CRP: Livestock

Flagship: FP3 – Feeds and Forages

Cluster: 2 - Development of new feed and forage options

Activity: P1685 – Activity/Product Line 3.2.1: Improved feed & forage germplasm and new tools and technologies for breeding

Deliverable: D17251 - Seed production and evaluation of new characteristics for BH16 at CIAT Headquarters

Seed production and evaluation of new characteristics for BH16 at CIAT Headquarters

David Alberto Florián Vargas, Agricultural Engineer.

Abstract

With the aim of increasing the amount of seed available from the hybrid group BH16, the trial was taken the trial plot FM1910 was taken, corresponding to a progeny test for the hybrid group BH16, where the 24 genotypes that make up this group and 5 controls were included (CIAT/16886, CIAT/26160, CIAT/16888, CIAT/6133 and CIAT/679), this trial changed its objective and was aimed at the production of seed to increase the available quantity of the hybrid group in general. It was sown under an Alpha Lattice design made up of 16 blocks (8 for each of the 2 repetitions), each one of the blocks having a total of 4 genotypes with 4 repetitions each, forming a total of 32 treatments for the entire experimental design (3 genotypes were subsequently removed from the trial, as they were found not to be apomictic). Most of the variables were measured without major problem except for seed production, which was affected by a generalized flower abortion, impeding the end of the harvest cycle, however, With the remaining variables a descriptive analysis of the data was made, which is presented in this report.

Introduction

One of the main objectives in plant breeding programs are the development and release of improved materials with beneficial characteristics compared to others, in order to solve different productive needs in the agricultural sector, for this, in these programs are performed the classification and characterization of the materials to be improved, in terms of the traits of interest, to finally identify groups of plants that have valuable and useful characteristics, which can be used in future plant breeding plans (FAO, 2012).

For the above, the International Center for Tropical Agriculture (CIAT) and Grupo Papalotla have established cooperation to develop new varieties of forages, in order to obtain highly productive pastures, great nutritional value, and resistance to different types of stress. For this purpose, is relevant the physiological characterization of variables such as width and length of the leaf blade (cm), pubescence of the hybrids, rooting capacity, level of flowering and seed production in the hybrid group corresponding to *Brachiaria humidicola* BH16, since seed yield is a trait of great interest for forage pasture species because its multiplication is economically important for new cultivars to compete commercially.

Seeds are the starting point for crop production and their production is an important component to ensure the desired genetic identity of the next generation that will be used for propagation (Welbaun, 2017), therefore, is necessary that CIAT and Grupo Papalotla standardize procedures that increase the availability of seeds, and thus, start new phenotypic characterization tests, and new breeding programs, hence, this trial was developed, with the aim of adopting a methodology for the management and sampling of variables jointly between the two entities, in order to standardize the knowledge contributed by each of the parties and take advantage of Papalotla's experience in the commercial and seed production area to increase the availability for the shipment of the hybrid group BH16 to Mexico.

Materials and methods

Location and Plant Material: The test was carried out at CIAT Headquarters based in the municipality of Palmira - Colombia at geographic coordinates 3°30'16" N, 76°21'25" W and an elevation of 968 above mean sea level, it was sown under an Alpha Lattice design with plots of $1m^2$ (see figure 1).

Figure 1. Field design of the test

For the evaluation of the variables, the methods suggested by the Grupo Papalotla R&D team were followed, thus:

Width and Length of the leaf blade:

This variable is of interest because the measurement of the foliar area allows estimating the growth of the plants, determining the phenological stages, estimating the potential of agronomic yield, the calculation of the efficient use of solar radiation, as well as the efficient use of water. and mineral nutrition (Villegas et al., 2019). For this measurement, 10 leaves were taken for each of the hybrids, to which the length presented from the end of the petiole to the tip of the leaf was measured by using a ruler, it should be clarified that none of the leaves that were taken for sampling were growing; For the measurement of the width of the leaf blade, the same 10 leaves were taken in the widest part and the measurement was carried out with a Vernier, as shown in Figure 2.

