Evaluation of Vegetative and Reproductive Characteristics of Some Quince (Cydonia Oblonga Mill.) Genotypes from Central Regions of Iran

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**ABSTRACT**

Identification and differentiation of quince cultivars and genotypes are more difficult than other members of the pomoideae sub-family due to the more limited range of traits of this species. This research was conducted to study the vegetative and reproductive traits of quince germplasm in the central regions of Iran and to identify important traits in the differentiation of these cultivars and genotypes. For this, 11 cultivars and genotypes collected from Isfahan province in the collection of the Agricultural Research Center were compared during 2018 to 2020 according to the National Guideline for Distinctness, Uniformity, and Stability (DUS) in quince. Fifty-five traits related to this guideline were considered along with 10 vegetative and fruit complementary traits. The results showed significant diversity in all plant organs and the general shape of the tree. Traits such as growth vigor, pubescence density, internode length, leaf dimensions, angle of leaf apex, flower size, petal arrangement, the undulation of petal margin, flowering time, fruit size, neck length, prominences of around the eyes, and fruit ripening time played an essential role in the differentiation of cultivars and genotypes. Cluster analysis divided cultivars and genotypes into four main groups. This grouping was able to divide the studied germplasm based on quantitative and qualitative characteristics as well as their collection location. NB4 and KVD2 genotypes are among the promising genotypes due to the quantitative and qualitative characteristics of the fruit.

**KEYWORDS**

DUS guideline; qualitative traits; quantitative traits; grouping; promising genotypes

**Introduction**

Quince (Cydonia oblonga L.) belongs to the Rosaceae family. Flower buds appear individually at the end of leafy branches that grow in the spring of the same year from the previous year’s wood (Sabeti, 1995). The quince tree has often medium growth in the form of shrubs up to 8 m tall (Bell and Leitao, 2011) and is used as a dwarfing rootstock for commercial pear orchards. Quince originates in Southeast Europe and Asia Minor, and its distribution centers are Iran, Afghanistan, and Southern Europe. According to Sabeti (1995), it is known as native to Iran and its distribution centers are forests and middle altitudes of northern Iran.

The study of genetic diversity and evaluation of germplasm characteristics of plants is important for various purposes such as the study of production and evolution process of cultivars and genotypes, germplasm grouping, use in breeding programs, and finally selection of new cultivars (Naghavi et al., 2007). Assessing plant morphology is one of the first steps in identifying genetic resources. This method is inexpensive, convenient, and affordable that provides an overview of existing germplasm for
breeders. In some cases, the correlation between morphological traits and some traits with difficult assessment can greatly help breeders to use these traits as markers in breeding programs (Li et al., 2009). Assessing the morphological diversity of different cultivars and genotypes of the quince tree is difficult due to the high similarity of leaves and fruits and less research has been carried out on it. Attempts have also been carried out by tree growers to classify them, leading to the naming of cultivars based on their shape (Bayazit et al., 2011).

Fruit Tree Gene Bank in the United States In Corvallis, Oregon, a gene bank of quince cultivars and genotypes established in 1981, containing more than 100 specimens of this tree from 15 different countries (Postman, 2008). In Iran, the first germplasm study was performed by Razavi et al. (1999) in some parts of Isfahan, and a significant variation in different traits was observed especially fruit shape. In their study, seven genotypes were selected from 1000 trees and introduced as the best genotypes.

Rodriguez-Guisado et al. (2009) studied the chemical, morphological, and organoleptic characteristics of five genotypes in Spain. The evaluation of these genotypes showed that the uniformity of leaf and fruit shape is high in them. The collection of quince germplasm in different regions of Iran began a decade ago by Abdollahi et al. (2013) and so far 50 different cultivars and genotypes have been collected from different regions of Iran and a small number from the Caucasus region. Studies on this germplasm have included evaluating resistance to fire blight (Mehrabipour et al., 2012) and evaluating their genetic diversity using simple repetitive sequence markers (RAPDs) (Alipour et al., 2014).

To identify differences of quince cultivars, the International Union for the Protection of New Varieties of Plants (UPOV) published a descriptor from this tree in 2003 (Anonymous, 2003). Based on the possibility of differentiation and identification of quince cultivars and genotypes (Yamamoto et al., 2004), UPOV published a guideline for the identification of cultivars based on molecular markers. In this guideline, only a limited number of known and commercial cultivars are considered (Kimura et al., 2005).

