

Research Article

Performance study of exotic variety of potato (*Solanum tuberosum* L.) for processing industry under the agro-climatic condition of Lahore-Pakistan

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Abstract

Potato (*Solanum tuberosum* L.) crop is popular among the farming community for its high production per unit area and consequently high returns, therefore three crops of potato autumn, spring from plains and summer from high hills, are being grown in Pakistan. Its utilization as fast food and use for processing has further increased its importance among farmers, consumers and processors. With the aim in mind to enhance the farmer's earnings by introducing new varieties of potato for processing and fresh market, current trial was performed to check the adaptability of exotic potato variety 'Melanto' (Cross: Impala × POS 97-1) in field trials, farms situated at Bedian Road, Lahore Cantt. Pakistan. This exotic variety is better adapted specifically to summer, fall and spring cultivation districts of the Punjab, Pakistan. Big oval tubers produced with 17.5% dry matter content was ranked under cooking type A, i.e., no discoloration after cooking. 'Melanto' showed resistance to potato cyst nematodes Ro 1 and Ro 4 having relatively longer dormancy period than the control variety 'Desiree'. The highest yield 30.46 t/ha (ton/hectare) was recorded for 'Melanto' followed by 'Desiree' 22.07 t/ha. But both varieties were found susceptible under high infection of late blight. Therefore, it can be concluded that 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.

Keywords: Adaptability test; Emergence percentage; Melanto; *Solanum tuberosum* L.

Introduction

Potato (*Solanum tuberosum* L.), king of vegetables belonging family *Solanaceae* being a multipurpose food crop ranked third

in the list as world's most popular food hence extensively grown over the world including Pakistan [1, 2]. It is cultivated on an area of 149,00 hectares, yielding 4,104,400 tones

and national average yield is 22.89 tones/ha with 14 kg per capita annual consumption and current population of ~ 170 million [3, 4]. Along with abiotic stress, fungal and viral diseases are also reported to cause decrease in yield and responsible for economic losses. Among these a serious threat to potato is late blight caused by *Phytophthora infestance* and its control is still a major bottle neck whereas, three billion US dollar/annum loss in yield has been recorded due to late blight in the world [5-7]. Despite many folds increase in potato yield, still yield/acre is quite less in Pakistan than other countries [8]. On the other hand developed countries are more efficient in processing of potatoes but now in developing countries this industry also got attraction due to an increased trend in urbanization, fast foods and easy-to-prepare, taking higher/capita income, preference for ready cooked food due to rise in number of working women as well as enhanced tourist trade [9, 10]. Beside potato use for backing, cooking, chips and fries processing of potato offers both preservation and value addition but it depends on high quality traits of potato. Hence, main constraint for boosting of potato processing industry is non-availability of quality raw material [11]. Nevertheless, in Pakistan this industry is also booming day by day which is directly linked with the constant supply of fresh and suitable potato varieties during whole year. However, after December-May potato industry depends on stored potatoes of clod stores which is very costly or depends on other growing areas with limited supply. Therefore in Pakistan, for maintaining the growth of potato processing industry as well as development and accessibility of suitable varieties is prerequisite. Furthermore the traits like more dry matter and less reducing sugars are essential for selection of varieties which is positively correlated with recovery of high quality processed product. If any appropriate variety, with showed acceptable chipping

ability under various seasons, can be established which lead to provision of fresh potatoes for processing [12, 13]. Whereas, a significant increase has been reported in Pakistan for potato consumption but processing characteristics and yield of few recently introduced (exotic) varieties mostly remains unidentified. These different varieties vary in their uses and characteristics. However, knowing about the favored requirements for each use and selection of varieties those have the particular traits to meet up these requirements, it very important. This will lead to increase in growers the ability to convene the challenge of rapidly changing production and market circumstances, potentially improving and maintaining their economic prosperity. The main purpose for the development of new varieties was to consider user liking and local situation, when commenced into a country. Many hundred varieties of this well-liked vegetable are grown today, all around the world, which vary in texture, shape, flavor and color, considering the suitability for end use [14]. All over the world many varieties of potato have been developed and introduced and released to farmers, over the years. These varieties exhibited considerable tuber characteristics; however, processing quality of such varieties for French-fries and chips is generally unidentified [15]. Basically, two very important factors are accountable for establishing potato processing sector. First, the ease of local varieties of potato for processing and the second, diverse agro-ecological conditions required for the cultivation of these varieties aimed for enough and continuous delivery of raw material for the processing industry [12, 16, 17]. Numerous indigenous and exotic genotypes are accessible in Pakistan but there is an urgent need for the selection and evaluation of potato genotypes, which are exhibiting better yield, processing and storage traits to meet the requirements and

