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EFFECT OF A WATER STRESS APPLIED AT DIFFERENT GROWTH STAGES TO *BRASSICA NAPUS L. VAR. OLEIFERA* : I - EFFECT ON YIELD AND YIELD COMPONENTS.

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ABSTRACT :

These experiments established the most sensitive period to water stress in oilseed rape under controlled conditions. Yield and yield components were mainly affected by water shortages occurring from flowering to the end of seed set. The greatest reduction (- 48 %) was observed when only 37 % of full water requirements were supplied to the plant. The number of seeds per plant was the main yield component affected. Compensation occurred when the water supply was restored. The 1000-seed weight was only affected by a water stress from growth stages G4 to G5.

INTRODUCTION :

Most oilseed rape plants (*Brassica napus L.*) grown in France are automne established and usualy drought is not an important limiting factor. Nevertheless, following a climatic period of dry years (1987-89-90), it appeared that water shortages could induce significant yield losses at several growth stages. Mingeau (1974) demonstrated a critical period from anthesis to anthesis + 2 weeks when water supply was reduced by 50% in this period. Seed yields were reduced by 20 %, higgest effects being upon pod- and seed-numbers per plant. Mailer & Cornish (1987) and Mailer & Wratten (1987) conclude that yield could be strongly reduced by a water deficit from flowering to maturity. The most sensitive yield component was the number of seeds per plant. In the research reported here, the objective was to observe the behavior of winter type "00" cultivars to define the most sensitive drought period in spring and summer and assess the effect on yield and yield components. The consequences on quality will be presented in a second article (Champolivier & Merrien, 1994).

MATERIALS and METHODS :

Trials were conducted in greenhouses during 1991 on the winter oilseed rape cultivar Cérès, sown in September 1990 and pricked out in pots in February 1991; 2 plants were sown per pot. Nutrients (including sulphur) were applied weekly following standard recommandations. The period from growth stage D1 (CETIOM, 1978) to G5 was divided in 6 intervals to apply 7 treatments, including the control, numbered T1 to T7 (Figure 1). Water deficiencies (around 50 % of the full requirements) were induced progressively for 2 weeks according to the interval chosen for the stress application. At the end of this period, full water requirements of the plant were satisfied. Water status was controlled twice a week (consumption and water potential). The following measurements were carried out plant by plant : the number of productive branches (i.e with pods), the number of pods (i.e. with at least one seed), the number of seeds and the 1000-seed weight. The average number of seeds per pod was calculated. There were four replications by treatment. All treatments were randomized and a statistical analysis was carried out using the Newman-Keuls test at 5 %-level.

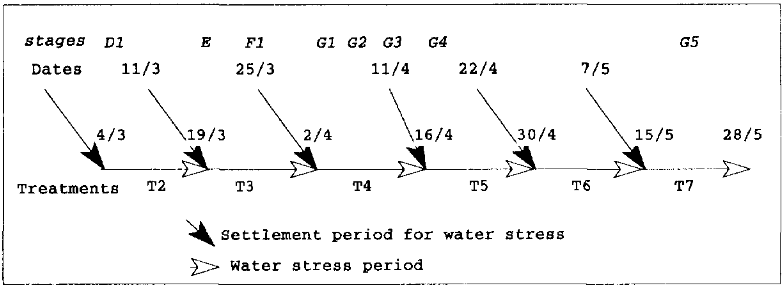

Figure 1: Schedule of water stress treatments

RESULTS :

a. Effect on growth:

Only the treatment T3 (water stress between growth stages E and F1) induced a significant reduction in the plant-size. Both treatments T3 and T4 affected the length of the main stem (-26% and -36% respectively). All treatments applied after growth stage E1 reduced the total amount of vegetative dry matter produced. The strongest effect was observed for treatment T5. This effect on dry matter was caused in part by the stem reduction (non significant at p= 0.01) but predominantly by pod walls. The treatment T4, applied at the end of flowering, induced a significant seed weight reduction (-35%) in the main stem compared with the control (T1) and to a lesser extent but not significantly, the later treatments. As soon as flowering occurred, the application of a stress (treatments later than T2) reduced seed weight on racemes with the greatest effect at T4 and T5, applied at full anthesis. The water stress affected the harvest index from early seed filling to maturity. The greatest reduction was observed between G1 and G4.

b. Effect on yield component (Figure 2):

<u>**Pod number per plant**</u>: As flowering occurred, water stress affected this component. The most sensitive period for the pod number per plant took place between anthesis and growth stage G4 + 10 days with an average loss of 30% compared with the control.

