

PERFORMANCE OF DIFFERENT APPLE VARIETIES UNDER CLIMATIC CONDITIONS OF MURREE HILLS

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ABSTRACT

Performance of 20 apple varieties was evaluated under the environmental conditions of Murree Hills at Hill Fruit Research Station, Sunny Bank, Murree, Pakistan during the year 2009 and 2010. At maturity of fruit; sensory and physicochemical analysis of apple varieties was carried out. The results revealed that fruit colour of Sky Spur variety gained maximum points (8.75) showing dark red-maroon colour. Regarding flavour of fruit maximum points were obtained by three varieties i.e. Apple No. 1, Star King Delicious and Sky Spur (8.5 each) while for taste Apple No.1 topped the list (8.5). Star King Delicious showed maximum size of fruit (4927.1 mm²). The variety Apple No. 1 matured by 30th June and found ideally fit for plantation in entire apple producing region of Murree. Maximum fruit weight (167.25g) was measured in variety Summer Red. Minimum number of seeds per fruit (7.75) was recorded in Sky Spur and maximum TSS (13 %) was noted in Early Shan Burry. Variety Star King Delicious excelled in fruit yield (228 kg/plant). Apple No.1 was found as the best among varieties on the basis of taste, flavour and its maturity during second week of June.

KEYWORDS: *Malus domestica*; cultivars; performance; chemico-physical properties; Pakistan.

INTRODUCTION

Apple (*Malus domestica*) belongs to genus *Malus*, Family Rosaceae, the great family of roses. It includes not only the apples but also several other fruits such as peaches, pears, plums and raspberries. Successful production of apple requires a long growing season, adequate sunshine, a plentiful supply of moisture, mild winter and protection from strong winds. Accordingly the climate of province Balochistan is well suited to produce high quality

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apple. However, the Murree Hills is the only place in Punjab where the apples can be grown successfully. Apple trees can endure temperature as low as 31°F to 40 °F (2).

Murree city is a popular hill station and a summer resort. It is located near Islamabad on Kohala highway at the distance of 65 km from Rawalpindi. It is situated on the southern slopes of the Western Himalayan foothills as these ascend to the Northeast towards Kashmir. In Murree Hills, apple growing is mainly practiced at altitudes between 4500 to 7500 feet above the sea level (8).

In Murree and its allied areas i.e. Chitta Morgh, Ghora Gali, New Murree, Upper Topa, Lower Topa, Alliot, Bhurban and Khaira Gali; high chilling varieties of apple and other deciduous fruits can be grown successfully while in the areas of Tret, Phagwari, Kotli Sattian, Lower Devil, Berot, Lora, Charhan and Kohala, low chilling varieties of apple can be grown. Murree mountains contain sufficient amount of clay soil rich with organic matter and after terrace formation the deciduous fruit plantation can be carried out. However, high humidity, spring frost, infestation of sooty blotches and hail storm are the limiting factors.

The characteristics such as colour, taste, flavour and texture continue to be important factors. Recent surveys of local consumers as well as experts showed that many consumers select apples based on appearance, taste, flavour, and other internal quality characters. The consumers rate the apple on the basis of eating quality (appearance, flavour, taste and texture).

Many apple varieties have been evaluated by different scientists in different climatic and ecological zones of the world on the basis of fruit quality, dietary importance and marketing (1, 3, 4, 5, 6, 7, 10).

The present study was conducted to find out some suitable varieties for cultivation at Murree Hills area for good physiochemical characters. Moreover, the commercial activities at Murree is seasonal i.e. from April to August, depending on the visit of local as well as foreign tourists. So there is a need to find out some varieties which may ripe between months of June and August because most of the varieties ripe during September and October.

MATERIALS AND METHODS

This study was conducted at Horticultural Research Station, Murree, Pakistan during the year 2009-10. Twenty varieties of apple i.e. Apple No. 1, Kandhari, Kashmiri Ambri, Star King Delicious, Golden Delicious, Golden

Russet, Sky Spur, Melrose, Sky Lime Supreme, Nugget MM-III, Oregon Spur, Annurica MM-106, Summer Red, Naga FU-2, Spartan, Red Chief, Joan Gold, Golden Lebanon, Saharni and Early Shan Burry were evaluated under climatic conditions of Murree Hills. Six year old plants of each variety, budded on Crab apple (*Malus bacata*) locally called "Choitta" were selected as experimental material. Terraces were made by leveling the slanting position of the mountain. At maturity of fruits, physiochemical analysis of apple varieties was carried out in the laboratory. Layout system was RCBD with four repeats.

