

**MORPHO-ANATOMICAL FEATURES OF WEED FLORA OF  
RAINFED MAIZE FIELDS IN MIR ALI, NORTH WAZIRISTAN  
AGENCY, PAKISTAN**

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**ABSTRACT**

*Morphological and anatomical study of eight prevalent weed species belonging to seven different families present in maize fields of Mir Ali, North Waziristan Agency, Pakistan was conducted during August and September of 2009 and 2010. The study comprised of noxious weeds like, Alhagi maurorum, Amaranthus viridis, Conyza bonariensis, Digera arvensis, Lippia nodiflora, Oxalis corniculata, Polygonum barbatum and Portulaca oleracea at full vegetative growth stages. Permanent microscopic preparations were made to measure and analyze elements of the anatomy of stems and root (epidermis, cortex, collenchyma, central cylinder and diameter). It was concluded that, Alhagi maurorum equipped with elaborate vascular bundles both in root and stem clarified its adaptation in the severe rainfed climate of the area. Because of its significant seed dispersal, it is acclimatized throughout the area. Other weeds like Amaranthus viridis, Conyza bonariensis, Digera arvensis, Lippia nodiflora, Oxalis corniculata, Polygonum barbatum and Portulaca caoleracea having the peculiar characteristics of typical mesophyte are well adopted and can complete their life cycle along with the maize crop. Due to special morphological and anatomical features of majority of the species studied, the capacity of rapid absorption of water along with minerals from the soil are enough to compensate the rapid loss of water, and thus can be easily adopted along with the maize crop.*

**Key words:** Anatomy, morphology, North Waziristan Agency, Pakistan, rainfed, root, stem, weeds.

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## INTRODUCTION

Mir Ali is situated in North Waziristan Agency. It is located at 32°59'4N 70°15'24E with an altitude of 655 metres (2152 feet). North Waziristan Agency is bounded on the north by Afghanistan, Kurram Agency and Hangu district, on the east by tribal areas adjoining Bannu and Karak districts, on the south by South Waziristan Agency and on the West also by Afghanistan. The total area of the agency is 4707 square kilometers. The climate of the area is cold in winter and warm in summer. Summer season starts from May and continues till September. June is generally the warmest month. The mean maximum and minimum temperature during the month of June is 31°C and 18 °C respectively. Winter starts in October and continues till April. December, January and February are the coldest months. The mean maximum and minimum temperature during the month of January is 10°C and -2°C respectively (New *et al.*, 2002). Rainfall is scanty except in the Razmak area where the rainfall is slightly higher (MINFA, 2010).

Weeds are plants out of place, not sown intentionally and grow where they are not wanted. These are competitive, persistent and interfere with human activities. Weeds are plants whose undesirable qualities outweigh their good points, weeds rapid population establishment, high seed dormancy, long-term survival of buried seed, adaptation for spread, presence of vegetative reproductive structures and also the ability to occupy sites disturbed by human activities. Weeds are also troublesome in many ways. Primarily, they reduce crop yield by competing for water, light, soil nutrients, and space. Weeds compete very successfully for these requirements, affecting growth and productivity of cultivated plants, as weeds are biologically more efficient than many cultivated plants. There are approximately 250,000 species of plants worldwide; of those about 3 percent or 8000 species behave as weeds (Mehsud *et al.*, 2013). Weeds are one of the dominant elements of the pest complex of major crops in Pakistan. Morphological, anatomical characters are now applied in solving of controversial taxonomical and phylogenetical problems (Balasbramania *et al.*, 1993). Proper identification and taxonomic classification was made through the transactions of the stems and roots along with photomicrograph of the species Khan *et al.* (2013). The objective of the present research was to study the morpho-anatomical features of weed flora of rain fed maize field in Mir Ali.

## **MATERIALS AND METHODS**

### **Plant material and collection procedure**

Eight weed species i.e. *Alhagi maurorum*, *Amaranthus viridis*, *Conyza bonariensis*, *Digera arvensis*, *Lippia nodiflora*, *Oxalis corniculata*, *Polygonum barbatum* and *Portulaca oleracea* were collected from different fields of North Waziristan Agency during September 2009-2010. The collected weeds were folded in newspapers and put into plastic bags. Collected weeds were sprayed with mercuric chloride to protect them from the attack of pathogenic fungi and bacteria. After complete dryness the plants were mounted on standard herbarium sheets with proper taxonomical identification (Daud *et al.*, 2013). Identification and taxonomy of weed species was conducted according to Jafri (1966), Stewart (1972), Qureshi and Khan (1972) and Ali (1977).

