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Plant Feeding Mites of South Dakota

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INTRODUCTION

This phytophagous mite study is the first of its kind in South Dakota. Previous records of identified species from this state are practically unknown.

The economic importance of phytophagous mites, their distribution and importance in surrounding states is a well documented fact. When one considers this plus the fact that South Dakota is one of the major agricultural states, the necessity for some beginning towards identifying the plant feeding mites and determining their distribution and host plants is obvious as an essential start for any future control program. The study period was too brief to prepare a complete picture of plant feeding mites in South Dakota, but hopefully it will serve as an effective springboard for future work.

It is difficult to estimate an annual dollar loss to South Dakota agriculture due to plant feeding mites. However, these pests are of major concern to the national agricultural economy and as such share with insects a position of pest importance to the economy of South Dakota.

Plant feeding mites cause damage principally by direct feeding, although a few species are also known to transmit serious plant virus diseases. Wheat streak mosaic disease is the only mite-vectored plant disease reported in South Dakota, although others are under suspect.

This bulletin includes: (1) species of plant feeding mites collected in past years in South Dakota and reported in the state insect survey reports, and (2) systematic

phytophagous mite collections since 1964 as part of South Dakota Experiment Station project No. 433.

Taxonomic Status of the Mites

Mites, like insects, are Arthropods, but beyond this are not taxonomically grouped. They are placed in the class Arachnida with the spiders and other eight legged arthropods, whereas insects are placed in the class Insecta. The order Acarina includes the suborders: Ixodides (ticks), Onychopalpida (mites–mostly predators), Mesostigmata (mites – divided among plant feeders, parasites and scavengers), Sacroptiformes (mites–divided among plant feeders, parasites and scavengers), and Trombidiformes (mites–includes plant feeders, parasites and predators).

Of the four suborders containing mites, only two contain well known plant feeding forms. Of these two, the principal suborder containing important and large numbers of phytophagous species is Trombidiformes. Therefore, emphasis in this paper will be restricted to species of Trombidiformes collected in South Dakota. These species are contained in the families Tetranychidae (spider mites), Eriophyidae (eriophyids, gall, blister, rust, or bud mites), and Tarsonemidae (tarsonemids).

Determination of Species

Identifications of all Tetranychidae in this study have been made and/or verified by Dr. E. W. Baker. H. H. Keifer provided determinations for all Eriophyidae. In the case of Tarsonemidae, the author has attempted the few determinations required.

COLLECTING AND MOUNTING METHODS

Plant feeding mites are so small they are often overlooked by the untrained observer. Thus their presence frequently remains undetected until they build up in numbers sufficient to cause grossly observable populations and/or symptoms of feeding and damage to the plant. However, with virus vectoring mites the gross expression of disease symptoms is not dependent on population density. We often used these symptoms in locating favorable collecting areas and host plants.

In the field, each collection was carefully recorded showing host plant, date, county, collector and population density estimates. When time and weather permitted, field examinations of the leaves were made using a standard binocular dissection microscope. The mites were removed with a teasing needle or brush and placed in vials of 70% alcohol along with a completed collection label. When time or weather prevented mite removal in the field, the infested leaves and completed label were placed in plastic bags and stored in an ice chest for later transfer to alcohol vials. If cool temperatures were maintained, the mites would remain viable in the bags for several days.

There are a number of mounting media available for slide preparations of spider mites, but the most practical one for this work was Hoyer's. It is easy to make and use, clears the specimens well, and except for the more arid parts of the country makes a good transparent and reasonably permanent mount. In drier areas the slides can be

ringed with Zutt to prevent crystalization of the medium.

The Eriophyidae were collected and mounted similar to the other mites. Subsequent results showing some inadequate clearing and specimen shrinkage suggested an improvement was needed in collection and mounting of the eriophyids. The authority in this field, Keifer (1965), suggested dry storage, followed by a sugar-alcohol preservation and wash medium, with final mounting in a special medium.

Eriophyid Preparation and Mounting Media

Preparatory medium

Sorbitol	1 gram
Chloral hydrate	3 grams
Resorcinol	0.1 gram
Phenol	0.25 cc
Iodine	0.1 gram
Water	2 cc
Glycerin	0.25 cc

Wash medium

Sorbitol	1.0 gram
Chloral hydrate	4.0 grams or 3.5 grams
Phenol	0.25 cc
KI	0.1 gram
Iodine	0.1 gram
Water	2 cc

Final medium

Sorbitol	1.0 gram
Chloral hydrate	5.0 grams or 4.0 grams
Phenol	0.20 cc
KI	0.1 gram
Iodine	0.15 gram
Formaldehyde sol. (37%)	2 cc

Suggested use of the eriophyid mounting media:

1. Place mites or infested plant parts in preparatory medium and heat until transparent, that is, until the soft inner parts of the mites are dissolved.
2. Transfer to wash medium until excess of No. 1 is gone.
3. Transfer to formaldehyde medium, place cover slip, label slide. It is well to add some kapok or cotton fibers to the drop of final medium on the slide before placing coverslip. This prevents crushing the mites which causes a disadvantageous distortion.

The lateral profile of the aedeagus is of prime importance in species determination of many spider mites since interspecific differences between females are often indistinguishable. To accomplish this, the male adults should be mounted singly. After several days (time varies with relative humidity) the medium will be partially hardened so that lateral pressure against the edge of the coverslip will rotate the specimen onto its side. This rolling action extrudes the aedeagus and makes a permanent lateral mount.

Most species determinations require the use of phase microscopy and oil immersion. Thus slide preparations should be relatively shallow and visual scanning area reduced. To accomplish this, the use of circular 12–15 mm. diameter and No. 1½ thickness cover slips is recommended. The amount of mounting medium required will

vary with size and thickness of specimens, but should not exceed the minimum amount necessary to fill the coverslip area. As a final aid to reduce the scanning area, place small india ink circles on the underside of the slide around each specimen.

ECONOMIC IMPORTANCE

Although there are some exceptions, virtually all mite damage to plants results from direct feeding and disease vectoring by various species from the families Tetranychidae, Eriophyidae, and Tarsonemidae.

Plant Feeding

It is doubtful a plant species exists that is not a potential or has not served as food supply for one or more of the plant feeding mites. Of the many phytophagous mite species, the most economically important ones are found in the spider-mite family Tetranychidae. These mites feed, and therefore damage the plant, by piercing the leaves (usually the underside) with their styletlike chilicerae (figure 1) and withdrawing the sap. This action results in removal of chlorophyl giving the leaves a pale mottled appearance. As feeding damage intensifies the leaves brown, wilt, die and drop.

The eriophyids and tarsonemids are also plant feeders. However, the small specimen size of both families and relative scarcity of the tarsonemids reduces their economic importance as plant feeding pests in comparison with the spider mites. Damage from feeding, when evident, is similar to that caused by the spider mites.

Plant Diseases and Mites

The spider mites are only now being seriously investigated as possible vectors of plant disease viruses. Moskovetz (1940) reported *Tetranychus telarius* (two-spotted spider mite) as a vector of a virus disease on cotton. The two-spotted spider mite has also been reported as a vector of *Y* virus on potatoes, (Schulz, 1963). A recently described spider mite, *T. sinhai,* (Baker, 1962), is also suspected of transmitting a virus disease in wheat and barley, (Wallace and Sinha, 1961). However, the reality and economic impact of these diseases in natural field conditions is as yet undetermined.

On the basis of present knowledge, the only mites of economic importance in the spread of plant diseases are species of the family Eriophyidae. Eriophyids (also known as gall mites, blister mites, rust mites, or bud mites) are known to transmit seven different plant virus diseases. But of this number, only one disease, wheat streak mosaic, is reported in South Dakota. Symptoms of the disease are too generalized to assure field identification, but include a greenish mottling or streaking of the wheat leaves and general stunting of plant growth. Final determination of the disease requires laboratory controlled transmission tests.

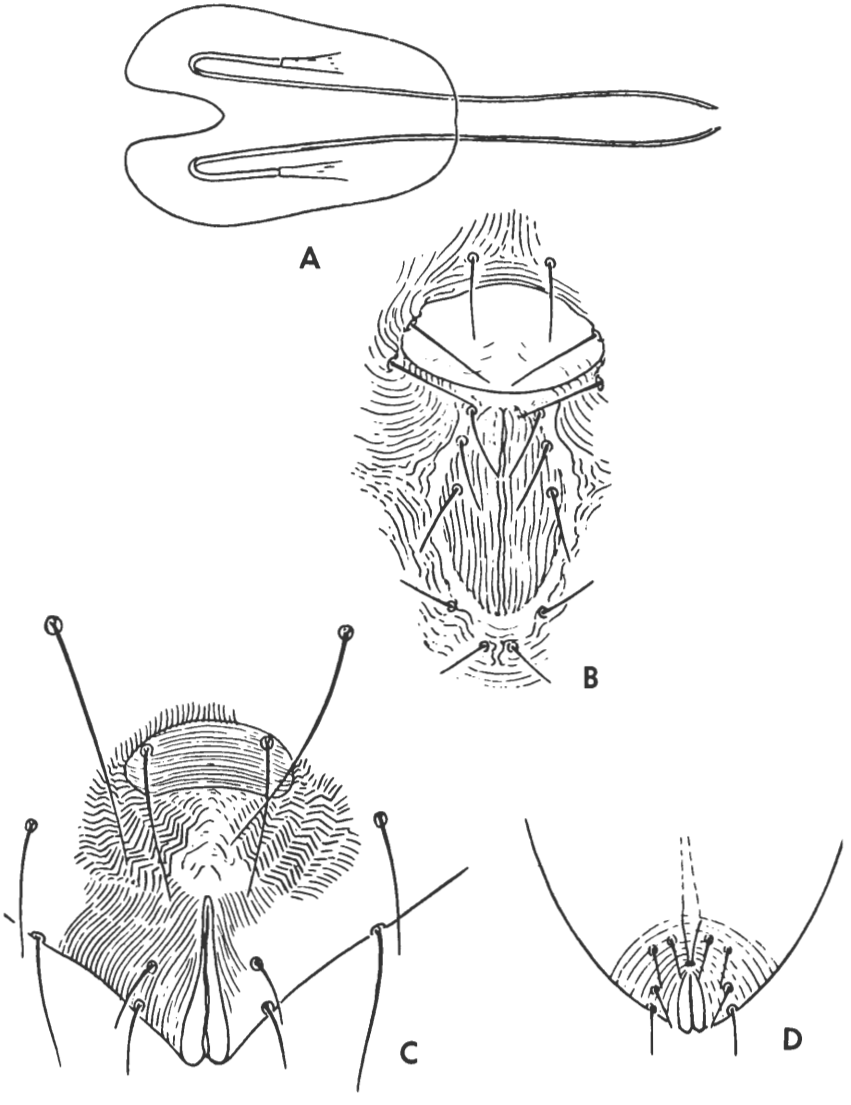


Figure 1. Cheliceral and opisthomal venters of Tetranychidae: (A) stylophore and chelicerae of *Tetranychus telarius;* opisthomal venters; (B) female of *Petrobia harti;* (C) female of *telarius;* and (D) male of *T. telarius.* (From Pritchard & Baker, 1955.)

DISTRIBUTION AND BIOLOGY

Tetranychidae

Geographic distribution

The family Tetranychidae (spider mites) contains the best known and most economically important species among plant feeding mites. This family is cosmopolitan in distribution and is recorded as a damaging pest on more native and cultivated plant hosts than any other arachnid.

Biology

There are numerous and detailed studies on the biology of many of the spider mites. From these studies emerge some basic life history similarities. Adult males do not commonly survive winter conditions in the field. The most common overwintering stage is the egg, although clover mites *(Bryobia praetiosa)* are reported to overwinter in all stages (Morgan & Anderson, 1958).

Parthenogenetic and sexual reproduction are commonly reported within species of Tetranychidae. Parthenogenetic reproduction is also arrhenotokous. Reeves (1963) reports male production as invariably the result of unfertilized eggs even when mating occurs. In typical populations there is a preponderance of females to males.

Considerable intra- and interspecific variation has been reported for developmental times of each stage. In general, however, these variations are shown to result from temperature and humidity differences. An average for optimum spider mite development from egg to adult is 8-11 days.

Developmental stages are egg, six-legged larva, quiescent preprotonymph, eight - legged protonymph, quiescent pre-deutonymph, deutonymph, quiescent pre-adult, and adult.

Eriophyidae

Geographic distribution

The microscopic size of eriophyids (average about 12 mm. in length) has resulted in a paucity of information regarding their known world distribution. Keifer (1952) reports that with the exception of Europe, Java and California the eriophyid areas of the world are essentially unknown.

Biology

Detailed life histories of nearly all eriophyids are lacking. However, Slykhuis (1955), Staples and Allington (1956), and Rosario and Sill (1964) have provided excellent life history studies on *Aceria tulipae* (K). These and other fragmentary reports have provided information for a generalized life history presentation which is at least representative of the wheat curl mite in South Dakota.

Approximately twelve eggs are laid per female. These eggs incubate an average of three days.

First and second nymphal instars average 2½ days each, after which there is a brief period of quiesence, followed by emergence of the adult. Complete egg to egg development requires an average of eleven days. Temperature variations affect these averages considerably. Rosario and Sill (1964) report an optimum temperature for development and maintenance of *Aceria tulipae* populations at 75°F. (24°C).

The most distinguishing characteristic of eriophyids is the presence of only four legs. They are located propodosomally, both pairs appearing in the first nymphal instar.

Parthenogenesis is common among the eriophyids. Keifer (1938) reports males are seldom collected in the field and in general are smaller in size than the females.

Tarsonemidae

Geographic distribution

Small body size and relative scarcity have limited reported observations of the tarsonemid mites. Therefore, a more complete picture of the geographic distribution of this group is not possible. Beer (1954) reports the family as predominantly tropical or subtropical in distribution with records of less predominant occurrence from all major zoogeographical regions of the world.

