

SEX IN ARISAEMA TRIPHYLLUM*

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Our common wild Jack-in-the-Pulpit (*Arisaema triphyllum* (L.) Torr.) is often referred to as a dioecious species. Gow (3), Atkinson (1), Pickett (5) and Schaffner (6), have noted, however, that a considerable number of the plants bear flowers of both sexes. While studying the Japanese Arisamea (*A. japonica*) which is morphologically close to our *A. triphyllum*, Maekawa (4) noted that the "Lighter corms are male and heavy corms are female without fail and the sexual state moves on from the asexual state to the male state and lastly reaches the female state and stays therein."

Schaffner (6, 7) and others have also shown that the sex of mature plants may be controlled by regulating the physiology of the plant, and Pickett (5) and Schaffner (6) have noted the difference in sex ratios in different habitats.

The present study has been conducted to ascertain the relation between the relative age and development of the plant and the type of flower appearing in the inflorescence.

The mature plant generally consists of one or two compound leaves and an elongated flower stalk, the aerial parts arising from a subterranean perennial corm. The flowers are borne on a spadix and are surrounded by a spathe, which is typical of all the Araceae.

Small, single-leaved, non-flowering plants commonly occur associated with the mature plants. These small plants have generally arisen from lateral buds on the parent corm. The plants originating from these "bud corms" soon become separated from the parent plant and after several years of development produce flowers. Occasional isolated individuals, or even small clumps of equal-aged plants, may be noted in areas where other plants are not abundant. It seems probable in these cases that the plant has arisen from a seed, or in the case of a clump of equal-aged plants, from the seeds of a single

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spadix. It is to be noted, however, that vegetative multiplication is much more common than reproduction by means of seeds.

Studies by the writer since 1925, both on marked plants in the field and in experimental plots, have shown that *Arisaema triphyllum* begins as a weak, non-flowering plant with a small corm. This is true for both the seedling plant and the plant having its origin in a vegetative off-shoot.

After several years of growth—generally more than three, depending on the habitat—the plant has its first flowers. The first inflorescence is generally small and contains only staminate or male flowers.

Since the habitat is a decided factor in the development of the individual, subsequent stages in the life history are closely linked with the environment. If the plant is in a moist, rich woods and little disturbed by animals, it increases in size from year to year, both in the aerial and subterranean parts.

In several years a few carpellate or female flowers may appear on the spadix, sometimes mixed with the staminate flowers, but generally near the base of the inflorescence. This intermediate or monoecious stage generally lasts several years, the proportion of carpellate flowers becoming greater until the whole inflorescence is made up of carpellate flowers.

It is thus apparent that in *Arisaema triphyllum* a single plant, if grown in a suitable habitat will, during its life history, run the whole gaunt of sexual expression from the immature non-flowering condition into the male and from that through varying degrees of intersexuality into a female condition. It remains thus as long as the plant is undisturbed, or does not become weakened through an over-production of side corms.

The stability of the sexual state is dependent upon the physiological condition of the individual. If the habitat is unfavorable to good growth, the plant may remain in the staminate or monoecious state indefinitely.

Schaffner (7) Maekawa (4) and others have shown that removal of the lower or storage part of the corm or a portion of the leaf surface throws the plant, in the succeeding year, into a condition similar to that occurring earlier in the life history. Specifically, if a small portion of the corm or of the leaf is removed from a mature plant bearing carpellate flowers, the plant will produce a mixed inflorescence the next year. If, however, the pruning is severe the plant may be thrown

into the staminate, or even the non-flowering condition. It is of course necessary to do this before the time of flower bud formation.

It is therefore reasonable to suppose that the basic physiology of the plant, influenced by the activity of the synthetic portion or the storage regions, directly influences the production of the different sexual types.

While no extended physiological studies have been made by the writer, certain correlations have been shown to exist between the physiology of the individual and its sexual expression.

The writer (2) has previously noted in twelve species of plants, including *Arisaema triphyllum*, that a portion of a plant bearing staminate structures has a higher catalase activity than similar structures bearing carpellate flowers. It is not intended to imply that the enzym catalase is a regulator, but rather a valuable indicator of the metabolic level of the portion of the organism studied.

A study of the activity of this enzym is relatively simple, consisting merely of measuring the amount of oxygen released from a standard quantity of hydrogen peroxide by the enzym in a given quantity of plant material. A more extended discussion of the method used has already been presented by the writer (2).

