



## RESEARCH PAPER

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## Ethnobotanical and ecological study of *Myrtus communis* (L.) in Bajaur agency (FATA) Khyber-Pakhtunkhwa, Pakistan

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### Abstract

*Myrtus communis* L. is a bushy, aromatic, ever-green shrub, belongs to the family Myrtaceae, commonly found in Bajaur Agency (FATA) Pakistan. The plant has been acknowledged due to the presence of aromatic compounds in the essential oil. The IUCN red list identifies the plant as endangered. To understand the Ethnobotanical and ecological importance of the plant, a questionnaire survey was conducted to collect quantitative and qualitative information from randomly selected 120 local inhabitants of the Bajaur Agency. The results indicate that Myrtle is mostly used as a flavouring agent (46.81%) and as stomachic (10.90%). The plant use was also recorded for blood purification (0.45%), constipation (0.45%) and (31.11%) as herbal tea. We also report on the people perception of the plant conservation status. People consensus recorded clearly shows that Myrtle is mainly eradicated due to over exploitation by humans (42.96%) and if any patches remain conserved is due to inaccessibility to it (30.70%). Geo-references data of the species were collected to identify and extrapolate their present distribution in Bajaur Agency. Cluster analysis was performed to check any similarities in ecological niches of the stands. We conclude from the survey that the species population has been drastically reduced and is under severe anthropogenic pressures including extensive and uncontrolled use of the plant as ethnomedicinal drug and due to its great economic value. However, it is recommended that further investigation into their possible future niche modelling and conservation analysis shall be carried out to save this important plant from extinction in the wild.

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## Introduction

*Myrtus communis* L. is a species of genus *Myrtus* L. belongs to the family Myrtaceae, which contain about 140 genera and 3,400 species growing in tropical, sub-tropical and temperate regions of the world (Treveset *et al.*, 2001; Sharma *et al.*, 2004; Khan *et al.*, 2016). Myrtle stem is branched having dark ever-green leaves which are glabrous, opposite, glossy, whorled or paired, coriaceous, with stiff structure, lanceolate to ovate, margined entire, aromatic, acuminate and (2.5-3.8cm) long also in the lamina glands is absent (Sumbul *et al.*, 2011; Ali *et al.*, 2016). Its flowers are white in color; axillary in position having slender peduncle, of 2cm in diameter”, stamen possess yellow color anthers. The flowers are star like in appearance which bloom from June-September having five sepals, five petals and also many stamens (Davis *et al.*, 1982). *Myrtus communis* L. are used as folk medicines different parts of the plants are used such as leaves, fruits, flowers, roots (Ertug *et al.*, 2004) and also volatile oils for several purposes (Baytop *et al.*, 1999; Tuzlasi *et al.*, 2006) of then Myrtle is one of the most important and highly medicinal species (Wannea *et al.*, 2010).

The essential oil of Myrtle possesses various Pharmacological properties (Trease and Evans, 2006). Having anti-bacterial, anti-fungal properties (Mansouri *et al.*, 2001; Othman *et al.*, 2007; Shan *et al.*, 2007; Pereira *et al.*, 2012; Taheri *et al.*, 2013), hypotriglyceridemic, hypoglycaemic (Elfellah *et al.*, 1984; Dineel *et al.*, 2007) and anti-mutagenic activities (Hayder *et al.*, 2008; Mimica-Duki *et al.*, 2010; Ali *et al.*, 2015) properties.

The essential oils are medicinally used as an anti-inflammatory, anti-mutagenic, anti-genotoxic, anti-hyperglycaemic and as strong anti-oxidative (Chryssavgi *et al.*, 2008; Wannes *et al.*, 2010). The oils are aromatic, balsamic, hemostatic, tonic, digestive disorders, genitourinary infections, respiratory tract infection, treatment of acne, wounds, pyorrhea, bleeding piles, rheumatism, as a food,

liqueur, cosmetic industries, anti-microbial (Bezanger *et al.*, 1975; Jerkovic *et al.*, 2002; Flamini *et al.*, 2004; Romani *et al.*, 2004; Faria *et al.*, 2005).

The other uses are inflammatory process such as prostatitis, bronchitis, and cold (Gruenwald *et al.*, 2000; Ali *et al.*, 2014), antibiotic action, plant taken internally in the treatment of urinary infections, vaginal discharge, bronchial congestion, sinusitis, dry cough, in India it is also considered useful for the treatment of cerebral affections, especially epilepsy, externally it is used in the treatment of gum infections and haemorrhoids and anti-septic. Myrtles also contain myrtle substance which is used as a remedy for gingivitis, as a rheumatism (Medicinal herbs of India, 2016), against blood- shed, for treatment of pyorrhea, rheumatoid pain (Setorki *et al.*, 2012; Nasir *et al.*, 2015) and skin diseases.

In turkey, oil of myrtle leaves are used to lower blood glucose in diabetic patients, bladder infection, anti-protozoal (Mahdi *et al.*, 2006).

