Chapter I

INTRODUCTION

Plantago lanceolata Linn. is a prominent polymorphic plant species growing gregariously in lawns, ornamental gardens, on foot paths, in cultivated fields, and in wastelands and other moist situations in Kashmir. The genus Plantago in India is represented by 12 species viz., P. major L., P. lanceolata L., P. tibetica L., P. brachyphylla L., P. ovata L., P. pumila L., P. psyllium L., P. stocksii L., P. amplexicaulis L., and P. ciliata L., of which the first four i.e. P. lanceolata, P. tibetica, P. brachyphylla and P. major grow in Kashmir (Hooker, 1894). P. lanceolata occurring in diverse forms is more common than the other three species. The plant species is spreading fast and has become a troublesome weed. The diversity of habit and habitat coupled with the peculiar modes of dispersal and spread aroused the interest in its detailed morphological, eco-physiological and cytological study. The investigations of such aspects of European and other forms of the genus Plantago seem to have received good attention (Watson, 1952, 56, 57; Knauer, 1926; Dowling, 1955; Gold'in, 1953; Gregor, Davey and Langham, 1936; Gregor, 1938, 39, 46; Holmes, 1941; Percival and Willox, 1949; Casper, 1942; Rahn, 1954, 57; Turesson, 1925; Stearns, 1955; Sagar and Harper, 1960, 61, 64; Basset, 1965, 66 and Basset and Crompton, 1967; Etc.), while any such information on Indian Plantains, in general and on P. lanceolata in particular is only scanty (Paliwal and Hyde, 1959; Misra, 1964, 66).

P. lanceolata populations growing under natural habitats show some easily detectable quantitative and qualitative variation in both vegetative and reproductive organs. Prostrate or erect; smooth or hairy and sessile or petioled leaves are some of the chief qualitative variations evinced by the vegetative parts while the curved or erect base of the scape and the length of the scape and spike are some of the chief variations shown by the reproductive parts of the plant species.
Thus, the curvature or erectness of scapes at the base; size, shape, margin and veination of leaf; the size, shape and branching of the root stock in addition to the length of the spike and scape are some of the chief characters that have been used in the present study to distinguish the various forms under the plant species occurring under varied biotic and edaphic conditions in Kashmir.

Morphological variations of this type have sometimes been attributed to environmental effects and have at other times been taken as genetically controlled. Boocher (1943) opined the hairiness of the leaves of the plant species to be a genetic trait though the same could be induced by subjection of the plants to drought conditions. Jenkin (1925) believed the prostrate or erect habit of the leaves to be greatly influenced by the habitat conditions as plants growing under the shade of tall grasses always grew erect and developed erect linear lanceolata leaves. According to Langheim (1941) the low light intensity as existed in long and short sward was causative in giving the prostrate habit to P. major. Trampling, mowing and clipping have also been thought to be determinative in giving it a particular habit by Kydd (1964). According to this author the petioles of P. lanceolata plants growing in the overgrazed swards were short and the rosette adpressed to the ground while plants growing in situations subject to lower intensities of grazing had elongated petioles and grew buried in ground. Pilger, (1934) divided P. lanceolata into two varieties viz., P. lanceolata variety communis and P. lanceolata var. dubia, on the basis of hairiness of the leaves and then subdivided each variety into subvarieties on the basis of habit and length and length/breadth ratio of the spike. Such a classification has been found suitable in regard to European types by Boocher (1943) and for distinguishing types growing under controlled conditions by Sagar & Harper (1944).

A large number of plant species are on record that exhibit varying morphology under varying environment. P. major has been reported as an extremely plastic species reacting quickly to the different soils by undergoing most conspicuous changes in respect of size, number and orientation of the leaves as well as of the reproductive parts. Huxley (1952) classed the phenotypes produced
within two years from seedlings as well as from the ramenta of a single clone as varieties and subspecies. Such variations have also been recorded within the populations of *P. maritima*. In the latter species these variations are either nearly constant in different populations or can be arranged in such a series as would show a continuous variation pattern throughout (Gregor, Davey and Lang, 1936). From his studies on *P. maritima*, Gregor (1939) recognised two types of clines, topo-clines similar to geographical or regional clines and eco-clines, related to ecological gradients within the restricted area. These eco-clines varied amongst themselves in characters like the density of the spikes and habit of the plant both being seemingly effected by good or poor drainage conditions of the habitat.

