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ORIGINAL RESEARCH

Analysis of Apricot Germplasm through Phenotypic Traits Under the Agro-Climatic Condition

Muhammad Ilyas Jan[1*], Farman Ullah[2,3*], Badshah Islam[1], Misbah Uddin[1], Muhammad Romman[4], Aminul Haq[5], Batool Nisa[3]

[1]Deparment of Horticulture, Abdul Wali Khan University Mardan, Pakistan
[2]Department of Biology, Govt. Degree College Barang Bajaur, Pakistan
[3]Department of Plant Sciences, Quaid-i-Azam University Islamabad, Pakistan
[4]Pharmacognosy Lab, Department of Botany, University of Chitral, Pakistan
[5]Department of Botany, Govt. Post Graduate College Bajaur, Pakistan

* Corresponding to Farman Ullah: farman@bs.qau.edu.pk

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ABSTRACT: This study was conducted to evaluate different apricot germplasms on the bases of phenotypic traits at the Agricultural Research Institute Mingora, Swat, during the year 2016. The experiment was laid out in a completely randomized design (CRD). We choose various traits of six different varieties of apricot, i.e., Protici, Vitilo, Begali, Shernabi, Swat Selection and Luizet, which are collected from diverse agro-ecological zones were evaluated to ascertain the extent of genetic diversity and assess geographical heterogeneity among these varieties. Data on different quantitative and qualitative traits such as number of fruits kg^{-1}, total soluble solids, fruit color, kernel taste, and stone nature were recorded through physical and biochemical tests. The variety Luizet produced the largest size fruit with an average of 17.33 fruits kg^{-1}. Whereas, the variety Begali produced the smallest size fruits with an average of 54 fruits kg^{-1}. The maximum total soluble solids (18.06 oBrix) were recorded in the variety Begali and Luizet followed by the variety Vitilo (17.36 ^{o}Brix). Whereas the least amount of TSS were recorded in the variety Swat selection (13.2 ^{o}Brix). The fruits of Shernabi, Swat selection and Luizet had a uniform yellow color. However, fruits of other varieties were greenish to yellowish. Furthermore, free stones were most frequent in the fruits of Protici, Vitilo, Begali, Swat Selection and Shernabi, whereas, Luizet had semi-cling stones. Our results suggest that the variety Luizet is the best in terms of fruit size, TSS, fruit color and kernel taste as compared to the other tested varieties and is recommended for cultivation under the agro-climatic condition of Swat.

KEYWORDS: Apricot, climate, germplasm, phenotypic-traits, fruit quality

1. Introduction

Apricot (*Prunus armeniaca*) belongs to family Rosaceae, and sub-family Prunoideae. According to botanical classification the section Armeniace consist of five species i.e., P. armeniace (common apricot), P. holosericea (Tibetan apricot), P. mume (Japenese apricot), P. brigantiaca (Alpine plum), and P. dasycarpa (black apricot) out of these P. armeniace is the most cultivated apricot (Rehder 1927; Rehder 1949; yilmaz, Kargi et al., 2012; Khadivi-Khub and Khalili 2017). Apricot cultivars are classified into four eco-geographical groups such as Irano-Caucasian, Central Asian, Dzhungar-Zailing

and European (Kostina 1960; Halász, Pedryc et al., 2010). However, Apricot (*Prunus armeniaca* L.) is an important stone fruit belong to the family Rosaceae, and mostly grown in the temperate climate regions of the world. *P. armeniaca* L. trees were mostly originated from Central Asia and China. It is reported that apricot is mostly originated specially from Xinjiang province of China (Maghuly, Fernandez et al., 2005; Yuan, Chen et al., 2007). There are a lot of apricot germplasm resources available across the world (Mehlenbacher, Cociu et al., 1991; Tian-Ming, Xue-Sen et al., 2007). Mostly apricot producing countries are Italy, France, Spain, Algeria, Morocco, Syria, Iran, Turkey, Uzbekistan, Afghanistan, USA and Pakistan which contribute approximately 80% of world apricot (Milosevic 2011; Zhebentyayeva, Ledbetter et al., 2012; Maryam, Rafi et al. 2020). According to FAO (2002) reported that Turkey has the major apricot producing and exporting country in the world. Globally, various research experiments were laid down to promote and enhance the production of high quality apricots (Vachun 1995). According to Anon (1998) apricot is one of the most important attractive, nutritious, delicious and common fruit of northern Pakistan (Hussain, Yasmin et al., 2010; Nadeem, Ishaq Javed et al., 2012; Karatas, Ercisli et al., 2021).