The Myrtle fruits (barriers) and fruit extracts (essential oil) are used as anti-septic, astringent, carminative, emmenagogue, demulcent, dessicant, analgesic, hair tonic, haemostatic, anti-emetic, lithotriptic, cardiogenic, diuretic, anti-inflammatory, stomachic, brain-tonic, nephro-protective, anti-dote, anti-diaphoretic and anti-diabetic (Hakeem *et al.*, 1895; Ghani *et al.*, 1920; Kabiruddin *et al.*, 1951; The wealth of India, 1962; Kirtikar and Basu, 1988; Nadkarni *et al.*, 1989; Baitar *et al.*, 1999; Trease and Evans, 2006). Chemically myrtle oil is the essential oil of *Myrtus communis* L. which is obtained from the leaves, fruits, flowers and branches through steam distillation process (The wealth of India, 1962; Nadkarni *et al.*, 1989). *Myrtus communis* L. propagation occurs both by cuttings and also by seeds (Shabana *et al.*, 2010; Khan *et al.*, 2014) *Myrtus communis* L. is widely cultivated as an ornamental plant in gardens and parks. It is also cultivated in gardens of North-west Indian region due to its fragrant flowers (Nadkarni *et al.*, 1989).

Internationally, the market value of myrtle are not well known due to its wild nature but in some region of the world its fruit and leaves are sold in the local markets such as, in turkey, fruits of myrtle are sold in the South-west provinces such as Milas, Mulga and Bodrum, in the Mediterranean town and Aegean markets (Ertug *et al.*, 2004; Ali *et al.*, 2013).

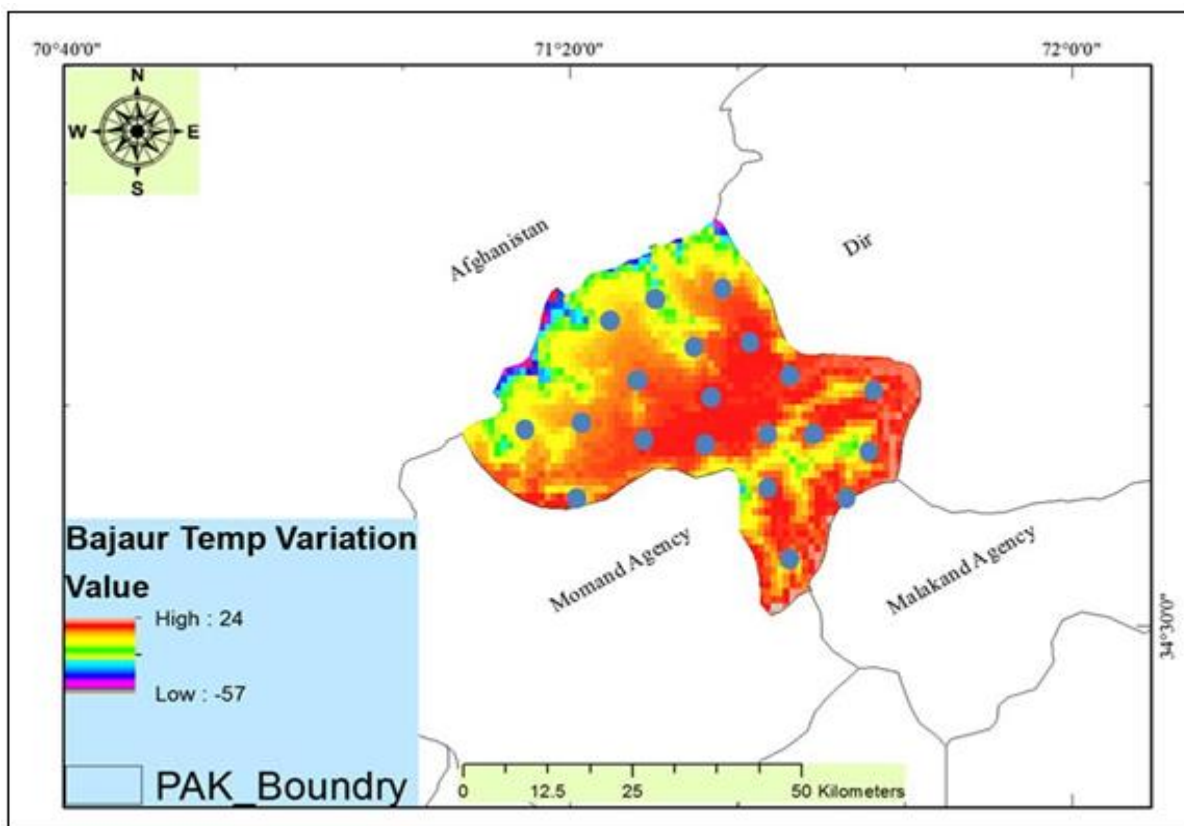
The aim of the study was to investigate the ethno-botanical survey of *Myrtus communis* L. and to identify the main reasons of their eradication, conservation, folk uses, methods of uses and their

community structure in Bajaur Agency Khyber Pakhtunkhwa, Pakistan.

## Materials and methods

### Data collection

Myrtle is an important medicinal plant of Bajaur agency. Thesurvey was carried out during January 2016 to June 2016. A total of 120 local people were interviewed, and were classified into four groups (Table 1). Respondent were asked about the folk uses, recipes, its community, reason of extinction and survival of the myrtle.