The variations, however, may not be the result of the environment alone. Anderson (1929) showed in *Aster anomalus* that different environmental conditions did modify the vegetative parts much more rapidly than the floral organs while Turill (1936) found *Centaurea nemoralis* to be little effected by the environment, compared to *P. major* that proved to be extremely plastic. Variation in the same or different populations of a plant species may primarily be due to its genetic set up as is true for *P. maritima*, considered to be the most simple diploid species for understanding the basic facts about variation and evolution (Gregor 1938,a,1939).

The wide spread occurrence of the phenomenon of population differentiation within plant species has been reported by Gregor (1946); Misra & Rao (1948), Clausen (1958), Clausen and Hiesey (1958), Misra (1959); Misra and Ramkrishnan (1959); Ramakrishnan (1959); Kaul (1958,1959 a,b,1964, a,b,1967) and many others. Turesson (1922) introduced the concept of "Ecotypes," and its importance in the constitution and origin of species was soon recognised. His wide study of plant species under both natural and experimental conditions led him to believe that the differences observable in the field between the populations of some species occupying diverse habitats, were maintained in the experimental conditions also, even when they were grown starting from seeds.
The author explained this to be due to genotypical response of the plant species to a particular habitat. Ramakrishnan and Singh (1965) recognised three edaphic ecotypes within the "Red Ecotypes" of *Euphorbia thymifolia*, growing in soils with different levels of soil calcium. Similar ecotypic variation has also been reported in *Tridax procumbens* (Ramakrishnan and Jain; 1965, a,b,c). Sen and Chatterjee (1966) have reported two forms of *Euphorbia caducifolia* in nature on the basis of colour of inflorescence. Kaul (1959 a,b,1964,1967) discovered four seasonal types linked with the light and temperature regimes of the different seasons, in the widely distributed *Xanthium strumarium* L. and Kaul (1967) recognised (1) "Erect" and (2) "Repent" morphological forms in *Macardonia clinthera*. Waisel (1959) suggested the ecotypic variation in *Nigella arvensis* to be either of hybrid nature or representing fairly constant intermediate combination.

In order to resolve the confusion and to ascertain the factors that cause the morphological variation in *P. lanceolata*, it becomes rather imperative to analyse the plants from natural populations as well as from those raised artificially under uniform conditions of growth, for their morphological, cytological and ecological traits. According to Hasselop-Herrison (1953) transplant experiments conducted to determine the effects on plant form of regional climate in different soils revealed *P. major* to be an extremely plastic species. Importance of such studies by transplant experiments under uniform conditions of growth for an ascertainment of the causes behind these morphological variations exhibited by the plant species in natural habitats has been advocated from time to time by workers like Tureson (1932, A,b); Gregor (1938 a,b,1939); Gregor, Davey and Lang (1936); Clausen, Keck & Hiesey, (1940) and Turrill et al (1940). "Transplantation of different types under the uniform habitat conditions eliminates the effects on phenotypes due to environmental differences and affords an opportunity for a direct comparison of the genotypes of different individuals, varieties and species" (Stebbins, 1950). A still improved method was, however, devised by Clausen, Keck and Hiesey (1940) by dividing a large perennial
plants into number of smaller parts and allowing these parts to grow in different environmental conditions for discovering the important physiological differences between closely related types.

The present study was primarily undertaken to (1) find out the variation pattern in the plant species under natural habitat conditions (2) to find the constant characters not fluctuating under experiments for establishing the "types" or varieties of the plant species and testing their validity by making thorough cytological investigations, (3) to find out the comparative ecological set up of established types in different habitats, their response to various soil moisture gradients, impact of soil texture and soil organic matter and the effect of light on shoots root ratio and on growth performance and (4) to check the validity of the field observations by growing the clones of these types under experimental conditions. The data and the observations presented in the thesis are a result of 4 years field observations and the confirmation thereof by garden-laboratory experimentation.

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