<u>**Seed number per plant**</u>: For the main stem, only two treatments led to a difference from the control: T4: -31% and T5: -23%. The earlier treatments did not affect seed number. A similar pattern was observed on branches, but the level of seed losses was higher : -65 % for the greatest reduction (T4 and T5). At the whole plant level, the most sensitive period for a water stress was recorded between growth stages G1 and G4 + 10 days.

<u>**Seed number per pod:**</u> this value was a calculated mathematical mean and was not analysed statistically but it appeared treatments T4 and T5 led to the most important reduction in this component, especially on branches (15.3 seeds per pod on average, compared to 20.4 for the control).

<u>**The 1000-seed weight**</u> : Treatments applied in the experiment did not affect this component on the main stem significantly; only the 2 latest treatments had effects (-6% and -12% respectively). For the earliest treatment, inducing a water stress from yellow bud formation to flowering, a 1000-seed weight increase was observed, correlated negatively with the reduction in seed number, thus allowing a compensation effect to occur.

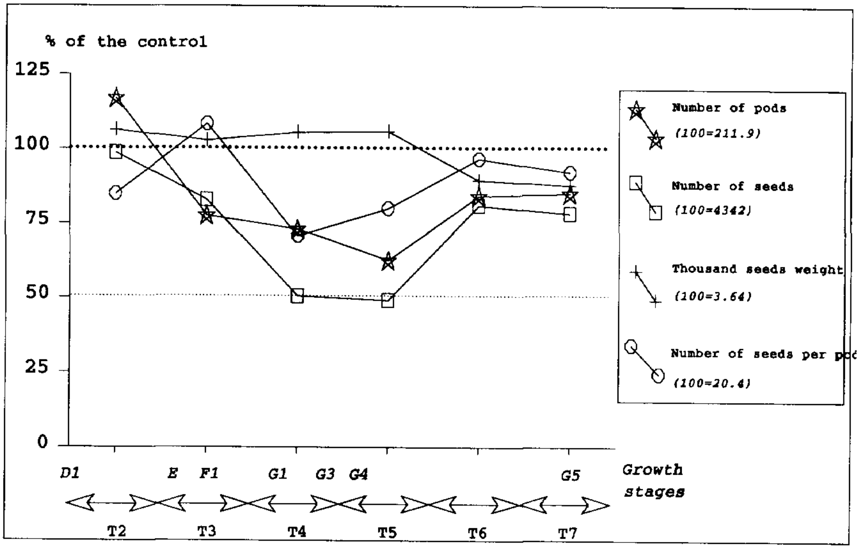

Figure 2 : Effect of water deficit on the yield and yield components.

DISCUSSION AND CONCLUSION:

From the results obtained the most sensitive period of *Brassica napus* to drought can be defined : this period occurs between anthesis and growth stage G4 + 10 days. More precisely, it corresponds to the transition period between flowering and pod development, when the final pod-length is reached (i.e. the seed-set period). The yield reduction (-48 %) was mainly correlated with the reduction in the seed number per plant (-50 %) and to a lesser extent, with the number of pods. This experiment also showed the strongest reduction in production on branches, compared with main stem productions.

Results were confirmed by irrigation trials (Merrien et al., 1992): in the case of a climatic deficit, the most efficient watering was obtained from the very beginning of flowering to growth stage G4. The results obtained on seed quality will be presented in a second article (Champolivier & Merrien, 1994).

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