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Fruitfulness of Ancient Grapevine Varety 'Ekşi Kara' (*Vitis Vinifera* L.)

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ABSTRACT

One of the important reasons for the low yield in the Turkey viticulture sector is that the vineyard plantations are established from material that has not been selected for clonally. 'Ekşi Kara' (*Vitis vinifera* L.) grape variety clonal selection study is being carried out by the Department of Horticulture of Selcuk University Faculty of Agriculture, which is widely grown in the vineyards of the Central Southern Anatolian Region of the Middle Taurus Mountains. It is suitable for multi-purpose usage, *Vitis vinifera* L. grape variety. In the clonal selection project Konya (Hadim, Bozkır and Güneysınır) and Karaman provinces initiated in 2010, 220 clone candidates (CC) were identified, taking into consideration the plant health, yield and development status in 15 areas that represent the variety well. This study was carried out in order to determine the difference in productivity potential between CC and the bud samples taken from their natural environment in producer conditions. Fertility (number of inflorescence per shoot) is a very important feature in grapevine improvement taht is affected by internal and external factors as well as the genetic capacity of the variety. Yield potential was investigated during the dormant periods of buds. 1st to 10th buds were sprout in greenhouse and inflorescences reached the visible level, fruitfulness was identified by counting the inflorescences numbers per shoot. The average yield of 2200 buds collected from 220 CC in 15 vineyards was 0.77. When all the CC were evaluated together, an overall relative decrease in the number of inflorescence per shoot was determined, depending on the position of the bud along the shoot. The average inflorescence numbers from basal to upward buds were 0.97 ± 0.35, 0.88 ± 0.35, 0.92 ± 0.35, 0.86 ± 0.36, 0.74 ± 0.35, 0.74 ± 0.34, 0.75 ± 0.33, 0.69 ± 0.35, 0.64 ± 0.32 and 0.53 ± 0.34 respectively. There were no more than 2 inflorescences in the CC while 0 to 2 inflorescences were determined at different positions. It is thought that when CC are not able to accurately reflect the genetic potential of the variety, the yield potency in shoots taken from the natural environment may lead to misleading results in the selection of clone candidates.

1. Introduction

One of the most important biological characteristics of the grapevine (*Vitis vinifera* L.) is its capacity to form buds in the axil of each leaf all along the length of its shoots. Grape buds are generally classified as mixed buds, i.e. both leaves and flowers from the same bud (Vasconcelos et al. 2009). Induction and differentiation of grapevine inflorescence primordia for the next year's crop begins soon after budbreak of the current season (May and Antcliff 1963) and is completed between veraison and harvest (Swanepoel and Archer 1988). Within genetic limits, floral initiation determines the number of fruitful buds and potential number of bunches per bud. The number of potentially fruitful buds per vine is managed by pruning during dormancy (Coombe and Dry 2000).

Fertility (number of inflorescences per shoot) is a trait of major importance for grapevine breeding. Obtaining a desired and stable level of fruitfulness (or yield, defined as berry number per hectare) is one of the major goals of vineyard management (Boss and Thomas 2000), besides constant quality (Doligez et al. 2010). Fertility, which in this article refers to the number of inflorescences per shoot at anthesis, is a major compo-

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nent of final fruitfulness (Fanizza et al. 2005). Fertility presents a large phenotypic variation in cultivated grapevine, *Vitis vinifera* L. mean values for table and wine grape cultivars taken together range from 0 to 3.5 in the world largest collection (Boursiquot et al. 1995) and to a similar extent, within controlled crosses (0.2–4.0, Madero et al. 1986; 0–3.2, Eibach 1990, 0-3.5, Ağaoğlu ve Kara 1993, 2.60-3.96 Çelik et al. 2016, 1.26-1.29 Dardeniz ve Kısmalı 2005, 1.25-2.00, Kara ve Ağaoğlu 1992a, 1.34-1.68, Kara ve Ağaoğlu 1992b, 0.55-1.57, Kara ve Beyoğlu 1995).

Bud fruitfulness has remained a key focus of crop yield studies for the past 30 years (Sánchez and Dokoozlian 2005). Interannual yield variation in vines has generally been explained by year-to- year fluctuations in the number of inflorescences per vine (Martin et al. 2000, Clingeleffer et al. 2001, Jones et al. 2005; Lobell et al. 2006; White et al. 2006, Holzapfel and Smith 2012).