Biology

Detailed biological studies are reported on only two species (*Steneotarsonemus pallidus* and *Hemitarsonemus latus*). Information available from these and other fragmentary studies will be used as a generalized life history for the family.

Beer (1954) reports all tarsonemids studied demonstrate four metamorphic stages of development (egg, larva, "pupa" and adult). The use of the term "pupa" is consistent with the existence of a quiescent stage preceding emergence of adults. Eggs are laid singly. Six-legged larvae emerge from the eggs with the three pairs of legs being situated in the usual adult positions of legs I, II, and III. Following the larval stage, the mites enter the sessile pupal stage from which they emerge as active eight-legged adults. Principal developments of this pupal stage are legs IV and the genital apparatus. Throughout all stages males are no more than two-thirds the size of females. The life cycle from egg to adult requires about two weeks.

Reproduction by tarsonemids is both parthenogenetic and sexual. Progeny resulting from parthenogentic reproduction in mites usually consists of males. Garman (1917), however, reports offspring of *Steneotarsonemus pallidus* were invariably females. Parthenogenetic studies by workers on several other tarsonemid species show the usual male progeny.

DISCUSSION OF THE SPECIES

Keys and species descriptions in this section for Tetranychidae, Eriophyidae and Tarsonemidae are the result of extensive use of publications by Pritchard and Baker (1955), Keifer (1952 and 1965), and Beer (1954) respectively. Complete descriptions are given only for species not included in the publications for Tetranychidae—Pritchard and Baker, (1955); Eriophyidae—Keifer, (1952); and Tarsonemidae—Beer, (1954).

A South Dakota county map (figure 2) will aid in locating distributional areas of mites collected and reported in this study.

An asterisk (*) indicates not reported in South Dakota.

Tetranychidae Donnadieu, 1875
Spider mites

Spider mites are all plant feeders. Feeding is usually confined to undersides of leaves although high populations result in dispersal to other plant areas. They are generally yellowish or greenish in color although some are reddish.

Spider mites are divided into two sub-families (Bryobiinae and Tetranychinae) and six tribes. The tribes of Bryobiinae are: Bryobiini, Hystrichonychini, and Petrobiini. The three tribes of Tetranychinae are: Tenuipalpoidini, Eurytetranychini, and Tetranychini.

A unique feature of most Tetranychidae is the production of webbing on the undersides of leaves in which eggs are laid and which offers some protection against natural predators. Exceptions to this occur for species of the tribes Bryobiini Reck, Petrobiini Reck, Hystrichonychini Pritchard and Baker, and *Panonychus* and *Allonychus* among the Tetranychini Reck.

The family Tetranychidae is characterized by the presence of a palpal thumb-claw complex, long, recurved stylets, tarsal claws with tenent hairs, a pair of eye-spots, well defined peritreme, and a transverse genital opening (figure 1 and 3).

A taxonamic separation of the family is given below. See figures 1 and 3 for morphological characteristics and figure 4 for setal nomenclature.

Key to subfamilies of Tetranychidae

1. Empodium with tenent hairs; female with three pairs of anal setae and male with five pairs of genito-anal setae BRYOBIINAE
1. Empodium (rarely appearing absent) without tenent hairs, female with two pairs of anal setae and male with four pairs of genito-anal setae ..... TETRANYCHINAE

Subfamily BRYOBIINAE Berlese, 1913

Characteristics of the Bryobiinae

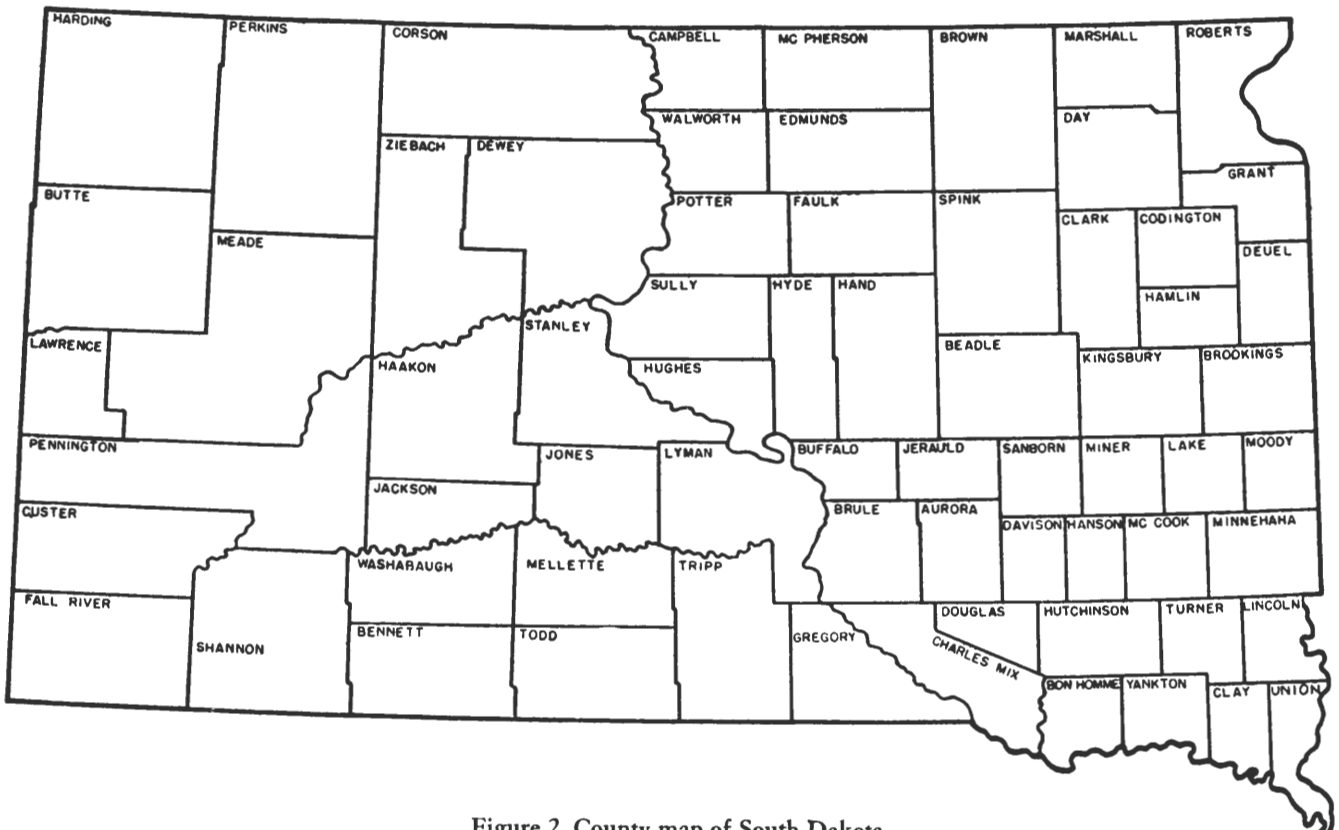


Figure 2. County map of South Dakota.

are: none is known to produce silken strands; duplex setae are located at the abruptly declivate distal end of the tarsus, and the proximal member of each pair is small and straight; the female has three pairs of anal setae and the male five pairs of genito-anal setae.

Key to tribes of Bryobiinae

1. Propodosoma with four pairs of dorsal setae; true claw long and with tenent hairs mediolaterally ..... BRYOBIINI
1. Propodosoma with three pairs of dorsal setae; true claw a short but slender pad with a pair of terminal tenent hairs 2
2. (1) Hysterosoma with five pairs of dorsolateral and dorsosublateral setae (with twelve pairs of dorsal hysterosomals) ..... HYSTRICHONYCHINI*
2. (1) Hysterosoma with three

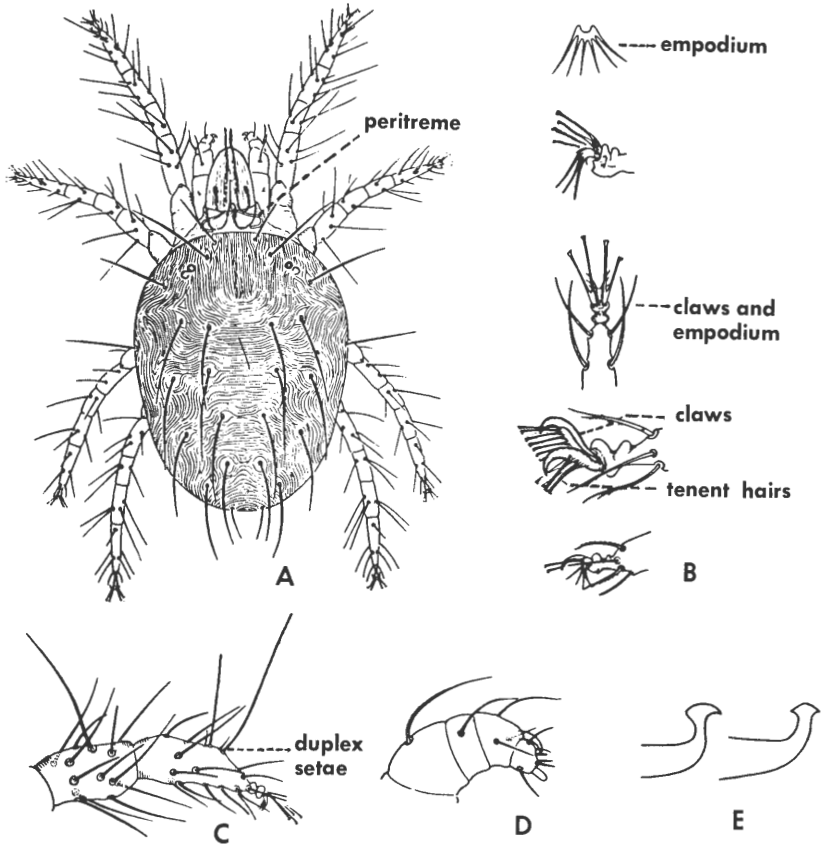


Figure 3. Morphological characteristics of Tetranychidae. (A) peritreme on female; (B) empodia, claws and tenent hairs; (C) duplex setae on tarsus I; (D) palpal thumb-claw complex; (E) aedeagi. (From Baker, et. al., 1958.)

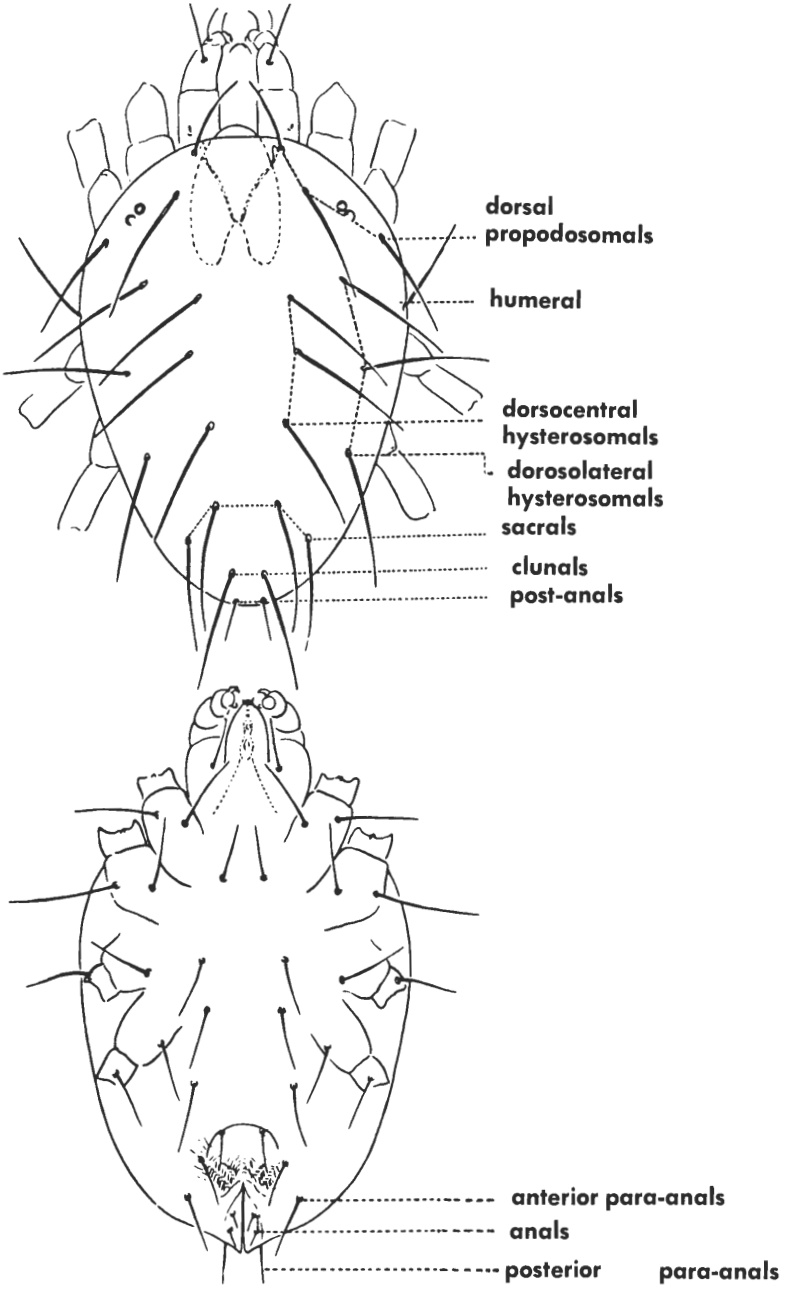


Figure 4. Dorsum (top) and venter (bottom) of hypothetical tetranychid showing setal nomenclature. (From Pritchard and Baker, 1955.)

pairs of dorsolateral setae (with ten pairs of dorsal hysterosomals) ..... PETROBIINI

TRIBE BRYOBIINI RECK, 1952

The tribe Bryobiini is characterized by having four pairs of dorsal propodosomals and the true claw is developed as a curved hook or a long pad, with lateral tenent hairs. There are twelve pairs of dorsal hysterosomals.

