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Research Note :

GLORIOSA SUPERBA L. : AN ENDANGERED MEDICINAL PLANT

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ABSTRACT : Medicinal plants constitute an important natural wealth of the country. These are important sources of therapeutic agents and constitute raw materials for the manufacture of traditional and modern medicines. Inspite of their huge bio-diversity, many of the potential herbs are yet not known to the scientific world. *Gloriosa superba* L. has now been listed as endangered species due to its overexploitation or over-collection. It has large pharmacological value due to presence of an important alkaloid, colchicine and also other biologically active compounds. So, the key challenges now lie in developing new conservation strategies so as to increase its germplasm base. Both *in situ* and *ex situ* conservation methods can be chosen depending on its distribution and as well as the availability of resources in the areas of its occurrence.

Key words : *Gloriosa superba, conservation, endangered, biodiversity, colchicine.*

Gloriosa superba L. (Colchicaceae) commonly known as glory lily, superb lily, tiger lily or tiger claws, is an important medicinal plant of the Tropics (Ridley, 32). Commonly it is known with different vernacular names like *Agnishikha* and *Agnimukhi* in Sanskrit and *Bachnag Karihari* in Hindi (Phatak and Hegde, 11). It is a perennial, greenish, climbing herb and native of South Africa. It is widely cultivated throughout the world as an ornamental plant and grows naturally in many countries of tropical South-Eastern Asia such as Bangladesh, India, Sri Lanka, Malaysia and Myanmar. In India, it is widely scattered in the tropical and sub-tropical parts and also in the foothills of Himalayas upto an altitude of 6000 feet and in Andaman Islands (Anon., 5; Lal and Mishra, 25). It is also called as Mauve beauty, Purple prince, Fire lily, Orange gem and Orange glow due to its showy flowers and is used as an ornamental plant worldwide (Bose and Yadav, 7). It is a national flower of Zimbabwe and is also a state flower of Tamil Nadu.

PLANT AND HABITAT

G. superba is an annual climbing perennial herbaceous vine growing from 3.5 to 6.0 meters in length. It has pointed, dark green, glossy leaves in whorls of 3 to 4, with a tendril by means of which it clings onto other plants. Leaves occur opposite or alternate, and are from 6 to 20 cm in length and 1.5 to 4 cm wide. The tubers are V or L shaped and highly poisonous in nature. The flowers are attractive borne on long stalks and have six erect petals ranging in colour from bright yellow to orange, red and sometimes yellow to deep pinkish-red. The fruits are capsules that split open to release several smooth red seeds with a spongy test (Maroyi *et al.,* 26).

The plant grows in sandy-loam soil or well drained red loamy soil in the thick forest areas in the sunny positions. It is very tolerant to nutrient-poor soils. It occurs in warm countries up to a height of 2530 m (Neuwinger, 28). It is also widely grown as an ornamental plant in cool temperate countries under glass house conditions. Planting is done mainly in June mostly through tubers and the climbers are supported through iron wires or supporting plants.

Alkaloids

All parts of the plant, especially the tubers are extremely toxic due to the presence of a highly active alkaloid, Colchicine (Singh *et al.,* 38). Calchicine and colchicoside produced from its seeds are principal components of drugs (Phatak and Hegde, 11). The species also contains another toxic alkaloid, Gloriosine. These two alkaloids are present in the every part of the plant. The colchicine content present in tubers is from 0.15 to 0.3% and in the seeds is 0.7 % to 0.9%. Colchicine plays an important role in the study of cell division as it inhibits the process of mitosis by inhibiting the spindle formation and arresting the polymerization of β–tubulin proteins and thereby inducing polyploidy. It is also used as an anti cancerous agent (Andreu *et al.,* 4; Kavithamani *et al.,* 22). Other compounds such as colchicocide, tannins, Beta silosterol and superbine are also present but in small amounts (Chulabhorn *et al.,* 9; Jain and Suryavanshi, 20). Due to the presence of these alkaloids *G. superba* shows many pharmacological properties like anti

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inflammatory, Antimicrobial, Anticancer activity, Antithrombotic potential (Kimberly, 24, Ade and Rai, 2; Reuter *et al.,* 31; Nikhila *et al.* 29), Snake bite potential (Haroon *et al.,* 17); Antioxidant activity (Amudha and Shanthi, 3), Anthelmintic Activity (Pawar *et. al.,* 3). It is used to treat patients suffering from gout which is a painful form of arthritis and also patients with an inherited inflammatory disorder (Joshi *et al.,* 21). Recently, metal nanoparticle synthesis has been done from the G. superba leaf extract (Gopinath *et al,* 16).

Propagation

The conventional method of propagation is by tubers which are white when young. This is a common but slow process as each plant produces a maximum of two daughter tubers. Germination in Gloriosa superba also occurs through seeds which remains dormant for 6-9 months and it takes three weeks to three months for germination . The poor seed germination due to hard seed coat restricts its use in multiplication. To complete one reproductive phase it generally takes four to five vegetative cycles (Samarajeewa *et al.,* 33). These conventional propagation methods are less efficient due to pollen sterility and certain biotic factors (Gopinath and Arumugam, 15).