The impact of environmental factors, including management practices, on the variation in fertility has been widely investigated. The environmental factors such as light intensity (May et al. 1976, Corzo 1978, Sánchez and Dokoozlian 2005), temperature (Palma and Jackson 1981, Huglin and Schneider 1998; May 2004, Vasconcelos ve ark., 2009), water supply, mineral nutrition, pruning mode, vine training, rootstock, or climatic events such as hail also affect fertility (Mullins et al. 1992; Rives 2000; Doligez et al. 2010, Jones et al. 2013). The effect of these environmental factors on fertility might be direct or indirect through vigor, plant winter reserves in relation to leaf/fruit ratio, bud position on the shoot, and/or cytokinin (Mullins et al. 1992; Duchêne et al. 2003a, b; Sanchez and Dokoozlian 2005).

2. Material and Method

The Ekşi Kara' (*Vitis vinifera* L.) is an ancient and autochthone grapevine cultivar intensively grown in Konya due to its well-adaptation to the ecology, and milty-purpose usage. Thus, it has been promising with its unique characteristics peculiar to similar ecologies. This cultivar is robust and very fruitful in comparison with many other *V. vinifera* varieties in the region. A clonal selection study has been continuing on the variety at the Selcuk University Faculty of Agriculture Department of Horticulture since 2010. 220 CC were selected in 15 producer vineyards in different elevation, cultural practices, pruning and training systems in Konya and Karaman provinces in middle Taurus Mountains under different commercial vineyard management regimes. The vineyards 2, 7 and 13 were short pruned and goble trained and not irrigated. In addition to these, the vineyards 9-11 were not irrigated, and training patterns were non-uniform cane pruned wall training patterns.

In this study fruitfullness of selected CC of 'Ekşi Kara' (*Vitis vinifera* L.) were searched by counting the infloscens numbers at forced shoots of from 1st to 10th nodes taken along the previous year mature canes. Bud samples were taken from Ekşi Kara grapevine clone candidates at Konya and Karaman vineyards, at midde Tourus Mountaind of Turkey in March 2016. The vines were between 20-30 year-old, grafted on 110 R rootstock and with spaced about 1.5-2 m apart on rows 2-3 m apart. All cultural practices were applied by producers traditionaly across blocks. The samples were placed in sealed plastic bags and stored in a cool place (4 °C) to preapre single node cuttings. Compound buds from the mature canes were placed in rooting media 1:1 perlite and peat mixture to forcing. Inflorescences reached the visible level, fruitfulness was identified by counting the inflorescences numbers per shoot.

Statistical analysis

A complete randomized block design with three replicates (consisted of four grafted vines) was established. Data were separately evaluated for each rootstock by analysis of variance (ANOVA) and treatment means were separated by Least Significant Differences (LSD) test at $P < 0.05$. Analysis was performed with SPSS program version 13.0 (SPSS Inc., Chicago, IL).

3. Results and Discussion

Potential productivity values were assessed by individual variance analysis and Duncan test for 15 vineyards. Strong differences were observed between inflorescence numbers between vineyards, clone candidates, and shoot positions (Fig. 1). In all CC, the yield value is not constant according to the position of the buds. The average number of clusters from first to the tenth nodes for 220 CC analyzed is less than one. The direction of the ripple differs among clone candidates. In spite of this, the yield level of the buds upper or near the end of the canes is lower than that of the lower or middle nodes in all CC.

There was a slow decline in the inflorescens numbers along with the shoot lengt basal to apicale. The average cluster numbers were 0.97 ± 0.35, 0.88 ± 0.35, 0.92 ± 0.35, 0.86 ± 0.36, 0.74 ± 0.35, 0.74 ± 0.34, 0.75 ± 0.33, 0.69 ± 0.35, 0.64 ± 0.32 and 0.53 ± 0.34, res-

pectively. No clone candidates were found in the first ten nods of which there were 2 or nearly 2 inflorescences rising.

At the 1st vineyard 1310 m a.b.s.l. at Bozkır town of Konya province the maximum 0.68 inflorescences per node at 6 CC of 9th node and 0.00 inflorescences per node at 4 cc of 10th node mean inflorescence numbers were between 1.23 at 1 CC and 0.56 at 5 CC of 10 nodes. While among the others were non-significant 1st, 6-8th and 10th buds were significantly important difference in 1st vineyard.