All the plants were given the standard cultural practices. The plants were watered by harvesting the water from spring. NPK @ 300-225-225g alongwith 30 kg FYM per plant was applied during December. Nitrogen was applied in three split doses i.e. before flowering, at pea stage and during August, 2009 and 2010. At maturity ten fruits per plant of each variety were picked randomly during June to November.

Hedonic scale was used to rate the cultivars for colour, taste, flavour and texture. On the scale, 1-unit intervals were considered as disliked extremely (1), disliked moderately (2), disliked very much (3), disliked slightly (4), neither liked nor disliked (5), liked slightly (6), liked moderately (7), liked very much (8) and liked extremely (9). A panel of judges was made and fruits of all varieties were given to them for filling the proforma of scoring. To adequately assess the attraction, local consumers and experts were instructed to lightly polish the surface of fruit with a soft towel to remove dust, spray deposit, bloom, or other surface residues.

The size of fruit was measured by electronic digital caliper, weight was measured by electronic scale (SF-400) and TSS was measured by digital Refractometer (Pal-1).

Data collected on fruit colour, taste, flavour, texture, maturity time, average fruit weight (g) average fruit size (mm²), average TSS (%), number of seeds per fruit and yield were analyzed statistically by using Fishers analysis of variance and per plant treatments were compared by using the least significant difference (LSD) test at 5 percent probability level (R1). Each variety was considered as individual treatment.

RESULTS AND DISCUSSION

Maturity period and sensory evaluation

The data showed that variety Apple No. 1 matured by 30th June with excellent taste, flavour and texture (Table 1 and 2) and was found as ideally fit for plantation in entire apple producing region.

Table 1. Colour of fruit and maturity time.

| Name of variety | Colour of fruit | Maturity time |
|---------------------|--------------------------------------|----------------------------|
| Apple No. 1 | Yellow with red streaks | 30 th June |
| Kandhari | Reddish with red blush | 15 th July |
| Kashmiri Ambri | Green with pink shade | 1 st August |
| Star King Delicious | Red with dark red streaks | 1 st August |
| Golden Delicious | Yellow | 15 th September |
| Golden Russet | Yellow with russeting | 15 th September |
| Sky Spur | Dark red-maroon | 15 th September |
| Melrose | Dark red with yellow base | 15 th August |
| Sky Lime Supreme | Brick red | 1 st September |
| Nugget MM-III | Yellow | 1 st September |
| Oregon Spur Franco | Green with red base | 1 st September |
| Annurica MM-106 | Yellow with red blush | 1 st September |
| Summer Red | Red with yellow blush | 1 st September |
| Naga FU-2 | Red with yellow base | 1 st September |
| Spartan | Yellow | 1 st September |
| Red Chief | Reddish yellow with dark red streaks | 15 th August |
| Joan Gold | Dark red with yellow base | 1 st September |
| Golden Lebanon | Red with maroon streaks | 15 th August |
| Saharni | Dark red with heavy bloom | 15 th July |
| Early Shan Burry | Reddish | 15 th July |

Table 2. Sensory evaluation by Hedonic scale rating.

| Name of variety | Colour | Taste | Flavour | Texture |
|---------------------|----------|----------|----------|-----------|
| Apple No. 1 | 8.25 ab | 8.50 a | 8.50 a | 8.00 abc |
| Kandhari | 6.75 cd | 6.00 d | 5.75 de | 6.25 e |
| Kashmiri Ambri | 5.00 efg | 4.00 f | 4.75 ef | 5.00 f |
| Star King Delicious | 8.25 ab | 8.50 a | 8.50 a | 8.50 a |
| Golden Delicious | 5.00 efg | 7.50 abc | 7.50 abc | 7.25 bcde |
| Golden Russet | 4.50 fgh | 4.75 ef | 5.50 ef | 6.50 de |
| Sky Spur | 8.75 a | 8.50 a | 8.50 a | 8.00 abc |
| Melrose | 8.25 ab | 7.50 abc | 8.00 ab | 7.75 abc |
| Sky Lime Supreme | 7.75 abc | 5.75 de | 5.75 de | 7.00 cde |
| Nugget MM-III | 5.75 de | 7.75 abc | 8.25 ab | 8.00 abc |
| Oregon Spur Franco | 3.75 h | 4.75 ef | 5.25 ef | 4.50 f |
| Annurica MM-106 | 4.00 gh | 3.75 f | 5.50 ef | 7.00 cde |
| Summer Red | 8.25 ab | 7.75 abc | 8.25 ab | 7.75 abc |
| Naga FU-2 | 5.50 ef | 4.00 f | 5.00 ef | 5.00 f |
| Spartan | 4.25 gh | 6.75 cd | 6.75 cd | 6.50 de |
| Red Chief | 8.50 ab | 8.25 ab | 7.50 abc | 8.25 ab |
| Joan Gold | 7.50 bc | 7.50 abc | 7.25 bc | 6.25 e |
| Golden Lebanon | 8.50 ab | 7.75 abc | 8.25 ab | 7.50 abcd |
| Saharni | 8.50 ab | 7.25 bc | 5.75 de | 7.25 bcde |
| Early Shan Burry | 4.00 gh | 3.75 f | 4.50 f | 4.00 f |
| LSD 0.05 | 1.0341 | 1.1161 | 1.0169 | 1.0808 |

