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Leaf variation studies in *Valeriana jatamansi* Jones- an endangered medicinal plant of temperate Himalayas

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ABSTRACT

Valeriana jatamansi Jones (syn *V wallichii* DC) commonly known as Indian Valerian is a perennial medicinal herb of temperate Himalayas. The species exhibits polymorphism in its various morphological characters and sex forms. During the present investigations variation in leaf morphology was extensively studied. The results of the study revealed that significant variation was observed in terms of leaf characteristics viz lamina shape and leaf apex, base, margin, profile and colour. Plants with radical leaves of different lamina shapes viz ovate, ovate-deltoid, deltoid, oval, oval and reniform were found growing separately and the character was found stable after repeated observations. This preliminary study provides baseline information for development of better strains satisfying distinct, uniform and stable (DUS) criteria.

Keywords: *Valeriana jatamansi*; endangered species; variation; leaf morphology; stability

INTRODUCTION

Valeriana jatamansi Jones (syn *V wallichii* DC) (Bennet1987) belonging to the family Valerianaceae is a medicinally important herb distributed in the temperate Himalayas ranging between 1500 to 3000 m (Kirtikar and Basu 1975). The species is reported to be used in several traditional and modern medicines and valued for its tranquilizing and sedative properties (Pande and Shukla 1995). Its roots and rhizomes are used for the preparation of phyto-medicines with mild sedative action (Houghton 1999, Wagner et al 1980). It is used for the treatment of hysterical fits, nervous unrest, epilepsy, hysteria, asthma, cholera and skin diseases (Kirtikar and Basu 1975, Husain 1993). The species propagates through seed as well as vegetatively through rhizomes. It has been reported that the species has a wide geographical range and displays variability in various phenotypic traits at various stages in its populations. As the species with wide distribution ranges may exhibit differential phenotypes that ultimately lead to taxonomic confusion (Ponsie et al 2009, Semir et al 2014) therefore morphological analysis is the easiest and least complex approach for plant identification and characterization employed to solve taxonomical problems. The technique involves description and monitoring of easily detectable characters like form and structure. Therefore quantification and visualization of morphological variation are essential for an overview of evolutionary and ecological processes of phenotypic diversification and are the fundamental bases to develop more complex studies to achieve new perspectives on the interaction of phenotype, genotype and environment (Jensen 2003). The detailed morphological studies in this species can be very useful as it exhibits wide diversity of forms. Several studies were performed on the species regarding morphological evaluation however on the aspect of leaf variation little information is available and no comprehensive assessment has been done yet. As the analysis of morphological leaf traits provides deep insight into the taxonomy, genetics, biogeography and evolution (Main 1966) morphological evaluation on the basis of leaves not only gives specific botanical identity to a species but also reveals interesting features which are helpful in understanding the range of morphological variation and isolation of stable morpho-variants. Therefore an attempt was made with the objective to study morphological variation on the basis of leaf

characters along with their stability among different plants of *V jatamansi*.

MATERIAL and METHODS

The experiment was carried out at medicinal and aromatic plants research farm, Shilly, Solan, Himachal Pradesh (altitude 1550 m amsl, latitude-N 30° 54' 30" and longitude E 77° 07' 30") and in the laboratory of Department of Forest Products, Dr YS. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during 2014 to 2016. Already existing plants of *V jatamansi* (about 400-500) of different populations were utilized for the present investigations. The plants were uniformly maintained under homogenous conditions and critically observed for recording variation in leaf characteristics. The plants displaying variability in leaf traits were selected, tagged and multiplied vegetatively in the field which were further maintained and monitored periodically for stability studies. The plants were planted at a spacing of 30 × 45 cm under the canopy of *Cedrus deodara*.