At the 2nd vineyard 1210 m a.b.s.l. at Hadim town of Konya province the maximum 2.00 inflorescences per node at 13 CC of 4th node and 0.20 inflorescences per node at 11 CC of 8th node mean inflorescence numbers were between 1.17 at 13 CC and 0.63 at 18 CC of 10 nodes. While the others were significantly important 3rd and 7th buds were non-significant difference in 2nd vineyard.

At the 3rd vineyard 1060 m a.b.s.l. at Güneysınır town of Konya province the maximum 1.33 inflorescences per node at 32 CC of 2nd node and 0.17 inflorescences per node at 31 CC of 5th node mean inflorescence numbers were between 0.81 at 32 CC and 0.48 at 31 CC of 10 nodes. While the others were significantly important 7th, 8th and 9th buds were non-significant difference in 3rd vineyard.

At the 4th vineyard 1060 m a.b.s.l. at Güneysınır town of Konya province the maximum 1.40 inflorescences per node at 41 CC of 1st node and 0.00 inflorescences per node at 51 cc 10th node mean inflorescence numbers were between 0.82 at 59 CC and 0.49 at 46 CC of 10 nodes. While the others were significantly important the only 10th bud were non-significant difference in 4th vineyard.

At the 5th vineyard 1060 m a.b.s.l. at Güneysınır town of Konya province the maximum 1.68 inflorescences per node at 69 CC of 1st node and 0.00 inflorescences per node at 63 CC 10th node mean inflorescence numbers were between 1.34 at 69 CC and 0.58 at 67 CC of 10 nodes. Significantly important differences werefound among the all buds in 4th vineyard.

At the 6th vineyard 1050 m a.b.s.l. at Güneysınır town of Konya province the maximum 1.75 inflorescences per node at 94 CC of 1st node and 0.17 inflorescences per node3 at 92 CC 8th node mean inflorescence numbers were between 1.03 at 88 CC and 0.59 at 102 CC of 10 nodes. While the others were significantly important 7th, 8th and 9th buds were non-significant difference in 6th vineyard.

At the 7th vineyard 1280 m a.b.s.l. at Karaman province the maximum 2.00 inflorescences per node at 104 CC of 4th node and 0.00 inflorescences per node at 109 CC of 10th node mean inflorescence numbers were between 1.01 at 108 C3C and 0.55 at 122 CC of 10 nodes. While the others were significantly important 1st, 3rd, 5th and 10th buds were non-significant difference in 7th vineyard.

At the 8th vineyard 1280 m a.b.s.l. at Karaman province the maximum 2.00 inflorescences per node at 125 CC of 3rd node and 0.00 inflorescences per node at 138 CC of 10th node mean inflorescence numbers were between 1.03 at 129 CC and 0.69 at 138 CC of 10 nodes. While the others were significantly important 9th and 10th buds were non-significant difference in 8th vineyard.

At the 9th vineyard 1290 m a.b.s.l. at Karaman province the maximum 1.75 inflorescences per node at 146 CC of 3rd node and 0.20 inflorescences per node at 148 CC of 8th node mean inflorescence numbers were between 1.03 at 146 CC and 0.74 148 CC of 10 nodes. While the others were significantly important 1st, 5th and 7-10th buds were non-significant difference in 9th vineyard.

At the 10th vineyard 1360 m a.b.s.l. at Güneysınır town of Konya province the maximum 2.00 inflorescences per node at 162 CC of 5th node and 0.17 inflorescences per node at 166 CC of 10th node mean inflorescence numbers were between 1.30 at 162 CC and 0.57 at 151 CC of 10 nodes. While the others were significantly important 2nd, 6th, 7th and 9th buds were non-significant difference in 10th vineyard.

At the 11th vineyard 1380 m a.b.s.l. at Bozkır town of Konya province the maximum 1.67 inflorescences per node at 176 CC of 6th node and 0.00 inflorescences per node at 180 CC of 10th node mean inflorescence numbers were between 0.83 at 179 CC and 0.50 at 180 CC of 10 nodes. While the others were significantly important 5th, 7-9th buds were non-significant difference in 11th vineyard.