### **Weed species collection sites**

Plants were collected from different maize fields of Mir Ali, North Waziristan Agency i.e Mir Ali, Hurmaz, Issori, Ipi, Umarki Kala, KhoshHaliWazir, Zerakki, HassuKhel, Khaddi, Muhammadi, Mullagan, Wuzi, Idak, Ali Khel and BaroKhel (Fig. 3).

### **Morphological and anatomical study**

Identification and classification of various parts of the plants like epidermis, cortex, endodermis, Pericycle, Medullary rays, vascular bundles and Pith was done using fresh plant parts. The botanical name and concerned family were properly identified. The plants, collected were dried, preserved and identified with the help of Flora of Pakistan (Nasir and Ali, 1971-95; Ali and Qaisar, 1995-2005). For anatomical & histological stained slides of transverse sections of stem and root of the collected plants were prepared carefully. Proper labeling of sections of stem and root were done using high power microscope. Photomicrography of the prepared sections was made by using digital camera, preserved in computer.

## **RESULTS AND DISCUSSION**

The present study was carried out to investigate the morphology and anatomy along with taxonomical classification of eight prominent weed species prevalent in maize field of Mir Ali, during 2009-2010.

The general morphological features like habit, root, stem, leaves and flowers of fresh materials of the collected weeds along with their photographs (Fig. 2 & 3) were recorded. Proper identification and taxonomy of each weed species and transverse sections of root and stem along with photomicrographs were conducted.

The classification, morphology and histology of the collected species, are described as under.

**Systematic position of *Alhaji maurorum* Medik.**

Family: Pappilionaceae  
Genus: Alhagi  
Species: *A. maurorum* Medik.  
Botanical name: *Alhaji maurorum* Medik.  
Common name: Camel thorn  
Local name: Tandhu

**Morphological description**

It is a deep-rooted, rhizomatous, perennial shrub, with roots 8 to 12 feet deep into the ground. It grows 1.5 to four feet in height. Leaves are grayish green and hairless simple, entire oval to lance-shaped and arranged alternately. Flowers are pinkish purple to maroon and are borne on short, spine-tipped branches. Fruits are reddish-brown to tan constricted between the seeds, with a short narrow beak at the end.

**Anatomical description**

Transverse section of stem and root show the following features (Fig. 4).

Stem: it has thick epidermis and poorly developed cortex. Vascular bundles are arranged radially from centre towards the periphery. Xylem is well developed helping in conduction of large amount of water from the ground with no pith. The same morphology and anatomy of root and stem was reported by Awmack and Lock (2002).

Root: Cortex is large and collenchymatous surrounded by epidermal layer. Numerous vascular bundles comprising of well developed protoxylem and metaxylem are arranged radially. Metaxylem are lying towards the centre while protoxylem towards the cortical zone. In the center parenchymatous pith retains moisture to help the xerophytic adaptation.

**Systematic position of *Amaranthus viridis* L.**

Family: Amaranthaceae  
Genus: *Amaranthus* L.  
Species: *A. viridis* L.  
Botanical name: *Amaranthus viridis* L.  
Common name : Slender Amaranth  
Local name: Ranzaka

**Morphological description:**

It is an annual simple erect, green and aerial stem herb with taproot and branched roots. Leaves have petiole as long as blade, ovate, rounded base, entire margins, plane, apex obtuse. Flower in spike is actinomorphic, unisexual, and incomplete. Staminate flowers are at tips of inflorescence with 3 stamens and 3 petals. Pistillate flowers are narrowly elliptic, obovate-elliptic, with three style erectly branched, stigmas. Seeds are small black or dark brown, subgloboseto

thick-lenticular. Flowering is in summer. Bojian *et al.* (2003) reported some morphological features which are similar to our results. Khan *et al.* (2013) reported that *Amaranthus* have alternate and clavate types of trichomes on both sides respectively. They further reported the presence of varieties in trichomes types at different taxonomic levels. Differences were observed at abaxial and adaxial surfaces of the same leaf.

#### Anatomical description

Transverse sections of stem and root of *Amaranthus viridis* show the following anatomical descriptions (Fig. 4).

**Stem:** Epidermis well developed surrounded by single layered epidermis. Cortex is composed of several layers of collenchymas. Pericycle is present. Secondary vascular bundles are present along the pericycle which is interconnected by conjunctive tissues. Vascular bundles arranged in a circle comprised of central xylem covered by phloem. Primary bundles are arranged surrounding the pith while secondary bundles are lying towards cortex. The centre is covered by large pith composed of collenchymatous polygonal cells.

