

## EVALUATION OF 24 POTATO CULTIVARS UNDER CENTRAL SAUDI ARABIA CONDITIONS

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### ABSTRACT

Two field experiments were conducted during autumn of 1996/97 and 1997/98 at the Experimental Farm of the College of Agriculture and Veterinary Medicine, King Saud University in Al-Qassim area, to evaluate the vegetative and reproductive performance of 24 potato cultivars introduced from the Netherlands, under Al-Qassim environmental conditions. The results indicated that there were considerable variations among the different studied cultivars with respect to the time taken from planting to emergence. Cv. Lola exhibited the earliest emergence, whereas the longest period from planting to emergence was exhibited by cv. Lemhi. Likewise, remarkable differences in foliage coverage percentages among the different cultivars were also observed during the growing period. Cv. Kingston resulted in the highest foliage coverage percentages in comparison to the other cultivars, since it attained 25.70, 50.30, 55.00 and 65.50% foliage coverage after 45, 60, 70 and 90 days from planting time, respectively. On the other hand, cv. Dundrum gave the poorest vegetative growth all over the growing period compared to the other cultivars. Cv. Cardinal resulted in the highest tuber yield (37.33 Ton/ha.) followed by cv. Mirka, Arranbanner, Morene and Diamont in a descending order. However there were no significant differences among the previously mentioned cultivars regarding to the tuber yield.

Therefore, cv. Diamont showed a high performance for cultivation under Al-Qassim environmental conditions, as it gave about 97% marketable yield out of the total tuber yield which is significantly higher than the performance of other cultivars.

**Key words:** *cultivars, environmental conditions, potato.*

## 1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is considered one of the most important vegetable crops all over the world. Among the world's most important food crops, it ranks first in terms of volume of the fresh product (Hardenburg, 1949), and fourth in world production in terms of human nutrition (Rowe, 1993). Between 10 top ranking food crops, potato is ranking first in terms of energy and third in terms of both dry matter production and protein content (Van der Zaag, 1991). In 1994, Saudi Arabia imported 99463 MT and exported 9049 MT of potatoes (FAO, 1994). According to the Ministry of Agriculture and Water in Saudi Arabia report's, potato ranks third among vegetable crops in terms of total planting area and production. In 1996, the planted area in Saudi Arabia was 17746 hectare, while the production was 349000MT. Every year, Saudi Arabia imports potato seeds mainly from Europe containing several varieties. Therefore, it is important to have an evaluating study for some potato cultivars. Also, screening potato cultivars for good quantitative and qualitative characteristics was and still is the aim of many investigators. Randhawa *et al.*, (1984) compared six genotypes of potato with two commercial cultivars grown in India. He found that there were significant differences among different genotypes with respect to yield and mineral contents. Tibbits *et al.* (1992) found that potato cultivars grown in Madison (USA) differ significantly in their response to light and high temperature. He added that both Harg and Rutt cultivars were the only two cultivars that performed well under continuous irradiation and high temperature. Moreover, Kieinkopf *et al.*, (1981) mentioned that the rate and duration of tuber growth, nutrient uptake and dry matter accumulation were controlled not only by the genotype but also by the environmental conditions. Furthermore, Utheib *et al.*, (1981) assured that the tuber yield of potatoes is greatly influenced by planting dates and other

environmental conditions. Tsao (1986) found that there were significant differences in both yield and specific gravity between 14 potato cultivars grown under Taiwan environmental conditions.

It is evident from the previously mentioned review of literature that the obtained results by different authors are hardly compared and less suitable for common interpretations. Since these studies were carried out on various potato genotypes grown under different environmental conditions. Therefore, it seems necessary to make an attempt through this study for evaluating and screening some imported potato cultivars under local conditions.

