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Morphological evaluation of *Asparagus* populations in central Kashmir

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Abstract

The present study was carried out in the Experimental Field of Division of Forest Products & Utilization of the Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Benhama, Ganderbal during 2019-2021. The germplasm was collected from two districts of central Kashmir viz., Srinagar (Dachigam, Dara, Harwan, Saedpora & Shalimar) and Ganderbal (Anderwan, Lar, Behama, Kangan & Sonamarg). Five sites from each district were selected based on distribution and abundance of the species. The study revealed that two species of *Asparagus* viz. *Asparagus racemosus* and *Asparagus officinalis* were found in two districts of Central Kashmir. The *Asparagus* plant species under study were perennial with crown-shaped (adventitious) and fasciculate root systems. Cladodes in *Asparagus racemosus* has a curved, needle-like shape and are light green in colour, arranged alternately while as cladodes in *Asparagus officinalis* are flat, needle-like and dark green in colour with whorled arrangement. *Asparagus racemosus* has petite, fragrant, white flowers, while *Asparagus officinalis* has yellow and non-fragrant flowers. Fruit type is berry. In *Asparagus racemosus* colour of berries is black while as in *Asparagus officinalis* colour of berries is red.

Keywords: *Asparagus racemosus*, *Asparagus officinalis*, morphological evaluation

Introduction

Asparagus species are perennial and belong to family Asparagaceae. The name *Asparagus* is derived from two Greek words "Stalk" and "Shoot" (Chughtai *et al.*, 2020) [3]. *Asparagus* species are widely distributed in northern Africa and western Asia and are native to the western shores of Europe (from northern Spain, north to Ireland, Great Britain, and northwest Germany). The world is home to about 300 different species of *Asparagus*. Of these, 22 species of *Asparagus* have been reported in India (Kirtikar and Basu, 1985) [12]. There are a variety of *Asparagus* species in India's temperate, tropical, and subtropical regions (Velavan *et al.*, 2007) [20]. *Asparagus racemosus*, *A. adscendens*, *A. officinalis*, *A. plumosus*, *A. sprengeri*, *A. virgatus*, *A. filicinus*, *A. falcatus*, *A. pyramidalis*, *A. retrofractus* etc. are some of the *Asparagus* species that are found and grown in North India (Kanno and Yokoyama, 2011; Prabakaran *et al.*, 2015) [11, 18]. According to reports, *Asparagus officinalis* has achieved popularity as a vegetable, *Asparagus racemosus* as a medicinal herb and *Asparagus plumosus* as a decorative plant (Kumar *et al.*, 2015) [15]. *Asparagus racemosus*, *Asparagus gonaclades*, and *Asparagus adscendens* are the three species of *Asparagus* that are most frequently employed in traditional Indian medicine out of the various species that are found in India (Hayes *et al.*, 2008) [8]. Three species *Asparagus racemosus*, *Asparagus officinalis* and *Asparagus filicinus* have been reported in Kashmir Himalaya (Polenin and Stainton, 1984) [17]. Herbaceous perennials, delicate woody shrubs, and photosynthetic stems are characteristics of genus *Asparagus* (Obermeyer, 1983) [16]. The roots are arranged in cluster form, attached at the base of the stem. The stem is fat having many soft branches. The leaves are needle like having a length of 6-12 mm and width of 1 mm, arrange in clusters. Flowers are greenish-white to yellowish, and round in shape. The fruit is berry, 6-10 mm in diameter and are poisonous to humans (Chen *et al.* 2000) [5].

Materials and Methods

The germplasm in the form of crown rhizomes of *Asparagus* species for the present study was collected during first week of March, 2020 from two districts of Central Kashmir viz., Srinagar (Dachigam, Dara, Harwan, Saedpora, Shalimar) and Ganderbal (Anderwan, Lar, Behama, Kangan, Sonamarg) and were planted in the Experimental Field at the Division of Forest

Products and Utilization, Faculty of Forestry, SKUAST-K, Benhama, Ganderbal. On the basis of distribution and abundance, ten sites (5 in each district) were selected in two

districts of central Kashmir. The geographical location and list of genotypes of the sites/populations are given in Table 1.

