Indian J. Genet., 49(3): 337–340 (1989)

NITROGEN HARVEST INDEX IN RAPESEED MUSTARD

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(Received: October 21, 1988; accepted: December 16, 1988)

ABSTRACT

Variation in nitrogen harvest index and some other physiological traits was estimated in eight *Brassica napus* genotypes. Considerable variation was observed for nitrogen harvest index, seed protein and harvest index. Relatively small variation was observed for seed protein yield capacity.

Key words: Oilseed rape, harvest index, nitrogen harvest index, seed protein yield.

Nitrogen is essential for plant growth and production of all plant proteins. It appears that a number of physiological and biochemical processes of nitrogen metabolism which precede plant maturity can be used as selection criteria for enhanced N-metabolism [1]. In the present study, variation in nitrogen harvest index and other physiological components has been examined in rapeseed.

MATERIALS AND METHODS

Eight *Brassica napus* cultivars from different agroclimatic conditions were used. All the selected cultivars had normal fertility. These were grown in 3 m rows, 45 cm apart, in randomized block design with three replications. At harvest, the plants were cut at ground level and weighed to obtain biological yield (BY). The seed yield (SY) was obtained after threshing. Nitrogen in the seed, straw (including chaff) and chaff samples was estimated by Kjeldhal method. Percentage of seed nitrogen was multiplied by 5.7 to obtain seed protein content. Nitrogen harvest index (NHI) was calculated according to Austin and Jones [2].

$$\text{NHI} = \frac{\text{Seed yield} \times \text{Seed N\%}}{\text{Straw yield} \times \text{Straw N\%} + \text{Seed yield} \times \text{Seed N\%}}$$

and seed protein yield was calculated by the following formula:

$$\text{Protein yield} = \frac{\text{Seed yield} \times \text{Seed protein}}{100}$$

The data obtained on the various traits were also used for statistical analysis.

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RESULTS AND DISCUSSION

Analysis of variance for different characters is presented in Table 1. In general, the genotypes differed significantly with respect to all the characters, except seed nitrogen and straw nitrogen content.

Table 1. Analysis of variance

Source of variation	d.f	Mean squares								
		total yield	seed yield	harvest index	seed nitrogen	straw nitrogen	chaff nitrogen	seed protein	nitrogen harvest index	protein yield
Genotypes	7	651.1**	28.8**	7.16**	4.49	0.22	0.68*	19.1*	52.7**	1.35*
Error	14	161.2	6.1	1.22	2.60	0.12	0.21	5.6	10.4	0.81

*, **Significant at 5 and 1% levels, respectively.

NITROGEN HARVEST INDEX (NHI)

The NHI is the proportion of total seed nitrogen in relation to total plant nitrogen at maturity [3, 4], and represents the capacity of a genotype to translocate nitrogen from vegetative organs to seed. The NHI varies from 27 to 41% in rapeseed, whereas in breadwheat it varies from 57 to 86% [3, 4]. Variety Christa of rapeseed mustard had higher NHI (41.4%) than the other genotypes in the present study (Table 2).

Table 2. Characteristics of *Brassica napus* cultivars

Variety	Biological yield (g)	Seed yield per plant (g)	Harvest index (%)	Nitrogen harvest index (%)	Seed nitrogen (%)	Straw nitrogen (%)	Chaff nitrogen (%)	Protein content (%)	Seed protein yield (g/plant)
Ashai	104.8	20.9	19.5	32.4	4.20	2.19	0.70	22.9	4.78
Christa	83.0	16.6	20.0	41.4	4.95	1.87	1.05	27.0	4.82
GSL-1	106.7	12.5	18.1	27.2	4.15	2.15	0.84	21.7	4.44
Bronowski	76.8	19.4	16.2	34.3	4.20	1.73	1.00	22.9	2.89
Lores	71.6	17.1	19.2	30.9	4.81	2.47	0.79	26.2	4.30
ISN-129	103.6	13.7	19.8	35.1	4.45	1.77	0.70	20.6	4.23
Topa	103.5	17.4	16.8	36.6	5.04	1.73	0.89	27.5	4.78
Pol-6	94.4	20.5	17.6	35.9	4.81	1.82	1.21	26.2	4.49
LSD	22.2	3.5	1.7	5.7	0.56	0.39	0.21	4.0	1.57

HARVEST INDEX (HI)

The cultivar Christa had the highest harvest index (20.0%). Thus, this variety has greater capacity to translocate photosynthates, followed by Ashai, ISN-129 and Lores. As mentioned above, this genotype also has the highest NHI, as well

as seed yield and seed protein yield. The variation ranged from 16.2 to 20.0% for harvest index.

SEED YIELD

High seed yield is the most important objective in rapeseed breeding programme. Although the seed yield of Indian varieties has already increased to 26 q/ha, it is still low in comparison with other seed crops. In order to achieve a significant jump in yield, a breeder has to use the biochemical and physiological mechanisms to enhance the yield level along with higher protein concentration. The seed yield represents the end results of C and N metabolism, sink size and ability to translocate assimilates from source to sink under specific environment [6]. The seed yield was found to be directly related to harvest index (Table 1).

SEED PROTEIN YIELD

This is the product of seed yield and protein content, therefore, seed protein yield can be enhanced by improving either of the two components. Here, the main objective is to increase grain protein yield without additional fertilizer application, which is possible by improving the nitrogen partitioning efficiency. The variation in seed yield ranged from 4.23 to 4.89 g/plant.

SEED PROTEIN

In rapeseed, increasing the protein content is one of the major objectives. As expected, seed protein content has a direct relationship with NHI. This means that with increase of NHI, the seed protein can also be improved. The variation of NHI in the material studied was in the range of 20.64–27.52%.

The study has led to the identification of certain lines, viz., Christa, Topa and Pol-6, of rapeseed that have relatively efficient N-metabolism. A plant breeding programme of this nature would result in genetically enhanced plant productivity together with an understanding of the physiological events leading to the improvement.

ACKNOWLEDGEMENT

The first author is thankful to the Indian Council of Agricultural Research for the financial assistance in the form of Senior Fellowship. Thanks are also due to Dr. S. S. Banga for research material and timely help.

REFERENCES

1. P. B. Cregan and P. van Berkum. 1984. Genetics of nitrogen metabolism and physiological/biochemical selection for increased growth productivity. Theor. Appl. Genet., **67:** 97–111.

2. R. B. Austin and H. C. Jones. 1975. The physiology of wheat. Annual Report. Plant Breeding Institute, Cambridge, England: 327–355.

3. D. T. Canvin. 1976. Inter-relationship between carbohydrate and nitrogen metabolism. *In*: Genetic Improvement of Seed Proteins. NRC–NAS, Washington, USA: 172–195.

4. R. B. Austin, M. A. Ford, J. A. Edrich and R. D. Blackwell. 1977. The nitrogen economy of wheat. J. Agric. Sci., **88**: 159–167.

5. F. H. McNeal, G. O. Boatwright, M. A. Berg and C. A. Watson. 1968. Nitrogen in plant parts of seven spring wheat varieties at successive stages of development. Crop. Sci., **68**: 535–537.

6. R. M. Desai and C. R. Bhatia. 1978. Variation in uptake and nitrogen harvest index in durum wheat. Euphytica, **27**: 561–566.