Carduus pycnocephalus L. (Asteraceae)
Italian Thistle

Description. Annual or biennial, herbaceous, from a stout taproot; stems 15-200 cm tall, erect, glabrous to sparsely tomentose, narrowly and discontinuously winged, the wings spinose, tomentose, branched above the lower third, branches erect to ascending. Basal leaves 6-15 cm long, oblanceolate, deeply 4-10-lobed, the base tapered; cauline leaves alternate, decurrent, sinuate to pinnately lobed, margins spinose, upper surfaces loosely tomentose, becoming glabrous, lower surfaces densely tomentose. Heads discoid (all corollas radial and salverform), 17-22 mm long, 10-20 mm wide, cylindrical to subcylindrical, sessile to stalked, solitary or 2-5 in terminal clusters. Outer phyllaries ovate-lanceolate, loosely tomentose, margins membranous, apices acuminate, terminating in a straight spine; inner phyllaries narrower, scarious. Corollas 10-14 mm long, pink to rose-purple, sometimes white. Achenes 4-6 mm long, tan to brown, sometimes shiny, transversely wrinkled, tubercled above; pappus 10-20 mm long, composed of flat, minutely barbed, white bristles. In California, flowering from May to July (Clapham et al. 1962, Franco 1976, Keil and Turner 1993, Munz 1959; Robbins et al. 1970, Webb et al. 1988).

Note: The closely related species, *C. tenuiflorus* Curtis (Slender Thistle) differs by stems with continuous wings, leaves 12-20-lobed, 5-20 heads per cluster, and scarious phyllaries that become glabrous at maturity. Although some authors have suggested that the two species may hybridize or intergrade (Keil and Turner 1993, Webb et al. 1988), Olivieri (1985) reported low levels of seed set in putative intermediate or known hybrids, suggesting that gene flow, if any, was relatively low.

Geographic distribution. A native of Mediterranean Europe and North Africa, it is naturalized in Australia, New Zealand, South Africa, Europe, and western Asia, where it is considered invasive (Dunn 1976, Sindel 1991). In the United States it is reported from Alabama, Arkansas, California, Idaho, Hawaii, Idaho, New York, Oregon, and Texas, but is apparently well established only in Texas and in California (Dunn 1976, Fernald 1950, Goeden 1974, Wagner et al. 1990).

Naturalized populations occur on San Miguel and Santa Rosa islands (Junak et al. 1997) and on mainland California from Mendocino County to San Diego County along the coast, the lower Sacramento River Valley. and the Sierra Nevada foothills in Butte and Nevada counties (Anonymous 1998, Keil and Turner 1993).

Ecological distribution. Italian thistle commonly occurs in disturbed, often moist habitats, in canyon bottoms, along roadsides, open grassland, fallow fields, grazed areas, the margins of cultivated fields, and along irrigation canals (Dunn 1976, Goeden 1974, McClintock 1993, Munz 1959, Robbins et al. 1970, Sindel 1991). In central California, Italian thistle has been reported as occurring in grassland-live oak ecotones (Maranon and Bartolome 1993).

Reproductive and vegetative biology. Italian thistle is bisexual, self-compatible, and pollinated by a diverse array of insects (Bendall 1975, Evans et al. 1979, Olivieri et al. 1983). Achenes are either dispersed widely by wind or remain enclosed in receptacular bracts of the head (Evans et al. 1979, Olivieri et al. 1983). Seeds remaining in the heads are generally dull brown in color;

those dispersed by wind are lighter in color and shiny. Fruit dimorphism probably represents a dual strategy for recruitment *in situ* and by long-distance dispersal, because dull brown seeds generally fall to the ground partially enclosed within the dried heads. Both forms of seeds are mucilaginous when wetted. Although Evans et al (1979) suggest that mucilaginous seeds may be advantageous for dispersal, studies of other species suggest that mucilaginous seeds also may confer an advantage during germination and establishment of seedlings under water-limited conditions (Sagar and Harper 1960, Sorensen 1986).

