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Quality of floral stems of different gladiolus cultivars grown in a subtropical environment

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Abstract. Currently, floriculture has drawn the attention of farmers as an option for income on their properties. The gladiolus is a culture destined to produce cut flowers, widely used by florists and decorators. Despite its wide use, there is still not much information about the behavior of different cultivars in some places of cultivation in the country and the possibility of producing quality stems. In this sense, the objective of this work was to evaluate the quality of stems from different cultivars of gladiolus in a subtropical environment. The work was performed in the city of Chopinzinho/PR. The experiment was conducted in a randomized block design with five repetitions. The factor studied is represented by cultivars of different cycles of the gladiolus culture, as follows: Red Beauty (intermediate II), White Friendship (early), and Jester (intermediate II). Planting was performed using bulbs, inserted in the soil at an average depth of 10 cm with a spacing of 30 cm between plants and 40 cm between rows. The quality of stems was evaluated by measuring the length of stems, length of the stem, the diameter of the stem, and the number of florets per spike. Also, based on one of the quantitative standards of quality of floral stems established for gladiolus, the plants were classified according to the length and diameter of the stems in the classes: 75, 90, and 110. The data were submitted to variance analysis, and after significant results were found, the data were submitted to mean comparison using the LSD test at a 5% error probability. For the data in relation to commercial classification, descriptive statistics were used. The results show that factors related to climate directly interfere in the development and flowering of gladiolus plants, and the cultivars White Friendship, Red Beauty and Jester express different responses to these factors. In general, the White Friendship and Jester cultivars obtained the best results for stem quality, considering the variables stem length and total length of the stem, length of the stem and diameter of the stem. Even though the cultivar Red Beauty showed lower quality indices, they are still within the commercialization standard for gladiolus. Thus, it is possible to produce gladiolus stems with quality in this environment.
Keywords: *Gladiolus* x *grandiflorus* Hort., Jester, Red Beauty, White Friendship.

Introduction

The profitability and the possibility of income diversification have sparked the interest of farmers in floriculture in recent times. According to Junqueira and Peetz (2018), they comment that this is a promising branch of Brazilian agribusiness, and in 2017 showed an average growth of 7% and the expectation for 2018 is a growth of around 4%.

Within this panorama of the growth of floriculture in Brazil, the gladiolus culture stands out as an opportunity for production. Being a cut flower par excellence, the gladiolus is widely used by florists and decorators to give volume and color to the arrangements, very versatile and can also form bouquets to decorate interiors of houses and offices besides adorning parties and weddings (SEVERINO, 2007).

The gladiolus (*Gladiolus x grandiflorus* Hort.) has had expressive gains in recent years, mainly in trade, occupying fifth place in cut flower

production in Brazil (Junqueira and Peetz, 2018). It has become a crop of great expression in the country due to the important cut flower for small farmers, for being a crop of easy production, which requires low initial cost and can be grown in an open field (Becker et al., 2021).

Although the characteristics pointed out for the gladiolus show that its cultivation is an option to be used on farms, there are still incipient works on the cultivation of several varieties in a subtropical climate. In this context, the general objective of this work was to evaluate the quality of stems of three cultivars of gladiolus in a subtropical environment.

Materials and Methods

The experiment was conducted in the municipality of Chopinzinho/PR (25°49'24.8 "S; 52°33'12.3 "W) during the period from February 2020 to June 2020. The climate of the region is classified as Cfb (Alvares et al., 2013). The soil of the site is classified as Red Latosol (EMBRAPA, 2006). The climatic data during the experimental period are presented in Figure 1.

The experiment was conducted using a randomized block design with five repetitions. The studied factor is represented by different cultivars of different cycles of the gladiolus culture, being: Red Beauty (intermediate II), flowering 71 to 174 days after planting date, White Friendship (early) with flowering between 60 to 121 days after planting date and Jester (intermediate II) with flowering between 78 to 131 days after planting (Schwab et al., 2015). The planting of the cultivars Jester and Red Beauty (intermediate II) occurred on February 22, 2020. The White Friendship cultivar (early) was planted on February 24, 2020, aiming to produce stems for one of the most popular commemorative dates, Mother's Day.

