Biological Studies On *COSCINIUM FENESTRATUM* Colebr. (Menispermaceae)

by

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ABSTRACT

Coscinium fenestratum Colebr. (Menispermaceae), a dioecious, woody climber, common in disturbed forests of the moist low country, is a widely used medicinal plant in Sri Lanka, due to the presence of alkaloids such as berberine, jatrorhizine and palmatine in it. While the water extract of its stem provides a decoction for treatment of body aches, pains, common colds and tetanus, the roots are used for dressing wounds and ulcers because of its antiseptic properties. Hitherto in Sri Lanka, the plant is collected from the wild depleting its natural gene pool without any consideration for its conservation, both *in-situ* and *ex-situ*. Its cultivation on a home garden or plantation scale has not yet been considered. This study examines the possibilities of domesticating the plant and the problems envisaged in growing it outside its natural habitat. The investigations carried out, results obtained, and their relevance to domestication are the following:

Natural habitat of the species

Forest fringes and gaps in the undisturbed forest, where there is partial light and an abundance of host plants for the liana to climb on, were the most favoured habitats of this species. It was not observed in the deep shade of the forest or fully exposed scrub lands. This suggests that the species could be grown as an inter-crop in coconut or forest plantations or home gardens.

Population biology of the species

Studies on two populations 1CF and 4CF, comprising 44 and 9 individuals, revealed that the species has a clumped distribution, could attain girth sizes upto 4.9 cm at 1 m from the main rooting

point and heights upto 30 m depending upon the availability of suitable supports. It has separate male and female plants, indistinguishable from each other outside the flowering and fruiting periods. The male to female plant ratio in each of the two populations was 2:1 and 5:4 respectively. Female plants in general, had a greater variation in leaf size and internode length, larger second order inflorescence axes and fewer floral heads per inflorescence, as compared to male plants. Fruit size and weight, and seed size varied much, in contrast to seed weight which was relatively more uniform, between the two populations and among individuals. In one of the two populations, fruit production per plant was 60, 95 and 71 in 1985/86, 1986/87 and 1987/88 respectively, and varied between 0-403, 0-246 and 0-600 among its female individuals in the three years. In the second population the corresponding values were 13, 14, 5.5 and 0-28, 0-35 and 0-22 respectively. One of the individuals being monitored did not produce any flowers in 3 consecutive years and it had much larger leaves than the rest.

From these observations it becomes clear that several plants should be grown together to ensure the presence of both sexes in a given vicinity. For collection of fruits, population 1CF provides a better source than population 4CF. The presence of the vine with larger leaves calls for further investigation. Such vines would be more desirable for commercial plantations of the species because the stem and roots are the parts harvested for medicinal purposes if their growth increments are greater than those that flower regularly. Vines that set more fruit would be desirable for breeding purposes so that, more opportunities for manipulation are available. In this respect too, population 1CF is more suitable than 4CF.

Breeding biology of the species

Phenological studies revealed that flushing was continuous throughout the year with a slight increase from February - April/May. Flowering takes place annually and was synchronised between and within the two populations. However, inflorescence initiation in male plants commenced in August and that of female plants in September/October. The former bloomed 2-3 weeks earlier in 1985 and 1986 and 7-9 weeks earlier in 1987 respectively, than female plants, but the peak period of anthesis overlapped in the two sexes. Flowering intensity in male plants was 2-356 floral heads per meter length as compared to 1-86 in female plants.

Fruit development in the species takes over 8 months and ripe fruits are abscissed over 4 months between July/August - October/November.

Flower visitors were found to be, two small, two-winged insects (suspected to be Hymenopterans). The larger of the two insects visited unopen, open and rotting flowers, and the underside of leaves, throughout the day, but at higher densities between 1630-1830 h. They were seen to oviposit on newly open male flowers. The smaller of the two insects, observed to be the more effective pollinator of the two, was seen in relatively fewer numbers, but it almost always alighted on the stigma of female flowers and visited them only between 1500-1830 h. They were seen on male inflorescences as well.

Pollination experiments revealed that the stigma remained receptive for a period of 10 days, but it progressively declined after the 5th day. The stigma though receptive throughout the day was most

so, between 1630-1830 h. This period is concurrent with anthesing and anther dehiscing time and all three events together possibly account for the increase of insect visitations during this period.

The plant being dioecious cross pollination experiments alone were carried out. These studies show that open pollinated fruit set studied in 2 consecutive years was 19-20%. In contrast, that in hand pollination was 34-39%. Inflorescences bagged with organdy, which permitted the movement of air borne pollen if any, but not insects, failed to set any fruit suggesting that insects are the effective pollinators.

These studies provide information on, the best individuals to select for breeding purposes, the time, duration and intensity of the flowering period and the best time of day to pollinate in future manipulative breeding experiments, the proportion of fruitset that could be obtained by hand pollinations and, when and how to collect fresh seed for germination purposes.

Seed biology of the species

A study of the availability of seeds and their germination success, which ensure recruitment of seedlings to the population, showed that 12% of the fresh fruits produced contained non-viable seed. Two terrestrial mammals, the spiny rat and porcupine, also destroyed most of the seed falling beneath the mother tree, by devouring them. Two other arboreally feeding mammals, the pole cat and a bat species on the other hand, fed on the pericarp of ripe fruits attached to the tree. Both carry these seeds away from the mother plant depositing them elsewhere out of reach of the seed destroyers, thus ensuring the survival of this species.

Under normal conditions seed germination of the species was found to be only 23-26%. Of the many germination experiments, such as treatment with concentrated NH_4OH, HCl and H_2SO_4, cracking, immersion in water at 90-92° C and exposure of depulped seeds to sunlight, the last proved to be the best and increased germination to 62%. Sunlight treatment acts by splitting open the two halves of the hard endocarp and it also reduced the dormancy period by 20 days. Even so an innate dormancy period of 40 days was present. The fruit pulp was also found to inhibit germination. Thus, under normal conditions seeds that escape predation must over come both chemical and mechanical inhibitions to germination imposed by the pericarp and hard endocarp respectively. The pole cat and fruit bat appear to be vital for seed propagation of this species in nature, because in addition to dispersing the seeds, they depulp them removing the chemical inhibition it presents.

These results point out the best methods of fruit collection and seed germination. i.e. ripe fruits must be harvested straight off from the plants by bagging them and seeds must be depulped and exposed to direct sunlight for 6 hours to increase germination. This also explains why plants grow in disturbed sites.