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Evaluation of Exotic Potato Varieties in Ecological Conditions of Islamabad During Autumn Season

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ABSTRACT

The evaluation of nine potato varieties was done on the basis of different plant growth and yield parameters. The emergence percentage of all the varieties showed non-significant difference except Draga, which gave the lowest percentage of emergence. Maximum numbers of plants were observed in varieties Hateema, Desiree, Diamant and Adora. The variety 9619 gave maximum number of stems per plant. The highest number of large tubers per plot (66.75) was produced by variety 9620 and variety Draga gave minimum number of large tubers per plot (7.75) while maximum weight of large tubers per plot (6.09 kg/plot) was given by the variety 9620. The highest number of medium tubers per plot was produced by variety 9619 with 195.3 followed by the variety Diamant with 168.3 number of medium tubers per plot, while variety Adora gave lowest number of medium tubers per plot (93.00). The maximum number of total tubers per plot (1343) were produced by variety 9619 followed by variety Diamant with 1247.50 number of tubers per plot. The maximum weight 54.11 kg/plot) of tubers was found in variety 9619 while the lowest weight (25.30 kg/plot) of tubers was given by variety Draga. Variety 9620 produced maximum percentage of marketable tubers with 73.19% followed by varieties Hateema, Adora and 9619 with 71.54, 69.44 and 69.09%, respectively. It was concluded that the variety 9620 produced maximum percentage of marketable tubers, although variety 9619 produced more number of tubers than that of the variety 9620 but the marketable tuber percentage was less in the variety 9619. So, this study recommends the variety 9620 for use in Islamabad ecological conditions during autumn season for maximum yield.

Key Words: Varieties; Autumn; Pakistan; Ecological; Potato

INTRODUCTION

Potato (*Solanum tuberosum* L.; Solanaceae) plants are extremely sensitive to environmental conditions. The crop belongs to cool season and flourishes well within a temperature range of 70-80°F. Potatoes are very sensitive to temperature at the time of planting. Potato is planted as a cash and food crop in Pakistan and plays an important role in maintaining the proper balance in agricultural economy of the country. Three crops of potato are produced one after the other. In fact, the developed countries produce about 30% of world potato crop and in these countries the production is expanding rapidly than most of the other food crops. Our yield at present is very low as compared to other countries due to many reasons. These include low yielding varieties, disease and insect attacks, etc.

It has been observed that the potato varieties being cultivated by the vegetable growers in Pakistan are very low yielding and do not compete well with the varieties grown in advanced countries of the world. The present project therefore, was envisaged with a view to screen a few exotic potato varieties received from Holland to find out the best suited one for local conditions.

MATERIALS AND METHODS

This research project was completed at National Potato Programme, Horticultural Sciences Institute, National Agricultural Research Centre (NARC), Islamabad. The seed tubers of nine potato varieties (including Dutch and local) were collected from National Potato Programme, National Agricultural Research Centre, Islamabad.

These varieties were sown according to Randomized Complete Block Design. There were nine treatments and each treatment was replicated four times. Area for each treatment plot was 3 m x 4 m = 12 m^2. Fertilizer was given as 250:125:125 kg of NPK/ha, respectively. Half dose of N and full dose of P and K was applied at the time of planting by placement method. Plant to plant distance was 25 cm and row to row distance was 70 cm, sowing depth was maintained at 5 cm (Mahmood *et al.*, 2001). First irrigation was given after two days of planting, followed by two irrigations with one week interval. Following potato varieties were evaluated:

Treatments	Varieties
T_1	Diamant
T_2	Desiree
T_3	9511 (CIP clone)
T_4	9620 (CIP clone)
T_5	9619 (CIP clone)
T_6	384093-844 (CIP clone)
T_7	Hateema
T_8	Adora
T_9	Draga

The different parameters studied included (i) Emergence (%): checked after 20 and 30 days of planting, (ii) Number of plants per plot after 45 days of planting, (iii) Number of stems per plot after 45 days of planting, (iv)

Number of tubers having size larger than 55 mm in diameter, (v) Weight of large tubers per plot, (vi) Number of medium tubers (35 to 55 mm) per plot, (vii) Weight of medium tubers per plot, (viii) Number of small tubers (< 35 mm) per plot, (ix) Weight of small tubers per plot, (x) Number of total tubers per plot, (xi) Weight of tubers per plot, (xii) Percentage of marketable tubers (> 35 mm), (xiii) Potato colour of tubers (white, pinkish or deep red), (xiv) Potato shape (oval, round and bell shape), and (xv) Eye depth (shallow medium deep and deep).