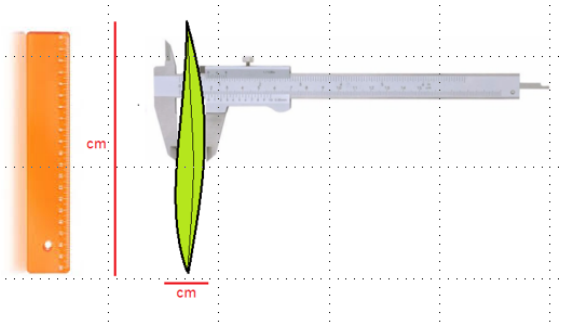


Figure 2. Measurement of width and length of the leaf blade of *Urochloa humidicola*.

Level of pubescence: To determine the level of pubescence of the hybrids, the scale represented in figure 3 was established, where there are 4 levels of pubescence (NULL, LOW, MEDIUM, HIGH) Using this scale, the level of pubescence of some commercial hybrids has been evaluated before (Bernal & Pizarro personal communication).

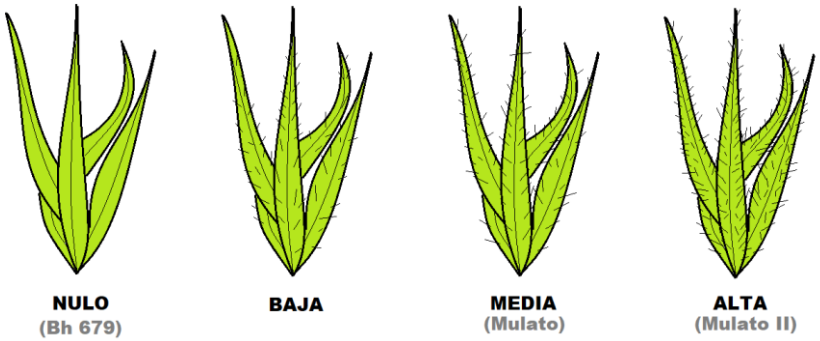


Figure 3. Level of pubescence for *Urochloa humidicola*.

Rooting ability: A stem of the plant with the presence of internodes was taken (Figure 4), the number of rooted nodes and total nodes was counted, with this the number of nodes present per meter and the percentage of rooting of the nodes were determined. This procedure was carried out 3 times for each of the hybrids.

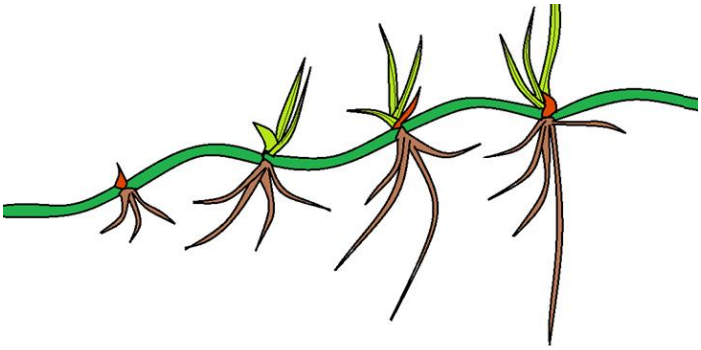


Figure 4. Measurement of internodes in a portion of the stem of *Urochloa humidicola*.

Level of flowering: The plots were monitored in the field, where the amount of inflorescences present in each plot was estimated, giving a value of 1 to 5 (Figure 5), where 1 is a plot that has not flowered and 5 is a plot with high inflorescence density per m^2.

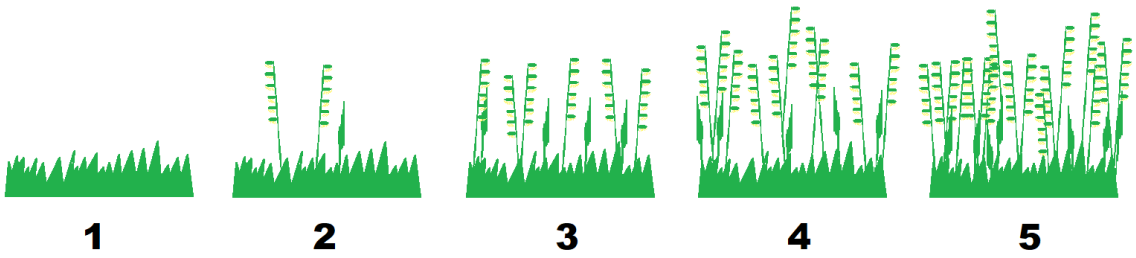


Figure 5. Level of flowering measurement of *Urochloa humidicola*.

