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Drought x Genotype Interactions in Cotton

Introduction

The responses to drought of 16 cotton varieties, representative of the existing variability within the cultivated types, were studied under sahelian conditions

Materials and methods

The experiment was carried out in the field. Three subplots were chosen depending on the distance from a line source sprinkler (plates 1 and 2). The 3 water regimes were humid (H), moderate drought (MD) and severe drought (SD), corresponding to the following quantity of water received through irrigation and rainfall : 728 mm (H), 649 mm (MD) and 553 mm (SD) respectively. Treatments were imposed after the onset of flowering in all varieties.

Results

Drought caused, in all varieties, a reduction in plant height (12% on the average) and main stem node number (11%), though there were no observable effects on mean length per node (table 1, and fig. 1). An earlier boll opening (4 days), and a decreased rate of node number above white flower (NAWF) were also observed under both drought conditions. Average seed-cotton yields were 3840 kg/ha for H, 3100 kg/ha for MD (19% reduction) and 2080 kg/ha for SD (46% reduction).

A separate seed cotton harvest was carried out on 6 varieties and 11 subplots, each having 3 plants, It was observed that production per plant decreased with the distance from the sprinkler line (fig. 2). At the same time the following were observed :

- an earlier onset of flower cutout, and consequently decreased number of fruiting sites (harvested boll number per plant reduced from 20 to 13),
- increased rates of abortion and abscission of reproductive organs from 56% to 65%
- a reduction of the average boll weight, from 4.5 to 3.5 grams (fig. 2).

The genetical and morphological variability of the varieties were confirmed by the significant differences noted for all the parameters (table 1). The average yields ranged from 1840 kg/ha for *Pima S6* (*Gossypium barbadense L. sp.*) to 3980 kg/ha for *Deltapine 90* (*Gossypium hirsutum L. sp.*). When yield potential was plotted against yield stability (fig. 3) the varieties showing similar agronomical behavior were grouped. However, three varieties (Deltapine 90 and Guazuncho, and Pima S6) did not fit into the normal distribution.

The analysis of variance of final yield reveals a significant genotype x water regime interaction.

The results of 6 selected varieties are presented in fig. 4. For example, within the most productive genotypes, three contrasting drought responses could be distinguished :

- *Deltapine 90* maintained a relatively high yield even under MD and SD drought conditions,
- *Guazuncho II* maintained a high yield under MD, and a sharp decrease under SD condition,
- *DES 119* showed a decrease in yield from MD, which accentuated under SD conditions.

Multiple correlation analysis did not show any relationship between the morphological or phenological indicators used in this experiment, and the observed variation in the responses to drought.

Conclusion

A physiologocal approach appears necessary, therefore, to complement some of these observations on cotton responses to drought. The water relations and the root development of the 6 selected varieties in fig. 4 are presently being carried out.

Acknowledgements

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Key words

cotton, drought x genotype interactions, genetic variability, differential irrigation.

Table 1. Varieties, water regimes and interaction analysis of variance

Statiiics	F var.	F reg*	F inter**	Over. average	Std Error
- Date of first flower as DAS (Days after sowing)	xxx	-	ns	55.8	1.5
- Date of first boll split (DAS)	xxx	xxx	ns	103.5	2.1
- Plant height at 102 DAS (cm)	xxx	xxx	ns	129.1	10.0
- Main stem node number at 102DAS	xxx	x	ns	25.4	1.4
- Height to node ratio at 102DAS (cm)	xxx	ns	ns	5.1	0.3
- Nodes above white flower at 94DAS	xxx	xxx	ns	4.1	0.7
- Average boll weight (g)	xxx	xxx	ns	4.5	0.4
- Seed cotton yield under H water regime (kg/ha)	xxx	xxx	x	3843	516
- Seed cotton yield under MD water regime (kg/ha)				3102	
- Seed cotton yield under SD water regime (kg/ha)				2076	
- R3% (earliness as percentage of total harvest from third pick)	xxx	xxx	ns	69.0	9.8

*: As irrigation levels are not randomized, regimes effects (F reg.) cumulate water irrigation effects and field orientation effects
**: F inter. for varieties x water regime interaction
- Statistical analysis: significance levels of F tests : x for 5%, xxx for 1% and ns for non significant

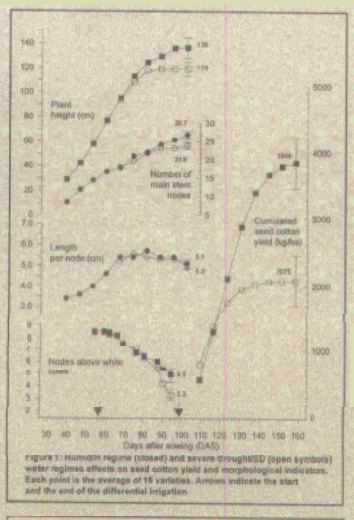

Figure 1 : Humidity regime (closed) and severe drought/SD (open symbols) water regimes effects on seed cotton yield and morphological indicators. Each point is the average of 16 varieties. Arrows indicate the start and the end of the differential irrigation

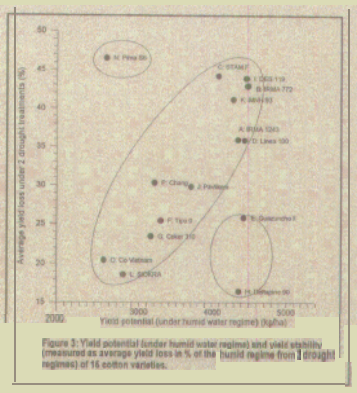

Figure 3: Yield potential (under humid water regime) and yield stability (measured as average yield loss in % of the humid regime from 7 drought regimes) of 16 cotton varieties.

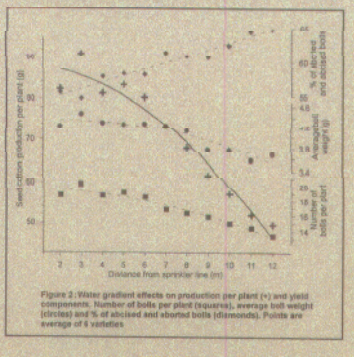

Figure 2 : Water gradient effects on production per plant (+) and yield components. Number of bolls per plant (squares), average boll weight (circles) and % of abcised and aborted bolls (diamonds). Points are average of 6 varieties

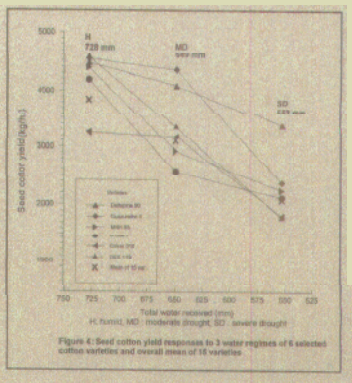

Figure 4: Seed cotton yield responses to 3 water regimes of 6 selected cotton varieties and overall mean of 16 varieties