At the 12th vineyard 1310 m a.b.s.l. at Bozkır town of Konya province the maximum 1.40 inflorescences per node at 188 CC 1st node and 0.20 inflorescences per node at 189 CC of 10th node mean inflorescence numbers were between 0.83 at 184 CC and 0.60 at 185 CC of 10 nodes. While among the others were non-significant 7th and 10th buds were significantly important difference in 12th vineyard.

At the 13th vineyard 1530 m a.b.s.l. Hadim town of Konya province the maximum 1.50 inflorescences per node at 195 CC of 1st node and 0.20 inflorescences per node at 191 CC of 6th node mean inflorescence numbers were between 0.78 at 192 CC and 0.54 at 200 CC of 10 nodes. While the others were significantly important 1st, 5th, 6th, 9-10th buds were non-significant difference in 13th vineyard.

At the 14th vineyard 1400 m a.b.s.l. at Hadim town of Konya province the maximum 2.00 inflorescences per node at 208 CC 1st node and 0.20 inflorescences per node at 204 CC of 9th node mean inflorescence numbers were between 1.16 at 208 CC and 0.72 at 206 CC of 10 nodes. While among the others were non-

significant 1st, 3-4th and 8th buds were significantly important difference in 14th vineyard.

At the 15th vineyard 1370 m a.b.s.l. at Hadim town of Konya province the maximum 1.75 inflorescences per node at 214 CC of 3rd node and 0.17 inflorescences per node at 223 CC of 9th node mean inflorescence numbers were between 1.1 at 220 CC and 0.41 at 224 CC of 10 nodes. While the others were significantly important the only 10th bud were non-significant difference in 15th vineyard.

The yield potency values for the 10 nodes from 1st to 15th vineyard was found to be 0.78, 0.83, 0.64, 0.71, 0.86, 0.79, 0.75, 0.80, 0.87, 0.83, 0.64, 0.73, 0.68, 0.91, 0.72 respectively. The vineyards 1, 7, 13 and 14 are short-pruned. No significant difference could be detected between spur or cane pruned shoots for the detection of productivity. No significant correlation was found between the irrigation or training patterns of the vineyards and their average productivity. For example, vineyard 3 and 11 have the lowest average bud fruitfulness, the first of which is a wall-type double condone trained with a height of 150 cm and the second is a 4-armed with 100 cm trunk height but heavy loaded. On the other hand, the average productivity of non-irrigated vineyards 8-10 was found to be higher than the average value of all vineyards, and the irrigation alone was not sufficient to explain the productivity level. The elevation of the vineyards from sea level does not explain the yield potential. The mean annual yield at the lowest altitude of 1050 m was 0.79 inflorescence per shoot, and 14 at 1530 m was found to be 0.91 inflorescence per shoot as average potency.

Yield variation in grapevines is a major source of uncertainty in viticultural production (Jones et al. 2013). The proportion of potentially fruitful buds that actually break dormancy and bear fruit depends heavily on variety, clone, and interaction with weather (Barnard 1932).

Successful bud development is a function of position on the cane. Bud fertility is lowest at the base, increasing toward to the middle before a modest decrease toward the tip (Carmo et al.2009). Sultana vines, the proportion of terminal buds that gave rise to shoots was high, while a comparatively high number of basal buds remained dormant (Barnard 1932).

The reason for the differences between the CC and their node positions is quite broad, as explained above in the cases of cultivation, cultural practices, nutrition, and the events that the buds are exposed to in the vegetation and their physiological reflections.

4. Conclusion

It is thought that the source of the significant differences between the data obtained from the studies on the yield potential of the CC is not attributable to the genetic potential of the clonal material alone. Efficiency-based studies in the 'Ekşi Kara' grape variety should be repeated to include the efficiency of the primary and subsequent buds in the environment where the factors other than the genetic potential is significantly eliminated. The 'Ekşi Kara' variety has a potency to prune spur, mixed or cane. It i3s thought that when CC are not able to accurately reflect the genetic potential of the variety, the yield potency in shoots taken from the natural environment may lead to misleading results in the selection of clone candidates.