## 2. MATERIALS AND METHODS

This study was conducted at the Experimental Farm of the College of Agriculture and Veterinary Medicine, King Saud University, Al-Qassim branch during autumn seasons of 1996 and 1997. The geographical location of the farm is 26° 18'N latitude and 43° 58'E longitude and altitude of 725m above sea level, in central Saudi Arabia. The soil type of this farm is classified as sandy; 96.3% sand, 1.8% silt and 1.9% clay. The soil of the experimental sites were chemically analyzed and the following values were recorded; pH ranged from 8.2 to 8.6, the ranges of the available N, P and K were 13-17, 15-18 and 31-43 ppm, respectively. The irrigation water has a pH 7.11 and total soluble salts of 945 ppm. SAR value is 2.66. This investigation was carried out to evaluate 24 potato cultivars. All cultivars were introduced from the Netherlands. The studied cultivars were; Cardinal, Origo, Burbank, Ajax, Lemhi, Mirka, Norgold, Dundrum, Clauster, Diamont, Claudia, 4389/16, Famosa, Sahel, Morene, Spunta, Apollo, Pentland Del, Kingstone, Korrenkane, Cara, Lola, Arranbanner and Concurrent. Each cultivar was represented with three replicates and arranged in a complete randomized block design. The plot was 4.5 x 4.5 m and contained 6 rows 75 cm apart. The planting distance was 30 cm within the row.

Planting date of experiment 1 and 2 was 7 October, 1996 and 9 October 1997, respectively. During the growing period, the plants were fertilized with 200 Kg/ha urea (46%N), 100Kg/ha calcium superphosphate ( 15.5 P<sub>2</sub>O<sub>5</sub> ) and 40 Kg/ha potassium sulfate

(48%K<sub>2</sub>O). Moreover, all required agricultural practices were done as necessary during the growing period in the two experimental seasons.

The plants in experiment 1 and 2 were harvested on 8 January 1997 and on 10 January 1998, respectively. The following growth and yield parameters were measured and the data were statistically analyzed by Duncans multiple range test;

1- Germination percentage.

2-Number of days from planting until 50, 65 and 80% of emergence.

3-The percentage of foliage coverage at intervals of 45, 60, 75 and 90 day.

4- Marketable and unmarketable yield of tubers.

### 3. RESULTS AND DISCUSSION

#### 3.1. Time from planting to emergence

It is evident from Table (1) that the period from planting to emergence varied clearly between the different studied potato cultivars. The period from planting to 50% emergence was between 21.40 and 27.90 days for cvs. Famosa and Korrenkane, respectively. Meanwhile, the period from planting to 65% emergence ranged between 22.85 and 35.75 days for cvs. Lola and Lemhi, respectively. Moreover, the time needed for 80% sprouting followed the same previously mentioned trend of 65% emergence. Accordingly, the investigated potato cultivars could be arranged in three groups; The first one, is that characterized by relatively early sprouting in comparison to the other cultivars, including both Lola and Famosa cultivars. The second group, which needed a moderate period from planting to emergence, contained Morene, Kingstone, Diamont, Cara, Cardinal, Origo, Burbank, 4389/16, Pentland Del and Claudia cultivar. Lastly, the third group of potato cultivars which required a relatively longer period from planting to emergence compared with the other two groups, where Sponta, Arrenbanner, Norgold, Mirka, Dundrum, Sahel, Korrenkane, Clauster, Apollo and Lemhi cultivars are arranged in this group (Table 1).

Table (1): Days required for emergence of the different potato cultivars<sup>\*\*</sup>.

Potato cultivars	Mean number of days required for emergence		
	50% Em.	65% Em.	80% Em.
Cardinal	22.60	25.05	27.50
Origo	24.70	26.15	27.60
Burbank	24.50	26.10	27.70
Ajax	27.70	29.05	30.40
Lemhi	34.80	35.75	36.70
Mirka	27.10	29.05	31.0
Norgold	27.30	29.00	30.70
Dundrum	27.40	30.05	32.70
Clauster	27.50	31.30	35.10
Diamont	24.60	25.90	27.20
Claudia	27.70	28.75	29.80
4389/16	22.60	25.15	27.70
Famosa	21.40	22.90	24.40
Sahel	27.20	30.70	34.20
Morene	23.10	25.10	27.10
Spunta	20.30	25.30	30.30
Apollo	32.20	33.90	35.60
Pentland Del	24.70	26.20	27.70
Kingstone	24.80	26.00	27.20
Karrendane	27.90	31.10	34.30
Cara	22.10	24.75	27.40
Lola	22.60	22.85	23.10
Arronbanner	27.50	29.05	30.60
Concurrent	27.40	28.55	29.70

<sup>\*\*</sup>Data are the average of the two seasons.

