THE BIOLOGY OF CANADIAN WEEDS. 54. *Crepis tectorum* L.

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Narrow-leaved hawk's-beard (*Crepis tectorum* L.) occurs across most of Canada but is particularly abundant in the parkland zone of Alberta, Saskatchewan and Manitoba. It is a serious weed in forage crop fields and has been increasing rapidly in many areas. This account is a summary of the most recent biological information on *C. tectorum*, including previously unpublished data.

Le crépis des toits (*Crepis tectorum* L.) se retrouve dans la plupart des régions du Canada, mais abonde particulièrement dans la zone des prairies-parcs de l'Alberta, de la Saskatchewan et du Manitoba. Il envahit les champs de cultures fourragères et se multiplie rapidement dans plusieurs régions. Cette étude monographique est un résumé de la plus récente information biologique sur *C. tectorum* et comprend des données inédites.

1. Name

Crepis tectorum L. — **narrow-leaved hawk's-beard** (Alex et al. 1980), annual hawk's-beard and yellow hawk's-beard (Alberta Agriculture 1979). **Crépis des toits** (Alex et al. 1980). Compositae, composite family, Composées.

2. Description and Account of Variation (Fig. 1)

Herbaceous annual or winter annual reproducing by seeds. Tap root slender, deep penetrating and pale yellow. Stems erect, slender, contain a milky white sap; sometimes branched above the middle or from the base, 30–100 cm in height. Basal and lower leaves variable; toothed or lobed and backward pointing, 10–15 cm long and up to 4 cm wide. Stem leaves sessile, narrow and entire, less than 1 cm wide. Flowers all ligulate, yellow, longer than bracts; 30–70, forming erect flower heads up to 2 cm across, resembling single flowers. Few or many heads per plant. Bracts in several rows; inner bracts 12–15 in two series with short appressed hairs on the inner surfaces; outer bracts narrow, about one-third as long as inner bracts. Seeds (achenes) dark purplish to purplish brown, 2.5–4.5 mm long, narrow, tapered at both ends and strongly ribbed (10 ribs). Pappus 4–5 mm long, with simple, fine white hairs (Babcock 1947b; Frankton and Mulligan 1970). Pollen grains uniform in size, 19.4 to 20.5 μm in diameter with ridges 2.3 μm high and spines 2.3 μm long (Wodehouse 1935).

A chromosome number of $2n = 8$ has been reported for material collected near Morden, Manitoba (Mulligan 1959) and for material collected in California (Mann 1925). Babcock and Navashin (1930) observed that 0.5% of a California population of *C. tectorum* consisted of triploids and tetraploids.

Narrow-leaved hawk's-beard may be confused with smooth hawk's-beard (*C. capillaris* (L.) Wallr.), an uncommon species found in Nova Scotia, Quebec, Ontario and British Columbia. *C. capillaris* has the following characteristics which distinguish it from *C. tectorum*: bracts of the

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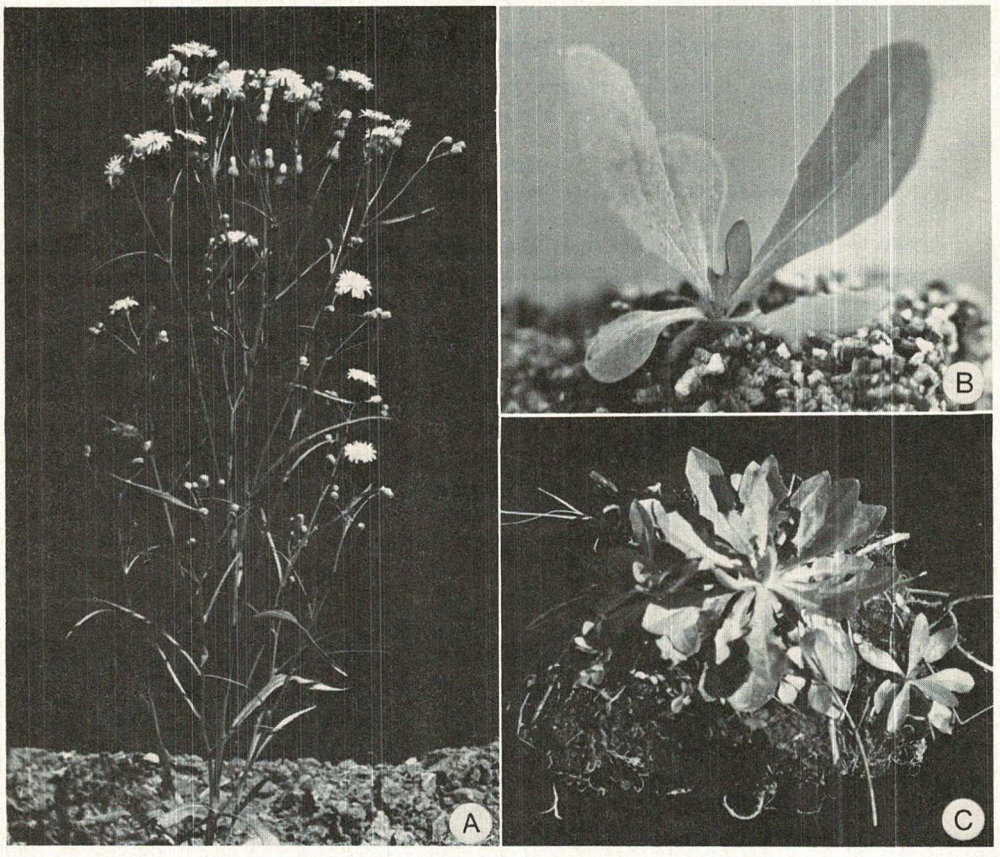

