

A UNIFOLIOLATE MUTATION IN THE ADZUKI BEAN

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THE Adzuki Bean (*Phaseolus angularis*), like other members of the genus *Phaseolus* to which our common beans belong, is trifoliolate. Although the first pair of leaves above the cotyledons are simple, those later formed are regularly compound each with three leaflets. Occasional abnormalities in individual leaves, it is true, may be found, and the writer has record of a seedling plant with but a single simple leaf which was unable to continue growth on account of the lack of buds. So far as the writer is aware, however, a full-grown Adzuki Bean plant with all its leaves simple has only once been observed. In view of the number of plants of this species that have been under close observation for a considerable length of time, it seems worth while to make a brief record of this occurrence.

The plant on the right in Fig. 2 is shown beside a normal individual from the same pedigree. Unfortunately the photograph was not taken till late in the season when the foliage was in an imperfect condition. A typical unifoliolate leaf isolated from this plant is shown on the background at the right in contrast with a typical trifoliolate leaf on the extreme left from the normal plant. The mutant plant was somewhat taller than its neighbors in the same pedigree, was more branched and retained its leaves longer. In fact it was difficult when the photograph was taken to find a normal plant that had not lost most of its leaves. These peculiarities in habit may be due to the fact that the plant was entirely sterile, and vegetative functions in consequence were not checked by the production of fruit. Buds were formed in densely packed

spikes giving promise of abundant flowers. No fully formed flowers, however, ever developed. The buds all dropped at an early stage before the petals were visible. As the dropping proceeded from the base upwards, the axis of the cluster progressively elongated and thickened. These floral clusters may be seen projecting from the plant in many places. They show the terminal clusters of young buds and the elongated axes studded with warty scars that mark the places from which buds have fallen.

The unifoliolate plant was the only one of its kind in a row of some 1,500 plants grown in 1918. The parents of this pedigree were the offspring of a single select plant grown in 1918. The line from which the mutant arose came from a single plant grown in 1913. The descendants of this original plant, including a number of sublines, comprise 2,672 individually counted plants in addition to about 4,700 plants not actually counted although grown under close inspection. It is safe to say, therefore, that the mutant in question was the only one of its kind in an inbred line comprising around 7,400 individuals. Moreover, no unifoliolate plant has been observed in rather extensive plantings of Adzuki Beans of various other lines. In 1917 all the plants in the field, numbering 42,174 individuals, were under close observation and frequent records were taken of them in regard to time of flowering and maturity of pods. In 1918, select pedigrees comprising around 74,100 individuals were likewise repeatedly inspected for flowering and maturity. All the plants grown in the field in 1917 and the select pedigrees of 1918 were so frequently inspected that it



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The Adzuki, like most common beans, is trifoliate as shown in the smaller plant at the left. A typical unifoliate leaf isolated from the mutant is shown on the background at the right in contrast to a typical trifoliate leaf on the extreme left. This mutation may be in the nature of a reversion. (Fig. 2.)

seems improbable that such a striking variation as the one photographed could have escaped notice. The same is true of 5,938 plants grown in the greenhouse. A total, then, of over 122,000 plants were grown under close observation without showing another mutant of this kind.

Since the simple-leaved form is sterile and moreover retains its leaves in the fall after other plants have become defoliated, it is a conspicuous object at time of harvest. If such a plant had been present in the 228,000 and more individuals grown in multiplication pedigrees in 1918, it would have stood good chance of being discovered at harvest, although these multiplication pedigrees were not so often nor so closely inspected during the growing season. It is not entirely improbable, therefore, that the mutant occurred only once among over 450,000 plants which were kept under more or less strict observation.

Numerous varieties of the Adzuki Bean have been introduced and grown in trial plats by the department of Forage Crop Investigation of the U. S. Bureau of Plant Industry during the last twenty years. Dr. C. V. Piper and Mr. W. J. Morse, who have had charge of the tests in this department, report that they have never seen a plant of the Adzuki Bean with unifoliolate leaves.

Another representative of the genus *Phaseolus* (*P. Vulgaris*) has been studied by Dr. J. Arthur Harris in reference to the occurrence of abnormalities in the seedlings. He has kindly informed the writer that only once has he found plants with unifoliolate leaves. Three individuals in a pedigree, the offspring from a single parent, had undivided leaves and were otherwise abnormal. Outside of this single pedigree, none of the several million plants of the pea bean individ-

ually examined for abnormalities was found with simple leaves.

The Leguminosae are predominately characterized by compound leaves. In a few genera, however, the leaves are simple. As familiar examples of the latter condition may be mentioned the Redbud (*Cercis*), the Rattlebox (*Crotalaria*) and the Dyer's Greenweed (*Genista*). In *Rhynchosia*, typically a trifoliolate genus, one species (*R. simplex*) has only unifoliolate leaves. These facts may suggest that in the evolution of the Leguminosae the present predominately compound foliage has been derived from a simple-leaved condition. Such a supposition might be supported by the genus *Bauhinia*, which apparently shows various stages in the process of conversion of a simple to a compound leaf by progressive furrowing between lobes. The unifoliolate representatives of the family might, therefore, be considered arrested stages in evolution or reversions to an ancestral type. Under this interpretation, the mutation under discussion would be in the nature of a reversion. It must not be denied, however, that some may prefer to read the evolutionary trend in the reversed direction and to consider the mutation a progressive one.

All the facts presented show that the unifoliolate type here reported for the Adzuki Bean is an extremely rare variant. Despite the fact that its inheritance could not be established by breeding experiments, it has been called a mutation. Its failure to appear more than once in so large a number of individuals indicates that it is a variation genotypic in nature, since it could scarcely be attributed to the reappearance of a character through normal segregation nor be considered a mere modification induced by environmental factors.