The data (Table 2) further showed that maximum points for colour (8.75) were obtained by variety Sky Spur showing dark red-maroon colour which was very much accepted in local market. Varieties Red Chief, Golden Lebanon, Saharni, Apple No. 1, Star King Delicious, Melrose and Summer Red were at par with 8.5, 8.5, 8.5, 8.25, 8.25, 8.25 and 8.25 points, respectively. Minimum marks were obtained by the varieties Golden Russet (4.5), Spartan (4.25), Annurica MM-106 (4.0)-106, Early Shan Burry (4.0) and Oregon Spur (3.75) (Table 2).

The data on flavour fruit showed maximum points secured by three varieties i.e. Apple No. 1, Star King Delicious and Sky Spur (8.5 each) (Table 2). Varieties Nugget MM-III, Summer Red, Golden Lebanon and Melrose were also ranked as well flavored with 8.25, 8.25, 8.25 and 8.0 marks, respectively. Minimum marks were obtained by the varieties Golden Russet (5.5), Annurica MM-106, (5.5), Naga Fu-2 (5.0) Kashmiri Ambri (4.75) and Early Shan Burry (4.5).

The data on taste of fruit revealed that maximum points were also obtained by three varieties i.e. Apple No. 1, Star King Delicious and Sky Spur (8.5 each) followed by Red Chief (8.25) (Table 2). The varieties Nugget MM-III, Summer Red, Golden Lebanon, Golden Delicious, Melrose and Joan Gold were also marked as tasteful varieties with 7.75, 7.75, 7.75, 7.5, 7.5 and 7.5 marks, respectively. Minimum marks were secured by varieties Golden Russet (4.75), Oregon Spur (4.25), Kashmiri Ambri (4.0), Naga Fu-2 (4.0), Annurica MM-106 (3.75) and Early Shan Burry (3.75). With regards to texture of fruit, variety Star King Delicious stood first (8.5) which was highly appreciated by the panel (Table 2). Variety Red Chief showed also good texture (8.25). Varieties Apple No. 1, Red Chief, Sky Spur, Nugget MM-III, Spartan, and Summer Red stood at par with 8, 8, 8, 7.75 and 7.75 percent, respectively. Minimum marks were obtained by Kandhari, (6.25) Joan Gold (6.25), Kashmiri Ambri (5.0) and Naga FU-2 (5.0).

Physicochemical analysis

The data regarding fruit size (Table 3) revealed that Star King Delicious showed maximum size (4927.1 mm²) followed by Nugget MM-III (4766.5 mm²), Spartan (4684.9 mm²), Summer Red (4556.0 mm²), Joan Gold (4475.6 mm²) and Kashmisi Ambri (4437.6 mm²). Minimum fruit size (2295.3 mm²) was observed, in Apple No. 1 (Table 3), however, its tree was found as heavy bearer with excellent fruit quality characters. The results are dissimilar to the findings of Nasir *et al.* (9) who reported that variety Early McIntosh had maximum fruit size index (62.28), fruit weight (108.12 g) and TSS (13%) while Laxton Epicure had higher number of fruits per tree (352). Variation in results may be due to change in climate, weather, type of soil, age or vigour, etc. Sometimes plant bears low number of fruits that results into larger fruit size.