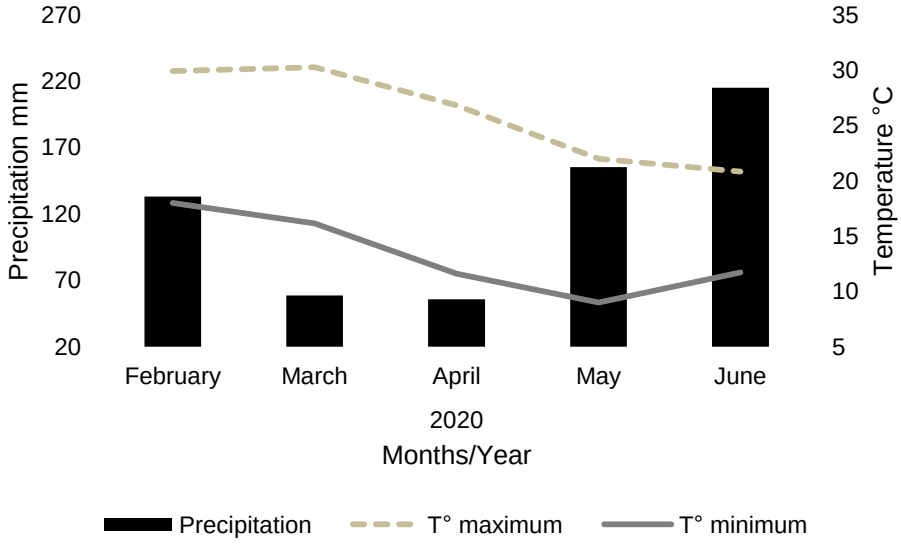

Figure 1. Precipitation (mm) and maximum and minimum temperature (ºC) during the experimental period (February 2020 to June 2020)

The planting was performed using bulbs, inserted in the soil with an average depth of 10 cm with a spacing of 30 cm in the row and 40 cm between rows. At planting time, 10 g of fertilizer (N-P-K, 12-32-18) was applied to each pit. When the plants had three fully expanded leaves, covering fertilization of 80 kg N ha^{-1} and 150 kg K_2O ha^{-1} was applied. After the emission of the seventh leaf, the plants began to be staked in the espalier system with the use of ribbons.

Stem quality was evaluated at the time of stem harvest. The harvest was defined by the appearance of the petals of the three florets at the base of the spike. Evaluations were made by measuring plant height, stem length, stem diameter, number of florets per spike, and stem class. For this, analyses were performed on ten plants per experimental unit at the R2 stage. The evaluation of plant height was performed using a graduated ruler, measuring from the base of the plant to the tip of the spike. For the length of the stalk, the distance from the insertion of the first floret to the spike tip was measured. The stem diameter was taken just below the base of the spike. For the number of florets, the number of florets per spike for each plant was counted. The qualitative classification was performed according to the standards described by Veiling Holambra (2013) for stem thickness. Thus, they were classified according to classes: 75, 90, and 110.

The evaluated data were submitted to variance analysis. When significant results were found, the data were submitted for comparison of means using the LSD test at a 5% probability of error. The analyses were performed in the R

programming language. In the case of qualitative classification, descriptive statistics were performed.

Results and discussion

Stem length was influenced by the different gladiolus cultivars studied (P=0.0048) (Table 1). The highest values were found for the cultivars White Friendship and Jester, with an average of 1.07 m. In the case of pendulum length was also affected by the different cultivars of gladiolus cultivated (P=0.0152) (Table 1). The highest value observed occurred for the cultivar White Friendship. On the other hand, the lowest value was observed for the cultivar Red Beauty.

Table 1. Total stem length, pendant length, stem diameter, and number of florets per spike as a function of different gladiolus cultivars

Cultivar	Total stem length (m)	Stem length (m)	Stem diameter (cm)	Number of florets per spike
Jester	1,07a	0,47ab	1,13a	16,47a
Red Beauty	0,92b	0,43b	1,03b	13,83b
White Friendship	1,08a	0,52a	1,14a	16,1

Averages followed by the same letters in the column do not differ by the LSD test at 5% probability of error.

