numerous pods failed to fill after setting. Broad beans, as with peas, normally show only a faint intervenal chlorosis of the leaves and the symptoms are not striking.

In a field trial in 1943, peas and broad beans (var. Exhibition Longpod) growing in an acutely manganese-deficient market garden soil in Bristol were examined and showed symptoms of the 'marsh spot' type in stages ranging from mild to severe. Similar material examined in 1944 showed severe 'marsh spot' in the peas and only mild symptoms of this trouble in the beans. Runner beans (Scarlet Emperor), dwarf beans (Prince and Masterpiece), a haricot bean (Comtesse de Chambord) and a tick bean included in the trial showed no symptoms in the cotyledons. The typical leaf symptoms were especially severe in the dwarf beans and in the haricot beans, in which the symptoms resemble those of the dwarf bean.

Leaf symptoms in these trials have been prevented and cured by spraying the leaves with an aqueous solution of manganous sulphate (0·25 per cent solution of $MnSO_4.4H_2O$). The results show that whereas peas are very susceptible to manganese deficiency, as shown by the severity of 'marsh spot', broad and runner beans are more resistant to this form of injury, whereas dwarf beans and haricot beans, which show the most marked leaf symptoms, are most resistant and may remain free from 'marsh spot' even when the leaf symptoms are very severe.

Some details of this and related work carried out under the Agricultural Research Council scheme for plant nutrition have already appeared, and a further report is in course of preparation[7].

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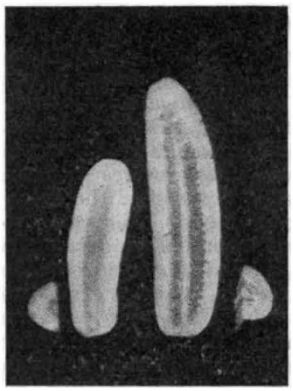
Fluorescein-induced Parthenocarpy

PARTHENOCARPY can be induced in, among other plants, the common edible members of Solanaceæ and Cucurbitaceæ by artificial treatment of the unfertilized ovary with pollens of a different family[1], pollen extracts[2,3], many growth-promoting substances like indole-acetic acid[3,4], and even manganese salts[5]. All the inducing agents so far employed, including manganese salts, have been shown either to contain auxin or to be auxin-like in their physiological activities. These facts have led to the hypothesis proposed by Gustafson[3] that growth hormones are essential for the initiation and maintenance of fruit development, and recent experimental evidence seems to support this view[6]. While there is no doubt that growth hormones, defined as they are, play a dominant part in fruit development, it is still a question whether auxins or auxin-like substances alone can induce parthenocarpy; for we have been able to induce parthenocarpy in members of these two families with fluorescein, a substance known to act on plants sometimes antagonistically to auxins.



Left: PARTHENOCARPIC FRUIT. *Right:* NORMAL CUCUMBER.

During our investigations on the physiological activities of fluorescein dyes, we had applied a lanolin paste of 1 per cent fluorescein to stigma and cut styles of protected female flowers of cucumber. About half the treated pistils eventually developed into fruits which answered all the descriptions of parthenocarpy, being a little smaller in size and with a relatively large fleshy pericarp and empty ovules (see accompanying photograph). Similar smaller and seedless parthenocarpic fruits have been induced in *Luffa*, egg plant and pepper in subsequent trials. Time, however, does not permit a detailed study.

It has been known that roots which have been treated with eosin, one of the fluorescein dyes, lose their geotropic sensitivity and acquire phototropism instead[7]. This action of eosin has been explained by Skoog[8], who showed that traces of eosin cause rapid photodynamic inactivation of solutions of indole-acetic acid. When fluorescein was fed to plants at regular intervals, Sellei[9] was able to show that fluorescein at certain concentrations (0·5–3 per cent) dwarfs the plant, but at lower concentrations (1 : 2,000,000) promotes its growth and general development. The concentration we used for inducing parthenocarpy far exceeds those which will have beneficial effects on plants. Fluorescein is neutral in the *Avena* test and fails to induce local swelling in decapitated epicotyls of *Vicia*, as auxins and, strangely enough, some of the very common chemicals (for example, sugar) would do. Since Muir[6] has shown that the initiation of fruit development by pollen may be an indirect one, growth hormones being liberated from inactive combinations in the ovary after the pollen tube has been introduced, fluorescein dyes might do the same. We have in mind an analogous case in animal embryology, when certain dyes may uncover the inducing power of an embryonic tissue[10]. The plant used in our experiments is well known for its tendency to yield parthenocarpic fruits. It would be of great interest if similar experiments on parthenocarpy can be extended to other dyes, chemicals and even mechanical treatment.

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