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# BUD FERTILITY DETERMINATION OF SOME NEW TABLE GRAPE CULTIVARS (*Vitis vinifera*)

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## ABSTRACT

When cultivating table grapes, cultivars with high yield and quality are preferred. For this reason, it is very important to pay attention to yield and bud fertility issues in breeding studies. It is necessary to conduct bud fertility studies of new cultivars and to determine appropriate product loading with correct pruning. In addition, since it is reported that bud fertility may change depending on the cultivar, it must be determined by researches to be made in new cultivars. So, studies on the bud fertility of new cultivars are essential in terms of informing the growers correctly. In this study, the bud fertility of 5 different new table grapes (Atak 77, Pembe 77, Arifbey, Prima and Trakya İlkeren) in Yalova Atatürk Horticultural Central Research Institute Vineyard Genetic Resources plot were studied. In order to determine the bud fertility of 5 new table grape cultivars, from the 1st to 10th buds on the annual shoots were examined. The bud fertility values of each bud and cultivar were investigated. As a result of the study, especially Atak 77 cultivar has come to the forefront as the highest bud fertility value, whereas Pembe 77 has the lowest bud fertility value. In addition, it was determined that the 3rd and 4th buds were the most productive buds over the general averages. It was determined that the first bud had the lowest bud fertility. The results obtained from this study will be transferred to the table grape growers for the correct winter pruning.

**Keywords:** Yield, winter bud, cluster number, winter pruning

## BAZI YENİ SOFRALIK ÜZÜM ÇEŞİTLERİNİN (*Vitis vinifera*) GÖZ VERİMLİLİKLERİNİN BELİRLENMESİ

## ÖZ

Sofralık üzüm yetiştiriciliği yaparken verim ve kalite yönünden yüksek çeşitler tercih edilir. Bu nedenle, ıslah çalışmalarında verim ve göz verimliliği konularına dikkat etmek çok önemlidir. Yeni çeşitlerin göz verimliliği çalışmalarını yürütmek ve doğru budama ile uygun ürün yüklemesini belirlemek gerekir. Ayrıca göz verimliliğinin çeşide bağlı olarak değişebileceği bildirildiği için, mutlaka yeni çeşitlerde yapılacak araştırmalar ile belirlenmesi gerekir. Bu çalışmada Yalova Atatürk Bahçe Kültürleri Merkez Araştırma Enstitüsü Bağ Genetik Kaynakları parselinde yer alan 5 farklı yeni sofralık üzüm çeşidinin (Atak 77, Pembe 77, Arifbey, Prima ve Trakya İlkeren) göz verimliliği incelenmiştir. 5 yeni sofralık üzüm çeşidinin göz verimliliğini belirlemek için, yıllık sürgünlerde 1.'den 10. tomurcuklara kadar olan gözler incelenmiştir. Her bir çeşide ait gözlerin verimlilik değerleri araştırılmıştır. Çalışma sonucunda özellikle Atak 77 çeşidi en yüksek göz verimlilik değeriyle ön plana çıkarken, Pembe 77 en düşük göz verimlilik değerine sahip olduğu anlaşılmıştır. Ayrıca, 3. ve 4. gözlerin genel ortalamalar üzerinden en verimli gözler olduğu belirlenmiştir. İlk gözün en düşük göz verimlilik değerine sahip olduğu belirlenmiştir. Bu çalışmadan elde edilen sonuçlar, doğru kış budaması için sofralık üzüm yetiştiricilerine aktarılacaktır.

**Anahtar Kelimeler:** Verim, kış tomurcuğu, salkım sayısı, kış budaması

## INTRODUCTION

Buds are the small part of the vine that rest between the vine's stem and the petiole (leaf stem). Inside the buds contain usually three primordial shoots. These buds appear in the summer of previous growth cycle green and covered in scales [17]. The winter buds on the

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annual shoots are closely related to the yield of the vine and thus the vineyard [12]. 0-4 pieces of inflorescences (primordium) can be found in the primary bud of the winter buds of the vine. However, 4 inflorescences are rarely encountered. The number of draft panicles in the primary bud is usually between 1-2 pieces. Conditions such as climate, maintenance conditions, and optimum product amount for vine can affect the number of cluster draft.