Evaluations of vegetative and reproductive traits are very important in differentiation programs of different fruit tree cultivars, including quince. Limited research has been done on this tree. This research was planned and carried out to study the range of traits, the diversity in different traits, and finally the use of evaluations performed in the registration of native cultivars and introducing them.

Material and Methods

Plant Materials

The present study was performed on four cultivars (Isfahan, Vuduja, Behta, and Torsh) and seven genotypes (ET1, SVS1, SVS2, NB1, NB4, KVD2, and KVD4) of Iranian quince trees for three years from 2018 to 2020. These cultivars and genotypes had collected from different parts of Isfahan province and cultivated in Horticultural Research Center, Iran. These trees were 15 years old and were trained in a modified central leader form.

Qualitative traits

The studied characteristics in this study were based on the National Guideline for Distinctness, Uniformity, and Stability (DUS), in which five general tree traits, six branch traits, 13 leaf traits, 9 flower traits, and 22 fruit traits were considered. Due to a large number of traits, some of the starred traits of this guideline are listed as traits that are more efficient in differentiating cultivars and genotypes compared to other traits. All measurements related to general tree traits were examined on five trees and other traits were studied with at least 10 replications on each tree.

Evaluation of all traits related to tree and the annual branch was carried out during December, January, and February during tree dormancy. General traits of the tree included vigor and growth habit, leafing time, flowering time, and fruit ripening time. Leaf traits were angle relative to stem, length and width, shape, the shape of the base, end angle, tip length, cross-section incision, marginal wavy, longitudinal axis wavy, surface pubescence, stipel size, and petiole length. To evaluate these traits, 20 mature leaves from each tree and five trees from each cultivar and genotype were collected.
and evaluated in late summer. The studied traits in flowers included flower size and color, petal arrangement, petal shape, petal margin wavy, sepal length and width, stigma position relative to anther, and filament color. To study the flower characteristics, 20 flowers from each tree and five trees from each cultivar and genotype were examined.

Morphological characteristics of the fruit including fruit size, general shape in longitudinal section, symmetry in longitudinal section, the vertical groove of fruit surface, number of fruit surface grooves, peduncle junction, the existence of neck, neck length, prominences around the peduncle, prominences around the eye, fruit cavity, cork around peduncle, prominences around fruit end cavity, eye diameter, calyx situation, skin color, flesh color, fruit flavor, juiciness, fruit texture, and amount and color of fruit pubescence were evaluated. For this, 20 fruits from each tree and five trees from each cultivar and genotype were evaluated.

**Quantitative Traits**

Evaluated quantitative traits included internode length, leaf dimensions, petiole length, trunk area cross-section, fruit weight, yield, soluble solids (TSS), firmness, and titratable acid (TA) of fruit. Internode length, leaf dimensions, and petiole length traits were measured using a ruler on five trees and 10 samples from each tree. The trunk diameter of five trees of each cultivar and genotype was measured at a height of 20 cm above the ground using a caliper and the trunk area cross-section was calculated. To study the characteristics of the fruit, the fruits were harvested in late October and the traits were recorded. The fruits of all five trees were harvested and weighed separately for three consecutive years and the average three-year yield was reported in kilograms per tree. To evaluate the fruit weight, the fruits were weighed separately with a digital scale. Fruit firmness was measured by a penetrometer (model EFFEGI, Italy, plunger diameter 11.1 mm, depth 7.9 mm), at opposite peeled sides, and expressed as kg/cm2. Total soluble solids (TSS) were determined by extracting and mixing two drops of juice from the two cut ends of each fruit into a digital refractometer (ATAGO N-1α, Japan) at 22°C. Titrable acids (TA) were determined in 10 g of pulp samples by titration of extracted juice with sodium hydroxide (0.1 N) up to pH 8.1 and expressed as a percent of malic acid. For fruit weight, TSS, TA, and fruit firmness, five trees and 10 fruits from each tree and a total of 50 fruits were studied.

**Data Analysis**

The data were recorded in Excel software and the means of quantitative traits were compared by the LSD method. Cluster analysis were carried out using Ward’s method and Euclidean square. Principal component analysis and rotation of components were performed by the Varimex method using SPSS software.

**Results and Discussion**

Comparison of different traits of cultivars and genotypes showed the diversity in characteristics of tree, form, and color of annual branches, leaves, flowers, and fruits. All the studied organs showed significant differences that can be well used in the differentiation of cultivars of this tree.