Islam *et al.* (2008) have studied another type of *Amaranthus viridis*. Joshi (1937) made the comparative study of secondary thickening in the stem and root of species of *Amaranthus*. Townsend *et al.* (1974) concluded the same morphology of *Amaranthus viridis*. Rajput (2002) reported the anatomy of Secondary xylem of seventeen species from nine genera of Amaranthaceae. Khan *et al.* (2011) reported that in both fresh and dry forms the stem was herbaceous, cylindrical, fibrous smooth and phyllotonicis was opposite.

**Root:** Epidermis surrounds the cortex to reduce water loss and also to protect it. The cortex is very large and composed of parenchymatous cells. No endodermis in the root. Few vascular bundles are present in the centre. Pith is small or unclear. Thus its peculiar characteristics it completes its life history within favorable conditions of the environment.

#### **Systematic position of *Conyza bonariensis* (L.) Cronq.**

Family: Asteraceae  
 Genus: *Conyza* Less.  
 Species: *C. bonariensis* (L.) Cronq.  
 Botanical name: *Conyza bonariensis* (L.) Cronq.  
 Common name : Asthma weed, flax-leaf fleabane  
 Local name: Kharboti.

#### Morphological description

It is a vertically straight perennial herb with branches at the basal part of the stem. Surface is covered with soft short hairs. Leaves are alternate, sessile, entire with no prominent venation. Flowers sepals are green, rayless and discoid. Petals are absent. The panicle is

elongated with compound branching forming clusters of flowers. Ovary is inferior with very small and syngenesious. Stamens are free filaments and fruit is light brown, achene with 2 mm pappus,. Seed is light brown. Negreón and Ciortan (2012) studied some morphological features of *Conyza bonariensis*. They believed that the plant may have originated from Buenos Aires in Argentina, South America.

#### Anatomical description

**Stem:** The parenchymatous cortex surrounded by thin layer of epidermis (Fig. 5). Similar epidermis characteristics were recorded by Susana et al., (2005). Endodermis is well developed. Vascular bundles are arranged radially in polyarch condition. Occupy central region of the stem, where metaxylem are focusing at the center while protoxylem are arranged towards the periphery. Protoxylems are scattered within metaxylem with no pith present. Jamil et al. (2002) reported that the genus *Sonchus* belongs to the tribe Lactuceae in family Asteraceae/Compositae whose taxonomic study has been carried out in Pakistan.

**Root:** The epidermis is hairy. Small cortex is composed of compact collenchymatous cells. Parenchymatous region is present between the cortex and endodermis. Vascular bundles are arranged in separate groups along with secondary meristem. The central zone comprises of large paranchymatous pith (Fig. 5).

#### **Systematic position of *Digera arvensis* Forssk.**

Family:                   Amaranthaceae  
Genus:                    *Digera* Forssk.  
Species:                 *D. arvensis* Forssk.  
Botanical name:        *Digera arvensis* Forssk.  
English name :         False Amaranth  
Local name:             Surmi.

#### Morphological description

A perennial herb with alternate, entire leaves. In elongated racemes, flowers are unisexual and small, having two bracteoles. Stamens and tepals are equal in number, but rarely fewer than tepals and opposite these. Filaments are free with lobes, united in to a cup at base. Pseudostaminodes present; anthers 2-loculed, dorsifixed and introrsely dehiscent. superior, 1-loculed. Ovary persistent and indistinct. Style short, stigma 2-lobed, capitate, penicillate. Fruit is fleshy capsule, indehiscent, irregularly bursting with lenticular verruculose seeds.

#### Anatomical description

**Stem:** It has thick Epidermis and poorly developed cortex. Primary and Secondary vascular bundles are well developed for conduction of water from the ground. Pith is also present (Fig. 5). Same morphology and anatomy of root and stem was reported by Awmack and Lock

(2002). Costea and Darleen (2001) observed that stem epidermis in this genus does not have a uniform arrangement of cells. The main stem of *Amaranthus* possesses a great number of primary and secondary vascular bundles. According to Gibson (1994) the primary vascular system in amaranths is of the closed type because it consistent network of bundles that anastomose along their path through the stem.

Root: Epidermal hairs are absent. The epidermis is hairy formed of closely packed cells, making a thick layer. Cortex is well developed and composed of thin walled parenchyma cells. Vascular bundles are arranged in two sets, secondary vascular bundles are present towards the periphery while the primary vascular bundles are covering the centre of the root (Fig. 5).

