PERFORMANCE OF SEVEN EARLY MATURING VARIETIES OF GRAPES (*VITIS VINIFERA*) UNDER AGRO- CLIMATIC CONDITIONS OF POTHWAR, PAKISTAN

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ABSTRACT

Seven early maturing grape varieties (Kings Ruby, Sultanina-C, Perlette, Flame Seedless, Vitro Black, Early White and Superior) were evaluated for their comparative performance under semi -arid conditions of Pothowar region during 2015-17 at Barani Agricultural Research Institute, Chakwal, Pakistan. As these varieties ripen before monsoon season so they are suitable for growing in Pothowar region. Data analysis showed that all quality traits regarding these varieties significantly differed from each other. During the year 2015-16, maximum cluster weight was observed in "Flame Seedless" (450.90 g) followed by "Kings Ruby" (449.74 g) and "Superior" (384.97 g) while minimum cluster weight was recorded in "Early White" (199.62 g). However, berries of "Early White" variety were of largest size (2.68 cm) and variety had highest numbers of clusters (49.66) per plant and 10 berries weight (29.21 g) as compared to other varieties. In terms of yield, variety "Superior" performed best and had highest yield (15.90 kg/plant), whereas "Perlette" had lowest yield (8.06 kg/plant). Fruit of "Sultanina-C" had highest T.S.S (19.72 and 19.53 % during the year 2015-16 and 2016-17 respectively) but acidity was highest in fruits of "Vitro Black" (0.35 and 0.34 %). Similar trend was observed for both quality parameters and organoleptic properties during year 2016-17 except cluster weight and 10 berry weight where "Kings Ruby" (412.54 g) and "Superior" (37.03 g) gave the best results. The present study obseved that varieties "Superior", "Sultanina C", "Kings Ruby" and "Early white" are most suitable for growing in agro-climatic conditions of Pothowar region.

Keywords: Grapes, Pothowar, yield, cluster, berries, TTS, Acidity

INTRODUCTION

Grape is one of the oldest and important perennial crops in the world (Munir *et al.,* 2015). It belongs to the genus *Vitis*, which consists of approximately 60 species. However, the principal species from which the cultivated grape has been derived is *Vitis vinifera*. It has been reported that in recently developed grapes growing regions of the world including USA, China, Australia as well as the traditionally grapes growing regions in Europe a small number of varieties are as elite cultivars are being grown representing a narrow portion of the grape's germplasm diversity (Wolkovich *et al.*, 2018). It can be consumed as fresh and many other products like juices, wine, raisins, jellies and jams (Sajid and Ahmed, 2008). Grapes are very nutritious and contain carbohydrates, sugars, dietary fiber and protein. Grapes contains different vitamins (B1, B2, B3, B5, B6, B9, B12) calcium, iron, phosphorus, magnesium, manganese, potassium, zinc and sodium that also flavors the nutritional importance of grapes (Munir *et al.,* 2015).

Pakistan has been conferred with different agro-climatic conditions by nature making it suitable for adaptability of wide variety of fruits including grapes (Tehrim and Sajid, 2011). Grapes farming' is gaining tremendous popularity among the farming community and is being practiced in many areas of Pakistan (Munir *et al.,* 2015). In Pakistan, grapes are grown over an area of 15.23 thousand ha with annual production of 77.22 thousand tones (GOP, 2015). Baluchistan is the main grape growing region accounting approximately over 70% of fruit production, while the remaining come from Khyber Pakhtunkhwa (Anonymous, 2015). Major growing areas of Baluchistan are Kalat, Loaralai, Mastung, Quetta, Khuzdar, Pishin, Kanak and Ziarat (Mengal *et al.,* 2017). Moreover, due to day by day increasing demand of a grapes in the country, its cultivation is also started in South Punjab (Anonymous, 2015).

