Valeriana jatamansi : a phenotypically variable plant species of Kashmir Himalaya

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Abstract: Kashmir Himalaya harbours large number of plant and animal species and is credited all over the world as a treasure of medicinal and aromatic plants. *Valeriana jatamansi* inhabit wide variety of habitats and the species exhibit phenotypic variability across these habitats, the variability aids the species for its survival under different environmental conditions.

[Aabid M. Rather, Irshad A.Nawchoo, Aijaz A. Wani , Aijaz H.Ganie. **Economic Botany and Reproductive Biology Research Laboratory Department of Botany, University of Kashmir, Srinagar-190 006. J&K. India**. Life Sci J 2012;9(2):540-543]. (ISSN:1097-8135). http://www.lifesciencesite.com. 81

Key words: Kashmir Himalaya; phenotypic variability; environmental conditions

1. Introduction

Many species occupy either a large geographical range or a variety of contrasting habitats within a limited area, or both. This raises the basic ecological question of how plants deal with these contrasting environmental conditions. Researchers have long known about genotypic and phenotypic variation in plant species and interaction of genotypes with environment, but these factors are often ignored in ecophysiological studies. In its simplest terms, genotypic variation deals with genetic differences among individuals or populations. If this variation can be related to habitat differences it may be considered ecotypic. Phenotypic variation involves non-genetic morphological or physiological plasticity or change to environmental variation such as seen in sun vs shade leaves (Abrams, 1993). Environmentally-induced phenotypic variation (phenotypic plasticity) in plants is often considered to be a functional response that maximizes fitness in variable environments. If there is relationship between environmental variation and phenotypic variation within species, it is reasonable to hypothesize that species which occupy a wide range of habitats will be more variable in phenotype than species that occupy a narrow range of habitats given by Van Valen (1965), Baker (1974), Sultan (2001).

Valeriana jatamansi inhabits an altitudinal gradient ranging from 1200-3000m asl, in addition the species also grows in wide variety of habitats which includes shady, moist, slopy and rocky habitats. Therefore, the present study was the first attempt to undertake phenotypic variability of the species in various habitats.

2. Materials and Methods

Plants were randomly selected in all the populations and the traits analyzed, include plant height, number of leaves per plant, internode length, leaf dimensions, number of flowers per inflorescence, flower dimensions, rhizome dimensions and number of roots per stock following methodology of Nath (1996), Kaufman *et al*.(1989).

3. Results

During the present investigation the species was found sporadically distributed in the mountain ranges of Kashmir Himalayas confined to sub-temperate and temperate regions, thriving in moist shady slopes, rocky slopes, land slide areas ranging in an altitude of 1200-3000m asl. The species is variable with respect to its quantitative traits (Figs.1-4). The phenotypic data gathered in different populations is described in detail below:

It was also observed that plants inhabiting shady, moist and fertile or humus rich soils attain vigorous growth, while plants growing under open sunny conditions and on rocky slopes were observed to be on the other extreme. The species produce two types of leaves- basal (radical) leaves which arise from rhizomatous portion and cauline (middle and apical) leaves which arise from the stem. Among this shade inhabiting plants showed maximum leaf dimensions. Root Stock, consisting of rhizome and roots, is characterized by underground thick horizontal rhizome with descending adventitious fibrous roots. Rhizome surface has nodes and internodes and terminates in a tuft consisting of leaf and flowering shoot bases.

Thus it is evident from the data that plants growing under dense canopy and humus rich moist soils as well as loose and fertile soil showed better plant development.

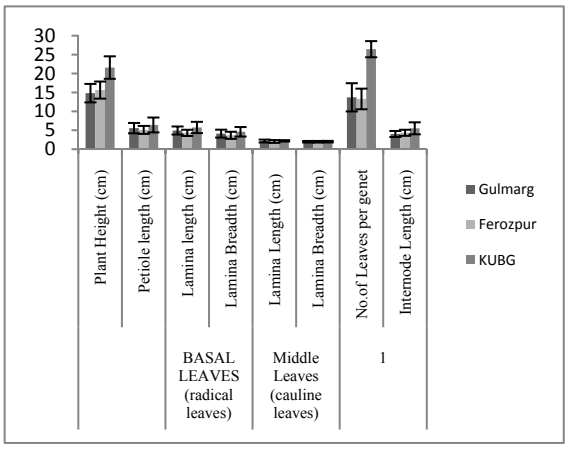

Fig. 1. Variability in morphological traits of hermaphrodite individual across different populations

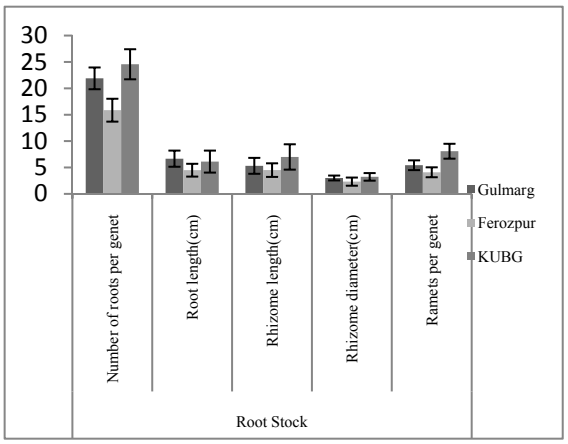

Fig. 2. Root stock dimensions of hermaphrodite individuals across different populations