**Systematic position of *Lippia nodiflora* Kunze.**

Family: Verbenaceae  
 Genus: *Lippia*  
 Species: *L. nodiflora* Kunze.  
 Botanical name: *Lippia nodiflora* Kunze.  
 English name : Frog fruit  
 Local name: Salwerpakhai

**Morphological description**

A creeping perennial herb with narrow stem consisting of nodes and internodes, rooting at nodes are glabrous. Leaves are opposite, spatulate, subsessile, 2-3cm long, toothed towards the rounded apex. Flowers are white or pinkish, about 3 mm long, 2 lipped. Inflorescence is head-peduncles 2.5-7.5cm long and 1-3cm long flowering heads. Fruit is about 1.6mm long globose-oblong, glabrous.

**Anatomical description**

Stem: A cuticle layered. Cortex is parenchymatous and surrounded by epidermis. Endodermis is clear and separate the vascular region from the cortex. Stem central part is covered by vascular bundles (Fig. 6).

Root: The epidermis makes a protective cover around the large collenchymatous cortex. The cortical cells are compactly arranged. endodermis is present under the cortex. There parenchymatous region is present between the endodermis and vascular region. Vascular bundles are arranged in a ring form. Large and thick parenchymatous pith is in the centre helps in storage of water (Fig. 6).

**Systematic position of *Oxalis corniculata* L.**

Family: Oxalidaceae  
 Genus: *Oxalis* L.  
 Species: *O. corniculata* L.  
 Botanical name: *Oxalis corniculata* L.  
 English name : Creeping Wood Sorrel  
 Local name: Therveekai

### Morphological description

It is a delicate, low-growing, herbaceous plant with narrow, creeping stem that readily roots at the nodes. Leaves are trifoliate and subdivided into three rounded leaflets like a clover. The leaves have unremarkable stipule at the base of each petiole. It gives flowers throughout the year (Khan et al., 2013). The fruit is a narrow, cylindrical capsule, 1-2 cm long important for its explosive discharge of the contained, 1 mm long seeds.

### Anatomical description

**Stem:** Cortex is surrounded by thick layer of unicellular hairs epidermis. Next to the epidermis collenchymatous cortex is present. Endodermis is clearly developed. Vascular bundles are arranged along the pericycle in the form of a ring (Fig. 6). Large parenchymatous pith is in the centre. Stewart (1972) has also reported the same results. Reddy and Lakshmi (2012) revealed that xylem elements are 8µm wide. Phloem elements occur on the lower end of the xylem strand. The palisade tissue is transcurrent across the vascular bundle and beneath the adaxial epidermis. The vascular strand is a cluster of narrow, angular thin walled structure. Khan et al. (2013) observed that edidermis is surrounded by trichomes. Cortex is surrounded by thick layer of epidermis. Collenchymatous cortex and endodermis are present. Vascular bundles are arranged as separate bundles along the pericycle in the form of a ring. Parenchymatous pith is present in the center.

**Root:** Epidermis encloses the cortex. Vascular bundles are radially arranged from centre towards the cortex. Protoxylems are present in the centre while metaxylems are arranged towards the periphery. Khan et al. (2013) studied *Oxalis corniculata* root transverse section collected from Bannu showed Metaxylems in the centre while Protoxylems arranged towards the periphery (Fig. 6).

### **Systematic position of *Polygonum barbatum* L.**

Family: Polygonaceae  
Genus: *Polygonum* L.  
Species: *P. barbatum*L.  
Botanical name: *Polygonum barbatum* L.  
English name : jointweed, knotgrass, smart-weed  
Local name: Khwar

### Morphological description

It is perennial, rhizomatous herb with 40-90 cm tall erect stem. Petiole 5-8 mm, densely hispidulous; leaf blade lanceolate or elliptic-lanceolate, both surfaces pubescent, marginciliate, apex acuminate; 1.5-cm, membranous, densely hispidulous, apex truncate, cilia 1.5-2 cm. Inflorescence terminal, spicate, erect, 4-8 cm, several spikes aggregated and panicle-like, rarely solitary; bracts funnel-shaped,



glabrous, margin ciliate, each 3-5-flowered with short pedicel. Perianth white or greenish, 5-parted; tepals elliptic, 1.5-2 mm. Stamens 5-8. Styles 3; stigmas capitate. Fruit achenes included in persistent perianth, black, shiny, ovoid, trigonous, 1.5-2 mm. Dwivedi and Pandey (2011) observed an erect annual herb with glabrous stem, thickened at nodes and sub sessile leaves. Flower white in dense erect racemes. Bract glabrous, perianth pinkish white. Kantachot and chantaranonthai (2011) working on achene morphology of twenty taxa in five sections of polygonums. i. from Thailand studied and compared in detail using stereoscopic light and scanning electron microscopy. The achene of all Thai taxa was typically lenticular or triangular in shape.

