**TABLE 7.1 Differences between Primary and Secondary Meristems**

|  |  |
| --- | --- |
| Primary Meristem | Secondary Meristem |
| 1. It develops from promeristem. | It develops from permanent tissue which regains the power of division. |
| 1. It is present from the beginning. | It is formed at much later stage. |
| 1. Cells are isodiametric and without large vacuoles. | The cells may be elongated or rectangular and highly vacuolated. |
| 1. It forms primary tissues except intrafascicular cambium. | It forms secondary tissues. |
| 1. It results in primary growth. | It results in secondary growth. |

**TABLE 7.2 Differences between Apical and Lateral Meristems**

|  |  |
| --- | --- |
| **Apical Meristem** | **Lateral Meristem** |
| 1. It occurs at the growing apices of stem, root. and their branches. | It is located on the sides of plant organs. |
| 1. It is a primary meristem. | It is primary as well as secondary in origin. |
| 1. It forms primary tissues. | It gives rise to secondary tissues. |
| 1. It brings about growth in length. | It gives rise to growth in girth. |
| Examples: Shoot apex and root apex. | Examples: Vascular cambium, cork cambium and marginal meristem of some leaves. |

**TABLE 7.3 Differences between Vegetative and Reproductive Shoot Apices**

|  |  |
| --- | --- |
| **Vegetative Shoot Apex** | **Reproductive Shoot Apex** |
| 1. It is narrow and conical in outline. | It is wide and comparatively flattened. |
| 1. It is protected by young leaves. | It is protected by sepals. |
| 1. It gives rise to leaves, buds and stem tissues. | It gives rise to sepals, petals, stamens and carpels. |
| 1. It gives rise to normal leaves. | Normal leaves are absent though bracts may be formed. |
| 1. Internodes are of equal length. | The first internode is very long, forms the pedicel. The other internodes are short and floral whorls develop close together. |
| 1. Lateral appendages are borne in spirals. | Lateral appendages develop in whorls. |
| 1. Summit of vegetative shoot apex IS comparatively inactive. | Summit of reproductive shoot apex shows active division. |
| 1. It shows indefinite growth. | Its growth is determinate |
| 1. Meristem is not consumed in the formation of vegetative organs. | It gets consumed in the formation of reproductive organs. |

**TABLE 7.4 Differences between Shoot Apex and Root Apex**

|  |  |
| --- | --- |
| **Shoot Apex** | **Root Apex** |
| 1. It is terminal. | It is subterminal. |
| 1. The size of shoot apex is comparatively large. | The size of root apex is comparatively small. |
| 1. Shoot apex is not protected by any cap. | Root apex remains protected by root cap. |
| 1. A quiescent centre does not occur. | Root apex remains protected by root cap. |
| 1. New cells are added towards the base. | New cells are added both towards the base and apex. |
| 1. It gives alternate bands of nodes and internodes. | Does not do so. |
| 1. It gives leafy lateral appendages. | Does not produce lateral appendages. |
| 1. Primordia of branches develop in the axils of leaves in the region of apex. | Primordia of branches develop far behind the root apex. |
| 1. Branches develop exogenously. | Branches develop endogenously. |
| 1. Plastochrons occur on the flanks of shoot apex. | They are not distinguishable in the root apex. |
| 1. Shoot apex changes its activity during reproductive phase. | No change occurs during reproductive phase. |
| 1. Organisation of shoot apex can be explained on the basis of tunica-corpus theory. | Organisation of root apex can be explained on the basis of histogen theory. |

**TABLE 7.5 Differences between Meristematic Cells and Permanent Cells**

|  |  |
| --- | --- |
| **Meristematic Cells** | **Permanent Cells** |
| 1. These do not have large central vacuoles | These often have large vacuoles |
| 1. These are thin-walled and isodiametric | These may be thin or thick-walled and have permanent shape |
| 1. These divide and produce new cells | These cells have lost the power of growth and division |

**TABLE 7.6 Differences between Parenchyma and Collenchyma**

|  |  |
| --- | --- |
| Parenchyma | Collenchyma |
| 1. The cell walls are uniformly thickened. | The cell walls get extra-thickened at places. |
| 1. It is found both in the outer and inner parts of plant organs. | It is mostly restricted to outer parts of plant organs. |
| 1. It provides turgidity to the plant body. | It provides tensile strength to the plant body. |