Seeds of Italian and slender thistles germinate during conditions favoring long, cool nights combined with relatively high humidity or winter precipitation (Groves 1989, Olivieri et al. 1983). Evans et al. (1979) reported germination rates of 83-96% , especially under conditions of cool nights (16 hours at 10 degrees C) and warm days (8 hours at 35 degrees C). No differences were found with either fresh or stored seeds. Seeds buried at depths up to 2 cm germinated more readily than those on the surface or buried at depths from 5 to 10 cm.

Growth of vegetative plants is promoted by "rich" soils (Groves 1989). Application of nitrogen and/or slightly acidic pH levels enhance vegetative growth (Bendall 1975). The occurrence of Italian thistle in disturbed sites and absence from cultivated fields suggests that it is not competitive against well established or ungrazed vegetation (Goeden 1974). Experimental studies by Maranon and Bartolome (1993) showed that Italian thistle is one of several invasive species whose seeds remain dormant under shaded conditions, and which can germinate and compete successfully in both light and shade, except when in sites with high grass (*Bromus diandrus, Avena sativa*) cover.

Weed status. Italian thistle is not considered a noxious weed in agricultural practice, at least at a global level (not listed by Holm et al. 1977), but is considered a noxious weed by the State Dept. of Food and Agriculture (Anonymous 1996). Both Italian and slender thistles are listed as weeds in the United States (Lorenzi and Jeffrey 1987).

Microbial pathogens. Several species of rust fungi (*Puccinia cardui-pycnocephali*, *P. cauduorum*, *P. centaureae*, and *P. galatica*) are known to infest both *Carduus pycnocephalus* and *C. tenuiflorus*. *Puccinia cardui-pycnocephali* is apparently restricted to *Carduus pycnocephalus* (Batra et al. 1981, Oliveri 1984, Bruckart 1991). In general, inoculations of experimental plants showed that the rust fungus reduces growth, especially at the rosette and vegetative phase, but has insignificant effects on flower and fruit production. Based on experimental greenhouse studies, optimal conditions for infection and decline of host plants are between 18 and 20 degrees C and 90 to 100% relative humidity.

Bruckart (1991) provided evidence of host-plant differentiation among strains of several *Puccinia* species, with *P. carduorum* found more frequently than *P. cardui-pycnocephali* on *Carduus pycnochephalus*. Strains isolated from one species of thistle were most effective on plants of the same rather than another species of *Carduus*, although rust fungi isolated from *C. pycnocephalus* were more virulent when introduced on plants of *C. tenuiflorus*. Olivieri (1984) reported some evidence of differential susceptibility in both species to infection by *Puccinia cardui-pycnocephali*. In general, naturalized strains were more susceptible than native European strains, suggesting that resistance to fungal infection had been lost during or after the colonization process.

Insect pathogens. Several species of phytophagous beetles (Curculionidae; weevils) are known to infest *Carduus* (Bolt et al. 1980, Goeden 1974), and have been used as biological agents for control in California and Australia (Frick 1978, Goeden 1974, 1978, Sindel 1991). However, only a few species appear to be effective as control agents, by causing severe injury to developing leaf rosettes, developing flowering heads, and flowers. Julien (1982) reported high levels of flower abortion in both *Carduus pycnocephalus* and *C. tenuiflorus*, after infestation with *Rhinocyllus conicus*. *Rhinocyllus conicus* has been used experimentally in California for control of both *Silybum marianum* (L.) Gaertner (Milk thistle) and *Carduus pycnocephalus* (Goeden 1974, 1978, Goeden and Ricker 1978, Hawkes et al. 1972). Although flower abortion (> 90%) was high in naturalized thistle populations in both New Zealand and California (Julien 1982, Goeden and Ricker 1978), populations of Italian thistle did not appear to decline (Goeden and Ricker 1978). *Ceutorhyncus trimaculatus*, a pest of artichoke and safflower crops, also has been found to be a potential predator of flowers and seeds of Italian and slender thistles (Bolt et al. 1980, Kok et al. 1982). Some success with an integrated pest management program, using 2,4-D in combination with *Ceutothoryncidius horridus* (Coleoptera Curculionidae), has been reported by Trumble and Kok (1980a, 1980b). However, the potential effect of introduced phytophages on native American thistles remains unknown (Turner 1991).

