



Plant Identification Basics

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Plant identification can be challenging. Being able to identify a plant is important, especially in the case of noxious weeds or toxic plants. This publication covers basic questions to ask about a plant that will assist with speedy and accurate identification. It will be especially helpful when used in conjunction with a field guide, dichotomous key, or smartphone app.

THE ABILITY TO IDENTIFY A PLANT IS IMPORTANT FOR several reasons. For example, knowing which plants are present in an area helps us understand more about our environment. From a vegetation management perspective, it is important to know a plant's identity to determine if it is a weed and the level of risk it poses to desired vegetation. Identification is especially important for early detection of new weeds that have never been documented in an area before and can be targeted for eradication. Plant identification is also important for people who raise livestock and are concerned about their animals eating toxic plants. In addition, many people are interested in harvesting edible plants from the wild or their garden and yard. Knowing what plant you are about to eat could become a matter of life or death.

Plant identification can be challenging and even intimidating. Many people are not comfortable using a **dichotomous key** and grow weary thumbing through a guidebook or scrolling through a smartphone app until they happen to find a picture that looks similar to the plant they want to identify. However, looking at just a few **morphological**

features of a plant can help narrow down the options or even identify the plant to **genus** and **species**. The purpose of this publication is to cover basic questions to ask about a plant that will help identify plants with speed and accuracy. Examples are in the context of noxious weeds, but the concepts can be applied to plant identification in general. This publication will be especially helpful when used in conjunction with a favorite smartphone app, field guide, or dichotomous key. Remember to always use multiple features of a plant to determine identity, instead of relying on a single feature. Occasionally there are variations in some of the rules or generalizations presented below, and looking at multiple characteristics helps to avoid errors in identification.

Is the plant a monocot or dicot?

Flowering plants (angiosperms) are split into two types: monocots and dicots. Monocots (mono: one) have a single seed leaf, called the cotyledon, that emerges from the seed, and dicots (di: two) have two seed leaves or cotyledons that emerge from the seed (**Figure 1**). Grasses are examples of monocots while a bean or pea is an example of a dicot. In addition to the number of seed leaves, leaf veins and floral parts help to separate monocots from dicots (**Figure 2**). Monocots have leaf veins that form a parallel pattern, for example the veins on a blade of grass. Dicots usually have leaf veins that form a net pattern. Monocots have floral parts (e.g. petals) in multiples of three while dicots have floral parts in multiples of four or five (**Figure 3**).

Figure 1. Seedlings.

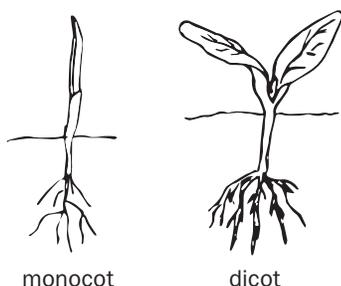


Figure 2. Leaf venation.

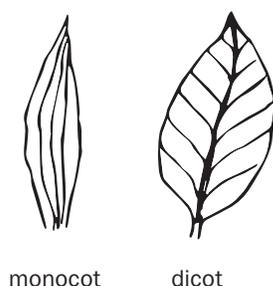
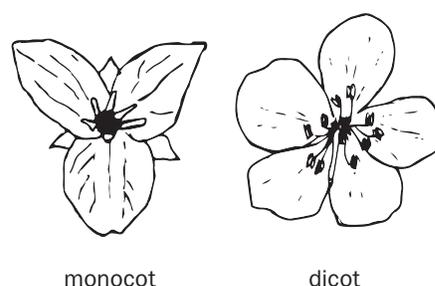


Figure 3. Floral parts.



From a weed management perspective, recognizing a plant as a monocot or dicot is helpful in regards to herbicide selectivity. Some selective herbicides target dicots or what are often referred to as “broadleaf” plants. Other herbicides target only grasses, an example of a monocot.

If a plant is a monocot in the grass **family** (Poaceae), it has additional identifying characteristics that are not covered in this publication. See “Additional Resources” for information on identifying grasses.

How are the leaves arranged?