In the present study, determinations of the activity of the enzym in the expressed juice of the corms of plants bearing the various types of inflorescences were made. The plants were collected in a moist, beech woods near Westerville, Ohio, May 20, and taken into the laboratory where the determinations were made as soon as possible.

The following table (Table I) shows the results obtained from determinations on a total of 22 corms fairly evenly divided between the different types.

TABLE I.

Arisaema triphyllum.

AVERAGE FOR THE CATALASE ACTIVITY OF THE EXPRESSED JUICE OF THE CORMS.
READINGS IN CC. OF GAS PRODUCED IN 5 MIN. AT 21° C.

Non-flowering	Staminate	Monoecious	Carpellate
4.3	7.2	6.4	4.8

It is thus apparent that the corms of the pure staminate plants had a higher catalase activity than those of the pure carpellate plants, while those giving rise to the monoecious or mixed inflorescences had an intermediate position. The non-flowering plants were the least active.

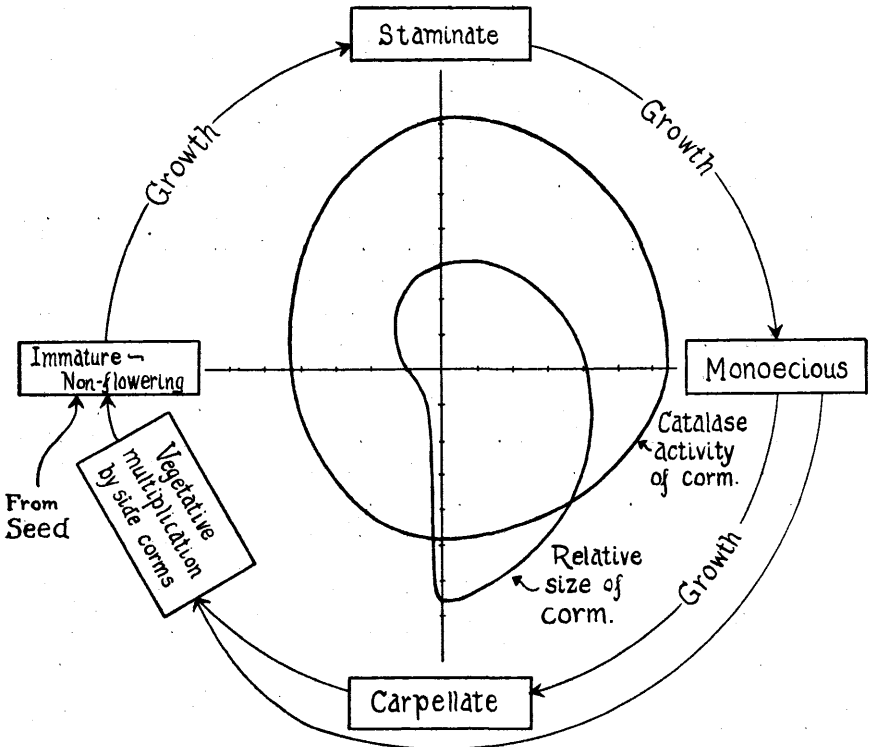


FIGURE 1. Diagram of the normal life history of *Arisaema triphyllum*, showing the relation between size and catalase activity of the corm and the sexual expression of the inflorescence.

Figure 1 is a diagram of the life history of a plant, showing the normal sequence of sexual expression, the catalase activity and relative weight of the corm.

CONCLUSIONS.

Arisaema triphyllum is not a true dioecious plant but undergoes a series of changes in the course of its life history. It arises either from a vegetative side corm or a seed as a small non-flowering individual. Later the plant produces successively

a pure staminate, next a mixed and last a pure carpellate or female inflorescence.

The sexual states are relatively unstable, being easily modified or changed by natural fluctuations in the environment or by mutilation of the vegetative parts of the plant.

Plants producing staminate flowers arise from corms characteristically light in weight and high in catalase activity, while those producing carpellate flowers are heavier with a lower catalase activity. Plants in a transitional or monoecious stage have an intermediate corm weight and catalase activity.

The type of sexual expression in *Arisaema triphyllum* is induced by the basic physiology of the vegetative parts of the plant at the time of flower bud formation.

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Medical Jurisprudence, by C. SCHEFFEL, M. D., LL. B., XII + 313 pp., Philadelphia, P. Blakeston's Son & Co., Inc., 1931.