RESEARCH ON THE POPLAR BUD-GALL MITE IN THE PRAIRIE PROVINCES

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INTRODUCTION

The poplar bud-gall mite, *Aceria parapopuli* (Acarina: Eriophyidae), was described in California by Keifer in 1952. Since then, numerous observations and collections have been made in the western United States and Canada. Brown (1964) has discussed briefly habits and control of the mite in Alberta where it occurs frequently on hybrid poplar shelterbelts. Baranyay (1964) and Cayford and Bickerstaff (1969) list this mite species as one of the most common pest problems of planted poplars in western Canada.

The impact of the gall mite in western Canada has been difficult to assess. Brown (1964) has indicated that heavy gall formation for several years results in branch mortality in the lower crown. Observations by us in Manitoba, Saskatchewan and Alberta from 1966 to 1968 agree with those of Brown but also indicate that branches with large numbers of galls formed annually for 5 to 6 years may be severely deformed yet not killed by mite attack. More commonly, mortality of poplar branches in the lower crown (where gall formation is most concentrated) has been attributed to natural pruning due to shading or to infection by disease pathogens.

A research project was initiated in 1967 to determine the importance of the poplar bud-gall mite in prairie poplar plantings and to elucidate certain aspects of the biology and ecology of the mite to determine practical methods of control. A field station was established at Mortlach, Saskatchewan, to permit intensive studies of infestation on poplar plantings there, and to serve as a central location for support investigations in town, park and farm plantings within the southern distribution of the mite in the Prairie Provinces.

This report is intended as an interim summary of research results obtained during the past 1½ years (July 1967 to February 1969). Much basic information on the life history and habits of the poplar bud-gall mite remains unknown. Until the remaining necessary investigations are completed, it is hoped that this summary will be of some value to departmental personnel receiving requests for information from the many concerned persons and government agencies in Alberta, Saskatchewan and Manitoba.

DESCRIPTION OF THE POPLAR BUD-GALL MITE

The poplar bud-gall mite bears little resemblance to the more familiar spider mites and predaceous mites found on many agricultural crops, weeds, shrubs, and trees. Dominant taxonomic characteristics distinguishing this mite (and other eriophyids) are the extremely small size, the elongated "cigar-shaped" body, the ringed (eriophyiform) abdomen, and the presence of only two pair of legs (most other mites have four pair). At maturity the adult female mite measures about 0.2 mm in length (Figure 1). Body color may range from transluscent greenish-white to dark orange-red, depending upon age and the chronological time of collection.

The mite feeds by inserting its needle-like mouth parts (stylets) into host tissue without causing apparent injury to the affected cells. Because of the very short legs in relation to the long body, the mite is slow-moving and not well-adapted for lengthy migration; its morphological characteristics, however, appear quite adequate for confined and protected feeding within the gall.

LIFE HISTORY AND HABITS

Although verification is not possible at this time, it is suspected that the poplar bud-gall mite has 3 life stages: egg, nymph (2 instars), adult.

Mating takes place within a compartment in the characteristic gall (Figure 2). Eggs may be deposited in the compartment utilized for feeding (Figure 3) or in what appear to be specialized chambers for egg incubation only. Keifer (1952) has indicated that growth from the egg to adult takes about 10 days to three weeks for eriophyid mites. This is probably the case also for the poplar bud-gall mite. Thus, eight or more generations may occur during the growing season in western Canada.

Mites, apparently conditioned by either biological or by environmental factors (e.g., competition for food and space within the gall) abandon their feeding quarters and move externally over shoots and leaves. New galls (Figure 4) are produced when a suitable new bud or a newly unfolding leaf is found. The substance causing gall formation is most probably secreted through the stylets shortly after they are inserted into the host tissues. As the new gall forms and the reproduction cycle of the mite continues, population numbers increase rapidly and the gall increases in size. Branch galls may reach 3-4 cm in diameter after one season's growth and may contain 3,000 or more mites; although portions of galls may remain suitable for occupancy by mites for 10-15 years, most galls are abandoned after 1 to 4 years in the southern prairie region (Figure 5).

The active period for feeding and reproduction extends from early April to late October. The mite apparently overwinters in all these life stages as eggs, nymphs and adults have been found in galls during mid-winter collections. A tentative and schematic 1-year life-cycle chart is shown in Figure 6.

DISTRIBUTION IN THE PRAIRIE PROVINCES

To date, the poplar bud-gall mite is known to occur mainly in western North America. Collections in Canada have been made from Vancouver Island to the Lake-of-the-Woods Region in Manitoba and north to the Yukon. Only within the past 10-12 years, however, have extensive and severe infestations occurred in poplar plantings in the agricultural zones of the provinces of Alberta, Saskatchewan and Manitoba (Figure 7). Reasons for these recent outbreaks are uncertain at this time, but possibly could be related to the extensive plantings of susceptible host trees. Infestations in native stands of poplar, cottonwood and aspen generally are sparse and of no economic importance other than serving as small reservoirs of mite populations (Figure 8). Most of the scrub stands of trembling aspen in the prairie region are uninfested.

