Accumulation of glucosinolates during the ripenning period in the seeds and pod walls of winter oilseed rape.

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Abstract:

In order to explain the variations of glucosinolates (GSL) content in oilseed rape (OSR) according to the agronomical practices and to the climat, we have tried to follow the accumulation of GSL in the seeds and pod walls.

The first results show that for the high GSL seed content's cultivars, the sulfur compounds are distributed to the seed until maturity; this seems to be related to the increase of the weight of the seed.

On the other hand, for the low GSL content's varieties, the GSL accumulation is interrupted about 30 days before physiological maturity. This behaviour seems also to be related to the weight of the seed.

We have also follow the accumulation of individual glucosinolates: for both kinds of varieties, the contribution of progoatrin (the main GSL in rape) to the final content of the seed is stable throught the time. On the opposite, our results shows a greater contribution of gluconapin and 4-hydroxy- glucobrassicin.

INTRODUCTION

Among the sulfur content of the seed, the glucosinolates (GSL) are the main form in rapeseed (Brassica napus L. Var. oleifera). In order to increase the quality of the harvest seeds, breeders had selected varieties with low glucosinolate content in the seed (about 10 to 15 µmoles per g of seed). Nevertheless, the effect of environmentals factors is very important and in some cases, the content can varied about 50% around the average (COOKE et al.,1987).

The mains factors responsibles for the variation had been previously indentified (SANG et al., 1986; MAILER and CORNISH, 1987; MAILER and WRATTEN, 1987; SCHNUG, 1987 b; MERRIEN et RIBAILLIER,1988).

The mecanism involved in such effect stay unknown. A lot of results (DROZDOWKA and ROGOZINSKA, 1982; SCHNUG, 1987 a; Mc GREGOR,1988; MERRIEN, 1989) indicated that a great part of GSL in the seed came from redistribution from the other part of the plant.

Mc GREGOR (1988) showed that such transfers concern more GSL-precursors than glucosinolates themselves.
SCHNUG (1987 a), STUDER et.al. (1988) indicated that there were differences in transfers of glucosinolates between pod-walls (very active synthesis place) and seeds.
The aims of the experiment present here was to follow the evolution of GSL during the ripenning period both in the seed and in the pod walls.

The nature of GSL is also important to be taken in account. RIBAILLIER and DE LA TAILLE (1981) showed that in rapeseed (Brassica napus L. Var. oleifera), highest contents are to be found in progoitrin (PRO), which represents 50 to 60% of total amounts, and gluconapin (GNA), amounting to 10-15%. In high GSL-content varieties, indole-glucosinolates represent about 5% of total glucosinolates.On the contrary, in low-content seeds, this percentage can reach 50%.

MATERIALS AND METHODS.

An experiment was carried out in the Bassin Parisien, on a silt/clay soil in 1988. Two cultivar had been sown at 80 seeds per square meter:

- Darmor, with an average GSL content of 40 µmoles/g of seed
- Samouraï, with a content usely bejong 20 µmoles/of seed.

The sowing date occurs the 6 of september, and anthesis the 5 of April (Samouraï) and the 12 for Darmor.
The fertilization was as following: N = 110 kg, P2O5 = 180, K2O = 270.

The pods was sampled at the same level in the canopy from 10 plants which had been identified previously for their homogeneity. Each sample was replicated.
The sampling start 25 days after anthesis (DAA) and from this stage, each week until maturity.
The pods were frozen in the field by liquid nitrogen and as soon as the sample arrived to the laboratory, they were freeze-dried. The separation between seed and pod walls was done after this step, the dry matter of each sample (pod and walls) check and the GSL-content controled by the EEC reference method (HPLC). The data present here are expressed in µmoles of GSL per g of seed at 9% of relative humidity.

RESULTS.

1. Accumulation of GSL throught the time.

In order to take in account the flux between the 2 organs, we have compared the evolution of the total quantity of GSL accumulated throught the time.
On figure 1, the first comment can be done for the high GSL seed content's cultivar (Darmor).

