MUTATIONS FOR DOUBLE ZERO BRASSICA JUNCEA

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ABSTRACT

Seeds of Brassica juncea (L.) Czern. var. NGP1 were treated with different doses of ethyl methane sulphonate, sodium azide and gamma radiations. M1 population raised from these seeds was investigated for germination, seedling height and mitotic and meiotic chromosomal aberrations, pollen sterility and seed set. M1 seeds were harvested plantwise and were analysed for erucic acid by Paper Chromatography and for glucosinolates by Tes-Tape method. Both erucic acid as well as glucosinolate content was compared with the pattern in Westar. Data obtained indicate variability in both the quality characters. Remaining seeds of these plants were used to raise the M2 generation and to study true breeding nature of these characters. The data obtained indicated high effectiveness of gamma radiations and EMS in the induction of mutations in genes controlling the synthesis of erucic acid and glucosinolates. However, these mutations were independent of each other and to produce double zero B. juncea, these mutants can be combined through hybridization. These investigations demonstrate possible utilization of induced mutation programme in further manipulation of fatty acids spectrum and glucosinolates in B. juncea.

INTRODUCTION

Indian Brassica juncea (L.) Czern. is characterized by brown seeds, high erucic acid and glucosinolates. Brown seeds give a tinge to the oil, while erucic acid and glucosinolates make the oil and meal undesirable from quality point of view. Vegetable oils have been tested for their effect on growth, food efficiency and safety (Mattson, 1983; Gottenbos and Visek, 1983). The Canola quality Brassica napus oil is already well accepted by the consumers in Canada, US and Europe and has made possible the utilization of low glucosinolate meal by the animal feed industry. Hence, an investigation on the effect of mutagens on the quality aspects of B. juncea which occupies wide acreage in India was undertaken.

MATERIAL AND METHODS

The seeds of B. juncea variety NGPI (2n = 36) were exposed to ethyl methane sulphonate, sodium azide and gamma radiations. Mutagen treated seeds were used to raise M1 generation. The M1 generation was investigated for germination,seedling height, mitotic and meiotic chromosomal aberrations, morphological and chlorophyll mutations and seed set. The M1 seeds were harvested plantwise and analysed for erucic acid by half seed technique (Downey and Harvey 1963; Downey and Craig 1964) and for glucosinolates by Tes-Tape method (Comer 1956; Lein 1970; McGregor and Downey, 1975). The plants with Westar level low glucosinolate and zero erucic acid were selected to raise M2 generation. The M2 progeny was selfed and seeds were harvested plantwise. These seeds were screened for erucic acid and glucosinolate following the above stated procedures. Selection was repeated for Westar level low glucosinolate and zero erucic acid. These seeds were used to raise M3

TABLE 1 : LEVELS OF GLUCOSINOLATE IN DIFFERENT MUTAGENIC TREATMENTS OF BRASSICA JUNCEA

Treatments	Total number of plants analysed	Levels of glucosinolate					
		–	±	+	++	+++	++++
Control	82	–	–	–	–	–	83 (100.00)
Westar	83	83 (100.00)	–	–	–	–	–
30 kR	24	–	–	1 (4.1)	8 (33.33)	10 (41.66)	5 (20.83)
40 kR	31	1 (3.22)	–	1 (3.22)	11 (35.48)	14 (45.16)	4 (12.90)
12h SA 0.008%	26	–	–	2 (7.69)	5 (19.23)	12 (46.15)	7 (26.92)
18h SA 0.006%	27	–	–	3 (11.11)	6 (22.22)	9 (33.33)	9 (33.33)
6h PSW + 3h SA 0.02%	30	–	–	2 (6.66)	5 (16.66)	12 (40.00)	11 (36.66)
12h EMS 0.01%	29	–	–	4 (13.79)	5 (17.24)	10 (34.48)	10 (38.48)
6h PSW + 3h EMS 0.03%	30	–	–	–	2 (6.66)	6 (20.00)	22 (73.33)
12h PSW + 3h EMS 0.03%	28	1 (3.57)	–	2 (7.14)	3 (10.71)	6 (21.420	16 (57.14)

Per cent values in parentheses.

generation.