One of the first and easiest features to observe on a plant is leaf arrangement. Leaf arrangement can be one of three types: opposite, alternate, or whorled (**Figure 4**). Alternate leaf arrangement is characterized by a single leaf per **node**. Opposite arrangement is characterized by two and only two leaves at a node on opposing sides of the stem. Leaves are whorled when three or more leaves per node are arranged in a circular pattern. Eurasian watermilfoil (*Myriophyllum spicatum*) is an example of a noxious weed with whorled leaves. Always examine the whole stem as leaf arrangement may vary; for example, leaves may be arranged oppositely at the very top but alternately further down the stem.

Figure 4. Leaf arrangements

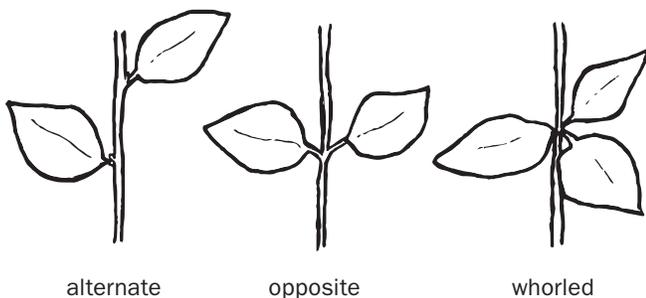
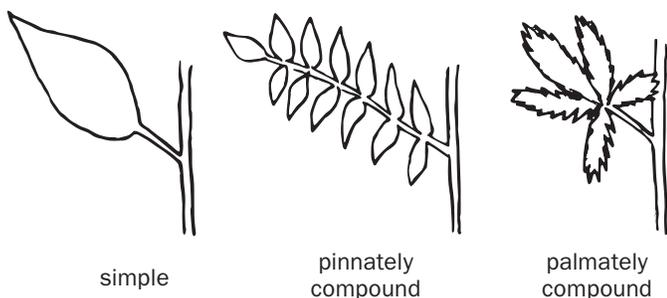


Figure 5. Leaf types



Are the leaves simple or compound?

A simple leaf is one that is undivided, meaning it has only one definite segment present between the stem and the end of the blade (**Figure 5**). Compound leaves are divided into definite and distinct segments called leaflets. Compound leaves can be further grouped into pinnately compound leaves and palmately compound leaves. Pinnately compound leaves have leaflets arranged on opposite sides of the leaf axis, similar to a feather. For example, Eurasian watermilfoil leaves are pinnately compound. The leaflets on a palmately compound leaf radiate from a central point, like fingers radiating from the palm of a hand. Sulfur cinquefoil (*Potentilla recta*) is an example of a noxious weed with palmately compound leaves.

What is the shape of the leaf?

There are many terms used to describe leaf shape. Only seven of the more common leaf shapes are presented here (**Figure 6**), but guides mentioned in “Additional Resources” provide additional terms and descriptions. Elliptic leaves are broadest in the middle and narrower at either end. Linear leaves are long and narrow with the sides being close to parallel to each other. Lanceolate leaves are much longer than wide, with the widest point below the middle of the leaf. Spatulate leaves look like a spatula, with the tip being rounded and gradually tapering to the base. Ovate leaves are egg-shaped while oval leaves are round to oval, lacking a pointed tip. Cordate leaves are heart-shaped.

What other leaf characteristics are important?

The margin, or edge of the leaf, can also assist in plant identification. As with leaf shape, there are many ways to describe leaf margins. Only three major descriptions are provided here (**Figure 7**), but check the “Additional Resources” for more information. Entire margins are smooth and do not have any teeth, notches, or divisions. Leaves that have a toothed or saw-like margin are called dentate or serrate. Lobed leaves have indentations along the margin that cut inward toward the leaf midvein.

Another leaf characteristic that can help with plant identification is whether the leaf is petiolate, sessile, or clasping (**Figure 8**). Petiolate leaves have a stalk (petiole) that attaches them to the stem. Sessile leaves do not have a petiole and are attached directly to the stem. Clasping leaves are sessile (i.e. do not have a petiole) and have a base that wholly or partly wraps around the stem. The leaves of Dalmatian toadflax (*Linaria dalmatica*) provide a good example of clasping leaves. Whitetop (*Lepidium draba*) leaves are petiolate on the lower portion of the stem and clasping on the upper portion of the stem.