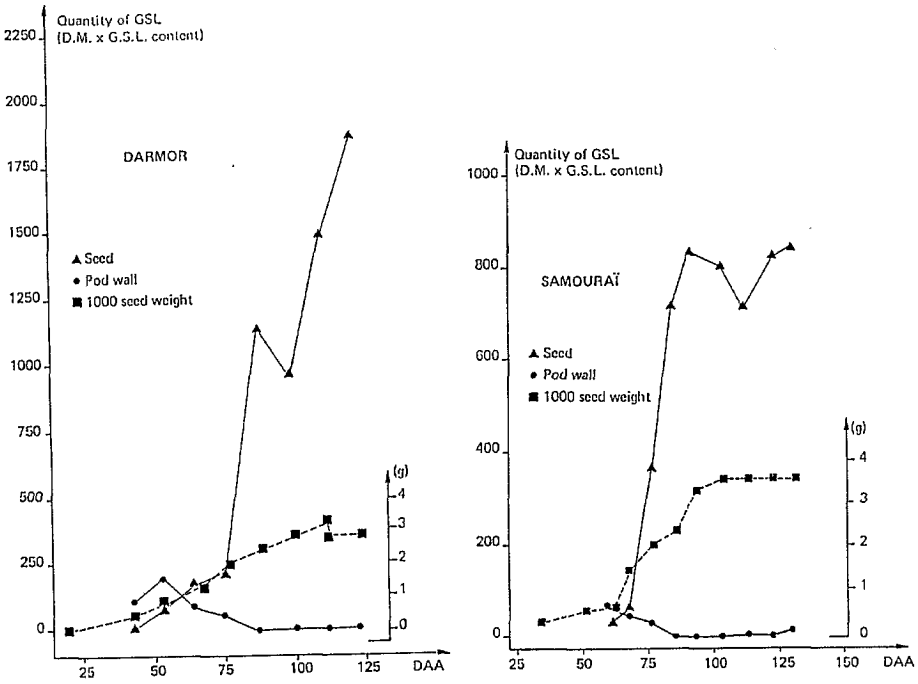


Figure 1 : Accumulation of the quantity of GSL in the seed and pod wall for 2 cultivars DARMOR and SAMOURAI
DAA = Days after anthesis

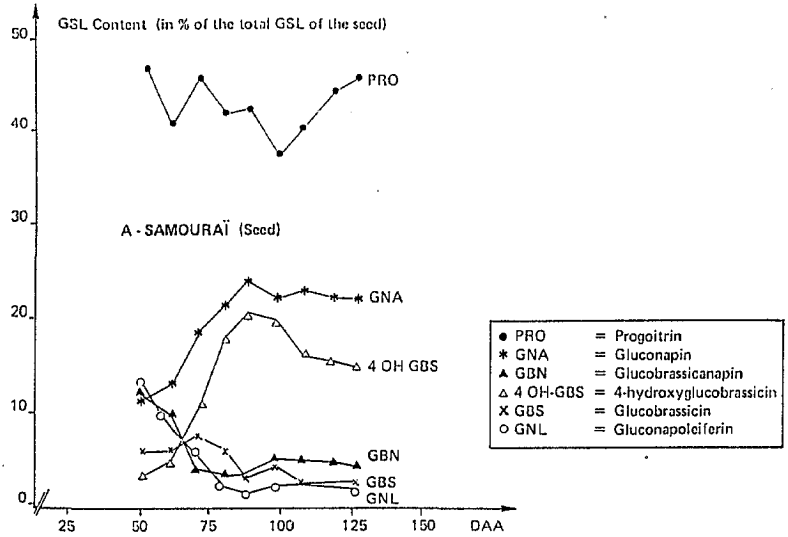
In this case, the sulfur compounds are distributed to the seed until maturity; this seems to be related to the increase of the weight of the seed.

On the other hand, for the low GSL content's variety (Samouraï), the GSL accumulation is interrupted about 30 days before physiological maturity. In this case also, this behaviour seems to be related to the weight of the seed who was stable one month after flowering.

As far as pod walls are concerned, it appears that pods wall contributed more to the translocations of GSL to the seeds for the high GSL content's varieties, compare to the low one. But in both case, the accumulation is very low compared to the quantities founded in the seeds.

2. The evolution of GSL by nature.

It's quite clear that in the seeds (like in the pods) progoitrin, which is the main glucosinolate in OSR, is stable. The results had been present in per cent of the total GSL detected in the organ; only the 6 most abundant GSL are present here.



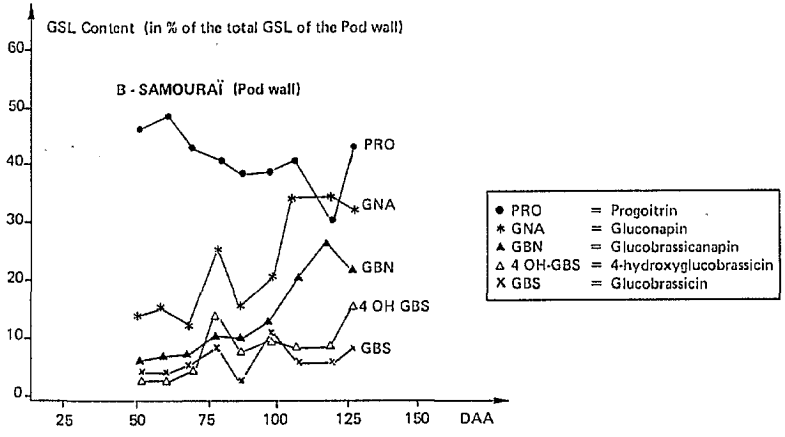


Figure 2 : Evolution of the GSL content by nature after anthesis in the seed (a) and pod wall (b) CV. SAMOURAI

On figure 2 a, the concentration of GNA and 4-OH GBS increase very much from 50 to 100 days after anthesis for the cv Samouraï. The behavior of Darmor (figure 3 a) is about the same. In both case, GBN, GNL and GBS contribute very little

to the evolution of the final GSL content.

