

## GERMPLASM EVALUATION OF MEDICINAL AND AROMATIC PLANTS IN HIGHLAND BALOCHISTAN, PAKISTAN

SARFRAZ AHMAD<sup>\*1</sup>, SHAISTA KOUKAB<sup>1</sup>, MUHAMMAD ISLAM<sup>1</sup>,  
KHALIL AHMAD<sup>1</sup> SOHAIL ASLAM<sup>1</sup>, AMINULLAH<sup>1</sup>, AND ASLAM GILL<sup>2</sup>

<sup>1</sup>Arid Zone Research Centre, Quetta

<sup>2</sup>Ministry of Food Agriculture and Livestock, Islamabad

### Abstract

Research studies are carried out for cultivation potential of medicinal and aromatic plants [Thyme, Oregano, Rosemary, Sage (belonging to the family Lamiaceae)] in Balochistan. The species studied showed good adaptability in cold and dry area and production potential in highland Balochistan. A medicinal herb garden was also established at Arid Zone Research Centre, Quetta with more than 60 potential medicinal and aromatic plants. This germplasm category includes culinary and herbal teas (*Thymus vulgaris*, *Matricaria recutita*, *Ocimum basilicum*, *Mentha piperita*, *Rosmarinus officinalis*, *Cymbopogon citrates*, *Artemisia drancunculus*, *Origanum majorana*, *Origanum vulgare*), Aromatic plants (*Lavandula angustifolia*, *Lavandula stoechas*, *Rosmarinus officinalis*) and medicinal plants (*Tanacetum parthenium*, *Hyssopus officinalis*, *Pimpinella anisum*, *Achillea celifolium*, *Achillea millefolium*, *Borago officinalis*, *Salvia officinalis*, *Oenothera biennis*, *Crocus sativus*). Available germplasm of annually sown crops like (*Foeniculum vulgare*, *Carum copticum*, *Linum usitatissimum*, *Anethum sowa* and *Nigella sativa*, *Cuminum cyminum*) were also evaluated and characterized for morphological description and registration with the Federal Seed Registration and Certification Department. These crops have also been introduced among the farming communities in different agro-ecological zones of Balochistan. The results indicate that medicinal and aromatic plants have great potential for commercial scale cultivation in Balochistan subject to provision of better and sustainable marketing avenues.

### Introduction

Medicinal plants have an important value in the socio-cultural, spiritual and medicinal use in rural and tribal lives of the developing countries (Shinwari, 2005). The demand of medicinal plants is increasing both in developed and developing countries. Most of the raw materials of medicinal plants are harvested from forests and rangelands and few medicinal plants are cultivated. Deforestation, over-exploitation, overgrazing, and conversion of natural habitats to agricultural fields resulted scarcity of medicinal plants (Hassain & Sher, 1998; Shinwari, 2005; Khan & Khatoon, 2008). Medicinal and aromatic plants can be defined as plants used in official and traditional medicine, aroma and flavor (Baricevic *et al.*, 2004). Haq (1983) listed more than 350 regular items as whole herbs or specific parts that are used in Unani herbal preparations by various Dawakhana in Pakistan. About 6000 plant species have been reported in Pakistan and among these about 3200 species have medicinal uses in Unani, allopathic, and homeopathic medicines and 300 species are used in traditional medicine (Haq, 1998; Perveen & Hussain, 2007).