Some primary buds may not be able to form a cluster at all. These winter buds have no fruitfulness, and the summer shoots that birth from them are also have no fruitfulness shoots [8]. Fruitfulness is also inherited characteristics that is also influenced by environmental factors at the time of inflorescence primordium initiation [17]. The number of panicle drafts in each bud is different according to the cultivars, and this number varies depending on the bud location on the shoot [7].

The number of winter buds to be left on a vine during pruning affects the development and yield of the green part of the vine during the development period. The important thing in pruning is to create a balance between vegetative development and product yield. Therefore, in order to decide on the shape of pruning, it must be known the productivity of the winter buds depending on the level of the shoots [18]. The yield potential of the vineyard is related to the number of vines per unit area, the number of buds on the vines, the number of bunch in the buds and the bunch weight [3, 10].

The productivity of the vineyard is related to the number of vines per unit area is also related to the number of buds on the vines, the number of panicles in the buds and the panicle weight. [10]. Knowing the bud fertility in advance will help to adjust the number of buds to be left on the vine during winter pruning and to determine the cut lengths of the annual shoots [12].

It is important to know the change of the fertility of winter buds on annual shoots of grapevines in order to determine the pruning method to be applied in grape cultivars. Pruning without taking into consideration the development and productivity of the cultivars causes the dwarf vine and also decrease the yield [6].

In short, pruning ensures that the vineyard gives regular and quality products every year during its economic life. For this, it is possible to determine the pruning requests of the cultivars correctly [8].

In very productive grape cultivars, all buds on the main shoots are productive from the bottom, but the buds at the bottom of the shoots are more productive. Such cultivars (Alphonse Lavalleé, Hamburg Muscat, Cardinal, Italy, Sergeant) 1-3. pruned short over the eyes. Therefore, cultivars such as Alphonse Lavalleé, Muscat, Hamburg, Cardinal, Italia and Çavuş are pruned short from second/third bud. Some cultivars (Papaz Karası, Hasandede, Sylvaner, Furmint and Öküzgözü) bud fertility increase after the second bud so we called these cultivars are moderate productive. Such cultivars are pruned half-long from third or fifth bud [1]. Such cultivars Sultani, Yuvarlak Çekirdeksiz, Siyah Çekirdeksiz, Black Monnuca, Pembe Gemre, and Yapıncak have productive buds in the middle of the shoots. So they must be pruned long from fifth to ten buds [15].

Environmental conditions have a great influence on bud fertility. Light intensity, temperatures, and water availability are the most important environmental factors. High light intensity and temperatures promote synthesis of cytokinins that favor differentiation of the inflorescence primordia [16]. Bud fertility has a strong genetic component, which results in wide variability of this trait among different cultivars. knowledge of the position of fertile buds in each cultivar is an important aid for establishing more rational pruning techniques that result in an increase in vineyard yield [18].

Different methods are used to determine the bud fertility of grapevine. Among these, the most preferred method; it is the method of forcing bud burst and detection of clusters on each bud. Forcing bud burst and the detection of clusters was preferred by different researchers. Akın et al. [6] and Taşçı [13] used the same method in their bud fertility studies with different grape cultivars. So in this study, five new table grape cultivars developed by cross-breeding were studied to determine bud fertility with this method.

## MATERIALS AND METHODS

### *Materials*

Five new table grape cultivars (Pembe 77, Atak 77, Arifbey, Prima and Trakya İlkeren) which are fifteen years old and grafted on Kober 5 BB were used in this study. Cultivars are grown in Yalova Atatürk Horticultural Central Research Institute Vineyard Genetic Resources plot (Figure 1).

Pembe 77, Arifbey and Atak 77 were developed by cross-breeding by Yalova Atatürk Horticultural Central Research Institute. Trakya İlkeren cultivar was developed by Tekirdağ Viticulture Research Institute and Prima was developed by INRA (France) with a similar breeding program. Some characteristics of these cultivars are given in Table 1.