Key to the genera of Bryobiini

1. True claw uncinate, with one or several pairs of mediolateral tenent hairs ..... *Bryobia*
1. True claw padlike, with two rows of ventrally directed tenent hairs ..... *Tetranycopsis**

Bryobia Koch, 1836

Bryobia is characterized by several pairs of ventrally directed tenent hairs arising from a hooked true claw.

The genus *Bryobia* is represented in South Dakota by two species, *B. praetiosa* and *B. rubrioculus*.

The key given below for separation of these two species is taken from Morgan and Anderson (1957).

Key to South Dakota species of *Bryobia*

1. Foreleg of adult longer than 0.69 mm.; body length more than 0.74 mm.; lateral distance between bases of anterior pair of dorsocentral hysterosonal setae (DC_1) greater than 0.10 mm. Larval setae lanceolate, unlike those of adult; lateral distance between bases of DC_1 approximately four times length of seta ..... *praetiosa*
1. Foreleg of adult less than 0.69 mm. long; body length less than 0.74 mm.; lateral distance between bases of DC_1 less than 0.10 mm. Larval setae foliaceous, like those of adult; lateral distance between bases of DC_1 approximately twice length of seta ..... *rubrioculus (arborea)*

Bryobia praetiosa Koch, 1836

clover mite
(Figures 5 and 6)

As noted from the above key, this species is difficult to separate as an adult from *B. rubrioculus*. Except for size (*B. praetiosa* is larger), morphological differences are not reported as evident.

Species of *B. praetiosa* are a common household pest during the fall and winter months. They are reddish or reddish-brown in color and are not harmful in homes except as a nuisance. In the field, these mites have been reported causing serious plant feeding damage to various orchard crops (Reeves, 1963). Other hosts include almond, walnut, various wild and native grasses, wheat, barley, clover, alfalfa, ivy, orchids, and various shade trees (Pritchard and Baker, 1955).

In South Dakota, this mite has been collected on brome grass (*Bromus inermis*), Faulk County, 5/10/57; and in homes, Hughes County, 5/22/54. No collections were made during our survey.

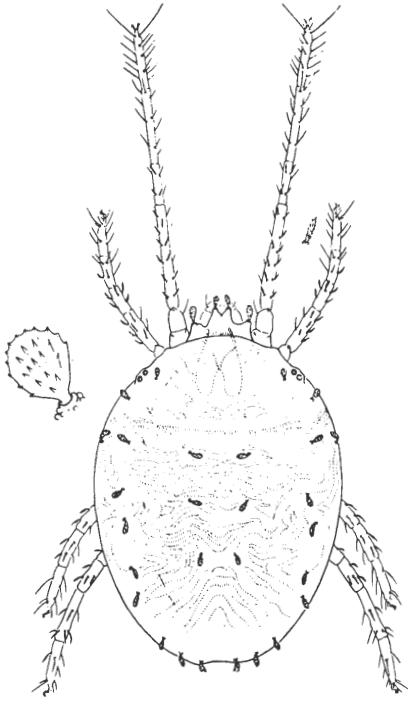


Figure 5. *Bryobia praetiosa.* **Dorsal aspect of female. (From Pritchard & Baker, 1955.)**

Bryobia rubrioculus (Scheuten, 1857) brown mite

New record for South Dakota

There is still some question among acarologists as to whether the correct name for this mite is *B. arborea* or *B. rubrioculus* (Baker and Pritchard, 1960; Eyndhoven, 1956; Morgan and Anderson, 1957; and Morgan, 1960). In view of the fact South Dakota specimens were identified by Baker as *B rubrioculus*, that determination will be accepted for this study. Morgan and Anderson (1957) have provided the original description for *B. arborea* which is considered synonymous with *B. rubrioculus* and is cited below.

Female – In general appearance very similar to *B. praetiosa* as described by McGregor (1950), but smaller in size. Body length 0.551 to 0.731 mm; body width 0.348 to 0.527 mm; foreleg (excluding coxa and tarsal claws) 0.543 to 0.659 mm. Lateral distances between the bases of the paired dorsocentral hysterosomal setae: DC_1, 0.047 to 0.084 mm.; DC_2, 0.027 to 0.061 mm.; DC_3, 0.020 to 0.044 mm.

Male – Not found. Species parthenogenetic.

Larva – Similar to *praetiosa* as described by McGregor (1950),

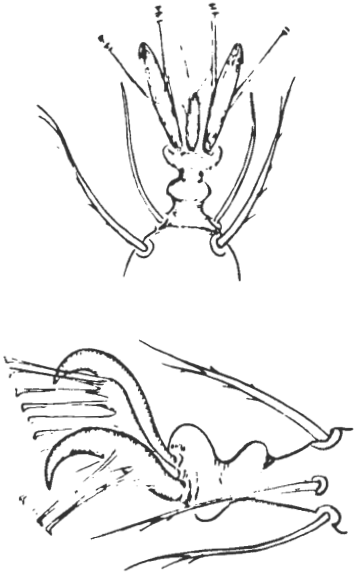


Figure 6. *Bryobia praetiosa.* **Appendages of tarsi II and IV. (From Pritchard & Baker, 1955.)**

but body setae foliaceous like those of the adult (not lanceolate to clavate as in *praetiosa).* Body length 0.172 to 0.193 mm.; body width 0.143 to 0.164 mm. Lateral distances between the bases of the paired dorsocentral hysterosomal setae: DC_1, 0.035 to 0.053 mm.; DC_2, 0.017 to 0.030 mm.; DC_3, 0.013 to 0.022 mm.

Egg – Spherical, slightly flattened at base. Diameter: 0.136 to 0.178 mm.

Holotype – Collected on Delicious apple leaves, Summerland, B.C., June 13, 1955 (N. H. Anderson and H. Dominique). No. 6425 in the Canadian National Collection, Ottawa.

The brown mite is reported as a pest on a variety of orchard trees and other woody plants throughout the world. This is the first report of *B. rubrioculus* in South Dakota.

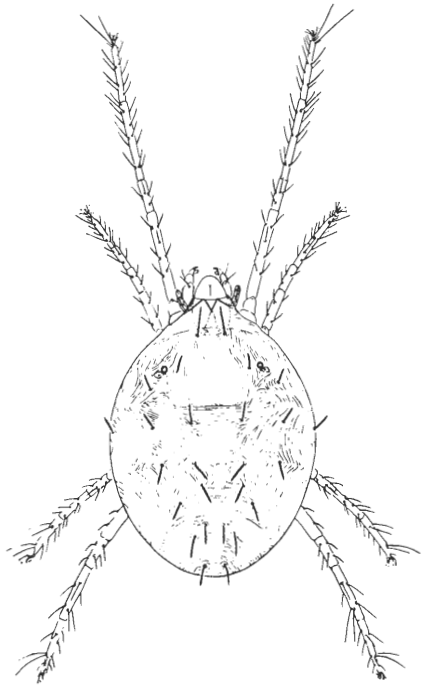


Figure 7. *Petrobia latens.* Dorsal aspect female. (From Pritchard & Baker, 1955.)

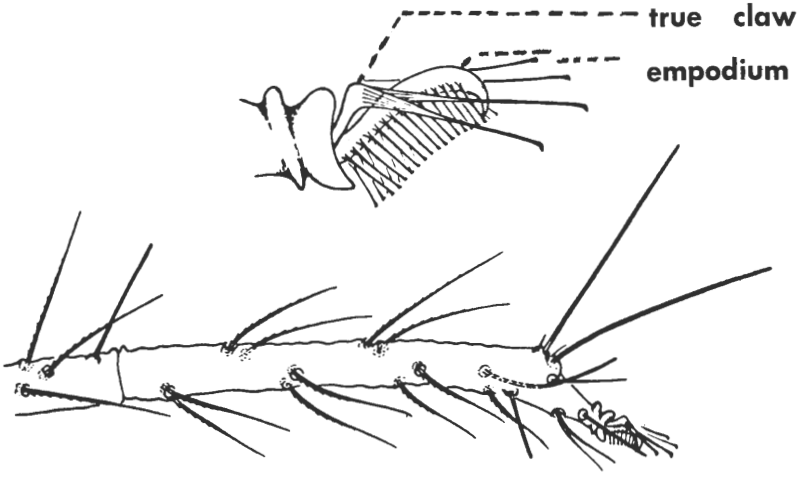


Figure 8. *Petrobia latens.* Tarsus I of female, with enlargement of appendages. (From Pritchard & Baker, 1955.)

The 1964 collections were from apple *(Pyrus malus)*, Fall River County, Slide Nos. 456, 457, 458, and 459, 7/29/64, LDW; Hughes County, Slide Nos. 460, 461, and 462, 7/23/64, LDW; and Meade County, Slide Nos. 463, 464, 465, 466, and 467, 8/19/64, LDW.

TRIBE PETROBIINI RECK, 1952

The tribe Petrobiini differs from Bryobiini and Hystrichonychini in that the second and third dorsolateral setae are single, rather than paired. Thus, the hysterosoma possesses only five pairs of dorsolateral and dorsosublateral setae (figure 7). The true claw consists of a small slender pad with a pair of tenent hairs distally (figure 8).

Key to the genera of Petrobiini

1. Empodium uncinate 2
1. Empodium without a terminal hook, being padlike or else consisting of a pair of tenent hairs....3
2. (1) Empodium with two rows of ventrally directed tenent hairs ..... *Petrobia*
2. (1) Empodium with one pair of mediolateral, distally directed tenent hairs ..... *Schizonobia**
3. (1) Hysterosoma with inner sacrals approximate and resembling a fourth pair of dorsocentrals ..... *Alponobia**
3. (1) Hysterosoma with inner sacrals more widely spaced than dorsocentrals and more removed from them than the dorsocentrals are from each other ..... *Monoceronychus**

Petrobia Murray, 1877

Petrobia is characterized by a double row of ventrally directed tenent hairs on the empodium.

The genus *Petrobia* is represented in South Dakota by only one species, *P. latens*.

Petrobia latens (Muller, 1776) brown wheat mite (Figures 7 & 8)

The brown wheat mite (adult female, males are not known) is separated from other *Petrobia* species in that the sacral and other dorsal hysterosomal setae are similar in length. The dorsal setae are not set on tubercles and are shorter in length than the intervals between them.

P. latens is largely a pest of monocotyledonous plants such as grasses, wheat, barley, sorghum, onions, gladiolus, and iris. Heavy populations may cause damaging migrations to cotton, carrots, lettuce, melons, alfalfa, burr clover, and apple.

South Dakota collections of this mite are from winter wheat *(Triticum aestivum)*, Stanley County, 5/7/62, SDH and GM (S. D. Ins. Surv. Rpt., 1962a); and alfalfa *(Medicago sativa)*, Shannon County, 5/4/65, PAJ. Large and damaging populations of *P. latens* in South Dakota have not been reported.

Subfamily TETRANYCHINAE Berlese, 1913

Characteristics of the Tetranychinae are: most species are producers of silken strands; duplex

setal location is variable, but proximal member is generally more strongly developed than in Bryobiinae; female possesses two pairs of anal setae, and male possesses four pairs of genito-anal setae; the true claw is reduced to a small pad bearing a pair of long tenent hairs.

Key to the tribes of Tetranychinae

1. Tarsus I dorsally with two pairs of duplex setae, the proximal member of each pair shorter than the distal member 2
1. Tarsus I dorsally with at most a single pair of usually loosely associated duplex setae, the proximal member usually as long as or longer than the distal member, or else duplex setae absent; empodium very small or absent ..... Eurytetranychini*
2. (1) Hysterosoma with sacral setae all marginal; tarsus II with distal member of duplex setae a short sensory peg; propodosoma reticulate dorsally ..... Tenuipalpoidini*
2. (1) Hysterosoma with inner sacrals mediodorsal; tarus II with distal member of duplex setae long and tapering; propodosoma without reticulations ..... Tetranychini

TRIBE TETRANYCHINI RECK, 1950

The tribe Tetranychini contains most of the economically important species in the family Tetranychidae. It is this group of mites for which species identification frequently requires the lateral profile of the aedeagus. Thus, representatives of both sexes are often necessary.

The empodium of all Tetranychini is well developed. Another characteristic of the tribe is the presence of two pairs of duplex setae on the dorsum of tarsus I and one pair on the dorsum of tarsus II.

