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Adaptability Trial to Determine the Yield Potential of Exotic Potato Varieties at Multi-Locations of Gilgit-Baltistan

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Abstract

An adaptive trial was conducted by Department of Agriculture Research Gilgit-Baltistan to evaluate the performance of nine exotic potato varieties under the climatic conditions of Gilgit-Baltistan. Tubers of varieties Zena Red, Kuroda, Roko, Lady Rosita, Melanto, Pameela, Sante, Bartina and Asterix were sown at Seed Potato and Vegetables Research Station, Naltar Gilgit. The experiment laid out using Replicated Complete Block Design (RCBD) with 3 replications. Standard agronomic and plant protection measures were applied. Data of the parameters such as plant height, number of stems per plant, number of tubers per plant, weight of tubers per plant and yield per hectare were observed. Analysis of variance showed that all the varieties were significantly different in all the parameters. LSD test was applied to compare means of all the parameters. Plant height showed significant difference among the varieties with Pameela showing maximum plant height of 60.1 cm followed by variety Zena Red having 56.4 cm. Variety Sante showed least plant height having mean of 21.1cm. Variations were observed among the varieties for number of stems per plant. Pameela showed maximum number of stems having mean of 5.9 followed by variety Roko having mean value of 5.6. Least number of stems were observed in variety Melanto which had mean value of 2.2. Variations were also observed among the varieties for number of tuber per plant. Variety Roko produced maximum number of tubers having mean value of 14.3 followed by variety Pameela with a mean value of 13.8. Variety Melanto produced least number of tubers per plant having mean value of 7.1. Maximum tuber weight per plant was produced by Zena Red having a mean value of 1107.1g followed by variety Bartina which produced 1030.7g of tubers per plant. Melanto produced least weight of tubers per plants with a mean value of 682.9g. Variety Roko was best yielder producing 21.6 tons/ha of seed potato while varieties Bartina and Lady Rosita showed minimum yield of 14.2 tons/ha

Key words: Adaptive Trial, Exotic Varieties, Potato, Climatic Conditions, Naltar, Gilgit-Baltistan, Analysis of Variance, LSD.

Introduction

Potato (*Solanum tuberosum* L.) belongs to family Solanaceae and is known as king of the vegetables as being part of every meal. It has been extensively cultivated all over the world and is ranked as 3rd after wheat and rice, whereas it is 4th valuable food crop on basis its domestic consumption after rice, maize and wheat (Devaux et al., 2014). Potato is a resourceful food crop being grown from sea level to might mountainous

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regions and is now under cultivation in almost 100 countries that can be grown in various environments and is currently cultivated globally in over 100 countries (United States Potato Board, 2015). It contains 79% water content in it along with carbohydrates (18%), protein (2%), and vitamins (1%) and many minerals and trace elements that make it a nutritious and energy rich food (Ahmad et al., 2011; Low et al. 2007). It has no cholesterol contents in it, additionally it possesses some antioxidants that can be useful to cure cardiac and cancer disease in human (Isobel Hoskins 2005, Al-Saikhan et al., 1995). Medically it has given keen importance to useful to manage hypertension and high blood pressure due presence of an organic content kukoamine (Anonymous 2017; Akande et al., 2000). It is also named as poor man's food as it is included in every meal because it provides more calories of per hectare than any food crop grown all over the globe (Amdie et al., 2017).

In Pakistan three crops are being cultivated as in summer (70-75%), autumn (20%), and sprig crop (7-10%). Summer crop is cultivated from March to April in the mountainous areas of Gilgit Baltistan and Kashmir. Autumn crop is being sown from the month of September to October in plains of Punjab, Sind and Baluchistan whereas, Spring crop season strats from January and ends in late February in the lower hilly areas of Balochistan and KP (GOP, 2016-2017). Due to more returns from potato to the farmers during the last decade in Pakistan it has been considered as high value potato cash crop. Potato has been grown on 0.196 m ha⁻¹ with annual production of 4.57 million tonnes having average yield of 19.32 t ha⁻¹ (Pakistan Economic Survey, 2018-2019). However, the potato production in Pakistan is very low due to several reasons i.e. high incidence of pests, insects, diseases, water scarcity etc along with cultivation of low yielding varieties and use of table potato as seed. Thus the aim to evaluate high yielding and well adapting exotic potato varieties is an integral component of research either in government or private sector. Being an important commodity from the consumption and trade perspectives, increase in potato productivity in future requires promising attention from the concerned stakeholders. Provision of high yielding varieties of the crop imported from other countries to farmers may significantly elevate its yield outputs and production. (Adul Majeed and Zahir Muhammad., 2018). The department of Agriculture Research Gilgit Baltistan has established well equipped Potato Tissue Culture Laboratories at Gilgit, Skardu and Ghizer along with components of Greenhouses and screen houses for production of pre-basic seed potato of exotic and National varieties as well. Pakistan to produce and evaluate such genotypes, which are suitable to our local environmental conditions. The pre-basic seed is then multiplied at high altitude seed potato production research stations at Naltar District Gilgit and Babusar Chilas District Diamer over an above elevation of 9000 feet from the sea level.