Table 1: Description of *Asparagus* accessions collected from different locations during the present study

District	Site	Genotype	Latitude (N)	Longitude (E)	Altitude (m)
Srinagar	Dachigam	<i>A. racemosus</i>	34°13'	75°03'	1676
	Dara	<i>A. racemosus</i>	34°18'	74° 91'	1598
	Harwan	<i>A. officinalis</i>	34°15'	74°90'	1583
	Saedpora	<i>A. officinalis</i>	34°10'	74°85'	1585
	Shalimar	<i>A. officinalis</i>	34°14'	74°87'	1596
Ganderbal	Kangan	<i>A. racemosus</i>	34°16'	74°54'	1799
	Lar	<i>A. racemosus</i>	34°26'	74°75'	1650
	Anderwan	<i>A. racemosus</i>	34°09'	74°79'	1655
	Behama	<i>A. officinalis</i>	34°73'	75°15'	1600
	Sonamarg	<i>A. racemosus</i>	34°19'	75°17'	2681

During the study different observations recorded were colour of roots, stem form, stem cross section, colour of stem, presence or absence of spines, type of spines (hard / soft), shape of spines (pointed / curved), branches (thin / thick), cladode shape (flat / curved), cladode colour, cladode arrangement (alternate / whorled), flower colour, fragrance of flower (fragrant / non-fragrant, time of flowering, fruiting, fruit type, colour of berries and shape of berries (round / globular / irregular).



Asparagus racemosus



Asparagus officinalis



Minute, white flowers of *Asparagus racemosus*



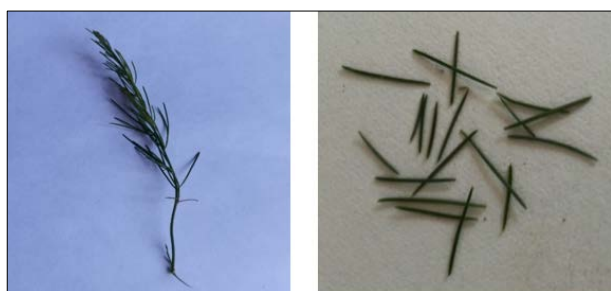
Bell-shaped, yellowish flowers of *Asparagus officinalis*



Berries of *Asparagus racemosus*



Berries of *Asparagus officinalis*

Thin, curved, needle like cladodes of *Asparagus racemosus*Thin, straight, needle like cladodes of *Asparagus officinalis*Roots of *Asparagus racemosus*Roots of *Asparagus officinalis*

Results

Asparagus species are perennial and belong to family Asparagaceae. The plant of *Asparagus racemosus* were observed to be woody climbing and scandent branched. Whereas, *Asparagus officinalis* were observed to be herbaceous, tall with stout and much branched.

Root

In *Asparagus racemosus* roots were thick, fleshy and tuberous as well as fibrous in cluster form, tapering towards both ends and brown in colour. In *Asparagus officinalis* long, thin, fibrous roots were observed. The colour of roots were ash white. The root system of both the *Asparagus* species were crown shaped (adventitious) and fasciculated root type were observed (Table 2).

Stem and branches

In *Asparagus racemosus* the stem was tall, woody, straight, round and light green in colour. In *Asparagus officinalis* stem was tall, herbaceous, round and dark green in colour. Pin needle like branches were observed in both the species (Table 2).

Spines

In *Asparagus racemosus* spines were present. They were hard, pointed and present below the node. In *Asparagus officinalis* spines were absent (Table 2).

Cladodes

In *Asparagus racemosus* shape of cladodes were curved, needle like and light green in colour. The arrangement of cladode were alternate. In *Asparagus officinalis* shape of cladodes were flat, needle like and dark green in colour. Whorled cladode arrangement were observed (Table 2).

Flowers

In *Asparagus racemosus* flowers were small, fragrant, white coloured. Yellow and non-fragrant flowers were observed in *Asparagus officinalis*. Flowering occurred during June-July in both the species (Table 2).

Fruit

Fruit type was berry. In *Asparagus racemosus* berries were irregular in shape and colour of berries was black. In *Asparagus officinalis* berries were round in shape and colour of berries was red. Fruiting occurred during September in both the species (Table 2).

Table 2: Morphological variations of *Asparagus racemosus* and *Asparagus officinalis*

Characteristics	Species	
	<i>Asparagus racemosus</i>	<i>Asparagus officinalis</i>
Family	Asparagaceae	Asparagaceae
Colour of roots	Brown	Ash white
Stem form	Straight	Straight
Stem cross section	Round	Round
Colour of stem	Green	Greenish purple
Presence or absence of spines	Present	Absent
Types of spines (hard/soft)	Hard	Absent
Shape of spines (pointed/curved)	Pointed	Absent
Place of spines	Below the node	Absent
Branches	Thin, pin-needle like	Thin, pin-needle like
Cladode shape (flat/curved)	Curved needle like	Flat needle like
Cladode colour	Light green	Dark green
Cladode arrangement	Alternate	Whorled
Flower colour	White	Yellow
Fragrance of flower (fragrant/ non-fragrant)	Fragrant	Non-fragrant
Time of flowering	June-July	June-July
Fruiting	September	September
Fruit type	Berries	Berries
Colour of berries	Black	Red
Shape of berries (round/globular/ irregular)	Irregular	Round

