Chapter III

MORPHOLOGY, TAXONOMY AND DISTRIBUTION

General Morphology

For a thorough scrutiny of the various morphological characters as well as for a definite understanding of the variation pattern exhibited within different populations types of the plant species both living plants and the herbarium specimens were examined. The general morphology of the plant species as described by various authors (Hooker, 1894; Gunderson, 1950; Rendel, 1959; Lawrence, 1963; Hutchinson, 1964; etc.) and supplemented by personal observations is briefly described under.

Root

A well developed tap root system in young plants is replaced by fibrous root system in sufficiently older plants. Root buds are common (Fig.4).

Stem

Underground condensed root-stock rhizome, sometimes elongated, conical in sufficiently old plants, coming a few cm above the ground, branched or unbranched with or without adventitious buds (Fig.5).

Leaves

Leaves arise in a basal rosette, 3-15 cm long, in certain cases the length may reach even up to 45 cm (Fig.6) depending upon the prevalent conditions of soil moisture, soil texture and exposure. Leaves are linear-lanceolate, ovate-lanceolate or spatulate with long or short petioles (0.4-6.5 cm). In sufficiently longer leaves, the petioles may be 10-15 cm long while in some cases the leaves may even be sessile. Newly formed leaves in plants with prostrate habit are sessile but become petioled as the leaves elongate. The number of leaves per shoot varies with age of the plant. Very young plants bear 3-5 leaves only while in 1-2 year old plants the number varies from 5-17. In sufficiently older root stocks the maximum number of
leaves recorded was between 68 and 78 (Fig.7). Leaf margin is entire, dentate or serrate. The teeth may be small or long that coil spirally with one or more turns in each coil (Fig.8). Leaf surface is smooth or pubescent. The pubescence is confined only to the upper, the lower or to both the leaf surfaces. In certain cases, however, the pubescence is restricted only to lower surface along the central vein. The hair is generally unicellular with pointed apex (Fig.9).

Leaf blade is with 5-5 distinct parallel ribs running from base to apex. Leaf axils are usually woolly.

Inflorescence.

The flowers are generally borne in short spikes produced on axillary scapes 10 - 15 or 32 - 48 cm long. The number of scapes per plant varies with age. Newly produced plants bear 1 - 3 such scapes while in 5 - 6 year old plants the number may be as high as 26 - 32. Scapes are rectangular and deeply furrowed with 2 - 5 furrows. The entire length of the scape is beset with short hairs.

Spike.

Spike are cylindrical or ovoid, 1 - 3.7 or 4 - 5 - 7.4 cm long.
The spikes, in general, are simple, unbranched, bearing small sessile spirally arranged tetramerous flowers. The basal flowers on the spike are larger than those produced on the apical side (Fig.10A).

Flowers

Are tetramerous which can be represented by the general formula

\[ \theta, \quad 4, \quad K_4, \quad \mathcal{G}(4), \quad A_4, \quad G(2) \]

Bracts

Flowers are subtended by 4 sessile ovato-accumulate bacacts, which are free, papery and colourless when dry (Fig.10B).

Petals

4, fused into a short tubular corolla, a prominent midrib running through the centre and extending up to the tip.

Stamens

4, with long filaments, epipetalous, white, anther lobes long dorsifixed,
Figure 4. Root buds on the stem of *P. lanceolata*.

Figure 5. Mode and extent of branching in the stem of *P. lanceolata*. 
versatile.

**Gynaeccium**

Bicarpellary, syncarpous, superior, ovary 2 celled with long feathery style, protogynous.

**Fruit.**

Fruit a pyxidium, capsule two seeded, opening by a transverse lid (Fig.10).

**Seed.**

Smooth, concavo-convex with prominent scar in the centre of the concave side; small, length varies from 1.8 x 0.7 - 2.5 x 1.2 mm, black or pale grey in colour.

Sagar and Harper (1964) encountered certain monostrous forms of the plant species with some floral abnormalities in the cultivated and aerable lands of Britain and these are:

1. A form with leafy inflorescence in which the lower bracts develop into leaf like structure.
2. A form in which a whorl of spikes arises at the base of a normal spike.
3. A form in which the scape has several slender branches subtended by leafy bracts arising more or less half way along its length, each bearing a normal spike and a form with an apical rosette on top of the spike.