Material and Methods

Tubers of nine exotic varieties i.e Zena Red, Kuroda, Roko, Lady Rosita, Pameela, Melanto, Sante, Bartina and Asterix were cultivated at Seed Potato and Vegetable Research Station Naltar on 25th May 2018. Experiment was laid using Randomized Complete Block Design having 3 replications. In each replication 33 tuber of each variety were sown Plants on ridges having plant to plant distance of 15 cm and row to row distance of 75cm. Standard agronomic and plant protection measures were applied. Crop was harvested on 27th September 2018 and 5 plants of each variety were randomly selected and data of parameters i.e. plant height (cm), number of stems per plant, number of tubers per plant and weight of tubers per plant (gms) were recorded. Total production (kg) of all plants of each variety in each replication were recorded and yield/hectare were calculated from it. Data was statistically analyzed using Statistix version 8.1 software.

Results and Discussions

The results pertaining to the adaptability of these exotic potato varieties under climatic conditions of Naltar valley Gilgit and their analysis of variance depicted significant differences in the selected parameters that are discussed under following headings.

Plant height

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The plant height of the potato varieties was recorded when they got maximum growth and development in the field. Highly significant results were studied among the varieties for this parameter. Pameela variety showed maximum plant height (60.1 cm) followed by variety Zena Red having (56.4 cm). The variety Roko showed (55.4 cm) and Koruda displayed (50.4 cm) plant height. The variety Melanto displaced medium (42.9 cm) height as the study of Khalid et al. (2019) Variety Sante showed least plant height (21.1 cm) whereas, variety Bartina produced 35.3 cm tall plants (Table 1). On the basis LSD values six homogenous groups (a, ab, bc, c, cd, d and e) were formed that showed significant variation for plant height among the nine potato varieties. The study of Khalid et al. (2019) is in congruence to our findings that the potato varieties showed variation for the morphological parameters as it is plant genetic attributes that cause variation. Our results are in accordance with Eaton et al. (2017) who reported difference in plant height of different potatoes genotypes and might be due to plant genetic makeup and environmental effects. The findings of Luthra et al. (2005) and Schittenhelm et al. (2006) also revealed the differences in potato and they concluded that all these differences for plant height are due to plant genotype, variety, nutrients availability and the agroecological factors under area of study.

Number of stems plant⁻¹

The number of main stems plant⁻¹ was also recorded for the potato varieties under investigation. There was significant variation among the tested potato varieties for stems plant⁻¹. Pameela variety showed maximum number of shoots/ plant with a mean value 5.9 followed by variety Roko having 5.6 shoots/plant. Minimum number of shoots/ plants was observed in variety Melanto having mean value of 2.2 shoots/plant. The ANOVA also depicted the significant differences among potato varieties for number of stems plant⁻¹ (Table 1). Khalid et al. (2019) revealed similar results that the potato variety Menato produced maximum (16.2 stems m²⁻¹). The findings of Eaton et al. (2017) are in strong conformity of our results that the potato varieties showed significant differences in number of stems plant⁻¹. Our results are similar to those reported by Hoque (1990) reported 5.17 main stems in potato variety Diamant, whereas Bashir (1978) reported 5.2 main stems plant⁻¹ in potato variety Cardinal. Difference in number of stems plant⁻¹ 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).

Number of tubers plant⁻¹

The number of tubers plant⁻¹ is amongst most economical parameter that directly measures the yield potential of tuber crops. In the current study this parameter was also recorded for the potato varieties under inquire. The varieties displayed variation for this parameter. The variety Roko produced maximum (14.3) tubers plant⁻¹ followed by Pameela having 13.8 tubers plant⁻¹. The least number of tubers plant⁻¹ were recorded in Melanto that produced 7.1 tubers plant⁻¹ followed by Lady Rosita (11.3.) Table 1. The statistical analysis also depicted significant differences amongst the candidate potato varieties. Our conclusions are in line with the findings of Khan et al. (2019) that envisaged great variation among the tested potato genotypes and potato lines. Our results are also in agreement with the assessment of Eaton et al. (2017) that exposed the tuber production in potato crop is a dependant on the genetic makeup of the genotypes, the method of planting used and the environmental conditions (availability of water and soil nutrients). The stolon and tuber formation in potato is critically affected by genetic makeup of varieties and agroecological and environmental features (Subarta and Upadhyaya, 1997). Any how the findings of Khalid et al. (2019) are in contrast to our findings that reported the potato variety Melanto produced maximum (50.76) tubers m² in comparison with Desiree (38.21) tubers m².

