

A Case of Gametic Coupling in Pisum.

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For some years past a variety of culinary peas has been grown at Verrières-le-Buisson, remarkable for the fact that it has no tendrils, each of the normal tendrils being represented by a leaflet. The figure shows the appearance of the leaves of this variety, with leaves of normal plants for comparison.

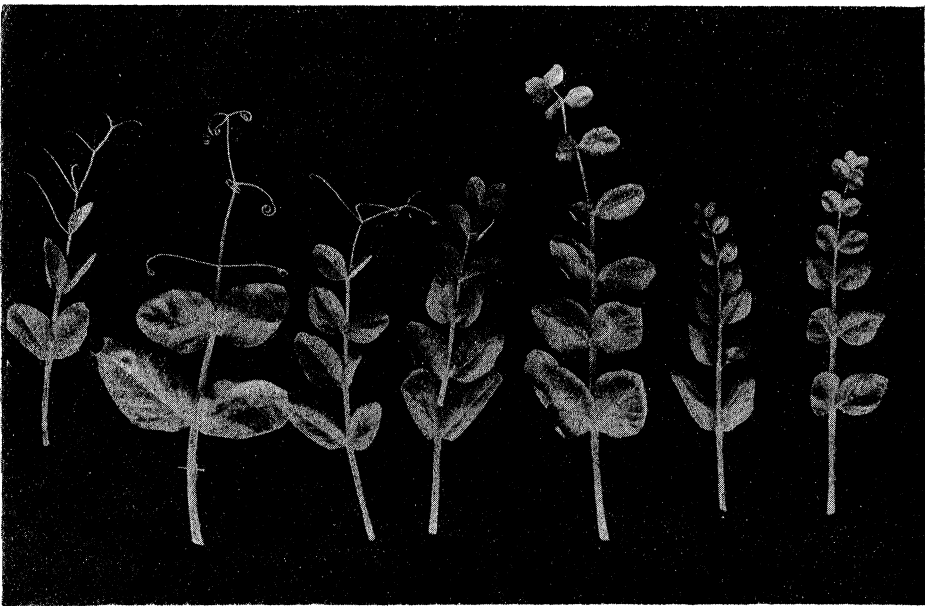


FIG. 1.—The four right-hand leaves are from "Acacia" peas; the three left-hand leaves are from normal plants. The figure on extreme left shows a leaflet with a tendril opposite to it. Such asymmetries are common in the normal types.

These "Acacia" peas, as they are called, breed perfectly true. Their origin is unknown. The variety has wrinkled seeds.

Crosses were made at Verrières between the Acacias and a variety having normal tendrils and round seeds. The tendrilled character was fully dominant in F_1 , which, of course, bore both round and wrinkled seeds. When these seeds were separately sown it was observed that the round seeds gave rise almost exclusively to tendrilled plants, and the wrinkled seeds almost exclusively to Acacias, though there were a few exceptions each way.

As the case was almost certainly one of gametic coupling between roundness of seed, and tendrils, the problem was clearly worth minute investigation, and a quantity of material was transferred to the John Innes Horticultural Institution, Merton, Surrey, for this purpose. The offspring of two F_2 plants, heterozygous in both respects, were, in particular, the subject of study.

Unfortunately, the distinction between rounds and wrinkleds was in these families not perfectly sharp, and much irregular pitting occurred. When the plants grown from these seeds were harvested it was found that errors in sorting had been made both ways, one seed having been sown for a round which gave rise to a plant with exclusively wrinkled seeds, and two seeds which had been sown as wrinkled proved to have been heterozygous rounds. The earlier counts had therefore to be rejected, and in order to obtain perfectly reliable numbers it was clearly necessary that the nature of the starch in each seed should be separately determined for each seed before it was sown. As Gregory* had observed, by microscopical examination of the starch grains, this discrimination may be made without difficulty.

The microscopical test was applied by Miss C. Pellew, Minor Student of the Institution, to F_4 seeds of heterozygous plants on a considerable scale, and the seeds were then sown. Only a fragment of a cotyledon need be removed for testing, and the seeds germinated perfectly after the operation. The results were as follows:—

	Round.		Wrinkled.	
	Tendrilled.	Acacia.	Tendrilled.	Acacia.
Observed	319	4	3	123
Calculated on a coupling of 63 : 1 ...	333	3·4	3·4	109

These figures leave no reasonable doubt that the system of gametic coupling followed in this case is

$$63 TR : 1 Tr : 1 tR : 63 tr,$$

where T is tendrilled, and R is round seed. This gametic system gives the zygotic ratio

$$12161 TR : 127 Tr : 127 tR : 3969 tr = 16384,$$

from which the above calculation is made. This particular system has not been hitherto encountered, but it is, of course, one of those contemplated by the general expression for coupled systems.

* 'New Phytologist,' 1903, vol. 2, p. 226.

There is no difficulty in distinguishing the tendrilled from the acacia plants when six to seven leaves are developed, but in some of the tendrilled—doubtless the heterozygotes—the apical tendril is sometimes strap-shaped, especially in the youngest tendril-bearing leaves.

