Glucosinolates in Canadian Canola

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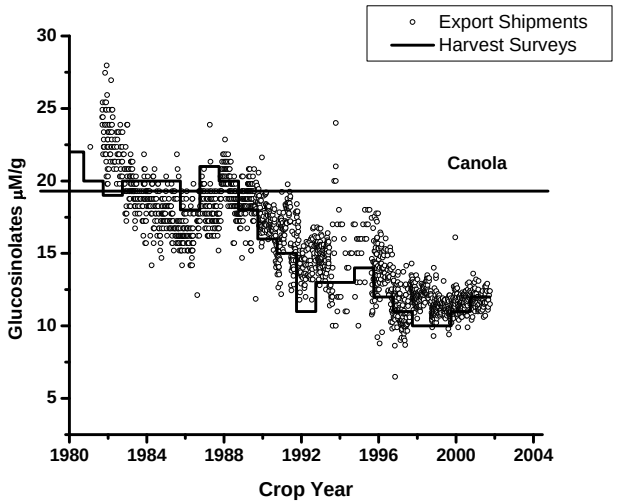

Figure 1. Glucosinolate levels in Canadian canola and rapeseed harvest surveys and export shipments.

Canada, as the initial developer of low glucosinolate varieties of rapeseed (Stefansson and Kondra, 1975), later to become known as canola, has played a major role in the development of analytical methods for measuring glucosinolates as well as of systems for ensuring that the glucosinolate level in Canadian canola remains at a level within the standard set for canola types of seed (Figure 1) (Daun, 1986a). While the first low glucosinolate variety was released in 1975 and canola was defined in 1982, it took a further 10 years before the vast majority of Canadian canola exports were actually within the definition. In order for this to happen, it was necessary to ensure that Canadian producers were growing varieties with low levels of glucosinolates.

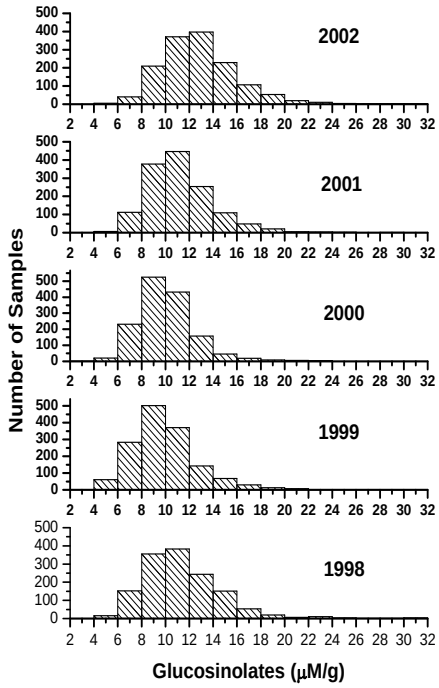

Figure 2. Distribution of glucosinolates in Western Canadian canola harvest surveys.

The glucosinolate level in *B. napus* varieties such as Westar, introduced in the mid-1980's was low, about 12 micromoles per gram total but contemporary *B. rapa* varieties such as Candle and Tobin had significantly higher levels of glucosinolates (about 18 micromoles per gram). It was only with the introduction of varieties like Parkland and Horizon in the early 1990's that the level of glucosinolates in *B. rapa* varieties approached the level in *B. napus* varieties. Also, in the 1990's, the proportion of early maturing but lower yielding *B. rapa* canola grown in Canada dropped dramatically. The reduction was due to a combination of factors including; disease problems with *B. rapa;* availability of herbicide tolerance in *B. napus* lines only; and the development of earlier maturing *B. napus* lines. (Daun, 1986b)

Even in recent years, there has been a low proportion of samples of Western Canadian

canola with glucosinolate levels greater than 18 micromoles per gram. In the past five years this has ranged from 1 to 3% of samples except for 2002 where 7% of the samples were above 18 micromoles per gram. This increase in 2002 may be due to the extreme drought in that year. Drought has been shown to cause an increase in glucosinolates (Mailer and Cornish, 1987; Mailer and Pratley, 1990).

The intrinsic quality of Canadian rapeseed and canola has been maintained through controls implemented in the variety registration system. All varieties sold in Canada must be registered with the Canadian Food Inspection Agency (CFIA). In order for a variety to be registered, it must obtain the support of a committee of experts recognized by the CIFIA. This committee considers data generated through co-operative growth trials. Up to the early 1990's, canola co-operative trials and registration data was generated through the oilseeds subcommittee of the Prairie Regional Recommending Committee (formerly the Western Expert Committee on Grain).

With the dramatic increase in the number of private breeding companies leading to a large increase in the number of canola lines. This resulted in the formation of a committee to deal exclusively with canola and rapeseed varieties. The Western Canada Canola/Rapeseed Recommending Committee Inc. was formed in 1990 as the official group to make recommendations on new variety registration in Canada. The WCC/RRC has established procedures that regulate the testing and the basic requirements for new canola and rapeseed varieties designated for growing in Western Canada. Data presented include one year of privately run trials and one year of public (i.e. fully collaborative trials). Analytical data for the public co-operative test are all generated by one laboratory but many laboratories may be involved in the private testing.

Included in the criteria are maximum levels for glucosinolates (12 micromoles per gram of seed) and a program to ensure that analytical data from different laboratories is comparable, accurate and precise. Although the absolute value of 12 micromoles per gram is given, the testing is always on the basis of comparison with the mean of check samples chosen to give an average of 12 micromoles per gram. This allows for some variability due to environmental conditions.

Analytical methods for determining glucosinolates used in Canada include gas chromatography of TMS-derivatives of and HPLC of desulfoglucosinolates, determination of glucose released on hydrolysis and NIR estimation of glucosinolates based on calibrations developed from the previous methods. The laboratory proficiency program has shown that, with the use of appropriate standards, all the methods can give equivalent results with similar precision. (Daun and DeClercq, 2002)

CFIA originally also specified limits for the glucosinolate level of certified seed and breeders seed. The success of the WCC/RRC registration program in ensuring that glucosinolate levels of varieties supported for registration are low has made this testing unnecessary and it has been discontinued.

Recently, the development of canola quality *Brassica juncea* has presented a new challenge to the variety testing program (Love et al. 1990). Glucosinolate levels for this type must not only meet the current guidelines of 12 micromoles per gram but the

varieties also must include no more than 2 micromoles per gram of allyl glucosinolate (sinigrin). This means that samples of this type must be tested using chromatographic techniques although there has been some work on NIR calibrations.

By ensuring that varieties of canola and rapeseed sold in Canada contain levels of glucosinolates well within the canola guidelines, it has been possible to ensure that seed grown for commercial use meets the specification. Controlling the glucosinolate level at the variety development stage has also allowed Canada to avoid implementation of an expensive program to test each farm shipment although testing mechanisms were developed and are still in place that could be used to ensure that canola samples entering the commercial handling system have acceptable levels of glucosinolates. These testing methods involve the use of rapid estimation of glucose released on hydrolysis. In the early 1980's the test relied on the use of a color change on paper strips (Tes Tape) but the most recent versions utilize the glucose sensor technology built into modern glucometers used for diabetic blood testing.

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