**General Traits of Trees and Branch**

The results of the growth habit study in cultivars and genotypes showed that all studied trees had upright and semi-upright growth habits (Table 1). This trait is specified in the DUS guideline as a starred trait, but according to the results, this cannot be used as a distinguishing trait. Tree growth vigor was also a starred trait that was observed in three situations, weak (SVS1, SVS2, Vuduja, and KVD4), medium (Isfahan, ET1, NB1, KVD2, and NB4), and vigorous (Torsh, PH2).
Examination of color in annual branches showed that all trees had grayish-green branches. Branch color only in Behta cultivar was observed grayish brown. The position of the lateral bud relative to the branch was strongly held out in most cultivars and genotypes. In SVS1 genotype, lateral bud position was adpressed and in Isfahan and Torsh cultivars as well as ET1 and KVD2 genotypes were slightly held out. The results showed that the annual branches in the studied trees had low to medium pubescence density. So that the last third of annual branches in ET1, SVS1, SVS2, and KVD2 genotypes had medium pubescence and in Isfahan, Torsh, Behta, NB1, NB4, and KVD4 cultivars and genotypes had low pubescence. This trait was also one of the starred traits in the DUS guideline that in some studied cultivars and genotypes in this study can be used as a distinguishing trait from other cultivars. Alipour et al. (2014) also used this trait to differentiate genotypes. Internode length in annual branches was observed in medium (ET1, SVS1, SVS2, NB1, KVD2, and KVD4 genotypes) and long situation (Isfahan, Torsh, Behta and, NB4 genotypes). Short internode length was observed only in Viduja cultivar (Table 1).

Leaf traits

The combination of the two traits of leaf length and width can be considered as a criterion of the general leaf form in this species. The study of variation in leaf shape and dimensions in different genotypes showed that this trait has significant stability and can be used as a basic criterion in distinguishing cultivars from each other along with other traits (Alipour et al., 2014). The results showed that Isfahan, Viduja, Torsh, and Behta cultivars and NB4 genotype had large leaves. The leaf shape was often observed in elliptical and oval forms. NB4 genotype was predominantly cordate. Other leaf forms mentioned in the DUS guideline were not observed in the studied cultivars and genotypes (Table 2).

Leaf tip length was medium and only in NB1 and KVD2 genotypes and Torsh cultivar was long. None of the cultivars and genotypes had short tip length. This trait is identified in the DUS guideline as a starred trait, which in this study, like the study conducted by Alipour et al. (2014) did not have the necessary efficiency to identify cultivars and genotypes in Iran. Unlike the leaf tip length trait, another starred trait namely leaf end angle was observed as right, acute, and obtuse between cultivars and genotypes, and therefore can be one of the differentiating traits. The shape of the base was rounded in all cultivars and genotypes and only in the NB4 genotype was as cordate shape (Table 2). These results are consistent with the results of Rodriguez-Guisado et al. (2009) about the characterization of Spanish quince genotypes. Leafing time in Isfahan and Behta cultivars and NB4 genotype occurred late and in other cultivars and genotypes occurred early (Table 2).
**Flower Traits**

Evaluation of flower appearance showed that the color of flowers in all cultivars and genotypes was light pink and only in NB1 genotype and Viduja cultivar was white. Flower size was medium in NB1, KVD2, and KVD4 genotypes, and other cultivars and genotypes was large (Table 2). Examination of the petal arrangement showed that the edges of the petals were irregular (Isfahan, ET1, SVS1, NB1, KVD2, Torsh, Behta, and KVD4), tangential (SVS2 and Viduja), and overlapping (NB4). The wave at the petal margin was low in ET1, SVS1, SVS2, KVD4, and Torsh, in Isfahan, Viduja and NB1 was medium and in KVD2, NB4, and Behta was high. The stigma and the anther were at the same level in SVS1, SVS2, and Torsh, and in other cultivars and genotypes, the stigma was lower than the anther. The stigma was not higher than the anther in any of the studied flowers (Table 2).

The full bloom time in SVS1, SVS2, KVD2, and KVD4 genotypes as well as Viduja and Torsh cultivars was earlier than other cultivars and genotypes. The flowering time in Isfahan and Behta cultivars, as well as NB4 genotype, was later than the others (Table 2). The flowering time of these cultivars and genotypes in 2015 and 2016 was in the same order (Tatari et al., 2018). This trait is identified in the DUS guideline as a starred trait. According to the results, this trait can be used as a distinguishing characteristic between different cultivars and genotypes, which is consistent with the results of Alipour et al. (2014).

