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Mutation breeding in *Catharanthus roseus* (L.) G. Don: An Overview

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Induced mutagenesis is best approach for creation of genetic variability but most of interest is paid towards crop plants with only a few exceptions. But even widely used medicinal plants could receive a little attention in this direction. *Catharanthus roseus* is an important plant medicinal plant yielding antihypertensive alkaloid ajmalcine and anticancerous alkaloid vincristine and vinblastine. Despite of considerable work had been done on biotechnological aspect of *C. roseus* alkaloid production but relatively little efforts has been made for its improvement by mutation breeding approach. The aim of this review is to summarize the all efforts of mutation breeding which were made for the improvement of *Catharanthus roseus*.

Keyword: *Catharanthus roseus,* Mutation Breeding, Alkaloids.

***Catharanthus roseus* (L.) G. Don** (2n=16), the periwinkle (Apocynaceae), native of south eastern and eastern Madagascar, has been popularly known for its considerable medicinal value. Its medicinal values were known even in 50 BC[1]. It possesses largest number of alkaloids in plant kingdom[2]. More than 125 alkaloids of the indole and dihydroindole groups have been isolated and characterized from different organs[3]. The medicinal importance of this plant has increased considerably because of the discovery of six anti-cancerous activity containing alkaloids. Among them only vincristine and vinblastine are active in humen system. The credit of discovery of these two alkaloids goes to Nobel *et al*[4]. *C. roseus* also owns its importance due to the presence of antihypertensive alkaloids such as ajmalcine and serpentine in roots[5,6] . The annual world demand for vincristine, vinblastine and ajamalcine is estimated 1kg, 12kg, 5000 kg and market value is about $3500, 000 /kg, $1000, 000/kg, and $5000/kg respectively[7].The phytochemistry of *C. roseus* has been investigated extensively and on an average, about 70 research papers were published each year on various aspects of this plant during the period 1950–2001, indicating continued interest in this plant[8]. More than 1200 publications and 85 patents on this plant appeared between 1950 and 1993[9]. Similarly several hundred publications have appeared on the production of secondary metabolites by cell and tissue cultures of *C. roseus*[9,10]. In industrial crops, such as medicinal plant content of the economically important metabolites is more important than the yield of the plant parts containing the metabolites because it determines the cost of extraction of the metabolite[11]. Despite of considerable work had been done on biotechnological aspects of periwinkle alkaloid

production as evident from recent reviews relatively very little work has been done on conventional approaches for development of periwinkle varieties with high alkaloid contents[8,12] . Among the conventional methods mutation breeding is a promising approach for approaches for creation of genetic variability and useful for the development of 'idiochemovars' in medicinal plants[11,13] . The aim of this review is to summarize the all efforts of mutation breeding which were made world widely for the improvement of *C. roseus.*

Mutation Breeding is a supplementary approach for creation of genetic variability, which is also applied in improvement of *C. roseus* (L.) G. Don at limited extent viz. Vekaateswarlu *et al.*[14,15] Bhattacharjee[16], Chatacharjee *et al.*[17] attempted induced mutagenesis in *C. roseus* for up-gradation of leaf alkaloid content and isolated several morpho- chemotypes. Kulakarni *et al*[18] reported three mutants, one dwarf, one semi-dwarf with high alkaloid content in the roots and one mutant with wavy leaf margin and high alkaloid content in its leaves, were isolated after chemical mutagenesis with EMS and N-nitroso-N etylurea in the variety 'Nirmal'. On the basis of inheritance studies on morphological traits, they found that the mode of inheritance of all three mutants was controlled by monogenic recessive genes.

Kulakarni *et al*[7] reported a mutant with indehiscent anther (functional male sterility), following an induced mutagenesis programme, which was taken up with an objective of inducing mutants with high alkaloid content in variety 'Nirmal'. The mutant had smaller anther, with lesser number of pollen grains. Rai *et al*[19] reported EMS induced mutant in which embryo had only one cotyledon but upon supplementation with the natural cytokinine, kinetine it developed two cotyledons. This is perhaps the first plant mutant in which development stage specific cytokinin deficiency has been demonstrated.

Mishra and Kumar[20] reported recessive salt resistant mutant with monocotyledonary and hsf mutant with herkogamous flower. Kulkarni *et al.*[21] reported a periwinkle variety 'Dhawal'(NCIMB Accession No. 41147), a high alkaloid producing variety produced by chemical mutagen treatment of seeds followed by rigorous selection in widely cultivated variety 'Nirmal'. Maithy *et al.*[22] reported six morphological mutants formed at different doses of gamma rays and EMS with their inheritance. Anjalica *et al.*[23] carried out a mutagenesis experiment using gamma rays and EMS as mutagens and reported six morphological mutants viz. very tall (vt), dwarf with obvate leaves (dwob), medium tall with small leaf area (mtsl), non trichomous (nt), upright oriented elliptical leaf (Upef) and spoon shaped leaf (Spl) and described dwob mutant as most promising mutant for cultivation in India. Kumar *et al*[24] reported a unique inflorescence bearing mutant (lli / lli) which is a monogenic recessive having leafless inflorescence architecture with increased flower frequency. This distinct plant of *C. roseus* was developed through chemical mutagenesis followed by salt tolerance selection (US Patent PP18315). Kulkarni *et al*[25] reported two mutants, one with small pollen and pollenless anthers (OR-EA) and another with 'Pin' flower (EMS-13-2), in contrast to "thrum' flower found in normal periwinkle plants, after induced mutagenesis in strain 'OR" and cultivars 'Dhawal' respectively. Verma *et al.*[26] reported dwarf mutant in *Catharanthus roseus* var. Nirmal which have enhanced antibacterial activity. Baskaran *et al*[27] reported two EMS induced macro-mutants ('necrotic leaf' and 'nerium leaf) of periwinkle with enhanced contents of total root and leaf alkaloids and anti-cancer leaf alkaloids, vincristine and vinblastine than the parental variety. Their leaf and root yields were, however, significantly lower than their parental variety.

It Evident form this review, although induced mutagenesis is an efficient approach for the development of improved genotypes but it is not attempted at adequate level for the improvement of *C. roseus*. Keeping this in view more concerted efforts on this direction are needed which may leads to development of high anticancerous and antihypertensive containing 'ideochemocultivars' which helps in decreasing

extraction cost as well as market value of these alkaloids.

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