**Fig. 1.** Shows map of Bajaur agency with annual temperature variation value.

### Quantitative ethno-medicinal data analysis

Conversion of the qualitative data into quantitative is essential for hypothesis-testing, statistical validation and comparative analysis (Hoffman and Gallaher, 2007).

Quantitative information increases the probability of identifying pharmacologically important plant (Andrade-Cetto and Heinrich, 2011).

### Relative frequency of citation (RFC)

The collected ethno-medicinal data was quantitatively analyzed using the Relative Frequency Citation (RFC) index. This indicator shows the local importance of the species and is calculated from the frequency of citation (FC, the number of informants mentioning the usage of the specie) divided by the total number of informants in the survey (N), without considering the use categories (Kayani *et al.*, 2014).

RFC can be defined by formula.  $RFC = FC/N$  value ranges from zero (non of the informant cites the plant as useful) to one (every informant report the plant to be useful) (Sadeghi *et al.*, 2014).

*Use value (UV)*

The use value (UV) demonstrates the relative importance of locally known plants (Song *et al.*, 2014). It is calculated using formula  $UV = \sum U_i/N$  where  $U_i$  is the number of use mentioned by each information for a given species and N is the total number of informants.

*Geo-referenced data*

Myrtle geo-referenced data was collected by GPS in studied sites. The collected degree, minute and

second format was converted into decimal point format by the formula = (Degree + minutes/60) + (second/3600).

*Cluster analysis*

Plant community was assessed and clusters were made using PC-ORD software. The two way cluster analysis was done by using distance measure (Correlation) and group linkage method (Ward's method).

**Results**

The Folk uses of Myrtle shows that it is used most abundantly as flavouring agent (46.818 %) stomach (10.909 %) followed by use as a food (9.545 %).

**Table 1.** Classification of respondents into groups.

S. No	Group	Age ranges	Respondents
1	G-I	20-30	34
2	G-II	31-40	28
3	G-III	41-50	27
4	G-IV	51-Above	31

**Table 2.** Medicinal folk uses of Myrtle in Bajaur agency Pakistan.

Table for folk uses (Bajaur)	FC (20-30)	FC (31-40)	FC (41-50)	FC (51-above)	$\sum U_i$	N	Use value (UV)	%UV
Flavouring agent	32	21	26	24	103	220	0.468	46.818
Stomach	3	5	6	10	24	220	0.109	10.909
Food	9	3	5	4	21	220	0.095	9.545
Dysentery	2	3	6	5	16	220	0.072	7.272
Blood clotting	1	4	2	2	9	220	0.04	4.09
chest disorder	2	1	2	4	9	220	0.04	4.09
Anti-diabetic	1	2	2	2	7	220	0.031	3.181
Anti-septic	3	3	0	0	6	220	0.027	2.722
Milk preservation	0	2	1	3	6	220	0.027	2.727
Throat infection	1	1	2	0	4	220	0.018	1.818
Fever	0	1	1	1	3	220	0.013	1.363
Prevent sweating	0	2	0	1	3	220	0.013	1.363
Remove teeth worm	0	1	0	2	3	220	0.013	1.363
Headache	0	0	0	2	2	220	0.009	0.09
Increase Eye Sight	0	2	0	0	2	220	0.009	0.909
Blood purification	0	0	1	0	1	220	0.004	0.454
Constipation	0	1	0	0	1	220	0.004	0.454

Note: FC=Frequency of Citation,  $\sum U_i$ =The total number of use mentioned by each informant, N= is the total number of informant, UV use value, and %UV is total percentage of use value.

The lowest used value (0.454 %) for blood purification and constipation (Table 2). Myrtle is also use as recipes for curing different diseases. Highly used value (31.11 %) as Dry leaves mixed with tea,

followed by (21.11 %) as mixed with milk; however the lowest value (2.77 %) as an edible fruits and (1.66 %) powder form of roots mixed with milk (Table 3).

**Table 3.** Use value of different recipes of Myrtle for curing different diseases.

Recipes (Bajaur)	FC (20-30)	FC (31-40)	FC (41-50)	FC (51-above)	∑Ui	N	Use value UV	%UV
Dry leaves mixed with tea	16	12	14	14	56	180	0.311	31.111
Dry leaves mixed with milk	5	7	14	12	38	180	0.211	21.111
Dry leaves mixed with boil water	9	7	4	7	27	180	0.15	15
Fresh leaves mixed with tea	5	3	3	3	14	180	0.077	7.777
powder form of leaves mixed with milk	0	2	4	7	13	180	0.072	7.222
Fresh leaves mixed with boil water	4	4	2	1	11	180	0.061	6.111
Fresh leaves mixed with milk	2	1	3	1	7	180	0.038	3.888
powder form of seeds mixed with milk	1	1	0	4	6	180	0.033	3.333
Fruits are edible	1	1	1	2	5	180	0.027	2.777
powder form of roots mixed with milk	0	1	1	1	3	180	0.016	1.666

Note: FC=Frequency of Citation, ∑Ui= The total number of use mentioned by each informant, N= is the total number of informant, UV use value, and %UV is total percentage of use value.

