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# Ecology and Management of Tarweed

Yellow tarweed, *Holocarpha virgata*, is a native plant that is well adapted to the hot dry summers in the Central Valley of California and the surrounding foothills. Tarweed is in the Composite family. It was first classified as *Hemizonia virgata*.

In the summer tarweed's aromatic summer growth is sometimes tall and sticky. It is not palatable to livestock, hides forage needed by livestock, and coats the faces and legs of livestock with a tarry resin.

With the arrival of Europeans, California's grasslands changed dramatically. Annual grasses and forbs from the Mediterranean area were introduced both accidentally and intentionally. These species were shorter-lived and shallower-rooted than the perennial grass that they replaced. Growing numbers of domestic livestock greatly increased the grazing pressure on the range, resulting in less soil moisture use by plants. Also, the summer fires that had swept through the perennial grasslands were controlled. These changes undoubtedly favored the spread of tarweed.

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**Phenology, Growth, and Reproduction**

Tarweed germination starts in the fall with the first rains and continues into April. Other summer annuals such as turkey mullein (*Eremocarpus setigens*) and vinegar weed (*Trichostema lanceolatum*) germinate in the spring and appear to be restricted to open areas with low vegetative cover, thus avoiding competition with the winter annuals.

By the end of winter, the tarweed plant has developed a deep taproot and about a dozen broad leaves in a rosette. Roots of tarweed go deeper than most of the winter annual grasses, reducing competition with them for soil nutrients and moisture. Penetration rates in sand of over 1.5 inches per day have been observed. From late spring until early summer the shoots elongate and branch out with bract-like leaves on woody stems that stand 1 to 2 feet tall.

In August and September tarweed produces composite heads that have 3 to 5 ray flowers and 3 to 12 disk flowers. The ray flower is incomplete, having only a carpel, but the disk flower also has anthers that produce abundant pollen, an important food source for honeybees. The ray and disk achenes (fruiting structure containing a seed left after the flower dries) mature by the end of September. Achene dispersal is caused by rain, wind, and wildlife and continues into the winter. The achenes, which have over 20% crude protein, are eaten by ground squirrels.

The ray achenes are quite different in appearance, hardness, and the vigor of resulting seedlings, but there appears to be no morphological difference between the plants they produce. The ray achene is 3 mm long, ovate-shaped, and extremely hard. In laboratory tests no germination was achieved without scarification. The factors causing ray achenes to germinate in the field are unknown. Tarweed produces at least 5 times as many fertile ray achenes as fertile disk achenes.

The disk achene is 4 mm long and lanceolate shaped. Newly collected disk achenes with filled endosperms have 100% germination without any pretreatment, but less than one-fourth

of the disk achenes are filled. Most of the germination in the fall is from disk achenes.

Achene dispersal and plant senescence starts at the end of October. By the end of spring only the woody stems and thicker branches remain, and they stand until the following rainy season.

Livestock use tarweed in winter and early spring while it is young and succulent. Use decreases rapidly as it increases in height and resin covering. It is hardly grazed at all at maturity when covered with resinous exudate, although it is still an important source of protein and moisture for ground squirrels. Summer annuals are often the only actively growing green plants, relatively high in protein, available in the summer on annual range. To discourage herbivory, summer annuals have apparently evolved mechanisms such as spines, aromatic compounds in vinegar weed (*Trichostema lanceolatum*), and aromatic resins as in tarweed. Few animals are able to feed on these plants in the summer.

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**Competition**

Tarweed competes with winter annuals by diminishing soil moisture in late spring. Because tarweed germinates in the fall and grows in close association with dense stands of winter annuals, there is probably also some competition for light and nutrients during the growing season, but the degree of competition is unknown.

The occurrence of tarweed in the early successional stages of the annual grassland-type indicates that it is more compatible with the less productive species commonly found in these stages, thus tarweed has been designated an "invader" species. The shallow-rooted, short statured, early maturing alien annual grasses use less light and water than the late successional perennial grasses or taller annual grasses. This results in a surplus of moisture that tarweed is able to utilize.

Because tarweed relies on stored soil moisture for summer growth, it is most competitive on deep fine textured soils. Tarweed is distributed widely over the range but is more common in swales, and tarweed often dominates the better forage-producing sites.

Annual variations in climate--mainly rainfall and temperature--result in large year-to-year differences in the composition of the California annual grasslands. Annual grasses are dominant in some years, and annual forbs or annual legumes in other years. The amount of competition between tarweed and these winter annuals is less in grass dominant years and greater in forb-dominant years. The nitrogen-fixing ability of annual legumes tends to increase soil fertility, which increases forage production and water use and therefore reduces tarweed densities.

Instead of being a highly competitive invader like some alien annual grasses, tarweed seems to have been able to invade the annual grassland by taking advantage of underused resources of moisture, nutrients, and light.

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**Control**

***Reducing Tarweed Density***

These techniques can greatly reduce a population of tarweed, leaving very few plants to flower and set seed. However, the timing of these activities is critical.

**Mechanical:** Mowing to 4" in May reduced tarweed by 20%, mowing in July reduced tarweed by 90%, whereas mowing in late August eliminated all but a few prostrate plants. Density in the year following late summer mowing was reduced by 90%

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**Chemical:** University of California researchers, using 1.5 lb/acre of a low volatile ester of 2,4-D, found that tarweed was affected much more by the herbicide treatment before elongation (April 21) than after elongation (July 14). Because legal restrictions on herbicides are constantly changing, you should contact your Ag. Commissioner before using any chemical control method.

**Seedbank:** One of the major obstacles to mechanical or chemical removal of tarweed is the seedbank of hard ray achenes that exists on sites. After five years of summer mowing, tarweed densities were about 10% of those in unmowed plots. To be successful, the use of these methods must be long-term (over five years) to totally eliminate tarweed, otherwise the pasture will be reinfested once the eradication project ends.

***Depleting Soil Moisture***

**Fertilization:** Nitrogen fertilization increases the vigor and productivity of tarweed's competitors, making them better able to deplete soil moisture that supports tarweed survival and growth in the summer. The fertilizer should be applied in the fall to ensure that winter annuals utilize it efficiently. However, it is doubtful whether the large amounts of nitrogen fertilizer required annually to reduce tarweed density effectively (107 lb/a) would be economical if applied to rangelands.

**Annual legumes:** Nitrogen fixation by annual legumes increases forage production and reduces soil moisture available to tarweed. Rose clover (*Trifolium hirtum*) fertilized with single superphosphate has been shown to reduce tarweed. Lana vetch, subterranean clover, and the annual medics should have the same affect.

**Perennial grasses:** Although no studies have demonstrated a reduction in tarweed, established perennial grass seedings should deplete soil moisture, making it unavailable to tarweed.

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**References**

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