However, the main barriers to produce grapes on commercial level in Punjab is ripening of fruit when the monsoon is at its peak. As due to prolonged cloudy days ripening time increased and with the rain fruit quality is depreciated. Firstly, it causes the flavor to be diluted (low brix level) and due to thrown off sugar and acidity balanced, grapes shelf life decreased. A well-planned research work has made it possible to grow grapes in the Pothowar region on commercial scale. Therefore, it is very important to select those varieties that ripened before the monsoon season (Mahmood *et al*, 2007). In Pakistan, grapes usually hit the market slightly ahead of the winter season. However, in the present era, the grapes farming is suitable and profitable in Pothowar plateau and has now developed as the largest producer of

grapes during peak summer season when grapes from other parts of the country are not yet available (Mahmood et *al.*, 2007).

For the table purpose grape industry, climatic conditions are the most important and dominant contributor to quality and quantity of grapes (White *et al.,* 2009). The time of maturity, ripening and harvesting depends upon variety, geographic location and climatic conditions. Different grapes cultivars have varying tolerance to temperature, heat stress, rainfall and their distribution through the season (Cameron and Pasqual, 2004). Many diseases attacks grapes and high humidity promotes the development of different diseases such as dead arm, anthracnose, bunch rot, black rot, downy mildew and powdery mildew. The quality of grapes fruit depends on biotic and abiotic factors (Ahmed *et al.,* 2004a, b). During berry growth and development, the climate also plays an important role for berry maturity, ripening, and development of physical, as well as chemical characteristics of the berry quality such as size, color, aroma and accumulation of anthocyanin (Khan *et al.,* 2011). There is an urgent need for the evaluation of grape germplasm diversity for fruit development and chemical composition (Gascuel *et al*., 2017), the focus must be kept on environmental effects on different attributes viz., the berry volume and the total soluble salts (sugars), acidity etc. A limited number of researches have been reported this aspect in grapes germplasm (Doligez *et al*., 2006, Mejia *et al*., 2007, Shiraishi *et al*., 2010; Houel *et al*., 2013; Duchêne *et al*., 2012, Preiner *et al*., 2013; Teixeira *et al*., 2013; Chen et al., 2015; Yinshan et al., 2017; Zhou et al., 2017).

Thus, keeping in view, the economic importance of grapes on commercial scale in Pothowar region the present research was conducted with objective to manage the problem of berry rottening due to monsoon rains, early maturing varieties of grapes were evaluated for their physicochemical quality characteristics under Pothowar climate.

MATERIALS AND METHODS

Seven grape varieties (Kings Ruby, Sultanina-C, Perlette, Vitro Black, Flame Seedless, Early White and Superior) were selected for their perfo-

rmance evaluation in experimental orchard of Barani Agricultural Research Institute (BARI), Chakwal, Pakistan during the cropping seasons of 2015-2017. The average summer temperature of Chakwal is 32.5 °C and in winters January is the coldest month, with temperatures averaging 10.5 °C. This area has 72° longitude and 32° latitude and 575 m altitude. Climate of Chakwal is semi-arid, sub-tropical and received annual rainfall less than 600 mm. Most of which falls during monsoon in the form of high intensity showers. Soil is silty loam to loam with pH 7-9. In present research, three plants of each variety were grown in each experiment (three plants in one replication). Plant to plant distance was 6ft while row to row distance was 10ft while fertilizer applied in each variety was NPK. Irrigation and all other agronomic practices were according to recommendation and same during the experiment in both seasons. Experiment was carried out according to RCBD (randomized complete block design). Data was analyzed by one-way ANOVA through "Statistix 8.1" software and difference between means were compared by L.S.D (Least Significance Difference) at 5% probability level.

Data for quality attributes such as cluster weight (g), berry size (cm), no. of seeds per berry, 10 berry weights (g), no. of clusters per plant, time of maturity and yield per plant (kg) were recorded in both years. Organoleptic properties such as berry color, number of seeds per berry, TSS and acidity of juice were examined in all varieties.

RESULTS AND DISCUSSION

Maturity time: Data related to time of maturity for different grapes varieties is given in Table 1. According to Table, all 7 grapes varieties mature in between mid-June to start of July. Perlette, Flame Seedless, Early White and Kings Ruby mature first in mid-June followed by Sultanina-C and Vitro Black which matures at the end of June. Variety Superior observed to be mature at the end usually at the start of July month. Apart from diff-erent maturing times, all these varieties mature before the monsoon season approaches thus avoid the danger of berry splitting.