Degrees day to flowering: To estimate the accumulated degree days (ADD) between the standardization cut-off until the phenological stage of flowering, equation 1 was applied first, in which the information corresponding to the minimum and maximum temperatures for the locality in which the established the test was obtained by the CIAT meteorological station; Regarding the base temperature, Andrade et al., 2015 mention that tropical pastures have a range of 12-17 °C, therefore, in this study was used the base temperature established for Brachiaria brizantha of 15 °C (Mendoça & Razinni, 2006); After that, the summation of the degree days calculated was carried out to obtain the ADD by applying the equaion 2, In this way, the degree days that the crop took to reach its flowering phase were determined.

$$DD = \frac{T_{max} - T_{min}}{2} - T_{base} \quad \langle \boldsymbol{Equation\ 1} \rangle$$

$$ADD = \sum DD_{1 \to n} \quad \langle \boldsymbol{Equation\ 2} \rangle$$

Where:

$\boldsymbol{GD}$: $Grados\ día$

$\boldsymbol{GDA}$: $Grados\ día\ acumulados$

$\boldsymbol{T_{max}}$: $Maximum\ temperature$

$\boldsymbol{T_{min}}$: $Minimum\ temperature$

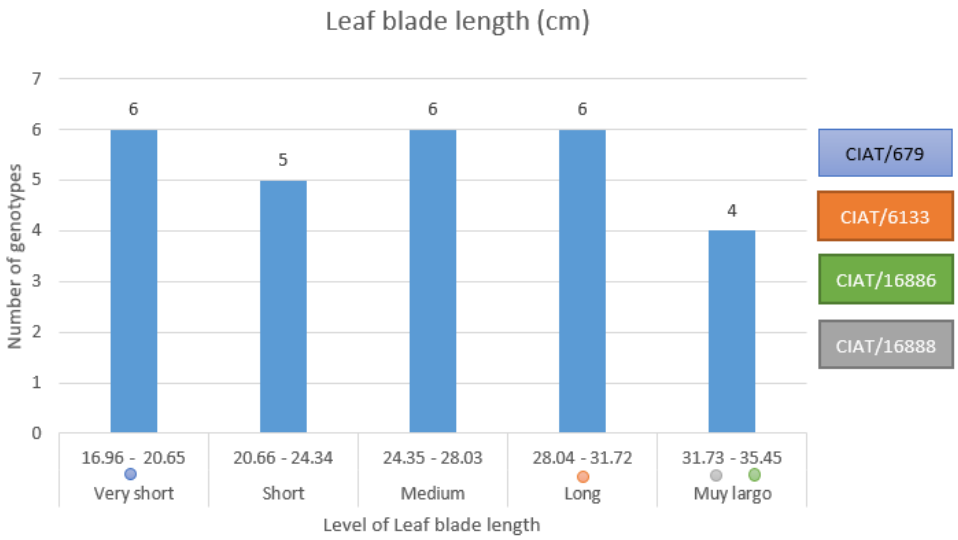
$\boldsymbol{T_{base}}$: $Base\ temperature$

