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Proposal for commercial classification of the gerbera capitulum based in the flower overlap index

Raquel DL Cardoso[2]; Simone M Scheffer-Basso[1]; Magali F Grando[1]
[1]UPF-FAMV, C. Postal 611, 99001-970 Passo Fundo-RS; [2]Estudante de Pós-Graduação em Agronomia, UPF; raqueldlcardoso@bol.com.br

ABSTRACT

The aim of this work was to propose a methodology for commercial classification of gerbera´s capitulum based on the *trans* flowers overlap coefficient. Three to eight capitula of twenty-eight cultivars of gerbera cut flower and seven non-commercial accesses were used. The width measurement of the *trans* flowers group (internal ray flower) as well as the sum of the width of the *trans* and ray flowers (external ray flower) groups were taken from each capitulum. The average of each access and the overlap coefficient were calculated (CS = width of the *trans* flowers group / Σ of the width of the *trans* and ray flowers groups) and submitted to the multivariate analysis, to verify the grouping by the average Euclidian distance matrix. It is proposed that gerberas with CS= 0.01 to 0.15 be classified as simple, CS= 0.16 to 0.40 as semi-double and CS superior to 0.41 as double. The overlap coefficient (CS) can be used to systematize the classification of the gerbera capitula, reducing the divergences in the classification and the subjectivity in the decisions of producers, florists and breeders.

Keywords: *Gerbera* sp., simple capitulum, semi-double capitulum, double capitulum.

RESUMO

Proposta para classificação comercial dos capítulos de gérbera com base no coeficiente de sobreposição das flores

Objetivou-se neste trabalho propor uma metodologia para classificação comercial dos capítulos de gérbera com base no coeficiente de sobreposição das flores *trans*. Foram utilizados três a oito capítulos de vinte e oito cultivares de gérbera com aptidão para corte e sete acessos não comerciais. Em cada um dos capítulos realizou-se a medição da largura do conjunto das flores *trans* (flores do raio interno) e a soma da largura do conjunto das flores *trans* e do raio (flores do raio externo). Com isso, calcularam-se os coeficientes de sobreposição das flores *trans* (CS= largura do conjunto das flores *trans* / Σ da largura do conjunto das flores *trans* e do raio) e submeteram-se os dados à análise multivariada, com a finalidade de verificar o agrupamento mediante matriz de distância euclidiana média. Propõe-se que gérberas com CS= 0,01 a 0,15 sejam classificadas como simples, CS= 0,16 a 0,40, semidobradas e CS superior a 0,41, dobradas. O coeficiente de sobreposição pode ser utilizado para sistematizar a classificação dos capítulos de gérbera, reduzindo as divergências e a subjetividade nas decisões de produtores, floricultores e melhoristas.

Palavras-chave: *Gerbera hybrida*, capítulo simples, capítulo semidobrado, capítulo dobrado.

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Gerbera (*Gerbera hybrida* Hort., Asteraceae) is one of the most important trade flowers in the international market, mainly in European countries such as the Netherlands, Germany, France and Italy and also Israel, Colombia and United States of America. Its commercial relevance is confirmed by the amount of money involved in the productive chain of this species. In the California State (USA) over 60 million units of gerbera flower are produced, which generate an income of U$30 million a year. In Europe, the sales in the Netherlands exceed 100 million units with value superior than € 100 million (Teeri *et al*., 2006; Chung *et al*., 2001).