Apricot is a very significant fruit crop with numerous health advantages, which has increased its commercial benefits, particularly in the temperate zone. Meanwhile, due to its high vitamin and nutrient content it is quite popular with consumers. The customers are highly interested in high quality of apricots i.e., flavor, scent, and particularly their sugar level, which is one of the most distinguished quality feature (Ruiz and Egea 2008; Khadivi-Khub and Khalili 2017). The variety of apricot cultivars demonstrate the fruits of high degree of climatic adaptability. According to Ruiz and Egea, (2008) and Khadivi-Khub et al. (2017), the diversity of fruit cultivars allows the production of fruits with the best qualities, including high sugar contents, flavorful flesh, scent, significant size, attractive colour, and a lengthy harvesting time (Ruiz and Egea 2008, Khadivi-Khub and Khalili 2017). According to Leccese et al. (2007), it is a nutrient-rich source of carbohydrates, minerals, fibers, bioactive phytochemicals, and vitamins A, C, thiamine, niacin, riboflavin, and pantothenic acid (Leccese, Bartolini et al., 2007; Singh 2020). Carotenoids, phenolics, and antioxidants are among the phytochemicals that are significant due to their biological importance (Lichou, Jay et al., 2003; Fatima, Bashir et al. 2018).

Additionally, the average size of the apricot fruit is about 5cm in diameter, and it hold one large seed (Hussain, Yasmin et al., 2010; Sumonsiri and Barringer 2014). This delicious fruit trees are grown from plain to altitude area of about 3000 meters' height. It is used for the preparation of many useful products such as jam and nectar. Apricot is preserved mainly by conventional method i.e., sun drying without the use of chemicals in northern areas. Meanwhile, fresh fruits enter the market by the end of May and remains there through September, dried fruit is accessible all the year (Faqir, Saeed et al. 2004). According to PAR (Agriculture Education portal), Apricot are mostly grown in the northern areas of Pakistan. According

to statistical report of FAO, 2012, Pakistan is rated 6th position in terms of apricot production. Pakistan horticulture development and export board reported that in Baluchistan province especially the region named Killa Saifullah contributed about 60% of apricot production. Another report highlighted that approximately 60 apricot varieties are grown in the northern areas of Pakistan. Some of them are Halman, Karfo, Chuli, Marghulam, and Shara karfa (Alam 1990; Rana, Moeen et al., 2021). Pakistan is famous for the production of best apricot varieties across the world. However, various report shows that about 180 apricot varieties are found in Pakistan (Waseem, Naqvi et al., 2021). Some other varieties are Red flesh early, Old cap, Charmaghz, Moorpark, Nari, Shakarpara, Kassel Bright, Sarda, Budgher, Travet, Swat selection etc (Ali, Masud et al., 2011).

Furthermore, the annual production of apricot in Pakistan is 197.2 tones in which 8.3% is produced in Khyber Pakhtunkhwa (KPK). The supreme quality apricot is produced by those genotypes which grown at the upper altitude due to this reason greater quality of apricot is produced in the northern areas of Khyber Pakhtunkhwa for example in Swat, Manshera, and Hangu (Akhtar, Akmal et al., 2013). The current project was designed to investigate different verities of apricot i.e. Protici, Vitilo, Begali, Shernabi, Swat Selection and Luizet on the bases of phenotypic traits, for their quality and production under the agro-climatic conditions of Swat.

2. Material and methods

2.1 Experimental deign and location

Apricot germplasm orchard were currently established at Agriculture Research Institute Mingora, Swat by collecting apricot samples from various localities. There are six different germplasms selected for the current study i.e., Protici, Vitilo, Begali, Shernabi, Swat Selection and Luizet. The germplasm were evaluated for various traits during the course of this study.

2.2 Data collection

Apricot is an important medicinal crop plants of Khyber-Pakhtunkhwa especially of district Swat. The survey were carried out during the year of 2016. The data were collected on various parameters of the apricot such as fruit colour, kernel test, number of fruits per kilogram, nature of stones and total soluble solids.

2.2.1 Fruit colour

Fruit colour was observed on physical appearance which play an important role in the quality of fruits. Fruit color was measured through visual observation by the scale of 10 scoring method such as yellow = 0-2, yellowish = 3-4, white = 5-6, white with pink blush = 7-8, yellow with red blush = 8-9.

2.2.2 Kernel taste

Kernel test was taken from apricot fruit randomly and the taste of each kernel was checked for its sweetness and bitterness.

2.2.3 Number of fruits per kilogram

One-kilogram fruit sample was taken in each treatment per replication for each variety and the number of fruits was counted and recorded**.**

2.2.4 Nature of stone

For determining nature of stone, Apricot fruits were randomly taken from each genotype to observe the nature of stone whether it is free stone, semi-cling stone or cling stone.