**Fruit Traits**

There were different sizes of fruits in small to large sizes in cultivars and genotypes. Among the evaluated germplasm, Isfahan, Torsh, and Behta cultivars and NB4 genotype had large fruits. Fruits of ET1, NB1, and KVD4 genotypes had a small size, and fruits of other genotypes had medium size (Table 3). It seems that the size of the fruit depends on the yield and alternate bearing of the quince tree. Regard as this trait is identified as a starred trait in the DUS guideline, the stability of this trait was examined for three years.

General shape in the longitudinal section of the fruit was observed in the forms of circular (Isfahan, NB1, Viduja, KVD2, Torsh, Behta, and NB4), elliptic (SVS1 and SVS2), and pyriform (ET1 and KVD4) (Table 3). All fruits except Isfahan and Torsh cultivars had symmetry in the longitudinal section. One of the most important traits in the study and differentiation of cultivars and genotypes is the neck size (Anonymous, 2013). The fruit had a small neck in most cultivars and genotypes. ET1 and KVD4 genotypes had large and medium necks, respectively.

The prominences around the eyes were observed as a low, medium, and high (Table 3). This trait was also one of the starred and effective traits in identifying cultivars and genotypes. Ripening times in

| Cultivar and genotype | Size | General shape in longitudinal section | Symmetry in longitudinal section | Neck Size | Prominences around the eye | Ripening time |
|-----------------------|------|--------------------------------------|---------------------------------|-----------|---------------------------|---------------|
| Isfahan               | Large| Circular                             | Asymmetric                      | Small     | Low                       | Medium        |
| ET1                   | Small| Pyriform                             | Symmetric                       | Large     | Medium                    | Medium        |
| SVS2                  | Medium| Elliptic                             | Symmetric                       | Small     | High                      | Late          |
| SVS1                  | Medium| Elliptic                             | Symmetric                       | Small     | High                      | Late          |
| NB1                   | Small| Circular                             | Symmetric                       | Small     | Low                       | Medium        |
| Viduja                | Medium| Circular                             | Symmetric                       | Small     | High                      | Early         |
| KVD2                  | Medium| Circular                             | Symmetric                       | Small     | Medium                    | Early         |
| Torsh                 | Large| Circular                             | Asymmetric                      | Small     | Low                       | Medium        |
| Behta                 | Large| Circular                             | Symmetric                       | Small     | Medium                    | Medium        |
| NB4                   | Large| Circular                             | Symmetric                       | Small     | Medium                    | Medium        |
| KVD4                  | Small| Pyriform                             | Symmetric                       | Medium    | Medium                    | Medium        |
Viduja and KVD2 were early and in Isfahan, ET1, NB1, Torsh, Behta, NB4, and KVD4 were medium. Ripening time in the two genotypes SVS1 and SVS2 was late (Table 3).

**Quantitative Traits**

The results of the analysis of variance showed that the trunk area cross-section, internode length, leaf dimensions, petiole length, fruit weight, yield, and TSS had a significant difference at the level of 5%. Cultivars and genotypes for the two traits of firmness and TA did not show significant differences with each other. According to the results, Torsh cultivar and SVS1 genotype had the highest and lowest trunk area cross-section with averages of 158.7 and 50.4 cm², respectively. The trunk area cross-section in other cultivars and genotypes was between these two values (Table 4). The vigor of quince cultivars is also expressed by the trunk area cross-section, which in the study of Radovic et al. (2016) was reported between 81.1 and 227.2 cm² in different cultivars, which was more than the reported values in the current study.

Evaluation of internode length in different cultivars and genotypes varied between 15.6 cm in Behta cultivar to 6.94 cm in Viduja cultivar. Mean comparison of internode length classified different cultivars and genotypes into four different groups. Isfahan (15.3 cm) and Behta (15.6 cm) cultivars had the highest internode length and Viduja (6.94 cm), SVS1 (8.5 cm), and SVS2 (8.1 cm) cultivars and genotypes.