Table 3. Physico-chemical analysis.

| Varieties | Fruit size (mm ²) | Fruit weight (g) | TSS (%) | No. of seeds/fruit | Yield (kg/plant) |
|---------------------|-------------------------------|------------------|-----------|--------------------|---------------------|
| Apple No. 1 | 2560.69 | 72 k | 12.25 ab | 7 defg | 106.25 fg |
| Kandhari | 3104.50 fgh | 82.25 jk | 9.75 def | 8.25 bcde | 89.25 gh |
| Kashmiri Ambri | 4826.62 abc | 140 bcde | 9 efg | 7 defg | 71 hi |
| Star King Delicious | 4766.52 ab | 163.25 abc | 12.25 ab | 4.25 j | 228 a |
| Golden Delicious | 2838.13 hi | 81.75 jk | 7.25 ij | 9.5 ab | 157.5 cd |
| Golden Russet | 3464.38 efg | 106.75 ghij | 7.5 hij | 6 ghi | 78.75 h |
| Sky Spur | 4160.62 bcd | 136.25 cdef | 12 ab | 4.75ij | 163.75c 111.25ef |
| Melrose | 3351.81 efgh | 98.75 hijk | 10.5 cd | 6.75 efg | g |
| Sky Lime Supreme | 2964.49 gh | 83.25 ijk | 10.25 cde | 6.5 fgh | 48.75 hi |
| Nugget MM-III | 4927.09 a | 164 ab | 12 ab | 6.5fgh | 190 b |
| Oregon Spur | 3387.07 efgh | 110 fghi | 7.75 ghij | 5 hij | 40 jk |
| Annurica MM-106 | 3196.00 efgh | 88.75 ijk | 6.75 j | 6.5 fgh | 17.5k |
| Summer Red | 4555.99 abc | 167.25 a | 11.5 bc | 7 defg | 132.5de |
| Naga FU-2 | 4102.39 cd | 139 bcde | 7 ij | 8.5 abcd | 91.25 gh |
| Spartan | 4684.85 abc | 150 abcde | 8.75 fgh | 10 a | 130 ef |
| Red Chief | 3759.77 de | 124.25 efgh | 10.5 cd | 7.75 cdef | 123 ef |
| Joan Gold | 4475.62 abc | 156.25 | 8.25 ghi | 6.25 fghi | 77.5 h |
| Golden Lebanon | 3550.26 defg | 105.75 ghij | 10 def | 6.25 fghi | 125.5 ef |
| Saharni | 3199.80 efgh | 97.125 hijk | 10.5 cd | 8.25 bcde | 45 j |
| Early Shan Burry | 3679.42 def | 131.75 defg | 13 a | 9 abc | 24.75 jk |
| LSD 0.05 | 616.76 | 27.146 | 1.4769 | 1.5016 | 25.307 |



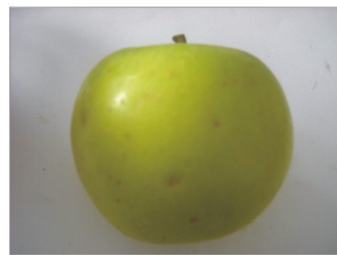
Apple No 1- A variety with attractive colour flavour and matures earlier



Star King Delicious- A high yielding variety with attractive colour



Summer Red- A high yielding variety with attractive colour



Nugget MM-III - A variety with attractive fruit size and weight

Maximum fruit weight (167.25g) was noted in apple variety Summer Red followed by Nugget MM-106 (164g) and Star King Delicious (163.25g) (Table 3). Nasir *et al.* (8) also reported similar findings. Minimum fruit weight (72g) was measured in variety Apple No.1 but number of fruits of this variety was high (Table 3). Maximum number of seeds (10.0) was noted in variety Spartan followed by Golden Delicious (9.5), Early Shan Burry (9.0), Naga FU-2 (9.0) and Kandhari (8.5). Variety Star King Delicious had minimum number of seeds (4.25).

The data regarding TSS revealed maximum TSS in variety Early Shan Burry (13%) followed by Apple No. 1 (12.25%), Star King Delicious (12.25%), Sky Spur (12%), Nugget MM-III (12%) and Summer Red (11.5%) (Table 3). Minimum TSS (6.75%) was recorded in variety Annurica MM-106. These results are supported by Greene *et al.* (5).

The results further revealed significantly maximum yield per plant (228 kg/plant) in variety Star King Delicious followed by Nugget MM-III (190 g), Sky Spur (163.75 kg) and Golden Delicious (157.5 kg). Minimum yield (17.5) was recorded in variety Annurica MM-106. These results are supported by Nasir *et al.* (8) who found Sky Spur as an outstanding variety with maximum yield (1200 fruits/plant), weight of fruit (180 g), size of fruit (6.3x6.2cm) and TSS (12%) which matured during mid September to mid October.

CONCLUSION

Variety Apple No.1 proved to be the best among varieties on the basis of taste and flavour. As far as fruit size is concerned, variety Summer Red had maximum size whereas Star King Delicious excelled in yield. These three varieties can be recommended for commercial cultivation at the Murree Hills.

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