Myrtle mainly eradicated due to over exploitation of human (42.96 %) however it was observed that human inaccessibility (30.70 %) hard to access the

point (17.54 %) and proximity to water (14.91 %) were naturally conserved (Table 4).

**Table 4.** Different reasons of natural conservation of Myrtle in Bajaur Agency Pakistan.

Reason of survival (Bajaur)	FC (20-30)	FC (31-40)	FC (41-50)	FC (51-above)	∑Ui	N	Use value UV	%UV
Human inaccessibility	7	11	9	8	35	114	0.307	30.70
Hard to access point	5	3	6	6	20	114	0.175	17.54
Proximity to water	3	2	4	8	17	114	0.149	14.91
Ornamental uses	4	4	2	0	10	114	0.087	8.77
Protected	1	3	2	4	10	114	0.087	8.77
Away from grazing animals	2	3	2	1	8	114	0.070	7.02
Ever-greens	3	0	1	1	5	114	0.043	4.39
Water storage capacity	2	0	1	1	4	114	0.035	3.51
Present on Non- arable lands	2	1	0	0	3	114	0.026	2.63
High fidelity	0	0	0	2	2	114	0.017	1.75

Note: FC=Frequency of Citation, ∑Ui= The total number of responses mentioned by each informant, N= is the total number of informant, UV use value, and %UV is total percentage of use value.

The reason of extinction of Myrtle in Bajaur Agency were investigated that over exploitation by human (42.96 %) was on the top which were followed by accelerated erosion (12.5 %), over grazing (11.71 %) and no protection (9.37 %), while climate change (0.78 %) also noted in the extinction of the species in the studied area (Table 5).

*Geo-referenced locations of Myrtus communis L.*

In the present research work the current position of Myrtle were recorded and summarized in Table 6. This data could further be analyzed in Geographical Information System (GIS) to calculate their future probability of occurrences in the climate change.

*Cluster analysis*

The cluster analysis is very informative in terms of showing how quadrates form groups are based on similarity. The horizontal lines in the dendrogram are drawn at the levels of similarity between 5 clusters of

fruits. C-1 contains St-1, St-12, St-4, St-8, St-9 and St-14. C-2 having St-2, St-11 and St-15. C-3 having St-3, St-7, St-10, St-5 and St-17. C-4 contains St-6, St-16 and St-18 while St-13, St-20 and St-19 genotypes were noted in C-5.

**Table 5.** Reason of extinction of Myrtle in Bajaur Agency Pakistan.

Reason of extinction (Bajaur)	FC (20-30)	FC (31-40)	FC (41-50)	FC (51-above)	ΣUi	N	Use value (UV)	%UV
Over exploitation by Human	12	13	16	14	55	128	0.429	42.968
Accelerated erosion	5	6	4	1	16	128	0.125	12.5
Over – grazing	5	3	4	3	15	128	0.117	11.718
NO protection	2	3	3	4	12	128	0.093	9.375
Excessive rain fall	4	2	2	1	9	128	0.07	7.031
Up-rooting	4	1	0	4	9	128	0.07	7.031
Due to Fires	2	1	2	3	8	128	0.062	6.25
Due to aging	0	2	0	1	3	128	0.023	2.343
Unknown reason (climate change)	0	0	0	1	1	128	0.007	0.781

Note: FC-Frequency of Citation, ΣUi-The total number of use mentioned by each informant, N- is the total number of informant, UV use value, and %UV is total percentage of use value.

**Table 6.** Geo referenced data of the species in the study area.

Site name	Species	Lat	Long
1	<i>Myrtus communis</i> L.	34.6675	72.71861111
2	<i>Myrtus communis</i> L.	34.66805556	71.71861111
3	<i>Myrtus communis</i> L.	34.66833333	71.5675
4	<i>Myrtus communis</i> L.	34.68333333	71.56722222
5	<i>Myrtus communis</i> L.	34.68333333	71.56722222
6	<i>Myrtus communis</i> L.	34.68416667	71.55194444
7	<i>Myrtus communis</i> L.	34.68416667	71.55194444
8	<i>Myrtuscommunis</i> L.	34.68416667	71.55166667
9	<i>Myrtus communis</i> L.	34.68416667	71.55194444
10	<i>Myrtus communis</i> L.	34.68361111	71.5525
11	<i>Myrtus communis</i> L.	34.68333333	71.56666667
12	<i>Myrtus communis</i> L.	34.66916667	71.5525
13	<i>Myrtus communis</i> L.	34.68527778	71.58444444
14	<i>Myrtus communis</i> L.	34.68527778	71.58444444
15	<i>Myrtus communis</i> L.	34.685	71.58416667
16	<i>Myrtus communis</i> L.	34.685	71.58416667
17	<i>Myrtus communis</i> L.	34.68527778	71.58472222
18	<i>Myrtus communis</i> L.	34.68583333	71.58472222
19	<i>Myrtus communis</i> L.	34.66888889	71.60222222
20	<i>Myrtus communis</i> L.	34.66888889	71.60222222

This means that well-separated clusters have long vertical stems or fork (Fig. 6). Myrtle consisting six different shapes such as flat, round, oval, preform, elliptical and elongated. We checked similarity among quadrates on the basis of fruit shapes (Fig.7). Myrtle having three different types of seed shapes such as

kidney, bean and snail shapes. According to this figure stand which show similarity having same type of seed shape (Fig. 8).