Anatomical description:

**Stem:** Epidermis is present. Vascular bundles are forming a ring like structure and show gradual increase in their number in the mature stem. The vascular cylinder is composed of 26 to 28 vascular bundles of different sizes (Manju, 2012). A fibres zone present at inner margins of the vascular bundles delimits the parenchymatous pith (Fig. 7).

**Root:** Epidermis is present around the several layered parenchymatous cortex making a partition between cortex and vascular region. More than half of the root section is covered by vascular bundles (Fig. 7). Large wood vessels are apparent. Frye and Kron (2003) studied polygonum using the inflorescence types achene, pollen morphology, leaf petiole and stem anatomy and molecular analysis.

**Systematic position of *Portulaca oleracea* L.**

Family: Portulacaceae  
 Genus: *Portulaca*  
 Species: *P. oleracea* L.  
 Botanical name: *Portulaca oleracea* L.  
 English name : purslane, pigweed, little hogweed  
 Local name: Parkhorai

Morphological description

Common purslane (*Portulaca oleracea* L.), a member of the Portulacaceae family, is one of 25 genera of succulent herbs and shrubs in this family (Mitich, 1997). Matthews *et al.*, (1993) traces the history of purslane's origins and lists the old world (India), North Africa, the Sahara, and even Australia as possible locations. Purslane can also reproduce from vegetative cuttings left in contact with the soil (Muenscher, 1980). *Portulaca oleracea* is an annual succulent plant of family portulacaceae, which can reach 40 cm in height. It has smooth, reddish, mostly prostrate stems and alternate leaves which are clustered at stem joints and ends. The flowers appear depending upon rainfall and may occur year round. The flowers open singly at the center of the leaf cluster for only a few hours on sunny mornings.

Seeds are formed in a tiny pod, which opens when the seeds are ready. Purslane has a taproot with fibrous secondary roots and is able to tolerate poor, compacted soil and drought. Splel man (1972) reported that common purslane is known as a drought resistant plant. Thick succulent leaves, stems and roots are able to absorb and store water and thus this weed easily with stand soil conditions of dry hot weather. It is reasonable to assume that its competition under water stress in soil should be effective.

#### Anatomical description

Transverse sections of stem and root reveal the following characters (Fig. 7).

**Stem:** The cortex is surrounded by thick epidermal layer. The cortical cells are parenchymatous which are tightly arranged. Endodermis is well developed. Vascular bundles are lying along the endodermis forming a ring like structure on which the bundles are arranged. The centre consists of large parenchymatpus pith resembling to cortex by the shape of cells. Lanjar and Sahito (2007) clarified the above study.

**Root:** Epidermis is composed of several layers. Large cortex is present composed of thick parenchymatous cells. Endodermis is separating the cortex from vascular region. The central zone of root is covered by large amount of vascular bundles. Big wood vessels or tracheae are apparent which confirm its special role with reference to rapid absorption.



**Figure 1.** Sampling sites of weeds collected in maize fields of Mir Ali, North Waziristan Agency, Khyber Pakhtunkhwa, Pakistan



