | | | Oversized | Mark | Culls | Total |
| Effect of cultivars | | | | 2003 season | | | |
| Abies | 2.63 | 223.33 | 0.545 | 2.383 | 6.154 | 1.836 | 10.375 |
| Beauregard | 4.52 | 165.00 | 0.746 | 5.430 | 9.505 | 1.097 | 14.227 |
| LSD. at 0.05 level | 1.43 | 51.00 | 0.180 | 1.135 | 3.090 | NS | 3.160 |
| Effect of harvesting dates | | | | 2003 season | | | |
| 90 days | 4.05 | 87.50 | 0.354 | 0.000 | 4.694 | 1.524 | 6.220 |
| 120 days | 3.32 | 230.00 | 0.764 | 2.574 | 9.854 | 1.708 | 14.138 |
| 150 days | 3.35 | 265.00 | 0.852 | 6.436 | 8.939 | 1.167 | 16.542 |
| LSD at 0.05 level | NS | 49.00 | 0.325 | 2.230 | 2.531 | 0.315 | 4.610 |
| Effect of cultivars | | | | 2004 season | | | |
| Abies | 2.64 | 266.33 | 0.589 | 3.190 | 5.383 | 1.282 | 9.917 |
| Beauregard | 4.33 | 180.33 | 0.785 | 3.627 | 8.486 | 1.260 | 13.375 |
| LSD at 0.05 level | 1.59 | 36.39 | 0.163 | NS | 2.660 | NS | 2.860 |
| Effect of harvesting dates | | | | 2004 season | | | |
| 90 days | 3.89 | 88.50 | 0.340 | 00.00 | 3.957 | 2.002 | 5.960 |
| 120 days | 3.27 | 256.00 | 0.783 | 3.080 | 9.764 | 0.858 | 13.705 |
| 150 days | 3.29 | 300.00 | 0.937 | 7.238 | 7.083 | 0.952 | 15.273 |
| LSD at 0.05 level | NS | 29.07 | 0.209 | 1.833 | 2.360 | 0.226 | 3.490 |

al. (2002) , Wanas (2002) and Ayoub (2005) on sweet potato.

b. Effect of harvesting dates

Data in Table 8 indicate that harvesting date had significant effect on average storage root weight, yield / plant, weight of oversized, marketable, culls and total yield/ *fed*, but had no significant effect on number of storage roots/ plant. Whereas, average storage root weight, yield/ plant, oversized, marketable and total yield /*fed* were significantly increased with delaying harvesting date till 150 days after transplanting with no significant differences between 120 and 150 days, with respect to yield / plant and marketable and total yield/ *fed*. This means that harvesting date at 120 days after transplanting gave the highest values of yield/ plant, marketable and total yield/ *fed* , whereas harvesting at 150 days gave the highest average storage root weight and oversized yield/ *fed*. Harvesting date at 90 days recorded maximum yield of culls/ *fed*. These results agree with those reported by Al-Esaily,(2002).

c. Effect of interaction between cultivars and harvesting dates

Results in Table 9 show that the interaction between cultivars and harvesting date had significant effect on number of storage roots/

plant, average storage root weight, yield / plant, weight of oversized, marketable, culls and total yield/ *fed* in both seasons. In both cultivars (Abies and Beauregard), all above mentioned characters increased with delaying harvesting date until 150 days after transplanting, except yield of culls decreased. Beauregard cv. at 120 days recorded maximum marketable yield and at 150 days recorded maximum yield /plant, oversized and total yield/ *fed*, whereas Abies cv. at 90 days recorded maximum yield of culls/ feddan in the second season. The increase in culls at early harvesting might be attributed to that at early storage the small roots did not take good chance to enhance carbohydrate-synthesis and more carbohydrate and starch storage in small roots. These results agree with results reported by Al-Esaily (2002).

4.2 Percentage of oversized, marketable and culls yield.

a. Effect of cultivars

Data in Table 10 show that Beauregard cv. recorded maximum percentage of marketable yield, whereas Abies cv. recorded maximum percentage of culls.