$\sum$: sum of the events

$\boldsymbol{n}$: Number of days of the evaluated period

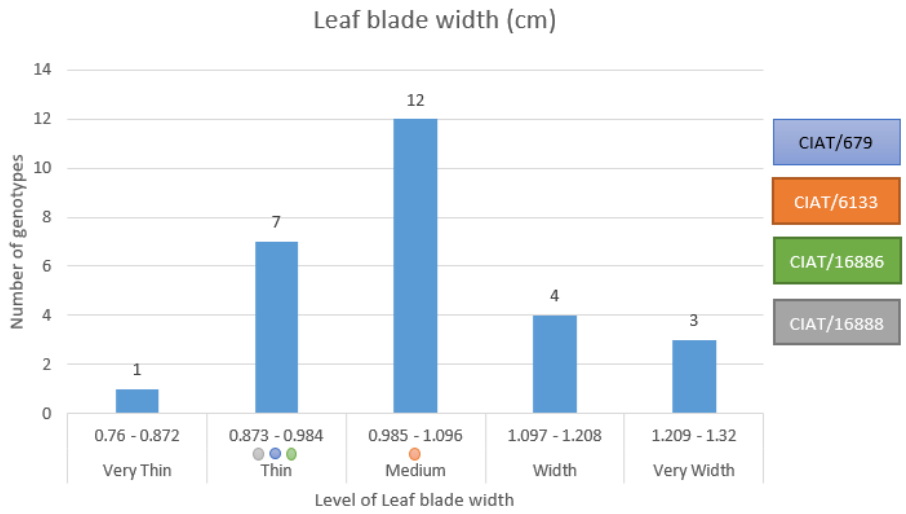
Analysis of data: From the results obtained for the variables of physiological characterization of leaf blade width and length (cm), production of nodes per meter, rooting capacity and level of flowering, a descriptive analysis was carried out in which the data are reported and They are classified into five classes from the lowest to the highest level; Regarding the pubescence variable of the hybrids, the graphic classification in two classes is presented, since during the evaluation only two of the levels mentioned above were identified. This descriptive analysis allowed to characterize the general behavior of the hybrids in the field and to differentiate them from the selected controls. Results and Discussion We can start the review of the results with the Length of leaf blade, which, as can be

seen in Graph 1, is located in a very similar way in the 5 classes, being the controls CIAT/16888 and CIAT/16886 in the class "Very long "Together with two more genotypes, the CIAT/6133 control in the long class together with 5 other hybrids, in the" Medium "class there are 6 hybrids, in the" Short "class there are 5 hybrids and finally in the" Very short "class ”The CIAT/679 control and 5 other BH16 hybrids are located.



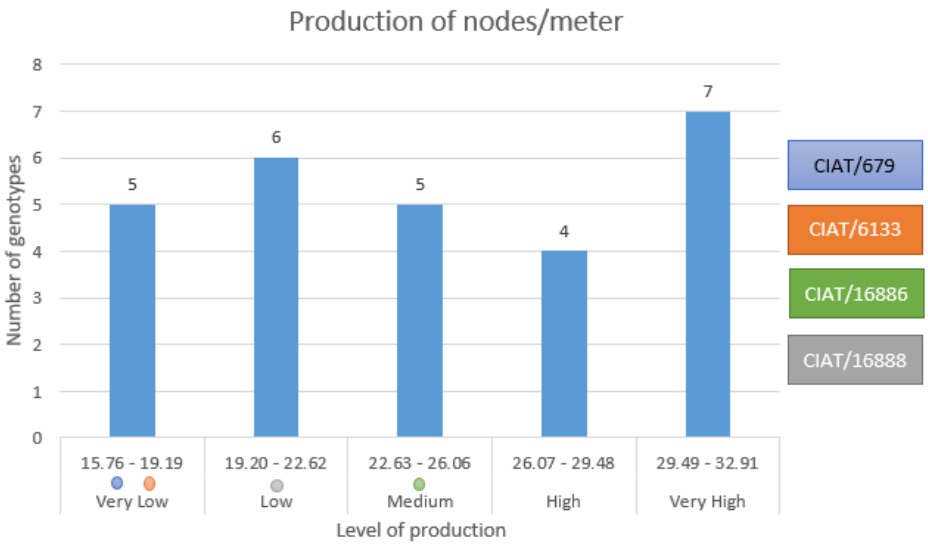
Graph 1. Leaf blade length (cm) for the hybrid group BH16

The length of the leaf blade for the group BH16 seems not to group in an average measure, instead, we note that the hybrids are distributed in a very similar way in all the classes, however, apart from the controls, the hybrids with a greater length leaf blade (located in the long and very long classes) are BH16/0564, BH16/4243, BH16/1622, BH16/1763, BH16/1771, BH16/4970 and BH16/4956. For the results of the leaf blade width, as observed in Graph 2, there is only one hybrid in the “Very thin” class, in the “Thin” class the controls CIAT/16888, CIAT/16886 and CIAT/679, in addition to 4 hybrids of the BH16, in the “Medium” class the CIAT/6133 control is located along with 11 hybrids, in the “Wide” class there are 4 hybrids and in the “Very Wide” class there are 3 hybrids of the group BH16.