Table 1. Some characteristics of new table grape cultivars used in the study

| Cultivar Name | Berry Colour | Berry Size | Seed | Harvest Time | Yield (kg/vine) |
|---|---|---|---|---|---|
| Atak 77 | Yellow | Large (8 gr) | Seeded | Late | 10-12 |
| Pembe 77 | Pink | Large (7-8 gr) | Seeded | Late | 8-10 |
| Arifbey | Yellow | Large (7-8 gr) | Seeded | Middle | 8-10 |
| Prima | Blue-Black | Middle (5 gr) | Seeded | Very Early | 7-8 |
| Trakya İlkeren | Blue-Black | Middle (5-6 gr) | Seeded | Very Early | 7-8 |

### *Methods*

The cuttings belonging to the cultivars were taken from the vineyard during the pruning period and kept in cold storage at +4°C and 80% humidity until the time of the study. In order to determine the bud fertility of the cultivars Ağaoğlu [2] and İlter [15] methods were used. A small amount of perlite was placed in the 50×35 cm and 10 cm deep plastic container, and a stretch film was made on the container to allow the buds to stand upright (Figure 2 and 3).

The study planned with completely randomized block design with three replications and there were 5 pieces of shoots which have ten buds in each replication. The buds were cut depending on the position of shoot and placed again their position on the container which covered with stretch film.

Plastic containers were filled with water in order to cover bottom of the buds with water. The buds kept in the climate room with temperature 23-25°C and humidity 50-65% for 3 weeks (Figure 4). Although the bud burst and see clusters differ depending on the cultivars, data were collected from buds that burst after 4 weeks. Bud fertility of the cultivars was determined by counting the clusters of each bud (Figure 5).

The research was planned in a completely randomized block design as a simple factorial experimental design analysis of variance with three replicates, also used two years average. Variance analyses and multiple comparison tests were done by JMP statistical package program (version 13.0; SAS Institute, Cary, NC, USA).

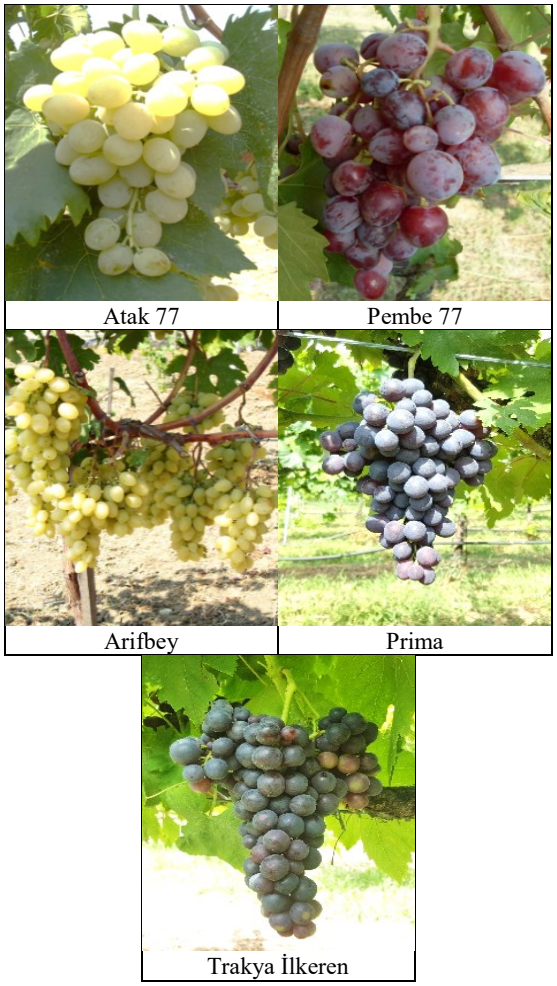


Figure 1. Photos of five new table grape cultivars

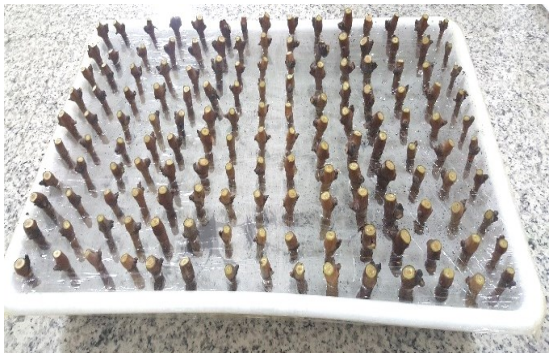

Figure 2. Placing buds on the plastic container

Figure 3. Forcing buds to burst in the climate room

Figure 4. The stage at which the buds begin to burst in the climate room

### *Results and Discussion*

When we evaluate the data obtained as a result of this study with 5 different new table grape cultivars, we see that the cultivars give different results in terms of bud fertility. The results of the evaluation on the average of the replications of each cultivar and bud are given in Table 2. The general bud fertility average of the cultivars was 0.68. While Atak 77 and Arifbey cultivars have above average and close to average bud fertility value, Trakya İlkeren, Prima and Pembe 77 cultivars were below average, respectively (Figure 6).