None of the above specified abnormalities in the floral parts of plant have been observed to be occurring in the local growth forms. However, the three abnormalities recorded are:

i) a form in which the spike bifurcates in the center and the process of bifurcation by the daughter branches is repeated one or twice in a typical dichotomous fashion. The branched spike bears normal flowers ii) a form in which a few basal flowers produce spikelets each with a short stalk, 1-1.2 cm long, in the axil of the comparatively longer leaf like bracts. Each stalk produces a well developed flower and a fruit (observed once) and iii) leaf chimaera is observed frequently.
Figure 6. A sufficiently old shoot of *P. lanceolata* (prostrate type) in which the length of the longest leaf measures about 40-45 cm.

Figure 7. A sufficiently old shoot of *P. lanceolata* (Erect type) in which with 78 leaves.
Fig. 6

Fig. 7
Pollination

Flowers are with a scent or nectar and as such no insect has been observed to visit the plant during the course of investigation, though Sagar and Harper (1964) report a few insects especially *Apis mellifera* visiting the plant in search of pollen grains. Pollination takes place by means of wind. Plants are completely self sterile in contrast to *P. major* which is 100% self pollinated. All attempts to self pollinate the flowers by bagging methods failed. Maximum anthesis according to Percival (1955) takes place between 7-10 A.M. According to estimates given by Hyde and Williams (1945) the average pollen production during 24 hours is $42.4 \times 10^6$ gm/m². Male sterile plants have been observed growing within the normal population (Fig. 12). The male sterility in the plant species appears to be protoplasmic as no accessory chromosomes (B chromosomes) have been observed associated in the male sterile plants during the cytological investigations. In *P. cornopus* male sterility has been ascribed to one accessory chromosome (Paliwal and Hyde, 1959).

Etymology

The general name *Plantago* has been derived from Latin word 'Plantae' meaning the sole of foot and refers to broad flat leaves of *P. major* (Meikland, 1956).

Synonyms

Various synonyms for *P. lanceolata*, as referred in 'Index Kewensis' are listed below:

- *P. allisma* Linn.
- *P. atrata* Tennore
- *P. byzantina* Koch
- *P. contorta* Guss
- *P. elata* Schur
- *P. ambigua* Guss
- *P. attenuata* Wall
- *P. capensis*
- *P. decumbens* Bernh
- *P. elata* Schur
- *P. argenta* Brot
- *P. azorica* Hoscht
- *P. capitata*
- *P. dubia* Linn
- *P. periophora* Hogg & Link
- *P. gerardi* Pourg
Figure 8. Leaf margin types in *P. lanceolata*.

Figure 9. Unicellular hair on the leaves of *P. lanceolata* with flat (1) or rounded basal (2) cells.
Figure 10(A) Young (extreme left) and sufficiently mature (extreme right) spike of *P. lanceolata*. Flowering starts from base and continues upto apex.

Figure 10(B) Flower (a) and bracts (b) of *P. lanceolata*.

Figure 10(C) Fruit (a) dorsal and ventral view of seed (b) and dehiscence of fruit (c).
Figure 11. Variegated leaves in *P. lanceolata* (note the normal and the variegated branches in the same shoot).

Figure 12. Male sterile shoot of *P. lanceolata*.
The majority of 200 species of the family Plantaginaceae are restricted to the genus Plantago while the other monotypic genera of the family are Beugeria and Littorella. The fundamental differences between Plantago on one hand and the remaining two genera on the other render the estimation of the original family type a bit difficult. In fact, assigning a concrete systematic position to the family is a matter of great controversy. Authors like Eichler and Doll, Vesque, Baulton, Lindley, Engler and Prantle (cf. McCullagh, 1935) consider the family as a descendant from the higher group of angiosperms.

The family shows a possible relationship with families like Scrophulariaceae in flower structure (Eichler and Doll) with Labiatae in hair types and stoma structure (Vesque); Plumbaginaceae in habit and general structure of the flower (Hutchinson, 1948); Ulmaceae, Betulaceae, Juglandaceae, Solanaceae, Chenopodiaceae and Amaranthaceae in wind pollination, flower being in catkin, stamens with slender filaments, feathery and bilobed stigma, single ovule and small green flowers without fragrance or nectar (Gunderson, 1950); with Primulales in sympetalous condition of flowers with basal placentation at later stages (Hutchinson, 1948); with Polemoniaceae, Primulaceae, Rubiaceae and Schrophulariaceae in forate state and absence of germinal furrows besides the smaller size of pollen grains (Gunderson, 1950).

Warnham (cf. Mc-Cullagh, 1935) states that there seems to be no convincing evidence supporting the view that Plantains are descended from any of the higher tubiflorae and suggests that the ancestry of the family must be sought more remotely than among the descendants of multiovatae. He regards them as derived from
Apocynal plexus on the evolutionary branch contemporary with the branches of transitional group. While according to Benthun, Hooker's classification Plantaginaceae has been regarded as an anomalous family in the series bicarpellatae of gamopetalae, Willis (1960) thinks the relationship of *Plantago* to be difficult to make out.