DISPERSAL

New plantings and uninfested but susceptible trees are attacked by mites moving by air currents. The small size and weight permit mites to become wind-borne and easily transported to new locations. Trapping methods, utilizing 4" x 4" glass panes coated with petroleum jelly (Figure 9) have produced positive results. Mites were collected from May to August 1968 at Mortlach, Saskatchewan. Thus, isolated prairie plantings many miles from infested trees may become infested by wind-borne mites. Insects (particularly ants) and birds moving over galled branches probably are vectors in local dispersal from tree to tree.

HOST TREES

Keifer (1952) has stated that "eriophyid host relations are intimate and nearly always show a high degree of specificity." Observations in the Prairie Provinces on the poplar bud-gall mite have indicated that feeding by this species is restricted to certain poplars only. The mite is not known to occur on plants other than those listed in Figure 10 as susceptible to attack, and on certain clones of trembling aspen (*Populus tremuloides*), balsam poplar (*P. balsamifera*) and plains cottonwood (*P. sargentii*).

To date, 11 hybrid poplars have been found to be resistant to attack by this mite. Most of these observations have been made in areas (i.e., Brooks, Alberta and Mortlach, Saskatchewan) where other adjacent hybrids (Figure 10) are moderately to severely infested. Reasons for host specificity are unknown as yet, but could be due to differences in chemical, morphological and phenological characteristics of the resistant and susceptible trees.

INJURY TO HOSTS

The poplar bud-gall mite stimulates the formation of characteristic woody galls on branches of host trees (Figure 11). New galls on current year shoots and portions of old galls still occupied by mites are at first dark green, and change to a deep red towards the end of the growing season. The outer surface is covered with minute hairs. Galls are succulent when new, but become harder and drier with age. When no longer occupied by mites the gall turns medium grey in color, but retains the typical convoluted surface (i.e., brain-like with irregular patterns of ridges and furrows).

Gall formation in all known cases commences in the lower third of the tree crown. Because many new galls are formed annually and because most galls persist for five or more years, the appearance of infested trees becomes unattractive, particularly in amenity plantings. Shoot growth becomes stunted and crooked (Figure 12) on branches where gall formation occurs for three or more years, although rapid mortality of branches due to mite attack has not been well documented as yet. Galls rarely encircle the branch; they usually occur on one side of the branch and cover about 3/4 of its circumference (Figure 13).

Normally, with age and increasing height growth lower crown branches become less vigorous and in many cases die due to shading from the upper crown and adjacent trees. Often, lower-crown branch mortality is intensified by disease pathogens entering through mechanical wounds (i.e., cracks in the bark caused by exposure to wind, frost or direct solar radiation). Dead and diseased branches also having large number of galls are thus difficult to assess for primary cause. More likely, a sequenced combination of factors has caused mortality. A hypothetical sequence of branch mortality in the lower crown could be:

1. Loss of vigor with age and shading.
2. Disease pathogen (i.e., a fungus disease) invasion through cracks in bark caused by wind and assisted by additional weight of many galls on branches.
3. Mortality due to tissue breakdown by the pathogen.

Gall formation on tree trunks is rare, and to date only a few collections and observations of these have been made within the range of trembling aspen in the Rocky Mountains near Jasper, Alberta, and in northern Saskatchewan. A trunk gall about 40 cm (16 in.) in diameter and about 20 years old was collected near Miette Hot Springs in 1968 (Figure 14). The gall was located 15 feet from the ground on a healthy 40 ft. trembling aspen. When sectioned, the trunk heartwood near the gall was sound; growth and vigor of the tree appeared normal.

The incidence of gall formation appears to be greatest within the southern prairie regions (e.g., at Lethbridge, Milk River, Brooks, Alberta; Elrose, Wilcox, Saskatchewan; Morden, Manitoba). Up to 90-100% of new buds have been found to be galled on hybrid poplars. In native stands to the north, however, gall infestations occur sporadically and often on only a few branches of each of a few trees.

Leaves produced near or from galled buds are often distorted. Galls also at times are produced on leaf surfaces and leaf margins (Figure 15), although it is suspected that these are produced by a closely related mite species, A. neoessigi.

Preliminary studies of the effects of gall formation on leaf production indicate that the impact generally may not be as severe as stated by Brown (1964). Although some reduction in effective photosynthetic surface area results due to the production of fewer and at times smaller leaves, many secondary buds occur and leaf complements on infested branches often are not significantly different from those numbers on uninfested branches during the first year or two of attack.

