Plant damage assessment in *urochloa* spp. to categorize resistance to spider mites (Acari: Tetranychidae) attack

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Report

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Summary

Despite improved brachiaria (*Urochloa* spp.) grasses increase the productivity in African livestock systems, its adoption and establishment in the region is challenged for the attack of spider mites (Acari: Tetranychidae) during dry seasons. Breeding for resistance to key pests is one of the principal objectives in the *Urochloa* scheme for East Africa. Thus, developing high-throughput phenotyping methodologies for screening the high diversity of the tropical forages' gene banks is crucial to identify potential sources of resistance, categorize the current available germplasm and optimize the selection process. 26 accessions of *Urochloa* spp. were assessed for resistance to red spider mites under greenhouse conditions in Mbita, Kenya with no-choice tests. For this report, we compared two techniques of analyzing digital images for plant damage to decide which is more accurate for categorizing tolerance.

Objective

Develop a methodology to categorize the plant damage in *Urochloa* spp. to red spider mites' attack

Background

Despite East Africa is the center of origin and diversity of *Urochloa* grasses, the improved cultivars developed by CIAT for the Americas are severely damaged in dry seasons for heavy spider mites' attack. It is spider mites .

Pests as stemborers (Lepidoptera: Noctuidae and Crambidae) and the sorghum shoot fly (*Atherigona soccata* Rondani), along with potential new pests (e.g. *Spodoptera exempta* Walker, *Spodoptera frugiperda* J.E. Smith and *Locris rubens* Erichson), threatens the spread of brachiaria crops particularly under future scenarios for climate change. Being spider mites (Acari: Tetranychidae) the most important limitation in Eastern Africa, it is needed further research focusing on this key pest their control since their biology allows them to migrate easily from and to other high-value cash crops, to have many generations per year and a large offspring. Furthermore, feasible and efficient integrated pest management strategies have not been reported yet for spider mites in grasses for the region.

Host-plant resistance has proven to be the most suitable alternative to manage pests in pastures as it is a low-cost and easy-adoption tool already incorporated in the seeds. A previous successful experience with spittlebug (Hemiptera: Cercopidae) control in America can be observed in current improved genotypes of *Urochloa* expressing antibiosis and tolerance. Similarly, CIAT and ICIPE have advanced on the development of a quick, accurate and precise methodology for screening for resistance to spider mites under greenhouse and laboratory conditions in Western Kenya.

Identify *Urochloa* genotypes to spider mites is crucial to increase productivity and adoption rates in African livestock systems. Since there are not reported sources of resistance in the agamic complex *U. brizantha, U. ruziziensis* and *U. decumbens* as, identify potential donors for spider mites' resistance this trait is the first step to integrate this trait incorporate it in a breeding scheme for the region.. Thus, research in efficient high-throughput methodologies to categorize diversity panels is needed to achieve this new breeding objective through the exploration of. Despite different levels of resistance and resistance sources were found among a narrow panel of *Urochloa* accessions, exploring the diversity conserved in the gene banks, while broadening is required to broaden the genetic variation within a breeding program.

Data

A panel of 26 accessions of *Urochloa* spp. that includes CIAT's gene bank accessions and hybrids of the breeding program, was selected for testing the methodologies (Table 1). No-choice tests were performed to assess the plant damage caused by spider mites (Fig. 1).

Table 1. Panel of *Urochloa* spp. to develop a methodology for plant damage assessment

Accession number	Species
CIAT 606	*U. decumbens* (cv. Basilisk)
CIAT BR02/1752	*U. ruziziensis* x *U. decumbens* x *U. brizantha* (cv. Cayman)
CIAT 16125	*U. brizantha* (cv. Piata)
CIAT 26110	*U. brizantha* (cv. Xaraes/Toledo)
CIAT 36087	*U. ruziziensis* x *U. decumbens* x *U. brizantha* (cv. Mulato II)
CIAT 16107	*U. brizantha*
CIAT 664	*U. decumbens*
CIAT 6370	*U. decumbens*
CIAT 6426	*U. brizantha*
CIAT 6702	*U. decumbens*
CIAT 6735	*U. brizantha*
CIAT 16122	*U. brizantha*
CIAT 26133	*U. brizantha*
CIAT 26646	*U. brizantha*
CIAT BR02/1794	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR02/0465	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR04/3025	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR04/3207	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR06/0423	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR05/1435	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR05/1467	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
CIAT BR09/3660	*U. ruziziensis* x *U. decumbens* x *U. brizantha*

CIAT BR09/4467	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
GP/0549	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
GP/2090	*U. ruziziensis* x *U. decumbens* x *U. brizantha*
MG4	*U. brizantha*

