Phenotypical Characters Associated with the Loss of the Seed and the Production of Biomass in *Panicum coloratum* var. *makarikariense*

Maria F. Moresco Lirusso
Instituto de Investigaciones en Ciencias Agrarias de Rosario, Argentina

Mónica B. Sacido
Universidad Nacional de Rosario, Argentina

Guillermo R. Pratta
Instituto de Investigaciones en Ciencias Agrarias de Rosario, Argentina

Silvina A. Felitti
Instituto de Investigaciones en Ciencias Agrarias de Rosario, Argentina

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Phenotypical Characters Associated With The Loss Of The Seed And The Production Of Biomass In *Panicum coloratum* var. *makarikariense*

Moresco Lirusso, María F.[1]; Sacido, Mónica B.[2] (*ex aequo*); Pratta, Guillermo R.[3]; Felitti, Silvina A.[4]
[1,3,4] IICAR-CONICET. Parque J.F. Villarino. CC 14 – S2125ZAA. Zavalla – Santa Fe – Argentina.
[2] FCAgr-UNR. Parque J.F. Villarino. CC 14 – S2125ZAA. Zavalla – Santa Fe – Argentina.

Key words: *Panicum*; dehiscence; seed; biomass.

Abstract

Since the beginning of humanity, plants have been manipulated by humans by artificial selection to obtain changes in their characteristics. This progress has been achieved through the domestication of the species. *Panicum coloratum* is a species of summer perennial grass, megathermic, tolerates waterlogging, cold and slightly saline soils. It is of African origin and used as fodder in various parts of the world. In Argentina around 130.500 hectares are sown, the most widespread varieties are: var. *coloratum*, and var. *makarikariense* Goossens. Its characteristics of determined flowering and ununiform ripening within the panicle, added to a very low retention of the seeds after maturation, establish serious difficulties in harvesting quality seeds. Megathermic forage species are good producers in forage quantity and, in turn, possess good quality. The objective of the work was to study the dynamics of seed dehiscence and the forage production of two cultivars of *Panicum coloratum* var. *makarikariense* (cv. Kapivera and cv. Bambatsi). The seed fall was evaluated weekly for 70 days between March-May 2017 and 2019 on 15 random inflorescences of each cultivar. Once the seed harvest was completed in May 2017 and 2019, the panicles were cut and the panicle height, panicle length, rachis length, wet weight, dry weight and percentage of dry matter were analyzed. Through a χ^2 distribution, it was found that there is experimental evidence that indicates that the dynamics of seed fall are different among cultivars. An analysis of main components was carried out in each year under study to simultaneously evaluate all the variables related to biomass, in the two ACPs mentioned there was not a defined grouping of the plants according to the cultivation to which they correspond.

Introduction

Starting in 1970, Argentine agriculture underwent an expansion of its productive frontier, favored by the expansion of the area destined for planting export crops and the incorporation of a truly promising technological package. The advancement of this model has caused a shift of livestock to marginal areas with less productive skills due to both environmental and edaphic limitations. These aspects restrict the choice of forage species to those that due to their origin have adaptation characteristics at the physiological, morphological and productive level (quality and quantity of forage produced) (Pérez, 2005). *Panicum coloratum* is a species of summer perennial grass. It has a habit of tussock growth, erect bushes with short rhizomes, slow establishment, tolerates puddling, cold and slightly saline soils. It belongs to the Poaceae Family, Panicoideae Subfamily, Paniceae Tribe. Its African origin has allowed it to evolve in a tropical and subtropical environment, developing adaptations that increase its efficiency in the use of light, temperature and water resources. In Argentina, the most widespread varieties are two: *P. coloratum* L. var. *coloratum*, and *P. coloratum* L. var. *makarikariense* Goossens (Armando et al., 2013). It has a good production and presents high quality forage in summer compared to other C4 grasses, which allows it to be conserved as deferred forage towards winter (Petruzzi et al., 2003). However, its determined flowering characteristics and uneven maturation within the panicle, added to a high seed dehiscence after maturation, establish serious difficulties in harvesting quality seeds. Dehiscence is the phenomenon by which the fruits reach maturity and open naturally to let out and spread the seeds. In Argentina around 7.8 million hectares are sown with forage pastures, of which 1.4 million are cultivated with type C_4 grasses and of these, 130,500 hectares are sown with *Panicum coloratum* (INDEC, 2002). The fruits have evolved through various mechanisms to mediate between the maturation and dispersal of their seeds. Since manipulation of dehiscence could improve crop yield, scientists have focused their attention on this process.