Figure 6. Leaf shapes.

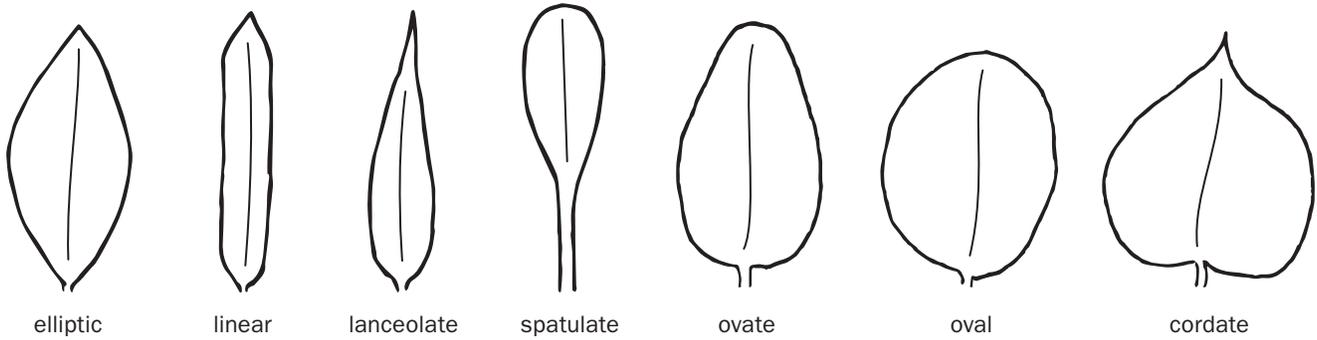


Figure 7. Leaf margins.

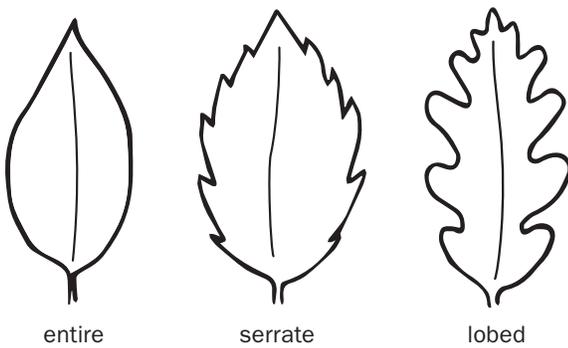
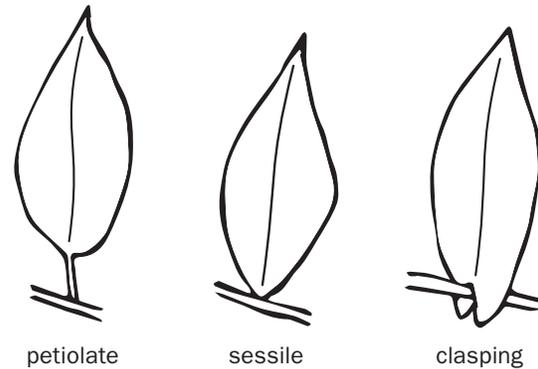


Figure 8. Leaf attachments.



What do the flowers look like?

If a plant is in bloom, flower characteristics provide excellent clues to the plant's identity. At the same time, flowers are extremely diverse across species and contain many small parts that are sometimes difficult to see with the naked eye or even a hand lens. For that reason, this publication covers only a few broad characteristics that can aid in narrowing the identity of a plant.

FLOWER PARTS (FIGURES 9-11)

For most flowers, there is an outermost whorl of leaf-like structures called sepals that protect the bud (**Figure 9**). Sepals are typically small and green, but may be just as colorful as the petals. Collectively, sepals are called the calyx. The next whorl of leaf-like structures is the petals (**Figure 10**). They are usually colorful and attractive. Collectively, petals are called the corolla. Some plants don't have both petals and sepals but just one undifferentiated whorl. For these plants, the petal-like structures are called tepals.