CONTROL

A. Silvicultural Control. On small trees and where only a few ornamental yard or amenity trees are planted pruning of infested branches may reduce gall formation temporarily. Pruning of infested branch portions is recommended during the dormant period when leaves are absent.

Gall removal and destruction by branch pruning, however, does not prevent rapid reinfestation by wind-borne mites or by mites migrating from active galls missed during pruning operations. Documented reports of intensive annual pruning for silvicultural control at Lethbridge, Alberta and at Tyner, Saskatchewan indicate that this method is difficult, time-consuming and impractical, particularly if large and/or many infested trees are present.

The selection and planting of resistant poplars (Figure 10) offers the best solution to silvicultural control of the poplar bud-gall mite. Only those hybrid poplars known to be resistant to mite attack should be planted in the agricultural zones of the Prairie Provinces. Regional test plantings and susceptibility studies now underway should provide necessary information for specific recommendations within the next few years. Because too few poplars have been examined, because parentage of old plantings is often difficult to determine, and because of regional climatic variations which apparently influence the degree of attack, an accurate listing of hybrid poplar susceptibility is as yet incomplete.

B. <u>Chemical Control</u>. Experimental applications of systemic acaricides and insecticides in Saskatchewan and Alberta have not given satisfactory control results. To date, 13 different chemicals and five application methods have been tested. Good mite mortality (96-99%) has been achieved with several of these; however, in most cases population levels have rebounded with dissipation of acaricidal residues, and gall numbers and gall size were similar to those on untreated trees.

Difficulty in poplar bud-gall mite control is directly related to its feeding and reproductive habits: (1) mites feed in crevasses and interior chambers in the gall and thus are not exposed to contact sprays, and (2) with several generations each year mites are not easily eradicated. Research underway is aimed at determining the efficacy of several applications of acaricides during spring and early summer weeks for control of mite infestations on large trees in shelterbelt and amenity plantings.

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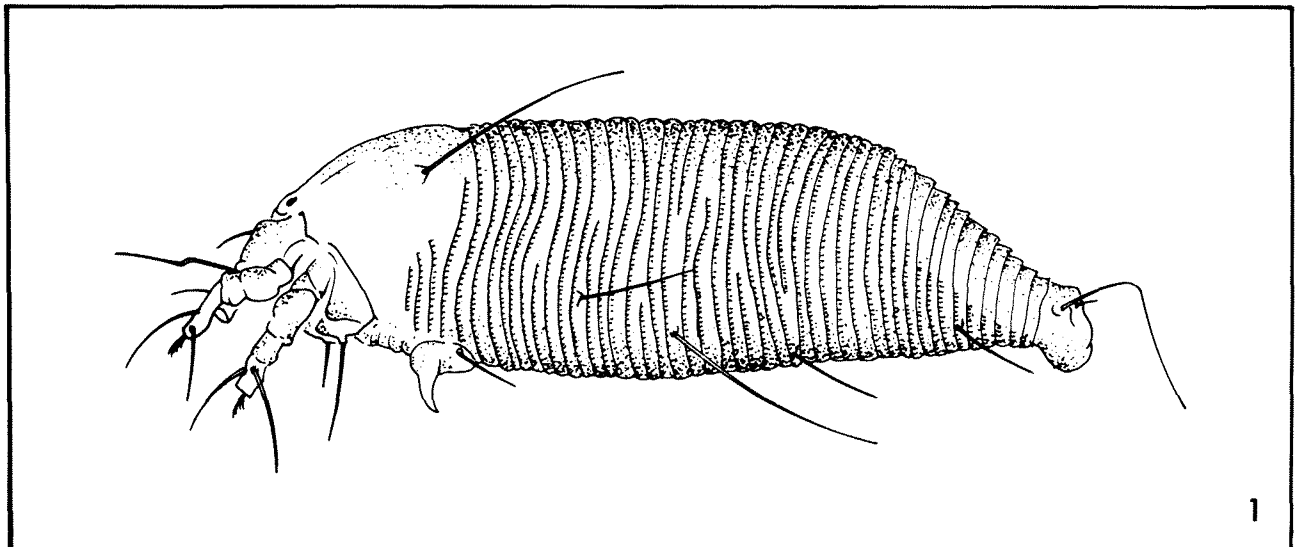

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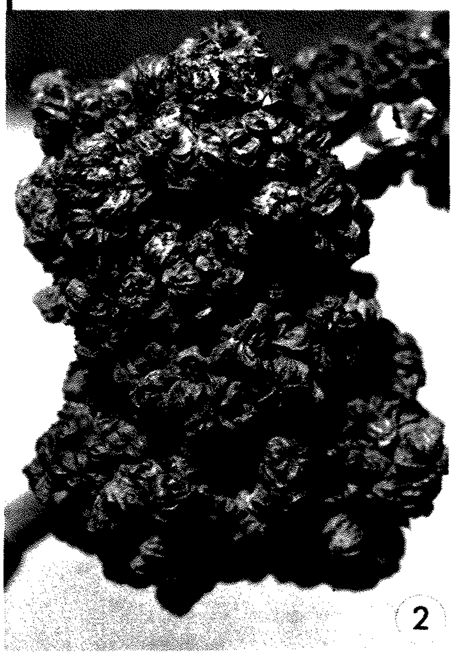