**TABLE 7.7 Differences between Collenchyma and Sclerenchyma**

|  |  |
| --- | --- |
| **Collenchyma** | **Sclerenchyma** |
| 1. It consists of living cells. | It consists of usually dead cells. |
| 1. Its cells contain protoplasm. | It consists of empty cells. |
| 1. The cell wall thickening is due to cellulose. | It is due to cellulose, lignin or both. |
| 1. Thickening of the wall is not uniform. | Thickening of wall is uniform. |
| 1. Cell lumen or cavity is wide. | Cell cavity is narrow |
| 1. Pits are simple and straight. | Pits are simple, oblique and unbranched or branched. |
| 1. It provides mechanical strength as well as elasticity to the plant organs. | Primarily it is a mechanical tissue, i.e., provides mechanical strength |
| 1. It keeps the organs soft. | It provides hardness to the plant organs. |
| 1. Sometimes, it has chloroplasts and photosynthesises food. | It does not possess chloroplasts. |

TABLE 7.8 Differences between Fibres and Sclereids

|  |  |
| --- | --- |
| **Fibres** | **Sclereids** |
| 1. Fibres are elongated and have tapering end walls. | Sclereids are broad with blunt end walls. |
| 1. These are generally unbranched. | These may be branched or unbranched. |
| 1. The pits are deep and branched. | The pits of fibres are narrow and unbranched. |
| 1. These originate from meristematic cells. | These are formed cells. by secondary thickening of parenchyma |
| 1. Fibres usually occur in bundles. | These occur singly or in loose groups. |

TABLE 7.9 Differences between Tracheids and Xylem Vessels

|  |  |
| --- | --- |
| **Tracheids** | **Xylem Vessels** |
| 1. Tracheids are unicellular in origin, i.e., these arise from a number of cells. | Vessels are multicellular in origin, I.e., these arise from single cell. |
| 1. Their ends are tapering or oblique. | Their ends are rounded or transverse. |
| 1. The septa between the tracheids are intact. | The septa between adjacent cells are lost. |
| 1. The lumen is narrow. | The lumen is wide. |
| 1. Their walls are more thickened. | Their walls are less thickened. |
| 1. They are present in all vascular plants, i.e., pteridophytes, gymnosperms and angiosperms. | They are mainly found in angiosperms with a few exceptions in gymnosperms. |
| 1. They are short, rarely exceeding 1 mm in length. | They are usually long and may attain up to 10 cm length. Rarely, they reach up to 2—6 m. |

**TABLE 7.10 Differences between Primary Xylem and Secondary Xylem**

|  |  |
| --- | --- |
| **Primary Xylem** | **Secondary Xylem** |
| 1. It develops from procambium of apical meristem | It is formed from lateral meristem called vascular cambium |
| 1. It occurs in the primary plant body of vascular plants. | It is formed during secondary growth |
| 1. It occurs towards the centre. | It occurs towards the outer side of primary xylem. |
| 1. It occurs in patches. | It forms a cylinder |
| 1. It is of two types, protoxylem and metaxylem. | It is not so. |
| 1. Xylem rays are absent. | Xylem rays are present. |
| 1. Annual rings are absent. | Annual rings are found. |
| 1. There is no distinction between sapwood and heartwood. | Sapwood and heartwood are present in large woody plants. |
| 1. Fibres are few. | Fibres are abundant. |
| 1. Tracheids and vessels are long and thick-walled. | Tracheids and vessels are shorter and more thick-walled. |
| 1. All types of thickenings are found in tracheary elements | Tracheary elements are usually pitted |
| 1. Tyloses are absent. | Tyloses are present. |

TABLE 7.11 Differences between Protoxylem and Metaxylem

|  |  |
| --- | --- |
| **Protoxylem** | **Metaxylem** |
| 1. It is early formed xylem | It is later formed xylem |
| 1. It is bears narrow vessels | It bears large vessels |
| 1. It is retained only for a short period. In later stages it gets crushed | It remains functional throughout the primary organ |
| 1. It lacks fibres. | It possesses fibres |
| 1. Thickenings are either annular or spiral | Thickenings may be reticulate scalariform or pitted |

**TABLE 7.12 Differences between Endarch Xylem and Exarch Xylem**

|  |  |
| --- | --- |
| **Endarch Xylem** | **Exarch Xylem** |
| 1. Endarch xylem lies towards the centre. | Protoxylem lies towards the outer side. |
| 1. It is found in stems. | It is found in roots. |
| 1. It occurs in collateral vascular bundles. | It occurs in radial vascular bundles. |
| 1. Metaxylem is formed towards outer side. | Metaxylem is formed towards the inner side. |