CC of ‘Ekşi Kara’ buds taken from spur pruned vineyards fertility by shoot positon practically were not stable in natural environment, and different training, loading, and cultural practices. All CC has between 0-2 inflorescens per bud, and all of them fluctuated along the canes. Natural conditions, including virus and deceases infections and different manegemet practices could not reflect the potential of fruitfulness of CC. Fruitfullnes of CC should be studied after the sanitation programme in the same vineyard, and same cultural practices. By the selection of fruitful CC of the ancient cultivar ‘Ekşi Kara’ will greatly contribute to further development of viticultural sector of midlle Anatolia.

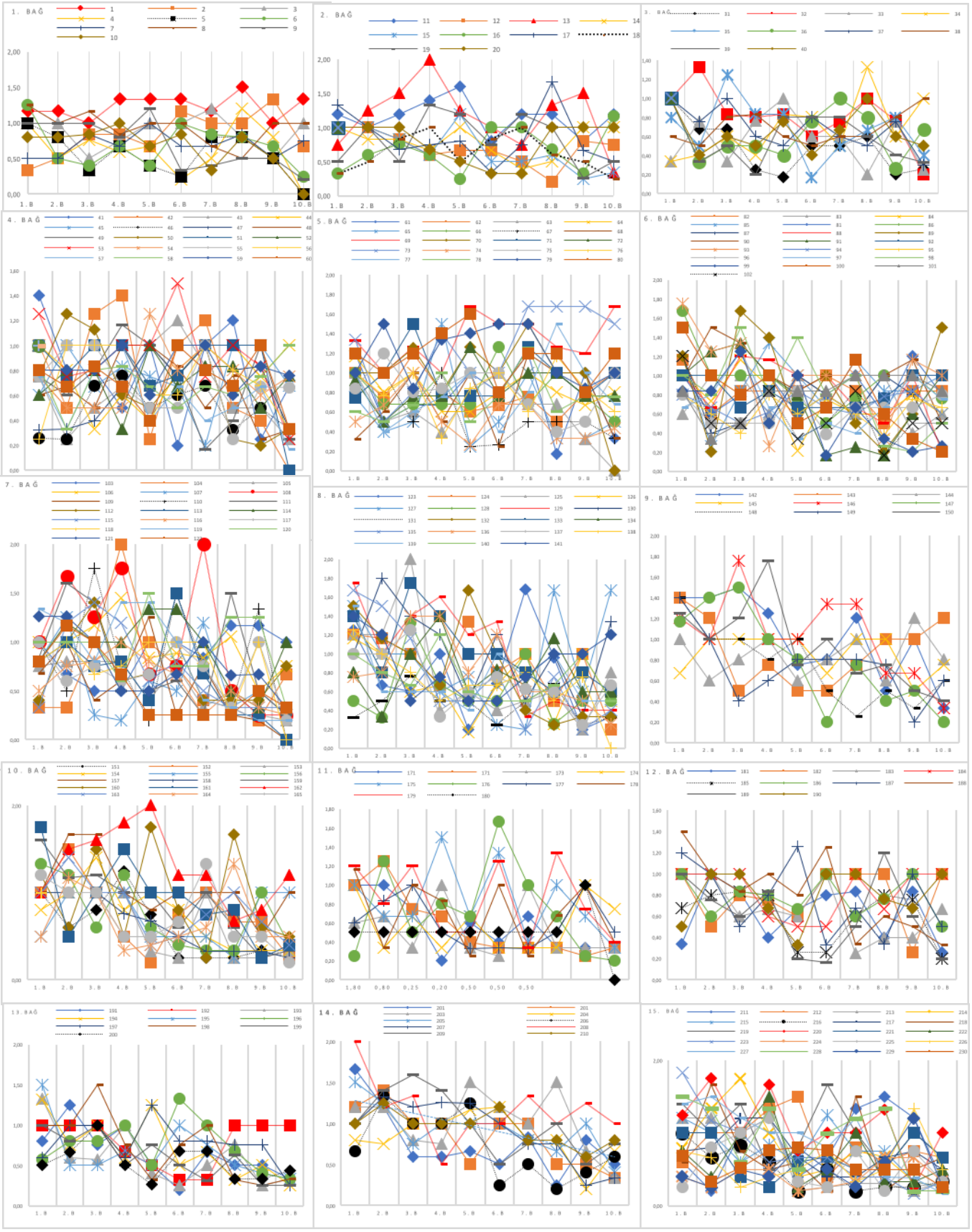

Fig. 1. Differantiantion of infloresence numbers by node position of clone candidates

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