Table 1: Maturity time for different grape varieties

Variety	Kings Ruby	Perlette	Flame Seedless	Sultanina-C	Early White	Vitro Black	Superior
Maturity time	Mid June	Mid June	Mid June	End June	Mid June	End June	Start July

Quality parameters: Evaluation of different quality parameters among grape varieties during 2015-16 and 2016-17 are shown in Fig.1. Data analysis

showed that maximum cluster weight during first year was exhibited by both "Flame Seedless" and "Kings Ruby" (450.90 and 449.74 g) followed by

"Superior" (384.97 g), "Vitro Black" (298.17 g), "Sultanina-C" (289.36 g) and "Perlette" (277.29 g) while minimum cluster weight was recorded in "Early White" (199.62 g). In second year, "Kings Ruby" produced clusters of maximum weight (412.54g) followed by "Superior" (403.44 g) and "Flame Seedless" (392.87 g), whereas least

cluster weight was studied in "Early White" (229.22 g) same as in first year. Bunch weight is one of the most important yield characteristics. Heavier the cluster is more will be the yield.

Fig. 1 Mean Comparisons of different quality parameters of different grape varieties

Different in cluster weight among different varieties were may be due to inherit genetic

character, canopy size, difference in berry size, number of berries per cluster and difference in nu-

mber of canes. Thus, the plant with highest canopy size may be maximum cluster weight (Havinal *et al.*, 2008).

Berry size is one of the important factors that determined the quality of table grapes. It varied significantly among different varieties in both years. Larger berry size (2.68 cm) was observed in "Early White" followed by "Superior" (2.65 cm) however in variety "Perlette", plant produced berries of small size (1.89 cm) for first year. Similar trend was also examined for second year where "Early White" had berries of maximum size (2.90 cm). Joshi *et al.,* (2015) studied that a smaller number of berries in clusters results in larger berry size as if a greater number of berries is present in a cluster then there is a reduction in berry size.

Quality parameter, 10 berry weight (g) is directly related with berry size. So as stated above larger berry size of "Early White" causes an increase in 10 berry weight (29.21 g) as compared to other varieties weight such as "Superior" (26.84 g), "Vitro Black" (24.03) "Sultanina-C" (23.74 g) and "Kings Ruby" (23.16 g) in first year however according to data analysis, minimum 10 berry weight (19.76 g) were in "Perlette". But for 2016-17 year, "Superior" had highest 10 berry weig ht (37.03 g) followed by "Early White" (29.75 g) and lowest berry weight was recorded in "Perlette" (18.18 g) respectively.

Analysis of data represent that like other parameters such as berry size and 10 berry weight, number of clusters per plant were also significantly highest in "Early White" in both first and second year (49.66 and 50.00) whereas "Superior" had 36.33 and 41.00 clusters while "Sultanina-C" had 34.66 and 35.33 number of clusters per plant during both years. But in year 2015-16, "Flame Seedless" had produced minimum number of clusters per plant (24.66) whereas in year 2016-17, minimum number of clusters (19.00) was in "Perlette" variety. This variation among different varieties was accounted due to plant different genetic and phenotypic expression under semi-arid environmental conditions. Different physiological functions like assimilation of photosynthesis products and their transportation, cell division, enzymatic reactions, metabolism of sugar and plant overall growth and development are also influenced by variation in temperature (Khan *et al.*, 2011).