**TABLE 7.13 Differences between Tracheids and Fibres**

|  |  |
| --- | --- |
| Tracheids | Fibres |
| 1. These are found only in xylem. | These occur in xylem, phloem, around vascular bundles, in pericycle, cortex, hypodermis, etc. |
| 1. They may be 1—6 mm long. | They may be 0.5— 100 cm long. |
| 1. Cell wall is less thickened. | Cell wall is more thickened. |
| 1. Lumen is narrow. | Lumen is wide. |
| 1. Thickenings may be annular, spiral, reticulate, | Fibres have pitted thickening. scalariform and pitted. |
| 1. Pits are bordered | Pits are usually simple. |
| 1. They serve in conduction of water and minerals and also provide mechanical support | They provide mechanical support. |

**TABLE 7.14 Differences between Xylem and Phloem**

|  |  |
| --- | --- |
| **Xylem** | **Phloem** |
| 1. Xylem conducts water or sap | Phloem conducts food. |
| 1. It provides mechanical strength. | It has no mechanical function. |
| 1. It is usually found deep in the plant. | It is usually situated towards the outer side. |
| 1. In older plants it forms bulk of the plant body. | It forms small part of the plant body. |
| 1. It is made up of vessels, tracheids and xylem fibres. These all are dead elements. | It is made up of only one type of dead cells, the phloem fibres. |
| 1. Xylem parenchyma are the only living cells. | There are three types of living cells. These are sieve tube elements, companion cells and phloem parenchyma. |
| 1. Conducting elements are vessels and tracheids. | These include only sieve tubes. |
| 1. Conducting cells have lignin thickening in the wall. | Wall of sieve tube elements does not possess lignin. |
| 1. Vessels are devoid of septa. | The sieve tube elements have porous septa. |

**TABLE 7.15 Differences between Primary Phloem and Secondary Phloem**

|  |  |
| --- | --- |
| **Primary Phloem** | **Secondary Phloem** |
| 1. It is formed from procambium of apical meristem. | It develops from lateral meristem, called vascular cambium. |
| 1. It is found in primary plant body of vascular plants. | It is formed only during secondary growth of dicots and monocots |
| 1. It occurs towards the periphery. | It is formed inner to primary phloem. |
| 1. It is differentiated into protophloem and metaphloem. | No such differentiation. |
| 1. Radial system is absent. | Radial system of phloem rays is present. |
| 1. Phloem fibres are a few. | They are in abundance. |
| 1. Sieve tubes are a few. | Sieve tubes are numerous. |
| 1. Sieve tubes are narrow. | These are wider and shorter. |
| 1. It is more abundant. | Phloem parenchyma is least abundant. |
| 1. Crystals and other depositions are rare. | Cells contain crystals and depositions of various substances. |

**TABLE 7.16 Differences between Vessels and Sieve Tubes**

|  |  |
| --- | --- |
| Vessels | Sieve Tubes |
| 1. These are made up of a large number of dead cells. | These are made up of living cells. |
| 1. They have thick wall. | They have thin wall. |
| 1. Wall has pits and other types of secondary thickenings. | Instead of secondary thickenings, plasmodesmata occur. |
| 1. The wall is lignified. | Lignification is absent |
| 1. End walls between adjacent cells are dissolved. | End walls are porous. |
| 1. Vessels provide mechanical strength also in addition to transport. | It does not provide mechanical strength. |

TABLE 7.17 Differences between Protophloem and Metaphloem

|  |  |
| --- | --- |
| Protophloem | Metaphloem |
| 1. It is the first formed pholem. | It is the later formed phloem which differentiates when the plant organ has completed its growth. |
| 1. Protophloem is comparatively less prominent. | Metaphloem is quite prominent. |
| 1. It is made up of smaller and narrower elements. | It is made up of longer and broader elements. |
| 1. Sieve pores are not prominent. | Sieve pores are prominent. |
| 1. Companion cells are often absent. | Companion cells are usually present. |
| 1. Protophloem is short-lived and gets crushed. | It is long-lived but can be crushed during secondary growth. |

**TABLE 7.18 Differences between Open and Closed Vascular Bundles**

|  |  |
| --- | --- |
| Open Vascular Bundle | Closed Vascular Bundle |
| 1. A strip of cambium (intrafascicular cambium) is present in-between xylem and phloem. | Intrafascicular cambium is absent. |
| 1. Xylem and phloem are not in direct contact with each other. | Xylem and phloem are in direct contact with each other |
| 1. Due to the activity of cambium, secondary xylem and secondary phloem are formed. | No such activity is found. |
| 1. They are found in the stem of dicots and gymnosperms. | They are found in stems of monocot plants and leaves of the most of the angiosperms. |
| 1. Open vascular bundle may be collateral or bicollateral. | Closed vascular bundles can be collateral or concentric. |

