A NEW MUTATION OF TARO *(COLOCASIA ESCULENTA)* OBSERVED AT BUBIA AGRICULTURAL RESEARCH CENTRE

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ABSTRACT

An unusual mutant of taro (Colocasia esculenta) *was discovered in the cycle-2 population of the recurrent selection programme at the Bubia Agricultural Research Centre, Papua New Guinea. The mutant plant developed a thin elongated stem (about 95 cm long). The stem had several nodes, each carrying one leaf. The leaf size decreased with distance from the corm top. The stem was filled with soft, aerated spongy tissue. Side stems were thin and relatively long, growing from lower nodes of the main stem and the corm top. Their structure was similar to that of the main stem. The plant had a normal corm. It was susceptible to the leaf blight and was not flowering.*

Key words: *Taro,* Colocasia esculenta, *breeding, population variability, mutation.*

INTRODUCTION

Taro (*Colocasia esculenta* (L.) Schott) belongs to the monocotyledonous family Araceae or the aroids. The aroids are a large and a very variable family with about 110 genera and more than 2,500 species (Bown 1988). The differences among some of the species (e.g. *Acorus calamus, Amorphophallus campanulatus, Colocasia esculenta, Pothos scadens* and *Monstera* spp.) are large.

The majority of the aroids are climbers and epiphytes of tropical rainforests. Many of the species are associated with humid or aquatic conditions. The most common characteristic of the aroid species is the spadix - spathe type of inflorescence. The small individual flowers can be bisexual or unisexual. If the flowers are unisexual, the spadix is divided into two parts (male and female) which are separated by a sterile tissue.

C. esculenta plants are herbaceous, with cylindrical starchy corms and relatively large peltate leaves borne on thick petioles. The height of the plants generally varies from 0.5 to 1.5 m. It is a very variable species with numerous forms and cultivars. They can be differentiated according to the shape, size and pigmentation of their corms, pigmentation and size of the leaves, plant height, floral characteristics, eating quality and several other characteristics.

The variability of the genetically controlled characteristics is extremely important for plant breeding. Natural genetic variation can be augmented through hybridisation, self-pollination, biotechnological methods or mutagenesis.

Taro varieties are clonal varieties and are propagated vegetatively. In natural conditions propagation by seed is very rare, although, it is essential for the evolution of the crop. The majority of the varieties are highly heterozygous. The genetic recombination between two randomly chosen clones generally results in high variability of the first offspring generation. Each of the superior genotypes from the segregating offspring generation can represent a new potential variety. Stabilisation of the variety by breeding for genetic homozygosity is not needed because of the vegetative propagation of the species. When mutations are not taken into consideration, one taro cultivar (one clone) consists of only one genotype.

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The Papua New Guinea taro improvement programme

The Papua New Guinea (PNG) Taro Improvement Programme started in 1993. The main objectives are the improvement of yield, eating quality, resistance to pests and diseases, earliness and adaptability to specific environmental conditions. It is based on the population approach, aiming at the improvement of the average performance of a population. The process is divided into cycles and each cycle consists of three steps: (a) development of a population, (b) evaluation of the individuals in the population and (c) selection of the superior individuals for crossing to form a new population.

The genetic sources used for forming the basic population (the population from which the breeding process started) were wild genotypes from PNG and South-East Asia, hybrids from a previous breeding programme in the Solomon Islands and cultivated varieties from PNG and other Pacific countries. Recombinations between these genetic materials resulted in a large range of variation. This variation could be considered to be a result of genetic segregation, mutagenesis and environmental effects.

The number of genetic recombinations per cycle generally exceeds 500 and the number of individuals germinated in each cycle averages more than 150,000. The time period needed to complete one cycle depends mainly on the evaluation procedure of a population and varies from 7 months to more than a year.

Genetic variability and rare genotypes of taro

The populations used in the recurrent selection of taro are generally characterised by high genetic variation. The average genetic variation within a population remains more-or-less unchanged from one cycle to another. Some of the traits, however, are reduced in frequency due to strict artificial selection. These are mainly undesired traits (small corm size, high % of oxalate, susceptibility to some of the diseases). A general decrease in genetic variation can result in genetic erosion, where some of the important genes can be lost from the population.

The taro breeders at Bubia continually follow the changes within populations (Ivancic *et al.* 1995, Ivancic 1995). These changes can be studied through an analysis of variance within each cycle or by analysing the genotypic and/or phenotypic frequencies within populations.

The analysis of genotypic frequencies is usually very simple for rare traits which are controlled by one or a few major genes (genes with strong effects) and which can be easily detected.

Rare genotypes or plants carrying rare genetically controlled characteristics appear constantly. The majority are probably the result of genetic segregation but some are the result of mutagenesis. Within the PNG taro breeding populations several rare genotypes have been determined such as plants with extremely dark purple leaf laminae, double spathe, fasciated male part of the spadix, double and multiple inflorescences, blue pollen, red and black seed, corms above ground, extremely elongated type of corm and semi-albino plants. Rare types of taro inflorescences were described by Ivancic (1995). The most atypical characteristic found so far is the plant type with an elongated stem (Fig. 1).

Elongated stem

A taro plant with an elongated stem was found in July 1995 in one of the sub-populations (U 1/95) of the second cycle of the recurrent selection programme at the Bubia Agricultural Research Centre. The stem of the plant was characterised by thin, green and extremely elongated internodes filled with spongy, colorless tissue. The height was about 95 cm. The internodes near the base were relatively short. As the stem elongated, the internodes became longer, but near the tip they became shorter again (Fig. 1).

The leaves (petioles and laminae) arose from the nodes and were highly susceptible to leaf blight (*Phytophthora colocasiae*). The size of the leaves decreased with distance from the corm top. Side stems emerged from auxilary buds on the corm top and from the lower nodes (leaf axils) of the elongated stem(s). Side stems were elongated in more-or-less the same way as the main stem.

