EFFECT OF WATER STRESS ON THE ABSCISSION OF REPRODUCTIVE ORGANS IN COTTON DURING THE RAINY SEASON IN NORTHERN CAMEROON

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Abstract

Studies were conducted in Maroua, to evaluate the incidence of water stress on the abscission of reproductive organs during the wet season. Observations recorded showed that abscission resulting from water stress applied at different stages of development, progressively affected position of floral buds and those of bolls. Stress that was applied before flowering affected buds in position 2, that at the begining of flowering caused the loss of buds in position 3 more than the other positions, and more bolls were affected in position 1 than the others. Late water stress affected more significantly floral buds at position 3,4 and 5 and position 2 and 3 for formed bolls.

Introduction

Rainfall amounts and distribution during the productive cycle of plants are two parameters that affect cotton production in the Sudano-Sahelian zones of Cameroon. Kaiser (1968) is among a number of authors who have indicated water requirements of each stage of growth and development of the cotton plant using yield as an evaluating tool. Evaluation is therefore at the end of the production cycle and neither allows the follow-up of real incidences of rain distribution in time, nor of eventual stress on the behaviour of the plant during its growth and development phases.

The establishment of reproductive organs is dependent on the moisture state of the plant (Demol 1969, G.Parry 1982, E. Jallas 1991). Water stress affects the evolution of this establishment and particularly in the cotton plant. The sensitivity of the floral buds and bolls is a function of age (Kater and al., 1992). In the pre-floral period, the stress duration is more severe in the case of 10 days than in the case of 20 days (E. Jallas 1991). Under sub-saharian conditions and particularly in Cameroon, evaluation of the actual effect of moisture deprivation to cotton under naturally wet condition on abscission has been very little or not studied at all. Putting in place a tool like plant mapping would allow an evaluation of the incidence of different stresses on the behavour of the cotton under a variety of conditions.

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Materials and methods

The trial was conducted on one of the experimental plots of the cotton programme in Djarengol Agricultural Station (IRA Maroua) during the normal cropping period (June to November). Maroua climate is of sudano-sahelian type with an annual average rainfall of 750 mm and an annual average temperature of 28°C. Plant material used was cotton variety IRMA 1243 which was created in Maroua and disseminated since 1989. Four water treatments were applied : SO (no water stress) ; SP (early stress applied before flowering or 28 days after germination); SM (average stress applied at the first week of flowering, or 41 days after germination) and ST (late stress applied 3 weeks after flowering, or 56 days after germination). Stress application consisted of the installation of a shed on cotton plots under treatment. The shed was covered a few hours before and during the rains, and opened after the rains. Each water stress lasted 15 days. It was a fisher experimental design with 3 blocs. Each bloc consisting of 4 plots of 24 m² (6mx4m) each. Observations were made on the water availability in the soil through the water potential of soil measured with tensionics at 2 depths : 20 cm and 40 cm; and on the abscission of floral parts with plant mapping.

Results and discussions

Soil water potential

Irrealistic values were obtained at 20 cm and hence not analysed. Only data obtained at soil depth of 40 cm were exploited and are presented here.

The effect of water stress on the soil water availability was evaluated in comparison each time to the control during the period of treatment application. For each water stress period, soil water potential were significantly different betwen the first days and the last days of treatment.

During the first days of stress (3 days, 8 days and 4 days for SP, SM and ST respectively), water potential of soil in each plot under treatment did not differ significantly from the control. In the last days, a significant difference was observed betwen the control and both the early (for the 4 last days) and the last (7 last days) stressed plots. The plots that were stressed mid-way in the growing cycle did not differ significantly from the control (Tab.1a, 1b, 1c). Results indicated that a water stress applied before or 3 weeks from the begining of flowering period only affects water availability after a latent period of some days. The intensity of this effect depends on the period in the wet season.

Abscission of organs

We only considered floral buds and bolls in this study. The intensity of the phenomenon was characterised by the abscission rate of organs calculated using the formula :T= number of fallen parts x100/total number of parts established the previous day. These rates were calculated for each treatment and for each position of organ on fruiting branch (FB) independently of the number of FB on the main stem. An analysis of variance with 2 factors was performed to evaluate the incidence of treatment and position of organs on the rate of abscission. A multiple comparison of treatments in pairs was done whenever a significant difference was found between treatments. Data corresponding to each water stress application period were grouped and analysed separately.

A global treatment of data at the end of cycle showed that not every treatment did have an effect on the falling of floral buds and bolls (P>5%) in our cropping system. However, a significant difference (P<5%) was observed between the 5 first positions on FB. A comparison of falling rate of the different positions conducted for each water stress period gave the following results :

* During the period of application of early water stress (from 26th to 41st day after germination), there is an important loss in floral buds at position 2 with statistically higher rate than at position 3,4 and 5 (Tab. 2).

* During the application of stress between the 43rd and 57th day after germination, the loss of floral buds was higher at position 3 as compared to the others as well as the bolls at position 1 (Tab. 3).

* During the late water stress from 58th to the 63rd day after germination, floral buds at position 3, 4 and 5 and bolls at position 2 and 3 were the most affected (Tab. 4)

These data showed that the availability of water (at 40 cm) for the plant is affected more towards the end of the stress application period than in the beginning. More so, the period of wet season when the availability of water drops as a result of stress is usually the end of July and the beginning of September. The level of water availability measured by tensionics in our condition for an affect also depends on the period in the wet season and the plant stage.

Loss of organs resulting from water stress applied at different stages of development shows that fruiting organs are very sensitive to water stress during the application of treatment as indicated by many authors.

In relation to water availability in the soil, we observed that, even when there is no significant difference between control and the SM stress (for example during August when there is a lot of rain), abscission of buds and bolls occurs. That means buds and bolls are very sensitive to stress period.

References

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Table 1 a. Average soil water potential (in mbars) at stress application period

	Period of SP	
	Begining	End
SP	-348.4	-478.6 a
SO	-359;5	-388.8 b
Precision	7.6	16.9

Table 1 b. Average soil water potential (in mbars) at stress application period

	Period of SM	
	Begining	End
SM	-327.3	-258.7
SO	-334.4	-278.9
Precision	9.75	35

Table 1 c. Average soil water potential (in mbars) at stress application period

	Period of ST	
	Begining	End
ST	-302.7	-280 a
SO	-267.6	-162.9
Precision	26.6	15.2

Table 2. Average rate of abscission (%) of buds by position on FB during early water stress

position on FB	rate of buds abscission
Position 1	0 b
Position 2	3,33 a
Position 3	0 b
Position 4	0 b
Position 5	0 b
Precision	0.129

Table 3. Average rate (%) of buds and bolls abscission during mid-way water stress

	rate of buds abscission	rate of bolls abscission
Position 1	04.14 b	07.02 a
Position 2	04.64 b	0.69 b
Position 3	12.76 a	0.00 b
Position 4	05.97 b	0.00 b
Position 5	01.17 b	0.00 b
Precision	0.411	0.192

Table 4. Average rate (%) of buds and bolls abscission during late water stress

	rate of buds abscission	rate of Bolls abscission
Position 1	01.93 b	15.4 b
Position 2	09.38 b	45.3 a
Position 3	30.73 a	48.3 a
Position 4	47.34 a	18.3 b
Position 5	39.39 a	18.0 b
Precision	1.12	16.5