Plant community and environmental variable (habitat) show similarity in various stands.

According to the figure there are four types of habitat such as stream, spring, field border and hill slope (Fig. 9). Plant community and environmental variable (soil) show similarity in various stands (Fig. 10).

There are (5) five types of soil texture were observed such as rocky, muddy, loam and sandy in the study area.

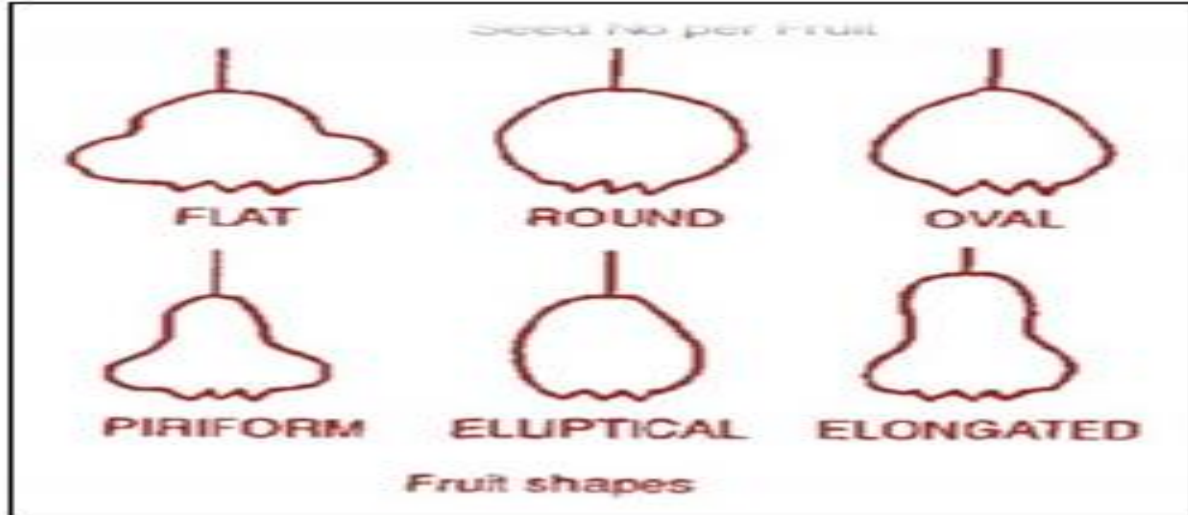


Fig. 2. Shows different fruit shapes (Rahim *et al.*, 2012).

**Discussion**

*Occurrence*

*Myrtus communis* L. is endangered species found in Africa, America, Australia, North western Himalaya, Asia and widespread in the in the Mediterranean region (Nadkarni *et al.*, 1989; Medicinal Plants of India, 1987).In Pakistan it is present in the hilly areas of Kashmir and Khyber-Pakhtunkhwa (Rahim *et al.*, 2012). We investigate their occurrence in Bajuar Agency although with passage of time some factors affect their habitat.

*Uses*

The present research was carried out to study the different aspects of Myrtle and it was observed that (46%) people use it as a flavouring agent, (31%) people used its dry leaves with tea while in the literature the Montoro *et al.*, 2006 and Sumbul *et al.*, 2011 also state the same result. The Myrtle is used for stomach (10.90%), food (9.54%), blood clotting (4.09%) which is supported by Charles, 2013 and Hosseinzadeh *et al.*, 2011. Serio *et al.*, 2014 and Setorki *et al.*, 2012 also reported the anti-diabetic (3.18%) and anti-septic (2.72%) uses of the specie.

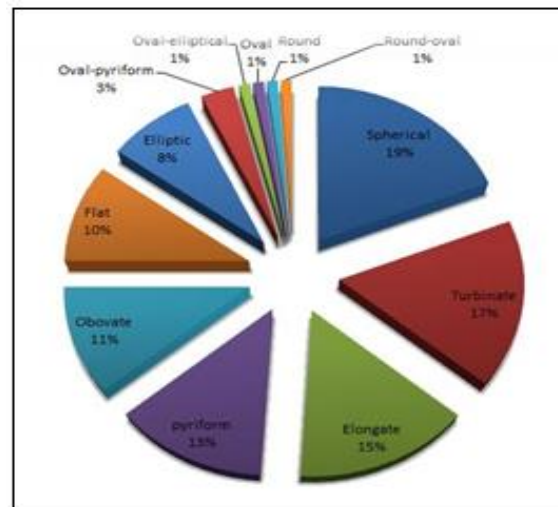


Fig. 3. Shows different fruit shapes percentage.

