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A MORPHOLOGICAL STUDY ON FIFTEEN MEDICINAL PLANTS GROWN IN BANGLADESH OPEN UNIVERSITY CAMPUS

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ABSTRACT

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The research focuses the understanding on morphological features of 15 medicinal plants for their authentic identification, popularization of cultivation, necessity, future scientific study, sustainable uses and useful information. The lowest growth rate was recorded 08.0 cm in arjun tree and the highest was 95.0 cm in neem tree. The highest number of primary branches (14) in arjun tree identical to orange jessamine, secondary branches (30) in gynura and tertiary branches (168) in arrowleafsida were recorded. The growth habit of majority of the plants were erect and some were of spreading. The canopy diameter was found the lowest 25 cm in arjun tree and the highest 160 cm in arrowleafsida. Wild almond and curry leaves tree did not show any branches. Among the remaining plants, the lowest branch density (02) was recorded in cedrela and the highest (188) was in arrowleafsida. The lowest stem diameter was found 0.64 cm in shalpani and the highest was 3.18 cm in wild almond tree. Different stem color was recorded. No plants showed stem hairs. The shape of leaf was found lanceolate, digitate, odd-pinnate, ovate, even pinnate, elliptic and linear. The shape of leaf apex in most of the plants was acute and other plants showed pointed, caudate, acuminate, obtuse and cordate. The acute shape of leaf base was found (5) followed by rounded and cuneate 4 of each and the other two showed oblique type leaf bases. Six plants had entire shaped leaf margin followed by undulate (5) shape, but other plants showed serrate, serrulate and dentate. Thirteen out of fifteen medicinal plants had green colored leaf, but the other two had dark green. The highest length of leaf was recorded 35.0 cm in cedrela. But the lowest was 1.8 cm in shalpani. The leaf width was found highest 30 cm in cedrela, but the lowest was 1.0 cm in arrowleafsida. The highest length of petiole was found 23.0 cm in wild almond tree, but the lowest 0.5 cm in pomegranate, arjun and glory bower. The leaves, roots, stems, barks, flowers, fruits and seeds of the medicinal plants perform to control different diseases e.g. headache, toothache, diarrhea, dysentery, fevers, coughs etc. The size, type and nature of the plants were also studied to comprehend the morphological characters.

Key words: morphological features, medicinal plants, sustainable uses, medicinal values, diseases

INTRODUCTION

The term ‘medicinal plant’ includes various types of plants used in herbalism where plants are used for medicinal purposes and the study of such uses. Medicinal plant is an important source of medicine and plays a significant role in world health (Sandberg and Corrigan, 2001). According to World Health Organization (WHO), many countries in the world that is two-third of the world’s population depends on herbal medicine for their primary health care (Akerele 1992; Hossain 2003 and Ghani, 2003). The reasons for this dependence are due to their better cultural acceptability, better compatibility and adaptability with the human body and assert lesser side effects. Some contain bioactive components or substances (active ingredients) which are obtained from medicinal plants (Shamim 2021). Medicinal plants are considered as a rich resource of ingredients which can be used in drug development either pharmacopoeial, non-pharmacopoeial or synthetic drugs. Many drugs currently available in the market are basically natural products or their semi-synthetic derivatives obtained from plant sources (Veeresham and Ciddi, 2012, Helmenstine and Anne Marie, 2021). A part from that, these plants play a critical role in the development of human cultures around the whole world. Moreover, some plants are considered as important source of nutrition and as a result of that they are recommended for their therapeutic values (Give reference). In the present era, plants are used as a range of treatments to physical problems of the human body. In China 40% of medication comes from plants and in Asian countries it is 80%. Recently, WHO surveyed that 80% of the world population depends on natural medicines at some stages of their primary health care concerns (Jhansi 2016). This implies the use of medicinal plants not only for the treatment of diseases, but also as potential materials for sustaining good health and conditions.

There are about 422,000 flowering plant species in the world, out of which 52,885 plant species are considered medicinal plants (Wakdikar 2004). Yusuf *et al.* 2009 had been reported that about 747 medicinal plants growing in Bangladesh have therapeutic value. The dependence on remedies from medicinal plants is particularly important in developing countries like Bangladesh where modern medicine is often absent or simply too expensive. The use of medicinal plant species is threatened by habitat destruction and by the unsustainable harvesting of plants from the nature (Taleb and Shamim, 2021). As a result, the raw materials of medicinal plants would be shortage in future. This is a valuable indicator of the current status of medicinal plant species in the nature and is a critical warning sign that action needs to be taken now, to reduce pressure on these diminishing populations.