The stamen is the male reproductive organ consisting of an anther, which bears pollen, and a filament, the thread-like structure that supports the anther (**Figure 11**). Field

Figure 9. Sepals, the outermost whorl of a flower (forms a star in this example).

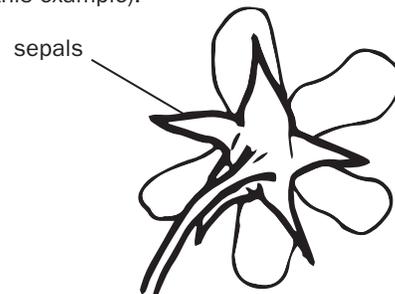


Figure 10. Sepals and petals from a side view and above.

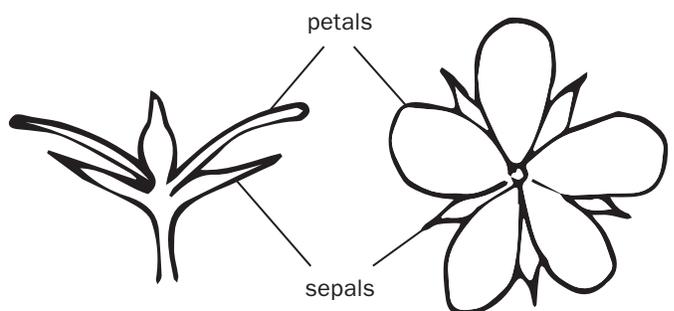


Figure 11. Reproductive parts of a flower.

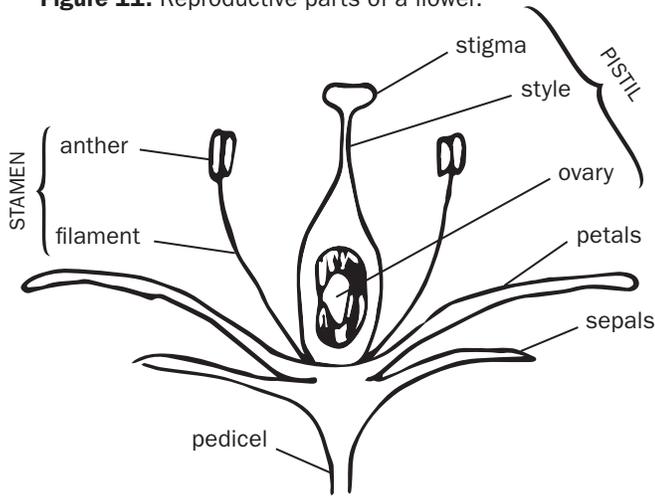


Figure 12. An Asteraceae with both ray and disc florets.

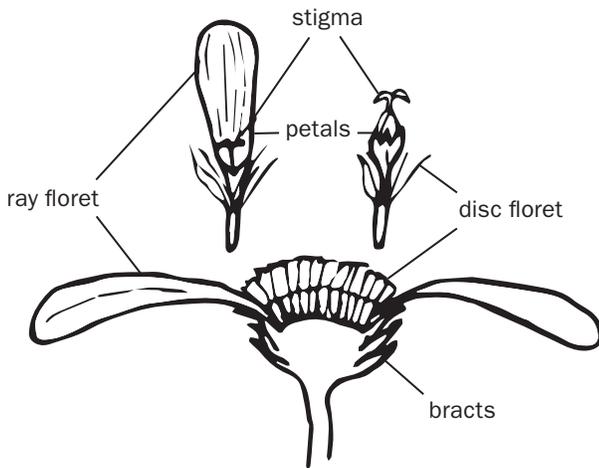
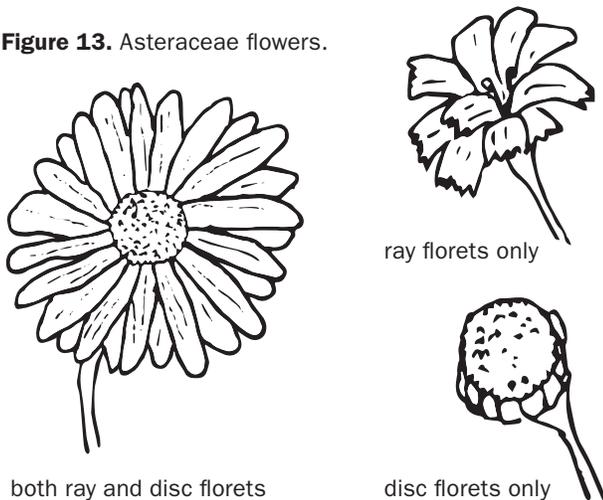


