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COMPARATIVE STUDY OF CLASSICAL AND NUMERICAL TAXONOMIC METHODS FOR INFRASPECIFIC TAXA OF TRITICUM AESTIVUM L. TRADITIONALLY CULTIVATED IN GALICIA (NW SPAIN)

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Abstract

Application of classical taxonomic methods of *Triticum aestivum* L. to traditional Galician wheats suggests the existence of four varieties. However, morphological characters used for identification of varieties are not well delimited and display frequently a continuity which makes it difficult to establish limits among them.

Numerical taxonomic methods consisted of an Analysis of Principal Components and an Association Analysis using the routines Factor and Quick cluster from the statistics package SPSS-PC+. This analysis indicates the poor discriminatory power of morphological characters.

Three classes were obtained by numerical taxonomic methods and no one would agree with the level of variety. Since traditional varietal differentiation for Galician wheats cannot be justified by numerical taxonomy neither classical taxonomics methods, it should be advisable not to use the level of variety for Galician wheats.

Introduction

Traditional Galician wheats are of special interest as phytogenetic resources, because of edaphoclimatic conditions in which they grow (high rainfall and acidic soils). Moreover, Galician farmers use their own caryopsis from previous years as seed stock for next crops. This process implies that traditional wheats cultivated for centuries persist nowadays.

At the present, it is very important to know their correct taxonomic status, because of their possible use in future plans for genetic improvement. Since it is not clear if infraspecific taxonomy of *Triticum aestivum* L. is better described by classical approach or by a numerical approach (SCHULTZE-MOTEL & MEYER, 1981; ZEVEN, 1986), in this study we compare the two taxonomic approaches.

In general, the application of the Numeric Taxonomic methods, in the area of plant taxonomy, offers a series of advantages. Among these, objectivity is perhaps the most important. The fact that these techniques permit the use of a high number of characters, make them particularly useful on a intraspecific level, where isolation in discrete groups is complex, owing to the slow nature of the natural evolution process, which in turn leads to continuity in the characters (CLIFORD & STEPHENSON, 1975).

Material and methods

Samples were taken from caryopsis collected from 131 places of traditional wheat growing areas in Galicia (NW Spain), where each farmer was asked for one kilogramme of caryopsis approximately.

The caryopsis were sown in a plot belonging to the Centro de Investigaciones Agrarias de Mabegondo (La Coruña) and the crop was monitored throughout its growth until plant maturity, whereupon 20 plants of each one of the 131 samples were harvested for taxonomic studies.

Traditional keys (MANSFELD, 1951; TUTIN & al., 1980) and monographic papers (PERCIVAL, 1921; FLAKSBERGER, 1935; SÁNCHEZ-MONGE, 1957; GADEA, 1954) were used for wheats identification. In addition the study was completed with the determination of chromosome number by standar techniques of chromosomatic counting in meristematic cells of tip roots, carrying out the staining with acetic orcein (DARLINGTON & al., 1969).

Using as base the descriptive norms given by the IBPGR (1981), and the MAPA (1986) a selection of characters was made, as well as quantitatives as qualitatives ones. Table 1 shows these characters and how their measurements were carried out.

I.- Morphoquantitative characters

- Tillering (60 days after emergence).
- Plant height (From ground to top of spike, excluding awns).
- Culm diameter (Between nodes 2 and 3 from base culm).
- Length and width of node (When superior node is turgid).
- Number of leaves.
- Leaf length (Of second superior leaf).
- leaf width (Of superior leaf).
- Number of ears.
- Rhachis length (From basal node of ear to insertion last spikelet).
- Rhachis sterile portion length (From basal node of ear to first fertile spikelet).
- Ear width (From central portion of spike).
- Number of fertile spikelets per ear.
- Number of flowers per spikelets.
- Length and width of glume.
- Length and width of lemma.
- Awn length.

II.- Morphoqualitative characters

- Habit 60 days after nascence
- Culm solidity Between nodes 2 and 3 from base of spike
- Ear position In the field
- Glume colour On the outer glume
- Glume pubescence
- Glume shape From the central portion of the spike
- Glume nerviation From the central portion of the spike

Table 1. Morphometric and morphoqualitative characters studied.

Data scored were stored in database DBIII+ from Ashton Tate. Qualitative characters were previously coded and standardization of the data was carried out to prevent scaling effects.