Fig. 1. *Crepis tectorum* L. (A) mature plant (×8); (B) seedling (×0.75); and (C) rosette (×0.5).

flower head are hairless on the inner surface, the seeds are pale brown, the cauline leaves clutch the stem by prominent pointed lobes and the heads are smaller than those of *C. tectorum* (Frankton and Mulligan 1970; Vanden Born 1972). *Hieracium* spp. may also resemble *C. tectorum*. However, the *Hieracium* spp. are fibrous-rooted, perennial plants while narrow-leaved hawk's-beard is a tap-rooted annual. In addition, the pappus of *Hieracium* spp. is brownish (Frankton and Mulligan 1970). Seedlings of *C. tectorum* are similar to those of sow thistle (*Sonchus* spp) and prickly lettuce (*Lactuca scariola* L.), but the margins of the true leaves of the latter have small, weak prickles. The seedlings of *C. tectorum* are also similar to those of dandelion (*Taraxacum officinale* Weber). The leaves of *T. officinale* have a shinier surface and are darker green than those of *C. tectorum* (Alberta Agriculture 1980).

Babcock (1947b) states that many ecological forms of *C. tectorum* exist and has listed types which have received Latin names as varieties or forms. In Babcock's (1947b) view, these forms and varieties are not sufficiently distinct morphologically to warrant recognition as subspecies.

3. Economic Importance

(a) *Detrimental — C. tectorum* is recognized as a serious weed in perennial forage crops in western Canada (Frankton and

Mulligan 1970; Vanden Born 1972; Darwent 1974b). It also occurs in annual cereal and oilseed crops in this same area (Thomas 1978a,b; Dew and Thomas 1978). The winter annual form of *C. tectorum* presents the greatest problem in established perennial forage crops, while the annual form of the species creates the greatest problem in seedling stands of perennial forages and in annual cereal or oilseed crops (Darwent and McKenzie 1978). Seeds of the species are found as a contaminant in alfalfa seed and are difficult to separate out (Mayell, R.W., unpubl. data).

(b) *Beneficial* — Honeybees have been observed foraging and collecting pollen from *C. tectorum* which may indicate that the plants serve as a source of nectar for honey production (Murrell and Szabo 1981).

(c) *Legislative* — *C. tectorum* is listed in the Provincial Weed Act of Manitoba as a noxious weed (Government of Manitoba 1970) and as a "nuisance weed" in the Provincial Weed Control Act of Alberta (Government of Alberta 1979). It is not listed in the Federal Seeds Act of Canada or any of the other Provincial Weed Acts.

4. Geographical Distribution

C. tectorum has been reported in all provinces of Canada except Newfoundland (Fig. 2). In southern Manitoba it is very abundant from the US border north to Dauphin and is also found in the Interlake region (Thomas 1978a). In Saskatchewan it is found primarily in the northern half of the cultivated portion of the province (Thomas 1978b). In Alberta, major infestations are in the north-central and Peace River regions (Vanden Born 1972; Darwent 1974b).