Figure 13. Asteraceae flowers.



guides and keys often refer to the number of stamens to help identify a plant. The pistil is the female reproductive organ consisting of the stigma, style, and ovary (**Figure 11**). The stigma is the tip of the pistil and receives pollen. The style is the narrowed portion that connects the stigma to the ovary. Some flowers have multiple stigmas that field guides and keys will refer to for identification. The pedicel is the stalk that attaches the flower to the stem (**Figure 11**). The pedicel is to a flower what the petiole is to a leaf (see above, “What other leaf characteristics are important?”).

Flowers in the sunflower family (Asteraceae) are unique in that they may have one or two different types of **florets**: ray and disc (**Figure 12**). For example, oxeye daisy (*Leucanthemum vulgare*) has disc florets forming the center yellow portion of the flower and ray florets forming the outer white “petal” portion of the flower. Other plants in the Asteraceae family may have ray florets only or disc florets only (**Figure 13**). Flowers in the Asteraceae family also have unique features called bracts (**Figure 12**). These are leaf- or scale-like structures that surround the base of the flower. For certain groups of species, like the knapweeds (*Centaurea* spp.), bracts are one of the most important characteristics for identification.

FLOWER SHAPE

Flowers can take many different forms and shapes, but some common shapes are shown in **Figure 14**. Shapes are helpful to recognize because in some cases they provide very strong clues to which family the plant belongs. For example, all plants in the mustard family (Brassicaceae) like hoary alyssum (*Berteroa incana*), dyer’s woad (*Isatis tinctoria*), and whitetop have a cruciform flower shape, four petals that form a cross. A plant with its flower shaped in a head is very likely in the Asteraceae family.

INFLORESCENCE TYPE

Flowers more often than not occur in clusters that have a specific arrangement called the inflorescence. Some of the more common inflorescence types are shown in **Figure 15**. On a spike, the flower is attached directly to the stem and pedicels (stalks) are absent. On a raceme, pedicels attach the flowers to the stem. Panicles are like compound or branched racemes. In a spike, raceme, and panicle, flowers mature from the base upwards.

A corymb is a type of inflorescence in which the pedicels are different lengths. Pedicels at the base are longer than those near the top, giving the inflorescence a flat to rounded top. An umbel is a flat topped or convex inflorescence with the pedicels arising from a common point, like an umbrella. A cyme is a

flat or round topped inflorescence where the terminal flowers bloom first (in contrast to a spike, raceme, and panicle). A helicoid cyme is coiled like a scorpion's tail and typical of plants in the Boraginaceae family (e.g. houndstongue, *Cynoglossum officinale*, and blueweed, *Echium vulgare*).

Does the stem have any unique characteristics?

There are not many terms to learn regarding stems, but stems are worth examining because some plants have unique characteristics that can serve as diagnostic features. Some examples from the noxious weed arena include blueweed which has long hairs with dark spots at their base; yellow starthistle (*Centaurea solstitialis*) which has a stem that appears pinched or flattened on each side giving it a "winged" appearance; and Japanese knotweed (*Polygonum cuspidatum*) which has a hollow stem.

What type of root system does the plant have?