RESULTS and DISCUSSION

In *V jatamansi* two types of leaves viz radical and cauline were found. The vegetative phase is characterized by persistent radical leaves which form more or less rosette at the base and cauline leaves that appear during reproductive phase with emergence of the flowering shoots which later get dried after seed setting. Cauline leaves were only a few, much smaller than radical leaves, pinnate and three- to five-lobed. Only radical leaves were taken for variation studies. The results revealed that radical leaves were persistent with long petiole displaying large variability in qualitative morphological leaf traits. The morphological traits observed in all the plants were lamina shape and profile and leaf apex, base, margin and colour. The plants with five types of lamina shape viz ovate, ovate-deltoid, deltoid, oval, oval and reniform (Plate 1) were found growing separately. The leaf apex was found to be broadly of four types viz acute, acuminate, obtuse and acute-obtuse (Plate 2). The lamina base was mainly of three types viz cordate, truncate with almost straight base and sagitate with overlapping base (Plate 3). Plants with cordate leaf base were further of three types viz cordate with wide gap, cordate with uniform gap and cordate with narrow gap. Four types of leaf margins viz entire, crenate-serrate, serrate and entire sinuate were observed (Plate 4). On the basis of lamina profile taken from upper side of leaves the plants could be categorized into two types viz flat and dome shaped. Among dome shaped two types were further recognized viz dome shaped partially and dome shaped totally (Plate 5). The colour of the radical leaves in all the plants under study varied from light green to dark green with colour code 137A, 137B, N137 A and N137 B representing dark green colour and 138A and 147A as light green colour using RHS colour chart (Anon 2015).

On the basis of variation studies in three consecutive years all the characters displayed stability except leaf base and margin. Periodic observations showed that with the advancement of growing stages/ seasons in some plants two types of leaf bases were found within the same plant. Initially the plant was observed to have cordate base but later on some leaves changed to sagitate with overlapping base whereas in some cases cordate shape changed to truncate with almost straight base. Such deviation in case of leaf margin was also observed where leaves showed various degrees of serration at different growth stages. Therefore leaf base and margin can be assumed as highly plastic characters in *V jatamansi* which can change according to growth and development. These considerable variations in the leaf traits may be attributed to exclusively cross-compatible breeding system and fixing of individual variations through vegetative means in the species. Variation within a species with respect to size, shape, coloration, behavior and physiology may be a product of current environmental differences between sites (phenotypic plasticity), a product of heritable differences between the subpopulations at different sites or a combination of both.

Morrison and Weston (1985) and Hageman and Fahselt (1990) reported that plant population might show morphological variations as an adaptation to selection pressures which may result from phenotypic plasticity, genetic differentiation due to natural selection, evolutionary forces to some extent, environmental conditions and genetic differentiation which in turn might be due to genetic divergence or polymorphism. A phenotypic response to environmental conditions may allow a genetically non-adapted population to survive long enough to accumulate variants and then adapt genetically (Baldwin 1896, Osborn 1897). Morphological variation and geographical separation among populations are also prerequisites to the formation of subspecies and species (Losos and Glor 2003).

a) Ovate

b) Ovate deltoid

c) Oval and reniform

d) Deltoid

e) Oval

Plate 1. Variation in lamina shape in *Valeriana jatamansi*

a) Acuminate

b) Acute

c) Obtuse

d) Acute-obtuse

Plate 2. Variation in lamina apex in *Valeriana jatamansi*

a) Cordate with wide gap

b) Cordate with uniform gap

c) Cordate with narrow gap

d) Sagitate

e) Truncate

Plate 3. Variation in lamina base in *Valeriana jatamansi*

a) Entire b) Crenate-serrate c) Serrate d) Entire sinuate

Plate 4. Variation in leaf margin in *Valeriana jatamansi*

a) Flat b) Dome shaped partially c) Dome shaped totally

Plate 5. Variation in leaf profile in *Valeriana jatamansi*

Leaf traits can thus provide a link between various environmental factors and leaf functions and also provide evidence for plant taxonomy. In many species leaf characteristics like leaf blade length, width and shape of leaf blade have been used as important descriptors to distinguish between different cultivars. Therefore on the basis of variation in leaf morphological features in this species baseline information is provided which will be helpful in proposing descriptors on leaf traits basis which can satisfy distinctness, uniformity and stability (DUS) criteria. Such variation studies will also help in characterization of plants and identification of promising populations. Similar studies have been performed in the species by Chakraborty et al (2015) where morphological characterization and selection of 9 lines were done on the basis of leaf margin and time of flowering.

CONCLUSION

The present study revealed that *Valeriana jatamansi* has developed a great diversity in its morphological characters and the most prominent being observed were leaf parameters. The radical leaves during the present study exhibited wide variability in terms of lamina shape and leaf apex, base, margin, profile and colour. Thus understanding the variation in leaf morphological features serves as a basis for morphological and genetic characterization of the germplasm which will further help in identification of lines that may be useful for future breeding programmes. In this context the results of present study will help in identification of promising populations for harnessing potential of the species. It can act as a preliminary study and contribute to the development of better genotypes in future breeding programmes.

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