Medicinal plant sector has traditionally occupied an important position in the socio-cultural, spiritual and medicinal arena of rural and tribal lives of Bangladesh. In recent years, the growing demand for herbal product has led to a significant jumping in volume of plants materials trade within and across the country. Bangladesh there is no systematic cultivation process or conservation strategies about medicinal plants (Bregum 2004).

Several scientists had been reported that herbal medicines can be considered safe alternative to modern medicines in some infectious disease in which the use has been established from time immemorial (Snigdha *et al.* 2018). The knowledge of herbal medicine is extensive and varies from one region of the country to another. It is hoped that this research will draw together a number of traditional healers to contribute knowledge and experience of BOU and local people. Their skills at identifying species and at monitoring the availability in the nature will be valuable asset to the research. The importance of medicinal plants cannot be taken lightly, because they have a significance to study the morphological characters in some of the medicinal plants commonly used in Bangladesh.

The morphological study of fifteen medicinal plants were therefore undertaken considering the above background with a view to: i) obtain information on morphological features which would help in their identification and authentication, ii) conserve for sustainable uses and future scientific study and iii) to popularize their cultivation and necessity.

MATERIALS AND METHODS

Experimental Location

Fifteen medicinal plants were grown-up in Bangladesh Open University (BOU) campus for the morphological study at a latitude of 90°31'N, longitude of 24°22'S at the elevation of 50 m above the sea level. The reason of growing those plants were to inspire local people and BOU employees to set up their own medicinal plant gardens.

Soil

The land was high and the soil was sandy loam with good internal drainage system. The site belongs to Madhupur tract under the Agro-ecological zone (AEZ) number 28.

Collection of Plant Resources

The sexual or asexual saplings of fifteen medicinal plants were collected from the nurseries situated from different locations of Bangladesh which are most commonly used by local people of Bangladesh as medicinal plants.

Cultivation and Intercultural Actions

After preparing the allotted land, the collected saplings were planted. Each significant plant was labelled mentioning their Bangla, English, scientific and family names. The care was taken after plantation of saplings like watering, manuring, earthing up, protection measures, weeding etc.

Data Accumulation

Data was taken from primary sources e.g. field temperature, relative humidity (RH), growth rate, number of branches, growth habit, canopy diameter, branch density, stem diameter, stem color, stem hair, stem hair density, shape of leaf, leaf apex, leaf base and leaf margin, color, length and width of fully-grown leaf, length of petiole etc. Data was also collected from secondary sources e.g. relevant books, magazines, journals, term papers, papers, proceedings, periodicals, essays, reports and internet information etc. The secondary sources were used to know the medicinal parts and values of the plants. Detailed records were kept that enabled thorough analysis to cultivate these medicinal plants.

Growth Rate

Initial height of each of the medicinal plants was measured using tape just after planting in the field. Their growth rate was recorded at every two months interval.

Number of Branches

The number of branches of every medicinal plant were counted in two times. One counting was done at planting time and another one was after six months of planting.

Determination of Canopy Diameter of a Tree

Canopy diameter of a tree is an important attribute of the size of the tree that influences the benefits e.g. cooling that a tree provides. The diameter of the tree's crown (canopy) i.e. the distance from one edge to the other was measured for the determination of canopy width. For the consistent and reducing subjectivity of the canopy, straight along the cardinal directions (north, east, south, and west) was measured. To identify the edge of the canopy, walked to its edge, and looked up imagining the drip line off its leaves. If a tree were to function as an umbrella, the drip line would be the edge of the canopy where the water would run off. The distance was measured from the trunk to the drip line in each of the four cardinal directions using measuring tape.

Determination of Stem Diameter of a Tree

The stem of a tree above the ground level was wrapped using a specially calibrated diameter tape around the outside (circumference) of a tree. It was made sure that the string was straight and tight around the trunk and

marked or cut the circumference on the string/rope. Then the length of string was measured. This indicated the total circumference of the tree. Now the circumference was divided by 3.14 to convert the circumference measurement to diameter. This diameter means the diameter of a tree with bark. For getting the diameter of a tree without bark, the circumference has to divide by 4.

