# EFFECT OF A WATER STRESS APPLIED TO *BRASSICA NAPUS L. VAR. OLEIFERA* AT DIFFERENT STAGES: II - EFFECT ON QUALITY

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**Abstract:**

The effects of water stress on oilseed rape quality at different growth stages from green bud stage to maturity were assessed in pot trials under controlled condition. The results demonstrated a strong oil content reduction when the water deficit occurred from anthesis to maturity. There was an inverse relationship between oil and protein contents. The most marked effect observed in this experiment was on the glucosinolate content where can increases up to 60 % were observed. These results help explain environmental effects on seed quality.

## INTRODUCTION :

The sensitivity of *Brassica napus L.* to drought has already been reported (Mingeau, 1974; Champolivier and Merrien, 1995). The most sensitive period to water stress occurred from anthesis to the end of seed set in the pod. Several researchers [Mailer and Cornish, (1987); Mailer and Wratten (1987)] demonstrated that water stress occurring during the ripening period of spring cultivars affected oil content of the seed. Mingeau (1974) showed that the fatty acid composition did not vary under different levels of a water stress applied to plants grown in pots. Under field conditions, Henry and MacDonald (1978) and Wright et al., (1988) indicated that early drought (occurring at green bud stage) could lead to seeds containing less oil compared with the control, implying that the allocation of assimilates to the seeds at the early stage of the embryo could be related to the final oil content. In case of severe water shortage at flowering or maturity, the final glucosinolate content of seeds can be increased substantially (Mailer and Cornish, 1987; Mailer and Wratten, 1987). In a range of Australian experiments, the same authors recorded a strong and inverse correlation between water availability and final glucosinolate content of the seed. Water stress causes a large reduction in the number of seeds per plant, but the glucosinolate precursors in vegetative organs and pod-walls are not affected (De March, 1989; Clossais-Besnard and Lahrer, 1991; Merrien et al., 1991) and are therfore distributed to a smaller sink, leading in term to a glucosinolate increase. In these pot trials the reaction of winter type '00'- cultivars to a water stress applied at different growth stages was observed and effects on quality reported.

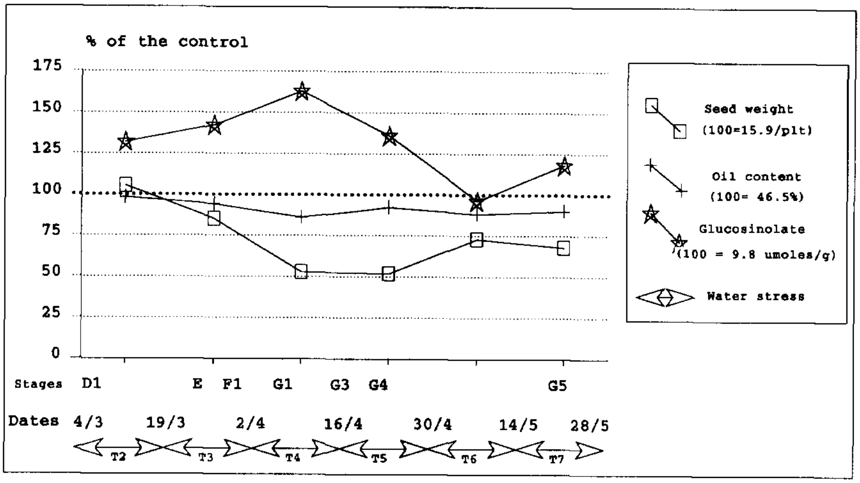
## MATERIALS AND METHODS:

Trials were conducted in 1991 on the winter '00'-oilseed rape , cultivar Cérès, grown in pots in greenhouses. Six water stress treatments (T2 --->T7) were applied as sequences for 2 weeks each from growth stages D1 to G5 and compared with a control (T1). The main controls are described in detail by Champoliver and Merrien (1995). Seed analysis were performed by standard methods in the CETIOM-laboratory at Ardon.

## RESULTS (Figure 1):

**Oil and protein content :** Only the very early stress treatment (T2) applied in the vegetative period did not affect the seed oil content. All other treatments had significant effects relative to the control. The greatest effect was observed when water stress occurred between growth stages G1 and G3 (T4: -14%), and to a lesser extent, with the latest treatments : (T6: -12% and T7: -10%). At the beginning of anthesis, the oil content could also be reduced (T3: -6%).

**Figure 1 : Stages at which oilseed rape plants are sensitive to water stress.**




This experiment showed a negative correlation between the oil and protein contents. All treatments (except the earliest, T2) led to an increase in the protein contents approximatively to 10 % compared to the controls. Oil and protein contents were negatively correlated. The concentration effect due to a limited sink could explain this result.

**Fatty acid composition :** The water stress before flowering (T2 and T3) did not affect the fatty acid composition. Each stress applied later induced variations in the oil composition: the stearic and oleic acid contents were lower compared with the control. Other fatty acids were increased.

**Seed glucosinolates content :** Compared with the control, the seeds produced by the treated plants have higher total glucosinolate contents at harvest. The greatest effect was observed in the case of a water deficit occurring at flowering (T3 : +42 % and T4 : + 63%). Water stress occurring later (T6 and T7) produced seeds with identical glucosinolate contents. This effect on total glucosinolate content seemed to be more correlated with the alkenyl fraction than with the indole fraction. In the alkenyl fraction, progoitrin was most affected by moisture stress.

DISCUSSION AND CONCLUSIONS:

As in the case of spring cultivars, the most sensitive period to quality occurs from flowering to growth stage G4 + 10 days. Oil content and oleic acid content are positively correlated; this conflicts with previous results obtained on spring cultivars (Mingeau, 1974). Oil biosynthesis was more affected by water stress than proteins. Combined with yield losses, the oil content reduction could reduce the oil yield by 44%, especially when the water stress occurred during the flowering period (treatment T4). The effects of water stress on the glucosinolate content of seed helps explain why the environmental effect on glucosinolate variabilities in seeds has been so great for so many years (Schnug, 1987; Bilsborrow and Evans, 1989; Merrien, 1989). Since water stress affects flowering and the number of seeds per plant is severely reduced, (-31 %) as demonstrated by Merrien and Champolivier (1995). Hence, the sink effect leads to a drastic increase (+ 60 %) in the final glucosinolate content of seeds. Also the possible compensatory effect on the 1000-seed weight will be responsible for this increase in glucosinolate levels.

Benefits could be obtained by irrigation of winter oilseed rape (Merrien et al., 1992), especially if the water stress occurred at flowering. Then, both yield but quality (oil and glucosinolates) are maintained.

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