

VARIATIONS IN CARPEL NUMBER OF *ABUTILON* *THEOPHRASTI*

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The genus *Abutilon* is represented in that part of the United States and Canada covered by Gray's Manual by a single species, *Abutilon theophrasti*, commonly known as the Velvet Leaf. It belongs to the Malvaceae, and, in common with other members of this family, possesses a flower with 5 sepals united at the base, 5 petals, numerous stamens, and a variable number of carpels. Gray gives the carpel number as 12 to 15, but the range of variability appears always to be greater than this, especially if the plants represent all types of habitats where it grows. The number usually ranges from 10 to 16, with a very few ovaries with as many as 17 carpels.

Having used *Abutilon theophrasti* for class studies of variation in a course in genetics about 25 years ago, the writer has been interested in the peculiar problem presented by these plants since that time, and has counted many thousands of them in widely separated localities. In the autumn of 1935, studies were made near Lafayette, Indiana; Lexington, Kentucky; Homewood, Illinois; Lawrence, Kansas; and St. Paul, Minnesota. This report deals only with the material collected at Homewood, Illinois, on September 21, 1935. The total number of plants counted at Homewood was 87, with 3152 ovaries. The range in carpel number was from 10 to 17 on the group as a whole, with a very strong mode on 15. Approximately 60 per cent of the ovaries belong to the modal class; and more than 99 per cent are included in the modal and submodal classes; less than 1 per cent have carpels more numerous than the modal class. The distribution of carpel number for these 87 plants is shown in figure 1, curve A, with scale along the left margin.

Well developed plants very frequently exhibit half-curve variability in carpel number; that is, the variances all fall upon or below the mode, none occurring above the modal number. Five moderately vigorous plants are plotted in curve B, figure 1, scale along the right margin. In every population of *Abutilon*

plants one finds individuals which exhibit this half-curve variability. The largest single plant collected at Homewood bore 352 ovaries, distributed with reference to carpel number per ovary as follows:

11	12	13	14	15
3	7	22	81	240

When the plants grow in difficult habitats, as in hard uncultivated soils, along roadsides, in heavy grass, or in severe competition with other plants in cultivated fields, the poor nutritional condition of the plants is reflected in a reduction of the carpel number. Curve C

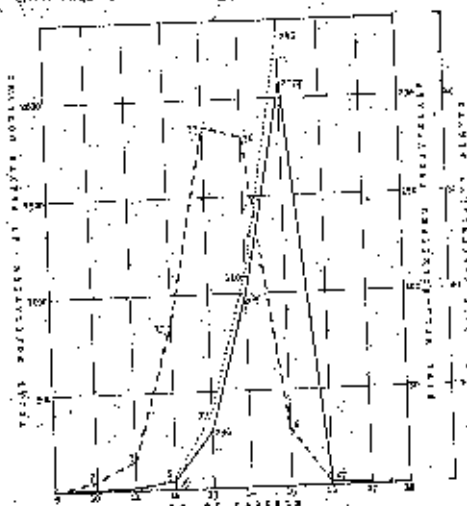


Fig. 1

in figure 1 was constructed from the counts of ovaries from 26 starved plants that had altogether only 100 ovaries, about 4 per plant. (Scale in interior of fig. 1). The range is now 10 to 15, the mode on 13 instead of 15, and the number of ovaries with 15 carpels is only about 17 per cent of the total instead of 60 per cent.

The explanation of half-curve variability is difficult, at best. If all of the ovaries had 15 carpels, we might explain it as an hereditary expression of the 5-paired condition of the floral organs, with 5×3 as a fixed arrangement in

floral ontogeny. Even if the mode is on 15 in plants with fair or abundant nutrition, there is as yet no evidence that an early stage in ovarial development has a 5-lobed primordium which subsequently develops three carpels to each lobe. The mere fact that preliminary observations have yielded no evidence of such 5-parted condition does not prove, however, that the tendency to produce carpels in five groups of three each may not be present. The earliest primordia examined seem to have all of the carpels differentiated, just as they will be in the completely developed ovary.

It is evident that the actual number of carpels formed is a function of the nutrition of the plant. With poor nutriment (starvation from poor soil, competition, etc.) the number of carpels is reduced. The range starts with lower numbers, and the modal condition is depressed. The writer has considered the possibility that inheritance of the 5-parted condition on the one hand, and the partial failure of nutrition on the other, might account

for the total behavior. One might expect that if every primordium received a full and equal distribution of nutrients, and just right for the development of 15 carpels, the tendency to develop the floral organs in 5-parted condition would show up in lack of variability in number— all of them with 15 carpels. But if some primordia receive not quite enough food, or mineral elements, or water, or hormone the number falls to 14, or 13, etc., because of insufficient material or insufficient growth stimulus. The greater the degree of malnutrition, the greater the carpel number varies from the inherited modal condition.

These ideas have served only as a working hypothesis, and have made the study of carpel number in *Abutilon theophrasti* something more than a mere counting exercise. Such examples of variation are worthy of penetrating and profound study, for it is only by such investigation that we may hope to understand the behavior of organisms showing pronounced half-curve variability of any of their characteristics.