The statistical study consisted of, on the one hand, an analysis of the Principal Components, for the quantitative characters, in order to determine what morphological characteristics were of greater importance to explain the sample variance, and its distribution; and on the other hand, an Association Analysis, using the routines FACTOR and QUICK CLUSTER from the statistics package SPSS-PC+. The latter analysis being applied not only to qualitative characters but to quantitative ones as well.

Results and discussion

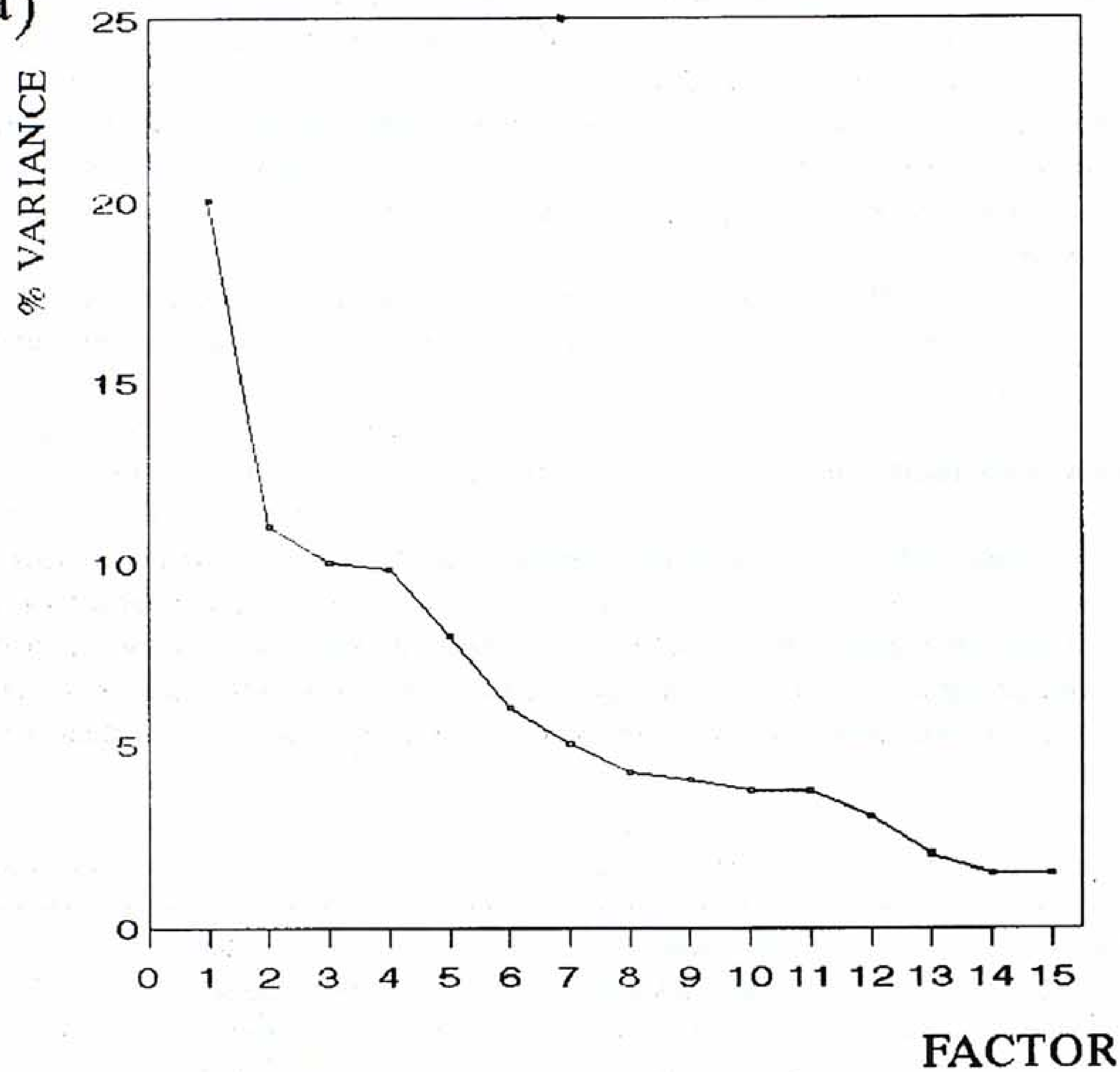
All plants studied, turn out to be hexaploids, or in other words, their chromosome number was 2n=6x=42. Taking the latter into consideration and because of their ears were not disarticulated at maturity, they were identified as *Triticum aestivum* L. According to previous studies about Spanish wheats (SÁNCHEZ-MONGE, 1957; GADEA, 1954), colour and pubescence of the glume could be used for varieties identification. On the basis of these characters, it could be distinguish four varieties: var. *erythrospermum* (Körn)Msf. (yellow glume and hairless), *ferrugineum* (Alef.)Msf. (reddish glume and hairless), var. *hostianum* (Clem.)Msf. (yellow glume and pubescent) and var. *barbarossa* (Alef.)Msf. (reddish glumme and pubescent) but these characters offer a continuity which make difficult to establish limits among them. For this reason, varietal differentiation was not taken into account during the statistical treatment, taking initially all samples as an undifferenciated population. Only at the end of the association analysis, each individual was related with its doubtful varietal identification.