The increase in summer temperatures, in response to climate change, has established a marked interest in evaluating the productive and reproductive behavior of new megathermic grass species in the Argentine Pampeana region.

The objective of this work was to study the dynamics of seed dehiscence and forage production of two cultivars of *Panicum coloratum* var. *makarikariense* (cv. Kapivera and cv. Bambatsi).

Methods and Study Site

During November 2015, were planted two cultivars of *Panicum coloratum* var. *makarikariense* (cv. Kapivera and cv. Bambatsi) in plastic cups on a substrate composed of earth and vermiculite. In March 2016, the transplant of 90 plants from each cultivar was carried out to an experimental lot located in the town of Zavalla, Santa Fe, Argentina (33 ° 01 ′ S; 60 ° 53 ′ W). The lot belongs to the Faculty of Agricultural Sciences (National University of Rosario) and consists of two consecutive plots of identical dimensions with a separation between plants of 1 meter, on which no previous chemical applications were made, neither during nor after transplant. This locality presents a temperate climate with annual precipitations close to 990 millimeters, typical/vertic Argiudol soil made up of moderately well-drained fine clays and insufficiently provided with organic matter.

- Seed dehiscence: Seed drop was evaluated weekly for 70 days between March-May 2017 and 2019 by placing traps on 15 random inflorescences of each cultivar when 80% of them had $^2/_3$ of anthesis. These traps consist of a vertical iron structure covered by a lycra mesh to which two rings of equal diameter are attached at a distance of 30 centimeters between them, containing a seed collection funnel at the base of the second ring (Fig. 1). The inflorescences were incorporated into the trap through a slot made on the funnel. The collections were carried out until approximately 80% of the inflorescences had lost all of their seeds. Using a χ^2 distribution, the results obtained were analyzed.

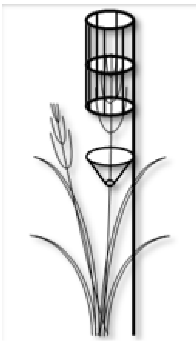

Fig. 1. Seed trap.

- Panicle production: After the harvest of seeds during the years under study, the panicles were cut and transferred to the laboratory where the following measurements were made: *Panicle height:* length in centimeters from the base of the panicle to the apex. *Panicle length:* measured in centimeters from the apex to the knot of the flag leaf. *Rachis length:* distance in centimeters from the upper end to the first branch of the panicle (Fig. 2). The panicles were weighed (weight h) from the apex to the node of the flag leaf, discarding the leaves and were placed in an oven at 60 ° C for 72 hours. Then, they were weighed (weight s) again to obtain the dry matter (dm %) of them. A principal component analysis (PCA) was carried out for each year under study in order to simultaneously evaluate all the variables and explore correlations between them.

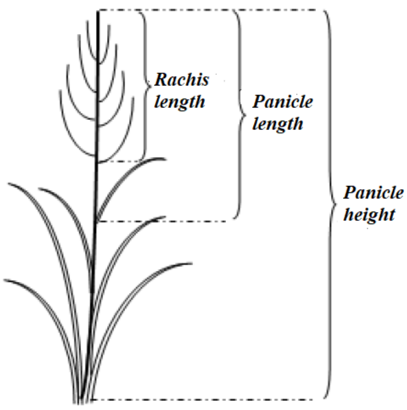

Fig. 2. Panicle morphological variables.

All analyzes were performed using the Infostat program (Di Rienzo et al., 2008).

Results

Seed dehiscence: The results indicate a similar seed drop for both genotypes until week 5, after which differences in the dehiscence process begin to be seen in both cultivars, being notably greater during the final 20 days of the experiment (Fig. 3). There is experimental evidence indicating that the dynamics of seed drop is different between cultivars, both for the accumulated number of seeds dropped during the trial and for the number of seeds dropped per week. The Bambatsi cultivar evidences a greater total dehiscence of seeds in the 2 years under study.