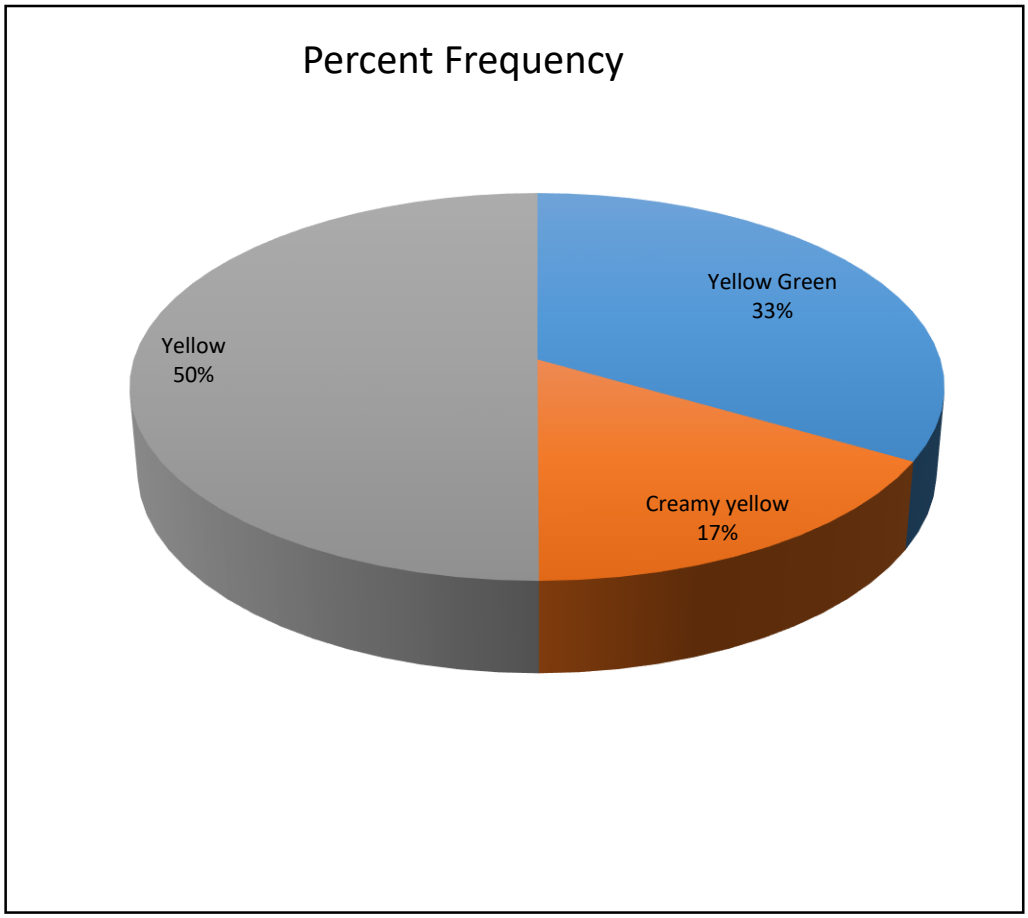

Figure 1. Frequency distribution (%) of fruit color among germplasms.

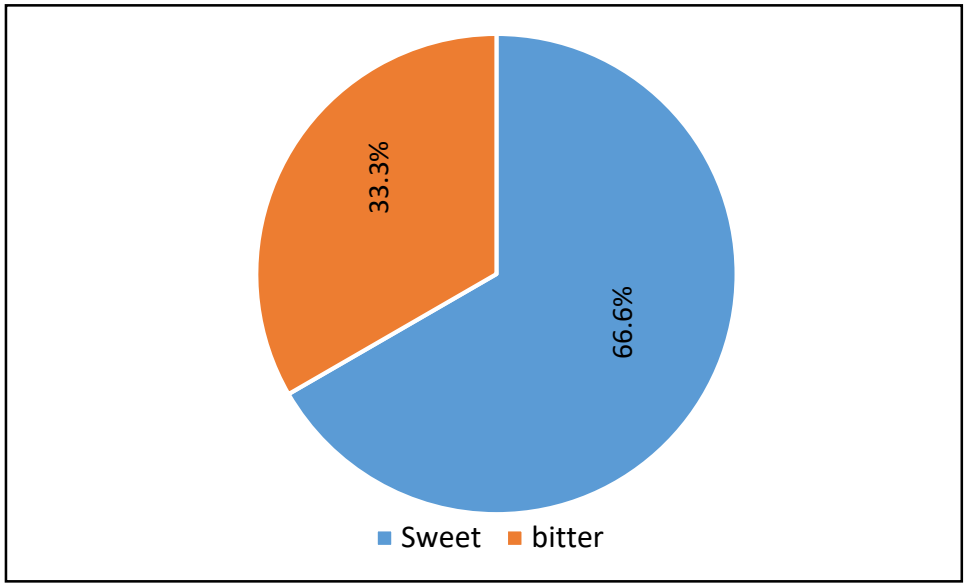

Figure 2. Frequency distribution (%) of kernel taste among the six Apricot germplasm

