ON THE WAY TO YELLOW SEEDED Brassica napus L. - HYBRIDS OF B.campestris x B.oleracea AND OF B.oleracea x B.carinata YELLOW SEEDED

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As it is well known, yellow seed coat causes higher protein and fat content and lower crude fibre content (Jönsson R., Bengtsson L. 1970; Pawlowski S.H., Youngs C.G. 1969; Stringam G.R., McGregor D.I., Pawlowski S.H. 1974; Liu Hou-Li et al. 1983).

It has been stated, that the seed coat colour depends at least from three independent factors: Br_1Br_1, Br_2Br_2, Br_3Br_3 (Mohammad A., Sikka S.M., Aziz M.A. 1942; Jönsson R. 1977) or Bl_1, Bl_2 and Bl_3 (Shirzadegan M. 1986), which in recessive state are causing the pale yellow colour of the seeds.

The aim of this work was to obtain yellow seeded B.napus forms on the way of interspecific crosses or at least to approach this difficult task.

Materials and methods

Two among the crossed species: B.campestris ssp. pekinensis cv. Nagaoka WR 55 Days and B.oleracea var. sabauda cv. Predzvest originated from the collection of the Plant Breeding Station of the Horticultural Plants in Puck. The other two species: B.oleracea var. acephala cv. Normal and B.carinata yellow seeded belonged to the own collection.

The maternal form B.campestris ssp. pekinensis cv. Nagaoka WR 55 Days is of Japanese origin, from the firm Takii and has large, lettuce-like leaves, used as vegetable. The paternal form B.oleracea var. sabauda cv. Predzvest was bred in Tschechoslovakia, in the firm Semex. B.oleracea var. acephala cv. Normal, the maternal form from the second pair of parental forms, is called also the Thousand Head Kale and originates from Great Britain. This is a fodder form, which charcterizes themselve with very strong vegetative growth. On the other hand, Brassica carinata , the paternal form in this crossing combination, is of rather poor growth habit and represents an oilseed and vegetable crop of Ethiopia. It is an ancient, widely grown crop there.

B.campestris ssp. pekinensis cv. Nagaoka WR 55 Days and B.oleracea var. sabauda cv. Predzvest have been crossed in 1981 with the help of in vitro cultures technique, as previous described (Zwierzykowska E. 1983).

After pollen viability testing and colchicine treat-

ment with 0,2% colchicine solution, plants with chromosome number 2n=38 have been selected.

Crosses between B.oleracea var. acephala cv. Normal and B.carinata yellow seeded began in the year 1982 and have been done in the conventional way.

The viability of pollen grains has been tested in Belling's solution.

For somatic chromosome counting the root-tips were pretreated with ice-cold water for 24 hr, fixed in ethanol-acetic (3:1) and stained with Feulgen.

Results

Presented results are dealing with the progeny of the interspecific crosses between B.campestris ssp. pekinensis cv. Nagaoka WR 55 Days (2n=20) x B.oleracea var. sabauda cv. Predzvest (2n=18) and B.oleracea var. acephala cv. Normal x B.carinata yellow seeded.

Hybrids of B.campestris x B.oleracea

The two first crossing components have been crossed in the greenhouse in the year 1981. 165 ovaries of B.c. ssp. pekinensis cv. Nagaoka WR 55 Days have been pollinated with the pollen of B.o. var. sabauda cv. Predzvest. From these 165 ovaries, 122 were layed out on the Murashige and Skoog medium and after 30 days of culturing 11 embryos have been isolated. From these embryos five plants have been obtained and four of them remained alive after planting them into the soil. Their pollen was completely sterile. Cytological testing has shown that chromosome number of these forms amounted 2n=19. This F_1 progeny has been treated with 0,2% colchicine solution through 24 hours on side shoots, aiming at obtaining synthetic forms of B.napus (2n=38). The F_2 generation (2n=38) phenotypically resembled the maternal crossing component. Among 8 plants of this generation the pollen viability varied from 29 to 82%. The height of plant amounted from 95 to 180 cm and number of seeds per plant - from 2 to 224. Three forms 5, 7 and 8 of the F_2 generation have been sown in the field conditions. In the year 1983 further observations, dealing with the C_4 and C_3 progeny of synthetic B.napus took place. Among C_4 generation there were 80% of overwintering plants, while in the C_3 - 90% to 94%. For further experiments there have been chosen plants with generative type of growth.