According to Mo-Cullagh (1955), cytological examination of the families Scrophulariaceae, Labiatae, Solanaceae, Primulaceae and Plumbaginaceae, which are believed to be related to the family Plantaginaceae, has failed to elucidate the troublesome question of the affinity of this family. This author believes the family to be monophyletic with basic chromosome number = 6 and possessing 6 morphologically recognisable chromosome types.

Stebbins (1950) considers Plantaginaceae as occupying the higher peak along with several mesophytic herbs of both temperate and tropic distribution and belong to families like Polemonaceae, Solanaceae, Bromeliaceae and Liliaceae, all of these being characterised by sympetalous actinomorphic, corolla definite number of stamens and hypogynous syncarpous ovaries with many ovules and axile placentation.

**Economic Uses**

*P. lanceolata* is commonly considered as an ugly and harmful weed persisting where it is not wanted. The plant species has been spreading fast locally and has undoubtedly created serious problems of eradication at times. The plant species has some beneficial uses as well and these are:

Young leaves, according to Felklova (1958), contain ethanol soluble substances which inhibit growth of *Streptococcus betahaemolyticus*, *S. aureus* and *Pacillus subtilis*. According to the author leaves contain but little of the active substance during and after flowering. In autumn the activity against *S. aureus* but not against the other micro-organisms tested increase again considerably. Because of this characteristics Europeans consider it to be favourable medicine for wound healing. In Kashmir, too, the crushed leaves are extensively used...
to cure wounds, sores and inflammed surfaces.

According to Mayer and Maber, (1963) the mucilage covering the seed is chemically composed of polyuronides, mainly glucuronides, sugars, hexoses, pentoses and proteins etc. Thus seeds used with sugar act as a drastic purgative. Locally the seeds are used to cure the inflammed surfaces of fingers and toes. A few grams of seed boiled and applied to a boil, results in a relief from the pain. An extract derived by boiling the leaves of this species alongwith those of *Semenaria parviflora* is generally prescribed by Ayurvedic physicians to check the oral and nasal bleeding.

In late summer, the plants with dry leaves, due to scorching heat are a common sight on the house tops in rural areas where these are used as a winter vegetable when any fresh vegetable is hardly available. The fresh leaves cooked with meat or fish make a delicious dish.

*P. lanceolata* is one of the most palatable species to sheep and these animals are actually seen chiseling the crowns out of the ground. According to Thomas and Thompson (1948), the leaves are very good source of Ca, Cl, P, K, Na and Co besides of small amount of Mg. Owing to high mineral content, the plant species is employed in herb strips for modern *Ay* and is supposed to give variety and supplement mineral supplies.

**Distribution and Dispersal**

*P. lanceolata* has been detected in late glacial deposits in small amounts restricted to arctic alpine grasslands (Sagar and Harper, 1964). Its tremendous increase in England is believed to be due to the destruction of forests. Presently it shows a cosmopolitan distribution and grows at all altitudes from 550 meters in west Yorks to 21,00 meters in Morocco while in Kashmir it grows at still higher altitudes of above 4,000 meters in Sheshnag (personal observation). It grows at all latitudes between 25° South in South Africa and 55° East in Norway and all the longitudes between 150° west in Alaska and 135° East in Japan.
The plant species, growing in diverse climatic zones in the world, has main area of its distribution in Europe, Extreme North Africa and Western Asia. It is an exotic in most of these areas. The species has not yet flourished in India and is restricted only to the western Himalayas and a few places in the South. In Kashmir, it is one of the most dominant weed and is spreading fast. It has broad ecological amplitude and is able to thrive in all habitats from moist to dry types that are grazed, tramped, scrapped, or protected. The particular types of the associated plants and the edaphic conditions like moisture, exposure etc. which normally determine the habit of the plant, do not seem to check its existence in a particular habitat. The plant perenniates throughout the severe winters by means of thick underground root stocks and vegetative buds and branches produced in autumn that sprout in the early spring in abundance.

Seeds do not have any special mechanism for wide dispersal but depend chiefly upon the natural agencies like wind and animals; and also on the fact that the species is extensively transported to far off places for use as a forage crop, a medicine and as a winter vegetable. The high seed output, high seed viability and high reproductive capacity coupled with vegetative propagation are main causes of its extensive infestation in the local habitats.

The dispersal of the propagules and the seeds of the plant species in addition to geographico-ecological distribution all over the world and more particularly in Kashmir have already been discussed by Durani and Kaul, (1968 Appendix, I).