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\* Corresponding author: [s\\_ahmadazrc@yahoo.com](mailto:s_ahmadazrc@yahoo.com)

Ecological conditions play a major role in the cultivation of medicinal plants and active ingredients. Germplasm is an important source for new plant types with desirable traits and increase in crop production (Yousaf *et al.*, 2005). Pakistan has a great biodiversity of medicinal plants due to its varied climatic conditions. Generally, medicinal plants are found more abundantly in the mountainous areas than in plains due to naturally conducive habitat and suitable climatic conditions (Anwar & Masood, 1998). Zaidi (1998) broadly classified the existing indigenous medicinal plants into naturally occurring plants and cultivated plants. The naturally occurring plants are further divided into naturally occurring wild plants and plants growing as weed remnants in cultivated fields. The existing medicinal plants can also be divided into long duration plants of higher elevations and short duration plants of lower elevation. Long duration plants require 3-8 years to reach maturity at higher elevation and short duration plants can be cultivated on foothills and plains. Long duration plants may not be easily cultivated on commercial scale and their conservation on natural habitat is essential to meet the needs of local demand. However, many medicinal plants like *Nigella sativa*, *Anethum sowa*, *Linum usitatissimum*, *Carum copticum*, *Foeniculum vulgare*, *Ocimum basilicum*, *Mentha arvensis*, *Cymbopogon citrates*, *Pimpinella anisum*, chamomile etc. can be cultivated on foothills and plains.

Balochistan is also a native home of many medicinal plants. In Balochistan, various medicinal plants have been collected and sold in the local market by local community. However, very limited scientific knowledge is available on the potential herbs, which can be cultivated and utilized for different purposes. Moreover, over-exploitation of medicinal plants in Balochistan caused serious threat to the survival and re-generation of many medicinal plant species. At present, most of the medicinal plants are confined only in protected areas. The International Trade Centre identified 12 best known and widely traded herbs are Basil, Bay, Dill, Marjoram, Mint, Oregano, Parsley, Sage, Savory, Tarragon, and Thyme. Arid Zone Research Centre (AZRC), Quetta has initiated work on medicinal herbs cultivation with the financial support of Ministry of Food, Agriculture and Livestock (MINFAL) in order to evaluate the cultivation potential of medicinal and aromatic plant species as crops in Balochistan. This paper highlights the results of four medicinal and aromatic plants (Thyme, Oregano, Rosemary, Sage) belongs to the Lamiaceae family.

### Materials and Methods

**Thyme (*Thymus vulgaris* L.):** Production potential of Thyme was monitored at AZRC, Quetta by cutting the plants at 3 months interval after transplanting the seedlings. The seedlings were transplanted during early February, 2007 in four replications. In each replication 10 rows were planted. Plant to plant and row to row distance was maintained as 0.3 m. First, second and third cuttings were made during the months of May, August, and November, 2007, respectively. Plant height, branches per plant, fresh and dry weight was recorded. In each replication 10 plants at random were picked for recording different parameters. One meter square quadrat was used for estimation of production.

**Oregano (*Origanum vulgare* L.):** Production potential of Oregano was monitored by cutting the plants at 3 months interval after transplanting the seedlings. The seedlings were transplanted during early February, 2007 in four replications. In each replication 10

rows were planted. Plant to plant and row to row distance was maintained as 0.3 m. First and second cuttings were made during the months of May and August, 2007, respectively. One meter square quadrat was used for estimation of production. The harvested plants were further divided into leaves and stems. Plant height and branches per plant was also recorded in each replication of 10 plants at random.

**Rosemary (*Rosmarinus officinalis* L.):** Current year's soft stem cuttings of Rosemary were used to test the propagation potential, survival, growth, and production. Stem cutting were transplanted in field during the month of mid February, 2006. Plant to plant and row to row distance was as 1 m. Total 258 cuttings were planted in seven blocks each of 5x5 m<sup>2</sup>. Irrigation was provided 10-15 days intervals depend on distribution of rainfall. Survival, plant height, number of branches/plant and fresh weight of leaves and small twigs were recorded during the first and second year of growth. For estimation of production one meter quadrat was used.

**Sage (*Salvia officinalis* L.):** Sage seedlings were transplanted on 12 February, 2006 at AZRC field. Total 248 seedlings were transplanted in seven plots (5x5 m<sup>2</sup> each) at a distance of 1 m plant to plant and row to row. Initially, the watering was provided at 10-day interval. Latter on the watering interval was maintained 15 days. During the first year of growth plant survival, plant height, number of branches per plant and fresh weight of twigs including leaves were recorded. During 2007 growing season, 20 plants randomly tagged for recording growth parameters. Production was measured with one meter square quadrat.