RESULTS AND DISCUSSION

In this communication mutation for yellow seed colour was obtained with 18h dry seed treatment of sodium azide 0.004% and this mutation has been found to be true breeding. This yellow coloured mutant would contribute towards the better oil colour. It is well known that yellow seeds include lower crude fiber,higher protein contents in the meal and higher oil content in the seed than brown seeded cultivars (Stringam et al. 1974; Jonsson and Bengtsson 1970; Jonsson 1975). Seed coat colour in B. juncea is under the control of gene pairs at two loci (Vera et al. 1979). However, Stringam (1980) demonstrated that seed colour was determined by two independent dominant genes Br1 and Br3. Dominance at the Br1 locus results in brown seed, while dominance at the Br3 locus and homozygous recessive alleles at the Br1 locus produces yellow-brown seed. The homozygous recessive condition at both loci results in yellow seed. Yellow seed was induced in brown seeded B. juncea by gamma radiations (Labana and Banga, 1988).

Seeds were also tested for erucic acid and variability for erucic acid content was recorded. However, this data is not yet complete and therefore not included in this communication. More emphasis in this study has been given to the screening of low glucosinolate mutants. The data on induction of low glucosinolate in M1 generation are recorded in Table I. A single plant with Westar level low glucosinolate was obtained in 12h PSW + 3h EMS 0.03% and 40 kR treatments, respectively. Other mutagens also induced low glucosinolate levels, however, were not comparable with Westar. Hence, Westar level low glucosinolate and one plus (+) plants from other mutagenic treatments were selected and sown for M2 generation. The data obtained on the frequency of low glucosinolate are summarised in Table 2. Gamma radiation, ethyl methane sulphonate and sodium azide were observed to induce Westar level low glucosinolate plants. The frequency of these plants was more in 40 kR (6.60%) and was followed by 30 kR (6.13%) and 12h PSW + 3h EMS 0.03% (5.71%). The lowest frequency of low glucosinolate plant was obtained in 12h SA 0.004%, 12h SA 0.008%, 12h PSW + 3h SA 0.01% and in 6h PSW + 3h EMS 0.01%. 18h dry seed treatment of EMS did not induce any low glucosinolate mutations. Plants with different low levels of glucosinolate were therefore selected in M1 and M2 generations and their inheritance pattern studied in M3 generation. In this report attempts, were made by Applqvist and Josefsson (1967), in rapeseed and they demonstrated the application of mutation breeding for achieving these goals. Kondra and Downey (1970), Kondra and Stefansson (1970) and Lein (1972) observed different levels of glucosinolate in single plant. Josefsson (1973), for the first time, demonstrated reduction in glucosinolate due to presence of a gene block. Recently Love et al. (1990) reported incorporation of a Bronowski gene block in the metabolic pathway of glucosinolate in B. juncea through conventional breeding procedures. They further indicated that the glucosinolate content was under the influence of genes and different alleles contribute to the total content. In the present investigation, mutations in these genes resulted in low glucosinolate levels.

The treatments with gamma rays, EMS and SA resulted in the induction of yellow seed coat, low erucic acid and glucosinolate in B. juncea. These three characteristics could be combined through conventional breeding procedures to achieve the Canola quality mustard. Besides these

TABLE 2: LEVELS OF GLUCOSINOLATE IN DIFFERENT MUTAGENIC TREATMENTS OF BRASSICA JUNCEA

Treatments	Total number of plants analysed	Levels of glucosinolate					
		-	±	+	++	+++	++++
Control	390	-	-	-	-	-	390 (100.00)
Westar	390	390 (100.00)	-	-	-	-	-
30 kR	163	10 (6.13)	2 (1.22)	35 (21.47)	23 (14.11)	47 (28.83)	46 (28.22)
40 kR	198	12 (6.60)	4 (2.02)	56 (28.28)	50 (25.25)	74 (37.37)	2 (1.01)
12h SA 0.008%	82	1 (1.21)	1 (1.21)	4 (4.87)	5 (6.09)	17 (20.73)	54 (65.85)
18h SA 0.006%	148	2 (1.35)	2 (1.35)	2 (1.35)	11 (7.43)	25 (16.89)	64 (43.24)
6h PSW + 3h SA 0.02%	115	5 (4.34)	-	17 (14.78)	19 (16.52)	30 (26.08)	44 (38.26)
12h EMS 0.01%	162	4 (2.46)	3 (1.85)	7 (4.32)	28 (17.28)	27 (16.66)	93 (57.40)
6h PSW + 3h EMS 0.03%	91	2 (2.19)	-	6 (6.59)	6 (6.59)	15 (16.48)	62 (68.13)
12h PSW + 3h EMS 0.03%	140	8 (5.71)	-	2 (1.42)	4 (2.85)	14 (10.0)	112 (80.00)

Per cent values in parentheses.

characteristics indications have been obtained for alterations in different fatty acid proportions and hence these studies could be further applied to the selection of desirable spectrum of fatty acids in mustasrd oil.

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