University of Idaho
College of Agriculture

Current Information Series No. 585

Cooperative Extension Service
Agricultural Experiment Station

July 1981


Fig. 1. Rush skeletonweed in flower.

Rush Skeletonweed

Biology and Control In the Pacific Northwest

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Rush skeletonweed, *Chondrilla juncea* (Compositae), a plant native to central Asia and the Mediterranean Basin area of Europe, has been inadvertently introduced into several countries around the world, including the U.S. Small infestations of the weed were first discovered in Washington in 1938 and in Idaho during the mid-1960s.

Since its discovery in the Northwest, rush skeletonweed has distributed itself over 3½ million acres in 12 northern and southwestern Idaho counties, 2 million acres in seven eastern Washington counties and 180,000 acres in one western Oregon county. Presently, the weed is spreading throughout the Pacific Northwest at an estimated rate of 100,000 acres a year.

Rush skeletonweed has become a serious problem for agricultural producers and urbanites alike. It infests rangelands, semiarid pasturelands, croplands, transportation rights-of-way, residential properties and other areas subjected to repeated soil disturbance. Infestations in the tristate area are for the most part confined to rangeland and roadside sites, although some encroachment of cropland has occurred and apparently is increasing.

In Australia, the weed rapidly established itself as a major wheat pest, resulting in annual losses to the industry in excess of $30 million. Weed scientists and state agricultural officials have expressed concern that a similar fate may eventually befall dryland and irrigated grain production areas throughout the Pacific Northwest.

Damage Caused

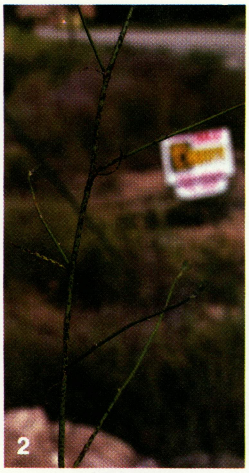
The plant's extensive root system enables it to compete effectively with crop plants for moisture and nutrients, especially nitrogen. Consequently, rush skeletonweed can reduce crop yields, often by as much as 70 percent. The wiry, latex-exuding stems of mature plants can obstruct harvest machinery, making crop harvesting costly and difficult if not impossible. Also, rangeland infestations displace desirable livestock and wildlife forage plants.

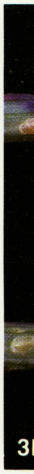
Biology

Growth Cycle — Rush skeletonweed is a taprooted, herbaceous perennial ranging from 1 to 4 feet in height at maturity (Fig. 1). Three strains or biotypes of the weed have been identified in the Pacific Northwest. The strains differ from one another in regard to stem length, branching pattern and flowering period duration.

The weed's seasonal growth cycle begins in the fall when rains promote germination of seeds and/or trigger the development of one or more rosettes from buds on established roots. The lance-shaped, deeply lobed rosette leaves are ½ to 1¼ inches wide and 2 to 5 inches long and develop a reddish tinge near the tips during the winter.

Increases in daylength and temperature during the spring stimulate the development of multi-branched, upright stem growth from the root





FIGURES — (2) Rust pustules on aerial shoots of rush skeletonweed; (3A) midge galls on leaf and (3B) flowering stem of rush skeletonweed; and (4) mite gall development on the stem.

crown. The pale-green, slender, sparsely leaved stems are smooth except for a covering of numerous, erect, downward-directed hairs on the lower 2 to 3 inches. Flower production begins when stems reach maximum length in midsummer and continues until ended by fall frosts. The rosette leaves die off during the flowering period.

Flower heads develop along or at the ends of the stems, either individually or in groups of two to five. A single plant may produce more than 1,500 flower heads, the number depending upon plant biotype, size and environmental conditions. The 10 to 12 bright-yellow florets in a head each form a seed.

Flower buds, blooming flower heads and mature seed heads are often on the stems at the same time. After flower stems die in the fall, new rosettes are once again established, thus continuing the cycle.

Vegetative Reproduction — The root system of rush skeletonweed consists of a slender, vertical taproot which may penetrate to depths of 8 or more feet. One or more rhizomatous lateral roots develop primarily in the upper 2 feet of soil.