According to opinion of (30%) people, this plant is survived due to Human inaccessibility; however (42%) people stated that this plant is eradicated due to over exploitation by human such as regular and over uses for different diseases, drinks and deforestation. Rahim and their co-worker (2012) reported that habitats destruction made it vulnerable and as a result reduced the population of Myrtle plants from the study area considerably. During the survey it was noted that the respondent of group (G-3 and G-4) having more knowledge about this endangered plant.

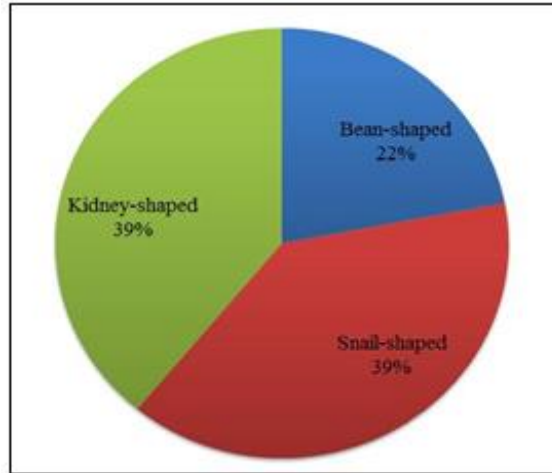


Fig. 4. Shows seed shapes variability.

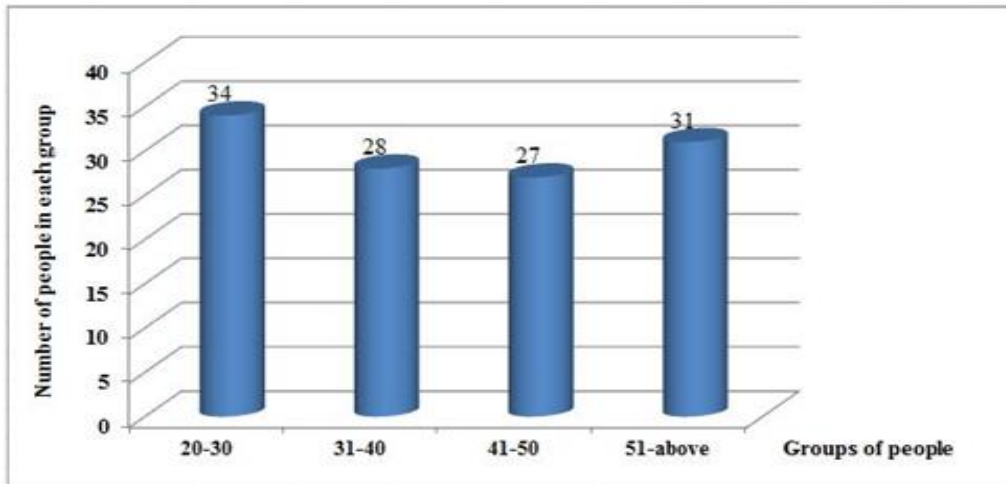


Fig. 5. Shows age groups of the respondents of the Bajaur agency, Pakistan.

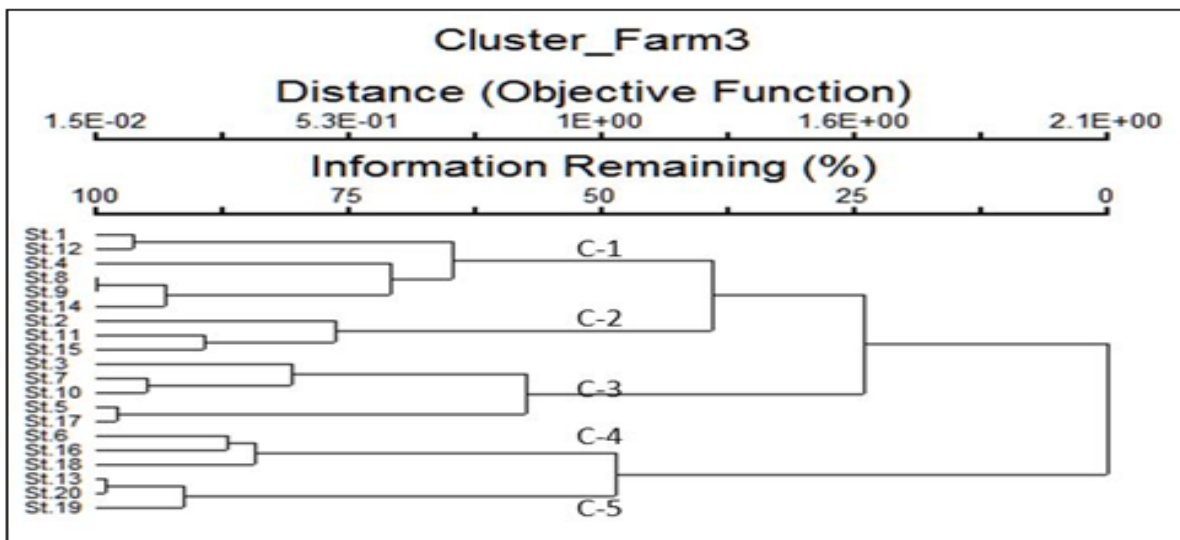


Fig. 6. Shows cluster analysis of plant community basis on similarities.