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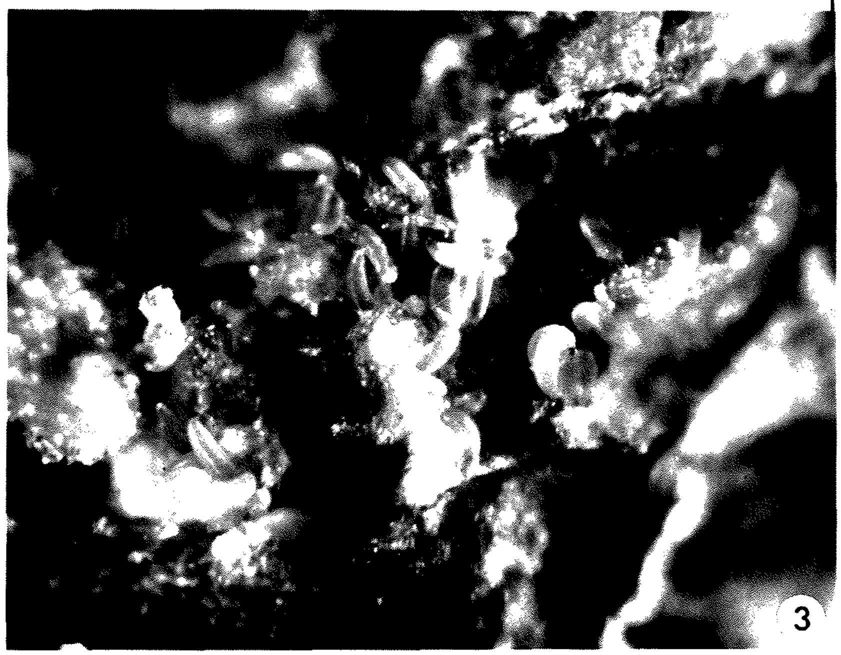

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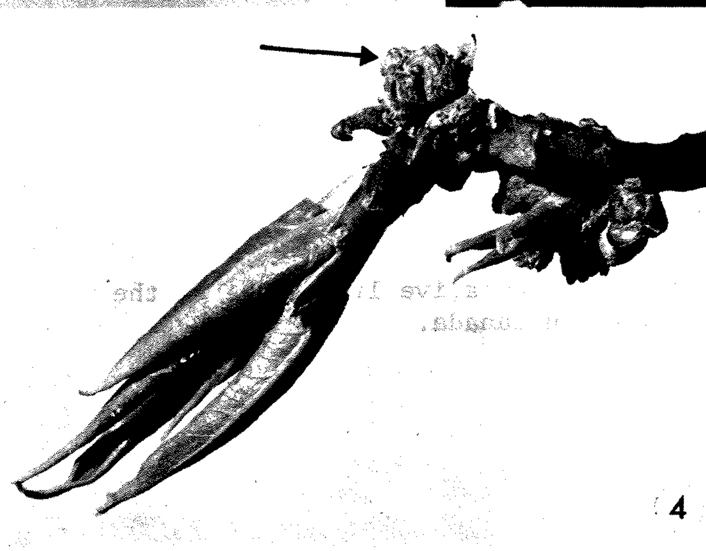

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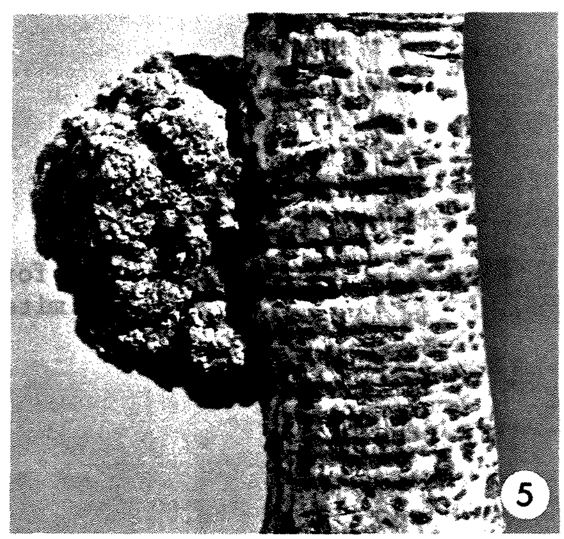