| Cultivar and genotype | Trunk area cross section | Internode length | Blade length | Blade width | Petiole length |
|-----------------------|--------------------------|------------------|--------------|-------------|---------------|
| Isfahan               | 113.8 ± 40.9ab           | 15.3 ± 3.63a     | 7.96 ± 0.36a | 5.48 ± 0.62abc | 1.58 ± 0.32abc |
| ET1                  | 146.2 ± 21.2ab           | 9.8 ± 3.63bc     | 6.34 ± 0.35c | 4.4 ± 0.57de  | 1.62 ± 0.29abc |
| SVS2                 | 82.1 ± 31.8ab            | 8.1 ± 2.45c      | 6.72 ± 0.79bc | 4.04 ± 0.5e   | 1.54 ± 0.37abc |
| SVS1                 | 50.4 ± 6.8b              | 8.5 ± 3.24c      | 6.9 ± 1.19bc | 4.66 ± 0.8cde | 1.32 ± 0.35bc |
| NB1                  | 104.3 ± 15.5ab           | 9.8 ± 1.82bc     | 6.48 ± 0.56bc | 4.2 ± 0.21de  | 1.52 ± 0.34abc |
| Viduja               | 77.1 ± 16.7ab            | 6.94 ± 2.67c     | 7.08 ± 1.09abc | 4.8 ± 1.15bcde | 1.3 ± 0.3 c   |
| KVD2                 | 82.6 ± 18.9ab            | 10.4 ± 3.36bc    | 6.64 ± 1.06bc | 4.44 ± 0.63de | 1.26 ± 0.28c  |
| Torsh                | 158.7 ± 35.2a            | 13 ± 4.18ab      | 7.04 ± 1.04abc | 4.96 ± 0.71abcd | 1.64 ± 0.3abc |
| Behta                | 131.4 ± 20.9ab           | 15.6 ± 4.15a     | 7.5 ± 0.75ab | 5.58 ± 0.81ab | 1.84 ± 0.23a  |
| NB4                  | 110.8 ± 27.5ab           | 13.5 ± 3.39ab    | 7.31 ± 0.51abc | 4.08 ± 0.48e  | 1.7 ± 0.25ab  |
| KVD4                 | 69.7 ± 20.2ab            | 9.6 ± 3.22bc     | 6.5 ± 1.1bc | 4.56 ± 0.2a   | 4.56 ± 0.2a   |

**Table 4.** Mean comparison of tree, leaf and fruit quantitative traits of quince cultivars and genotypes±SD.

Similar letters in each column indicate no significant difference at the 5% level of LSD.
genotypes had the lowest internode length (Table 4). This trait is important because it correlates with fire blight tolerance in pome fruit trees, such as apples (Abdollahi and Majidi Heravan, 2005).

The leaf length varied between 7.96 and 6.34 cm in Isfahan cultivar and ET1 genotype, respectively. Mean comparison of this trait with LSD test were placed cultivars and genotypes in five different groups (Table 4). This trait is also specified as starred in the DUS guideline. Evaluation of this trait in the present study showed that this trait can be used as a prominent trait in identifying the studied cultivars and genotypes. The width of the leaf blade varied between 5.82 cm in NB4 genotype to 4.04 cm in SVS2 genotype and a significant difference was observed between cultivars and genotypes at the level of 5%. Based on this, cultivars and genotypes were classified into eight different groups (Table 4). The average leaf length and width in quince genotypes were proposed 3.76 and 2.96 cm, respectively, by Tatari et al. (2020). This trait is also starred in the DUS guideline. Alipour et al. (2014) also introduced leaf trait as an important trait for differentiation of superior quince genotypes in Iran, which is consistent with the results of the current study. Petiole length varied between 1.84 cm in Behta cultivar to 1.26 cm in KVD2 genotype and cultivars and genotypes were divided into five different groups (Table 4).

Fruit weight varied from 102.5 g in Viduja to 215.4 g in NB4 (Table 4). Rop et al. (2011) stated that fruit weight in Czech Republic genotypes was from 89.7 g in Juranska cultivar to 472.1 g in Bereckeho cultivar. Rodriguez-Guisado et al. (2009) stated that the fruit weight in their studied clones varied between 194.01 g in MEMB5 clone to 297.86 g in MEMB2 clone. In collected genotypes in Turkey, the fruit weight ranged from 88 to 573 g (Pinar et al., 2016). The range of the lowest and the highest fruit weight in the present study was lower than the reported results by these researchers.

Isfahan cultivar and SVS2 genotype had the highest and lowest TSS with averages of 15 and 8.64%, respectively (Table 4). In a study conducted by Rasheed et al. (2018), TSS in collected quince fruits from five different regions of Pakistan were evaluated. The highest and the lowest TSS was 14.22 and 13.94%, respectively. In another study, TSS values of different quince cultivars were reported between 13.9 and 14.26% (Mir et al., 2016). The range of TSS in the current study is higher than the reported results by them.