Tree Identification by the Shape, Apex, Base and Margin of Leaves

The fully-grown leaves of different medicinal plants were seen. Because the shape of leaf, leaf apex, leaf base and leaf margin are the discriminating features for identifying plant species. There are basically three main parts of a leaf-stalk or petiole, leaf blade or lamina and stipules. The stalk or petiole is the thin section joining the base to the lamina, it is generally cylindrical or semicircular in form. In some of the plants the stalk is absent. Such types of leaves are called sessile. The leaf blade is consisted by base, midrib, veins, margin and apex. The connecting point from stem to leaf blade is called base point. Every leaf has got a mid-vein, which starts from leaf base and extends to the length of the leaf. The mid-vein of the leaf is not necessarily straight and bends towards left or right. For symmetric leaf, the mid-vein is straight and length of the mid-vein corresponds to length of the leaf. The asymmetric leaves have mid-vein bent towards right or left. The lamina or leaf blade is the widest part of the leaf. The stipules are small structures located on either side of the base of the petiole. Not every species produces leaves with all of these structural components. In certain species, paired stipules are not obvious or are absent altogether. A petiole may be absent, or the blade may not be laminar (flattened). There are large varieties exist in leaf structures. Hence, leaf blade was considered as a peculiar feature for recognition and classification.

The shape, apex, base and margin of plant leaves can diverge substantially. The different leaf shapes based on base angle, base shape, tip angle, tip shape and margin like lanceolate (pointed at both ends), digitate (divided into finger-like lobes), odd pinnate (leaflets in rows, one at tip), oblong (having an elongated form with slightly parallel sides, roughly rectangular), ovate (egg-shaped, wide at base), even pinnate (leaflets in rows, two at tip), elliptic (leaves with acute angle at both base and apex and having widest part at center, oval with a short or no point), linear (parallel margins, elongate), pointed (leaf base and tip incisive or angular less than 90°), caudate (an attenuate apex with a slender tail-like appendage at the tip), acuminate (a sharp-pointed apex with straight or convex margins that form an angle less than 45 degrees), acute (leaf or leaflet margins taper gradually or abruptly to a point at the apex), obtuse (rounded point, angle base), cordate (heart shaped, stem attaches to cleft with wide and has broader base than apex), rounded (without a pointed apex), cuneate (wedge shaped, acute base), oblique (a leaf twisted or inclined from the normal position), serrate (margin has a series of toothlike pointed teeth around the entire leaf edge), entire (margin is even and smooth around the entire leaf edge), undulate (widely wavy), serrulate (with fine serration), dentate (with symmetrical teeth) etc. were found in the research.

Gazipur district of Bangladesh was of low rainfall and moderately high temperature. The research zone was surrounded by heavy industrial areas. Weekly meteorological aspects in respect of air temperature and relative humidity during the period of research were recorded by thermometer and hygrometer respectively.

RESULTS AND DISCUSSION

Field experiment was carried out on different features of medicinal plants for one year (2017-2018) and various data were taken. The research was studied at temperature ranged from 8.7 to 36°C with mean $24.63 \pm 0.68^\circ\text{C}$ and relative humidity 67.29 to 92.07 percent with mean 79.28 ± 1.10 percent.

Conservation of Medicinal Plants






The seedlings of different medicinal plants were collected from the various corners of Bangladesh and planted in a piece of land in the Bangladesh Open University Campus. Land preparation and management practices were done properly. The allotted plot was maintained by fifteen medicinal plants (Table 1). Each of the medicinal plants was indicated with scientific name including their local, English and family name in the field.

Fifteen medicinal plants have been conserved at the campus of Bangladesh Open University. Every plant was marked mentioning their local, English, scientific and family name so that one can identify the plant easily (Ambarish Mukherjee 2014).