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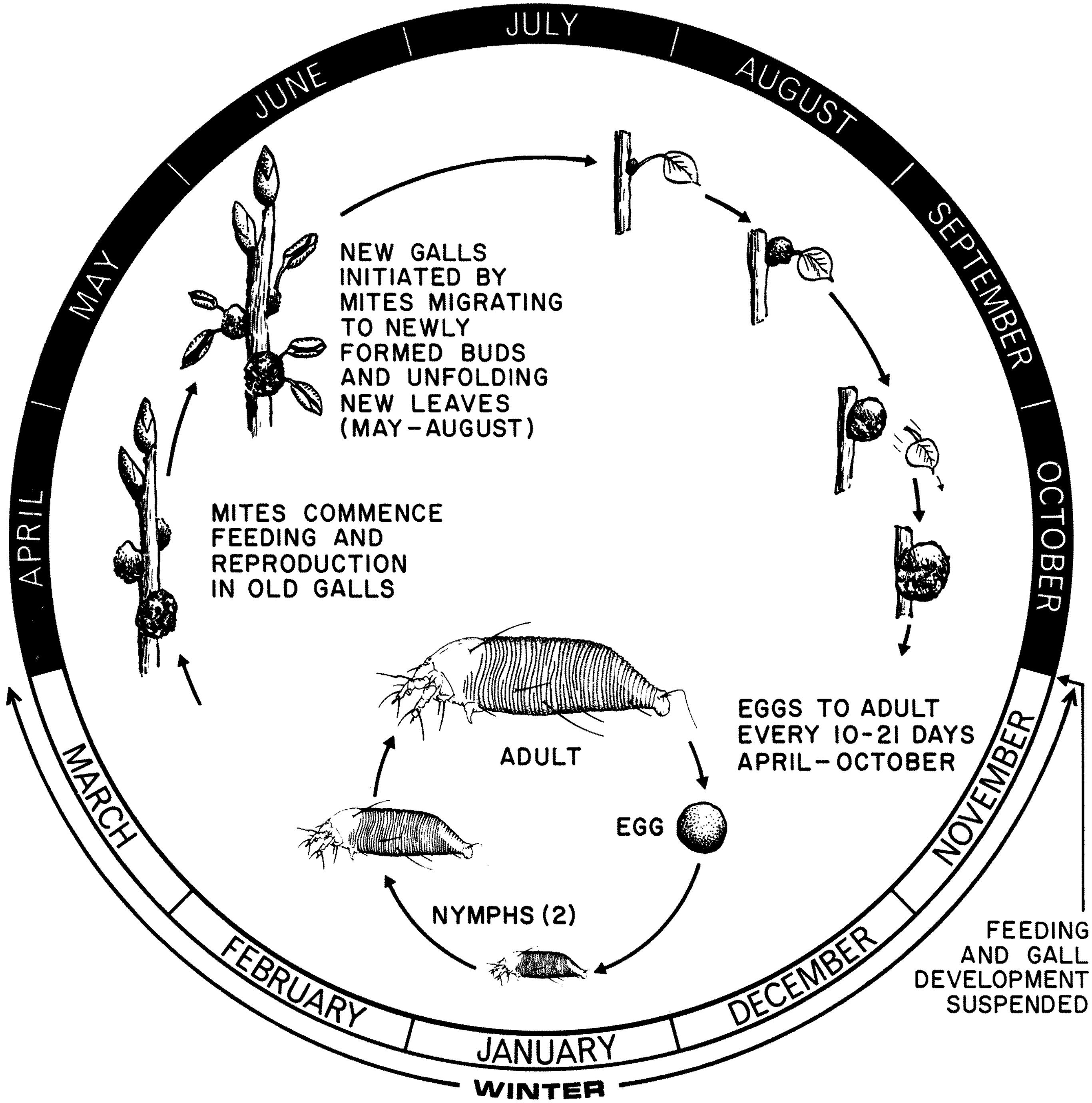
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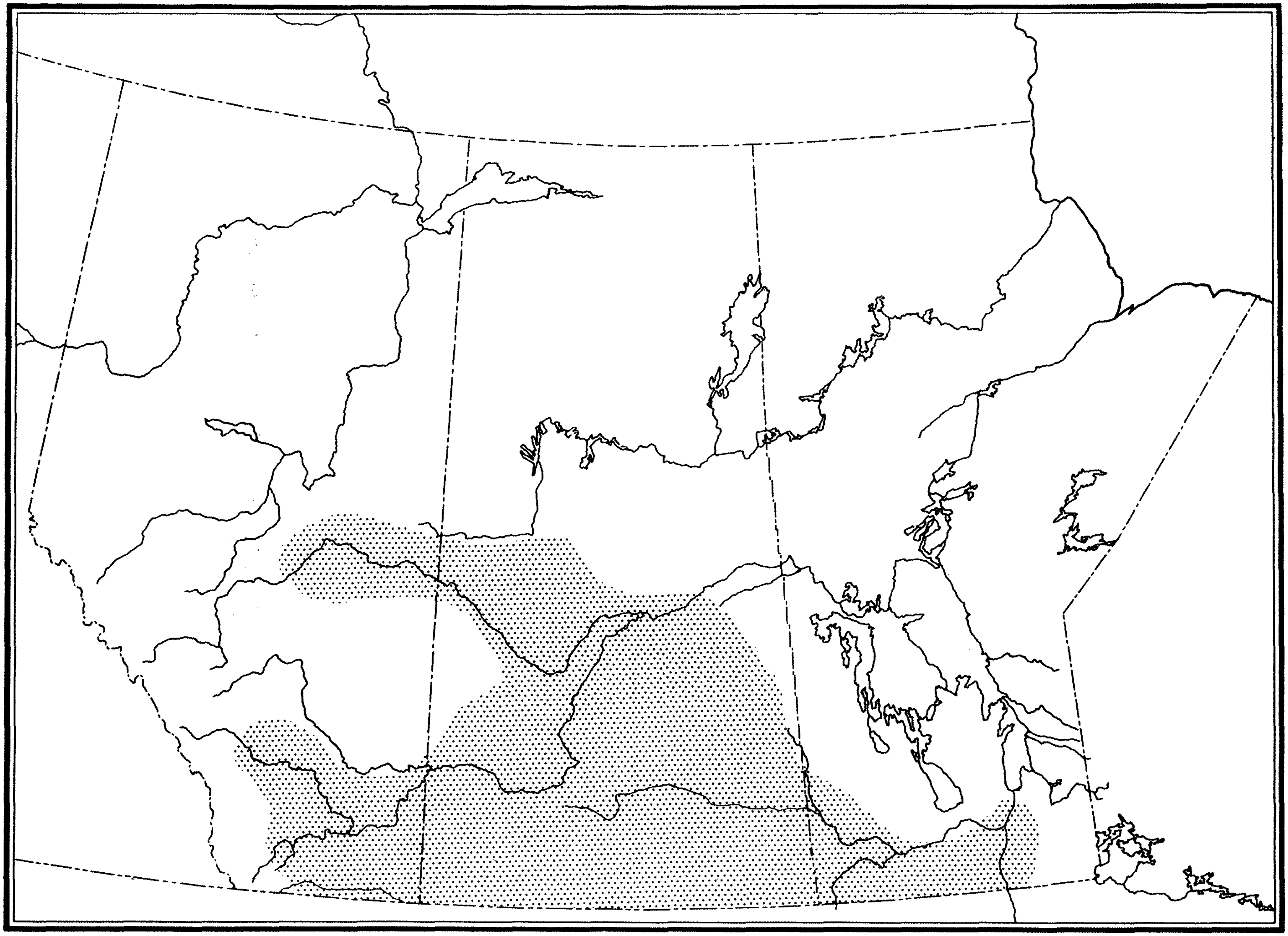
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
WINTER
NEW GALLS INITIATED BY MITES MIGRATING TO NEWLY FORMED BUDS AND UNFOLDING NEW LEAVES (MAY-AUGUST)
MITES COMMENCE FEEDING AND REPRODUCTION IN OLD GALLS
ADULT
EGG
NYMPHS (2)
EGGS TO ADULT EVERY 10-21 DAYS APRIL-OCTOBER
FEEDING AND GALL DEVELOPMENT SUSPENDED



