TRANSFER OF RESISTANCE TO RACE 2 OF
PLASMODIOPHORA BRASSICAЕ FROM BRASSICA NAPUS TO CABBAGE (B. OLERACEA SSP.
CAPITATA). III. FIRST BACKCROSS AND
F₂ PROGENIES FROM INTERSPECIFIC HYBRIDS
BETWEEN B. NAPUS AND B. OLERACEA SSP.
CAPITATA

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disease, fungal resistance, interspecific cross, resistance breeding, chromosome numbers, meiosis.

SUMMARY
The first backcross and F₂ progenies from triploid F₁ and tetraploid F₁ hybrids between B. napus and 2x and
4x B. oleracea ssp. capitata (cabbage) were studied for their general morphology, resistance to race 2 of the
clubroot pathogen, chromosome number and meiotic chromosome behavior. No linkage was apparent
between resistance and the major morphological characters. Unreduced gametes played a large part in the
successful formation of seed of the B₁ and F₂ progeny. B₁ plants with low chromosome numbers were
selected for use in recurrent backcrosses. The potential use of anther culture to extract gametic progenies
from resistant B₁ and F₂ plants with higher chromosome numbers was suggested. The presence of ho-
moeologous pairing observed in all the plants is considered advantageous for selecting suitable progeny in
later generations.

INTRODUCTION
The transfer of resistance to race 2 of Plasmodiophora brassicae Wor. from Brassica
napus L. (rutabaga) to Brassica oleracea L. ssp. capitata L. (cabbage) has been pre-
viously reported by the authors (CHIANG et al., 1977, 1978a). The first of these studies
dealt with the development of the F₁ interspecific hybrids; the second with meiosis in
the hybrids. The current paper presents information gathered from the first ba-
ckcrosses and F₂ progenies derived from triploid F₁ (2n = 28, a₁c₁c) and tetraploid F₁
hybrids (2n = 37, a₁c₁cc). Unlike the behavior of primary hybrids between B. napus
and B. campestris (NwANKITI, 1970), our triploid F₁ hybrids were almost completely
pollen sterile. Upon selfing, only a single seed formed which did not germinate. Hence
no F₂ progeny was obtained for study from the triploid F₁ hybrids of this cross.
From the cross between cabbage (2n = 18, cc) and a triploid hybrid (B. campestris × B. oleracea, 2n = 28, acc), Gotoh (1959) obtained only a single plant (2n = 20) which looked like cabbage in general appearance. From selfing, backcrossing or open pollination of a similar triploid hybrid [B. oleracea (female gamete irradiated) × B. campestris], Davies & Wall (1961) reported that no viable seed was produced. From the backcross of the F1 hybrid (rutabaga × ‘Greenball’ cauliflower) with broccoli, Honma & Summers (1976) obtained a few highly sterile plants but no cytological or disease reaction data were taken.

Although seed set per pollination was generally low in our tetraploid F1 hybrids (Chiang et al., 1977), many B1 and F2 seeds were obtained and pooled for the present study.

MATERIAL AND METHODS

During 1976 and 1977, studies were conducted with three types of experimental material as plants became available: (1) first backcross plants (B1) from hybridization between triploid F1 hybrids (2n = 28, a1c1c) and 2x cabbage, (2) B1 plants from tetraploid hybrids (2n = 37, a1c1cc) × 2x cabbage, and (3) F2 plants derived from selfing and sib-mating of tetraploid F1's.

All B1 plants in both types (1) and (2) resulted from using 2x cabbage as the pollen source since the triploid hybrids produced practically no pollen, and there was no seed set when pollen from the tetraploid hybrids was applied onto cabbage flowers. For testing the reaction to clubroot disease, seedlings were grown in a greenhouse and transplanted into a P. brassicae race 2 infested field at the 5 to 6-leaf stage in June. Scoring for resistance was carried out in mid-October according to the grading system suggested by Chiang & Crete (1972). Procedures for assessing pollen stainability and for carrying out the cytological examinations were the same as described previously (Chiang et al., 1977, 1978a).

RESULTS AND DISCUSSION

First backcross progeny from hybridization between triploid F1 (2n × 28, a1c1c) and 2x cabbage. Thirty five of 39 seeds germinated but only four plants survived. The somatic chromosome numbers of these four plants are 18, 19, 20 and 38, and they will be referred to henceforth as B1-A-1, B1-A-2, B1-A-3 and B1-A-4, respectively. Apparently, egg cells of the triploid hybrids with n = 9, 10 and 11 chromosomes can combine with normal (reduced) cabbage pollen, while probably a 20-chromosome F1 hybrid gamete united with an unreduced pollen of cabbage (Table 1). However, the possibility cannot be ruled out that plant B1-A-4 could also have resulted from chromosome doubling of a parthenogenetically developing 19-chromosome egg of the F1 hybrid.

Morphologically, B1-A-4 is like the F1 plants, that is, intermediate between B. napus and cabbage. However, the other three B1 plants all resemble their cabbage parents more closely (Fig. 1 and 2). B1-A-2 (2n = 19) is much smaller in stature and produced only a few abortive flower buds. It rated grade 1 in its susceptibility to the race 2 clubroot pathogen in the field. B1-A-3 (2n = 20) has not reached the flowering stage and its disease reaction is not available yet because the seed for this plant was harvested.