The differences in the required period, from planting to emergence among the different studied cultivars, could be ascribed to the genetical variations between the different cultivars, which are associated with controlling the biosynthesis rate of the endogenous phytohormones such as GA<sub>3</sub>, IAA and Cytokinins. This consequently affected the period from planting to emergence of each cultivar. Similar results were reached by Tibbits *et al.*, (1992).

### 3.2. Foliage coverage during the growing period

Table (2) shows that the percentage of foliage coverage can be used as an indicator for vegetative growth of the plant. This percentage varied considerably between the different potato cultivars. Kingstone cultivar resulted in the highest foliage coverage compared to the other cultivars. It attained 25.70, 50.30, 55.00 and 65.50% foliage coverage after 45, 60, 75 and 90 days from planting, respectively.

Meanwhile, cv. Spunta gave lower foliage coverage than, cv. Kingstone and higher than the other cultivars. On the other hand cv. Lola ranked thirdly in this respect, whereas cv. Cara produced lower foliage coverage percentage (40.80% after 90 days) than those exhibited by cv. Kingstone, Spunta and Lola. (Table 2). In addition, there were no clear differences in this respect among the cultivars of Origo, 4389/16, Sahel, Pentland Del and Korren Kane, which gave about 35.00% foliage coverage. The poorest foliage coverage during the growing period was produced by cv. Dundrum (Table 2). These results reflect the vegetative growth variation among the different studied potato cultivars, which could be attributed to the genetical differences. Generally, all cultivars showed lower foliage coverage percentages, as its maximum value was 65% after 90 days from planting time. The general decrease in the foliage coverage of the different cultivars could be due to the lower temperature effect and to the frost damage during the end of December. However some cultivars, such as Kingstone, Spunta and Lola seem to be more tolerant to the lower temperature levels in comparison to the other cultivars as they maintained their maximum foliage coverage after 90 days from planting time (Table 2). The variation in foliage coverage of different potato genotypes was stated by Tibbits *et al.*, (1992).

### 3.3. Tuber yields

The data in Table (3) indicate that cv. Cardinal produced the highest tuber yield (37.33 Ton/ha). This was followed by Mirka, Arranbanner, Morene and Diamont, which gave tuber yields of 36.06, 36.03, 34.43 and 34.36 Ton/ha, respectively. On the other hand, cv. Norgold, 4389/16, Apollo and Lola were characterized by their considerably lower yield production than the other studied cultivars. The lowest tuber yield was produced by cv. Lemhi, which was

characterized by a poorer vegetative growth compared with the other cultivars (Table 2). Beside their highest total tuber yield production, cultivars Cardinal, Mirka, Arranbanner, Morene and Dimont also attained the highest marketable yield percentage; therefore those could be recommended for cultivation under Al-Qassim conditions.

**Table (2): Foliage development percentage of the different potato cultivars \*\***

Potato cultivars	Soil coverage percentage			
	After 45 days	After 60 days	After 75 days	After 90 days
Cardinal	25.7	27.3	20.8	15.6
Origo	25.4	35.1	32.9	35.1
Burbank	27.1	27.2	22.1	25.4
Ajax	22.3	27.5	27.2	25.5
Lemhi	15.0	20.3	18.7	18.8
Mirka	12.2	20.2	20.3	20.6
Norgold	15.8	25.1	25.1	25.8
Dundrum	08.5	12.7	12.3	12.7
Clauster	20.1	27.0	25.7	20.4
Diamont	18.3	20.7	20.8	20.1
Claudia	20.7	27.3	20.9	15.0
4389/16	20.8	30.5	35.2	35.8
Famosa	30.7	45.3	45.5	45.6
Sahel	22.4	30.2	37.6	35.5
Morene	20.9	25.6	20.7	20.3
Spunta	27.6	45.5	50.4	55.2
Apollo	10.3	20.7	22.7	20.4
Pentland Del	25.1	32.1	35.6	35.3
Kingstone	25.7	50.3	55.0	65.5
Karrendane	18.5	30.2	30.3	35.7
Cara	25.3	40.7	42.1	40.8
Lola	40.7	45.8	40.4	50.1
Arronbanner	20.1	22.0	22.7	20.9
Concurrent	20.8	20.0	15.6	12.6

\*\* Data are the average of the two seasons.