challenges of changing market faced by growers. 'Melanto' (Cross: Impala × POS 97-1) is approved for import in Pakistan and is registered with FSC & RD Islamabad so that seed may multiply here in Pakistan to provide best certified seed to farmers to enhance the potato production and earn valuable foreign exchange for country. Therefore, the current adaptability trial was conducted to determine the germination potential and yield of the exotic variety 'Melanto' in different areas of Pakistan including hilly areas [18].

Materials and methods

Experimental design

Current paper pertains to local and exotic varieties of potato in field area situated at Bedian Road, Lahore and the treatments were given on Randomized Complete Block Design (RCBD) covering three (3) blocks in triplicate. Each block consisted of six (6) plots with a measurement of 5 m long and 3 m wide. For sowing, plant to plant (9 inches), and row to row (75 centimeter) distances were maintained. Standard plant protection and agronomic practices were followed to raise the crop successfully. The experiment was conducted for two consecutive seasons, namely, September 2012 to January 2013 and February 2013-May 2013. The local (Desiree) was used as a check variety and exotic (Melanto) varieties of potato were procured from the Hunza seed crops, PVT Ltd. Pakistan. Crop was monitored regularly throughout the crop season.

Dehauling of crop

Dehauling, at crop maturity was done and after 15 days of dehauling tubers were harvested to firm up the tuber skin. Emergence percentage by counting the number of plants emerged after 45 days from the day of planting was noted from a specified 15 m² (meter square) area of every treatment. Marketable and yield t/ha s were studied after recording the data about stem/m² and tubers/m². The level of the incidence of late blight disease of economic

importance under natural field conditions was also determined.

Data collection

Parameters regarding up-ground morphology like, plant, foliage structure, stem, anthocyanin color, color of leaf, silhouette, flower frequency, anthocyanin coloration: inner side of a flower was recorded. Tubers and sprouts characters were also recorded. At the time of harvesting, observations were noted. Tubers from 15 m² area were weighed and counted. All tubers (>35mm in diameter) considered as the marketable, obtained from 15 m² area were weighed. The tuber sample was scored for shape i.e., 1 (Round); 2 (Round to short oval); 3 (Short oval); 4 (Short oval to oval); 5 (Oval); 6 (Oval to long oval); 7 (Long oval); 8 (Long oval to very long oval); 9 (Very long oval) according to the following key (Wooster and Farooq, 1995). Color of tuber skin i.e., red or white {1 (Round); 2 (Round to short oval); 3 (Short oval); 4 (Short oval to oval); 5 (Oval); 6 (Oval to long oval); 7 (Long oval); 8 (Long oval to very long oval); 9 (Very long oval)} were observed visually instantly after harvesting. Ten (10) tubers from every treatment were slice into two halves for the assessment of the potato sample for the flesh color. From every treatment, ten tubers were sliced into two equal halves for the assessment of the potato sample for the color of the flesh {1 (White); 2 (Cream); 3 (Yellow)} was done as illustrated by [19]. Sample's evaluation, for the tuber eye depth {1 (Very deep); 2 (Very deep to deep); 3 (Deep); 4 (Deep to medium); 5 (Medium); 6 (Medium to shallow); 7 (Shallow) 8 (Shallow to very shallow); 9 (Very shallow) was made as mentioned by [19].