Table 1. List of collected medicinal plants grown at Bangladesh Open University Campus

Sl. no.	Local name	English name	Scientific name	Family name	Picture
01	Pith berela	Arrowleafsida	<i>Sida rhombifolia</i>	Malvaceae	
02	Box badam	Wild almond tree	<i>Sterculia foetida</i>	Malvaceae	
03	Currypata	Curry-leaves tree	<i>Murraya koenigii</i>	Rutaceae	
04	Dalim	Pomegranate	<i>Punica granatum</i>	Punicaceae	
05	Shalpani	Shalpani	<i>Shorea robusta</i>	Dipterocarpaceae	
06	Toon	Cedrela	<i>Cedrela microcarpa</i>	Meliaceae	
07	Aparajita	Butterfly pea	<i>Chitoria ternatea</i>	Fabaceae	
08	Arjun	Arjun tree	<i>Terminalia arjuna</i>	Combretaceae	
09	Gynura	Gynura	<i>Gynura nepalensis</i>	Asteraceae	
10	Neem	Neem tree	<i>Melia azadirachta</i>	Meliaceae	

Cont'd

Sl. no.	Local name	English name	Scientific name	Family name	Picture
11	Bakul	Indian medaller	<i>Minusops elengi</i>	Sapotaceae	
12	Lal tulsi	Shrubby basil	<i>Ocimum gratissimum</i>	Lamiaceae	
13	Tejpata	Bay leaves	<i>Cinnamomum tamala</i>	Lauraceae	
14	Bamonhati	Glory bower	<i>Cherodendrum indicum</i>	Verbenaceae	
15	Kamini	Orange jessamine	<i>Murraya paniculata</i>	Rutaceae	

Growth Rate

It was found that the least height was 8.0 cm in gynura and the highest was 115 cm in neem tree during planting. But the lowest growth rate was recorded 08.0 cm in arjun tree and the highest was 95.0 cm in neem tree (Table 2).

Growth rate of fifteen medicinal plants was found different. It was recorded that the growth rate of neem tree was 11.86 times more than that of arjun tree. It might be due to the favor of the environment.

Table 2. Growth rate of planted seedlings of medicinal plants after every two months

Medicinal plants	Height of medicinal plants at planting time(cm)	Height of planted medicinal plants measured after every two months(cm)			Height increased from the transplanting time(cm)
		1	2	3	
Arrowleafsida	36	55.0	68.0	115.0	79
Wild almond tree	95	105.0	111.0	135.0	40
Curry-leaves tree	10	18.0	23.0	40.0	30
Pomegranate	45	65.0	77.0	134.0	89
Shalpani	45	50.5	53.0	60.0	15
Cedrela	60	81.0	93.0	140.0	80
Butterfly pea	35	42.0	46.0	65.0	30
Arjun tree	60	63.0	64.5	68.0	08
Gynura	08	28.0	39.0	60.0	52
Neem tree	115	140.0	159.0	210.0	95
Indian medaller	40	59.0	63.0	80.0	40
Shrubby basil	41	47.0	49.3	55.0	14
Bay leaves	50	61.2	65.3	75.0	25
Glory bower	90	120.4	132.5	155.0	65
Orange jessamine	90	111.3	116.2	138.0	48

Number of Branches

Three types of branches like primary, secondary and tertiary were recorded (Table 3). Some of the medicinal plants had no any type of branches during planting time e.g. wild almond tree, curry leaves tree, cedrela, arjun

tree, gynura, neem tree and Indian medaller. But the different types of branches were found after passing six months. The highest number of primary branches (14) in arjun tree identical to orange jessamine, secondary branches (30) in gynura and tertiary branches (168) in arrowleafsida were recorded.

Table 3. Number of branches per medicinal plant at planting time and after six months

Medicinal plants	Number of branches at planting time			Number of branches after six months		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
Arrowleafsida	06	14	-	06	14	168
Wild almond tree	-	-	-	-	-	-
Curry-leaves tree	-	-	-	-	-	-
Pomegranate	03	08	-	03	14	35
Shalpani	02	-	-	02	15	12
Cedrela	-	-	-	02	-	-
Butterfly pea	03	-	-	03	22	33
Arjun tree	-	-	-	14	-	-
Gynura	-	-	-	02	30	149
Neem tree	-	-	-	06	-	-
Indian medaller	-	-	-	04	18	22
Shrubby basil	02	-	-	02	12	33
Bay leaves	02	-	-	02	02	-
Glory bower	03	-	-	03	-	-
Orange jessamine	04	-	-	14	05	-

‘-’ indicates no branches.

Branching capacity was found different in the plants. Some of the plants showed no any branches, but some showed primary, secondary and tertiary branches. Arjun tree and orange jessamine plant showed the highest primary branches (14), gynura showed highest secondary branches (30), but arrowleafsida showed the highest tertiary branches (168). It might also be happened due to their growing nature.