In the United States, *C. tectorum* is found from the Canadian border south to North Carolina and has advanced westward to Nebraska (Meunscher 1949). Jordal (1951) has reported it near Fairbanks, Alaska.

In Europe it is distributed from 70°N latitude south to eastern Spain, France, northern Italy, the Middle of the Balkan

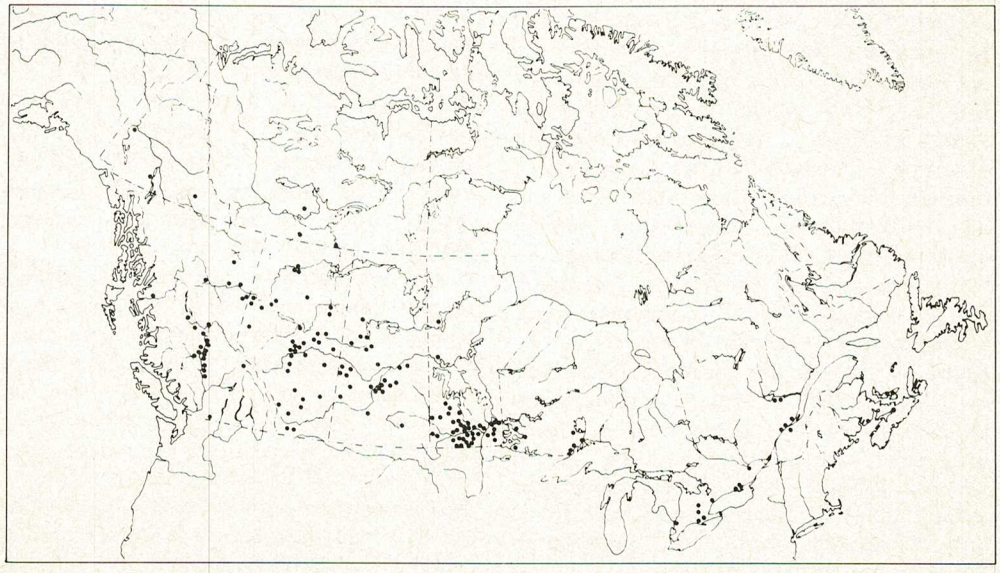

Fig. 2. Distribution map of *Crepis tectorum* L. in Canada based on specimens from the Vascular Plant Herbarium, Biosystematics Research Institute, Research Branch, Agriculture Canada, Ottawa, and from the Herbarium, Nova Scotia College of Agriculture, Truro, N.S.

peninsula and in the USSR to the Caucausus. In Asia, it occurs in the greater part of Siberia extending from the Urals, northern Kazakstan and Turkestan eastward to Manchuria and Kamchatka (Babcock 1947b).

C. tectorum has become naturalized in Australia (Babcock 1947b).

5. Habitat

(a) *Climatic requirements* — The widespread distribution of *C. tectorum,* a mesoxerophyte, throughout the temperate zone is indicative of its adaptation to a wide range of environmental conditions. With many ecological forms it is found in boreal forests, lakeshores, seashores, dry prairies, mountain regions and parklands (Babcock 1947b).

(b) Substratum — *C. tectorum* grows on a diversity of soil types (Vanden Born 1972). Looman and Best (1979) maintain there is a preference for light soils. Babcock (1947b) states that narrow-leaved hawk's-beard grows on both calcareous and lime-deficient soils. Hanf (1973) has reported that in Europe the species thrives on nutrient-rich heavy clays and loams, as well as sandy and stony soils.

(c) *Communities in which the species occurs* — *C. tectorum* occurs in a wide variety of habitats. Infestations have been observed in abandoned fields, roadsides, railroad lines, grainfields, forage seed and hay fields, pastures, wooded slopes, forest clearings, vegetable crops, lakeshores, fallow land and native prairie (Babcock 1947b; Canada Weed Committee 1973; Frankton and Mulligan 1970). It can be found as isolated plants, in small patches or in pure stands. The most serious infestations are usually observed in poor stands of forage crops (Vanden Born 1972). Darwent (1974a) observed over 300 plants/m^2 in a stand of creeping red fescue (*Festuca rubra* var. *genuina* L.) growing in northeastern British Columbia.