According to the results of the evaluation on the cultivars, it was understood that the Atak 77 cultivar, which is a white and late-season cultivar, has the highest bud fertility. In the evaluation made on the average of 10 buds, this cultivar was found to have 1.08 bud fertility. The most fertile bud was the first bud with 1.33 bud fertility value. The lowest bud fertility was found that fifth bud with 0.73 bud fertility value. Similar to the results obtained from this study, Atak et al. [4] reported that Atak 77 cultivar is superior to other cultivars in terms of yield in their study. They also reported that this cultivar can be stored for a long time in cold storage due to its large berry and thick skin structure.

Arifbey cultivar, which is a white and middle-season cultivar, has the second-highest bud fertility. In the evaluation made on the average of 10 buds, this cultivar was found to have 0.68 bud fertility. The most fertile bud was the 6$^{th}$ bud with 0.93 bud fertility value. The lowest bud fertility was found that first bud with 0.13 bud fertility value.

Pembe 77 cultivar, which is a pink and late-season cultivar, has the lowest bud fertility. In the evaluation made on the average of 10 buds, this cultivar was found to have 0.45 bud fertility. The most fertile buds were the 3$^{rd}$, 4$^{th}$, 5$^{th}$ and 6$^{th}$ buds with 0.53 bud fertility value. The lowest bud fertility was found that 6$^{th}$ and 7$^{th}$ buds with 0.33 bud fertility value.

Trakya İlkeren, which is below the general average of bud fertility, is a black and very early cultivar. Average bud fertility value was 0.64 and the most fertile bud was 8$^{th}$ and 9$^{th}$ buds with 0.80. The lowest bud fertility was found first and 5$^{th}$ buds with 0.40.

Prima, which is below the general average of bud fertility, is a black and very early cultivar. This cultivar is developed by INRA (France) and ripens quite early. Average bud fertility value was 0.57 and the most fertile bud was tenth bud with 0.73. The lowest bud fertility was found first bud with 0.13.

According to the evaluation made according to the order of the buds in the shoot, especially the third (0.77), fourth (0.75) and ninth (0.75) buds were found to be the most fertile compared to the overall mean. The first (0.49) and seventh (0.61) buds had the lowest bud fertility. Çelik et al. [11] reported that the bud fertility of genotypes belonging to *V.*

*labrusca* species was higher than *V. vinifera*. In their study, they found bud fertility values ranging from 0.34 to 3.82 with *V. labrusca* genotypes. Gutiérrez-Gamboa et al. [14] examined bud fertility in their study with a local Chilean cultivar ('Carménère'). Bud fertility reached an average of 1.3 bunch per bud, min. 0.9 and max. 1.7. According to this, 'Carménère' showed low fertility in basal buds.

Leão et al. [18] studied to determine the fertility index of 11 cultivars over five production cycles. As a result of their studies, they reported that cultivars had bud fertility average values ranging from 0.24 to 0.95, as very similar to our study. Also they reported that bud fertility was strongly determined by genetic and environmental factors, identifying genotypes of high, intermediate, and low fertility.

Table 2. Bud fertility values of the grape cultivars (between the 1st and 10th buds). (Means followed by different superscripts within the columns of each cultivar are significantly different at $\alpha = 0.05$)