Gerbera hybrida Hort., Asteraceae presents capitulum inflorescence with centripetal development. The capitulum is formed by many flowers called floscules, which lye in a common receptacle, surrounded by involucral bracts (phyllaries) organized in one or more series (Barroso, 1991). The gerbera capitulum is a highly organized structure, formed by different kinds of flowers: ray flowers (flowers from the external ray), *trans* flowers (flowers from the internal ray) and the disc flowers. The ray flowers are female and the disc flowers are hermaphrodites, which can be grouped in fertile hermaphrodites and functionally male flowers. The *trans* flowers present pistils, whose anthers are absent or poorly developed and presents corolla with ligule and two lips; the superior lip presents intermediate length among the disc and the ray flowers lip lengths. Botanically, the gerbera capitulum is classified as actinomorphic, which means it presents radial symmetry (Cabrera & Klein, 1973; Barroso, 1991; Yu *et al*., 1999; Elomaa & Teeri, 2001). In spite of it, the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA, 2007) classifies the gerbera capitula for commercial finality in simple, semi-double and double based on subjective criteria, according to illustrations presented in gerbera descriptors (Figure 1), of the Brazilian National Service for Protection of Cultivars (SNPC). It leads to opinion divergences and a high level of subjectivity in the classification.

There are papers in which the authors describe what is considered as a double capitulum. For Kloss *et al*. (2004), a double capitulum is the one which presents widened row of *trans* flowers. However, for Rogers & Tija

(1990), a double capitulum is the one which presents more than one row of ray flowers. It demonstrates the divergence and the difficulty in the definition of a gerbera classification towards the capitulum type for commercial finality.

This work aimed at proposing a methodology to help the commercial classification of the gerbera capitula based on its morphology, favoring the cultivars description.

MATERIAL AND METHODS

The study was carried out from December 2005 to March 2006, in Passo Fundo, Rio Grande do Sul State, Brazil. Twenty eight cut gerbera commercial cultivars (Orca, Cosmo Dino, Classic Fábio, Orange, Tonga, Rokie, Miriam, Amazone, Terra Fame, Azteca, Tennessee, Cariba, Cabana, Bianca, Dino, Kozak, Igor, Lady, Gunda, Havanna, Eyecatha, Orange Dino, Onedim, Junk Frau, Solemio, King Alexandre, Lamborghini and Pink Elegance) and seven non-commercial accessions, collected from Rio Grande do Sul (A9, A10, A11 and A12) and Espírito Santo (A7, A8 and A13) states gardens were evaluated. The following accessions are registered in the Herbarium of Universidade de Passo Fundo, Rio Grande do Sul State, Brazil: (RSPF): A7 (RSPF-11.315), A8 (RSPF-11.316), A9 (RSPF-11.325), A10 (RSPF-11.326), A11 (RSPF-11.327), A12 (RSPF-11.318) and A13 (RSPF-11.317).

Plants were grown in a semi-protected environment, which was constituted by an impermeable cover (low-density 0.15 mm thick turbid polyethylene film) surrounded by a 50% shadowed with retractile transparent plastic drapery, which allowed the transmittance of 30% of the solar global radiation. Plants were grown on polyethylene contents filled with 5 litters of the commercial substrate Rendimax Floreira (turf + bentonite) mixed at the same proportion to carbonized rice husk, which presented the following characteristics: density: 345 g L^{-1}; porosity: 70%; pH = 6.4; electric conductivity: 0,66 mS. Plants were manually irrigated whenever it was necessary. Liquid fertilizers were applied once a week and two solutions (A or B) were applied on each week. Solution A was constituted by 0.8 g L^{-1} calcium nitrate, 0.4 g L^{-1} ammonium nitrate, 0.01 g L^{-1} "tenso ferro" and 0.001 g L^{-1} borax. Solution B was composed by 0.7 g L^{-1} potassium nitrate, 0.6 g L^{-1} magnesium sulphate, 0.15 g L^{-1} MAP and 0.01 g L^{-1} of "tenso cocktail" (Guiseline, 2002).

Three to eight capitula of each accession were evaluated at the moment they reached the commercial stadium, which was considered when two of the disc flower rows were opened. In each of the capitula the width of the *trans* flowers set was measured (LFT) and the sum of the LFT and the ray (LT) (Figure 1) was calculated. Then, the overlap coefficient (CS) was obtained by the ratio LFT/LT. The parameters were submitted to the multivariate analysis by the average Euclidian distance estimative (DEM) and, after, to the generation of a dendrogram by the complete ligation method. Statistical analyses were performed by Genes program (Cruz, 2001).