Growth habit, Canopy Diameter and Branch Density

The growth habit, canopy diameter and branch density of different medicinal plants are shown in Table 4. The growth habit of majority of the plants were erect and some were of spreading. The canopy diameter was the lowest 5 cm in curry leaves tree during planting time and 25 cm in arjun tree after six months of planting respectively. The highest was found 75 cm at planting time and 160 cm after six months of planting time in arrowleafsida. Some of the medicinal plants were found without branches and some were with branches. Wild almond and curry leaves tree showed no any branches at six months passing of planting. Among the remaining plants, the lowest branch density (02) was recorded in cedrela and the highest (188) was in arrowleafsida after six months of planting time.

Table 4. Growth habit, canopy diameter and branch density in different accession of medicinal plants after six months of planting time

Medicinal plants	Growth habit	Canopy diameter (cm)		Branch density	
		Planting time	After six months	Planting time	After six months
Arrowleafsida	Spreading	75	160	20	188
Wild almond tree	Erect	30	70	-	-
Curry-leaves tree	Erect	05	30	-	-
Pomegranate	Erect	35	70	11	52
Shalpani	Spreading	30	60	02	29
Cedrela	Erect	18	110	-	02
Butterfly pea	Spreading	50	90	03	58
Arjun tree	Erect	20	25	-	14
Gynura	Spreading	20	100	-	181
Neem tree	Erect	28	55	-	06
Indian medaller	Erect	10	50	-	44
Shrubby basil	Spreading	15	60	02	47
Bay leaves	Erect	20	30	02	04
Glory bower	Erect	31	45	03	03
Orange jessamine	Erect	25	65	04	19

The growth habit of medicinal plants was erect and spreading. These types of different habits might be occurred for their developing nature which have been supported by Hoque *et al.* 2014; Anonymous 2006. Arrowleafsida showed 15 times higher canopy diameter than that of curry leaves tree during planting time and showed 6.4 times more canopy diameter than that of arjun tree after planting of six months. Each of the plants showed different canopy diameter. This kind of differences might be happened for their nature. Some of the medicinal

plants grew in BOU campus without showing any branches. The arrowleafsida plant showed 94 times more branch density than that of cedrela plant.

Stem of Medicinal Plants

The stems of medicinal plants with different characteristics like diameter, color, hair, hair density is summarized and shown in Table 5. All the stem characteristics were observed and recorded after six months of planting. The lowest stem diameter was found 0.64 cm in shalpani and the highest was 3.18 cm in wild almond tree. Different stem color was recorded like greyish, light green, dark green and dark brown. No plants showed stem hairs.

It was found that 4.97 times more stem diameter was recorded in wild almond tree than shalpani. None of the medicinal plants were found with hair. Stem color of various plants were found different. It might be occurred due to their rising nature.

Table 5. Main stem diameter, stem color, stem hair and stem hair density of medicinal plants after six months of planting time

Medicinal plants	Main stem diameter (cm)	Stem color	Stem hair	Stem hair density
Arrowleafsida	1.88	Greyish	Absent	-
Wild almond tree	3.18	Greyish	Absent	-
Curry-leaves tree	0.80	Greyish	Absent	-
Pomegranate	1.34	Greyish	Absent	-
Shalpani	0.64	Greyish	Absent	-
Cedrela	2.71	Greyish	Absent	-
Butterfly pea	1.11	Greyish	Absent	-
Arjun tree	1.11	Greyish	Absent	-
Gynura	1.27	Dark green	Absent	-
Neem tree	2.42	Dark brown	Absent	-
Indian medaller	1.27	Light green	Absent	-
Shrubby basil	1.02	Greyish	Absent	-
Bay leaves	0.96	Light green	Absent	-
Glory bower	1.40	Light green	Absent	-
Orange jessamine	1.46	Dark brown	Absent	-

‘-’ means stem hair not found.

Shape, Apex, Base and Margin of Leaves of Medicinal Plants

Leaf shape, shape of leaf apex, base and margin in fifteen medicinal plants are presented in Table 6. Various shape of leaves was found in medicinal plants. However, four medicinal plants showed lanceolate leaf shape, one showed digitate leaf shape, four showed odd-pinnate leaf shape, one showed ovate leaf shape, one even pinnate, two elliptic and one linear leaf shape. Shape of leaf apex in most of the plants was acute and other plants showed pointed, caudate, acuminate, obtuse and cordate. The acute shape of leaf base was found (5) followed by rounded and cuneate 4 of each. Among the other plants oblique type leaf bases were also found. The highest number of leaf margin was 6 of entire shape followed by undulate (5) shape, but other plants showed serrate, serrulate and dentate.