Although root systems are not obvious without digging up a plant, they can help in identification (Figure 16). Plants with taproots have a single, dominant root that penetrates downward to a considerable depth from which lateral roots sprout. Fibrous roots are densely branching roots that are similar in size with growth oriented both outwards and downwards. Plants with rhizomes have elongated, horizontal, below ground stems that can emerge some distance from the mother plant, giving rise to new plants. Stolons are similar to rhizomes except that the elongated, horizontal stems are above ground. Stolons root at the nodes or tips and give rise to a new plant. From a weed management perspective, plants with taproots like houndstongue are typically easier to hand-pull or dig up than those that are rhizomatous like Canada thistle (*Cirsium arvense*) or stoloniferous like meadow hawkweed (*Hieracium* spp).

Figure 14. Flower shapes.

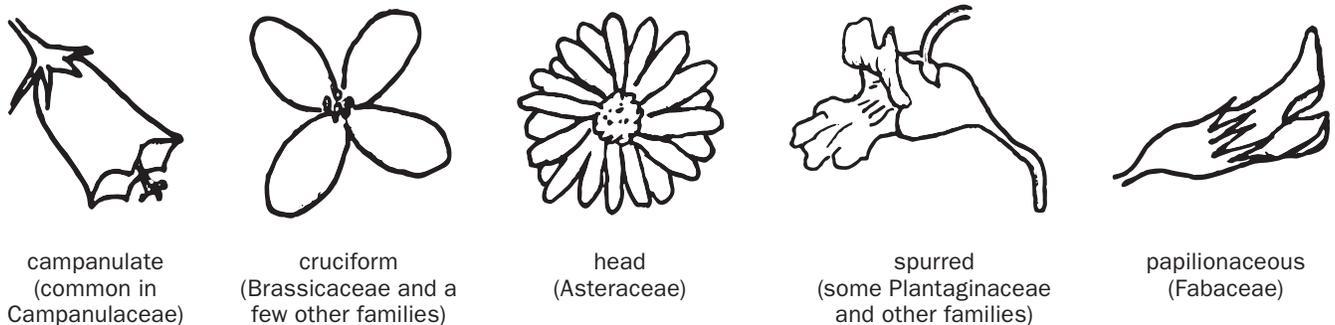


Figure 15. Inflorescence types.

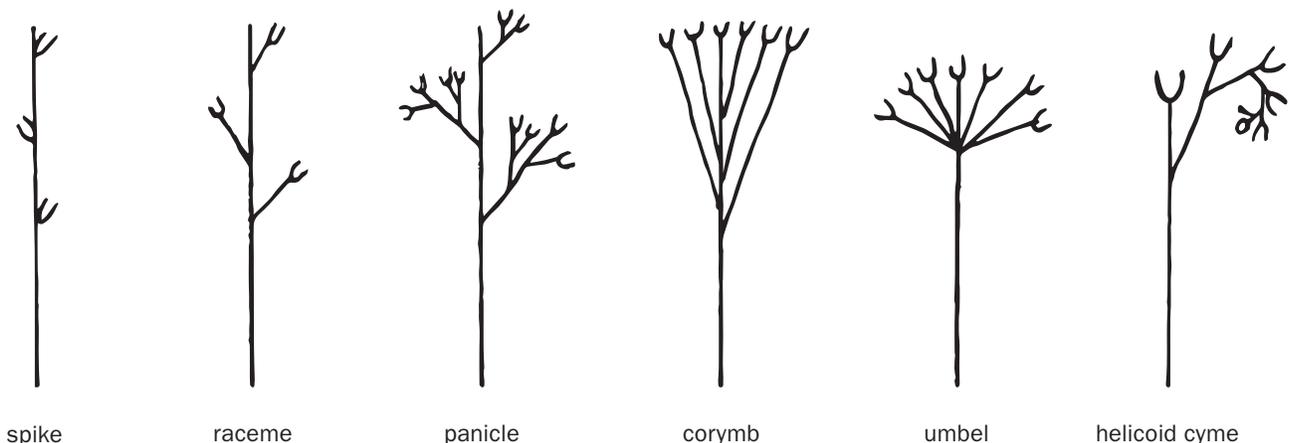
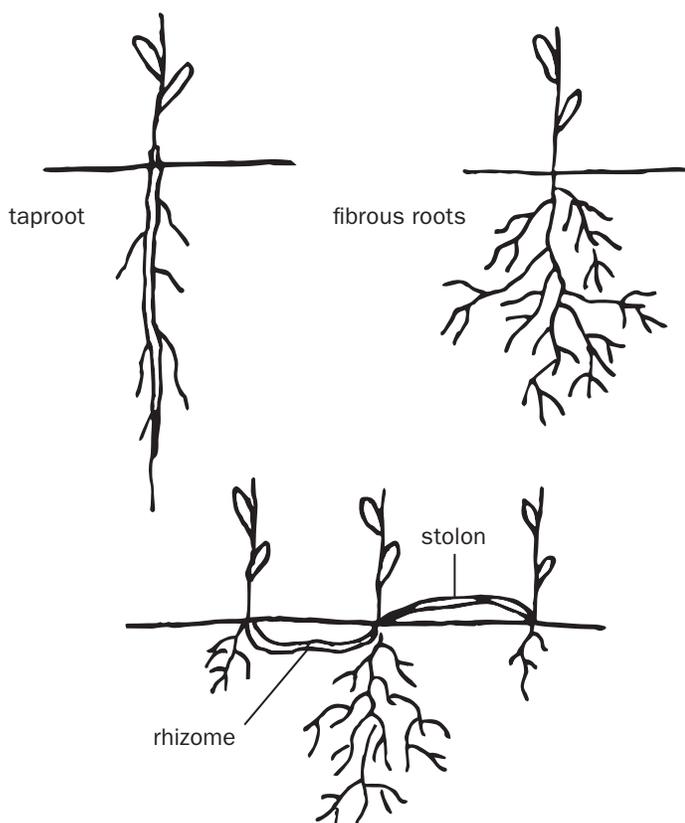