## Results and Discussion

**Thyme (*Thymus vulgaris* L.):** Growth, fresh and dry weight of leaves and small twigs of Thyme during different time period is presented in Table 1. The dry production of Thyme during first, second and third clipping was recorded 1969, 1659 and 845 kg/ha, respectively. Maximum production was obtained during the first clipping followed by second and third clippings (Table 1). The results indicate that more than one cutting/clipping of Thyme is possible in highland Balochistan before the start of winter season. The Thyme plants were survived under the minimum temperature of -12°C during winter season. Omidbaigi & Nejad (2000) reported that nitrogen fertilizer had a significant effect on the dry-matter production of Thyme yield. The herb yield increased from 671.88 kg to 1021 kg/ha as a result of 150 Kg nitrogen dose. The thymol % in Thyme has been reported from 34% to 38% (Omidbaigi & Nejad, 2000). Thyme is a perennial dwarf shrub belonging to the Lamiaceae family, a pleasant smelling perennial shrub and grows in several regions of the world (Davis, 1982). Thyme has been used medicinally since ancient times (Hornok, 1992). Thyme is used for seasonings, herbal teas, suppress coughing, ease chest congestion and stimulate production of saliva (Baytop, 1984; Jellin *et al.*, 2000; Lueng & Foster 1996). Thyme has bactericidal and fungicidal effects and its alcoholic extracts is expectorant (Omidbaigi, 2001). Its active ingredient thymol has antifungal activity in a number of species, including *Cryptococcus neoformans*, *Aspergillus*, *Saprolegnia*, *Zygorhynchus* species, and antibacterial prosperities against *Salmonella typhimurium*, *Staphylococcus aureus* and *Escherichia coli* (WHO, 1999).

**Table 1: Growth and Production of Thyme (*Thymus vulgaris*)**

Harvest	Plant Height (cm)	Branches/Plant	Fresh Weight (Leaves & Small Twigs) (kg/ha)	Dry Weight (kg/ha)
H <sub>1</sub>	23.47±0.48	67.7±4.78	5423.14±1066.15	1968.67±400.59
H <sub>2</sub>	18.1±0.62	24.6±3.70	3900±335.0	1659.16±139.61
H <sub>3</sub>	10.28±2.28	23.5±3.25	1476.41±314.95	845.25±180.26

**Table 2: Growth and Production of Oregano (*Origanum vulgare*)**

Harvest	Plant Height (cm)	Branches/m <sup>2</sup>	Fresh Weight (kg/ha)		Dry Weight (Kg/ha)	
			Leaves	Stem	Leaves	Stem
H <sub>1</sub>	55.58±1.84	599±18	6417±180	6107±207	2417±179	2107±207
H <sub>2</sub>	25.45±1.27	114±22	2020±328	608±95	1966±700	500±89

**Table 3. Growth and Production of Rosemary (*Rosmarinus officinalis*)**

Parameter	
Plant height (cm)	56.75±3.15
No. of branches/plant	37.4±3.61
Fresh weight of twigs (kg/ha)	796.10±99.11
Dry weight of twigs (kg/ha)	566.20±67.33
Fresh weight of leaves (Kg/ha)	3600.50±293.82
Dry weight of leaves (kg/ha)	1897.00±159.15

**Table 4: Growth and Production of Sage (*Salvia officinalis*)**

Parameters	
Plant height (cm)	47.69±2.51
Branches/plant	35.4±3.64
Number of flowers/plant	38.3±3.64
Fresh flower weight (kg/ha)	365.50±68.10
Dry flower weight (kg/ha)	169.00±30.60
Fresh leaves weight (kg/ha)	1148.50±196.56
Dry leaves weight (kg/ha)	484.00±59.40
Fresh twigs weight (kg/ha)	587.00±88.56
Dry twigs weight (kg/ha)	329.00±42.79