On figure 2 b, the kinetic of GSL accumulation in the pod walls is represented. Against, its remarquable to see to small variation for Progoitrin. For samouraï, as GNA is stable in the seed (90 DAA), the concentration increase in the pod walls and in a less extend for 4-OH GBS. It appears also clearly that the accumulation of GBS and GBN is greater in the pod wall compared to the seed, leading to the hypothesis of a lower translocation of those GSL.

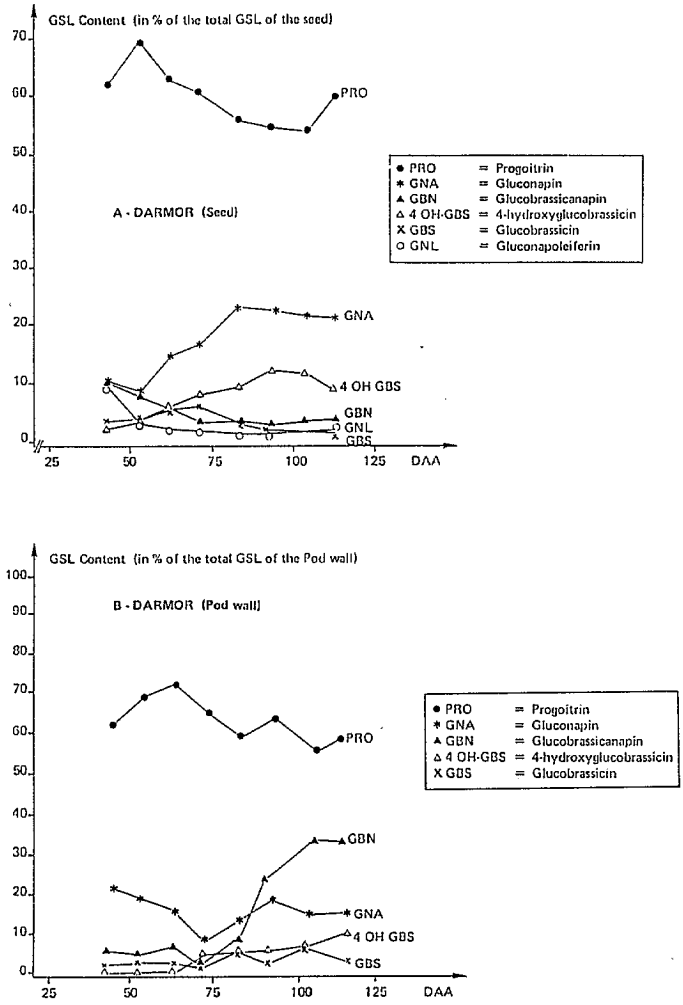


Figure 3 : Evolution of GSL content by nature after anthesis in the seed (a) and pod wall (b). CV DARMOR.

For Darmor (Figure 3 b), it's possible to confirm the accumulation of GBN in the pod wall and by consequences, a small variation trought the time in the seed for this GSL.
Compare to Samouraï, the part play by GBS, 4-OH GBS and GNA to the total GSL content is more stable in this case.

DISCUSSION.

The same results presented in the litterature came from BILSBORROW (1989). Their work demonstrated clearly that the main differences between cultivars (high and low GSL content) came from difference in progoitrin an gluconapin. De MARCH and al (1989) compare the evolution of GSL in the seed and pod wall: they conclude that the increase of GSL in the seed profiles along with a decrease in the pod wall. Those results are consitent with the pod wall being a source of GSL accumulation to the seed. More recently, IORI and al. (1990) indicated that the kinetic accumulation of GSL varied according to the growing environments. In this case , most of the variation came from progoitrin and gluconapin.
From our results, its quite clear that a flux exists between pod wall and seed. Among the GSL type, GNA and 4-OH GBS seems to varied very much along the ripenning period. GBN is less redistributed to the seed and accumulated in the pod walls.

If those results could be confirm by studiing the variation from one place to another, the variability of GSL in the seed could be reduced by selecting varieties with very low content in GNA and 4-OH GBS who represent both about 30 to 40 % of the total GSL of the seed. It will be then possible to growth such varieties less sensitive to enviromental effect on the quality of the harvest seeds.

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