In the year 1984 among 35 plants of the C_3 progeny the seeds of the plant No 16 (2n=38) characterized themselves with brown seed coat. The lightest seeds of this form have been sown in the greenhouse and field conditions.

Among 69 plants observed in the C_4 generation there appeared two different phenotypes. Observations at the 5-6 leaves stage allowed to distinguish "the hybrid type", with loose rosettes, smooth leave blades with short petioles and the first leaves a little dentated. This phenotype characterized 55 plants. The residue 14 plants had dense rosettes, with leaves nearly without petioles and leave blades more or less wrinkled. This type was called "maternal type". Among the hybrid type 11 plants with yellow seed coat have been found. Their seed yield was lower in comparison to the plants with dark seeds, and amounted from 0,6 to 28 seeds per plant, while dark seeded plants had from 0,7 to 1003 seeds.

In the F_2 generation there appeared strong segregation dealing with the seed coat colouration. Among 594 plants investigated, only two had yellow seeds on free pollinated stems and under isolated conditions as well. These two plants No. 612/34 and 613/7 have been sown during the current vegetation period 1986/87.

Hybrids of B.oleracea (2n=20) x B.carinata (2n=34)

The main aim of this cross combination was to obtain the yellow seeded form of B.oleracea, which after crossing with B.campestris yellow seeded, should lead to B.napus with yellow seed coat.

Hybridization of these two species started in the year 1981. The female parent was B.oleracea var. acephala cv. Normal. The paternal plant was represented by the yellow seeded form of B.carinata, consisting of the genomes B.oleracea (2n=18) and B.nigra (2n=16). Informations dealing with the F_1 generation of this cross have been already reported (Barcikowska B., Balicka M., Zwierzykowska E. 1983).

In the year 1983 10027 backcrosses with B.oleracea have been done, which gave 40 seeds (0,31%) and 8 BC_1 plants with chromosome number varying from 2n=22 to 28. Only 3 plants were fertile. Then two cycles of selfpollination followed, giving the BC_1S_1 and BC_1S_2 generations in the years 1985 and 1986. Eight plants in the BC_1S_2 progeny represented phenotypically B.oleracea. Unfortunately all these forms characterized themselves with dark seeds.

Plant vigour of these forms was quite satisfying. According to the results in the year 1986 the height of plants oscillated from 109,2 cm to 152,5 cm and number of branches - from 1,3 to 3,1. Fertility of forms investigated, determined by the percentage of set pods in relation to the number of flower petioles on a studied plant, varied from 0 to 86,4% with averages of 28,7%, 28,9% and 38,8% for the evaluated progeny of three forms selected. These rather low values are certainly due to the hybrid character of these plants. Pollen viability characterized also very great variation, from 0 to 99,3% with the mean values 80,0%, 94,88% and 75,32% for the three investigated groups. Number of seeds per pod amounted from 0,3 to 20,2 with average numbers 3,4, 9,6 and 4,1 for the three progenies tested. Besides these datas, observations of plant phenotypes in the BC_1S_2 generation, have been made. The most promising phenotypes have been sown in the greenhouse, during the vegetation period 1986/87. Before all, the plants of B.oleracea phenotype have been chosen, then the intermediate phenotypes between B.carinata and B.oleracea, B.campestris and B.oleracea, B.campestris and B.napus and also between B.napus and B.carinata, with the hope, that these visible characters of hybrid origin suggest the possibility of appearing the yellow seed coat.

During current vegetaion period, there are 341 BC_1S_3 plants in the greenhouse. Their chromosome numbers vary from 2n=26 to 2n=72. Phenotypical variation is widely spread - from those plants, which resemble B.oleracea to a considerable number of intermediate and of B.napus phenotype, with chromosome number 2n=38. All these plants are just forming their pods and some of them begin to mature.

Conclusions

1. Great phenotypical variation of the BC_1S_2 and BC_1S_3 progeny and low fertility of BC_1S_2 confirm the hybrid origin of the BC_1S_2 and BC_1S_3 generations.
2. Presumably there will be necessary to prolongue the selfpollination in the next generations of the hybrids, to enable the segregation of yellow seed coat, the recessive charcter, depending from three independent genes.
3. Among forms sown in the greenhouse, in 1986/87, which are now just in maturing stage, the most promising seems to be the BC_1S_2 generation of plant No. 63/2 and 63/6 of B.oleracea phenotype. Yellow seed coat of these forms would gave B.oleracea ready for crosses with yellow seeded B.campestris.

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