RESULTS AND DISCUSSION

The obtained overlap coefficients varied from 0.03 to 0.64, which indicated difference among the capitula in relation to the *trans* flowers overlap. When the classification criteria of the Brazilian Ministry of Agriculture, Livestock

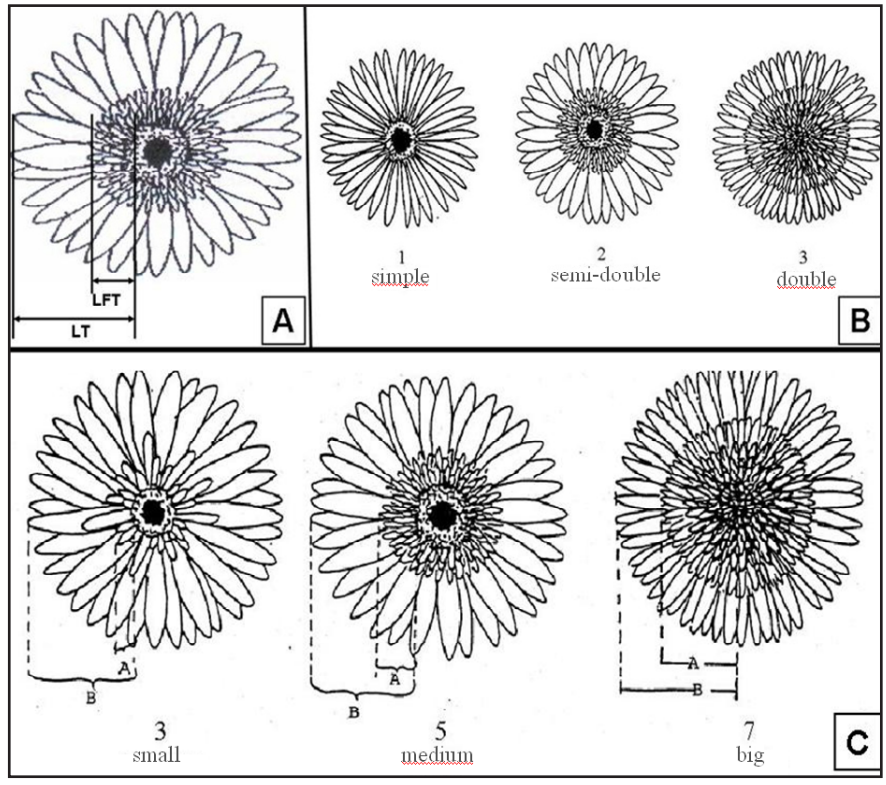

Figure 1. (A) Measures used to obtain overlap coefficient. LFT= width of *trans* flowers set and LT= sum of width of the *trans* and ray flowers sets. (B) Classification of capitula according to information of the SNPC (Brazilian National System for Protection of Cultivars). (C) Figure made available by the Brazilian Ministry of Agriculture (MAPA) for capitulum classification. Only for semi-double or double cultivars: Capitulum= width of ligulated internal flowers set, (A) compared to the width of the capitulum (B). Illustration adapted from MAPA (2007) ((A) Medidas utilizadas para a obtenção do coeficiente de sobreposição LFT= largura do conjunto das flores *trans* e LT= soma da largura do conjunto das flores *trans* e do raio. (B) Classificação dos capítulos conforme informações do SNPC (Sistema Nacional de Proteção de Cultivares). (C) Figura disponibilizada pelo MAPA para classificar os capítulos. Apenas cultivares semidobradas ou dobradas: Capítulo= largura do conjunto das flores liguladas do raio interno (A) comparado à largura do capítulo (B). Figura adaptada de MAPA (2007)). Passo Fundo, UPF, 2008.

Table 1. Gerbera accessions, overlap coefficient, classification of the gerbera capitula by subjective criterion (MAPA) and by the overlap coefficient (CS) (acessos de gérbera, coeficiente de sobreposição e classificação dos capítulos pelo critério subjetivo (MAPA) e pelo coeficiente de sobreposição (CS)). Passo Fundo, UPF, 2008.