2.2.5 Total soluble solids (°Brix)

Total soluble solids were determined according to the association of official analytical chemists (AOAC, 2000) by using a hand refractometer at room temperature. So one drop of extracted juice from each sample was placed on refractometer prism and reading was recorded in the unit of brix.

2.3 Statistical Analysis

A frequency test, also known as a chi-square test, was used to statistically analyze the data using software Statistix (Version-10, Analytical Software). It compares the pattern of observed counts or frequencies to those that are anticipated to occur and Least Significant Difference (LSD) was performed for individual mean comparison at 5% probability level. The LSD determines the least significant difference between two means as if a test had been conducted on those two means alone (rather than on the means of all the groups combined). This enables you to compare two means from two different groups directly. Any difference that exceeds the LSD is regarded as a significant finding.

3. Result and Discussions

The research article discusses the results obtained from the data which is collected and then subjected to statistical analysis. We choose six different types of germplasms and are discussed one by one in detail both theoretically and graphically.

3.1 Fruit Colour

The frequency distribution of fruit colour among six different germplasm as shown in Figure 1. Considerable degree of variation was observed among fruit colour i.e. yellow color were more observed (50%), followed by yellow green (33%) and creamy yellow was observed with the lowest percentage of (17%). The germplasms Shernabi, Swat selection and Luizet showed yellow fruit color. However, the fruit colors of germplasms Portici and Vitilo were yellow green, while the germplasm Begali revealeds were creamy yellow color as shown in Table 1. These findings are in line with Asma, Kan et al. (2007).

3.2 Kernel Taste

The frequency distribution of kernel taste among germplasm as shown in Figure 2. Sweet taste was observed more frequently about 66.6% in different apricot varieties, while Bitter Taste were observed is about 33.3% in among germplasm. Our results highlighted that Begali, Shernabi, Swat Selection and Luizet were more sweet kernel taste germplasms. Whereas, the germplasms Protici and Vitilo were of bitter kernel taste shown in Table 1. The kernal taste is a genetically controlled trait which shows a genetic diversity among germplasms. Our results are more likely consistent with the findings of (Yilmaz, Paydas-Kargi et al. 2012).

3.3 Number of Fruits per kg

The frequency distribution of number of fruits per kg of six different germplasms as shown in Figure 3. The highest number of fruits per kg was recorded in the Begali germplasms (54), followed by Shernabi while the lowest number of fruits were observed in germplasm Luizet (17.33). The number of fruits per kg depends on the size of the fruits i.e., large size germplasm is less in number per kg, while small size of the germplasm is more in number. For example, Luizet germplasm produced fruits of larger size as compared to the remaining germplasms,

therefore the number of fruits per kg remained the least in this germplasm. Our results confirmed with the findings of (Amurrio, Varela Varela et al. 1995).

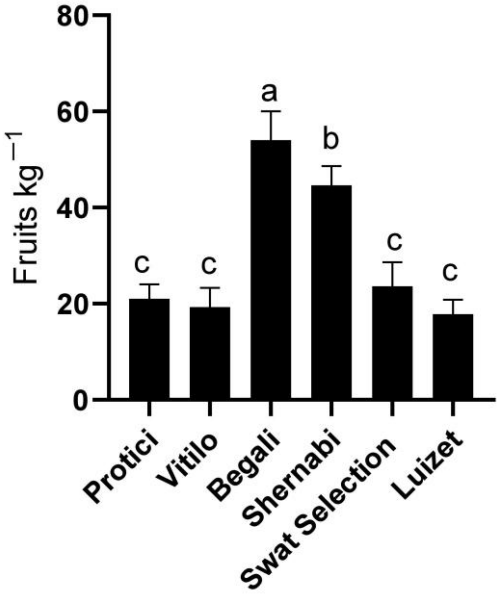

Figure 3. Number of fruits per kg of six apricot germplasms.