Key to the genera of Tetranychini

1. Opisthosoma with two pairs of para-anal setae 2
1. Opisthosoma with a single pair of para-anals 6
2. (1) Empodium with a simple, clawlike dorsal member and with paired proximoventral hairs 3
2. (1) Empodium not clawlike and with paired proximoventral hairs 4
3. (2) Empodium with a simple "claw" nearly as long as three pairs of similar, proximoventral hairs; tarsus I with duplex setae adjacent near distal end of segment ..... *Panonychus*
3. (2) Empodium with "claw" much shorter than the longest of the dissimilar proximoventral hairs; tarsus I with duplex setae separated along dorsal surface of segment ..... *Allonychus**
4. (2) Empodium with the two proximoventral hairs enlarged forming two clawlike appendages, the dorsal hairs very short if present ..... *Schizotetranychus*
4. (2) Empodium (excluding legs I and II of males) comprised of three pairs of hairs of similar length, the proximal member of which is slightly the stronger, or else with the hairs united proxim-

ally to form a single appendage..5

5. (4) Empodium forming a single, slender appendage on at least proximal one-half ..... *Neotetranychus**

5. (4) Empodium (excluding leg I and II of male) composed of three pairs of hairs..... *Eotetranychus*

6. (1) Empodium clawlike and somewhat shorter than or about as long as proximoventral hairs; peritreme usually straight distally and ending in a simple bulb; tarsus I usually with duplex setae adjacent and placed near distal end ..... *Oligonychus*

6. (1) Empodium with clawlike dorsal member much shorter than proximoventral hairs or else rudimentary; peritreme recurved distally or rarely anastomosing; tarsus I with duplex setae widely spaced on dorsum of segment ..... *Tetranychus*

Panonychus Yokoyama, 1929

The genus *Panonychus* is characterized by having the dorsal se-

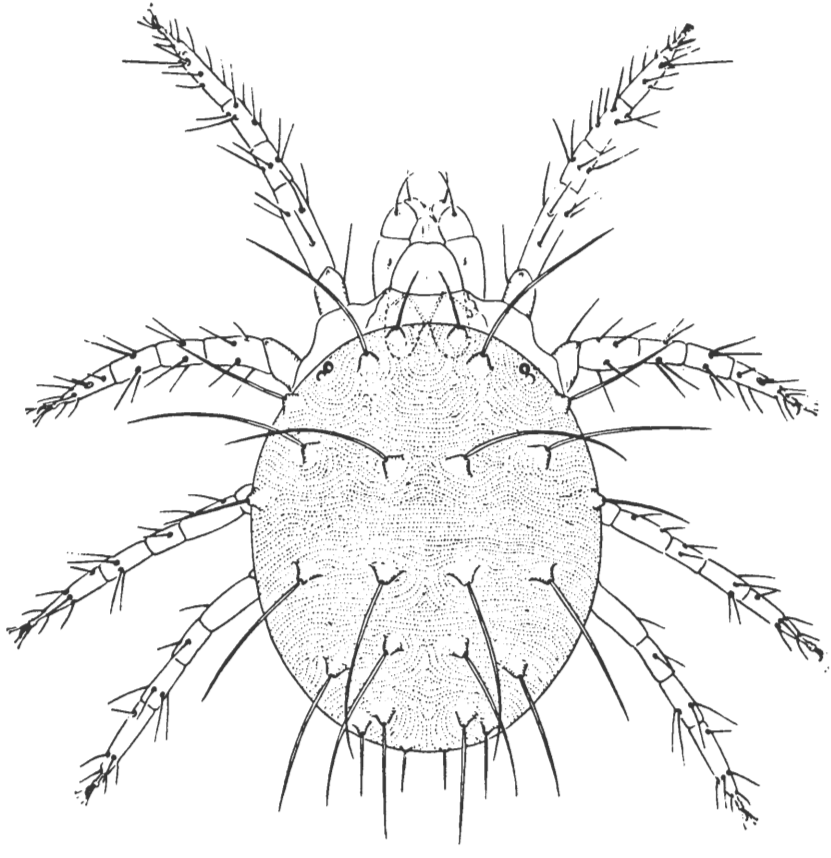
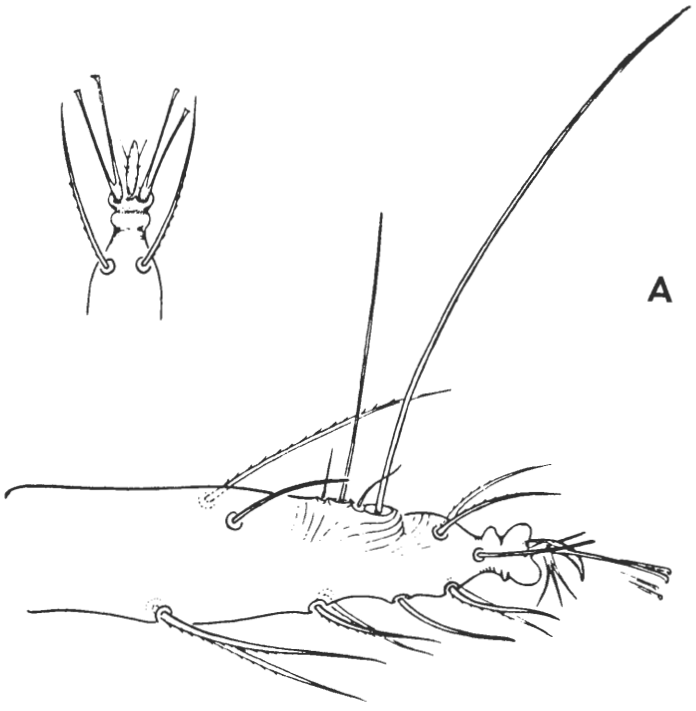


Figure 9. *Panonychus ulmi.* **Dorsal aspect of female. (From Pritchard & Baker, 1955.)**



tae borne on strong tubercles. Three pairs of proximoventral setae are borne on the empodial claw. Two pairs of para-anal setae are present.

In South Dakota, *Panonychus* is represented by only one species, *P. ulmi.*

Panonychus ulmi (Koch), 1836
European red mite
(Figures 9 & 10)

Adult females of *Panonychus ulmi* are brick red with whitish dorsal tubercles. The outer sacrals of the hysterosoma are about two-thirds as long as the inner sacrals and longer than the clunals.

The European red mite is commonly a serious pest of orchards,

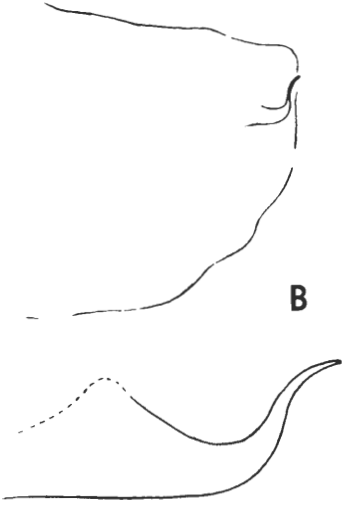


Figure 10. *Panonychus ulmi.* **(A) tarsus I of female; (B) aedeagus. (From Pritchard & Baker, 1955.)**

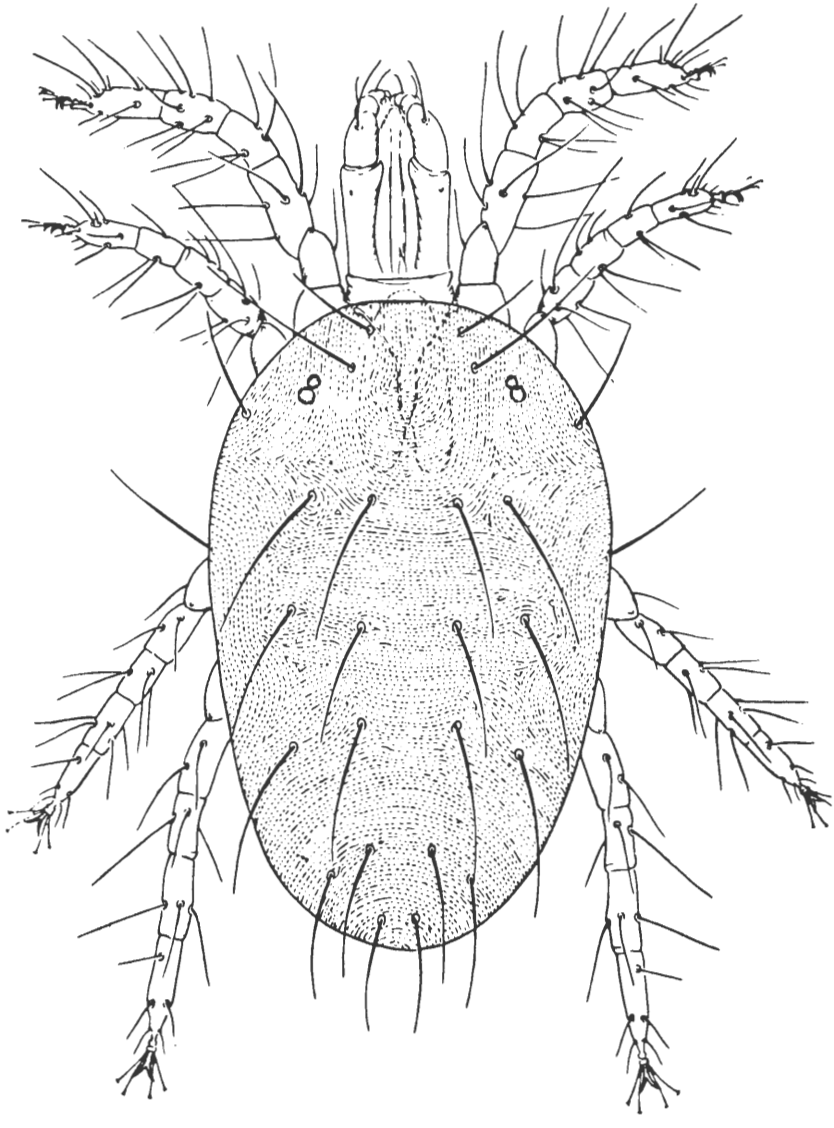


Figure 11. *Schizotetranychus elymus*. Dorsal aspect of female. (From Pritchard & Baker, 1955.)

ornamental trees and shrubs (Chapman and Lienk, 1950). This pest is common throughout much of the world, and is reported on such hosts as apple, cherry, pear, peach, plum, prune, berries, cotoneaster, pyracantha, elm, almond, walnut, mountain ash, and black locust.

In South Dakota, the European red mite has been collected on apple *(Pyrus malus),* Brookings County, 5/12/58; plum (*Prunus domestica),* Lake County. Slide Nos. 38 and 57, 8/15/64, HCS.

Schizotetranychus Trägårdh, 1915

The genus *Schizotetranychus* can be recognized by the presence of two claw-like appendages which are outgrowths of the ventrolateral pair of empodial hairs.

In South Dakota, the genus is represented by only one species, *Schizotetranychus elymus.*

Schizotetranychus elymus McGregor, 1950

New record for South Dakota

(Figures 11, 12 & 13)

Males of *Schizotetranychus elymus* are characterized by having the aedeagus with a dorsally directed sigmoid portion that is about one-half the length of the shaft. Dorsal body setae of both sexes are similar in length and slightly longer than the longitudinal intervals between them.

Little is known about the economic importance of this species. Collections are reported for only the western United States. Hosts include bent grass, Bermuda grass, and other undetermined grasses.

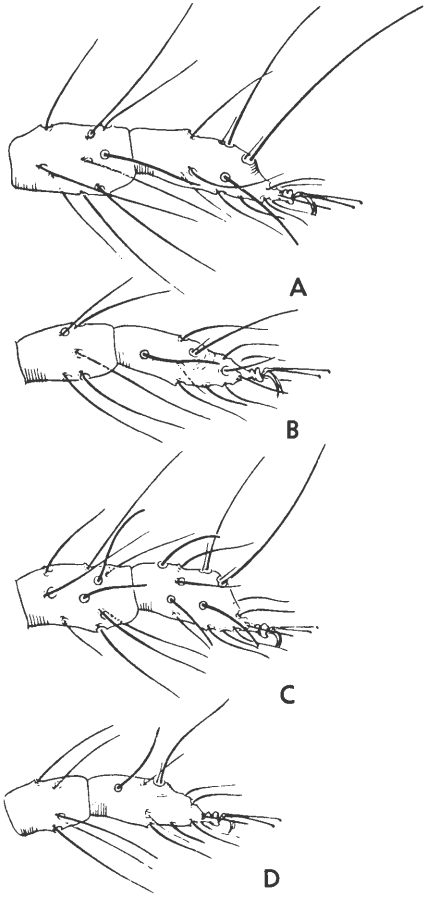


Figure 12. *Schizotetranychus elymus.* **(A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus I of male; (D) tibia and tarsus II of male. (From Pritchard & Baker, 1955.)**

In South Dakota, this mite has been collected on western wheat grass *(Agropyron smithii),* Shannon County. Slide No. 434, 7/29/64, LDW; and Todd County. Slide Nos. 435, 436, 437, and 438, 7/30/64, LDW.

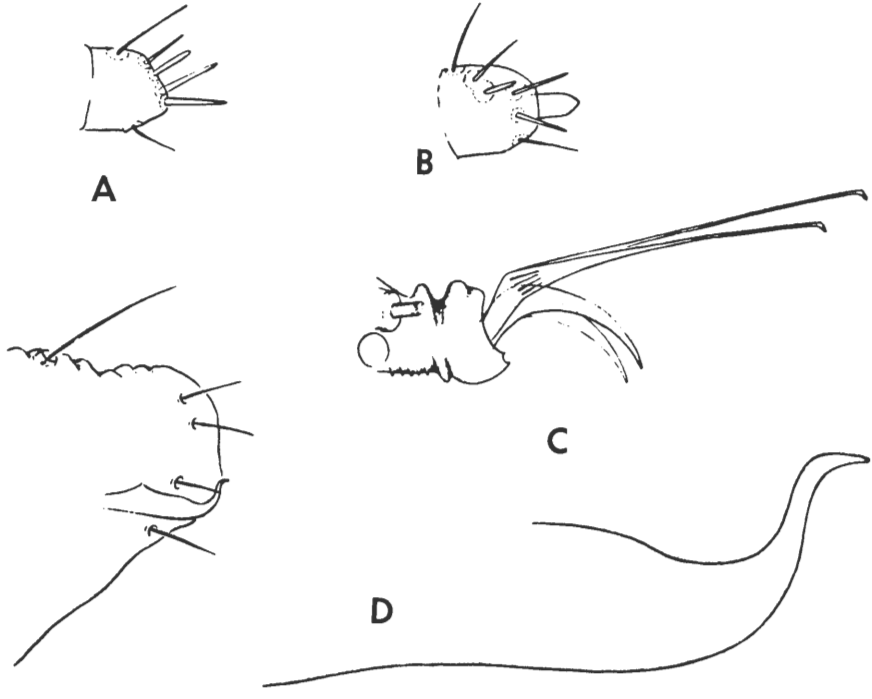


Figure 13. *Schizotetranychus elymus.* **(A) distal segment of palpus of male; (B) distal segment of palpus of female; (C) appendages of tarsus of female; (D) aedeagus. (From Pritchard & Baker, 1955.)**

Eotetranychus Oudemans, 1931

Eotetranychus is characterized by the presence of the caudal pair of para-anals, and having the empodium (except for leg I, and sometimes II, of the male), consist of three pairs of hairs.