The data were statistically analyzed according to the procedure as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Emergence percentage. All the varieties were statistically similar and had no significant difference except variety Draga which gave lowest percentage of emergence (77.75%). All agronomic and external factors were kept similar (Table I). These results are in line with the findings of Bugarcic *et al.* (1997).

Potato tubers germination is the phenomenon, which is controlled by external (temperature, moisture) as well as internal factors (dormancy, physiological maturity) present within the seed tuber. As external factors were similar but the difference noted here might be due to internal factors. This difference in emergence can be attributed to the tuber dormancy controlling factor. Presumably the sprout inhibition factor present within the tubers of variety Draga might have played a key role in expressing the least values of emergence.

Number of plants per plot. Variety Hateema, Desiree, Diamant and Adora had maximum number of plants per plot (Table I). The lowest number of plants per plot was observed in variety Draga. Difference in number of plants per plot might be due to the difference in seed conditions of different varieties and lines because all external factors were similar for all the varieties tested in this experiment.

Number of plants per plot was dependent upon the emergence. In case of Draga, number of plants per plot were significantly less than the others. It could be due to the poor emergence (Table I). The results are in agreement with Mahmood *et al.* (2001) who achieved 51 plants per plot (9 m^2). In this trial, except Draga all other varieties produced optimum desirable plants per plot.

Number of stems per plot. Variety 9619 gave maximum number of stems per plot (253.8 stems), followed by variety 9511 and 384093 with 223.3 and 212.8 stems per plot, respectively (Table I). It was also observed that CIP clones produced higher number of stems per plot than Dutch varieties. The minimum number of stems per plot was observed in variety Draga and Adora with 112.3 and 116.3 stems per plot, respectively which are at par with each other.

Difference in number of stems per plot was due to the genetic variability of varieties. Similar results were reported by many researchers who found that different potato cultivars exhibit great variation for different characteristics like number of stems, number of leaves, plant height and number of tubers per plot (Hanan & Lodhi, 1979; Randhawa *et al.*, 1980).

In this study, stem density has been taken into account because it represents crop density in better way. Stem density influences number of tubers, size of tuber and multiplication rate. The recommended stem density depends on the environment, purpose of the crop and potato variety (Wiersema, 1987). Number of stems is some times directly related to the potential yield from a plant. The number of stems per tuber is directly related to the number of eyes, more the number of eyes per tuber, more will be number of stems. The less number of stems in Draga and Adora are likely due to less number of eyes than other varieties (Hanan & Lodhi, 1979).

Number of large tubers per plot. Maximum number of large tubers per plot (66.75) produced by variety 9620 which differed significantly from rest of the varieties tested during this study (Table I). The variety 384093 remained second with value (45.50) and was different from rest of the varieties. Variety Draga gave minimum number of large tubers per plot (7.75). The varieties 9511, Adora and 9619 in this study remained at par with each other producing 42.00, 38.25 and 36.75 number of large tubers, respectively. The variety which produced more number of large tubers is considered to be the best regarding marketability. The difference for the number of large tubers among the varieties is most likely due to certain genetic factors, which favoured variety 9620 to flourish better under Islamabad conditions. These results are in line with the findings of Safdar (1975) who concluded that the number of large tubers and finally the yield was more in crop raised during autumn season as compared to spring season.

It has also been observed from the literature that the plants having less number of stems can produce more number of large tubers (Sadiq *et al.*, 1995). In this study, it was also observed that variety 9620 produced more number of large tubers while the number of stems was more in variety 9619 than 9620. Plaisted and Peterson (1967) and Sanchez (1996) reported that among eight varieties received from Holland, the variety "Walse" gave maximum number of large tubers and reasoned that the production of large tubers is genetically controlled.

Weight of large tubers per plot. Maximum weight of large tubers per plot (6.097 kg/plot) was given by variety 9620 which differed significantly from rest of the varieties tested during this study (Table I). The variety Hateema and Adora remained second and third in the ranking with weight of 4.45 and 4.40 kg, respectively which were at par with each other. Variety Draga gave minimum weight of large tubers per plot (0.73 kg/plot).

It is also evident from the literature that the varieties which have less number of stems produced more number of large tubers and more weight of the tubers so the variety 9620 produced more number of large tubers and weight of the tubers of the variety was more than any other variety.