Comparison of yield in the tree of studied quince cultivars and genotypes during the two years showed a significant advantage of Viduja cultivar with an average yield of 30.6 kg. After that, NB4, Behta, KVD2, and Isfahan cultivars, and genotypes were placed with averages of 22.5, 22, 20.7, and 18.82 kg, respectively (Figure 1). The growth habit of spore type and uniform distribution of spores throughout the branch caused significant yield in Viduja cultivar compared to other cultivars and genotypes. Due to the desirable quality of KVD2 and NB4 genotypes based on fruit and organoleptic characteristics (Alipour et al., 2014), these two genotypes have been selected as the most promising genotypes in the quince collection in central Iran.
Table 5. Initial eigenvalues, % of variance, and cumulative % for tree components of quantitative traits in quince cultivars and genotypes.

| Component | Initial Eigenvalues | % of Variance | Cumulative % |
|-----------|---------------------|---------------|--------------|
| 1         | 4.63                | 46.34         | 46.37        |
| 2         | 1.86                | 18.59         | 64.94        |
| 3         | 1.43                | 14.34         | 79.28        |

Principal Component Analysis

According to the results, the first three components represented 79.28% of the total variability on the base of the total variance explained (Table 5). In the first component, leaf length and width, as well as fruit weight traits, with component coefficients greater than 0.75, explained 46.37% of the total variance. In the second component, internode length, petiole length, fruit TSS, and firmness were placed and this component explained 18.59% of the total variance. The third component explained 14.34% of the total variance and the trunk area cross-section and TA of the fruit were included in this component. Based on these results, it can be inferred that leaf traits, internode and petiole length, trunk area cross-section, and fruit qualitative traits can be used as the most important traits in differentiating cultivars and genotypes to the central region of Iran.

Cluster Analysis of Studied Quince Cultivars and Genotypes

Cluster analysis divided different quince cultivars and genotypes in the Euclidean distance into four main groups (Figure 2). The first group consisted of two quality cultivars of Isfahan and Behta and promising genotype NB4. These two cultivars along with NB4 genotype have vigorous to medium growth vigor, long internode length with low pubescence density and grayish-green color, long and wide leaf, large flower size, late flowering, medium ripening time, and yield between 18 and 22 kg/tree. Germplasm in this group was more desirable than germplasm in other groups.

In the second group were SVS1 and SVS2 genotypes that were collected from Semirom. These genotypes are characterized by semi-upright growth habit, weak growth vigor, medium internode length with medium pubescence density and grayish-green color, medium leaf length with the rounded shape of the base, early flowering with late-ripening time, medium fruit size with elliptic general shape in longitudinal section, without neck, 7 to 8 kg of fruit per tree with the least fruit TSS and firmness.

In the third group were placed Viduja cultivar as well as KVD2 and KVD4 genotypes. This germplasm was collected from the Natanz region. Elliptical leaf shape with the rounded shape of
the base, early flowering, early to medium fruit ripening time, low trunk area cross-section, medium fruit weight, and high yield (15–30 kg/tree) were the characteristics of this group.

In the fourth group were placed Torsh cultivar and NB1 and ET1 genotypes. Medium to vigorous growth vigor, early to medium flowering time and medium fruit ripening time, leaf length shorter than other cultivars and genotypes with fruit weight and average yield were the characteristics of this group.

**Conclusion**

Based on the total results of this study, it was found that the genetic differences between cultivars and genotypes of native quince will be obvious and visible at the morphological level. Some traits including growth vigor, pubescence density, internode length, leaf dimensions, leaf tip angle, flower size, petal arrangement, petal margins, flowering time, fruit size, neck length, prominences around the eye, Fruit ripening time can be used as the most important traits in the differentiation of quince cultivars and genotypes in the central region of Iran, which indicates the compliance of the starred traits of the DUS guideline with the important traits of this germplasm.

Among the studied cultivars and genotypes, Isfahan and Behta cultivars, and the promising genotype NB4 were placed in the first group that had large fruits with superior quality. NB4 genotype along with KVD2 genotype with desirable quantitative and qualitative characteristics as well as desirable organoleptic characteristics of fruit can be introduced as new cultivars. Certainly, doing this will require presenting all the obtained results about disease resistance and marketability in comparison with the Isfahan control cultivar.

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