b. Effect of harvesting dates

Data in Table 10 show that, in general, the percentage of

Table 9: Effect of interaction between cultivars and harvesting date on yield and its components of sweet potato plants

| Treatments | No. of roots /plant | Average root weight (gm) | Yield / plant (kg) | Yield of tuber roots (ton/fed) | | | | |
|-------------------------------------|---------------------|--------------------------|--------------------|--------------------------------|------------|--------|-------|--------|
| | | | | Oversized | Marketable | Culls | Total | |
| Cultivars X Harvesting dates | | | | 2003 season | | | | |
| | 90 days | 3.33 | 100 | 0.333 | 0.000 | 3.923 | 2.070 | 5.995 |
| Abies | 120 days | 2.25 | 270 | 0.608 | 2.180 | 7.056 | 1.973 | 11.210 |
| | 150 days | 2.32 | 300 | 0.696 | 4.969 | 7.483 | 1.466 | 13.920 |
| Beauregard | 90 days | 4.78 | 75.0 | 0.358 | 0.000 | 5.466 | 0.978 | 6.445 |
| | 120 days | 4.40 | 190 | 0.836 | 2.969 | 12.653 | 1.444 | 17.066 |
| | 150 days | 4.39 | 230 | 1.009 | 7.904 | 10.396 | 0.869 | 19.170 |
| LSD at 0.05 level | | 2.11 | 70.0 | 0.465 | 3.196 | 3.619 | 0.453 | 6.589 |
| Cultivars X Harvesting dates | | | | 2004 season | | | | |
| | 90 days | 3.56 | 98.0 | 0.348 | 0.000 | 3.424 | 2.665 | 6.090 |
| Abies | 120 days | 2.11 | 303 | 0.639 | 2.774 | 7.969 | 0.440 | 11.185 |
| | 150 days | 2.25 | 347 | 0.780 | 6.980 | 4.757 | 0.741 | 12.478 |
| Beauregard | 90 days | 4.22 | 79.0 | 0.333 | 0.000 | 4.490 | 1.339 | 5.830 |
| | 120 days | 4.44 | 209 | 0.927 | 3.387 | 11.560 | 1.277 | 16.225 |
| | 150 days | 4.33 | 253 | 1.095 | 7.496 | 9.409 | 1.164 | 18.070 |
| LSD at 0.05 level | | 1.96 | 51.0 | 0.370 | 3.216 | 4.110 | 0.401 | 6.413 |

Table 10: Effect of cultivars and harvesting dates on percentage of oversized, marketable and culls yield of sweet potato plants

| Treatments | (%) | | |
|-----------------------------------|--------------------|------------|-------|
| | Oversized | Marketable | Culls |
| Effect of cultivars | 2003season | | |
| Abies | 22.96 | 59.31 | 17.69 |
| Beauregard | 25.88 | 67.87 | 7.83 |
| Effect of harvesting dates | | | |
| 90 days | 00.00 | 75.46 | 24.50 |
| 120 days | 18.20 | 69.70 | 12.08 |
| 150 days | 38.89 | 54.02 | 7.05 |
| Effect of cultivars | 2004 season | | |
| Abies | 26.64 | 55.19 | 17.87 |
| Beauregard | 20.78 | 66.77 | 12.42 |
| Effect of harvesting dates | | | |
| 90 days | 00.00 | 66.61 | 33.36 |
| 120 days | 22.44 | 71.24 | 5.90 |
| 150 days | 48.70 | 45.08 | 6.22 |

oversized yield was increased with delaying harvesting date until 150 days, whereas marketable and culls decreased. Harvesting date at 150 days gave the highest percentage of oversized yield; at 120 days gave the highest percentage of marketable yield, and at 90 days recorded maximum percentage of culls yield. It could be also explained that the increase in oversized roots at late harvesting might be due to enhancing of carbohydrate syntheses and more storage in roots.

c. Effect of interaction between cultivars and harvesting dates

Data in Table 11 indicate that percentage of oversized tuber yield was increased with delaying harvesting date until 150 days, but percentage of marketable and culls decreased for both cultivars. *Abies* and *Beauregard* cvs recorded maximum percentage of oversized yield at 150 days, total yield percentage at 120 days and percentage of culls yield at 90 days after transplanting.

5. Tuber Root Quality

a. Effect of cultivars

Data In Table 12 illustrate that *Abies* cv. recorded maximum values of total carbohydrates and

sugars, N and K contents in tuber roots, while *Beauregard* cv. recorded maximum carotene, DM % and P contents in tuber roots.

b. Effect of harvesting dates

Results in Table 12 show that carotene, DM %, carbohydrates, sugars and K contents in tuber roots were significantly increased by delaying harvesting date till 150 days after transplanting, whereas P content in roots was decreased by delaying harvesting dates.

c. Effect of interaction between cultivars and harvesting dates

In general, carotene, DM (%), carbohydrates, sugars, and N and K contents were increased in both cultivars by delaying harvesting date till 150 days, while TSS and P contents were decreased, in both cultivars, were delaying harvesting date (Table13). In general, *Abies* cv. recoded maximum TSS, DM %, carbohydrates, sugars and N contents in roots when harvested at 120 days and recorded maximum K contents when harvested at 150 days. *Beauregard* recorded maximum carotene, TSS, DM %, carbohydrates and sugars when harvested at 150 days and recorded maximum P when harvested at 90 days.