Lateral roots increase the size and density of primary infestations because daughter rosettes arise from these roots at varying distances from the parent plant. The proliferation of lateral roots enables a single plant to become a colony which increases in size until it grows together with other colonies. This results in total infestation of an area.

Established plants have extraordinary regenerative capacity. New plants can arise from buds on the taproot and lateral roots, and severed portions of roots are frequently distributed throughout agricultural lands by cultivation implements. Along highway rights-of-way, roadgraders or other kinds of soil-disruptive road maintenance equipment help spread root pieces.

Continuous cropping of winter cereal grains has suppressed rush skeletonweed populations. Fall tillage with applications of broadleaf herbicides will suppress rush skeletonweed growth in the rosette stage. A crop can then compete favorably with skeletonweed in the spring.

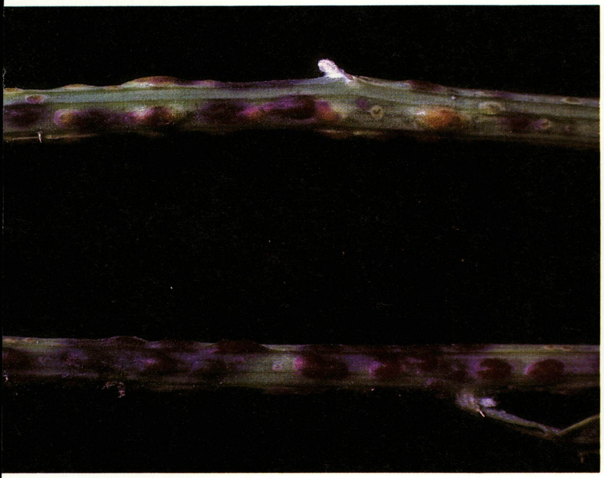
Seed Production — An individual plant can produce up to 15,000 seeds a year of which 90 percent will germinate. Each seed has a parachute of fine hairs which facilitates wind dispersal. Many seeds fall close to the parent plants, but others are transported long distances. Seeds also may be carried from place to place in the fur or hair of grazing animals or on the clothing of persons walking through infested areas.

Ecology — The broad distribution of rush skeletonweed indicates its adaptation to a wide variety of climatic and environmental conditions. Infestations are well established in eastern Washington and southern Idaho where annual rainfall is less than 10 inches and in western Oregon where rainfall is more than 40 inches a year.

Well-drained sand or gravel soils are more conducive to infestation than heavy loam or clay soils. The weed also thrives in rock or gravel pits and in rocky fill of railroad beds or along road shoulders. These soils are also characteristically inhabited by plants such as Nevada lotus *(Lotus nevadensis),* wavyleaf thistle *(Circium undulatum),* snowy buckwheat *(Eriogonum niveum),* Dalmatian toadflax *(Linaria dalmatica)* and blazing star *(Menzelia* spp.). The occurrence of one or more of these "indicator" plant species identify areas that are susceptible to rush skeletonweed invasion.

Biological Control

Biological control is the deliberate use of damaging natural enemies (insects, mites, plant pathogens) to reduce weed abundance. Rush skeletonweed is not considered to be an economically important plant in its native homeland because a variety of natural enemies effectively limit its popu-



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lation size. The plant is an ideal candidate for biological control because much of the land it infests is only marginally productive, and the cost for its chemical control is prohibitively expensive.

Several destructive host-specific organisms associated with rush skeletonweed in Europe have been introduced into the U.S. The University of Idaho, Oregon State University, Washington State University and state agricultural weed control specialists began releasing natural enemies in 1976 in infested areas. The organisms released include a rust fungus, a gall-forming midge and a gall-forming mite.

Rust Fungus *(Puccinia chondrillina)* — This fungus initially attacks skeletonweed's seedling and regenerative rosettes produced during the fall and spring. The fungus causes numerous dark, cinnamon-brown pustules that cover the upper and lower leaf surfaces. Each pustule is surrounded by a yellow halo (Fig. 2). Within the pustules, infestive spores are produced which are dispersed by wind and rain. As the rosette leaves die from rust infection, the fungus attacks the flowering stems and buds, producing additional spore-exuding pustules.