In South Dakota this genus is represented by two described species *(E. populi* and *E. matthyssei)* and one new species not yet described.

Key to South Dakota species of *Eotetranychus*, males

1. Aedeagus with a broad curve medially and with distal end rounded; peritreme anastomosing distally ..... *populi*
1. Aedeagus with a strong wave near the middle and tapering to a point; peritreme with simple bend distally ..... *matthyssei*

Eotetranychus populi (Koch), 1838

New record for South Dakota

(Figures 14 & 15)

Eotetranychus populi is differentiated from other species in this genus by the irregular, anastomosing enlargement of the distal end of the peritreme. Another charact-

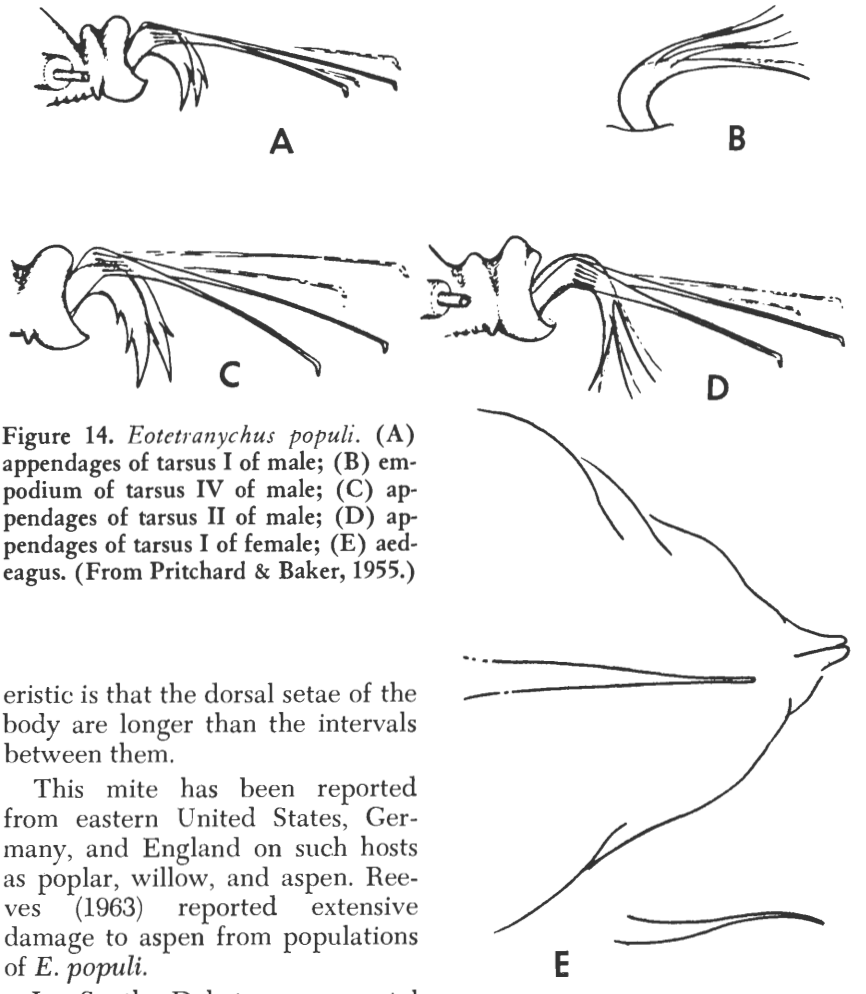


Figure 14. *Eotetranychus populi.* **(A) appendages of tarsus I of male; (B) empodium of tarsus IV of male; (C) appendages of tarsus II of male; (D) appendages of tarsus I of female; (E) aedeagus. (From Pritchard & Baker, 1955.)**

eristic is that the dorsal setae of the body are longer than the intervals between them.

This mite has been reported from eastern United States, Germany, and England on such hosts as poplar, willow, and aspen. Reeves (1963) reported extensive damage to aspen from populations of *E. populi.*

In South Dakota, ornamental willow trees throughout the state suffered heavy damage from large populations of this mite. Large numbers of cast skins and heavy webbing were frequently encountered on willow leaves during the latter half of the summer of 1964. Damage was easily discernible as the leaves were frequently curled and chlorotic or brown.

South Dakota collections were from weeping willow *(Salix babylonica),* Fall River County. Slide Nos. 77, 78, 79, 80, 81, and 82, 7/29/64, LDW; Hughes County. Slide Nos. 101, 102, 103, 104, 105, 106, 107, 108, and 109, 7/23/64, LDW; Jerauld County. Slide Nos. 110, 111, 112, 113, 114, 115, and 116, 7/24/64, LDW; willow *(Salix* sp.), Turner County. Slide Nos.

83, 84, 85, 86, 87, 88, 89, 90, and 91, 8/25/64, HCS; Clay County. Slide Nos. 92, 93, 94, 95, 96, 97, 98, 99, and 100, 8/26/64, HCS; McCook County. Slide Nos. 122, 123, 124, 125, 126, 127, and 128, 8/12/64, HCS; McCook County. Slide Nos. 129, 130, 131, 132, and 133, 8/15/64, HCS; Jackson County. Slide Nos. 247, 248, 249, 250, 251, 252, 253, 254, and 255, 7/30/64, LDW; golden willow (S. sp.), Roberts County. Slide Nos. 117, 118, 119, 120, and 121, 8/13/64, LDW; Sandbar willow *(S. interior),* Jackson County. Slide Nos. 420, 421, 422, 423, and 424, 7/29/64, LDW; and western wheat grass *(Agropyron smithii),* Shannon County. Slide No. 439, 7/29/64, LDW.

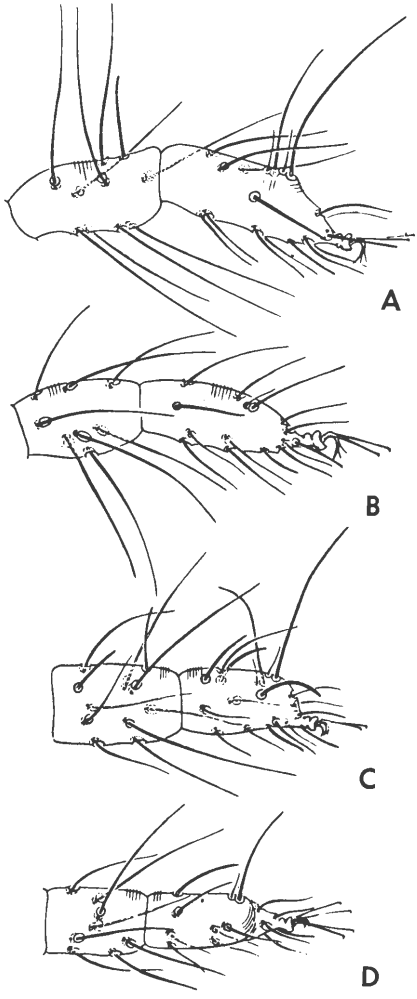


Figure 15. *Eotetranychus populi.* **(A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus I of male; (D) tibia and tarsus II of male. (From Pritchard & Baker, 1955.)**

Eotetranychus matthyssei Reeves, 1963

New record for South Dakota

(Figure 16)

This species is distinctive from *E. populi* in that the peritreme has a simple bend at its distal end and the aedeagus is strongly curved in the middle and tapers to a point. Reeves (1963) reports this mite as a serious pest of American elm in New York. Previously reported hosts include American elm, hackberry, black locust, and slippery elm.

The original description of *E. matthyssei* is given by Reeves (1963) as follows:

> Male — Palpus with terminal sensillum slender, about 3 times as long as wide. Peritreme ending distally in a simple, bent, usually 1-chambered bulb. Tibia I with 9 tactile and 3 sensory setae; tarsus I with 4 tactile and 3 sensory setae proximal to the duplex setae; empodium I tridentate,

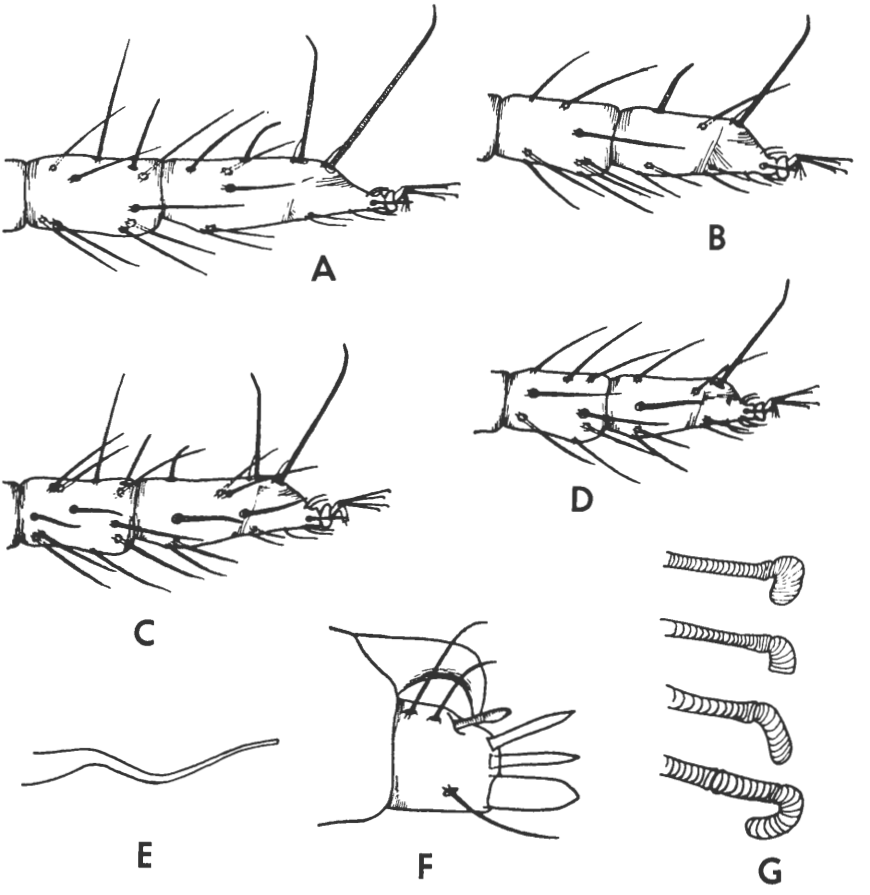


Figure 16. *Eotetranychus matthyssei.* **(A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus I of male; (D) tibia and tarsus II of male; (E) aedeagus; (F) terminal segment of palpus; (G) various shapes of distal end of peritreme. (From Reeves, 1963.)**

the central tooth is the most prominent. Tibia II with 8 tactile setae. Aedeagus long and slender, strongly undulate near the center. Length of body 210 microns; including rostrum, 232 microns (from mounted specimens).

Female – Palpus with terminal sensillum 2 to 2½ times as long as wide. Peritreme ending distally in a simple, bent, usually 1-chambered bulb. Tibia I with 9 tactile and 1 sensory setae; tarsus I with 5 tactile and 1 sensory setae proximal to the duplex setae; empodia I, II, III, and IV composed of 3 pairs of hairs. Tibia II with 8 tactile

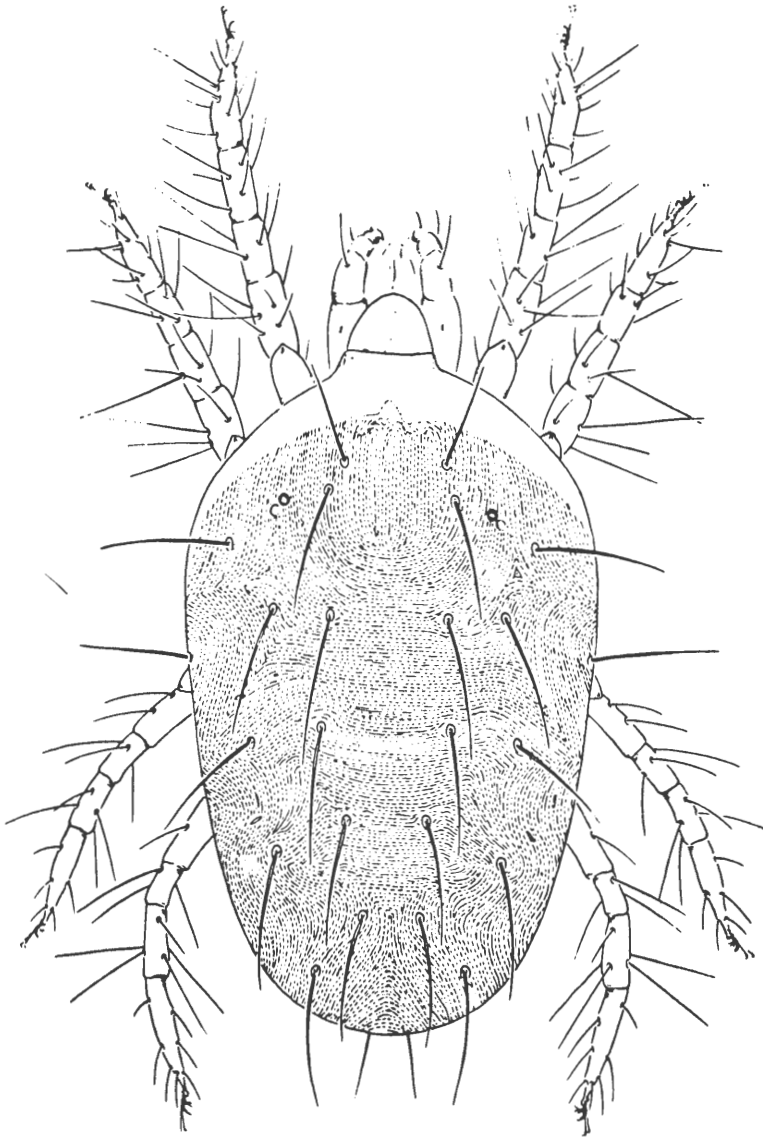


Figure 17. *Oligonychus pratensis*. **Dorsal aspect of female. (From Pritchard & Baker, 1955.)**

setae. Striae just anterior to genital flap transverse. Length of body 290 microns; including rostrum, 333 microns (from mounted specimens).