Table 11: Effect of interaction between cultivars and harvesting dates on Percentage of oversized, marketable and culls yield of sweet potato plants

| Treatments | | (%) | | |
|--------------------|-------------------------|-------------|------------|-------|
| | | Oversized | Marketable | Culls |
| Cultivars X | Harvesting dates | 2003season | | |
| Abies | 90 days | 00.00 | 65.43 | 34.52 |
| | 120 days | 19.44 | 62.94 | 17.60 |
| | 150 days | 35.69 | 53.75 | 10.53 |
| Beauregard | 90 days | 00.00 | 84.80 | 15.17 |
| | 120 days | 17.39 | 74.14 | 8.46 |
| | 150 days | 41.23 | 54.23 | 4.53 |
| Cultivars X | Harvesting dates | 2004 season | | |
| Abies | 90 days | 00.00 | 56.22 | 43.76 |
| | 120 days | 24.01 | 71.24 | 3.93 |
| | 150 days | 55.92 | 38.11 | 5.93 |
| Beauregard | 90 days | 00.00 | 77.01 | 22.96 |
| | 120 days | 20.87 | 71.24 | 7.87 |
| | 150 days | 41.48 | 52.06 | 6.44 |

Table 12: Effect of cultivars and harvesting dates on the root quality of sweet potato plants in 2004 season

| Treatments | Root quality at harvesting date | | | | | | | |
|-----------------------------------|---------------------------------|------|-------------------|--------------|-------|---------------------|-------|-------|
| | Carotene mg/gm FW | TSS | Dry matter (%) | Total (%) | | Mineral content (%) | | |
| | | | | Carbohydrate | Sugar | N | P | K |
| Effect of cultivars | | | | | | | | |
| Abies | 1.69 | 7.38 | 16.06 | 82.77 | 14.09 | 3.02 | 0.195 | 1.414 |
| Beauregard | 2.16 | 7.27 | 18.94 | 80.04 | 12.58 | 2.82 | 0.312 | 0.810 |
| LSD at 0.05 level | 0.20 | NS | 1.52 | 2.00 | 0.61 | 0.19 | 0.05 | 0.480 |
| Effect of harvesting dates | | | | | | | | |
| 90 days | 1.62 | 7.99 | 11.07 | 77.63 | 12.37 | 2.76 | 0.371 | 0.790 |
| 120 days | 1.77 | 7.24 | 21.94 | 82.13 | 13.66 | 3.09 | 0.208 | 0.700 |
| 150 days | 2.39 | 7.24 | 19.94 | 84.46 | 13.97 | 2.91 | 0.181 | 1.830 |
| LSD. at 0.05 level | 0.19 | NS | 2.82 | 1.34 | 0.93 | NS | 0.02 | 0.190 |

Table 13: Effect of interaction between cultivars and harvesting dates on the root quality of sweet potato plants in 2004 season

| Treatments | | Carotene mg/gm FW | TSS | Dry matter (%) | Total (%) | | Mineral content (%) | | |
|-------------------|-----------------------|-------------------------|------|----------------------|--------------|-------|---------------------|-------|------|
| | | | | | Carbohydrate | Sugar | N | P | K |
| Cultivars | X Harvesting dates | | | | | | | | |
| Abies | 90 days | 1.39 | 7.66 | 8.13 | 80.33 | 13.74 | 2.88 | 0.230 | 0.89 |
| | 120 days | 1.45 | 7.33 | 23.25 | 83.46 | 14.08 | 3.02 | 0.177 | 0.76 |
| | 150 days | 2.24 | 7.16 | 16.81 | 84.53 | 14.45 | 3.17 | 0.180 | 2.58 |
| Beauregard | 90 days | 1.86 | 7.33 | 14.02 | 74.93 | 11.01 | 2.65 | 0.513 | 0.70 |
| | 120 days | 2.09 | 7.16 | 18.81 | 80.80 | 13.24 | 3.17 | 0.240 | 0.64 |
| | 150 days | 2.53 | 7.33 | 23.08 | 84.40 | 13.49 | 2.65 | 0.183 | 1.09 |
| LSD at 0.05 level | | 0.27 | 0.41 | 3.86 | 1.89 | 1.31 | 0.44 | 0.03 | 0.27 |

From the aforementioned results, it could be suggested that Beauregard cv. gave the highest yield owing, directly, to the increase in number of storage roots, root/plant and yield / plant and more DM building as well as low cull quantity. The variation between cultivars is due to heredity.