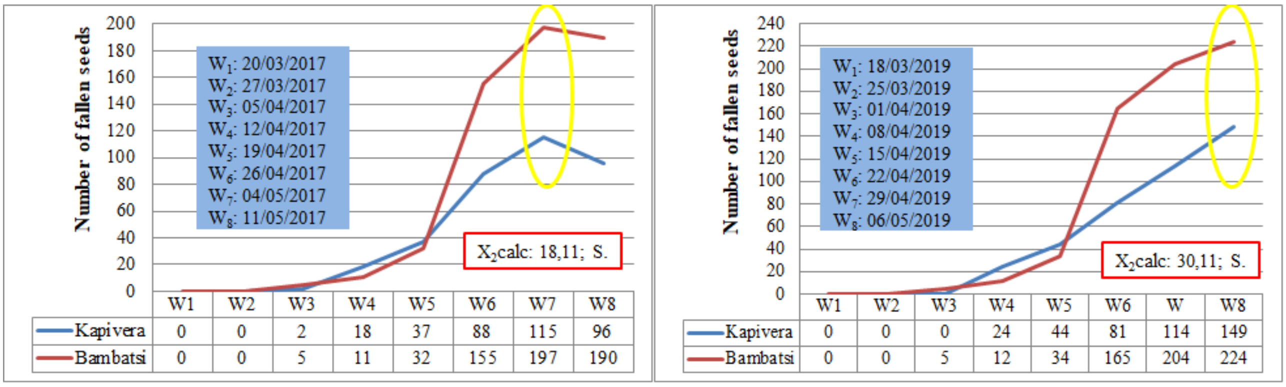

Fig. 3. Seed drop dynamics (α=0,05. DF=7)
Yellow ellipses indicate the peak of seed fall.

<u>Forage production:</u> The analysis of variance showed that in the two years there is experimental evidence indicating the existence of significant differences between cultivars for the variables “panicle l” and “rachis l”. In the two PCAs mentioned, a defined grouping of the plants according to the cultivar to which they correspond is not displayed. The yellow triangles represent individuals of the Kapivera cultivar, and the blue triangles represent individuals of the Bambatsi cultivar.

PCA 2017: In the biplot it can be seen that the variables “dry w” and “wet w” (correlation coefficient: 0.96) and the correlated variables “rachis l” and “panicle l” (correlation coefficient: 0.86) (Fig. 4).

PCA 2019: two groups of correlated variables are also displayed, on the one hand we find “rachis l” and “panicle l” (correlation coefficient: 0.82), and on the other “dry w” and “wet w” (correlation coefficient: 0.93) (Fig. 5).