In South Dakota, *E. matthyssei* was collected only once. This collection was on American elm *(Ulmus americana),* Roberts County. Slide Nos. 353, 354, and 355, 8/13/64, LDW.

Eotetranychus (new species)

A suspected new species of *Eotetranychus* is currently held by E. W. Baker pending description, and was collected from wild rose *(Rosa),* Sanborn County. Slide Nos. 398, 399, 400, 401, and 402, 2/6/64, LDW.

Oligonychus Berlese, 1886

The genus *Oligonychus* can be recognized by having the empodial claw well developed with three to six pairs of proximoventral hairs. The caudal pair of para-anal setae is absent.

In South Dakota, this genus is represented by *O. bicolor, O. pratensis,* and one undescribed species.

Key to South Dakota species of *Oligonychus,* females

1. Tibia I with nine tactile setae; venter of tarsus I with two tactile setae beyond first duplex; empodium with three pairs of proximoventral hairs ..... *pratensis*
1. Tibia I with seven tactile setae; venter of tarsus I with one tactile seta beyond first duplex; empodium, with four to six pairs of proximoventral hairs ..... *bicolor*

Key to South Dakota species of *Olygonychus,* males

1. Aedeagus with bent portion directed dorsally and bearing a terminal knob ..... *pratensis*
1. Aedeagus with bent portion directed ventrally at an obtuse angle and with the distal end abruptly narrowed ..... *bicolor*

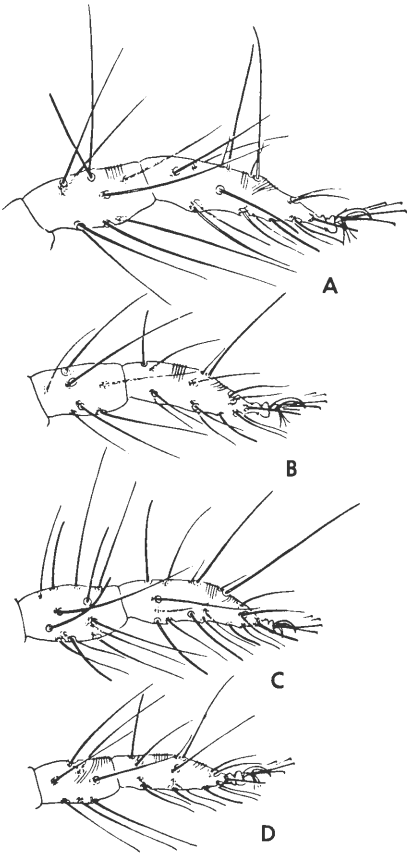


Figure 18. *Oligonychus pratensis.* **(A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus I of male; (D) tibia and tarsus II of male. (From Pritchard & Baker, 1955.)**

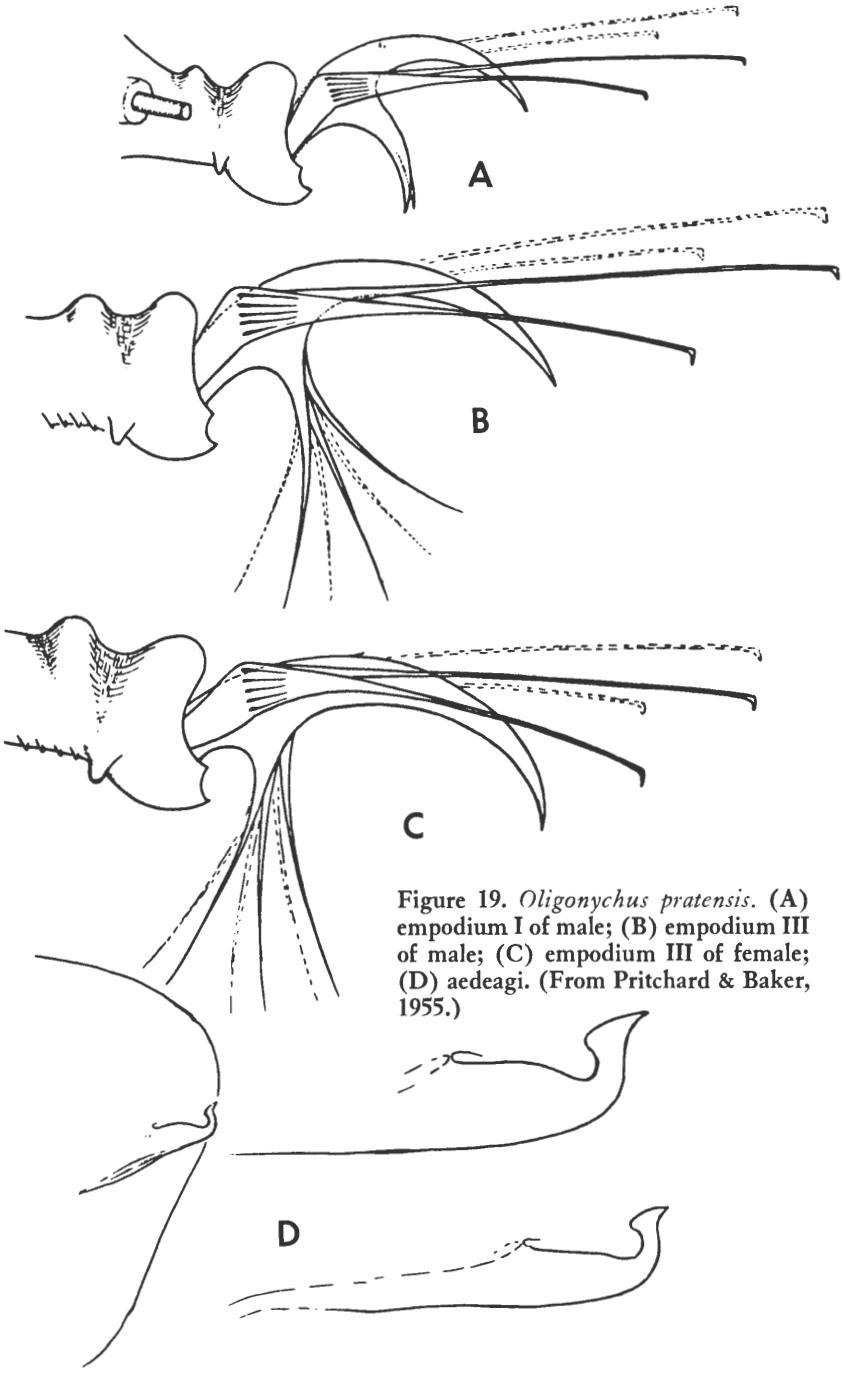


Figure 19. *Oligonychus pratensis.* (A) empodium I of male; (B) empodium III of male; (C) empodium III of female; (D) aedeagi. (From Pritchard & Baker, 1955.)

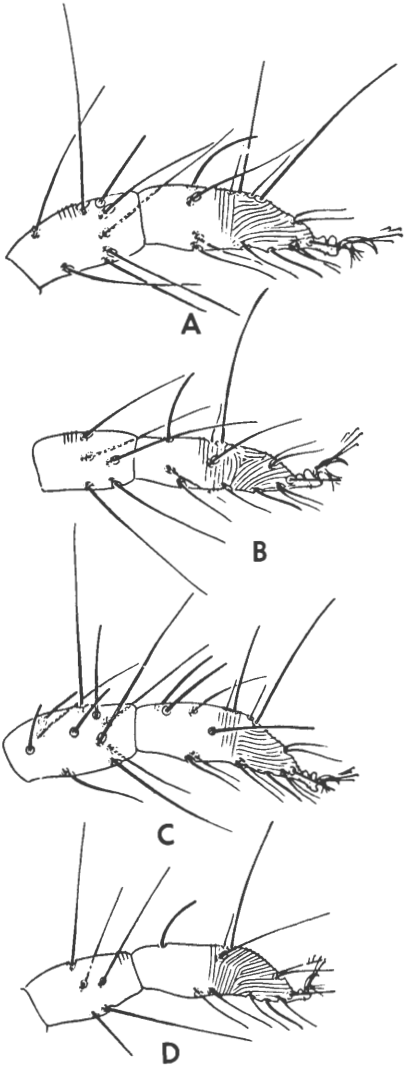


Figure 20. *Oligonychus bicolor.* **(A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus I of male; (D) tibia and tarsus II of male. (From Pritchard & Baker, 1955.)**

Oligonychus pratensis (Banks), 1912, Banks grass mite

New record for South Dakota

(Figures 17, 18 & 19)

Males of the Banks grass mite are recognized by having the distal knob of the aedeagus about twice as wide as the stem of the knob. The axis of the knob forms a right angle with the shaft. Females are characterized by having nine tactile setae on tibia I.

O. pratensis is reported in various areas throughout the United States on such hosts as wheat, aspen, dates, sugar cane, para grass, smut grass, broom grass, bermuda grass, panic grass, and other grasses.

In South Dakota, Banks grass mite has been collected on oats *(Avena sativa)*, Beadle County. Slide Nos. 426, 427, 428, 429, 430, 431, 432, and 433, 7/8/64, HCS; wheat *(Triticum aestivum)*, Walworth County. Slide Nos. 440, 441, and 442, 6/25/64, LDW; western wheat grass *(A. smithii)*, Hughes County. Slide Nos. 443, and 444, 7/17/64, HCS; and barley *(Hordeum vulgare)*, Beadle County. Slide No. 469, 7/8/64, LDW.

Economic damage from *O. pratensis* has not been observed in South Dakota.

Oligonychus bicolor (Banks), 1894 oak mite

New record for South Dakota

(Figures 20 & 21)

Of the *Oligonychus* species occurring in South Dakota, *O. bicolor* can be recognized by the presence of seven tactile setae on tibia I and four tactile setae proximal of

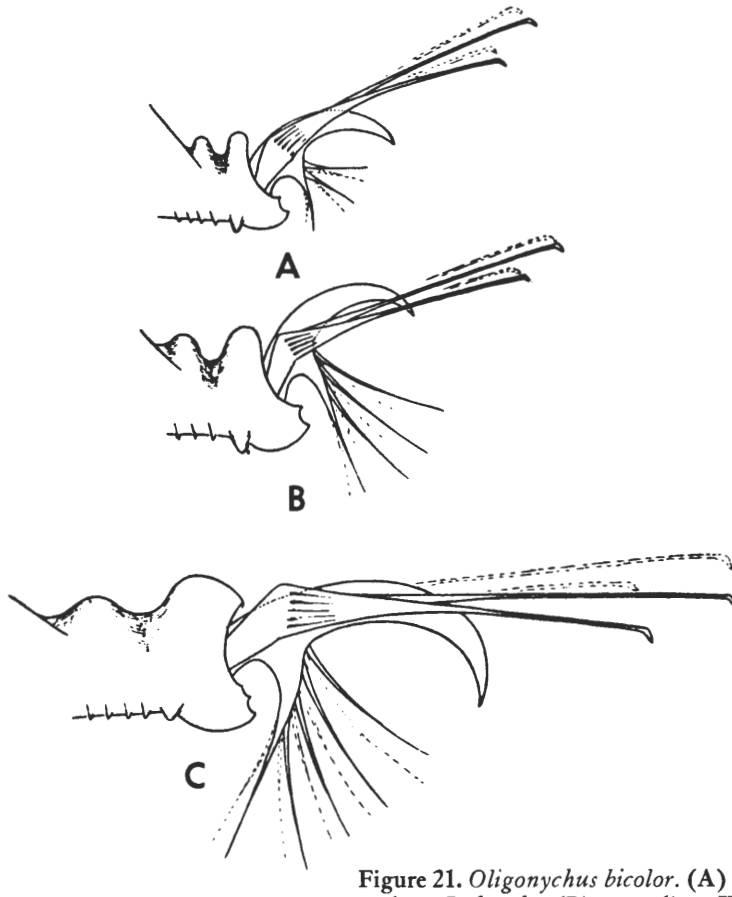


Figure 21. *Oligonychus bicolor*. (A) empodium I of male; (B) empodium III of male; (C) empodium IV of female; (D) aedeagus. (From Pritchard & Baker, 1955.)

the duplex setae on tarsus I. The female is also reddish in color.

This mite is recognized as a serious pest of oak and various ornamental trees throughout the eastern United States and in Kansas. It has been recorded on red oak, willow oak, white oak, pine oak, beech, chestnut, and American elm.

In South Dakota one collection has been made of this mite on oak (*Quercus* sp.), Lake County. Slide Nos. 144, 145, 146, 147, 148, 149, 150, 151, 152, and 153, 8/13/64, HCS.

Oligonychus (new species)

A suspected new species of *Oligonychus* is currently held by E. W. Baker pending description, and was collected from crested wheat grass (*A. smithii*), Jerauld County. Slide Nos. 72, 73, 74, 75, and 76, 8/4/64, LDW.

Tetranychus Dufour, 1832

Pritchard and Baker (1955) provide the following description of *Tetranychus.*

> Mites belonging to the genus *Tetranychus* feed on the underside of leaves of most of the angiospermous plants, usually forming colonies, at least to start with, and sometimes producing a great deal of webbing. The eggs are pearly, spherical, and without a dorsal stripe.
>
> Adult females in the more northern climates are nearly always greenish or straw-colored, but those in tropical areas are carmine in basic color. They overwinter, or enter a non-feeding phase, as orange females; elsewise reproduction is continuous throughout the year.