In this respect, delaying harvesting date till 120 and 150 days after transplanting gave the maximum total sweet potato yield, with no significant differences. This increments in total yield owing directly to the vigor growth, chlorophylls and minerals contents and more carbohydrate- synthesis and activation of enzymes and translocation of carbohydrate. This in turn led to increased the capacity of plant in building high yield of storage roots with good quality. So that, it could be recommended, economically, harvest that sweet potato after 120 days from transplanting under the condition of sandy soil and drip irrigation system.

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تأثير الأصناف و مواعيد الحصاد علي إنتاجية وجودة جذور البطاطا تحت ظروف الأراضي الرملية ونظام الري بالتنقيط

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أجريت تجربتان حقليتان خلال موسمي صيف ٢٠٠٣ و ٢٠٠٤ فسي مزرعة التجارب الزراعية بالخطرة التابعة لكلية الزراعة - جامعة الزقازيق، بهدف دراسة تأثير الأصناف وميعاد الحصاد على النمو، والمحتوى الكيماوي للنبات، والمحصول وجودة الجذور المتدنة للبطاطا تحت ظروف الأراضي الرملية ونظام الري بالتنقيط.

سجل الصنف أبيض أعلى القيم لكل من عدد الأوراق والجذور المتدنة للنبات بو الوزن الجاف لكل من الأفرع والأوراق والمجموع الخضري بو كلوروفيل ب، الكلوروفيل الكلى (أ+ب)، الكاروتينويدات، ومتوسط وزن الجذر، و محتوى الأوراق من النيتروجين، ومحتوى الجذور من كل من الكربوهيدرات، السكريات الكلية، النيتروجين والبوتاسيوم، بينما سجل الصنف بيروجارد أعلى القيم لكل من محتوى الأفرع من البوتاسيوم، عدد الجذور على النبات، ومحصول النبات، والمحصول القابل للتسويق، والمحصول الكلى، ومحتوى الجذور من كل من الكاروتين، المادة الجافة والفوسفور.

أعطى ميعاد الحصاد بعد ٩٠ يوم من الشتل أعلى القيم لكل من عدد الأوراق على النبات، ومحتوى الجذور من المواد الصلبة الذائبة والفوسفور، بينما أعطى ميعاد الحصاد بعد ١٢٠ يوم من الشتل أعلى القيم لكل من طول النبات، وعدد الأفرع على النبات، واوزن الجاف لكل من الأفرع والأوراق والمجموع الخضري، وكلوروفيل أ، ب، الكلوروفيل الكلى (أ+ب)، الكاروتينويدات، ومحتوى الأوراق من النيتروجين والبوتاسيوم، و محصول النبات، والمحصول القابل للتسويق والمحصول الكلى. بينما أعطى ميعاد الحصاد بعد ١٥٠ يوم من الشتل أعلى القيم لكل من محتوى الأفرع من الفوسفور والبوتاسيوم ومحتوى الأوراق من البوتاسيوم وكذلك محتوى الجذور من كل من الكاروتين، والمادة الجافة، والكربوهيدرات، والسكريات الكلية والبوتاسيوم

سجل حصاد الصنف أبيض بعد ١٢٠ يوم من الشتل أعلى القيم لكل من ارتفاع النبات، وعدد الأوراق والأفرع على النبات، والوزن الجاف للعرش (الأفرع + الأوراق)، وكلوروفيل أ، ب، الكلوروفيل الكلى (أ+ب)، الكاروتينويدات، بينما أدى حصاد الصنف بيروجارد بعد ١٢٠ يوم من الشتل أعلى القيم لكل من محصول النبات، الجذور الكبيرة، والمحصول القابل للتسويق وكذلك محصول الغدان، بينما سجل كل من الصنفين أبيض و بيروجارد أعلى القيم لكل من محتوى الأوراق والأفرع من النيتروجين والفوسفور والبوتاسيوم، وكذلك محتوى الجذور من المادة الجافة والكربوهيدرات والسكريات الكلية والكاروتين والنيتروجين والبوتاسيوم مع تأخير الحصاد حتى ١٥٠ يوم بعد الشتل.