**TABLE 7.19 Differences between Collaterai and Bicollateral Vascular Bundles**

|  |  |
| --- | --- |
| 1. Collateral Vascular Bundle | Bicollateral Vascular Bundle |
| 1. Only a single patch of phloem is present. | Two patches of phloem are present. |
| 1. Xylem lies towards inner side of the phloem. | Xylem is surrounded by phloem both on the inner as well as on the outer sides. |
| 1. Only a strip of cambium is present between the xylem and phloem. | Two cambium strips (one on each), inner and outer side of xylem are found. |

**TABLE 7.20 Differences between Dicot and Monocot Roots**

|  |  |
| --- | --- |
| Dicot Root | Monocot Root |
| 1. The vascular bundles vary from 2 to 4 and rarely to 6 | The vascular bundles are numerous, i.e, 8 or more. |
| 1. Cambium appears as secondary meristem at the time of secondary growth. | Cambium is absent. |
| 1. Xylem vessels are smaller in size and are polygonal in shape. | Xylem vessels are large and more or less circular in outline. |
| 1. Secondary growth occurs after the appearance of cambium. | Secondary growth is absent. |
| 1. Pith is small or absent. | Pith is well-developed. |
| 1. Pericycle gives rise to lateral roots and cambium. | Pericycle gives rise to lateral roots only. |
| 1. The thickening of endodermis is not so prominent due to the presence of casparian strips. | The inner wall of the cells of endodermis is considerably thickened and gives U-shaped appearance. |

**TABLE 7.21 Differences between Dicot and Monocot Stems**

|  |  |
| --- | --- |
| **Dicot Stem** | **Monocot Stem** |
| 1. The epidermis may be provided with multicellular hair or trichomes. | Trichomes are absent. |
| 1. Hypodermis is collenchymatous. | It is sclerenchymatous. |
| 1. Ground tissue is differentiated into cortex, endodermis and pericycle | Ground tissue is not differentiated into cortex, endodermis and pericycle, instead it consists of a mass of uniform and alike cells. |
| 1. Vascular bundles are fewer in number and arranged in a ring. | Vascular bundles are numerous and lie scattered in the ground tissue. |
| 1. Vascular bundles are of uniform size and wedge-shaped. | They are smaller near the periphery and bigger in the centre, and are oval-shaped. |
| 1. Vascular bundles are conjoint, collateral or bicollateral, endarch and open. | They are conjoint, collateral, endarch and closed. |
| 1. Xylem vessels are numerous and arranged in radial rows. They are polygonal in shape. | Xylem vessels are a few in number and arranged in the form of 'Y', and are oval or rounded in shape. |
| 1. There is no lysigenous cavity in xylem. | It is present. |
| 1. Phloem consists of sieve tubes, companion cells and phloem parenchyma. | Phloem consists exclusively of sieve tubes and companion cells. |
| 1. Vascular bundles are not surrounded by any sheath. | They are surrounded by a layer of sclerenchymatous cells forming bundle sheath. |
| 1. Medullary rays and pith are present. | They are absent. |
| 1. Secondary growth takes place due to the presence of cambium. | Since cambium is absent, it does not show any secondary growth. |

**TABLE 7.22 Differences between Dicot Stem and Dicot Root**

|  |  |
| --- | --- |
| **Dicot Stem** | **Dicot Root** |
| 1. Epidermis is covered with a thin layer of cuticle. | Epiblema is not cutinised, i.e., not covered by cuticle. |
| 1. In many cases, epidermis bears multicellular hair which are simply protective. | Epiblema bears numerous unicellular extensions called hair. They help in absorption of water and minerals from the soil. |
| 1. Cortex is narrower than in the root and bears resin ducts. | Cortex is wider. Resin ducts are absent. |
| 1. Pericycle is made up of sclerenchymatous patches and the intervening masses of parenchyma. It lies in-between the vascular bundles and the endodermis. | It consists of a single layer of thin-walled parenchyma cells. |
| 1. Vascular bundles are conjoint and collateral. | They are arranged in a ring but are radial, i.e., phloem and xylem are found on different radii. |
| 1. Xylem is endarch. | It is exarch. |