3.4 Nature of Stone

The frequency distribution for nature of stone among six different germplasms of Apricot are shown in Figure 4. Our results shown great variation in the nature of stone. The germplasm with free stone nature were more frequent (83%), while semi-cling stone nature was 17%. Further, the results showed that Protici, Vitilo, Begali, Shernabi and Swat Selection were free stone nature germplasm, whereas, the Luizet has semi-cling stone germplasm (Table 1). It is a genetic phenomenon whether a variety will have a free, semi cling or cling stone and result shows a great genetic variability. Our results are consistent with the findings of (Asma, Kan et al. 2007).

Table 1. Analysis of six different germplasms of Apricot for number of fruits/kg

Source	DF	SS	MS	F	P
Germplasms	5	3745.33	749.067	50.88	0.0001
Error	12	176.67	14.722		
Total	17	3922			
Grand Mean	**30.333**	**CV**	**12.65**		

Table 2. Analysis of six different germplasms of Apricot of total soluble solids.

Source	DF	SS	MS	F	P
Germplasms	5	53.667	10.733	7.67	0.0019
Error	12	16.793	1.3994		
Total	17	70.46			
Grand Mean	16.433	**CV**	7.2		

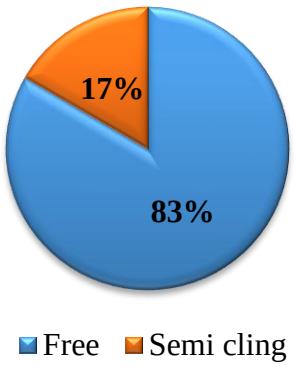

Figure 4. Frequency distribution (%) of stone nature among the germplasms.

3.5 Total Soluble Solids (ºBrix)

The frequency distribution of total soluble solids of six different germplasms of Apricot (Figure 5). The highest total soluble solids were measured in the germplasm Begali (18.067ºBrix). Whereas, Swat selection resulted in lowest total soluble solids (13.2ºBrix). In terms of total soluble solids,

the germplasm Begali is better and the Swat Selection is the worst. Our result is almost similar with Yilmaz, Paydas-Kargi et al. (2012).

Table 3. Qualitative traits of six apricot germplasms

Germplasms	Fruit color	Kernel Taste	Stone Nature
Protici	Yellow green	Bitter	Free
Vitilo	Yellow green	Bitter	Free
Begali	Creamy Yellow	Sweet	Free
Shernabi	Yellow	Sweet	Free
Swat Selection	Yellow	Sweet	Free
Luizet	Yellow	Sweet	Semi cling

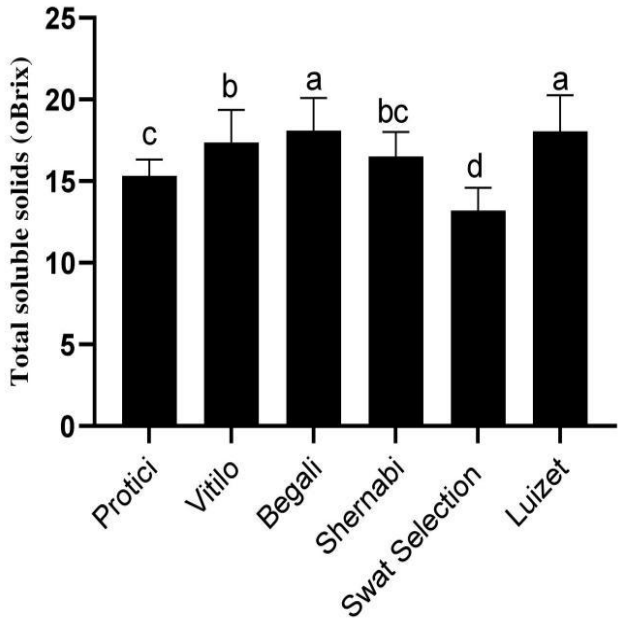

Figure 5. Total soluble solids (oBrix) of six apricot germplasms.

4. Conclusions

From the comprehensive quantitative and qualitative evaluation of the six different apricot varieties, it is concluded that this germplasm provides extensive genetic diversity in terms of production, color and taste of the fruits. Among the tested varieties, some varieties are best suitable for quantitative characters, whereas others were found suitable for qualitative characters. Hence, it is recommended that this germplasm may be used for breeding purposes in order to combine their good characters in a single variety suitable for cultivation in Pakistan. Also, recommended for young researchers to works on their ecology, taxonomy, pollen study and genetic diversity.

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Author's contribution:

Conceptualization and designing: Badshah Islam, Muhammad Ilyas Jan, Farman Ullah and Muhammad Romman. Manuscript Preparation: Farman Ullah, Muhammad Ilyas Jan, Aminul Haq, Misbah Uddin and Batool Nisa.

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The authors bear no competing interest.

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