Graph 2. Leaf blade width (cm) for the hybrid group BH16

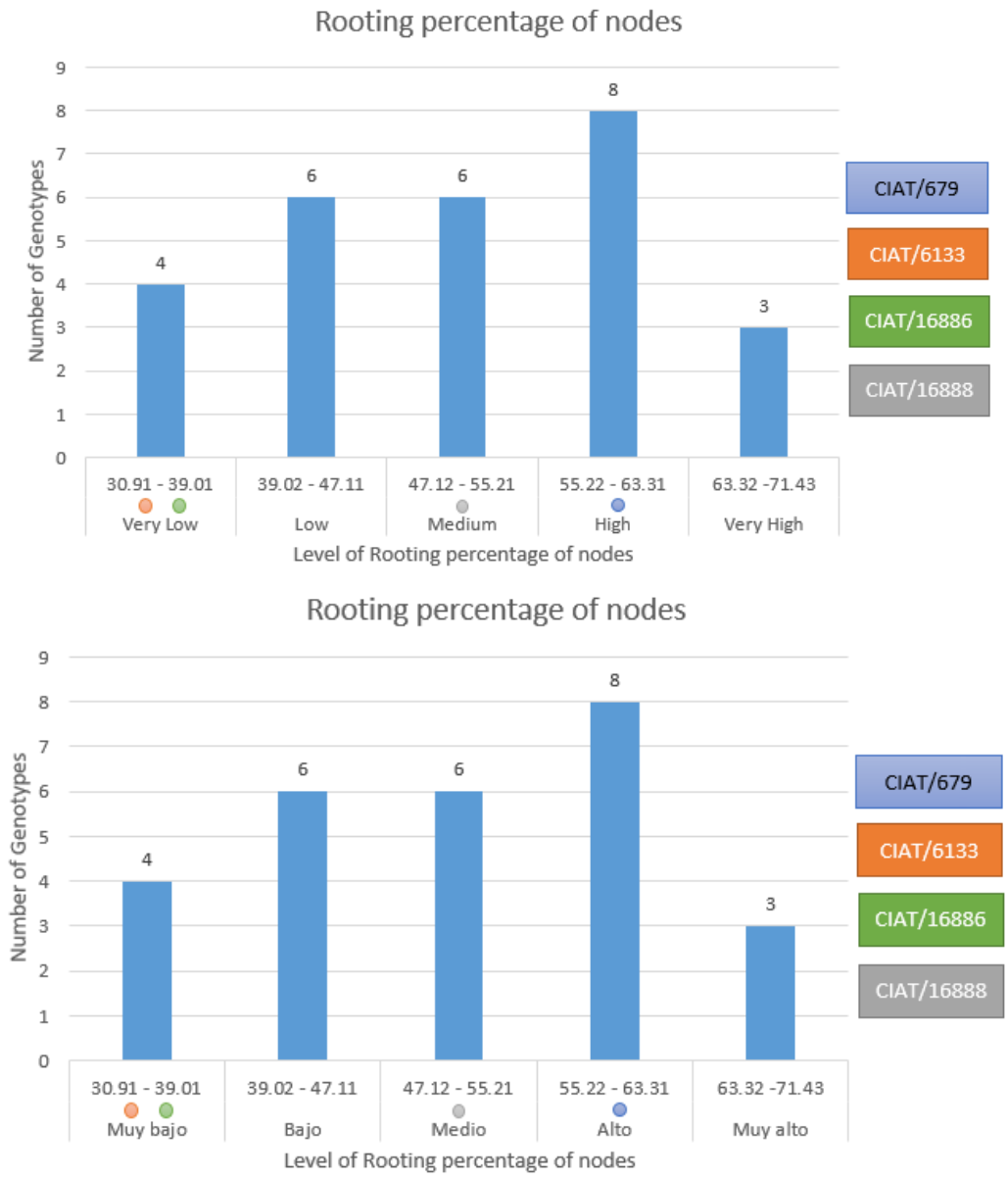
In this case, according to Graph 2, the hybrids are mainly grouped in the Medium class, indicating that the majority have a width of the leaf blade between 0.985 cm and 1.096 cm, however, there are 7 hybrids classified as wide and very wide, which are BH16/0503, BH16/2542, BH16/2532, BH16/4059, BH16/0181, BH16/2185 and BH16/4956. Continuing with the production of nodes per meter, as observed in Graph 3, there are 3 hybrids located in the “Very low” class next to the CIAT/679 and CIAT/6133 controls, in “Low” there are 5 hybrids and the CIAT control/16888, in "Medium" there are 4 hybrids and the CIAT/16886 control, in "High" there are 4 hybrids and finally in the "Very high" class there are 7 hybrids of the BH16 group.