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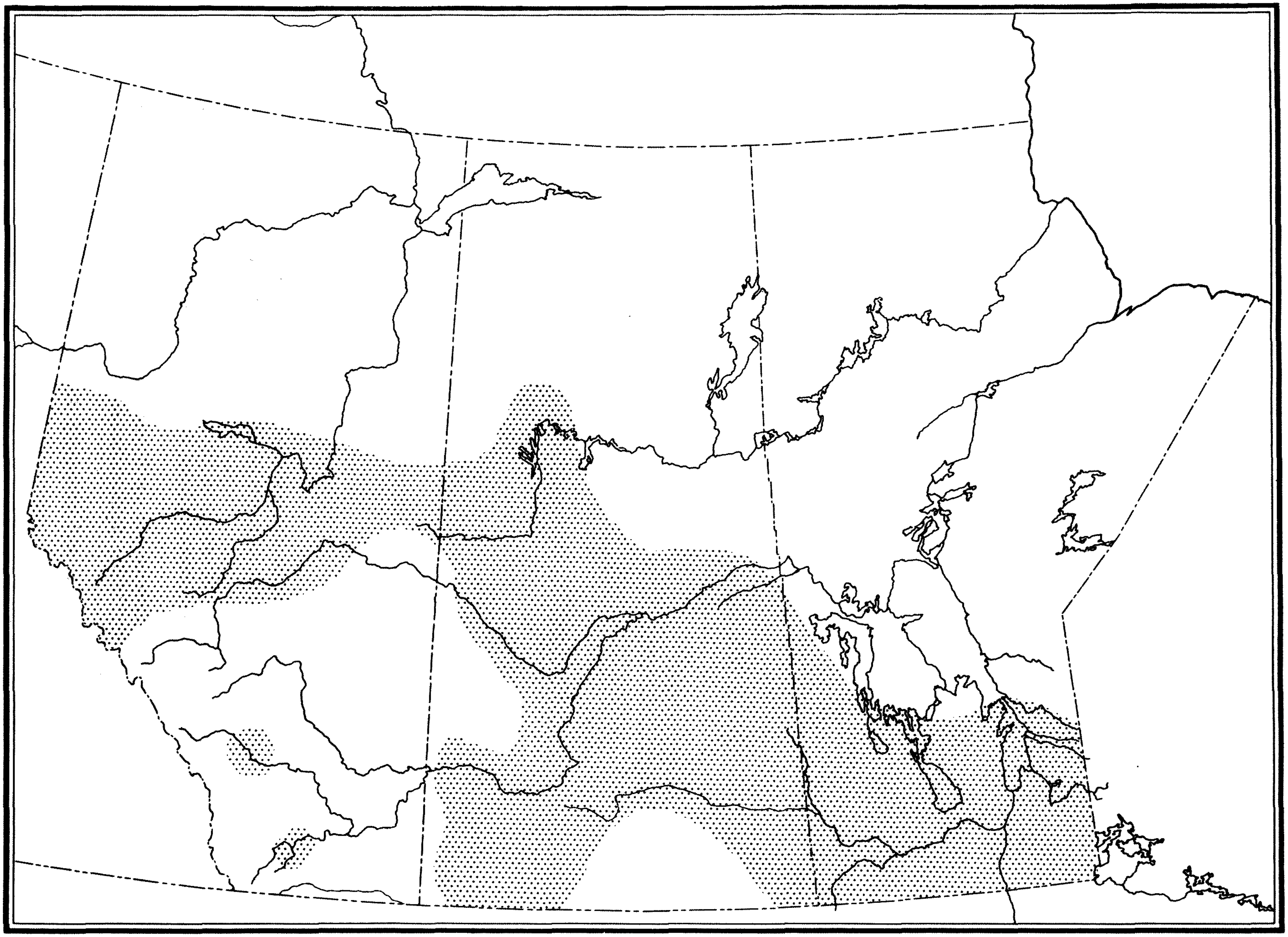

