

tance and redundancy, the latter defined by the correlation coefficients estimated among the traits. According to Jolliffe (1972, 1973) and Mardia et al. (1979), variables with the highest coefficients in their components with eigenvalues smaller than 0.70 should be discarded.

This methodology was applied using the software GENES (Cruz, 1998).

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) for agronomic descriptors showed significant differences among accessions, except for DMW (percentage of dry matter in winter) which was not significant. Coefficients of variation (CV%) ranged from 1.30 to 24.25 considering the original 16 traits in the experiment.

The relative importance of the principal components was estimated from the percentage of total variance contained on its first corresponding eigenvalues. Table 1 shows the eigenvalues and the absolute and relative contribution of the descriptors in the explanation of total observed variation for the first components and three types of studied characteristics.

For agronomic characters it was evidenced that the first three principal components explained 79,86% of the available variation, while for reproductive and vegetative characters (Table 1) the first five principal components were necessary,

Table 1 - Estimates of the eigenvalues associated to the principal components and its relative and accumulated contribution, obtained in the study of 16 agronomic, 16 reproductive and 21 vegetative descriptors evaluated in 32 accessions of *Paspalum*.

Components	Eigenvalues	%	% accumulated
Agronomic descriptors			
1	6,8576	42,85	42,85
2	3,4338	21,46	64,31
3	2,4873	15,54	79,86
Reproductive descriptors			
1	4,3224	27,02	27,02
2	2,4424	15,26	42,28
3	1,8604	11,63	53,91
4	1,5056	9,41	63,32
5	1,4473	9,05	72,37
Vegetative descriptors			
1	5,7736	27,49	27,49
2	4,2541	20,26	47,76
3	2,2822	10,87	58,62
4	2,1304	10,15	68,76
5	1,4827	7,06	75,83

so that 72,37 and 75,83% of the variation could be represented, respectively. Dispersion of the variance in several components was also observed by Strapasson (1997) in *Paspalum*, Cury (1993) in cassava and Dias (1994) in cocoa. Dilution of the variation among the components can be attributed to the diversity of the appraised descriptors.

Principal component analysis allowed reduction of 69%, 69% and 62% in the initial number of descriptors for agronomic, reproductive and vegetative traits, respectively. It also allowed the election of the following most important descriptors: 1) agronomic descriptors: DMYS, DMYW, RGS, CPPW and NDFW (dry matter yield in summer, dry matter yield in winter, regrowth score in summer, crude protein percentage in winter and neutral detergent fiber in winter, respectively); 2) reproductive descriptors: NSG, PE, PFA, PS and LE (number of seeds per gram, pubescence of the escape, pubescence of the floral axis, pubescence of the spikelet and length of the escape, respectively); and vegetative descriptors: PLDI, PLL, PSDE, PINDE, LL, LWH, SWB, SWT (pubescence of leaf – distribution, pubescence of leaf – length, pubescence of sheath – density, pubescence of internode – density, leaf length, leaf width – half, sheath width – base and sheath width – top, respectively).

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Production and quality of *Paspalum* forage in State of São Paulo¹

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ABSTRACT

Biomass produced by accessions of 26 species, belonging to 12 botanical groups of the genus *Paspalum*, collected in the south and central regions of Brazil, were evaluated during the first year of establishment for quantitative characteristics: production of dry biomass (DMY), percentage of dry matter (PDM) and regrowth score and qualitative traits: concentration of neutral detergent fiber (NDF), "in vitro" dry matter digestibility (IVDMD) and crude protein percentage in dry matter (CPPDM), in the central area of the state of São Paulo, in a completely randomized block design with two replications. The largest averages of DMY were obtained by the species *P. regnellii*, *P. coryphaeum* and *P. atratum*, belonging respectively to the botanical groups Virgata, Quadrifaria and Plicatula. The analyses of canonical correlation showed existence of nonindependence between the group formed by the quantitative variables and the group formed by the qualitative variables. The variables which presented the largest coefficients within each group were PDM and IVDMD, with opposite signs, indicating a nonindependent relationship between the analyzed groups.

KEYWORDS: Plant genetic resources, native vegetation, native pasture, grasses, biomass production

INTRODUCTION

The origin of most of the species of the genus *Paspalum* is mainly the south of South America: in the states of Rio Grande do Sul, Santa Catarina, Parana and Mato Grosso do Sul in Brazil, in Uruguay, in the north of Argentina and in the center-east of Paraguay (Chase, 1937; Burton, 1945; Barreto, 1974 and Valls, 1987), in which ecosystems they can be found in practically all herbaceous communities. Due to the diversity of the genus, which has more than 100 species, it was partitioned in taxonomic groups (Chase, 1929), and it has now 38 groups. Forage potential of the genus is recognized and it has been evidenced. In many vegetal formations, *Paspalum* species are dominant and responsible for the largest portion of forage produced (Valls, 1987). According to Rodrigues (1986), "the groups Dilatatum, Notatum and Plicatulum", present excellent adaptation ability to tropical and subtropical conditions. Species of this genus are not much demanding

in soil fertility and they vegetate well even in sandy and poor soils, like the Cerrado soils. More recently, *Paspalum atratum* was released as cultivar "Suerte" in the United States (Kalmbacher et al., 1997) and as cultivar "Ubon" in Thailand (Hare et al., 1999).

The objective of the present work was to estimate the variability in productive performance and forage quality of species of different botanical groups of the genus *Paspalum* in the central area of São Paulo state.