Graph 3. Production of nodes/meter for the hybrid group BH16

For the percentage of node rooting, as illustrated in Graph 4, there are 2 hybrids located in the very low class together with the CIAT/6133 and CIAT/16886 controls, 6 hybrids located in the low class, 5 hybrids located in the middle class together with the CIAT/16888 control, in the high class there

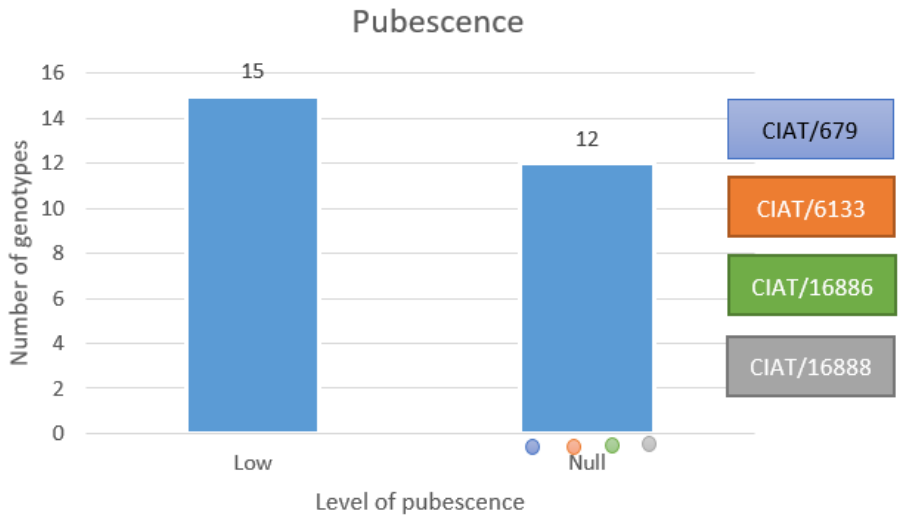
are 7 hybrids together with the CIAT/679 control and finally in the very class there are 7 hybrids of the BH16 group.