On one occasion at Verrières, Acacias came in a strain of Sandar's Marrow. Though natural cross-fertilisation is extremely rare among peas (much rarer than in sweet peas) we can hardly doubt that these Acacias were recessives extracted after an accidental cross with the pure strain growing in the same garden. Both among various peas grown at Verrières, at Reading, and at Grantchester, a few unquestionable examples of crossing have been observed since critical attention has been devoted to the study of heredity in peas. The crossing is probably effected by visits of *Megachile* to flowers in which for some reason their own pollen has been inoperative.

In the case of the derivatives from the Sandar's Marrow strain the occurrence of strap-shaped tendrils, presumably on the heterozygotes, has been often observed, and some plants have many such intermediate tendrils.

The original cross which gave coupling between T and R was in the form $TR \times tr$. Experiments are now in progress for testing whether when a cross is made in the form $Tr \times tR$ the gametogenesis of F_1 will show repulsion of T from R, and on the analogy of what has been seen in sweet pea and in *Primula sinensis* this result may be confidently anticipated.

Whether any similar inter-relation exists between the tendril factor and factors other than that for round seed cannot be yet stated, but it is practically certain that the factors for yellow seed and for tall stem do not stand in any such special relation to it. The case is also interesting inasmuch as it is the first yet met with in which neither of the coupled factors is in any way concerned in determining pigmentation.

In conclusion it may be remarked that an identical "acacia" variety exists in the sweet pea, and its properties are also under investigation. In the sweet pea, however, there is no variety with truly wrinkled seed. The types with self-coloured lavender flowers have somewhat shrivelled seeds, but the starch of these is normal.

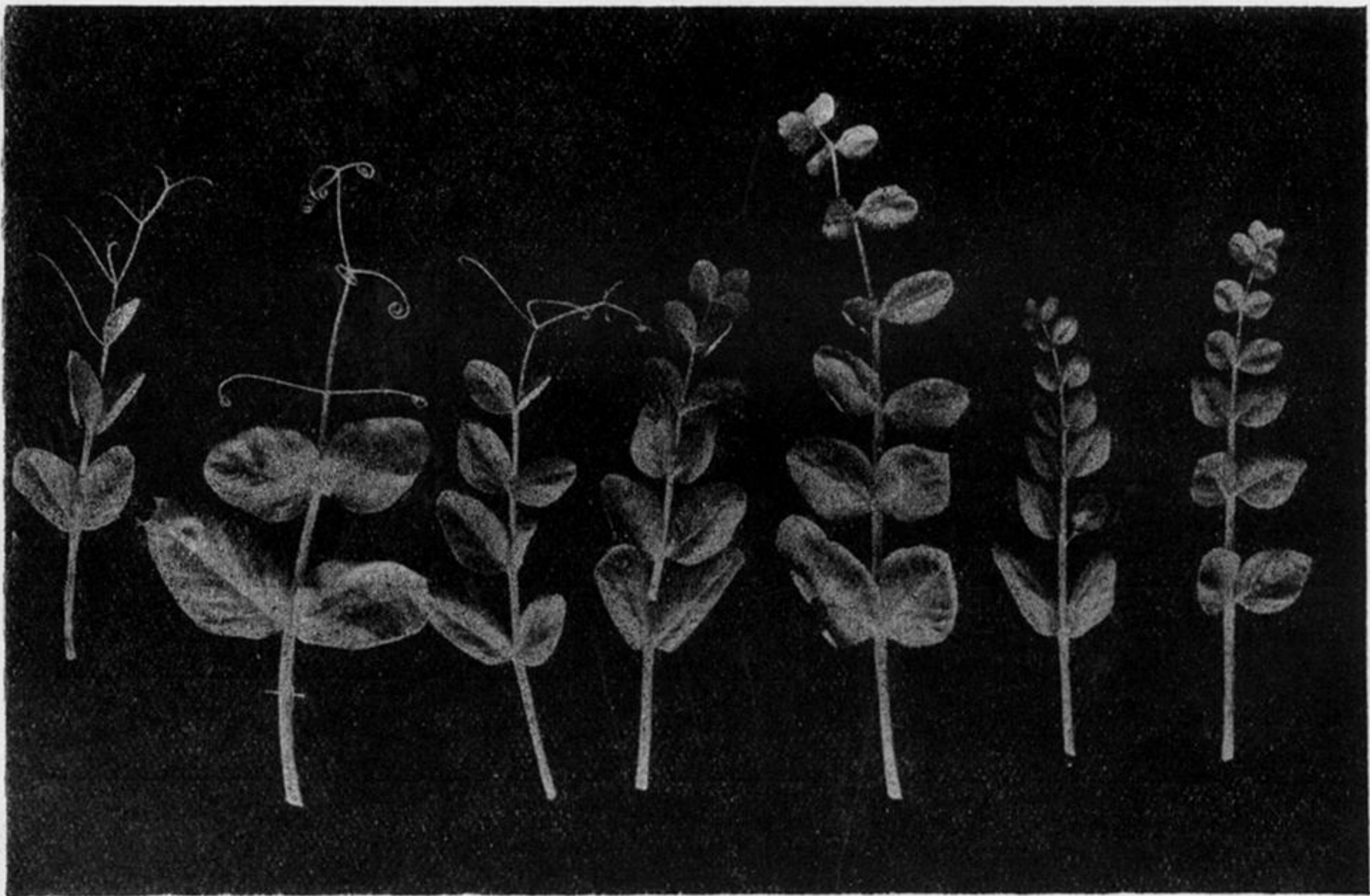


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