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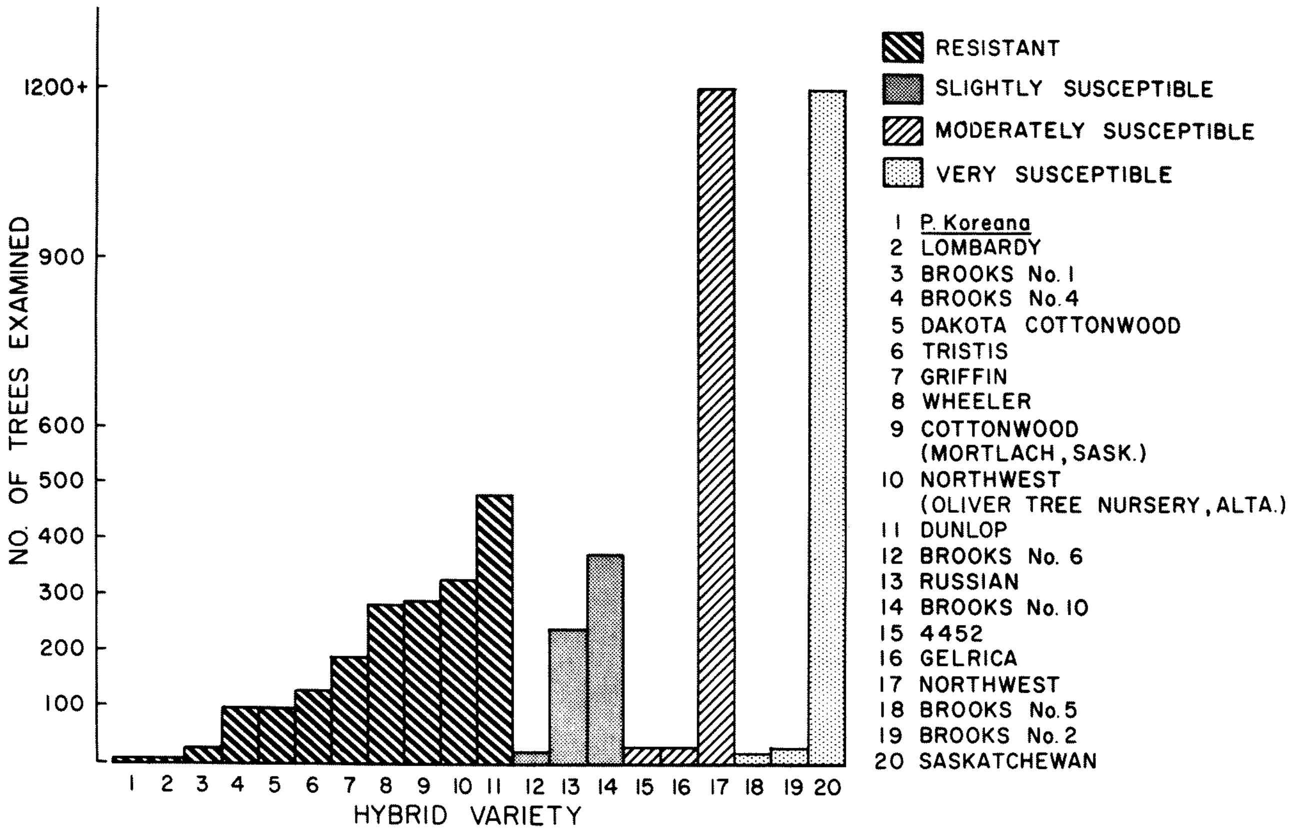
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1200+
900
600
500
400
300
200
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
HYBRID VARIETY
RESISTANT
SLIGHTLY SUSCEPTIBLE
MODERATELY SUSCEPTIBLE
VERY SUSCEPTIBLE
1 P. Koreana
2 LOMBARDY
3 BROOKS No. 1
4 BROOKS No. 4
5 DAKOTA COTTONWOOD
6 TRISTIS
7 GRIFFIN
8 WHEELER
9 COTTONWOOD (MORTLACH, SASK.)
10 NORTHWEST (OLIVER TREE NURSERY, ALTA.)
11 DUNLOP
12 BROOKS No. 6
13 RUSSIAN
14 BROOKS No. 10
15 4452
16 GELRICA
17 NORTHWEST
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20 SASKATCHEWAN