In the case of the commercial classification of the stems according to length (Figure 2), there was a great difference among the cultivars evaluated. For Jester and White Friendship approximately 90% of the stems were in the 90 or 110 class. In the case of Red Beauty, a large percentage of the stems were in the 75 and 90 classes.

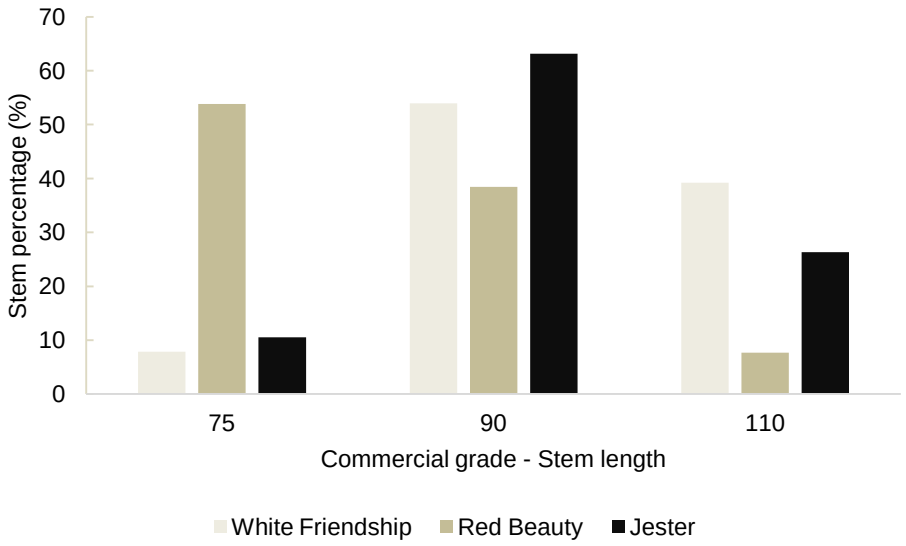

Figure 2. Commercial classification of the cultivars White Friendship, Red Beauty and Jester according to stem length.

The quality of gladiolus stems is highly related to the total length of the stem. According to Veiling Holambra (2013) for the minimum standard for commercialization, gladiolus stems need to present a ratio between stem length:stem length greater than 0.4. In this case, most of the stems presented a standard for commercialization, and all evaluated stems, 89.5% of the Jester cultivar, 97.4% of Red Beauty, and 97.4% of White Friendship were within the standard. In this case, this standard guarantees a product with a harmonic proportion between the portion without flowers and the stem, which makes it aesthetically pleasing (Schwab et al., 2015).

The differences found in the values of the total length of the stem and of the pendulum may express the responses to climatic factors during the experiment, especially the average temperatures between 8 ºC and 25 ºC that occurred during the vegetative phase. The cultivars White Friendship and Jester developed their stalk during the hottest days of the experimental period, between April 26, 2020 and May 08, 2020. On the other hand, the cultivar Red Beauty faced lower temperatures (Figure 1). This factor is related to the cycle of each of the cultivars (early and intermediate II). According to Uhlmann et al. (2017), the optimal temperature for development in the vegetative phase is 27ºC, and temperatures below 15ºC are harmful in this phase of development (Severino, 2007).

Pereira (2014) in his work found average values of gladiolus stem length for the White

Friendship cultivar of 82.83 cm. Bosco et al. (2020), on the other hand, found average gladiolus plant length values of 110 cm for the cultivar Red Beauty. Schwab et al. (2015), in their work, found maximum values of plant length for cultivar Jester of 110 cm. The same authors also found stalk lengths of the cultivars Jester and White Friendship of up to 62.4 and 58.8 cm, respectively. Thus, the length values are variable and very much related to local conditions. Thus, the values for total length and stalk length could be higher, if there were no climatic limitations, generating higher quality stems, especially for Red Beauty.

The diameter of the stem showed different results for the cultivars studied (P=0.0022) (Table 1). The highest values were found for the cultivars White Friendship and Jester, with an average of 1.12 cm. For the commercial classification of stems according to their thickness (Figure 3), it was observed that they were only in classes 90 and 110, i.e., higher quality classes. For all cultivars, the highest percentage occurred for class 110, with Red Beauty standing out for having 69.2% of the evaluated stems in class 110.