The elongation of nodes of the mutant plant are different from the elongation of the corm of some 'normal' genotypes (Fig. 3). Several wild genotypes and cultivated varieties of taro produce very long corms (similar to *Alocasia* spp.). This elongation is associated with the general expansion of the corm and there is no formation of a 'true' stem.

The mutant plant had a normal corm and did not flower. Vegetative multiplication by cuttings, which were very similar to stolons (runners), was not

Figure 1. **A drawing of a taro plant with an elongated stem (a), and a normal plant (b).**

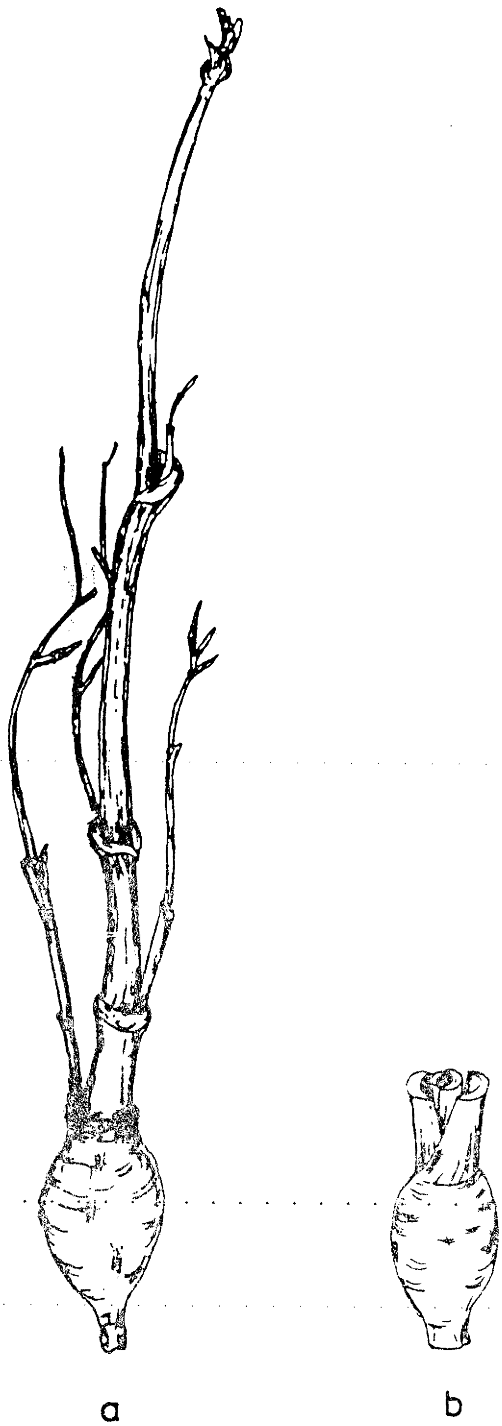
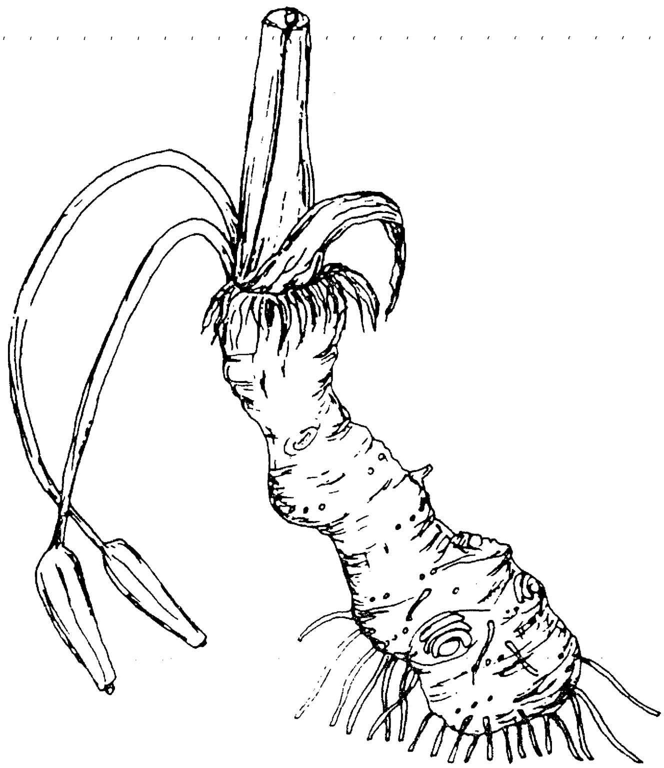


Figure 2. **An elongated corm of a wild taro genotype.**



successful. The nodes of the main elongated stem and side stems did not produce a normal root system. It is possible that the plant with the elongation of the stem(s) is expressing a lethal character or that stem elongation is genetically linked with it.

Conclusion

Taro breeding work in Papua New Guinea is based on a large scale programme of genetic recombinations and has resulted in enormous genetic variation within the breeding populations. In such populations it was possible to identify genotypes which could not be found in natural populations. The plant with the elongated stem is one example. It is difficult to say whether it is the direct result of mutagenesis, the result of a specific genetic combination or both.

Elongation of the taro stem is presently not an important trait for agriculture. However, it indicates that the taro plant may have completely different forms, resembling plants with indeterminate growth of the stem and creeping or climbing habit. In the future, genotypes with such charcteristics could be used as a genetic source for breeding which would be able to grow in deeper swamps or along rivers with variable water level. These environments represent an additional potential area for taro production.

The elongated stem may also be of interest in evolutionary studies of the Araceae family since it resembles the stem of creeping and climbing aroids.

References

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