Graph 4. Rooting percentage of nodes for the hybrid group BH16

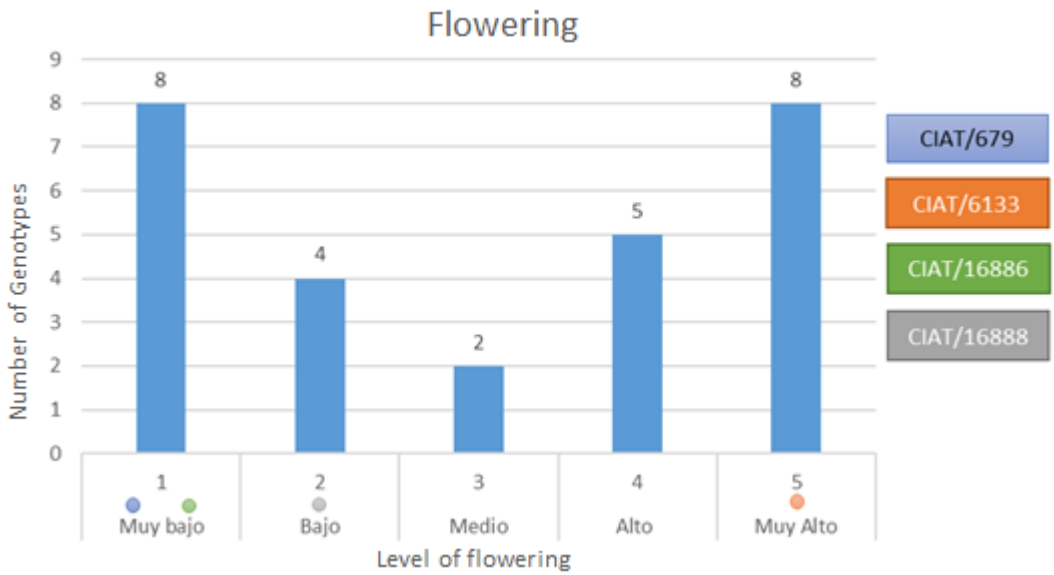
Analyzing Graphs 3 and 4, which in this case are related to the proliferation capacity and area coverage of the hybrids, clarifying, in this case that a hybrid with a high number of nodes/m does not directly indicate that These will develop to the degree of forming a new plant, which is what is taken into account when observing the% of rooted nodes, from this analysis we can cross the hybrids that are located in both the high and very high classes and report those that they produce a high number of nodes/m and in turn present a high% of rooting, being for this case BH16/2185, BH16/3916, BH16/4956, BH16/0181 and BH16/4243. The level of pubescence, as illustrated in Graph 5, was only classified into 2 classes, since as described in the methodology, there are no

hybrids of the BH16 group that have a level of flowering that can be considered medium or high, for what only these two classes were worked with, having 15 hybrids classified in the Low level and 8 hybrids and the 4 controls in the Null level.



Graph 5. Level of pubescence for the hybrid group BH16

For the level of flowering, as illustrated in Graph 6, there are 6 hybrids located in the very low class together with the CIAT/679 and CIAT/16886 controls, 3 hybrids located in the low class together with the CIAT/16888 control, 3 hybrids located in the middle class, 5 hybrids located in the high class and 7 hybrids together with the CIAT/6133 control at the time of sampling.