| Cultivars | Bud Fertility (Clusters per Shoot) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1st bud | 2nd bud | 3rd bud | 4th bud | 5th bud | 6th bud | 7th bud | 8th bud | 9th bud | 10th bud | Cultivar mean |
| Pembe 77 | 0.47 b | 0.40 b | 0.53 b | 0.53 a | 0.53 ab | 0.33 c | 0.33 a | 0.53 b | 0.40 b | 0.40 a | 0.45 |
| Atak 77 | 1.33 a | 1.20 a | 1.27 a | 1.00 a | 0.73 a | 1.13 a | 0.87 a | 1.20 a | 1.13 a | 0.93 a | 1.08 |
| Trakya İlkeren | 0.40 b | 0.60 b | 0.60 ab | 0.67 a | 0.40 b | 0.73 b | 0.67 a | 0.80 ab | 0.80 ab | 0.73 a | 0.64 |
| Prima | 0.13 b | 0.60 b | 0.60 ab | 0.67 a | 0.67 a | 0.60 bc | 0.47 a | 0.60 b | 0.60 ab | 0.73 a | 0.57 |
| Arifbey | 0.13 b | 0.67 b | 0.87 ab | 0.87 a | 0.60 ab | 0.93 ab | 0.73 a | 0.53 b | 0.80 ab | 0.67 a | 0.68 |
| Bud Mean | 0.49 | 0.69 | 0.77 | 0.75 | 0.59 | 0.74 | 0.61 | 0.73 | 0.75 | 0.69 | 0.68 |

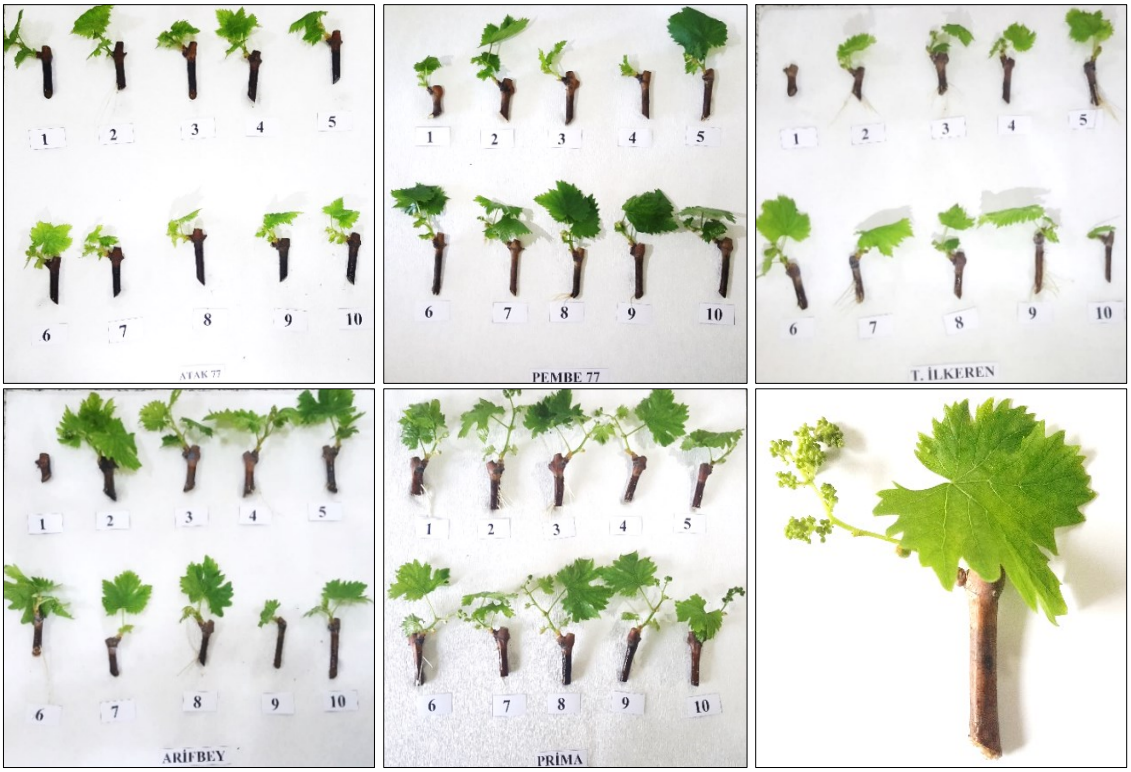


Figure 5. Just before evaluation of cultivars bud fertility and a bud with a cluster

Uyak and Doğan [20] determined bud fertility at rates ranging from 0.14 to 1.96 in their study to determine the bud fertility of local grape cultivars in Şemdinli region. The bud fertility values they obtained is largely similar to the values obtained in our study. They also reported similarly with our studies that there were differences between the cultivars and the position of the buds. Uyak et al. [21] in another study, bud fertility and pruning levels of 8 cultivars grown in Hakkari Yüksekova were determined. Similar to our

study they reported that cultivars had bud fertility values between 0.67 and 1.84. Also, they suggested pruning the cultivars medium or long. In addition, depending on the bud fertility values obtained from these cultivars, when working with these cultivars in the vineyards where excess product load is desired, a medium level of pruning can be suggested instead of short pruning.