**TABLE 7.23 Differences between Dorsiventral and Isobilateral Leaves**

|  |  |
| --- | --- |
| Dorsiventral Leaf | Isobilateral Leaf |
| 1. It is exposed horizontally to the sun rays, i.e., one side is exposed to the sunlight. | Its both sides are equally exposed to sunlight. |
| 1. It has distinct upper and lower surfaces. The upper layer is more thickly cutinised. | Its both the surfaces are alike and equally cutinised. |
| 1. Stomata are mostly present on the lower surface. They guard cells are bean-shaped. | Stomata are equally distributed on both the surfaces. They have dumb-bell-shaped guard cells |
| 1. Due to unequal illumination, mesophyll is differentiated into palisade and spongy parenchyma. | Owing to equal illumination, mesophyll is not differentiated into palisade and spongy parenchyma. All the cells are alike and contain chloroplasts. |
| 1. Spongy parenchyma has large intercellular spaces and air cavities. | Intercellular spaces are small but present throughout the mesophyll. |
| 1. Vascular bundles have sclerenchymatous patches only on upper side. | Vascular bundles are partially or completely surrounded by the sclerenchymatous sheath. |
| 1. Vascular bundles have a downward phloem and an upward xylem. | In Vascular bundles phloem is on upper side and xylem on lower side. |

TABLE 7.24 Differences between Intrafascicular and Interfascicular Cambium

|  |  |
| --- | --- |
| Intrafascicular Cambium | Interfascicular Cambium |
| It is a primary meristem. | It is a secondary meristem. |
| It is present in the primary stem within the vascular bundles. | It develops at the time of secondary growth. |
| It is derived from procambium of apical meristem of stem. | It develops from permanent cells of primary medullary rays through differentiation. |

**TABLE 7.25 Differences between Phellem (Cork) and Phelloderm (Secondary Cortex)**

|  |  |
| --- | --- |
| **Phellem** | **Phelloderm** |
| 1. Phellem is formed on the outer side of the phellogen. | Phelloderm is formed on the inner side of phellogen. |
| 1. It is made up of dead cells. | It is composed of living cells. |
| 1. It is protective in function. | Its cells serve for the storage of food. |
| 1. Its cell walls are highly suberised and are thus impermeable. | Its cells are not suberised. |
| 1. The cells are filled with tannin. | Tannin is not found. |
| 1. The cells are compactly arranged. | The cells are loosely packed with small intercellular spaces. |

**TABLE 7.26 Differences between Softwood and Hardwood**

|  |  |
| --- | --- |
| **Softwood** | **Hardwood** |
| It is called softwood because it lacks the wood fibres. | It is called hardwood because it contains abundant wood fibres. |
| Softwood lacks vessels and hence the wood IS called non-porous. | Hardwood contains vessels. Therefore, it is called porous wood. |
| Softwood contains 90—95% tracheids. | It contains 5—10% tracheids. |
| It is found in gymnosperms. | It is found in angiosperms |

**TABLE 7.27 Differences between Heartwood (Duramen) and Sapwood (Alburnum)**

|  |  |
| --- | --- |
| **Heartwood** | **Sapwood** |
| 1. It forms the central wood of an old stem. | It forms outer wood of an old stem. |
| 1. It is dark-coloured. | It is light-coloured. |
| 1. It is heavier. | It is lighter in weight. |
| 1. Living cells are absent. | It contains living cells. |
| 1. It is the dead and non-functional part of secondary xylem. | It is the functional part of the secondary xylem or wood. |
| 1. It does not conduct water and minerals. | It carries out conduction of water and minerals. |
| 1. The tracheary elements are plugged by tyloses and other substances such as gums, resins, tannins, etc. | The tracheary elements are not plugged by tyloses and other depositions. |

**TABLE 7.28 Differences between Early Wood and Late Wood**

|  |  |
| --- | --- |
| Early Wood (Spring Wood) | Late Wood (Autumn Wood) |
| 1. It is formed during favourable period of growth. | It is formed during unfavourable period of growth. |
| 1. It forms the major part of the annual ring. | It forms a narrow strip in the annual ring. |
| 1. It occurs in the beginning of an annual ring. | It occurs at the end of an annual ring. |
| 1. It contains large and wider elements. | It contains small and narrower elements. |
| 1. Fibres are fewer. | Fibres are abundant. |
| 1. It is lighter in colour. | It is darker in colour. |
| 1. It has lower density. | It is of higher density. |