Cultivars/accessions		Overlap coefficient	MAPA (2007) classification	CS classification
Orca		0,07	S	S
Orange		0,16	S	SD
A8		0,04	S	S
Dino		0,24	SD	SD
Kozak		0,42	SD	D
Igor		0,41	SD	D
Lady		0,54	SD	D
Eyecatha		0,46	SD	D
A7		0,06	SD	S
Solemio		0,60	D	D
Pink Elegance		0,32	D	SD
A11		0,54	D	D

Commercial classification of gerbera capitula: S = simple capitulum; SD = semi-double capitilum and D = double capitulum. Controversies in the gerbera capitula classification among the current and the proposed criteria are enhanced by gray (classificação comercial dos capítulos de gérbera: S = capítulo simples; SD = capítulo semidobrado e D = capítulo dobrado. Em destaque, sombreado, controvérsias na classificação dos capítulos de gérbera utilizando os critérios atuais e o proposto).

and Food Supply (MAPA, 2007) and the classification criteria based on the overlap coefficient were compared, the results matched highly (80.5%) in the types of capitula. It indicated the similarity among results and the possibility of adoption of an objective criterion based on linear measures for the cultivars description.

Through the grouping analysis (Figure 2), the formation of three groups was verified. The group 1 was formed only by the accessions which presented capitula with CS ranging from 0.03 to 0.09; the second grouped capitula whose CS ranged from 0.16 to 0.34; and the third, from 0.41 to 0.60. The most divergent accessions were 'Tonga' (simple capitulum) and 'Junk Frau' (double capitulum) (DEM= 2.95) and the most similar ones were 'Orca' and 'Cosmo Dino' (DEM= 0.0). For the most divergent accessions, the CS ranged from 0.03 cm ('Orca') to 0.64 cm ('Junk Frau'). Hence, it is proposed here to classify as simple capitula the ones with CS between 0.01 and 0.14; as semi-double capitula when CS is between 0.15 and 0.35 and as double capitula the ones whose CS is equal or superior to 0.36 (Figure 2). The capitulum classification criterion based on the *trans* flowers overlap coefficient, which is proposed by this paper, might support the current gerberas capitula classification models, which are subjective and contradictive. Some authors consider as double capitula the ones which present a widened *trans* flowers row (Kloss *et al*., 2004), without differentiation among the semi-double and double capitula, since all of them present a widened *trans* flowers set. However, the width-based criterion to classify a capitulum as double is not exact. For Rogers & Tija (1990), gerbera with a single row of radian flowers are considered as simple flowers and the ones with more than one line are considered double. Nevertheless, this criterion does not match the classification which is carried out by growers, who classify gerbera as simple, semi-double and double. Moreover, if that first method of classification were used, then possibly all the cultivars would be classified as double, since there are many cultivars classified as simple even though they