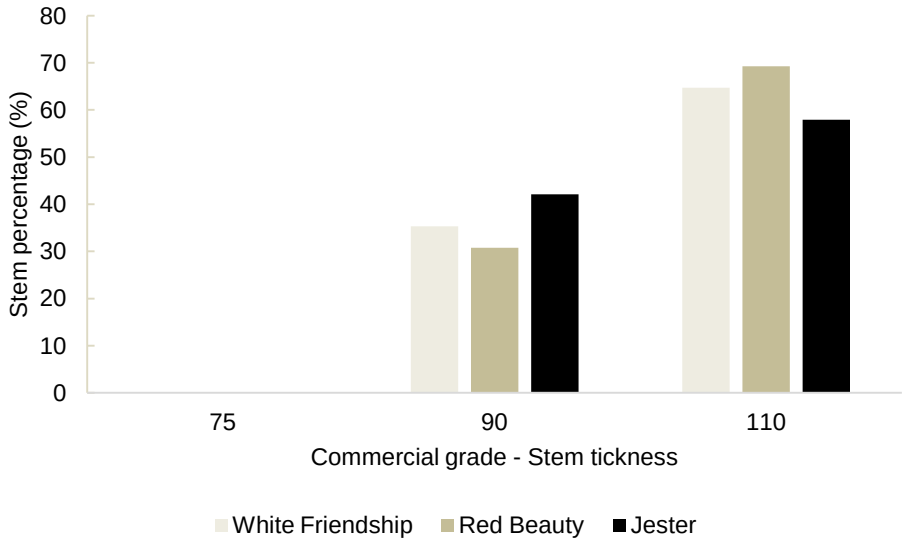

Figure 2. Commercial classification of the cultivars White Friendship, Red Beauty and Jester according to stem thickness.

The quality of gladiolus stems is also considered its diameter. According to Veiling Holambra (2013), the minimum values required are 0.5 cm, thus contributing to the reduction of damage related to the lodging process. When the radial expansion of the stem is inhibited, the gladiolus plants tend to become more susceptible to lodging and consequently a decrease in the number of plants that can use the floral stems (Campos et al., 2010). According to Farias et al. (2013), the resistance of the stem is directly influenced by the diameter, that is, stems with larger diameters have greater resistance to mechanical damage, which can occur still in the field (caused by wind) or during harvest, packaging, and transport of the stems.

In an experiment conducted by Schwab et al. (2015), with the cultivar Jester, they found average values of 0.77 cm for stem diameter at different planting times. Furthermore, Bosco et al. (2019) also found average values of 0.8 cm for the cultivar Red Beauty. Thus, the stems evaluated in the present work presented a diameter greater than that found in the literature, emphasizing the possibility of producing quality flowers in the studied location.

The number of florets per spike was also affected by the cultivars used (P=0.0024) (Table 1). The cultivars Jester and White Friendship had the largest number of florets, with an average of 16.3 florets.

The number of florets on gladiolus stems is primordial in defining the quality since they are highly related to the stem length. According to Azimi (2020), the number of florets per spike in gladiolus is highly influenced by competition for minerals, light, and water. The same author emphasizes that the interaction between gene and environment has great interference, with the possibility of variation of 6 more flowers because of these factors.

Bosco et al. (2021), working with different production systems for the White Goddess cultivar, found average values of 18 florets per spike. Souza et al. (2020) evaluating the cultivar White Goddess and Red Beauty found values of 15.3 and 12.6 florets per ear, respectively. Ahmad et al. (2017) also found similar averages, with 12.6 florets per ear in different production systems. From this, it is observed that the stems harvested under the conditions of the experiment presented a higher amount than commonly found in the literature. Also, it is emphasized that there are different responses of cultivars to the variable, with a large effect of the interaction with the production environment.

Conclusion

The White Friendship and Jester cultivars were the ones that obtained the best results in stalk quality, considering the variables of the ratio of stem length to total stem length, stem length, and diameter. The cultivar Red Beauty even though it showed inferior results compared to the other cultivars obtained good results if within the classification for commercialization.

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