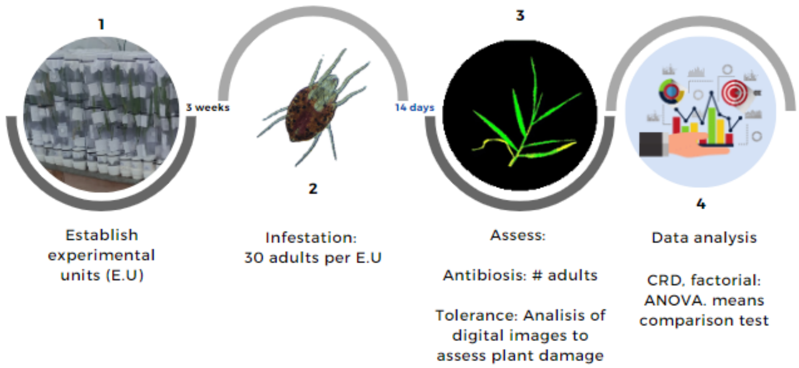


Figure 1. Workflow for no-choice tests

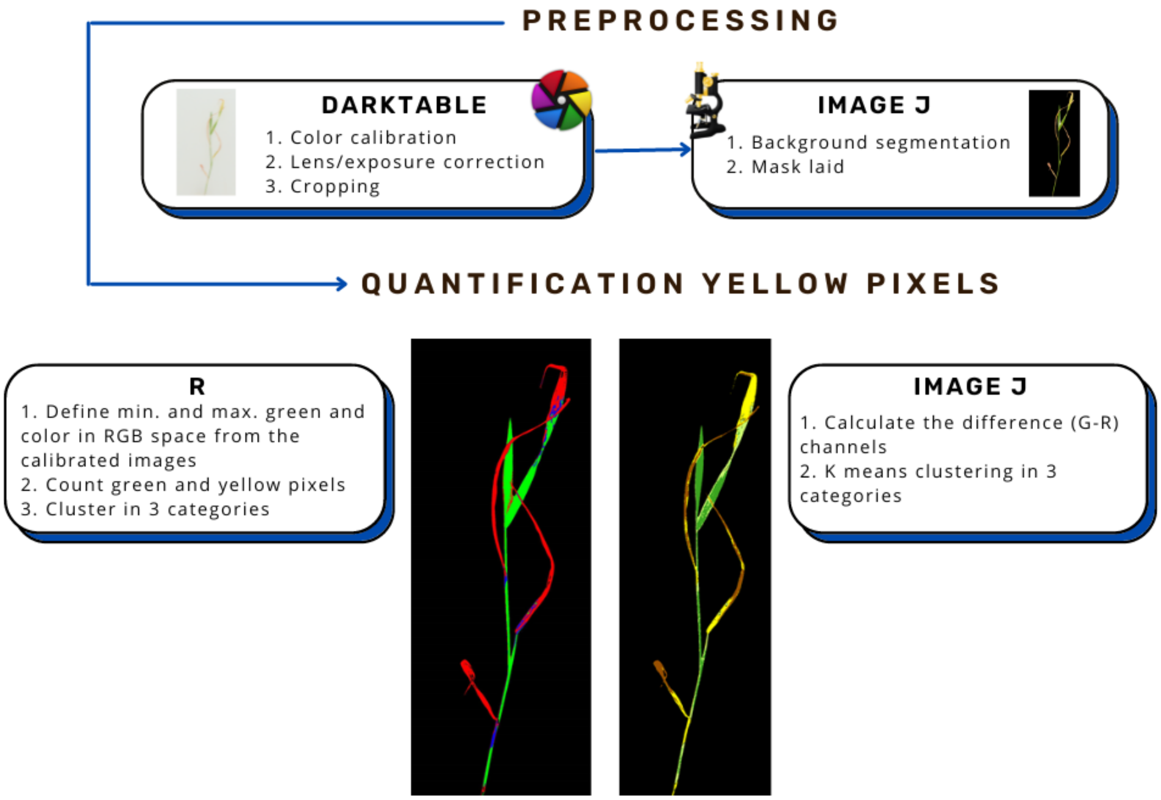
Images acquisition

Each experimental unit was photographed with a professional camera (NIKON D7500) under controlled light conditions with the following set-up: ISO Lo 0.7, shutter speed 1/1.6, aperture F14, white balance 0.0 in mode 4 fluorescent. The images were saved with high quality JPEG and RAW formats.

Figure 2. Photo of an experimental unit 14 days after infestation under light controlled conditions

Images analysis workflow

Based on our previous experience (Hernández et al., 2022), we designed a pipeline for analyzing the data and obtain the damage percentage (% yellow pixels) from the yellow pixels proportion in each image (number yellow pixels / number of total pixels):



References

Hernández, L., Espitia, P., & Cardoso, J. A. (2022). Digital imaging outperforms traditional scoring methods for spittlebug tolerance in Urochloa humidicola hybrids. *Tropical Grasslands-Forrajes Tropicales*, *10*(3), 271–279. https://doi.org/10.17138/TGFT(10)271-279