Figure 1 (a,b) reflects the results of the Analysis of the Principal Components, in which dispersion of sample variance is shown. Fig. 1a, shows the seven factors needed to explain 70% of this variance, and in addition reveals the lack of importance of each one of these 7 factors. This analysis indicates the poor discriminatory power of the morphological characters included in each one of the 7 factors (fig. 1b).

Character	Mean Square	d.f.	F	Tail Prob.
Tillering	0.4708	19	1.276	0.20
Node length	0.0861	19	1.152	0.30
Node width	0.0604	19	0.830	0.67
No. of leaves	0.2776	19	1.059	0.42
Leaf width	0.2294	19	1.547	0.07
No. of ears	0.4288	19	1.151	0.30
Glume length	0.3493	19	1.016	0.44
Glume width	0.0554	19	1.366	0.15
Lema width	0.046	19	1.106	0.35

Table 2. ANOVA of Association Analysis for morphometric characters. d.f.: Degree freedom

a)



b)

FACTOR 1: Tillering, no.ears
FACTOR 2: Glume and lemma width
FACTOR 3: Node length and width
FACTOR 4: No. fertil spikelets
FACTOR 5: Ear face width
FACTOR 6: Plant height
FACTOR 7: Leaf length
FACTOR 8: Awn length
FACTOR 9: Sterile rhachis length
FACTOR 10: Glume length
FACTOR 11: No. leaves
FACTOR 12: Leaf width
FACTOR 13: Culm diameter
FACTOR 14: Lemma length
FACTOR 15: Ear profile

The ANOVA for the quantitative characters carried out prior to final Association Analysis shows very high constancy for all plants (p>20%)(table 2). Only four characters present a greater variation, these are: height, culm diameter, leaf length, and number of fertile spikelets. Given that the majority of these characters are included within the first seven factors of the Principal Component Analysis, we consider them to be the most discriminating, together with the leaf width which presents a low constancy.

With respect to the qualitative characters, table 3 reflects the result of the ANOVA and it can be observed that they present a very high constancy and therefore have not a discriminating value .

As a result of the Association Analysis Cluster, using the quantitative characters which present greater differences among individuals, most of samples can be arranged into three classes (fig. 2-a,b,c). In figure 2a are shown maximum values obtained for each one of the differentiating characters in each one of the classes. No differences were found among the three clases. Figure 2b are represented the percentage of the varieties considered different which appear in each class. The four varieties appear in the 3 classes. And figure 2c depict geographical areas included in each class, based on the source of the samples. No one area were result to be representative of a particular class.

Character	Mean Square	d.f.	F	Tail Prob.
Habit	0.1901	19	0.534	0.94
Culm solidity	0.0021	19	0.208	1.00
Thickness wall culm	0.6997	19	1.119	0.33
Ear position	0.6800	19	0.984	0.48
Glume pubescence	0.1670	19	0.751	0.76
Glume shape	0.7905	19	0.921	0.56
Glume position	0.4079	19	0.988	0.47

Table 3. Anova of Cluster Analysis for morphoqualitative characters. d.f.: Degree freedom

Conclusion

Taking as a base the results observed in the statistical analysis used in this paper, we can draw the conclusion that classes obtained by numerical taxonomic methods, do not agree with the level of variety which is established following traditional taxonomic methods, which are based on morphological characters and present a high degree of subjectivity. In our opinion, this traditional varietal differentiation for Galician wheats should be ignored because it cannot be justified by numerical taxonomy neither classical taxonomics methods.