Tubers weight plant⁻¹

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Tuber weight plant⁻¹ also contributes considerably to the yield attribute of potato crop. The variability in tuber production is an inherited character that is genotype dependant. Currently to determine yield potential, the tuber weight plant⁻¹ was investigated. The potato varieties responded significantly different for this economically important parameter. In the current study, the potato variety Roko produced more bulky tubers plant⁻¹ with maximum (110.7 g) tubers weight plant⁻¹ whereas, the variety Bartina (1030.7g). Least weight of tubers plant⁻¹ having 682.9 g was observed in variety Melanto followed by Lady Rosita (742.2 g) Table 1. The ANOVA also displayed significant variation among the potato varieties under study. Our results are supported by the findings of Panday et al (2004); Panday et al; (2008) that reported variation in tuber yield among the assessed potato varieties and lines. The findings of Patel et al, (2008) also concluded that the bulky and large size tuber production in potato may be due to good seed germination and better plant growth and development under a favorable agroecological zone.

Yield hectare

Yield determination is the main parameter that assesses the potential of seed potato production in the varieties under study. In this investigation the potato variety Roko was recorded as the high yielding variety among the compared varieties with a production of 21.6 tons ha⁻¹ followed by variety Pameela which yielded 17.2 tons ha⁻¹ of seed potato. Asterix and Koruda also yielded more production with 17.0 tons ha⁻¹. On the other hand, the potato variety Bartina and Lady Rosita emerged as least productive with 14.2 tons ha⁻¹ followed by Lady Rosita (14.6) tons ha⁻¹ (Table 1). The findings of Khalid et al, (2019) also depicted that the yield potential of potato crop is dependent on variety, its genetic features and influence of various biotic and abiotic factors in the area of study. The findings of Patel et al, (2008); Patel et al, (2004) are also in strong conformity of our study that potato varieties different from each other on basis of yield that is directly related with maximum seed germination, better plant growth and development, successful tuber formation having good size and shape under available field conditions. Variation in yield of seed potato had been reported by Hossain et al 2003 and Anonymous (1990). In contrast the findings of Shafayet et al who found that a highest yield was observed in Granola (27.82 t/ha) followed by Asterix (26.83 t/ha) and Provento (26.33 t/ha). Our findings are different from those reported by Shafayet et al . (2005) who reported significant variation in the yield potential of various seed potato varieties. Shehroz et al (2018) also find that several exotic varieties of potato with same plant to plant and row to row distance could be adopted for local cultivation to enhance the potato production in the country.

Melanto variety shown high yield per hectare as desired, the development and accessibility of new varieties of potato which are suitable for the processing is quite critical for sustaining the rise in processing industries of Pakistan. Moreover, the potato varieties with more dry matter and less reducing sugars are required by potato processing industry to ensure high quality processed products. Enhancement in the production of potato is just due to the application of modern technologies and utilization of new seed varieties. White potatoes and the red potatoes are the major contributors in potato production by volume in Pakistan (Sana, 2019)

Conclusions:

On basis of field performance Roko emerged as best yielding variety for seed potato production at Naltar Gilgit followed by Pameela, Asterix and Koruda whereas; var. Bartina, Zena Red and Lady Rosita responded as least productive in this area.

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Table 1. Data of various parameters of potato varieties

S.No	Variety	Plant Height (cm)	No. of Stems/Plant	No. of Tubers/Plant	Weight of Tubers/Plant (gm)	Yield/ha (Tons)
1	Zena Red	56.4ab	5.5a	12.6a	1107.1a	14.2c
2	Koruda	50.6bc	3.3bc	9.7abc	977.4abc	17.0b
3	Roko	55.4ab	5.6a	14.3a	772.7bc	21.6a
4	Lady Rosita	43.6c	2.8bc	11.3bc	742.2bc	14.6c
5	Melanto	42.9cd	2.2c	7.1c	682.9c	14.8c
6	Pameela	60.1a	5.9a	13.8a	802.7abc	17.2b
7	Sante	21.1e	3.9b	12.2ab	865.4abc	17.0b
8	Bartina	35.3d	3.9b	11.4b	1030.7ab	14.2c
9	Asterix	48.7ab	3.5bc	7.4bc	934.5abc	17.0b

The values followed by different letters are significantly different from each other at 0.05 % level of probability