6. History

C. tectorum, a native of Siberia, was introduced to eastern North America prior to 1890 (Babcock 1947b). Herbarium material from the Vascular Plant Herbarium, Biosystematics Research Institute, Research Branch, Agriculture Canada, Ottawa, shows that Fowler collected the species in 1877 at St. John, New Brunswick. In 1912, Gallant collected narrow-leaved hawk's-beard in fields near Abrams Village, Prince Edward Island. Initial collections in other parts of southern Canada, except Nova Scotia, were made between 1920 and 1940. In Nova Scotia, initial collection of the species was not made until 1980 (Palfrey, G. D., pers. commun.). In northern Canada, *C. tectorum* was collected by Gillett and Mitchell at Whitehorse, Yukon in 1949 and by Cody at Fort Smith, Northwest Territories, in 1949. The method by which the species was introduced to North America is unknown. However, early collections from such habitats as ballast heaps indicate a possible method.

7. Growth and Development

(a) *Morphology* — The mobility of its seeds is the primary factor contributing to the rapid spread of *C. tectorum*. The extensive pappus of the species gives it a high voilure value (Hitrovo 1912), thus permitting extensive transport by wind and water. In addition, its rough ribbed seeds easily adhere to animals and humans (Babcock 1947a). The low, rosette habit of the vegetative phase protects winter annual plants from low temperatures and drying winds, enabling them to gain maximum advantage from the insulating effect of the snow cover. The rapid development of the flowering shoots in the spring gives the species a competitive advantage over many perennial forage species.

(b) *Perennation* — Narrow-leaved hawk's-beard is well adapted to a winter annual habit. The vegetative rosettes live through winter and flower the following spring or early summer (Babcock 1947a).

(c) *Physiological data* — In controlled

environment studies, the growth and development of narrow-leaved hawk's-beard was influenced by photoperiod. In a study on Canadian material, plants of the species grew as long-day plants flowering under a photoperiod of 18 h, but remaining vegetative under a photoperiod of 14 h (Darwent and McKenzie 1978). In a European study, *C. tectorum* also grew as a long-day plant (Wanner and Bruhin 1950). In this study flowering occurred under a photoperiod of 14 h but not of 8 h. Ecotypic differences between the material used in the two studies may account for the discrepancy.

In northern Alberta, the date of planting, and presumably the date of emergence, affected the rate of winter survival (Darwent and McKenzie 1978). Between 10 and 40% of the plantings made in July and early August survived winter while between 50 and 90% of the plantings made in August to mid-September survived. The winter survival rate of plantings made after mid-September declined sharply. *C. tectorum* planted in late October did not survive the winter. Date of planting also affected the size of winter annuals. Those planted in July were largest. There was a decline in the size of the plants from August and September planting dates.

(d) *Phenology* — The phenology of *C. tectorum* has been studied by Darwent and McKenzie (1978) and by Darwent (unpubl. data) in northern Alberta and British Columbia (55°N latitude). Germination and emergence occurred throughout the growing season when soil temperatures were above 5°C and moisture conditions were favorable. However, flushes of germination and emergence were noted during a period from mid-May to mid-June and also during a period from early August to mid-September. The latter appeared to occur after periods of extensive rainfall. Seedlings emerging during mid-May to mid-June developed as annuals. Bolting of these plants was first observed in late June and continued through to early August. Flowering started in early July and continued through to late August while mature seed production began in early August and continued until the end of the growing season. Winter annual *C. tectorum* started bolting on approximately 20 May. Plantings made in July or early August bolted slightly ahead of those planted at later dates. Flowering of winter annuals started near 30 May, but the majority of flowering occurred between mid-June and mid-July. The first seeds of winter annuals matured in mid-July. Most seed of winter annuals matured between mid-July and mid-August, although seeds continued to mature until the end of the growing season. The pattern of flowering in northern Alberta and British Columbia corresponds to that described by Frankton and Mulligan (1970) for the rest of western Canada.

(e) *Mycorrhiza* — No information is available.

