products of photosynthesis is incorporated in leaf tissue, changes in it lead to changes in the former.

It seems likely that the heights of dwarf and normal plants grown in the greenhouse were limited, though to markedly different degrees, by deficiency of endogenous gibberellin, since both types of plant responded to applied gibberellic acid, the former strongly, and the latter relatively slightly. The growth of dwarf plants was also limited by the relatively deficient photosynthesis, since the number and size of leaves are characteristically less in dwarfs than in normal plants. Photosynthetic tissue was increased in greenhouse-grown dwarfs by gibberellic acid treatment, due to an increase in the size, but not in the number of leaves. (Photosynthetic efficiency, measured as net assimilation-rate, was similar in normal and dwarf plants, and was not affected by gibberellic acid[1].)

The growth and development of untreated and gibberellic acid-treated dwarf and normal plants grown under low light intensity in the growth cabinet was profoundly modified by reduced photosynthesis; and, in consequence, the morphogenetic response of the dwarf to gibberellic acid was modified, since during the protracted vegetative phase the apical meristem responded to gibberellic acid, and the treated dwarfs produced as many leaves as normal plants. Thus the effect of gibberellic acid on the photosynthetic tissue of the dwarf mutant was relatively greater when the plants were grown in the growth cabinet than when they were grown in the greenhouse, and this may have accounted for the relatively increased stem elongation of treated dwarfs in these conditions. Stem elongation was greater in these treated dwarfs than in untreated normal plants which were probably deficient in natural gibberellin, as indicated by the response of normal plants to treatment with gibberellic acid.

It is evident that the morphogenetic responses of *S. vulgaris* to gibberellic acid are considerably modified by environmental factors, and it seems probable that this is due to effects on both the photosynthetic capacity of the plants and their native growth substances, including gibberellin. It may well be that an investigation of the responses to gibberellic acid of dwarf mutants in other species grown in different environments would be of interest, and might lead, as in this case, to still more striking demonstrations of the effects of this substance.

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Volatile Mustard Oils of *Brassica juncea* Seeds

Brassica juncea Coss. and Czern. is an important cultivated mustard species. It is said to be a native of Asia and is grown particularly in China, Japan, India, Pakistan, Nepal and eastern Europe as a vegetable and an oil-seed crop, although it has also been introduced into North America and certain West European countries as an oil-seed crop and for use in the manufacture of condiments[5]. The species is of botanical interest in that it shows marked variation in external morphology, especially leaf form[1]. Variation, too, has been reported in the type of volatile oil produced on the hydrolysis of the seed glucoside; three conditions have been described: (*a*) the production of allyl isothiocyanate only[2,4]; (*b*) the production of 3-butenyl (= 'crotonyl') isothiocyanate only[4]; (*c*) the production of a mixture of allyl and 3-butenyl isothiocyanates[2].

In present investigations into variation in *B. juncea* in connexion with a programme of plant breeding, 96 samples of seed were obtained from a wide range of geographical sources, and grown in England; this collection was found to include all the main varietal forms of the species previously described in the literature. The volatile mustard oils of the seeds were identified using a paper chromatographical method[3]; in this analysis two controls were run, one of allyl thiourea and the other of phenyl thiourea (which gave a reference spot from which Rph values of other compounds were defined). Allyl isothiocyanate gave an Rph value of 0·26 and the value of the only other compound detected in the test, 0·62, indicated that it was 3-butenyl isothiocyanate.

All the three conditions of volatile oil production previously described were found during these investigations, and there appears to be a correlation between this variation and the geographical distribution of the species, a situation, so far as is known, not previously reported. Seeds from China, Japan, Nepal and Eastern Europe (49 samples) exhibited only condition (*a*), with the exception of three samples which produced very faint traces of 3-butenyl isothiocyanate in addition to allyl isothiocyanate. Conditions (*b*) or (*c*) defined here were shown only by seeds from India and Pakistan (twenty-one samples). The remaining twenty-six samples received from North America and western Europe had volatile oil production entirely consistent with their described origins from various countries, namely, six samples originating from India and Pakistan showed conditions (*b*) or (*c*), and twenty samples of other origin showed condition (*a*).

The possible amphidiploid origin of *B. juncea* from *B. nigra* (L.) Koch and *B. campestris* L. may account for these variations of volatile oil production, as *B. nigra* has been reported as giving only allyl isothiocyanate[6], which has been confirmed in the present investigations, and *B. campestris* has been found to produce only 3-butenyl isothiocyanate. The correlation with geographical distribution, together with other evidence from investigations of plant and seed morphology, might suggest that natural hybridization to produce *B. juncea* has occurred at different geographical loci.

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