The genus *Tetranychus* may be recognized by having only one pair of para-anal setae (the postanals being absent) and by having the empodium composed of three (only two in *T. fijiensis*) pairs of proximoventral hairs on the female, or on tarsi III and IV of the male, above which there is a rudimentary or small spur, much shorter than the ventrally directed hairs. The paired empodial hairs are all similar in length and width (except in *T. fijiensis*).

The end of the peritreme always bears a long, four or five chambered hook, rarely anastomosing. The duplex setae on tarsus I are widely separated on the dorsum on the tarsus, and this segment is long and gradually narrows distally. Empodium I of the male usually consists of a pair of short, tridigitate appendages with or without a mediodorsal spur, and tarsus II usually bears a short spur above the paired empodial hairs. The aedeagus bends sharply dorsad, and the development of the distal end is characteristic of the species. Dorsal setae of the body are long and slender, and they are not borne on tubercles.

In South Dakota, *Tetranychus* is represented by four species, (*T. mc-*

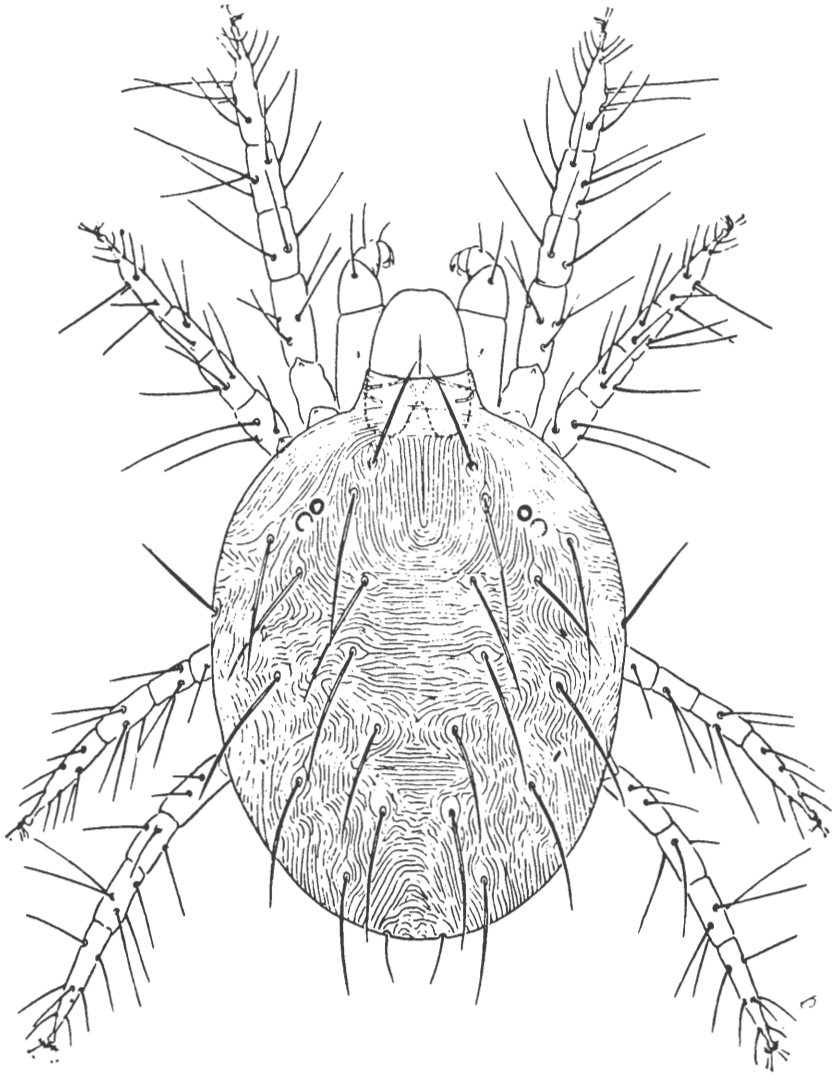


Figure 22. *Tetranychus telarius*. Dorsal aspect of female. (From Pritchard & Baker, 1955.)

danieli, canadensis, sinhai, and *telarius).*

Key to South Dakota species of *Tetranychus*

1. Female† with transverse (sometimes irregularly so) striae between the pair of dorsocentral hysterosomals and in the area caudad of these setae (Pacificus Group) ... 2

1. Female with longitudinal striae between the third pair of dorsocentral hysterosomals and with a diamond shaped pattern in the area caudad of these setae (Telarius Group) ... *telarius*

2. (1) Female with transverse integumentory striae between inner sacral setae ... *mcdanieli*

2. (1) Female with longtiudinal or irregular integumentary striae between inner sacral setae ... 3

3. (2) Longitudinal pattern of striae between inner sacral setae slightly irregular; neck of aedeagus about equal in length to knob; knob of aedeagus bearing acute angle to neck ... *canadensis*

3. (2) Longitudinal pattern of striae between inner sacrals more irregular; neck of aedeagus much shorter than length of knob; knob of aedeagus acutely angled with angle to neck ... *canadensis*

†Males belonging to the Pacificus and Telarius Groups may be identified by reference to figures of the aedeagus, but it is exceedingly difficult to present a key to the shapes of the simple aedeagus without considering the integumentary striae of the females. Moreover, females are found more easily than the males and are nearly always present in any collection.

Tetranychus telarius (L), 1758
two-spotted spider mite
(Figures 22, 23 & 24)

Of the *Tetranychus* species reported in South Dakota, *T. telarius* can be separated by the presence of longitudinal striae between the third pair of dorsocentral hysterosomals and, in the females only, by the presence of a diamond shaped striae pattern in the area caudad of the longitudinal striae. The aedeagal knob is not more than one-fifth the length of the dorsal margin of the shaft.

The two-spotted spider mite is world wide in distribution and is known to attack nearly every plant species. For these reasons, it is the most important pest species known among the spider mites. In addition to extensive feeding damage, this mite has been recently cited as a possible plant virus disease vector (Moskovetz, 1940 and Schultz, 1963).

Earlier collection records in South Dakota report the occurence of *T. telarius* or rose *(Rosa* sp.), Brookings County, 7/12/61 and from Turner County (no host record), 7/2/58. Field collections from this study show *T. telarius* occurring on green beans *(Phaseolus rulgaris),* Union County. Slide Nos. 134, 135, 136, 137, 138, 139, 140, 141, 142, and 143, 8/26/64, LDW; soybean *(Glycine* sp.), Codington County. Slide Nos. 294 and 295, 8/14/64, LDW; and rose *(Rosa* sp.), Hughes County. Slide No. 217, 7/30/64, HCS.

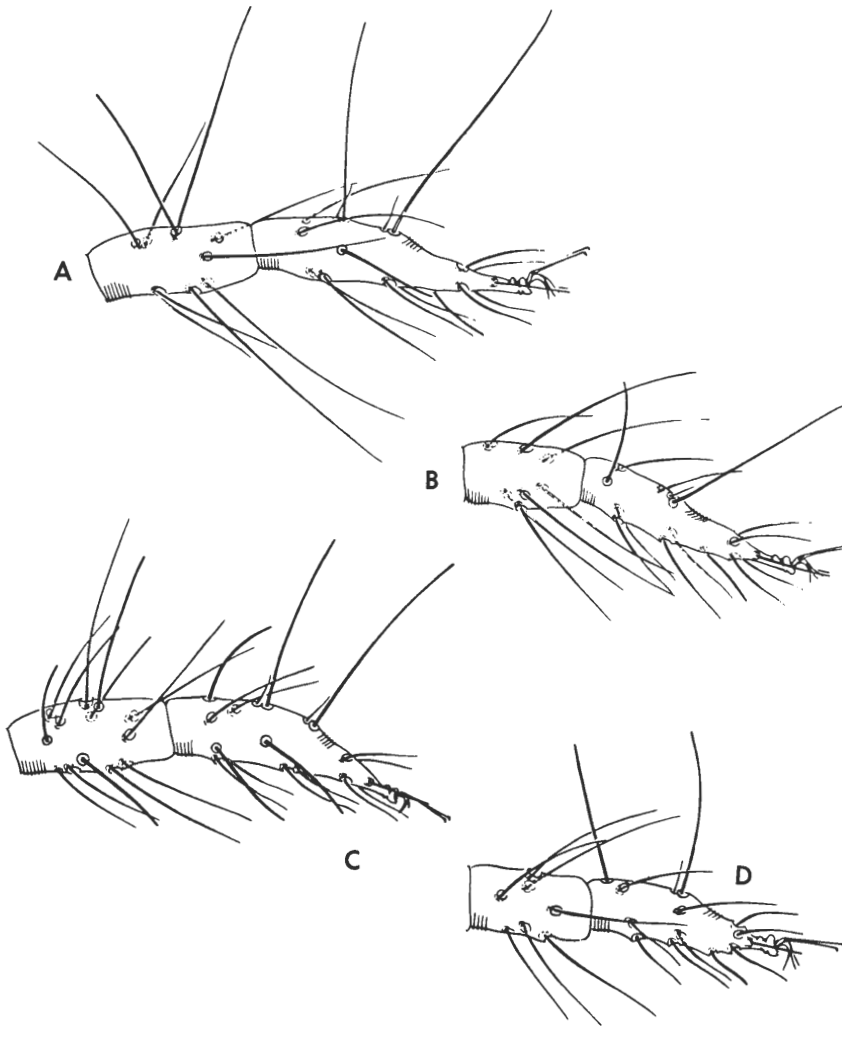


Figure 23. *Tetranychus telarius.* (A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus I of male; (D) tibia and tarsus II of male. (From Pritchard & Baker, 1955.)

Figure 24. *Tetranychus telarius* Aedeagi. (From Pritchard & Baker, 1955.)

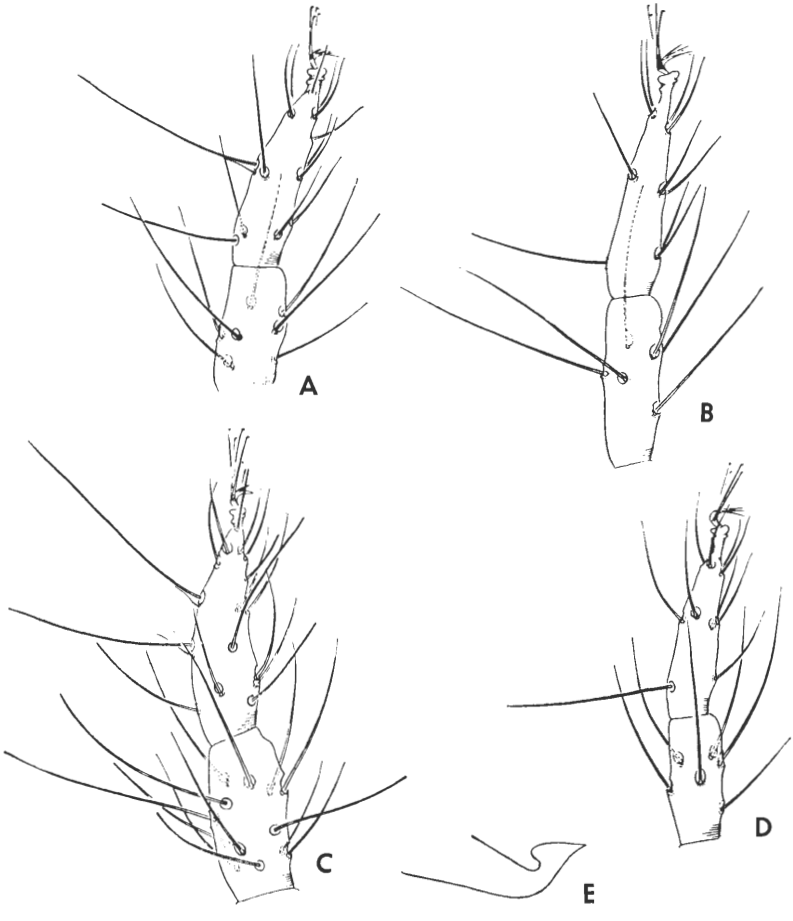
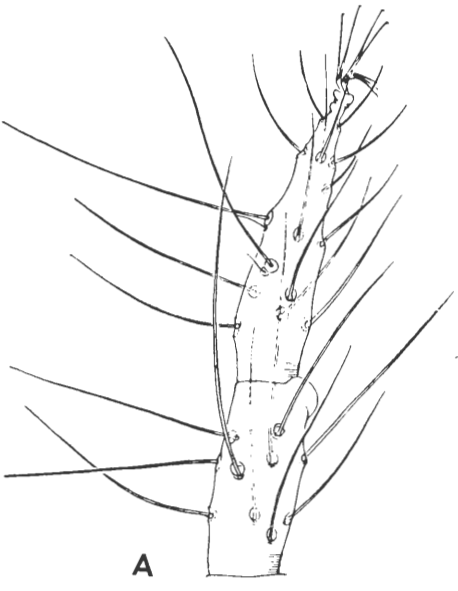


Figure 25. *Tetranychus sinhai.* (A) tibia and tarsus I of male; (B) tibia and tarsus II of male; (C) tibia and tarsus III of male; (D) tibia and tarsus IV of male; (E) aedeagus. (From Baker, 1962.)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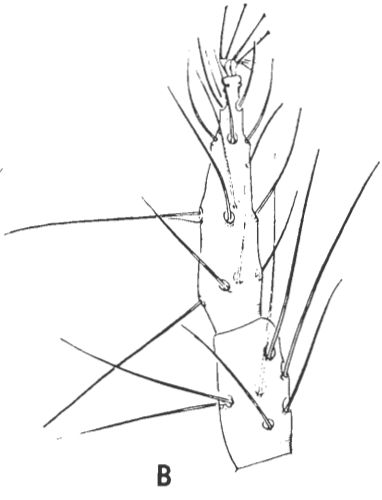
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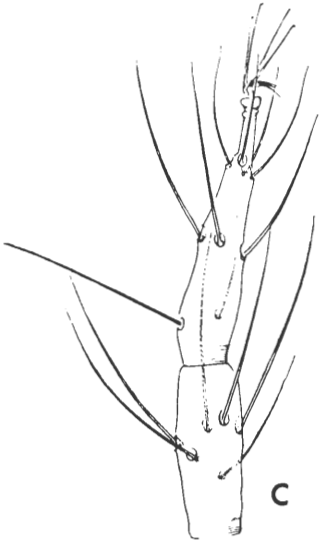

C


D

Tetranychus sinhai Baker, 1962
New record for South Dakota
(Figures 25 & 26)

This description is reported from Baker (1962).