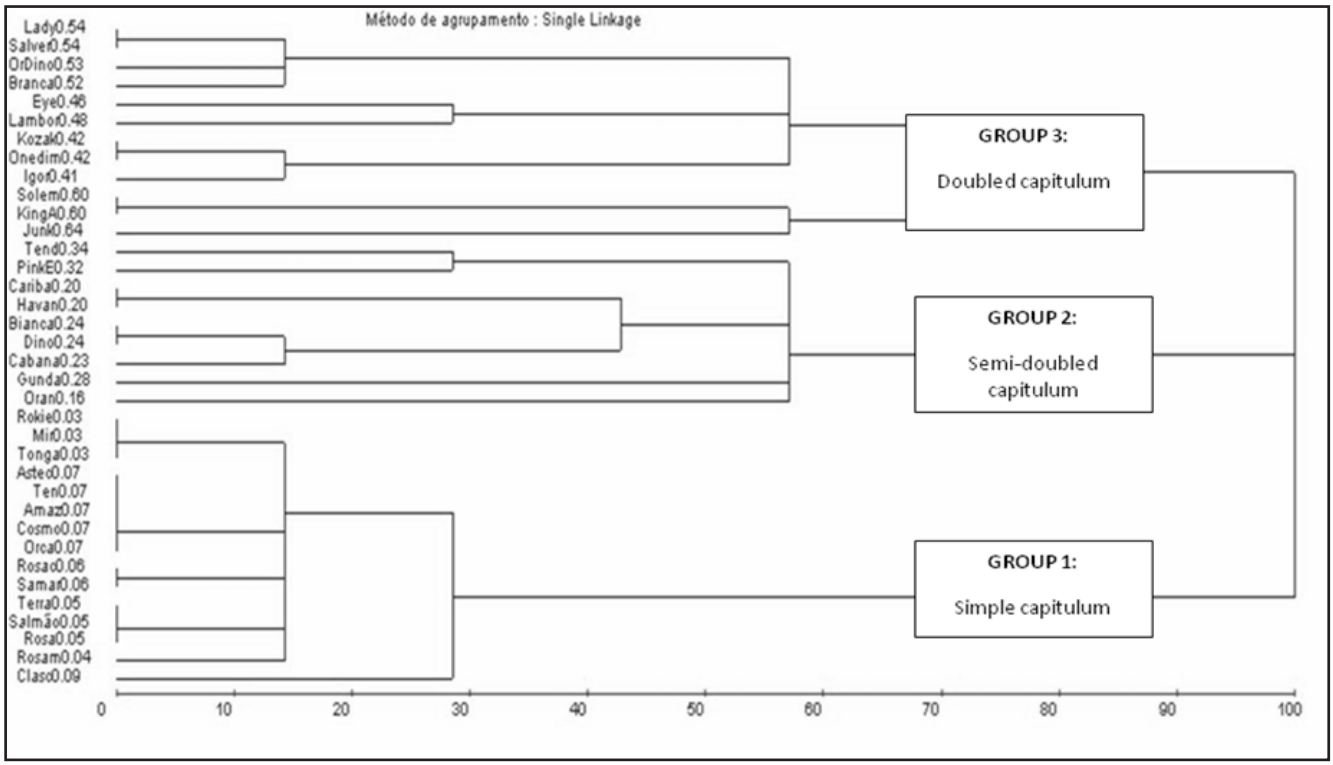

Figure 2. Genetic dissimilarity dendrogram among 35 gerbera accesses based on the overlap coefficient of the trans flowers group, obtained by the method of the most distant neighborhood, based on the matrix of euclidian medium distance (dendrograma de dissimilaridade genética entre 28 cultivares e sete acessos de gérbera com base no índice de sobreposição do conjunto das flores *trans*, obtido pelo método do vizinho mais distante, baseado na matriz de distância euclidiana média. Passo Fundo, UPF, 2008.

present more than one line of ray flowers.

Here, many cultivars matched the classification of the Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA, 2007). The greatest divergences occurred in semi-double capitulum flowers (Table 1), which can also be noticed in the dendrogram. In the dendrogram, difficulties in establishing groups can be noticed when CS are superior to 0.15. The Orange cultivar, classified by the MAPA (2007) methodology as simple, would be classified as semi-double by the overlap coefficient method (0.16). The A7 accession, classified by the MAPA (2007) methodology as semi-double, did not present a CS value high enough to match this classification (CS= 0.06) and was classified as simple. The Pink Elegance cultivar presents divergences in its commercial classification and is controversially recognized by growers as a double or as a semi-double flower. By the overlap coefficient method, its CS value (0.32) would classify it as a semi-double flower. The Eyecatha cultivar presented CS= 0.46 and would be classified as a double cultivar. In addition, the Kozak (CS= 0.42) and the Igor (CS= 0.41) cultivars presented the minimum values to be classified as double, but they are, visually, similar to the semi-double flowers.

The overlap coefficient of *trans* flowers may be utilized to the commercial classification of gerbera capitula, reducing divergences and the subjectivity in the classification carried out by growers, sellers, plant breeders and by the Brazilian National System for Protection of Cultivars (SNPC). This approach can be improved with the evaluation of a greater number of cultivars, in order to establish the limits for the three capitula categories.

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