Results and discussion

Current paper aims to estimate the emergence percentage, stem/m², tuber/m², marketable produce percentage, late blight infestation percentage and yield t/ha (Figure 1a,b,c) to local and exotic varieties of potato (Melanto

& Desiree) during field trial as these characters influence consumer choice. The exotic variety 'Melanto' gave high percentage of emergence (96.2%) than 'Desiree' (91.8%). Seed germination being first crucial and the greatest sensitive duration in the life span of plants which is influenced by seeds characteristics, developmental stages of seeds and genetic control under environmental conditions [2], [20], [21]. Therefore, the commercial producers of potato mostly need information to figure out time of emergence, population and uniformity of seedling. Consequently, the parameters such as seeds germination rate and percentage are specifically in relation to seed lot, temperature, water supply and seed treatments are very important. When seed is being sown in a germination medium such as soil then its germinability rely on environmental factors which indirectly influence the growth of seedlings and so the quality of crop with ultimate yield. Outcomes of the here in experiment exhibited that external factors were similar; hence difference in germination percentage might be noted due to internal genetic features [22]. Similarly, better performance was recorded for the variety 'Melanto' with long stolons as compared to the control variety 'Desiree'. The highest yield 30.46 t/ha was recorded for 'Melanto' followed by 'Desiree' 22.07 t/ha. Whereas, the 'Melanto' produced more tuber/m² (50.76) as compared to 'Desiree' (38.21) with less stem/m² (16.97) which was 20.27 in 'Desiree'. It is very obvious from the results of the current study that 'Melanto' had more resistant to Late blight infestation (70.20%) as compared to Desiree (81.20). Data presented in (Table 1) depicts the various distinguished morphological characters of the 'Melanto' which shows that it is with medium to early maturity having average dormancy. Up ground characteristics of the potato are listed in (Table 1) which shows that plant height was medium to tall

with upright stem having dark green leaves color. Moreover, flower frequency was high with intermediate too open silhouette. Tubers shape was oval to round with yellow color, medium rough skin. Flesh color was pale yellow bearing shallow eyes. Sprouts were medium ovoid having small terminal buds and many root tips. Intensity of anthocyanin was medium to strong whereas anthocyanin coloration of tip was weak [2]. It is evident from the results that more tubers/m² (50.76) were produced by the 'Melanto' as compared to 'Desiree' (38.21) because the number of tubers is correlated with stolons and stolons which tuberize which ultimately is controlled by both environmental and genetic attributes [23]. It has been reported that distinguish qualities of potato such as tuber shape, skin color, flesh color and eye depth) influence the consumer choice hence general appearance is most important feature. Moreover, many countries like India, Bangladesh and Pakistan prefer to use red potatoes whereas for chip making round to oblong tubers and for French-fries very long oval to oval shaped potatoes are also recommended. And to reduce the peeling losses in potato, medium shallow to shallow eyes are preferred [12, 16, 18, 24]. It is well documented now that many loci determine skin color in potatoes and is genetically controlled factor [20, 25, 26]. Moreover, 'Melanto' is very strong to internal bruising but due to big size of tubers, careful harvesting to avoid mechanical damage is recommended. As this variety has an average dormancy hence it can be easily stored for shorter period but for longer storage, the use of well-equipped cold stores is necessary. Moreover, normal planting distance in the rows accompanying normal treatments for late blight is recommended [5, 6]. However, it is suggested to plant in soils of at least 10 °C (centigrade). Nevertheless, the 'Melanto' is resistant to Cyst Nematodes (Ro1 and Ro4) rather strong against common

scab also shows high tolerance to late blight in the foliage and in the tubers is average [7].