Table I. Emergence (%), number of plants, stems, large tubers and weight of large tubers (kg) of different potato varieties during 2000-2001

S.No.	Varieties	Emergence (%) per plot	Number of plants per plot	Number of stems per plot	Weight of Large tubers per plot	Weight of large tubers per plot
1	Adora	99.00 A	59.25 A	116.3	4.400	4.400
2	Desiree	98.75 A	59.25 A	190.0	1.700	1.700
3	Hateema	98.75 A	59.50 A	172.0	4.450	4.450
4	9619	98.25 A	59.00 AB	253.8	3.700	3.700
5	9511	97.25 A	58.25 AB	223.3	3.125	3.125
6	9620	96.00 A	57.75 AB	203.3	6.097	6.097
7	Diamant	94.25 A	59.25 A	195.3	1.800	1.800
8	384093	93.75 A	56.25 B	212.8	2.400	2.400
9	Draga	77.75 B	46.75 C	112.3	0.732	0.732

Table II. Number of small tuber, weight of small tubers (kg), weight of medium tubers (kg), number of medium tuber, number of total tubers of different potato varieties during 2000-2001

S.No.	Varieties	No. of total tubers per plot	Weight of small tubers per plot	Number of small tubers per plot	Weight of medium tubers per plot	Number of medium tubers per plot
1	Adora	657.50 G	0.667	57.75 E	5.028	93.00 D
2	Desiree	775.50 F	1.200	76.75 DE	4.200	102.0 D
3	Hateema	1149.25 C	1.263	81.75 CDE	7.695	160.0 B
4	9619	1343.00 A	1.600	146.3 A	8.833	195.3 A
5	9511	769.50 F	1.375	103.8 D	3.800	98.75 D
6	9620	1187.50 BC	1.233	79.75 CDE	6.560	151.0 BC
7	Diamant	1247.50 B	1.000	124.0 AB	6.467	168.3 AB
8	384093	1060.00 D	1.067	112.8 B	5.568	124.0 CD
9	Draga	940.00 E	0.900	106.0 BC	4.267	120.8 D

Table III. Percentage of marketable tubers, weight of total tubers, colour, shape and eye depth of tubers of different potato varieties

S.No.	Varieties	%age of marketable tubers	Weight of total tubers (kg)	Color	Shape	Eye depth
1	Adora	69.44 B	41.37	White	Oval	Shallow
2	Desiree	60.79 C	28.40	Red	Oval	Shallow
3	Hateema	71.54 B	53.60	Red	Oval	Shallow
4	9619	69.09 B	54.57	White	Oval	Shallow
5	9511	49.03 E	27.00	Red	Oval	Shallow
6	9620	73.19 A	54.11	White	Oval	Shallow
7	Diamant	60.20 C	39.47	White	Oval	Shallow
8	384093	57.36 CD	36.16	Red	Round	Medium deep
9	Draga	54.81 D	25.30	White	Oval	Shallow

Number of medium tubers per plot. There was a significant difference among all the varieties except Desiree, 9511 and 9619, which remained at par with each other (Table II). The highest number of medium tubers per plot (195.3) was produced by variety 9619, followed by variety Diamant with 168.3 number of medium tubers per plot. The variety Hateema remained third with value (160.0) which statistically differed from rest of the varieties. Variety Adora gave the lowest number of medium tubers per plot (93.00) which was at par with Desiree (102 medium tubers per plot) and 9511 (98.75 medium tubers per plot).

Overall, trend showed that maximum number of stems (Table I) resulted into maximum number of medium tubers For example variety 9619 produced 253.8 stems per plot which were higher than all other varieties and maximum number of medium tubers was produced by the variety 9619.

Weight of medium tubers per plot. Maximum weight of medium tubers per plot (8.833 kg/plot) was found in variety 9619, closely followed by variety Hateema (7.695 kg/plot) which differed significantly from rest of the varieties tested during this study (Table II). The variety 9620 and Diamant remained third and fourth in ranking with weight of 6.560 and 6.467 kg, respectively and have no significant difference. Variety 9511 gave the lowest weight of medium tubers per plot (3.800 kg/plot) and differed significantly with rest of the varieties except Draga (4.267 kg/plot) and Desiree (4.200 kg/plot). As there is a positive relationship between number of medium tubers and their weight so the varieties might have shown the difference among themselves for this character. These results are in agreement with the findings of Hanan *et al.* (1998) who showed difference among the varieties for weight of different tubers and showed positive relationship between number of tubers and weight of tubers per plant.

Number of small tubers per plot. The highest number of small tubers per plot (146.3) were produced by variety 9619 followed by variety Diamant with 124.0 number of small tubers per plot (Table II). Variety Adora gave the lowest number of small tubers per plot (57.75). According to the farmer's choice it is not a good character of variety to produce small tubers because it is of no benefit for the farmer as the market value of small tubers is very low.