*Alhagi maurorum*



*Amaranthus viridis*



*Conyza bonariensis*



*Digeria arvensis*

**Figure 2.** Plants of *Alhagi maurorum*, *Amaranthus viridis*, *Conyza bonariensis* and *Digeria arvensis*



*Lippia nodiflora*



*Oxalis corniculata*

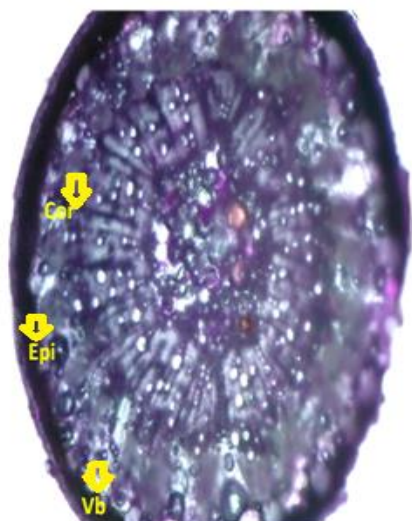


*Polygonum barbatum*

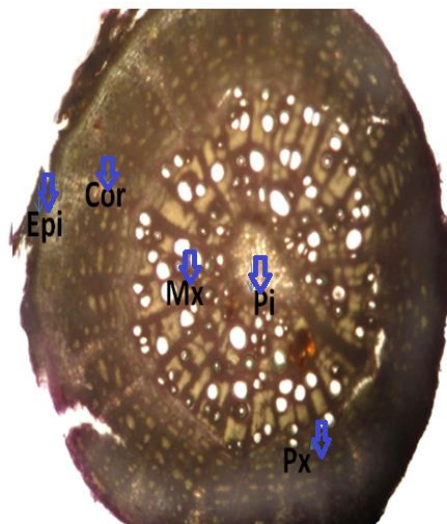


*Portulaca oleracea*

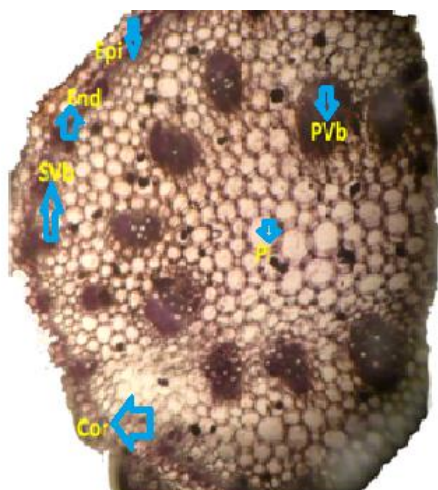
**Figure 3.** Plants of *Lippia nodiflora*, *Oxalis corniculata*, *Polygonum barbatum* and *Portulaca oleracea*



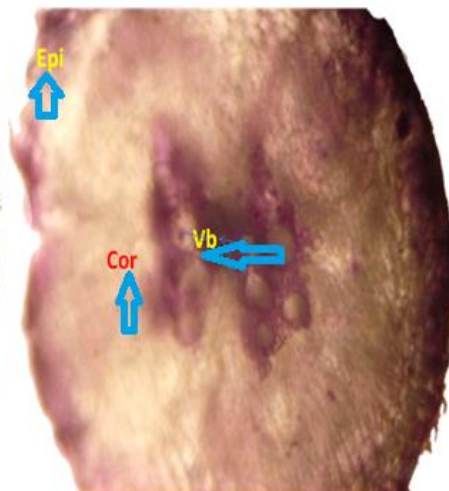
Stem of *Alhaji maurorum*



Root of *Alhaji maurorum*

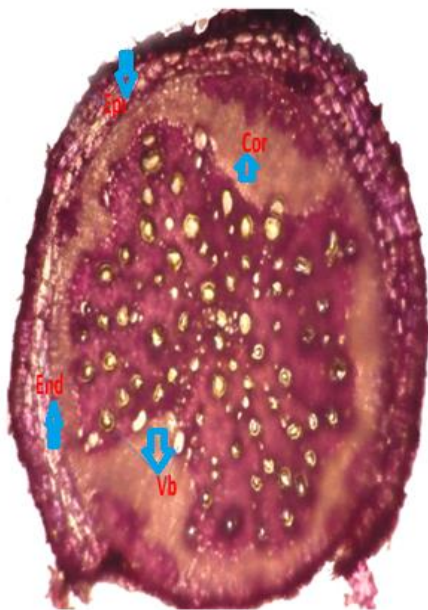


Stem of *Amaranthus viridis*

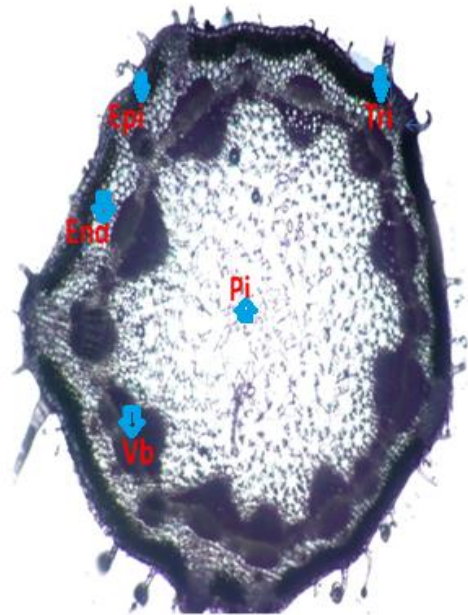


Root of *Amaranthus viridis*

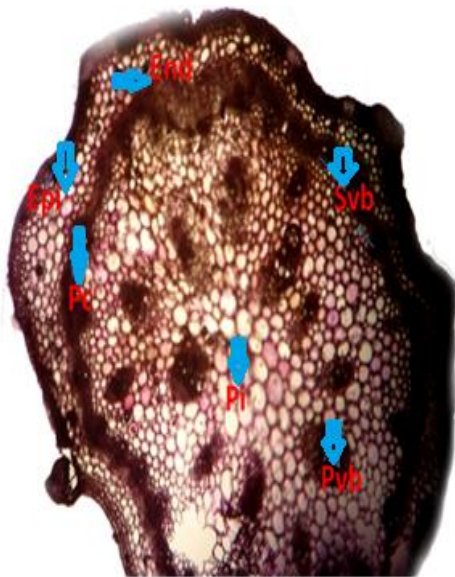
**Figure 4.** Transverse sections of stem and root of *Alhaji maurorum* and *Amaranthus viridis*