Figure 16. Root systems.



Summary

Plant identification is important and can even be fun. By asking the questions listed above, one can be on the way to successfully identifying a plant of interest. For further assistance, there are helpful Extension resources. Visit your local Extension office for more information or access Extension publications at store.msuextension.org. Receive plant identification assistance from the MSU Schutter Diagnostic Laboratory, montana.edu/extension/diagnostics.

Glossary

Dichotomous key: a reference tool used for the identification of organisms where a series of choices between alternative characters progressively leads to the correct organism; “dichotomous” means “divided into two parts,” therefore dichotomous keys always give two choices in each step

Family: group of genera (plural of genus) that resemble one another in certain broad characteristics; family names usually end in –aceae or –ae; for example, Asteraceae, the largest family of plants, consists of 950 genera and 20,000 species

Floret: very small flowers found in dense arrangements

Genus: taxonomic group of related species; first element of a scientific name, examples include *Centaurea*, *Fallopia*, *Hieracium*

Morphological: having to do with the form and structure of a plant or animal

Node: a joint or point of attachment for leaves and branches

Species: a plant or animal with distinct features that can only reproduce with individuals of a similar nature; second element of a scientific name, for example in *Centaurea stoebe*, *stoebe* is the species

Acknowledgments

Special thanks to Linnea Skoglund, Shantell Frame-Martin, and Damian Stoy for reviewing this publication. All illustrations by Hilary Parkinson.

Additional resources

Harris, J.G. and M.W. Harris. 2001. *Plant Identification Terminology, 2nd Edition*. Spring Lake Publishing: Spring Lake, Utah. 216 pages.

Lesica, P. 2022. *Manual of Montana Vascular Plants, Second Edition*. Botanical Research Institute of Texas: Fort Worth, Texas. 785 pages.

Wildflower Identification website: wildflowersearch.org. Scroll to bottom for Montana Wildflowers app

Parkinson, H., J. Mangold, F. Menalled and N. Orloff. 2019. *Weed Seedling Identification Guide for Montana and the Northern Great Plains*. Montana State University Extension, Bozeman, Montana. EB0215.

Pokorny, M. and J. Mangold. 2018. *Montana's Noxious Weeds*. Montana State University Extension, Bozeman, MT. EB0159.



MT201304AG, REVISED 03/25
**AGRICULTURE AND NATURAL RESOURCES
(PLANTS)**

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