Yield is an important parameter as viticulturist favored to grow those varieties which gives high economic return. In present research, variety "Superior" observed to be high yielding during with 15.90 kg/plant yield in first year and 16.78 kg/plant in second year. Second high yielding variety during first year was"Kings Ruby" having 14.26 kg/plant yield followed by" Flame Seedless" (13.66 kg/plant) respectively whereas during second year, "Sultanina-C" comes at second position (15.23 kg/plant) followed by "Kings Ruby" (14.86 kg/plant) respectively. Least performing variety as confirmed from above quality parameters were "Perlette" which had 8.06 and 8.33 kg/plant yield in both first and second years. Yield variability among different varieties were due to plant inherit genetic along with environmental conditions, moreover it also may be due to plant nutrition status, age, cultural practices and abiotic and biotic stress incidence (Joshi *et al.,* 2015). As high yielding varieties are of grower preference so in this research, varieties such as "Superior", "Sultanina-C" and "Kings Ruby" were suitable for cultivation in agro-climatic conditions of Pothowar region.

Organoleptic properties: Data related to organoleptic properties of different grapes varieties are presented in Table 2. According to data analysis for first year highest TSS was recorded in variety "Sultanina-C" (19.73 %) which is significantly higher than TSS of "Flame Seedless" (19.26 %), "Kings Ruby" (19.04 %) and "Perlette" (18.86 %) while in "Vitro Black" significantly lowest TSS value (17.06 %) was examined. Similarly, for second year, "Sultanina-C" shows maximum value (19.53 %) whereas "Vitro Black" had minimum TSS (17.33%). Sweetness is one the most important quality parameter of fresh fruit that determine its ripening status as well as its shelf life. Thus, in fresh produce Total soluble solids (TSS) are used to calculate fruit sweetness (Jongen, 2002). In grapes, sugar content or sweetness level must be maintained at harvesting for enhancing its flavor and to prolong storage life. Usually grapes had no remaining starch reserves that can hydrolyze and increased the berry sugar content once it is harvested. Accumulation of sugar occurs during ripening and it's depends upon crop management practices and on ripening period length. Sugar content increases as the crop reaches towards maturity while at a same time acidity in fruit start decreasing (Yinshan, 2017).

Table 2: Organoleptic properties of different grapes varieties

Variety	Year				
	2015-16		2016-17		
	T.S.S (%)	Acidity (%)	T.S.S (%)	Acidity (%)	Color
Kings ruby	19.04± 0.19 a	0.31± 0.005 c	18.81 ± 0.12 ab	0.32 ± 0.006 ab	Dark purple
Perlette	18.86 ± 0.82 a	0.34 ± 0.003 ab	19.03 ± 0.15 ab	0.31 ± 0.005 bc	Yellowish green
Flame seedless	19.26 ± 0.81 a	0.31 ± 0.005 c	19.13 ± 0.48 ab	0.31 ± 0.012 bc	Light purple
Sultanina C	19.72 ± 0.24 a	0.29 ± 0.005 d	19.53 ± 0.24 a	0.30 ± 0.005 c	Yellowish green
Early white	18.48± 0.45 ab	0.33 ± 0.01 b	18.54 ± 0.17 b	0.33 ± 0.005 ab	Yellowish green
Vitro black	17.06 ± 0.4 b	0.35± 0.003 a	17.33 ± 0.14 c	0.34 ± 0.003 a	Dark purple
Superior	18.40± 0.32 ab	0.34 ± 0.005 ab	18.64 ± 0.36 b	0.33 ± 0.008 ab	Yellowish green

Means followed by the same letters in the same column are not significantly different, at $P \leq 0.05$.

As acidity decreases when sweetness level or TSS increased in fruit so in present research during both years (2015-16 and 2016-17) minimum acidity percentage was observed in "Sultanina-C" (0.29 and 0.30 %) whereas maximum acidity level was found in "Vitro Black" (0.35 and 0.34%) due to reduction sweetness percentage. Lowest acidity value in grapes varieties were because of subtropical climatic conditions. As high temperature during berry development, maturation and ripening increases the malic acid consumption and lower the acid accumulation which ultimately decreases the acidity level in fruit at maturity (Karibasappa and Adsule, 2008).

Among different grape varieties selected for evaluation, "Perlette", Sultanina-C", "Early White" and "Superior" are of yellowish green color whereas "Vitro Black" and "Kings Ruby" is of dark purple color and "Flame Seedless" has light purple color. Apart from sweetness or color of berry, all these varieties are seedless which a major liking factor among the consumers is.

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