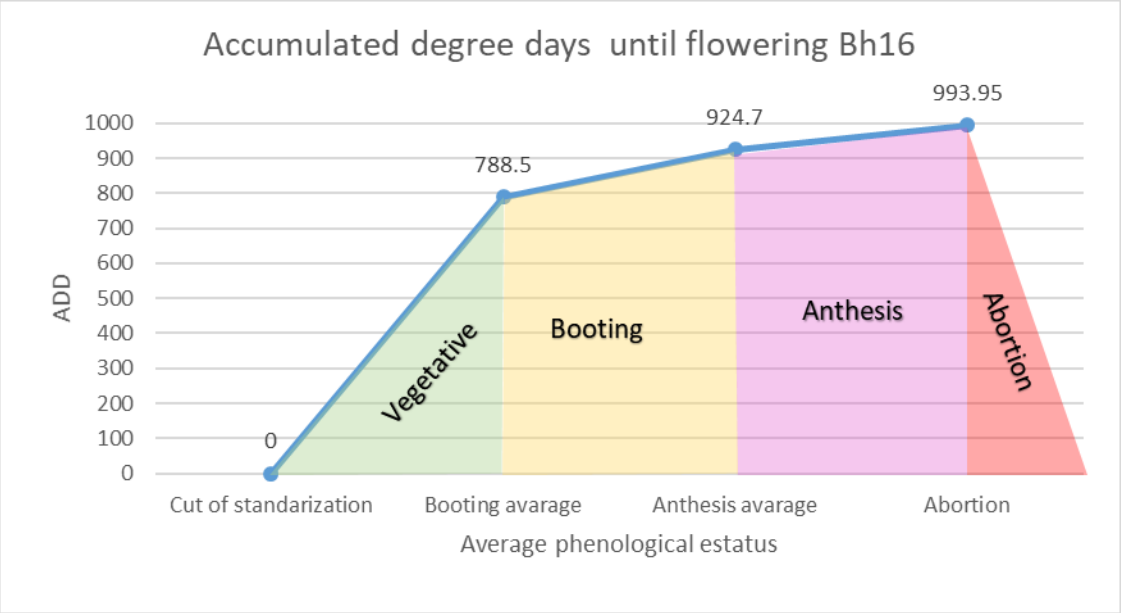


Graph 6. Level of flowering for the hybrid group BH16

This characterization allows to indirectly estimate from which genotypes it was expected to have a higher seed production and at the same time, from which genotypes it will definitely be difficult to

increase the available seed bank or for which several harvests will be needed; which favors us in this case, as it gives us an idea of the future harvests of these hybrids since the floral abortion that occurred did not allow us to reach the seed harvest phase. We note that most of the hybrids are located at the extremes of production, finding that for the hybrids Bh16/1622, BH16/4243, BH16/3916, BH16/1767 and BH16/1756 the production of inflorescences per plot is quite low or null, and little seed will be obtained in the future, so this must be taken into account.

Finally, for the calculation of accumulated degree days, these are reported in Graph 7, finding that from the time the standardization cut was made until the first booting state plots were found, 788.5 degree days were accumulated, between this booting and the time of anthesis of the plots, 136.2 degree days more accumulated reaching 924.7 GDA, after this 69.25 degree days were accumulated until the grain aborted in the trial began to appear in a generalized way, reaching 993.95 GDA, which prevented the harvest phase from reaching to determine the grain production of the hybrids and increase the level of seed available from the BH16 group.



Graph 7. Accumulated degree days until flowering BH16.

This condition of flower abortion occurred in a general way throughout the trial, being that the inflorescences took on a light yellow color (Figure 6) and the seeds began to detach without having completed their filling phase (Figure 6a, 6b and 6c), generating this the loss of production of the hybrids under evaluation, for which it was determined to end the trial.

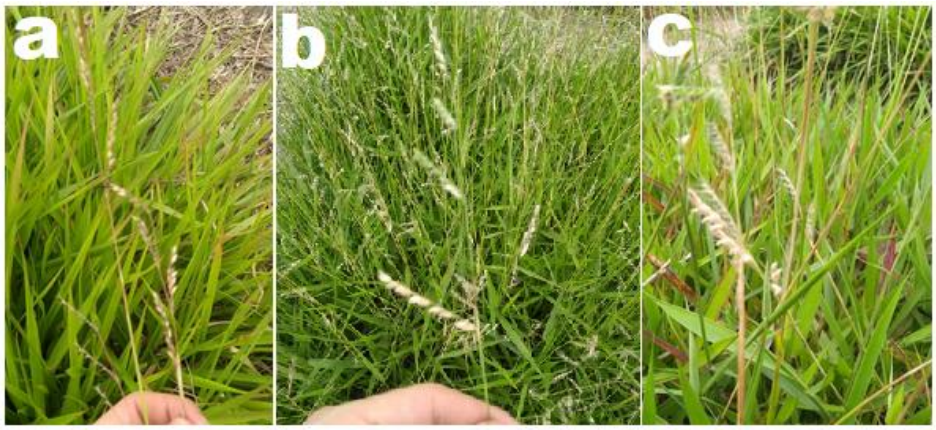


Figure 6. Floral abortion presented in the BH16 test, a) Dry inflorescence with some unfilled seeds detached; b) inflorescence aborted without seed detach, against the background of a plot with symptoms; c) Inflorescence aborted without seeds.

Conclusions

The implementation of new evaluation methodologies for tropical forages allows observing other characteristics of the pastures, giving a new vision of their behavior and development in the field. For the increase of the *Brachiaria humidicola* seed bank in Colombia, it is necessary to propose a scenario that is completely favorable for the development of the plants until the flowering phase, avoiding the loss of seeds due to grain abortion or floral abortion, therefore, It is imperative to establish a trial dedicated exclusively to seed production under ideal environmental and management conditions.

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