**Oregano (*Origanum vulgare* L.):** The dry production of Oregano leaves during first and second cutting ranged from 2417 to 1966 kg/ha (Table 2). The maximum production was obtained during the first cutting. The Oregano has also survived under the minimum winter temperature of -13°C. The results indicate that at least two clippings of Oregano are possible in highland Balochistan before the start of winter season. The total dry matter yield of leaves and flowers of Oregano has been reported 24330 kg/ha and 10100 kg/ha, respectively (Droushiotis & Dell, 2004). In Turkey the green herb yield of *Origanum onites* has been recorded from 23320 to 26520 kg/ha (Osman & Oguz, 2004). Oregano is an aromatic perennial herb that can grow up to two feet in height. The genus *Origanum* (tribe Mentheae, Labiatae family) is characterized by a large morphological

and chemical diversity. The genus *Origanum* comprises 49 taxa belonging to 10 different sections. Most *Origanum* species are found in the east Mediterranean sub region (Spada & Perrino, 1996). The essential oils of the genus vary within species and season of plant collection (Kokkini *et al.*, 1996). The dried herb contains several compounds including volatile oil (carvacrol, thymol, borneol), flavonoids (rosmaric acid, triterpenoids) (Wren, 1985). The thymol and carvacrol contents in oregano are responsible for its antimicrobial and antifungal effects (Lueng & Foster, 1996). Oil of oregano has inhibited the growth of *Candida albicans* in a test tube study (Stiles *et al.*, 1995). Oregano oil has also shown strong anti-microbial action against bacteria including *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella enteric* and *Staphylococcus aureus* (Hammer *et al.*, 1999).

**Rosemary (*Rosmarinus officinalis* L.):** Fifty eight % of the cuttings were survived and attained average plant height of 57 cm and 37 branches/plant. Fresh and dry weight of leaves recorded 3600 kg/ha and 1897 kg/ha, respectively (Table 3). Initial results indicated that Rosemary has the ability of environmental stresses of highland Balochistan like cold and drought. Rosemary belongs to Lamiaceae family, an evergreen perennial shrub, native to the Mediterranean, Portugal and northwestern Spain and has resistance to environmental conditions (Kowalchik & Hylton, 1987; Franco *et al.*, 2001). Rosemary is a culinary herb, landscape plant, and antioxidant in processes foods (Debaggio, 1990). The oil extracted from flowering tops, stems and leaves is also used in food products, perfumes, cosmetics. Gachkar *et al.*, (2007) reported that essential oil of Rosemary may be considered as potent agents in food preservation. Rosemary is rich in antioxidant compounds particularly rosmarinic acid. The plant and extracts possess antibacterial and antioxidant activities. For medicinal purposes rosemary has been used as an external stimulant and as a relaxant for nervousness, muscle spasms and headaches (Marin *et al.*, 2006). Essential oil from the leaves of Rosemary has been used in perfumes and medicine (Liberty Hyde Bailey Hortorium, 1976).

**Sage (*Salvia officinalis* L.):** Survival was 95% and average plant height during second year of growth was 48 cm, 35 branches per plant with an average 38 flowers per plant. The fresh and dry leaves weight was recorded 1148 kg/ha and 484 kg/ha, respectively (Table 4). The results indicate that Sage has a potential of cultivation on marginal lands in highlands of Balochistan due to its better survival, growth and production potential. Sage belongs to the Labiatae (Lamiaceae) family, an evergreen perennial small shrub. Sage is cultivated in many regions of the world. Sage is commonly used as food flavoring (Tucker *et al.*, 1980) or as a mouth wash and tooth powders. The yield of essential oil at different growth stages of Sage was recorded as floral budding (0.9%), vegetative (0.7%), flowering (0.5%), immature fruit (0.4%), and ripen fruit (0.2%) (Hossein *et al.*, 2006).

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