**Table (3): Tuber yield (tons/ha) of the different potato cultivars \*\***

Potato cultivars	Total yield	Marketable yield	Unmarketable yield
Cardinal	37.33	32.90 a	4.43
Origo	23.23	20.33 cde	2.90
Burbank	15.90	12.46 e.g.	3.44
Ajax	30.83	28.16 abcf	2.97
Lemhi	07.33	06.10 g	1.23
Mirka	36.06	32.56 a	3.50
Norgold	09.26	07.66 g	1.60
Dundrum	24.10	21.40 acde	2.70
Clauster	25.00	22.56 bcd	2.44
Diamont	34.36	33.40 a	0.96
Claudia	29.69	25.26 abcd	4.43
4389/16	10.90	09.50 fg	1.40
Famosa	18.96	17.16 def	1.80
Sahel	14.96	12.66 efg	2.30
Morene	34.43	30.90 ab	3.53
Spunta	19.36	16.56 defg	2.80
Apollo	12.23	10.26 fg	1.97
Pentland Del	22.80	20.60 cde	2.20
Kingstone	18.56	16.33 defg	2.23
Karrendane	18.86	16.66 defg	2.02
Cara	15.83	13.03 efg	2.80
Lola	13.93	12.13 fg	1.80
Arronbanner	36.03	32.93 a	3.10
Concurrent	23.50	22.16 cd	1.34

\* Means which are followed by the same letter are not significantly different ( $p=0.05$ ) according to Duncan's multiple range test.

\*\* Data are average of two seasons.

In spite of the importance of the photosynthesis process for carbohydrate formation and translocation down to the tubers, which will end up with increasing plant productivity, unexpectedly, tuber yield did not exactly reflect the foliage coverage percentage. This phenomenon could indicate that yield in potatoes under the circumstances of this study may not only depend on leaf area factor, but mainly on genotype factor as well as the availability of soil nutrients and possibly other environmental factors.



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تقييم 24 صنف من البطاطس تحت الظروف البيئية للمنطقة الوسطى  
من المملكة العربية السعودية

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ملخص

أجريت تجربتان حقلتان خلال الموسم الخريفي لعامي 1996 و 97م، وذلك بمزرعة كلية الزراعة والطب البيطري - جامعة الملك سعود فرع القصيم، لهدف تقييم 24 صنف من أصناف البطاطس المستوردة من هولندا لمعرفة مدى نموها وإنتاجيتها تحت الظروف البيئية لمنطقة القصيم . لقد تم تقييم الأصناف: كارديال ، اوريجو ، بارينك ، أجاكس ، لمهي، ميركا، نورجولد، دندرم، كوستر، ديامنت، كلوديا، 16/4389 ، فاموزا، ساحل، مورنيا، سيونيا، ابولو، بنت لاندل، كنجستون، كورنكين، كارا، لولا، ارنبر، وكونكرنت.

كان صنف لولا أول الأصناف إنباتاً بينما كان آخرها صنف لمهي وكان صنف كنجستون أعلاها من حيث النمو الخضري ، حيث وصلت نسبة تغطيته للأرض 65.5% بعد 90 يوم من الزراعة. هذا وقد كان الصنف دندرم أقل الأصناف نمواً خضرياً. أما من ناحية الإنتاجية فقد أعطى الصنف كارديال محصولاً يقدر بـ 37.33 طن/هكتار يليه صنف ميركا ثم أرنبير فمورين وديامنت، ولم يكن هناك أي فروق معنوية بين هذه الأصناف من ناحية الإنتاجية بوحدة المساحة. أما من ناحية المحصول القابل للتسويق فقد كان الصنف ديامونت هو أنسب تلك الأصناف جميعاً إنتاجية في منطقة القصيم حيث أعطى 97% مقارنة بباقي الأصناف المدروسة.

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