The pathogen frequently kills seedling plants. Also, growth rate, root regenerative capacity, flower, stem and bud production and seed viability are reduced in infected plants. At a 5 percent level of infection, flower bud production is reduced by 50 percent and seed viability by 40 percent.

Several strains of the rust have been released against the Pacific Northwest rush skeletonweed biotypes. However, the Spokane, Washington and Post Fall, Idaho biotypes are resistant to the rust.

Gall Midge *(Cystiphora schmidti)* — All rush skeletonweed biotypes are susceptible to infestation by this tiny insect. Females deposit numerous eggs on leaves and stems. Round, reddish-purple or elongate, blister-like galls develop around the plant tissue-feeding larvae on leaves and stems (Figs. 3A and 3B).

Galls may frequently cover entire leaves and stems, disrupting photosynthesis and reducing plant size, vigor and flower bud production. Infested plants produce 60 percent fewer buds than uninfested plants of comparable size and age. The plant may die when developing seedling stems become heavily infested.

Gall Mite *(Aceria chondrillae)* — The gall mite is a microscopic-sized organism which infests the flowering stems of rush skeletonweed early in the spring. Female mites feed on both vegetative and flower buds, transforming them into galls. The galls are composed of many small, deformed leaflets where the mite population develops (Fig. 4).

Once maximum gall size is reached, the galls stop growing and change from green to brown as they dry out. The mites inside are forced to exit and crawl or are blown by the wind to adjacent plants which subsequently become infested. The mite readily attacks all biotypes of rush skeletonweed.

Damage caused by the mite is more impressive. Flower buds are destroyed because of gall formation, thereby reducing seed production and often totally suppressing it. Heavily galled plants turn yellow, are noticeably stunted and deformed and compete less effectively with neighboring vegetation.

Chemical and Cultural Control

Often, conventional control measures are not used on rush skeletonweed infestations because of terrain and minimal return on the acreage infested. The broadleaf herbicides now registered for use in small grains provide little or no control of rush skeletonweed in cropping situations.

On rangelands, rush skeletonweed can be controlled by applying Tordon 22K and Tordon 2K pellets in the fall of the year (Table 1). Applications of above mentioned Tordon formulations provide residual control of the weed and, in comparison to nontreated areas, can increase forage grass production by as much as 300 percent.

In Oregon, eradication procedures were initiated in 1979 by treating known infestations with Tordon 22K and 2,4-D amine. An area 1 mile in radius around the infestations was also treated. In many areas of Oregon, infestations were treated aerially where ground application was impossible. To date, the amount of rush skeletonweed scattered over 192,000 acres has been reduced from 300 to 30 acres.

Table 1. Herbicide control on rush skeletonweed 12 and 18 months after application.

Treatment	Rate	Control 4/26/79	Control 10/15/79
	(lb a.i./acre)		
Tordon 2K Pellets[1]	1.0	93	92
Tordon 22K	1.0	99	92
2,4-D amine	1.0	0	3
2,4-D amine	2.0	7	2

[1]Picloram dry and potassium salt formulations applied 4/18/78; remainder of herbicides applied 6/6/78.

Wheat fields in Oregon and northern Idaho are beginning to be infested with rush skeletonweed. Rush skeletonweed has reduced yields by 42 and 26 percent respectively in the two areas. Cultural methods are being analyzed because available herbicides that control rush skeletonweed in non-crop areas are not registered for use in small grains. At present, continuous cropping of winter cereals followed by early applications of broadleaf herbicides in either the fall or spring will decrease rush skeletonweed density.

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Acknowledgment

Funding for research on rush skeletonweed was made possible through a grant from the Pacific Northwest Regional Commission, 700 East Evergreen Blvd., Vancouver, Washington 98660.

Trade Names

Trade names are used in this publication to simplify the information presented. Use of trade name does not imply an endorsement of the product nor criticism of similar products that are not mentioned.

Chemical Recommendations

The chemical recommendations made in this publication are based on the best information available at the time of printing. Before using pesticides, read the instructions on the label, and be sure you follow all precautions and restrictions for safe use of the product.

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