Cluster analysis

From cluster analysis we can conclude that stands are divided into groups and sub groups on the basis of similarities, the similar groups have similar environmental conditions. The inhabitants of Bajaur have more knowledge of this significant medicinal plant of their area. Due to advancement in our society and insufficient knowledge, we lose medically

important plants day by day. The present documentary and research work provide basis for the development of cultivar from this potentially commercial oriented drug plant. It is also recommended that further studies on the impact of climate change on this plant shall be carried out from the area and should be given priority to be protected for the future generation to come.

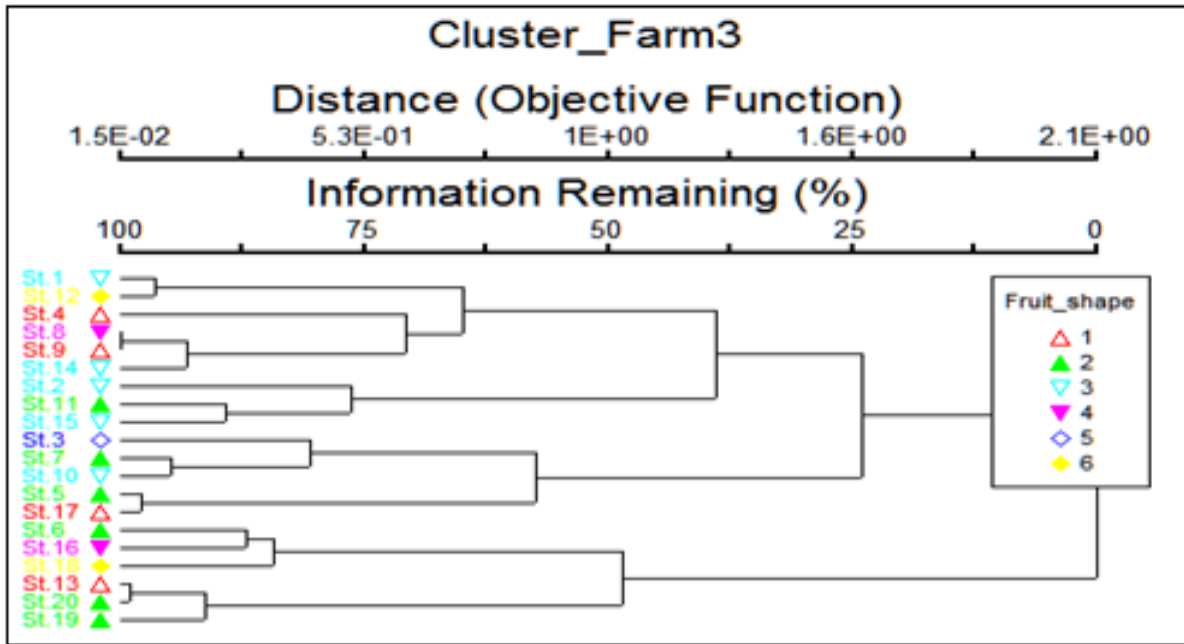


Fig. 7. Shows cluster analysis of myrtle fruit shape.

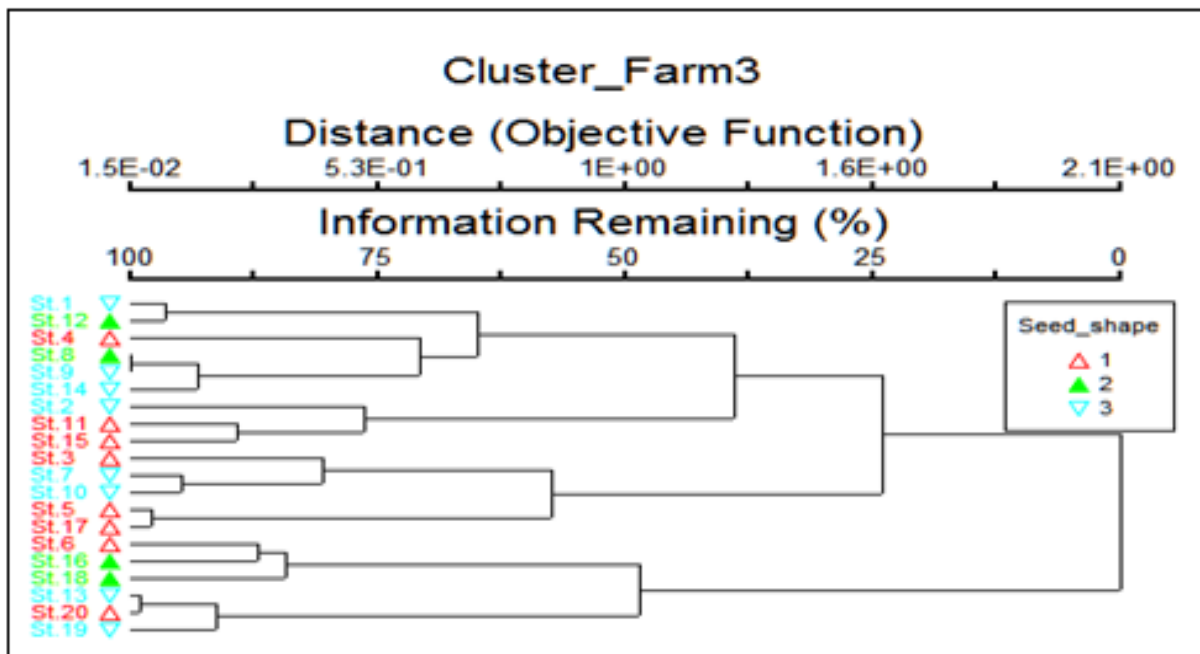


Fig. 8. Shows cluster analysis of myrtle seed shape.