Extinction

Due to its poor seed germination and tuber dormancy, the germplasm available is very less. The plant has been overexploited due to the tremendous pressure generated in national and international drug markets as a source of colchicine. The plant has been included in the world record of endangered plants *i.e.* Red Data Book by International Union for Conservation of Nature (IUCN). There is urgent need to conserve this plant which has been done by some workers using biotechnological approaches like micropropagation, callus induction, apical buds, nodal segments (Samarjeeva *et al.,* 33; Ade and Rai, 1; Khandel *et al.,* 23; Gopinath *et al.,* 16).

Phytochemicals

The methanol extracts of Gloriosa superba showed enormous occurrence of phytochemicals like phenols, alkaloids, flavonoids and tannins (Senthilkumar, 35). The leaf samples showed the presence of proteins, phenols, tannins, starch, terpinoides (Shanmugan *et al.,* 36). The flowers, seeds and tubers samples showed the high content of flavonoids (Singh *et al.* 38). Glycosides and alkaloids were found in maximum amount in seed and tubers in all samples, but they were absent in the leaves and flower extracts. Saponins were found in moderate concentration in all the samples of seeds and tubers extracts but showed the absence in all the sample extracts of leaves (Senthilkumar, 35). Megala and Elango (27) observed a high concentration of colchicine in the seeds of *G. superba*.

In vitro Conservation

The conventional method using tubers or seeds restricts its multiplication so propagation by in vitro methods is necessary (Ade and Rai, 2; Singh *et al.,* 38). The in vitro approaches can alleviate destruction of medicinal plants in their natural habitat and thereby conserve their diversity (Sharma *et al.,* 37). Even for commercial production of colchicine and its derivatives, in vitro methods of the source plant are thus of great attention.

Successful *in-vitro* techniques for micropropagation of Gloriosa superba has been reported using shoot tips, axillary buds, eye buds of corms, root primordial and even by culturing embryos (Finnie and Staden, 12; Selvarasu and Kandhasamy, 34). Finnie and Staden (12) initiated callus production on a basal medium containing 2, 4-dichlorophen oxyacetic acid and observed that repeated longitudinal sectioning of the bud resulted in multiple plantlet formation. reported in vitro propagation and corm formation in *G. superba* by directly placing the dissected propagules with shoot and root primordia on MS basal medium. Addition of kinetin upto 4mg/l resulted in shoot and cormlet regeneration. Custers and Bergervoet (10) reported that addition of a low level of 6-benzyladenine in the medium improved *in vitro* plant growth, whereas a high level of BA caused proliferation of multiple shoots from the rhizome meristems. They applied alternately the high and low BA levels which resulted in a four- to seven-fold multiplication of qualitatively good plantlets every 18 weeks. observed microuber formation in young shoot basal explants of *Gloriosa sp.* on MS medium supplemented with BA and NAA.

Samarajeeva *et al.* (33) reported that using Gamborg's B5 medium in combination with different growth regulators results in multiple shoots. In contract to it, Ade and Rai (1) observed maximum shoot formation in MS medium supplemented with 2,4-D and BAP. Hassan and Roy (18) studied the role of growth regulators in shoot formation and observed that the nodular calli supplemented with 2,4-D and 1-isopentyldene induced embryoids from leaf tissue of *G. superba*.

Markers and Diversity

It was observed that an extreme degree of variability existed in *G. superba* with respect to habitat, colchicine content and morphological characteristics of plants in different parts of India and it is difficult to differentiate tubers on the basis of morphological and histological characteristics. Genetic polymorphism cannot be studied alone using morphological features as they do not represent the total genome (Forrest *et al.,* 13). Thus PCR based molecular markers can be successfully used for assessing general levels of genotypic variation within and between populations and also in characterizing some elite varieties. Markers can be used for assessing genetic diversity, authenticating plant material used for drugs and for marker-assisted breeding (Canter *et al.,* 8). Thus the polymorphisms found between RAPD profiles can serve as genetic markers and has been widely used to produce DNA polymorphisms in many medicinal plant species (Ho *et al.,* 19; Aros *et al.,* 6). Ghosh *et al.* (14) studied polymorphism in five populations of *Gloriosa superba* using RAPDs and revealed 76% polymorphism among the populations.

CONCLUSIONS

Gloriosa superba known for its anticancer activity and diverse medical applications has been affirmed as endangered medicinal plant due to overexploitation or over-collection so to fulfill its demand in national and international markets. Therefore, there is a pressing need to conserve the plant by *in situ* and *ex situ* means as all its parts are used in the medicine. Thus, it is important for people to explore its use across many fields of application from conservation of this endangered species to its use in industries.

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