Herbicide control. Related species (*Carduus acanthoides* L., plumeless thistle, and *C. nutans* L., musk thistle) are best treated with 2,4-D for young leaf rosettes or a combination of mowing and 2,4-D for plants that have bolted (Lorenzi and Jeffery 1987).

Literature Cited

Anonymous. 1996. Exotic pest plants of greatest ecological concern in California as of August 1996. California Exotic Pest Plant Council. 8 pp.

Anonymous. 1998. California county flora database version 2, Santa Barbara Botanic Garden and USDA National Plants Data Center, Santa Barbara and New Orleans. URL = plants.usda.gov

Anonymous. 1998. USDA Plants Database. USDA National Plants Data Center, New Orleans, Louisiana. URL: usda.plants.gov

Batra, S., J. Coulson, P. Dunn, and P. Bolt. 1981. Insects and fungi associated with *Carduus* thistles (Compositae). USDA Technical Bulletin 1616. 100 pp.

Bendall, G. 1975. Some aspects of the biology, ecology, and control of slender thistle, *Carduus pycnocephalus* L. and *Carduus tenuiflorus* Curtis (Compositae) in Tasmania. Journal, Australian Institute of Agricultural Science. 41: 52-53.

Bolt, P., G. Campobasso, and E. Colonnelli. 1980. Paleartic distribution and host plants of *Ceutorhynchus trimaculatus* and *Trichosirocalus horridus* (Coleoptera: Curculionidae). Annals, Entomological Society of America. 73: 694-698.

Bruckart, W. 1991. Phenotypic comparison of *Puccinia caduorum* from *Carduus thoermieri, C. tenuiflorus*, and *C. pycnocephalus*. Phytopathology. 81: 192-197.

Clapham, A., T. Tutin, and E. Warburg. 1962. Flora of the British Isles. Cambridge University Press, Cambridge. 1269 pp.

Dunn, P. 1976. Distribution of *Carduus nutans, C. acanthoides, C. pycnocephalus*, and *C. crispus*, in the United States. Weed Science 24: 518-524.

Evans, R., J. Young, and R. Hawkes. 1979. Germination characteristics of Italian thistle (*Carduus pycnocephalus*) and slenderflower thistle (*Carduus tenuiflorus*). Weed Science 27: 327-332.

Fernald, M. 1950. Gray's Manual of Botany. Eighth Edition. American Book Company, New York. 1632 pp.

Franco, J. 1976. *Carduus*. pp. 220-232. In Tutin et al. (eds.) Flora Europaea. Volume 4. Plantaginaceae to Compositae. Cambridge University Press, Cambridge. 505 pp.

Frick, K. 1978. Biological control of thistles in the genus *Carduus* in the United States : a progress report. USDA, Science and Education Administration, Stoneville, Mississippi. 50 pp.

Goeden, R. 1974. Comparative survey of the phytophagous insect faunas of Italian thistle, *Carduus pycnocephalus*, in southern California and southern Europe relative to biological weed control. Environmental Entomology 3: 464-474.

Goeden, R. 1978. Initial analyses of *Rhinocyllus conicus* (Coleoptera: Curculionidae) as an introduced natural enemy of milk thistle [*Silybum marianum* (L.) Gaertner]) and italian thistle (*Carduus pycnocephalus* L.) in southern California. pp. 39-50. In Frick, K. (ed.) Biological control of thistles in the genus Carduus in the United States.

Goeden, R. and D. Ricker 1978. Establishment of *Rhinocyllus conicus* (Coleoptera: Curculionidae) on Italian thistle in southern California. Environmental Entomology 7: 787-789.