Fig. 1. Results of Principal Components Analysis. a, Percentage of variance explained by each factor; b, characters included in each factor.

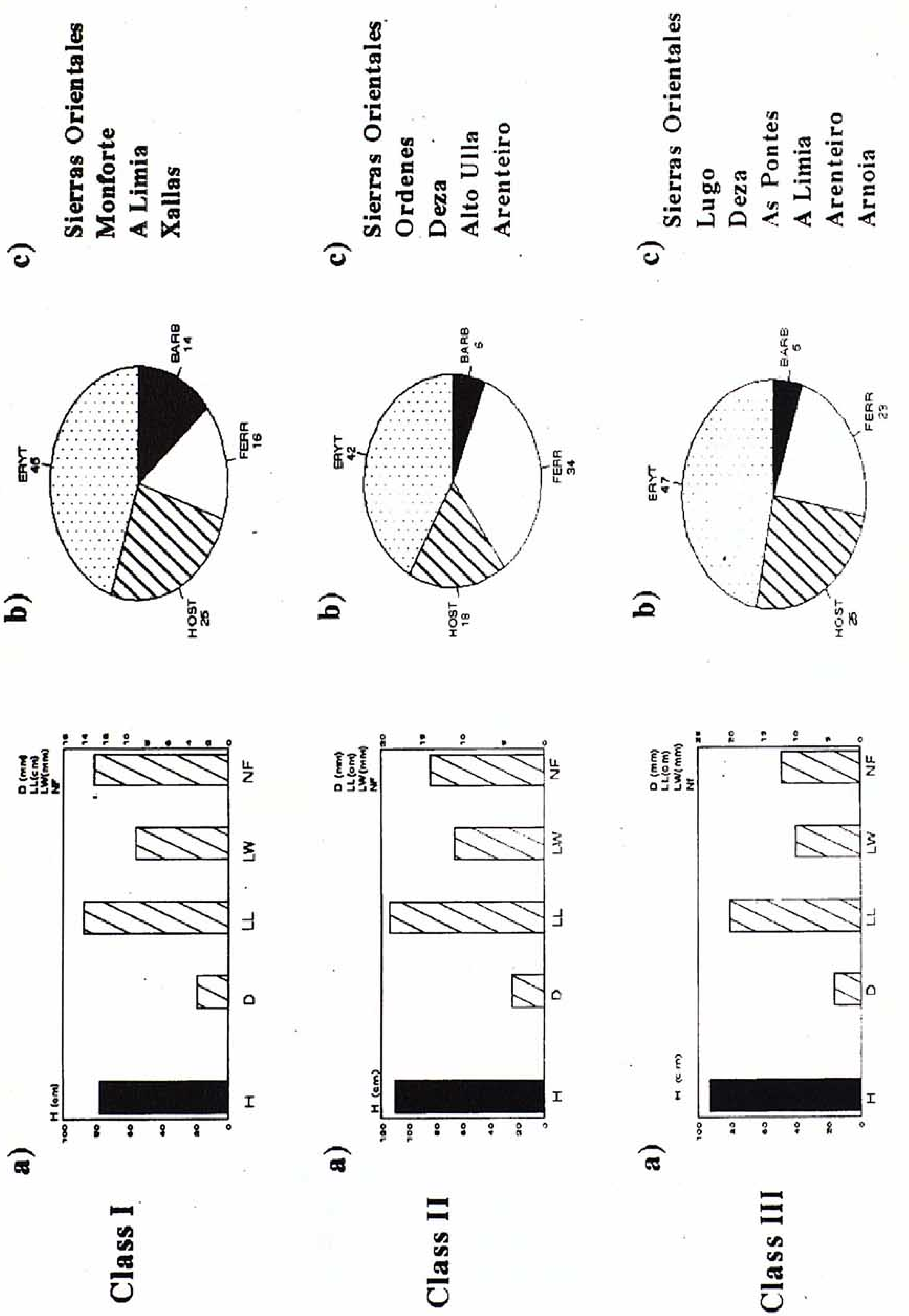


Fig. 2. a, Maximum values obtained for differentiating characters in three classes. H:Height; D:Diameter; LL, Leaf length, LW, leaf width; NF, Number fertile spikelets; b, Percentage of the four varieties considered different which appear in each class; c, Geographical areas included in each class.

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