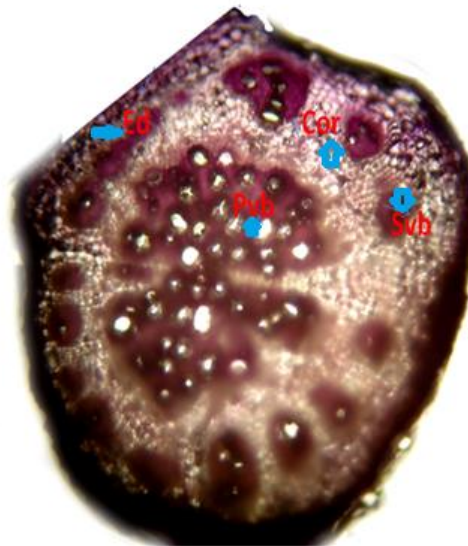
Stem of *Conyza bonariensis*



Root of *Conyza bonariensis*

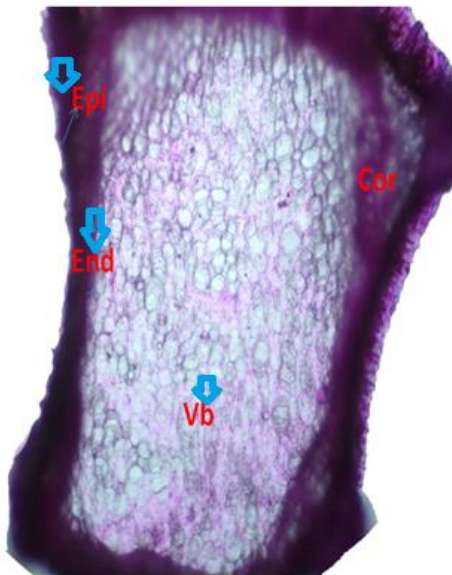


Stem of *Digera arvensis*

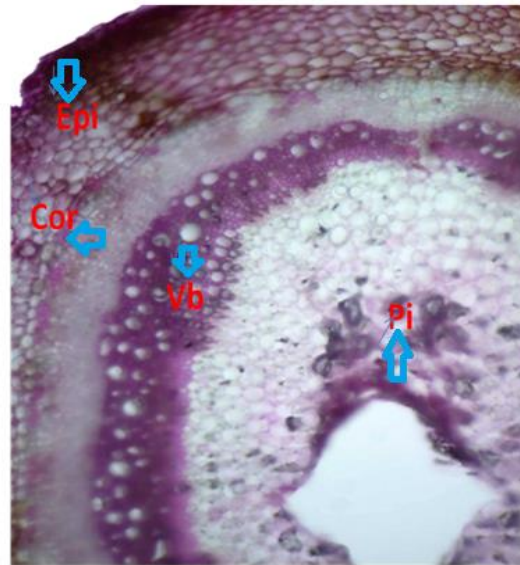


Root of *Digera arvensis*

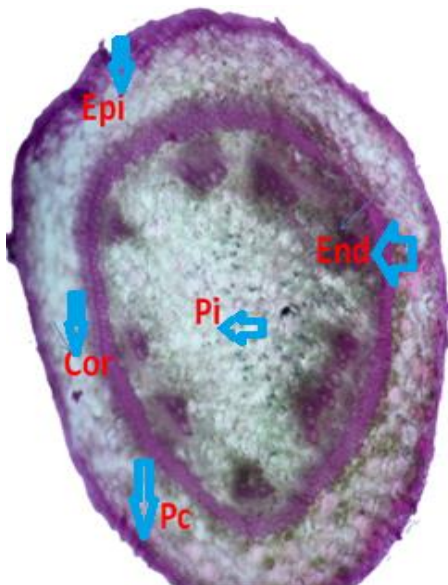
**Figure 5.** Transverse sections of stem and root of *Conyza bonariensis* and *Digera arvensis*