It is recommended that more similar investigations shall be carried out for the conservation and sustainable use of the species.

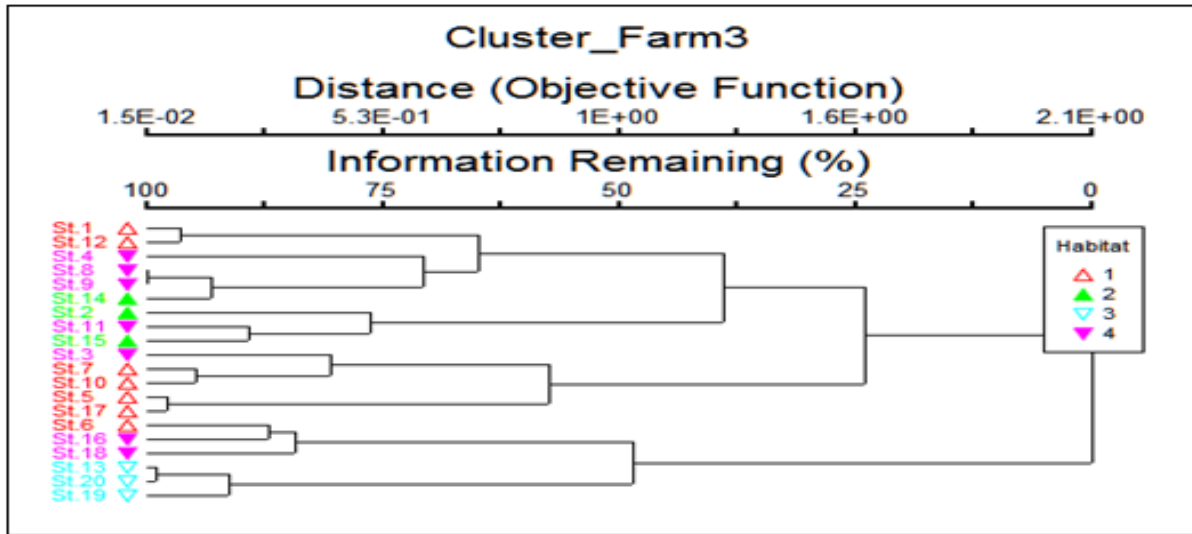


Fig. 9. Shows cluster analysis of habitat of plant community.

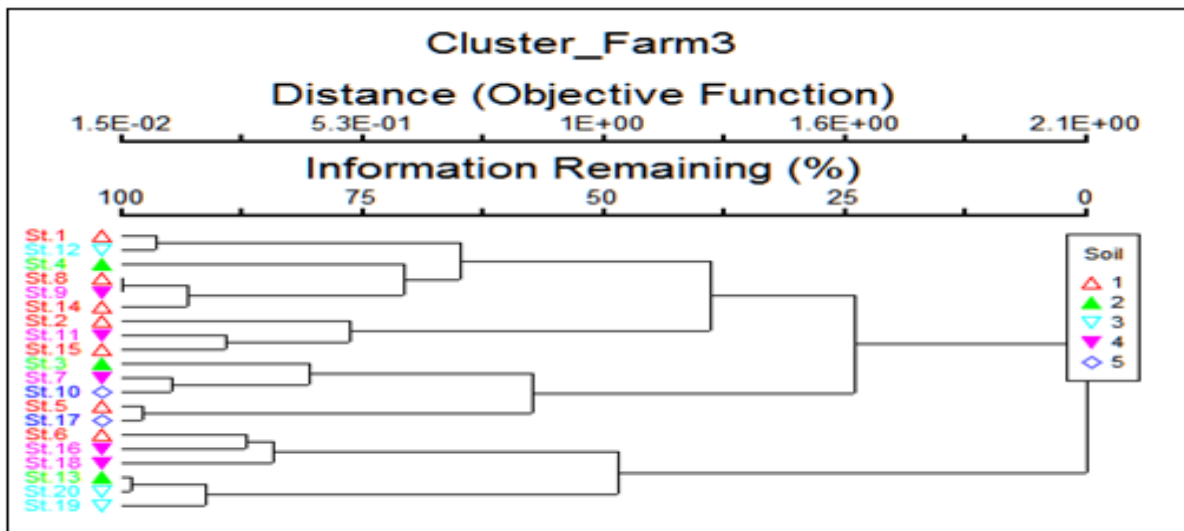


Fig. 10. Shows cluster analysis of soil types.

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