FIELD EVALUATION OF *BRASSICA RAPA* DOUBLED HAPLOIDS

D.B.DEWAN, G.RAKOW AND R.K.DOWNEY

Agriculture and Agri-food Canada Research Centre, Saskatoon, S7N 0X2, Canada

ABSTRACT

Seed yield of doubled haploid (DH) lines of *Brassica rapa* was evaluated in field tests at Saskatoon, Canada in comparison to parent populations. DH lines yielded 31% and 25% of parent populations in 1993 (43 lines) and 1994 (131lines), respectively. The lower mean seed yield of DH lines was due to the expression of deleterious recessive alleles in the homozygous state. Seed yield of the highest DH line was 80% of its parent population. Correlations between seed yield of DH lines to that of parent populations was 0.87 and 0.78 in 1993 and 1994, respectively indicating that high yielding *B. rapa* populations produced higher yielding DH lines.

INTRODUCTION

The doubled haploid (DH) technique is a breeding tool for the rapid and cost effective production of homozygous inbreds to be used as parents in synthetic and/ or hybrid varieties of *B. rapa*. A prerequisite for the utilization of the DH technique in *B. rapa* improvement is the availability of a culture protocol that allows the production of large numbers of DH lines through microspore culture. A highly efficient microspore culture technique has recently been developed (Baillie et al, 1990). This paper presents data on seed yield of microspore derived *B. rapa* DH and their parent populations at Saskatoon, Canada, in 1993 and 1994.

EXPERIMENTAL

Doubled haploid seed production and field test

Microspore derived *B. rapa* DH plants were obtained from Dr. A. Baillie, Plant Biotechnology Institute, Saskatoon. The DH plants were derived from five *B. rapa* canola quality breeding populations of the Agriculture and Agri-Food Canada, Saskatoon breeding programme. The material consisted of genetically diverse breeding stocks which included very low glucosinolate (<1 µmoles/g meal), high oil content, yellow seeded and white rust resistant germplasms. The DH plants were grown in pots in the greenhouse and seed was produced by bud pollination. Second generation bud pollinated seed was produced and used for field testing.

Seed yields of DH lines and parent populations were determined in single row, 4 replicate tests. Rows were 6m with 200 seeds/row and 3m with 100 seeds/row in 1993 and 1994, respectively. In 1993, 43 DH lines from three populations and in 1994, 131 DH lines from five populations were tested. For yield determination 30 plants/row were used in 1993 while, in 1994 all plants in the row were combine harvested. Seed was cleaned, dried and weighed and weights were recorded.

Seed yields

The average seed yield/ plant of DH lines was 2.9g which was 31% of parent populations (9.3g) in 1993 (Table 1). In 1994, average seed yield/ row for DH lines was 46.5g which was 25% of parent populations (187.7g).

In 1993 seed yield/plant of the DH lines and parent populations ranged from 0.4 to 7.6g and from 5.7 to 13.8g, respectively. In 1994, the range was 0.0 to 185.9g and 135.2 to 253.5g for DH lines and parent populations, respectively. The ranges for seed yield for the DH lines and the parent populations were significantly different in both years. Correlations between seed yield of DH lines and their corresponding three (1993) and four (1994) parent populations were 0.87 and 0.78 in 1993 and 1994, respectively. The highest yielding DH line yielded 80% of its parent population.

TABLE 1. Mean and range for seed yield of DH lines of *Brassica rapa* and their parent\ populations.

		Seed yield (g)		
	Year	Doubled haploids	Parent populations	CV (%)
Mean	1993[1]	2.9	9.3	33.3
	1994[2]	46.5	187.7	37.1
Range	1993	0.4-7.6	5.7-13.8	-
	1994	0.0-185.9	135.2-253.5	-

[1] yield per plant, [2] yield per row

Discussion

Low average seed yield of DH lines compared to parent populations was due to the expression of deleterious recessive allles. Seeds of many DH lines had low germination rates resulting in thin and uneven plant stands. The emerged seedlings grew slowly and were less vigourous than seedlings of parent populations. This was particularly evident in 1993 when the test was planted early on 18. May and the seedlings experienced low temperatures of 0^0C two to three times at the end of May. In 1994, the test was planted on 6. June and seedlings were less affected by low temperatures than in 1993 resulting in overall better seedling growth of DH lines. It was observed that the lower yielding DH lines had small, yellow and brittle leaves, weak stems and were only one third or less in height compared to their parent populations. DH lines were late flowering, the flowers opened slowly and leaves senescened early during flowering. All these characteristics were clear indication of severe inbreeding depression as deleterious recessive alleles were expressed due to complete homozygosity. The higher yielding DH lines had growth characteristics similar to their parent populations and suffered significantly less from inbreeding depression. However, even the best DH line yielded only 80% of its parent population.

During seed increases in the greenhouse, it was observed that many DH plants had low pollen production and thin and hairy styles, one DH plant was completely male sterile. The stems of some DH plants were spindly and root development was severely reduced in few lines. It was observed that weak, spindly, yellow leaved plants remained in the rosette stage longer than more vigourous plants and flowered and matured late. These plants performed poorly in the field and could be eliminated early from the breeding programme. About one third of the DH plants could be discarded in the greenhouse to save time and space. This was not done in the present study since the objective was to asses the full array of DH plants in *B. rapa* to characterize inbreeding depression in this species.

This initial evaluation assessed the performance of 43 (in 1993) and 131 (in 1994) DH inbred lines of *B. rapa* which was an insufficient number of lines to fully describe the potential of this technique for *B. rapa* inbred development. Many more lines must be produced and tested. However, result of this research indicated that the use of DH lines is a powerful tool for the development of high yielding inbreds for production of synthetic and or hybrid varieties of *B. rapa*.

REFERENCE

Baillie, A.M.R., Epp,D.J., Keller W.A. and Hutcheson, D.S. (1990). In vitro culture of isolated microspore and regeneration of plants in *Brassica campestris*. Proceedings 8th International Rapeseed Congress, Saskatoon, Canada. 4:1154-59.