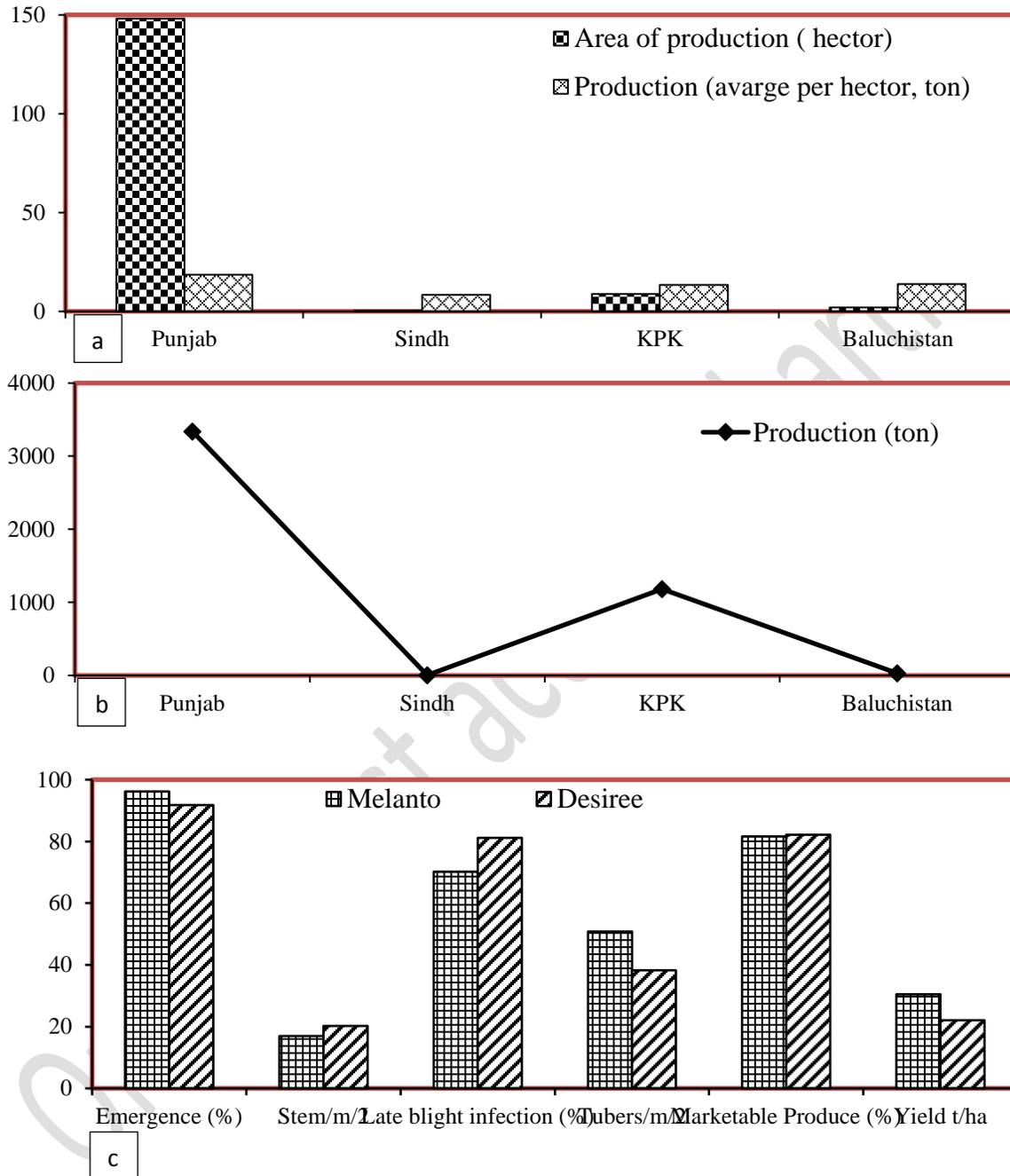


Figure 1. Potato production (a) area (hectar) and the (b) production in ton and (c) performance of exotic potato variety ‘Melanto’ in comparison to local variety Desiree during 2013

Table 1. Morphological characteristics of the exotic variety ‘Melanto’

S. No.	Character	Features
	Up-ground morphology	
1	Plant	Medium to tall
2	Foliage structure	Intermediate type
3	Stem	Upright to semi upright
4	Anthocyanin color	Weak to large
5	Color of leaf	Dark green
6	Silhouette	Intermediate too open
7	Flower frequency	High
8	Anthocyanin coloration: inner side of a flower	Absent to very weak
	Tubers	
1	Shape	Oval to round
2	Skin color	yellow
3	Skin	Medium rough
4	Flesh color	Pale yellow
5	Eyes	Shallow
	Sprouts	
1	Sprout	Medium ovoid
2	Intensity of Anthocyanin	Medium to strong
3	Coloration pubescence base	Strong to medium
4	Buds	Small terminal
5	Anthocyanin coloration of tip	Weak
6	Root tips	Many

Conclusion

Due to attack of late blight at bulk stage ‘Melanto’ was found susceptible like control variety Desiree. It can be concluded that this exotic variety has potential to get popularity among the potato growers in Pakistan as tubers of ‘Melanto’ were attractive in shape, color and having shallow eyes with smooth and shining skin.

Authors’ contributions

Conceived and designed the experiments: S Khalid, Performed the experiments: R Siddique, Analyzed the data: A Ishfaq, Contributed materials/ analysis/ tools: S Shaheen, Wrote the paper: S Khalid.

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