8. Reproduction

(a) *Floral Biology* — Reports from the literature are unclear on the mode of pollination of the flowers of *C. tectorum*. Gerassimova (1936) has reported that during reproduction the egg nucleus degenerates and the sperm nucleus itself functions in the cytoplasm of the egg, thus producing a "male embryo." However, under artificial conditions the species has been shown to cross with a number of other *Crepis* spp. (Babcock 1947c). Babcock (1947a) has observed that chromosome transformations occur spontaneously in stored seeds. Although these transformations are rare it seems probable that this is a source of evolutionary change in the species. Milliron (1971) reported visitations to *Crepis* spp. by HYMENOPTERA:Apidae:Bombinae (1 species), *Megabombus* (Bombus) *nevadensis* Cr. Honeybees (*Apies mellifera* L.) have also been reported visiting flowers and collecting pollen of *C. tectorum* (Murrell and Szabo 1981).

(b) *Seed production and dispersal* — Nar-

row-leaved hawk's-beard is a prolific seed producer. Each flower head is reported to contain 30–70 flowers (Vanden Born 1972). In studies at Beaverlodge, Alberta, Darwent and McKenzie (1978) observed a range of 112–706 flower heads per plant indicating a potential seed production of 3360–49 420 seeds per plant. Among winter annual plants, the number of flowers, and hence the number of seeds produced per plant, was greater in those plants starting growth in July to mid-August than those starting growth in mid-August to early October.

Seeds of *C. tectorum* are ribbed and have a pappus which allows for rapid dispersal by wind as well as adhesion to animals and humans. The lightness of the seeds allows for ready transport by water (Babcock 1947a).

(c) *Viability of seeds and germination* — The seeds exhibit little or no dormancy. Most seeds germinate upon reaching maturation (Anderson 1968). Seed viability declines rapidly. Babcock (1947b) states that at the end of 2.5 yr of storage nearly all seeds had lost their ability to germinate. Anderson (1968) reports an original germination of 94% followed by 77, 9 and 0% germination after 3, 5 and 6 yr of storage, respectively.

C. tectorum seeds germinate over a wide range of temperatures. In controlled-environment tests conducted during December 1974 on seed collected at Fort Vermilion on 22 July 1974, the average percent germination at 10, 15, 20, 25, 30, 35 and 40°C was 92 ± 5, 92 ± 2, 99 ± 2, 99 ± 2, 96 ± 4, 37 ± 10 and 0 ($\pm$ standard deviation, each percentage germination was the average of four lots of 50 seeds each), respectively (Darwent unpubl. data). The seeds were stored at -10°C from July until the start of the tests in December.

Under growth chamber conditions Darwent (unpubl. data) observed $59 \pm 12\%$, (+ standard deviation, eight lots of 25 seeds each were used) of seeds planted at a depth of 0.25 cm in a Cadotte silty clay to clay soil (Scheelar and Odynsky 1968) germinated and emerged. The germination of seeds placed on the surface was $43 \pm 9\%$ while only 27 ± 19, 14 ± 11, 6 ± 5 and $2 + 1\%$ (+ standard deviation, each percentage germination is the average of eight lots of 50 seeds each) of seeds placed at 1, 2, 3 and 4 cm, respectively, produced seedlings.

(d) *Vegetative reproduction* — No information is available.

9. Hybrids

No naturally occurring hybrids have been reported. Under artificial conditions *C. tectorum* has been hybridized with a number of other *Crepis* spp. However, the resulting seedlings have little or no viability (Babcock 1947c).

10. Population Dynamics

The species exhibits an ability to invade and compete with other plants in a number of habitats. It occurs as solitary plants, in patches or in field-sized infestations. Densities as high as 304 plants/m^2 have been observed in field-sized infestations (Darwent 1974a).

In perennial forage crops the most serious infestations occur in poor stands. In density of *C. tectorum*. Vanden Born (1972) has reported results similar to those of Waddington et al. (1976). However, Darwent (1974b) observed that good narrow-leaved hawk's-beard control can be obtained from high rates of 2,4-D. Fall applications of 2,4-D at 1.12 kg/ha to *C. tectorum* growing in creeping red fescue reduced the dry weight (g/m^2) of shoots of the weed by 93% during the following summer. Darwent (1974b) also obtained a 92% reduction in the dry weight (g/m^2) of shoots of *C. tectorum* from fall applications of a mixture of dicamba plus 2,4-D plus mecoprop at 0.13 + 0.35 + 0.08 kg/ha, respectively. Spring applications of 2,4-DB at 1.68 kg/ha, 2,4-D at 1.12 kg/ha and a mixture of dicamba plus 2,4-D plus mecoprop at 0.13 + 0.35 + 0.08 kg/ha, respectively, to *C. tectorum*

growing in the same stands of creeping red fescue gave good weed control but tended to be less effective than when applied in the fall.