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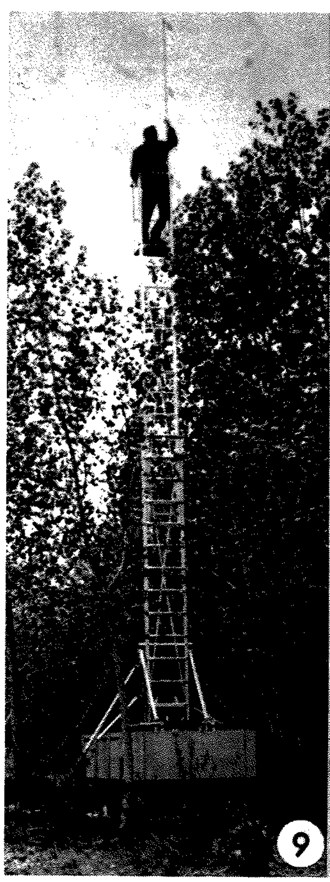

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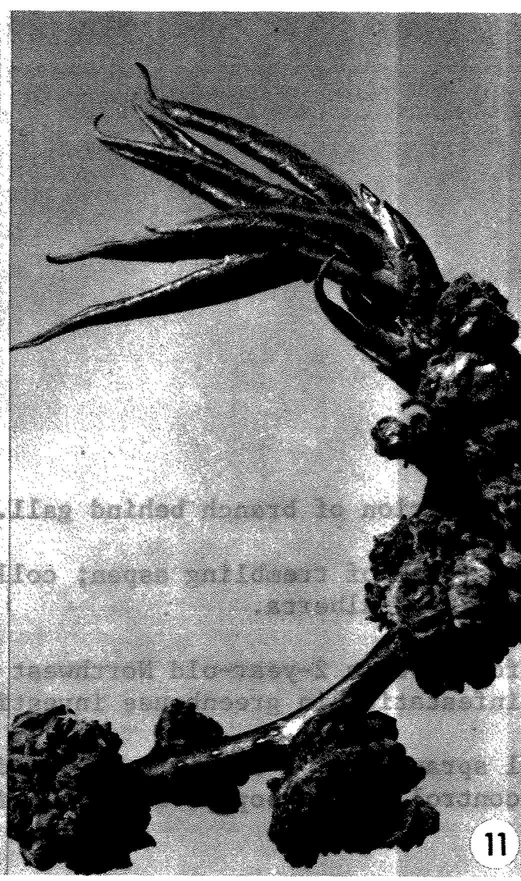

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