MATERIAL AND METHODS

Twenty six accessions of *Paspalum*, from twelve different botanical groups, collected in the central and south regions of Brazil, were evaluated at the Southeast - Cattle Research Center (21°57' S, 47°50' W) located in São Carlos, central region of the state of São Paulo. Experiment was conducted on a low fertility red-yellow latosol and statistically evaluated through a randomized complete block design with two replications. Accessions were grouped by botanical classification and the effects of species within botanical groups and accessions within species were isolated in analysis of variance (ANOVA). Production of *Paspalum* forages was evaluated through the following characteristics: first year production of dry biomass (DMY), obtained on four cuts in a year; percentage of dry matter (PDM), determined on a sample of each cut, dried until constant weight was obtained, at 60°C in a forced air dryer; and score of regrowth, seven days after harvest, when the accessions were scored for their phenotypic aspect of regrowth, through a scale of records: 1 = no regrowth; 2 = regrowth of 10% of the plants; 3 = regrowth of 50% of the plants; 4 = regrowth of 100% of the plants and 5 = 100% of the plants with vigorous regrowth.

Quality of *Paspalum* species was evaluated by determination of the concentration of neutral detergent fiber (NDF) (Van Soest, 1963); "in vitro" dry matter digestibility (IVDMD) (Tilley, and Terry, 1963); and crude protein percentage in dry matter (CPPDM) (AOAC (1980).

Canonical correlation analyses were performed to estimate the relationship between quantitative and qualitative characteristics (Kshirsagar, 1972).

RESULTS AND DISCUSSION

The ANOVA results showed highly significant mean squares for the effects of botanical group and *Paspalum* species for all quantitative and qualitative forage characteristics evaluated in the accessions during the first year of production. The largest dry matter production was shown by the next botanical groups: Quadrifaria (22 ton.ha⁻¹) followed by the groups Malacophylla (16 ton.ha⁻¹) and Virgata (14 ton.ha⁻¹). Species of these groups presented larger regrowth scores, ranging from 3.5 in *P. simplex* to 5.3 in *P. malacophyllum*, and intermediary values of percentage of dry matter in the forage. The same relation was not demonstrated for forage quality traits, and different botanical groups were responsible for the largest estimates. The groups with the highest percentage of CPPDM were Notata, Disticha and Caespitosa (10%). Conjugata (72%) and Modesta (70%) botanical groups the greatest IVDMD. Ovalia group showed the largest NDF (82,%) and the species of the group Conjugata, the smallest percentage (67%). At species level, the largest mean production of dry matter was obtained by accessions of *P. regnellii*, *P. coryphaeum* and *P. atratum*, with productions of 22, 22 and 20 ton.ha⁻¹, respectively. Regrowth characteristics and PDM presented the same trend shown by botanical groups. For forage qualitative characteristics, the largest CPPDM was obtained respectively by accessions of *P. notatum* and *P. indecorum*, with averages of 11% and 10%, species from the groups Notata and Caespitosa, respectively. The largest values IVDMD were obtained by the species *P. conjugatum* and *P. modestum*, respectively, with 72% and 70%. Neutral

detergent fiber was 84% in species *P. ionanthum* of the group Notata, while the smallest value of this trait was 67% in *P. conjugatum* of the group Conjugata.

The sequence of the three estimated canonical correlations analyses showed significant difference from zero with minimum probability of 0.0089 for the third estimate and with probability of 0.0001 for the first two correlations, allowing to conclude for the nonindependence between the two groups of variables expressing quantitative characteristics in relation to qualitative characteristics. The generated canonical variables showed the variable PDM and DMY associated to each other and correlated in a suppressive way to the qualitative variables IVDMD and NDF. The quantitative variable with the smallest coefficients of correlation was regrowth score, however the negative sign indicates association to the qualitative CPPDM in a suppressive form. As a general conclusion can be mentioned that the variability among the evaluated species within botanical groups was high for quantitative and qualitative characteristics, indicating that species of *Paspalum* present high potential of biomass production in dry conditions in the central area of the state of São Paulo, confirming data of Grof et al. (1989), who considered the species *P. plicatum* a promising native grass to be used as forage in flooded soils of the central plateau of Brazil, because this presented high digestibility and high concentration of nutrients associated to the high annual production of dry matter.

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Variation of agronomic traits in a world collection of vetch (*Vicia sativa* L.)

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ABSTRACT

More than 850 accessions of vetch (*Vicia sativa* L.) representing 16 countries were obtained from the Italian Germplasm Institute and grown in a Southern Italy environment. The five following quantitative characters were analysed: days to harvest, plant dry weight, number of pods per plant, seed yield per plant, and seed yield per pod. The frequencies of various phenotypes were examined for total world collection and for each country in which there was a sufficient number of accessions. Wide phenotypic variability was observed for all characters, and usually within each country. The Shannon-Weaver diversity index (H') was used to examine

overall phenotypic diversity on a world and geographic basis. The total world collection showed a high diversity ($H' = 0.872$) and also the collections of substantial size (Turkey, FAO and Italy) showed a highly significant diversity index ($H' = 0.826, 0.762, 0.801$). A strong positive correlation was found between biomass and seed yield for total accessions ($r = 0.794^{**}$) and for the accessions of some countries; these results indicate that simultaneous selection for both traits should be successful.

KEYWORDS: Vetch, germplasm collection, accession, variability, diversity index