The shape of leaf, leaf apex, leaf base and leaf margin were observed and found different shapes e.g. lanceolate, odd pinnate, acute, obtuse, rounded, entire, undulate etc. It might also be happened for their growing nature (Xiang Zhang *et al.* 2019).

Table 6. Shape of leaf, leaf apex, leaf base and leaf margin of medicinal plants

Medicinal plants	Leaf shape	Shape of leaf apex	Shape of leaf base	Shape of leaf margin
Arrowleafsida	Lanceolate	Pointed	Rounded	Serrate
Wild almond tree	Digitate	Caudate	Cuneate	Entire
Curry-leaves tree	Odd pinnate	Acuminate	Oblique	Undulate
Pomegranate	Oblong	Acute	Acute	Entire
Shalpani	Ovate	Pointed	Rounded	Entire
Cedrela	Even pinnate	Acuminate	Acute	Undulate
Butterfly pea	Odd pinnate	Obtuse	Rounded	Entire
Arjun tree	Lanceolate	Acute	Cuneate	Serrulate
Gynura	Elliptic	Acute	Acute	Dentate
Neem tree	Odd pinnate	Cordate	Oblique	Serrate
Indian medaller	Linear	Acute	Acute	Undulate
Shrubby basil	Elliptic	Acute	Rounded	Undulate
Bay leaves	Lanceolate	Acuminate	Cuneate	Entire
Glory bower	Lanceolate	Acuminate	Cuneate	Undulate
Orange jessamine	Odd pinnate	Obtuse	Acute	Entire

Color, Length, Width of Fully-Grown Leaf and Length of Petiole

Different leaf characters like color, length, width of fully-grown leaf and length of petiole of medicinal plants are shown in Table 7. Thirteen out of fifteen medicinal plants had green colored leaf. The number shown dark green color was 2. The highest length of leaf was recorded 35.0 cm in cedrela. But the lowest was 1.8 cm in shalpani. The leaf width was found highest (30 cm) in cedrela, but the lowest was 1.0 cm in arrowleafsida. The highest length of petiole was found 23.0 cm in wild almond tree, but the lowest 0.5 cm in pomegranate, arjun and glory bower.

Table 7. Color, length, width of fully-grown leaf and length of petiole in different medicinal plants

Medicinal plants	Leaf color	Length of leaf (cm)	Width of leaf (cm)	Length of petiole (cm)
Arrowleafsida	Green	2.8	1.0	0.6
Wild almond tree	Green	17.0	2.6	23.0
Curry-leaves tree	Green	15.0	6.5	2.2
Pomegranate	Green	7.0	2.2	0.5
Shalpani	Dark green	1.8	1.5	1.0
Cedrela	Green	35.0	30.0	9.5
Butterfly pea	Green	8.5	9.0	1.4
Arjun tree	Green	7.5	3.0	0.5
Gynura	Green	12.6	6.8	2.0
Neem tree	Green	30.0	22.0	9.6
Indian medallier	Green	11.5	5.0	0.8
Shrubby basil	Green	3.6	2.0	1.5
Bay leaves	Green	12.5	4.0	1.0
Glory bower	Dark green	16.0	3.8	0.5
Orange jessamine	Green	13.5	8.4	2.0

Medicinal plants showed different leaf colors for their developing nature. The length of leaf was found 19.4 times more in cedrela than shalpani. Cedrela showed 30.0 times more leaf width than that of arrowleafsida. The length of petiole was found 46.0 times more in wild almond tree than that of pomegranate, arjun and glory bower. These types of characters might be differed due to their producing habit which supported the findings of Haider and Alam, (2014).

