CHANGES IN THE GLUCOSINOLATE CONTENT OF OILSEED RAPE VARIETIES

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Efforts by plant breeders to develop varieties of oilseed rape with a low content of glucosinolates in the seed have made it necessary to establish procedures for their accurate assessment. Such procedures are required not only by breeders but also by those involved with varietal assessment and, ultimately, for marketing purposes. EEC proposals to change financial support arrangements to favour these varieties give extra impetus to satisfying this requirement.

NIAB assesses the performance of winter oilseed rape varieties in trials grown at eight centres every year. These trials normally involve about 30 varieties, most of which change from year to year depending on submissions from breeders. Levels of total glucosinolates in the seed submitted by breeders for trial purposes have been assessed by the Institute since 1979. These showed from the outset that variation from year to year (Table 1) upset varietal comparisons and suggested that tests should therefore be carried out on seed harvested from trials, i.e. seed produced in a common environment.

Results for the harvest years 1981 and 1982 (Parnell et al, 1983) showed clearly that glucosinolate levels in harvested seed varied and usually tended to be higher than those in seed sown. This was particularly marked in varieties with a reduced glucosinolate content. An exception was found in varieties in trials at Sparsholt, Hampshire, where the levels of glucosinolates in the harvested seed were consistently lower than in the seed sown.

Further data for the harvest years 1984 and 1985, summarised in Table 2, confirmed the variability of glucosinolate content according to site. The high glucosinolate variety, Jet Neuf, had a content of total glucosinolates in the seed sown of 143 micromoles per gram dry defatted meal in 1984 and 121 micromoles in 1985, but the content in seed harvested varied from as low as 49 at the Bridgets, Hampshire, site, to 136. The other two high glucosinolate varieties, Rafal and Bienvenu, showed similar variability, although Bienvenu appeared to have a somewhat lower content than Jet Neuf and Rafal generally.

Darmor and Liradonna, both of which are varieties with reduced total glucosinolate content, were also in these trials. The seed sown of Darmor in 1984 had a relatively high content, while the harvested seed did not show undue variation from site to site. However, although Darmor had a lower content in the seed sown in 1985, contents in the seed harvested at different sites were invariably high, except again at the

Hampshire site. Liradonna also showed variability in glucosinolate content in both years.

These results appear to support the premise that the levels of total glucosinolates in the seed vary according to variety, year, site and, perhaps, husbandry practice. The latter is of interest because of the results from the Hampshire trials (at Sparsholt see Farnell et al, 1983 and at Bridgets, Table 2). These trials had a similar harvesting programme: they were direct combined without desiccation or swathing beforehand.

It seemed possible that a difference in seed maturity might account for the Hampshire results. Experiments were carried out in 1985 and 1986 to investigate whether seed maturity affected glucosinolate content. The first study involved the analysis of seeds of different, defined sizes, separated by sieving, on the assumption that mature seeds may be larger than immature ones. The results did not show an unequivocal effect of seed size on glucosinolate levels (data not presented).

The second experiment involved the analysis of seeds harvested over a period of time in 1986. This work was conducted at Cambridge and compared glucosinolate levels in seed direct harvested or after swathing on four or five dates over a four week period (Table 3). While levels were very low in immature seed, the results demonstrated again the variability of glucosinolate content and provided no information which growers might use in order to achieve low contents in their crops.

Overall, various factors have been proposed to account for the observed changes in glucosinolate content between seeds sown and harvested. These include: a) the period of seed storage, b) mechanical admixture, c) cross pollination, d) seed maturity, e) husbandry practices, and f) environmental factors. It is improbable that the first three suggestions contribute in a major way to variability. The available data (not presented) show that only slight variation is recorded in glucosinolate levels in seed stored for 12 months or longer. Any admixture would have to be large to account for the observed changes. Glucosinolates are reported to be maternally inherited (Robbelen, 1981) and, hence, cross pollination can have no significant effect on harvested seed, unless it has occurred in earlier generations.

It is unlikely that any one of the above factors provides an overall explanation and an interaction between different factors seems more likely. We have been unable to demonstrate a consistent effect of maturity on glucosinolate levels, although there is some evidence that environment or husbandry can influence the level. Work is continuing in 1987; tests will be undertaken at harvest when glucosinolate content of seeds from different varieties grown on a range of soils, environments and husbandry treatments will be compared.

References

Parnell, A., Craig, E.A. and Draper, S.R. (1983) Changes in the glucosinolate content of seed of winter oilseed rape varieties in successive generations. Journal of the National Institute of Agricultural Botany, 16:207-212.

Robbelen,G. (1981) Breeding for low content of glucosinolates in rapeseed. in Production and Utilisation of Protein in Oilseed Crops (ed. E.S.Bunting), pub. Martinus Nijhoff, pp 91-106.

Table 1

Glucosinolate content of seed submitted for trial

Variety	1980	1981	1982	1983	1984	1985
Jet Neuf	124	120	177	143	121	-
Rafal	126	97	140	118	94	141
Bienvenu	-	107	138	69	78	99
Mikado	-	-	123	96	100	102
Darmor	-	36	41	44	32	39
Liradonna	-	-	25	27	32	33

Table 2

Glucosinolate content of seed harvested: NIAB trials 1984/1985
micromoles/g dry defatted meal

Variety	1984						1985					
	seed sown	BEDFORD	BRIDGETS	CAXTON	MORLEY	S.BON.	seed sown	BEDFORD	BRIDGETS	ROSEMAUND	CAXTON	MORLEY
Jet Neuf	143	99	49	97	126	96	121	136	67	110	130	97
Rafal	118	81	45	140	106	98	94	125	45	82	134	76
Bienvenu	69	81	47	83	67	87	78	103	38	73	115	70
Mikado	-	-	-	-	-	-	100	94	57	79	93	99
Darmor	44	38	36	48	40	41	32	55	25	52	56	58
Liradonna	27	48	39	45	40	44	32	61	25	42	46	53

Table 3

Glucosinolate content with different harvest dates and methods
micromoles/g dry defatted meal

Variety	July 15	22	28	Aug 5	13
Direct harvest					
Bienvenu	12	170	129	169	145
Rafal	48	163	185	178	160
Ariana	2	71	55	69	52
Liradonna	3	34	24	31	30
Swathed: 6-8 days earlier					
Bienvenu	-	130	147	163	167
Rafal	-	192	188	171	204
Ariana	-	58	67	80	36
Liradonna	-	36	37	25	42