11. Response to Herbicides and Other Chemicals

C. tectorum is susceptible to 2,4-DB (Vanden Born 1972; Darwent 1974b; Waddington et al. 1976). At rates normally recommended, *C. tectorum* is more susceptible to 2,4-DB than 2,4-D. In studies conducted on *C. tectorum* growing in alfalfa (*Medicago media* Pers.) near Melfort, Saskatchewan, Waddington et al. (1976) obtained a 100% reduction in the density of the weed from a fall application of 2,4-DB at 1.68 kg/ha. An application of 0.56 kg/ha of 2,4-D at the same time provided only a 56% reduction in the plant density of *C. tectorum*. Vaden Born (1972) has reported results similar to those of Waddington et al. (1976). However, Darwent (1974b) observed that good narrow-leaved hawk's-beard control can be obtained from high rates of 2,4-D. Fall applications of 2,4-D at 1.12 kg/ha to *C. tectorum* growing in creeping red fescue reduced the dry weight (g/m^2) of shoots of the weed by 93% during the following summer. Darwent (1974b) also obtained a 92% reduction in the dry weight (g/m^2) of shoots of *C. tectorum* from fall applications of a mixture of dicamba plus 2,4-D plus mecoprop at 0.13 + 0.35 + 0.08 kg/ha, respectively. Spring applications of 2,4-DB at 1.68 kg/ha, 2,4-D at 1.12 kg/ha and a mixture of dicamba plus 2,4-D plus mecoprop at 0.13 + 0.35 + 0.08 kg/ha, respectively, to *C. tectorum* growing in the same stands of creeping red fescue gave good weed control but tended to be less effective than when applied in the fall.

12. Response to Other Human Manipulations

Fall or spring cultivation of land seeded to annual crops will destroy winter annuals which germinated the previous summer or fall. Proper fertilization and other agronomic practices which produce vigorous annual crops will prevent serious losses from annual *C. tectorum* plants, while in perennial forage crops grown for herbage, proper fertilization helps to reduce narrow-leaved hawk's-beard (Vanden Born 1972). Muenscher (1949) suggests mowing of *C. tectorum* in waste places before seeds are formed as an effective means of control.

13. Response to Parasites

(a) *Insects and other non-domestic animals* — INSECTA, LEPIDOPTERA: *Phlyctoenia profundalis* Packard eats foliage of *Crepis* spp. along the West Coast of North America (Essig 1938). DIPTERA: *Ensina sonchi* L., the larvae infest seeds (Plant Pest Control Division 1968); *Trupanea jonesi* Curran (Foote and Blanc 1963); *Paroxyna achyrophori* Lw.; *Tephritis fallax* Lw.; *T. dioscurea* Lw. (Hendel 1927); *Phytomyza lactuca* Frost, the larvae make long linear mines on the underside of leaves (Sehgal 1971); *P. syngenesiae* Hardy and *Ophiomyia pulicaria* Mg. (Spencer 1969). NEMATODA: *Anguillulina* spp., *Anguina* spp., *Ditylenchus* spp., *Rotylenchus* spp., *Tylenchus* spp., and *Pratylenchus* spp. are listed as possibly infesting *Crepis* spp. (Crossman and Christie 1937).

(b) *Microorganisms and viruses* — FUNGI. The following species are listed as attacking *Crepis* spp. Leaf spot: *Cercospora stromatis* Clements, *Phyllosticta eximia* Bubak, *Ramularia crepidis* Ell. and Ev. (US Dep. Agric. 1960; Westcott 1971) and *Pleospora herbarum* (Fr.) Rabh. (Conners 1967). Powery mildew: *Erysiphe cichorwacearum* DC. and *Sphaerotheca macularis* (Westcott 1971). Rust: *Puccinia crepidis-montanae* (Syd.) Magn., *P. hieracii* Marius (Westcott 1971), *P. stipae* Arth. (Pirone et al. 1960) and *P. dioicae* P. Magn. (Conners 1967). Stem, leaf and pod spot: *Mycosphaerella tassiana* (de Not.) Johans. (Conners 1967).

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