Salient Features of Medicinal Plants

The different characteristics of medicinal plants including their medicinal values and uses of plant parts are described in Table 8. The plants bear many distinguishable characteristics like perennial herb or shrub, evergreen

Table 8. Salient features of medicinal plants grown at Bangladesh Open University Campus

Medicinal plants	Characteristics	Medicinal values	Uses of plant parts
Arrowleafsida	A perennial plant producing more or less herbaceous, many-branched stems.	Used as a poultice in the treatment of headaches, boils, cramps, rheumatism, toothache, chapped lips and pimples.	Whole plant, leaves
Wild almond tree	An attractive, umbrella-shaped, spreading deciduous tree.	Effective for the treatment of dropsy and rheumatism.	Bark, leaves, fruits
Curry-leaves tree	A most attractive, small evergreen tree with wonderfully sweet, curry-pungent foliage.	used internally in treating constipation, colic and diarrhea.	Bark, leaves, roots
Pomegranate	A deep-rooted but slow-growing, spiny, deciduous shrub or small tree.	Used externally in the treatment of vaginal discharges, mouth sores and throat infections.	Whole plant, flowers, seeds
Shalpani	An evergreen tree with an elongated crown when young, becoming more rounded as the tree ages.	Operative for the treatment of dysentery, gonorrhea, boils and toothaches.	Leaves
Cedrela	A monoecious, deciduous, medium-sized to large tree.	Used to reduce fever and pain.	Seeds, leaves, bark
Butterfly pea	A short-lived, herbaceous, perennial climbing, scrambling or trailing herb.	Active to treat eye problems.	Flowers, roots, bark
Arjun tree	A very large evergreen tree.	Reduces blood cholesterol levels and maintain a steady heartbeat.	Bark
Gynura	An herbaceous perennial plant with erect stems.	Applied to cuts and wounds.	Leaves
Neem tree	A fast-growing, deciduous tree.	Reactive for the treatment of neuralgia and nervous headache.	Fruits, leaves

Cont'd

Medicinal plants	Characteristics	Medicinal values	Uses of plant parts
Indian medaller	An evergreen tree with a dense, rounded, spreading crown.	Used to treat gonorrhea, snakebites, fevers, wounds, scabies and eczema.	Leaves, flowers
Shrubby basil	An erect, much-branched, aromatic shrub.	Used internally in the treatment of colds, especially chest colds; fevers, headaches, impotence, flatulence, diarrhea, dysentery.	Leaves
Bay leaves	An evergreen tree.	Useful for the treatment of stomachache, colic and diarrhea.	Bark, leaves
Glory bower	A semi-deciduous, perennial plant with stems that are sometimes herbaceous but more often become woody, with the plant adopting the habit of a shrub or a small tree.	Effective for the treatment of asthma, coughs and syphilitic rheumatism.	Leaves, roots
Orange jessamine	A slow-growing, evergreen shrub or small tree with a fine-textured, compact crown.	Act efficiently to treat swellings due to sprain and contusions and poisonous snake bites.	Bark, roots, leaves

shrub or small tree, deciduous large tree etc. These medicinal plants perform to control different diseases e.g. headache, toothache, rheumatism, diarrhea, mouth sores, throat infections, dysentery, gonorrhea, snakebites, fevers, wounds, scabies, eczema, asthma, coughs, piles etc. The leaves, roots, stems, barks, flowers, fruits and seeds of the described medicinal plants are used as medicine. Plant parts based on medicinal values vary from plant to plant.

There are many medicinal plants found passim which are wild in nature and not known to us. These different medicinal plants are used for the treatment of different diseases. We suffer from many kinds of diseases. It was found that same diseases are controlled by different plants. e.g. arrowleafsida, neem tree and shrubby basil are used to control headache. Here three different plants are used for same purpose. But this difference and diversity is very important for the people (Gafna *et al.* 2017).

Because all the plants are not found easily surrounding to the people when needed. It is seen that one plant is available, but the others not. It was also found that diarrhea is controlled by using the plant parts of curry leaves tree, shrubby basil and bay leaves which are different in nature. Curry leaves plant is medium tree and evergreen, shrubby basil is small sub-shrub and evergreen, but bay leaves are large tree and evergreen. These kinds of differences in nature between the plants might be helpful for the users or growers based on the plant's habitat. The option would be the best if one plant is used to control all the diseases. But it is impossible and impractical, because one plant is not possible to grow due to environmental variation in a country or in the world. So, it might be absurd to collect this plant. On the other hand, if the plant is destroyed due to pest attack (insects, mites, pathogens etc.), many patients would die for the lack of medicinal plants. So, we should conserve the medicinal plants according to their habitat and our needs.