In this study, it was observed that the variety which produced maximum number of stems also ranked first in producing number of small tubers. The variety 9619 produced maximum number of stems i.e., 253.8 and small tubers i.e. 253.8 and 146.3, respectively. It was observed that numbers of small tubers were directly related to the number of stems. These results are in confirmation with the findings of Sanchez (1996) who reported significant difference in number of small tubers per plot of different potato varieties. These differences among different varieties may be due to the difference in their genetic make up, showing a great variation for various characteristics related to yield.

Weight of small tubers per plot. Maximum weight of small tubers per plot (1.600 kg/plot) was found in variety 9619, closely followed by variety 9511 (1.375 kg/plot) which differed significantly from rest of the varieties tested during this study (Table II). The varieties Hateema, 9620, Desiree and 384093 differed clearly with each other and had no statistical differences. Variety Adora gave the lowest weight of small tubers per plot (0.667 kg/plot) and differed significantly with rest of the varieties. The weight of tubers have a positive relationship with their number of tubers so, more number of tubers will lead to more weight of tubers.

Number of total tubers per plot. Maximum number of total tubers per plot (1343) were produced by variety 9619 followed by variety Diamant with 1247.50 tuber per plot.

The lowest numbers of tubers per plot (657.50) were produced by variety Adora.

The number of tubers per plot will depend mainly on number of stems per plot, total number of stolons and stolons which tuberize. Stolons development and their tuberization is a complex phenomena, which is not completely understood as yet. Both genetic and environmental factors play a vital role in stolon development and tuberization process (Subarta & Upadhya, 1997). In this study, experimental plants were grown in the same field, thus difference in number of tubers seems to be influenced by genetic factor. According to the literature, total number of tubers depends upon number of stems and more number of stems will lead to more number of tubers. In this study, it is observed that number of stems produced by variety 9619 as more than any other variety and it produced highest number of total tubers. Rizvi (1987) tested 10 US clones for adaptation for sub tropical production and concluded that clone B 9589-17 showed the highest yield followed by B 8185-4 and B-956-4.

Weight of tubers per plot. Statistical analysis of data regarding weight of tubers per plot is presented in Table III. All the varieties showed statistical differences among each other. Maximum weight of tubers per plot (54.11 kg) was given by variety 9619, followed by variety 9620 with 54.11 kg per plot. The lowest weight of tubers per plot (25.30) kg was given by variety Draga.

The weight of tubers has a positive relationship with the number of tubers so more number of tubers will lead to more weight of tubers.

Percentage of marketable tubers. Tubers which are more than 35 mm in diameter are referred to as marketable tubers. Various varieties differed significantly for the said parameter. Variety 9620 produced maximum percentage of marketable tubers (73.19) and showed statistical difference with all other varieties (Table III). Hateema, Adora and 9619 gave almost same percentage of marketable tubers with the values of 71.54, 69.44 and 69.09%, respectively. Hateema showed 2nd highest percentage of marketable tubers and differed significantly from 9611, Diamant and Desiree. The variety 9620 showed highest percentage which means this variety is better to grow in Islamabad conditions in respect to said parameter. The number of stems for this variety is lower than those of the varieties 9619 and 9511 but still percentage of marketable tubers is higher. It means the number of stems do not show any influence on percentage of marketable tubers.

Our results are in agreement with the findings of Kumar (1989) who observed that percentage of marketable tubers is not influenced by the number of stems.

Potato colour. The data presented in Table III showed that Desiree, 384093, 9511 and Hateema had red skin colour and others had white. This might be due to the genetic characteristics of the varieties. The colour of all the varieties is genetically controlled. They produced the same colour as in their home environment.

Potato shape. Potato shape in different varieties was observed as oval and round (Table III). The data about the shape of varieties showed variation in case of 384093. Genetically, it is of oval shape but here the shape is round. This might be due to the compaction of soil which resisted 38409 to develop as oval. Shape of tuber is affected by many factors, tubers are normally oval, round and oblong shaped (Wang *et al*., 1995).

Eye depth. The data showed (Table III) that variety 384093 had medium deep eye depth while other varieties had shallow eye depth. Here, the variety 38403 again showed deviation from its genetics. Genetically, the eye depth of 384093 is shallow but in this study it had medium depth. Randhawa *et al.* (1980) studied the eye depth of potato tubers in relation to other parameters and reported that eye depth is normally deep, medium deep and shallow depending upon cultivar and environmental conditions.

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