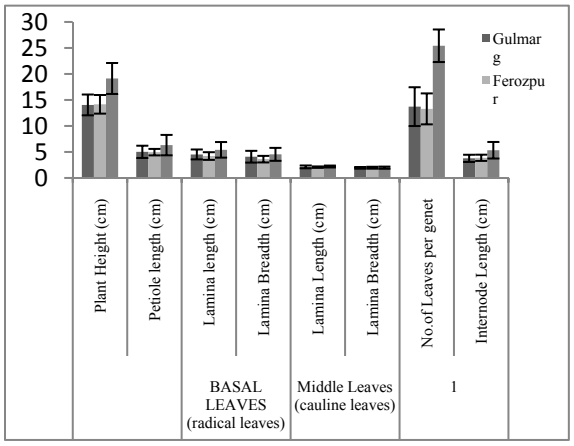

Fig. 3. Variability in morphological characters of female individual across different populations

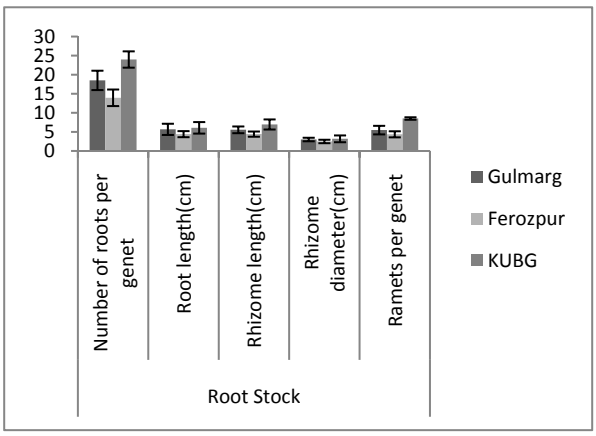

Fig. 4. Root stock dimensions of female individuals across different populations

4. Discussion

The valley of Kashmir, extending from Banihal to Baramulla is situated in the lap of the Himalaya. Himalaya is credited all over the world as a treasure of medicinal plants. Himalaya is ranked as one of the bio-diversity hot spots owing to its considerable abundance of medicinal plants. Among these medicinal gems *Valeriana jatamansi* (Valerianaceae) is a species with tremendous medicinal importance adding color to the crown of Himalayas. In Kashmir Himalayas *Valeriana jatamansi* inhabits sub-temperate and temperate habitats ranging from 1500 to 3000m asl. This species was found sporadically distributed over various sites of Kashmir Himalayas which include Shajnar, Dara, Harwan, Gulmarg, Yusmarg, Ferozpur, Sonamarg and Pahalgam by Naqashi and Dar (1982-86). These sites experience severe climatic conditions (low temperate, extreme variability in rainfall, fast winds, frequent clouds and high cosmic fallout etc.) and are too inaccessible. Within these specific natural habitats the individuals are sporadically distributed in a population, that too much less in number. This taxon has a greater endurance to extreme environments which are ecologically specific and unique in terms of habit, altitude, plant associations, edaphic conditions. These ecological preferences act as barriers preventing them from further spread. It needs to be borne in mind that species with highly stringent and specific habitat requirements have greater possibilities of extinction than species with a broad habit range (Samant *et al*.1996).

Valeriana jatamansi is displaying variability in various phenotypic traits at various stages in its populations. This wide distribution in trait values is the raw material for operative evolutionary forces and natural selection. This phenotypic variability speaks the language of a typical meiotic and breeding system,

which generate the variability in *Valeriana jatamansi*. The present study reveal that in response to their highly specific ecological environments this species have developed a spectacular diversity in their morphological characters viz., plant height, leaf number and dimensions, number of ramets, floral density, root length and number, rhizome dimensions etc. detailed morphological studies not only give specific botanical identity to a species but such studies reveal interesting features which are helpful in understanding the range of morphological variations present across different ecological zones (Anonymous,1976). The diversity across various ecological zones provides a strong edifice at which an ambitious plan for domestication and genetic improvement for commercial exploitation can be built. Plant height is highly plastic and varies among different populations. The plants growing in complete shady or dappled shade environments show maximum variability in this trait while the individuals growing in open or exposed conditions show least variation and are by and large uniform. Increase in plant height in shady environments seems advantageous for the species as the shady environments provide the conditions where plants have to compete for light. The species also exhibit enormous variability in leaf number per genet and leaf dimensions at inter-population level. However, it was also observed that plants growing under shade respond to shade by allocating more biomass to leaves and hence registers maximum leaf number and dimensions as well as plant height to compete for light, as holds true of many other plant species (Abrahmson and Gadgil, 1973). Stem-elongation responses in plants provide an example of adaptive plasticity that could involve an opportunity cost. Increased stem elongation is advantageous among plants growing in dense stands because taller plants overtop their neighbours and have higher lifetime light interception (Weinig, 2000a) and fitness (Schmitt et al. 1995 ; Dudley and Schmitt, 1996 ; Weinig 2000a). Elongation responses early in the life history may limit the duration of elongation or subsequent responsiveness because elongation lowers structural stability (Schmitt *et al*., 1995) and reduces resource acquisition by decreasing allocation to resource-harvesting organs such as leaves given by Morgan and Smith (1978), Robson et al. (1996), Cipollini and Schultz (1999). However, it was also observed that plants growing under shade respond to shade by allocating more biomass to leaves and hence registers maximum leaf number and dimensions as well as plant height to compete for light, as holds true of many other plant species (Abrahmson and Gadgil, 1973). Maximum amount of biomass is allocated to the organs of support i.e., rhizome and stem followed by leaves and inflorescences which is more in plants grown is shady habitat as holds true of other plants growing in shady environments of the forests (Abrahmson and Gadgil, 1973; Abrahmson, 1979).

Acknowledgements:

Authors are grateful to the Department of Botany, University of Kashmir Srinagar, India for their necessary support to carry out this work.

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12/16/2011