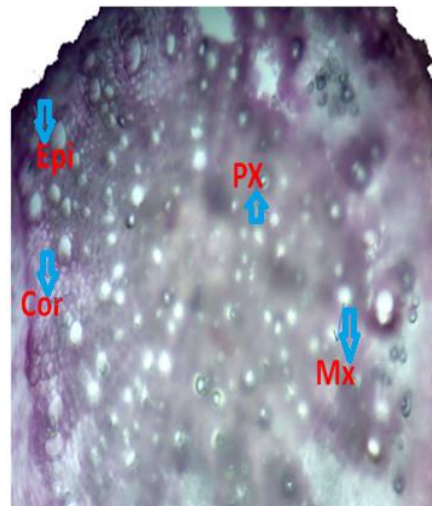
Stem of *Lippia nodiflora*



Root of *Lippia nodiflora*



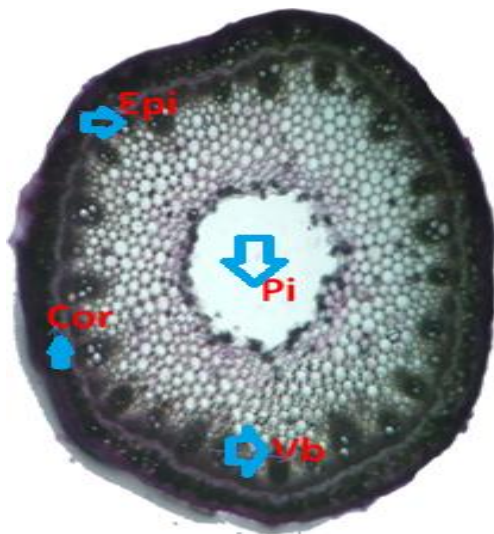
Stem of *Oxalis corniculata*



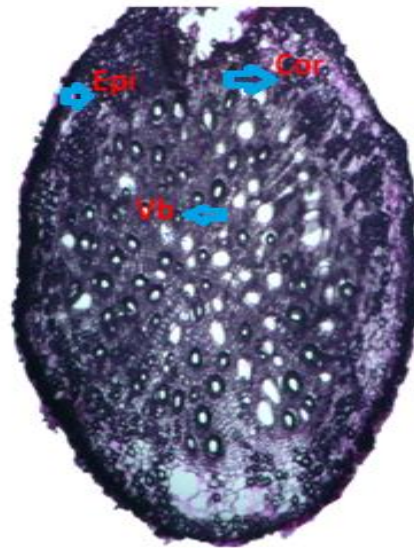
Root of *Oxalis corniculata*

**Figure 6.** Transverse sections of stem and root o *Lippia nodiflora* and *Oxalis corniculata*

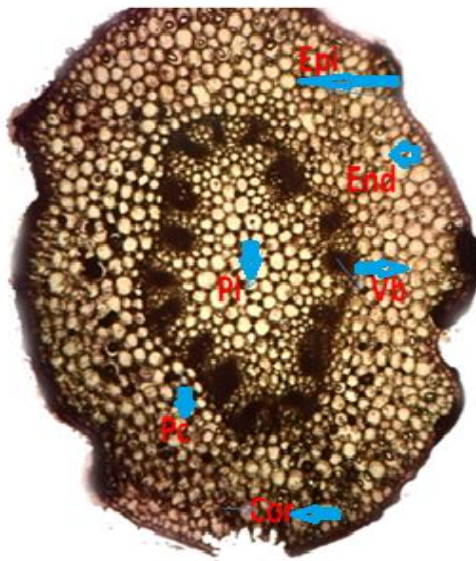




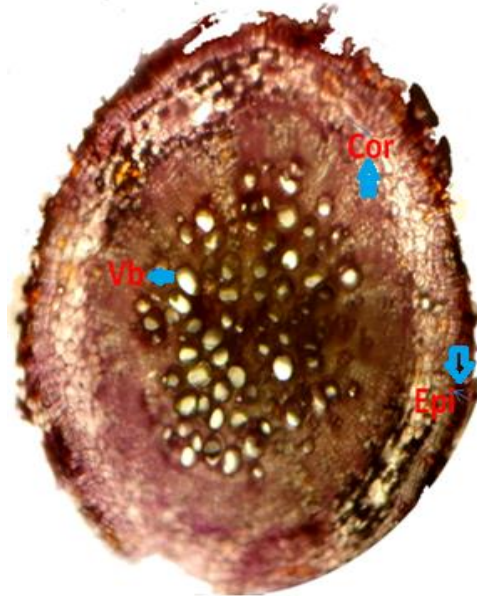
Stem of *Polygonum barbatum*



Root of *Polygonum barbatum*



Stem of *Portulaca oleracea*



Root of *Portulaca oleracea*

**Figure 7.** Transverse sections of stem and root of *Polygonum barbatum* and *Portulaca oleracea*

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