Size, Type and Nature of the Plants

The size, type and nature of the medicinal plants have been presented in Table 9. Five types of tree size were found in the research e.g. small, small to medium, medium, medium to large and large. The highest number was recorded 5 in small tree identical to large tree, but the lowest was found 1 in medium tree. The type of medicinal plants was listed highest 8 in tree followed by herb (4). But the lowest was 1 in sub-shrub. Eleven out of fifteen medicinal plants showed evergreen nature, three showed deciduous nature, but the lowest was 1 in semi-deciduous nature.

Table 9. Tree size, type and nature of different medicinal plants

Medicinal plants	Tree size	Tree type	Nature
Arrowleafsida	Small	Herb	Evergreen
Wild almond tree	Medium to large	Tree	Deciduous
Curry-leaves tree	Medium	Tree	Evergreen
Pomegranate	Small to medium	Shrub or small tree	Deciduous
Shalpani	Large	Tree	Evergreen
Cedrela	Large	Tree	Evergreen
Butterfly pea	Small	Herb	Evergreen
Arjun tree	Large	Tree	Evergreen
Gynura	Small	Herb	Evergreen
Neem tree	Large	Tree	Deciduous
Indian medaller	Medium to large	Tree	Evergreen
Shrubby basil	Small	Sub-shrub	Evergreen
Bay leaves	Large	Tree	Evergreen
Glory bower	Small	Herb	Semi-deciduous
Orange jessamine	Small to medium	Shrub or small tree	Evergreen

The size, type and nature of medicinal plants were found diversified. Small and large tree was found 5 times more than medium tree. The type of tree plants was 8 times higher than sub-shrub. The evergreen plants were found 11 times more than semi-deciduous plants. It might be happened due to the favor or disfavor of the environment and their growing nature which was similar to the findings of Yusuf *et al.* (1994).

CONCLUSION

Each of the medicinal plants was indicated with scientific name including their local, English and family name in the field so that one can identify the plant easily. The lowest growth rate was recorded 08.0 cm in arjun tree and the highest was 95.0 cm in neem tree. The highest number of primary branches (14) in arjun tree identical to orange jessamine, secondary branches (30) in gynura and tertiary branches (168) in arrowleafsida were recorded. The growth habit of majority of the plants were erect and some were of spreading. The highest canopy diameter was found 75 cm at planting time and 160 cm after six months of planting time in arrowleafsida. Some of the medicinal plants were found without branches and some were with branches. Wild almond and curry leaves tree showed no any branches. Among the remaining plants, the lowest branch density (02) was recorded in cedrela and the highest (188) was in arrowleafsida. The lowest stem diameter was found 0.64 cm in shalpani and the highest was 3.18 cm in wild almond tree. Different stem color was recorded like greyish, light green, dark green and dark brown. The shape of leaf, leaf apex, leaf base and leaf margin were observed and found different shapes e.g. lanceolate, odd pinnate, acute, obtuse, rounded, entire, undulate etc. Thirteen out of fifteen medicinal plants had green colored leaf and the other two were of dark green color. The highest length of leaf was recorded 35.0 cm in cedrela. But the lowest was 1.8 cm in shalpani. The leaf width was found highest (30 cm) in cedrela, but the lowest was 1.0 cm in arrowleafsida. The highest length of petiole was found 23.0 cm in wild almond tree, but the lowest 0.5 cm in pomegranate, arjun and glory bower. The plants bear many distinguishable characteristics like perennial herb or shrub, evergreen shrub or small tree, deciduous large tree etc. Five types of tree size like small, small to medium, medium, medium to large and large were found. The highest number was recorded 5 in small tree identical to large tree, but the lowest was found 1 in medium tree. The type of medicinal plants was listed highest 8 in tree followed by herb (4). But the lowest was 1 in sub-shrub. Eleven out of fifteen medicinal plants showed evergreen nature, three showed deciduous nature, but the lowest was 1 in semi-deciduous nature.

Some of the customs might be occupied for the future expectant which are itemized below:

- Govt. should take instigation for the publicity of effectiveness of medicinal plants through different media e.g. radio, television, print media, social media etc.
- A precise division should be introduced in the ministry to recognize the medicinal plants easily.
- To launch gardens of medicinal plants in all the districts as gene bank.
- To organize seminars, symposiums, workshops, conferences for increasing responsiveness about medicinal plants.
- To stimulate the mass people to produce medicinal plants in their homestead gardens.

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