### *Conclusions*

Bud fertility is determined mainly by genetic and environmental factors, also some other factors also affect bud fertility. Bud fertility mainly use to determine the pruning also crop load. Knowledge of bud fertility is an important aid in selection of new cultivars of table grapes with high yield potential. As can be seen from results, the bud fertility value varies according to the cultivar and bud position of the cultivar. Bud fertility of new cultivars must be known for product load and pruning advice in different systems. This is even more important in pergola bond systems, which have become increasingly widespread in recent years because this system needs high crop load. Therefore, it is necessary to make recommendations according to pruning and crop loading applications by knowing that it is not the same bud fertility value for each cultivar. Pruning is recommended for 3rd or 5th bud in Pembe 77, 2nd or 3rd buds for Atak 77, 4th or 5th buds for Trakya İlkeren, 4th or 5th buds for Prima and 3rd or 4th buds for Arifbey. While making pruning recommendations, the maximum product load that can be left on the vine is taken into consideration for obtaining a quality product.

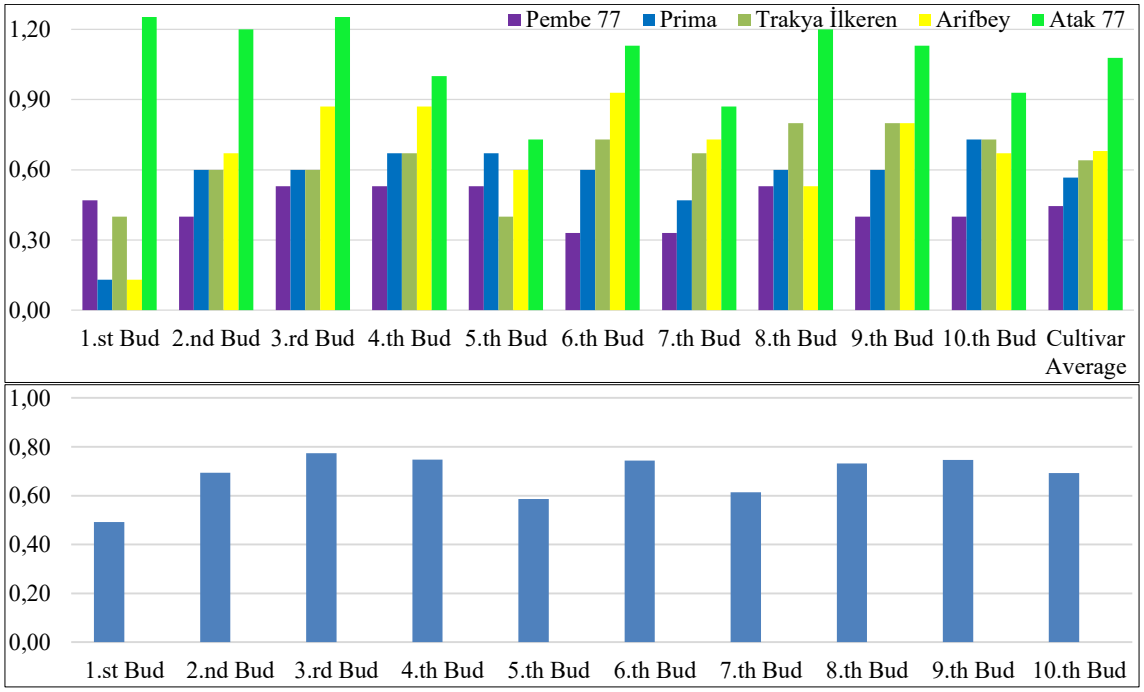

Figure 6. Bud fertility index (bunches/shoot) of cultivars and general bud fertility mean of the cultivars (upper graph). General bud fertility mean of the buds (down graph)

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