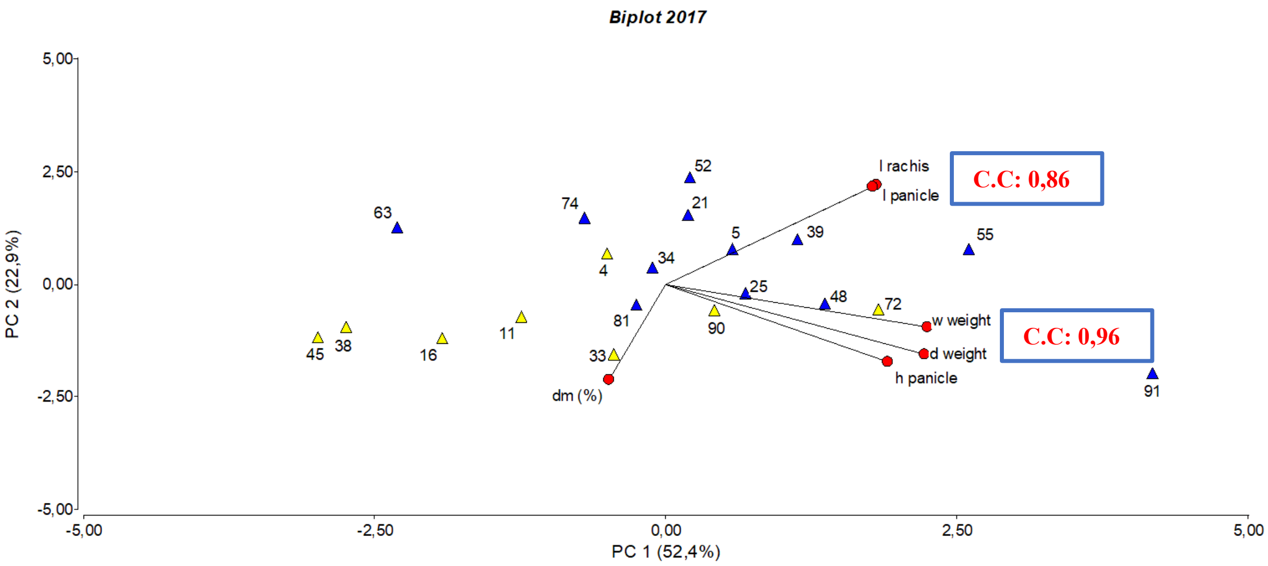

Fig. 4. PCA for the year 2017.

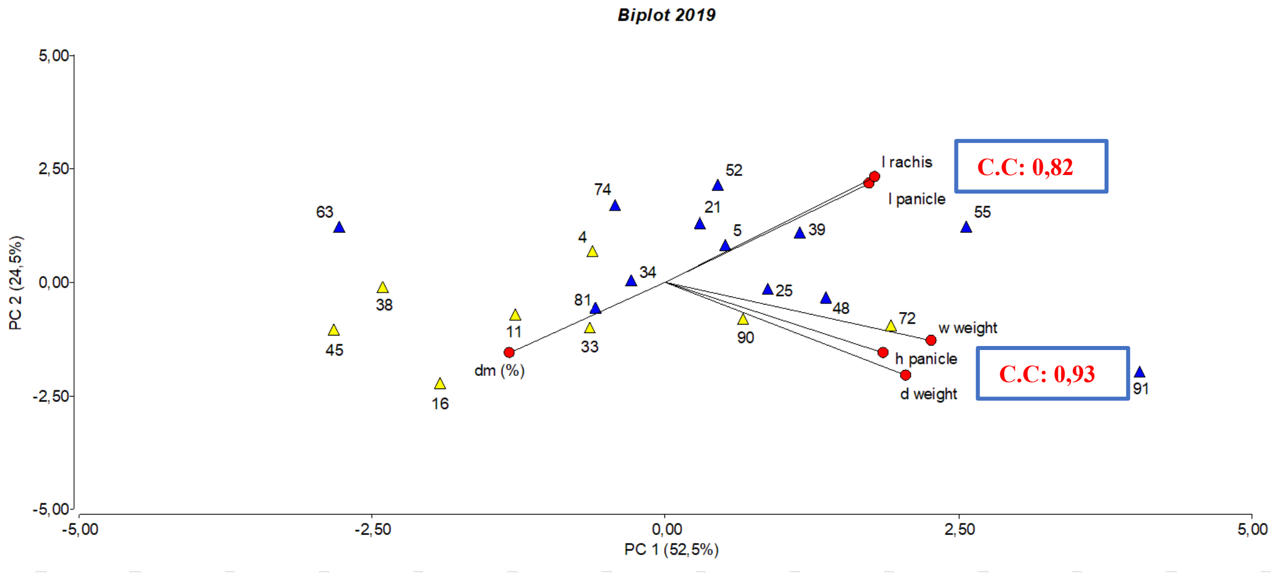

Fig. 5. PCA for the year 2019.

Discussion

Numerous studies on phenotypic traits in forage grasses of great agronomic interest have been reported, evidencing the importance of selecting certain species that are useful in intensive systems with abiotic stress conditions. In Argentina, the Pampeana region is characterized by high temperatures, concentrated rains and high evapotranspiration in the summer. It also shows low temperatures and lack of rain in the winter. The amount of product that a farmer obtains for each unit of surface depends on multiple natural and human factors. In this sense, seed dehiscence is a major component of yield loss in many cereal crops worldwide. The first seeds began to detach from the mother plant 15 days after flowering began, in correspondence with what Burson (1983) stated in his research. The peak of fall for the data set for the years 2017 and 2019 is given on the same date for both cultivars, although that means different weeks.

In the evaluation of the characters related to biomass, the expected correlations between a certain groups of variables can be visualized. Furthermore, according to the length of the vector, they seem to have a similar importance when discriminating crops. The variables "rachis l" and "panicle l" present a phenotypic correlation, and possibly a genetic correlation due to the significant differences found for both in the ANOVA. Regarding the variables “dry w” and “wet w”, the correlations are phenotypic (environmental) both in 2017 and in 2019.

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