THE EFFECT OF INTENSITY OF SELECTION DURING SUCCESSIVE GENERATIONS OF SEED MULTIPLICATION, ON THE FIELD PERFORMANCE OF BRUSSELS SPROUTS

A. G. JOHNSON and J. C. HAIGH
National Vegetable Research Station, Wellesbourne, Warwick

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ABSTRACT

An experiment in which two different intensities of selection were applied, in each of three successive generations, to two varieties of Brussels sprout showed that the progeny resulting from lax selection were frequently inferior in agronomic characteristics to those from the more stringent selection. In one of the varieties used, this inferiority took the form of an increase in the proportion of off-types, and in the other there was a decrease in yield.

These results imply that deterioration in the agronomic value of a variety is likely to occur whenever standards of selection are relaxed, for example, to accelerate the multiplication of seed. It is suggested that such deterioration is most likely to occur in those characteristics for which selection has improved the uniformity of a variety but has produced only partial homozygosity over the range of loci affecting those characteristics.

INTRODUCTION

Natural seed production in Brussels sprouts predominantly results from cross-pollination. An ordinary variety consists of a heterogeneous mixture of heterozygous plants, and each generation of seed production can release phenotypic variation in the progeny. It is normally assumed that the more critical the parent plant selection, the less the heterogeneity of the group of plants selected, and hence the smaller the range of variation released in the progeny.

If improvement is sought in a variety, it is usual to make a highly critical selection, retaining an extremely small proportion of the plants and ensuring that as far as possible all plants seeded together are phenotypically similar. Such selection, often continued for several successive generations, produces a "breeding line" or "breeder's type" which may be agronomically superior to the original population. The seed produced in this manner, of the breeding line, may be known as the "nucleus", or "basic" seed and the populations grown from such seed as the nucleus, or basic, "stock". The amount of nucleus seed available is usually very limited, and it is necessary to multiply this in order to obtain a quantity of "commercial" seed which is sufficient to supply the needs of growers. However, during multiplication of a breeding line prior to release as a variety, or during maintenance of a variety already released, standards of selection are often relaxed in order to improve the rate of multiplication. If the assumption already stated is correct, deterioration in uniformity, and hence in agronomic value, is likely to occur as a result of multiplication.

Heterogeneity of a population is expressed as variation of the phenotype about a mean, which is known as the "main" or "true" type, and plants which are obviously
different from the mean type are known as "off-types". Thus the percentage of off-types provides a measure of the variability of a population and comparison of the percentage of off-types between the nucleus or basic stock on the one hand and the commercial population on the other provides an indication of the deterioration in uniformity. Horne, reporting surveys of Brussels sprouts made by the National Institute of Agricultural Botany during the period 1948 to 1951, noted that commercial populations of three varieties contained between 50% and 100% of variants from the main type, the mean being 81%; while the nucleus stocks of the same varieties contained an average of only 12% variants from the main type. Other tests quoted by the same author showed that commercial growers' populations of new varieties, obtained by multiplication for two or more generations, differed widely from the breeder's nucleus stock.

In order to provide information on the change in phenotypic uniformity which may follow from changes in the intensity of selection during multiplication, experiments were carried out in which each of two varieties of Brussels sprout was subjected to two different levels of selection intensity during each of three generations of multiplication. The resulting lots of seed were then grown in field trials. The varieties "Cambridge No. 1" and "Cambridge Special" were used for these experiments, since the National Vegetable Research Station (N.V.R.S.) and the National Institute of Agricultural Botany (N.I.A.B.), which co-operated in the experiments, are jointly responsible for the maintenance of these varieties and are therefore familiar with them.

TREATMENTS

When the experiments began, there was already an established practice for maintenance and multiplication of the "Cambridge" varieties of Brussels sprout under the N.I.A.B. certification scheme. The N.V.R.S. maintained nucleus seed which was obtained by seeding together about 25 plants selected from a field crop of about 2500 plants grown from previous nucleus seed. Thus the nucleus seed of each variety was maintained by successive selections at the 1% level. As required, this nucleus seed was used by the N.I.A.B. to grow field crops for the second phase of multiplication. In this phase, about 10% to 15% of the plants were selected from a population of about 5000. The seed so produced was supplied to seed firms who carried out the third phase of multiplication to produce "field certified" commercial seed for sale to growers. During this last phase of multiplication only those plants which were obviously of incorrect type were removed, a process known as rogueing. In order to avoid confusion of terms, the process of rogueing, in which not more than 15% of the plants were removed, will be regarded in this paper as selection of not less than 85%.

In each phase of multiplication in the present experiments it was only practicable to impose one level of selection additional to that normally used in the seed certification scheme. In the first phase, nucleus seed production, a treatment consisting of selection of 5% of the plants was applied for comparison with the existing practice of 1% selection. In the second phase, where the existing practice was 10% to 15% selection, a treatment of 85% selection was made for comparison; and in the third phase 10% selection was compared with the existing practice of 85% selection. Table 1 gives details of the various seed lots involved in these experiments.

It was desirable that all factors, apart from the specified treatments, should be held