Discussion

The Table 2 makes it clearly evident that there were highly substantial morphological variations between the genotypes of *Asparagus* species, confirming the existence of genotype variability. The *Asparagus racemosus* plant was seen to have scan dent branches and to be a woody climbing plant. *Asparagus officinalis*, on the other hand, was found to be herbaceous, tall, thick, and heavily branched. The roots of *Asparagus racemosus* were brown in colour, thick, succulent, and tuberous as well as fibrous in cluster pattern. There were long, thin, fibrous roots in *Asparagus officinalis*. The roots were ash white in colour. Both kinds of *Asparagus* have crown-shaped (adventitious) and fasciculated root systems, which have been observed. The *Asparagus racemosus* plant has spines, they are firm, sharp, and present below the node. While *Asparagus officinalis* did not have spines. Cladodes in *Asparagus racemosus* has a curved, needle-like shape, light green in colour and arranged alternately. In *Asparagus officinalis* cladodes are flat, needle-like, and dark green in colour with whorled arrangements. *Asparagus officinalis* has yellow and non-fragrant flowers, while as *Asparagus racemosus* has petite, fragrant, white flowers. Fruit type is berry. In *Asparagus racemosus* berries are irregular in shape and colour of berries is black while as in *Asparagus officinalis* berries are round in shape and colour of berries is red. The morphological evaluation of the species has been the focus of numerous studies conducted throughout the world and the morphological features presented above are supported by those of Hooker (1894) [9] who reported that rootstock of the *Asparagus* genus is sturdy and creeping. Stem is terete, radially grooved outward, erect, sagging, or climbing. Flowers are small, axillary, solitary and fascicled or racemes, pendulous and occasionally unisexual with joined pedicel and spreading perianth segments. Gupta (1901) [7] reported thick fascicle, spindle-shaped farinaceous roots of genus *Asparagus*. Collet (1971) [4] defined *Asparagus* genus as being composed of upright or ascending, frequently straggling, heavily branched, thorny or unarmed shrubs or herbs. The rootstock is thick and spreading with cylindrical, fleshy branches, or occasionally tuberous. Leaves are reduced to miniscule, occasionally spine scent scales with tufts of

uneven, needle-like branch lets or cladodes that resemble linear leaves in their axils. Flowers are typically 2-sexual, axillary, tiny, yellowish, white, drooping, single or in clusters or racemes, with the stalks joining around the base. Perianth is bell-shaped and six-parted. The fruit is a globose berry that has a diameter of about 14 inches and turns bright red when ripe. Polunin and Stainton (1984) [17] reported that *Asparagus* genus is characterized by the paucity of leaves, which are replaced by cluster of needle-like cladodes, leaves reduced to scales. Fruit is berry-shaped. Flowers are small. Ellision (1986) [5] reported that cladodes, which resemble leaves, are stem changes that distinguish members of the genus *Asparagus*. Flowers typically appear in groups of 1-4, either axillary or terminal. On specific branches lacking cladodes, they are occasionally umbellate and frequently racemose. Perianth has six segments. Berry is a fruit. Kubitzki and Rudall (1998) [13] reported that *Asparagus* species may display different phyllocladodes from flattened to cylindrical forms. Chen *et al.* (2000) [2] reported that *Asparagus* has tuberous roots that grow in clusters and are attached at the base of the stem. The stem has several delicate branches. The leaves are grouped in clusters and resemble needles. Round, greenish-white to yellowish flowers are the most common types. Fruit appears to be a small red berry. Fukuda *et al.* (2005) [6] reported that *Asparagus* species may display different phyllocladodes from flattened or cylindrical forms. Schnitzler and Arnold (2010) [19] reported that genus *Asparagus* is herbaceous, shrubby and climbing forms. Plants are provided with underground rhizomes from which the aerial shoots arise. All species are characterized by cladodes which correspond to green photosynthetic stems. The true leaves are reduced to small scales. Kubota *et al.* (2012) [14] reported that the cladodes evolve from a leaf-like (flattened) to a rod-like (cylindrical) form. Similar other studies on morphological evaluation of *Asparagus* species had also been conducted (Irshad *et al.*, 2019; Chen *et al.*, 2020) [10, 1], thereby validating our findings that the plants belong to *Asparagus*.

Conclusion

This study represents the initial accounts of morphological

evaluation for the *Asparagus* species in Central Kashmir. The findings emphasized the significance of the morphological characteristics of the *Asparagus* species and also bring clarity for a better understanding of the diversity of species, particularly *Asparagus racemosus* and *Asparagus officinalis*.

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