Groves, R.H. 1989. Germination and phenology of seven introduced thistle species in southern Australia. Australian Journal of Botany. 37: 351-359.

Hawkes, R., L. Andres, and P. Dunn. 1972. Seed weevil released to control milk thistle. California Agriculture 26: 14.

Holm, L., D. Plucknett, J. Pancho, and J. Herberger. 1977. The world's worst weeds: distribution and ecology. University Press of Hawaii, Honolulu. 609 pp.

Julien, M. (ed.) 1982. Biological control of weeds. A world catalogue of agents and their target weeds. Commonwealth Agricultural Bureaux, Farnham Royal, United Kingdom. 108 pp.

Junak, S., S. Chaney, R. Philbrick, and R. Clark. 1997. A checklist of vascular plants of Channel Islands National Park. Southwest Parks and Monuments Association, Tucson, AZ. 43 pp.

Keil, D. and C. Turner. 1993. Carduus. p. 220. In Hickman, J. (ed.). The Jepson Manual: higher plants of California. University of California Press, Berkeley. 1400 pp.

Kok, L., T. McAvoy, G. Johnson, and P. Dunn. 1982. Further tests on *Ceutorhyncus trimaculatus* R. as a candidate for the biological control of *Carduus* species. Crop Protection 1: 67-74.

Lorenzi, H. and L. Jeffery. 1987. Weeds of the United States and their control. Van Nostrand Reinhold Company, New York. 355 pp.

Maranon, T. and J. Bartolome. 1993. Reciprocal transplants of herbaceous communities between *Quercus agrifolia* woodland and adjacent grassland. The Journal of Ecology. 81: 673- 682.

Munz, P. 1959. A flora of California. University of California Press, Berkeley. 1681 pp.

Oliveri, I. 1984. Effect of *Puccinia cardui-pycnocephali* on slender thistles (*Carduus pycnocephalus* and *C. tenuiflorus*). Weed Science 32: 508-510.

Olivieri, I. 1985. Comparative electrophoretic studies of *Carduus pycnocephalus* L*., C. tenuiflorus* Curt. (Asteraceae) and their hybrids. American Journal of Botany 72: 715-718.

Olivieri, I., M. Swan, and P. Gouyon. 1983. Reproductive system and colonizing strategy of two species of *Carduus* (Compositae). Oecologia 60: 114-117.

Robbins, W., M. Bellue, and W. Ball. 1970. Weeds of California. California Dept. of Agriculture, Sacramento. 547 pp.

Sagar, G. and J. Harper. 1960. Factors affecting the germination and early establishment of plantains (*Plantago lanceolata, P. media*, and *P. major*). pp. 236-245. In Harper (ed.) The Biology of Weeds. Blackwell Science Publications, Oxford, England.

Soprensen, A. 1986. Seed dispersal by adhesion. Annual Review of Ecology and Systematics 17: 443-463.

Sindel, B. 1991. A review of the ecology and control of thistles in Australia. Weed Research. 31: 189-201.

Trumble, J. and L. Kok. 1980a. Impact of 2,4-D on *Ceutothorynchidius horridus* (Coleoptera: Curculionidae) and their compatibility for integrated control of *Carduus* thistles. Weed Research 20: 73-75.

Trumble, J. and L. Kok. 1980b. Integration of thistle-head weevil and herbicide for *Carduus* thistle control. Protection Ecology 2: 57-64.

Turner, C. 1991. Biological control of yellow starthistle, Centaurea solstitialis L.: a progress report. Proceedings, 43rd California Weed Conference. pp 78-82.

Wagner, W., D. Herbst, and S. Sohmer. 1990. Manual of the flowering plants of Hawaii. 1853 pp.

Webb, C., W. Sykes, and P. Garnock-Jones. 1988. Flora of New Zealand. Volume 4. Naturalized pteridophytes, gymnosperms, dicotyledons. Department of Scientific and Industrial Research, Christchurch. 1365 pp.