Females of *Tetranychus sinhai* resemble those of *T. canadensis* (McGregor) in that the integumentary striae are transversely parallel between the third pair of dorsocentral hysterosomal setae and the inner sacrals, but are longitudinal between the inner sacral setae. The longitudinal pattern, however, is more irregular than in *canadensis*, and does not extend as far posteriorly. The aedeagus of the male has the same pattern as that of *canadensis* but the neck is much shorter and the knob is much more acutely angled with the neck.

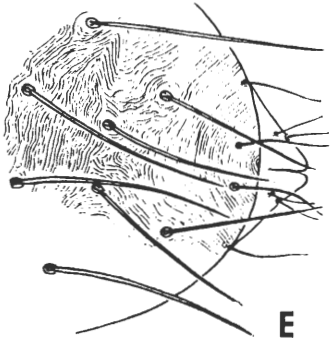


Figure 26 (above and facing page). ***Tetranychus sinhai.*** **(A) tibia and tarsus I of female; (B) tibia and tarsus II of female; (C) tibia and tarsus III of female; (D) tibia and tarsus IV of female; (E) posterior dorsal portion of female showing striation pattern. (From Baker, 1962.)**

Male – Palpus with terminal sensillum slender, about three times as long as wide. Peritreme with strong hook distally. Tibia I with nine tactile and four sensory setae; tarsus I with three tactile and two sensory setae proximal to duplex setae; one sensory seta on level with posterior duplex setae; empodium I with strong dorsal spur, but smaller than proximoventral spurs. Tibia II with seven tactile setae; tarsus II with three tactile and one sensory setae well proximal to the duplex setae; empodium with short mediodorsal claw and three pairs of proximoventral hairs. Tibia III with six tactile setae; tarsus III with a long slender sensory seta and a single proximal tactile seta, four mediodistal tactile setae, and four distal tactile setae; empodial claw lacking. Tibia IV with six tactile setae; tarsus IV with a long, slender sensory seta and two proximal ventral tactile setae, three medioventral tactile setae, and four distal tactile setae; empodial claw lacking. Dorsal setae of idiosoma long, slender, pubescent. Aedeagus with shaft gradually narrowing, with short neck, and with a relatively large knob set at a strong angle with the neck, the anterior portion of the knob being well rounded. Length of body 382 microns.

Female – Palpus with terminal sensillum stout, about twice as long as broad. Peritreme with strong hook distally. Tibia I with nine tactile and one sensory setae; tarsus I with four tactile and one sensory setae proximal to duplex setae. All empodia without dorsomedian spurs. Tibia II with seven tactile setae; tarsus II with one long, slender sensory and three tactile setae proximal to duplex setae. Tibia III with six tactile setae; tarsus III with a long slender sensory and single posterior tactile setae, with three mediodistal tactile setae, and four distal tactile setae. Tibia IV with seven tactile setae; tarsus IV with a long slender sensory and a single posterior tactile setae, with four mediodistal tactile setae, and four distal tactile setae. Hysterosoma with transverse striae between third pair of dorsocentral and inner sacral setae, but with irregular longitudinal striae between inner sacrals. Striae lobed. Dorsal setae of idiosoma long, slender, pubescent. Length of body 446 microns.

Holotype – Male, Brandon, Manitoba, July 21, 1961 (R. N. Sinha), on barley. In the Canadian National Collection, Ottawa.

Since its original description from Canada in 1962, this mite has been a subject of considerable interest. Wallace and Sinha, (1961) reported severe infestations on barley in Manitoba, Canada. Damage from the presence of this mite has been reported on barley leaves from seedling stage to just prior to maturity. Symptoms included necrosis (usually at the leaf bend), followed by yellowing and wilting from the point of feeding to the tip. The condition of necrosis was often accompanied by downward and inward curling of the leaves. This and other studies by these workers (Sinha and Wallace, 1963 and Sinha, 1965) have placed this mite under suspect as a possible vector of Agropyron mosaic virus and an undescribed wheat virus.

Reported hosts have included barley, rye, and wheat with marginal infestations on corn and sunflower.

The presence of this mite in South Dakota is the only known report of its occurence in the United States. Collections have been made from barley *(H. vulgare)*, Spink County. Slide Nos. 154, 155, 156, 157, 158, 159, 160, 161, and 162, 7/7/64, HCS; crested wheat grass *(Agropyron cristatum)*, Sully County. Slide Nos. 165 and 166, 7/24/64, HCS; crested wheat grass *(A. cristatum)*, McPherson County. Slide No. 419, 7/21/64, LDW; barley *(H. vulgare)*, Beadle County. Slide Nos. 280, 281, 282, 283, 7/8/64, LDW; Brown County. Slide Nos. 284, 285, 286, 287, 288, and 289, 7/15/64, HCS; Ree wheat grass *(Agropyron intermedium)*, McPherson County. Slide Nos. 258, 259, 260, 261, 262, 263, and 264, 7/21/64, HCS; grass (genus and species unknown), Hughes County. Slide Nos. 270, 271, and 272, 8 20 64, LDW; wheat *(Triticum*

aestivum), McPherson County. Slide Nos. 256 and 269, 7/21/64, HCS; Brown County. Slide No. 257, 7/15/64, LDW; Grant County. Slide Nos. 273, 274, 275, 276, 277, 278, and 279, 7/2/64, HCS; Day County. Slide No. 315, 7/13/64, HCS; Rose *(Rosa* sp.), McPherson County. Slide Nos. 392, 393, 394, 395, 396, and 397, 7/21/64, HCS; and choke cherry *(Prunus virginiana)*, Turner County. Slide Nos. 163 and 164, 8/25/64, HCS.

Tetranychus mcdanieli McGregor, 1931 Mcdaniel mite
New record for South Dakota
(Figures 27 & 28)

The Mcdaniel mite and four-spotted spider mite are the only species of the Pacificus Group found in South Dakota. Females of this Group are characterized by transverse striae (sometimes irregular) between the third pair of dorsocentral hysterosomals. Transverse striae are also present between the dorsocentral hysterosomals and the inner sacrals. Striae between inner sacrals of *T. mcdanieli* are transverse. The peritreme of the Pacificus Group terminates in a simple hook. The aedeagus of *T. mcdanieli* is sigmoid in shape as shown in figure 28.

T. mcdanieli is considered a serious pest of fruit trees particularly in areas of the western and north western United States. It has also been reported in the central and eastern United States and in Manitoba, Canada. Hosts have included apple, plum, prune, raspberry, and ornamentals.

In South Dakota, this mite has been collected only on rose *(Rosa* sp.) Butte County. Slide Nos. 296, 297, 298, 299, 300, 301, 302, and 303, 6/24/64, LDW.

Tetranychus canadensis (McGregor), 1950 four-spotted spider mite
New record for South Dakota
(Figures 27 & 29)

The four-spotted spider mite is the second species of the Pacificus Group found in South Dakota. In addition to the Pacificus Group features cited previously, *T. canadensis* females bear longitudinal or irregular integumentary striae between the inner sacrals. The males of *T. canadensis* possess an aedeagus bearing a distinct distal knob which is about one-fourth as long as the dorsal margin of the shaft.

Severe infestations following orchard pest control practices have been reported from Illinois (Orchard Pests, USDA, CEIR, 1961 and 1963), and Missouri (Orchard Pests, USDA, CERI, 1962).

Records of heavy or general infestation by *T. canadensis* have occurred in orchards in Ontario and Quebec, Canada and in Missouri on peach and apple, in Illinois on red clover, apple and peach, in Oklahoma on tomato, beans, sweet potato, and okra, in Massachusetts on elm, in Utah on ash, in New Mexico on ornamentals, and in Tennessee on orchards in general. Bronzing of leaves with subsequent dropping has been observed in cases of heavy infestation (White, 1964).

T. canadensis has been previously reported infesting at least 28

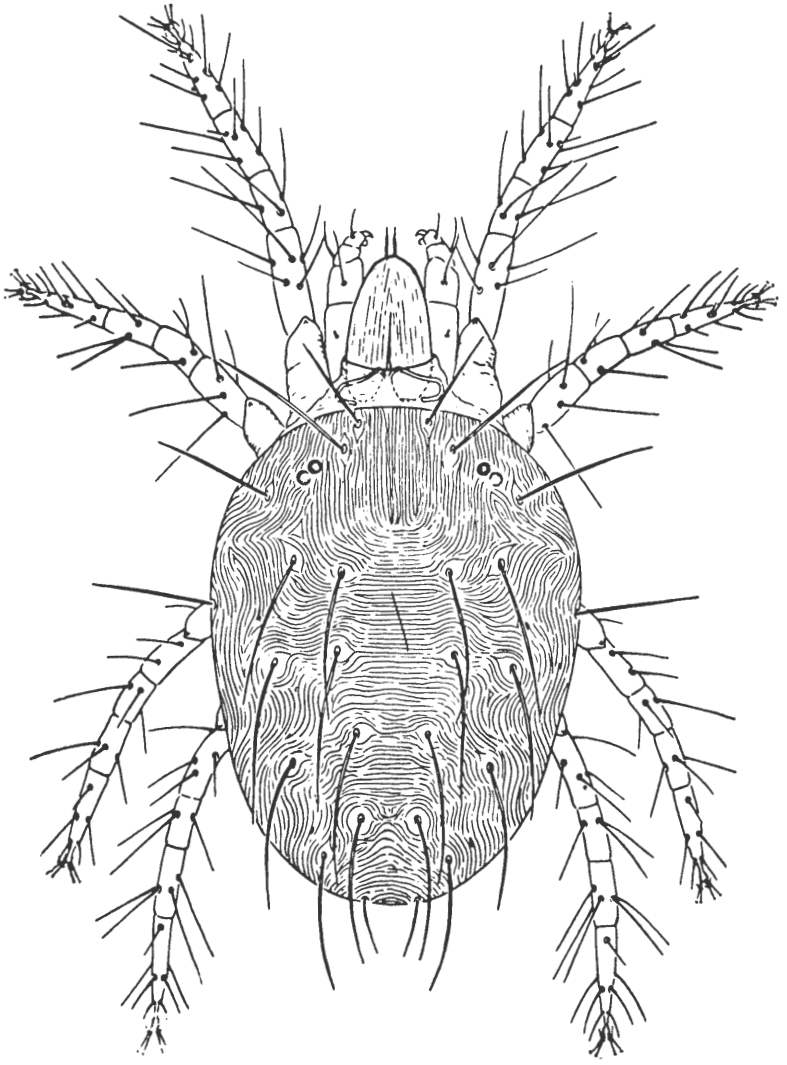


Figure 27. Pacificus Group (*Tetranychus pacificus*). Dorsal aspect of female. (From Pritchard & Baker, 1955.)

Figure 28. *Tetranychus mcdanieli.* Aedeagi. (From Pritchard & Baker, 1955.)

different host plants with scattered distribution in Canada and all but the extreme western and northwestern states.

In South Dakota, this mite has been observed in large numbers causing extensive damage, particularly to apple orchards in the northeastern corner of the state.

South Dakota collection records for *T. canadensis* are lengthy and include: plum *(Prunus domestica)*, Lincoln County. Slide Nos. 9, 10, 11, 12, 13, 14, 15, and 16, 8/27/64, HCS; McCook County. Slide Nos. 332, 333, 334, and 335, 8/12/64, HCS; Minnehaha County. Slide Nos. 1, 2, 3, 4, 5, 6, 7, and 8, 8/12/64, HCS; Lake County. Slide Nos. 17, 18, 19, 20, 21, 22, 23, 24, 25, and 26, 8/13/64, HCS; Hanson County. Slide Nos. 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, and 37, 8/12/64, HCS; Bon Homme County. Slide Nos. 41, 42, 43, 44, 45, 46, 47, and 48, 8/18/64, HCS; Turner County. Slide Nos. 49, 50, 51, 52, 53, 54, 55, and 56, 8/25/64, HCS; Clay County. Slide Nos. 197, 198, 199, 200, 201, 202, 203, and 204, 8/26/64, HCS; terry plum *(Prunus domestica)*, Roberts County. Slide Nos. 336, 337, 338, 339, 340, 341, and 342, 8/13/64, LDW; wild plum *(Prunus americana)*, Sanborn County. Slide Nos. 205, 206,

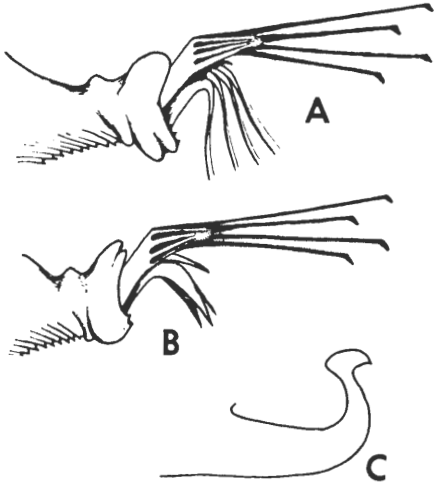
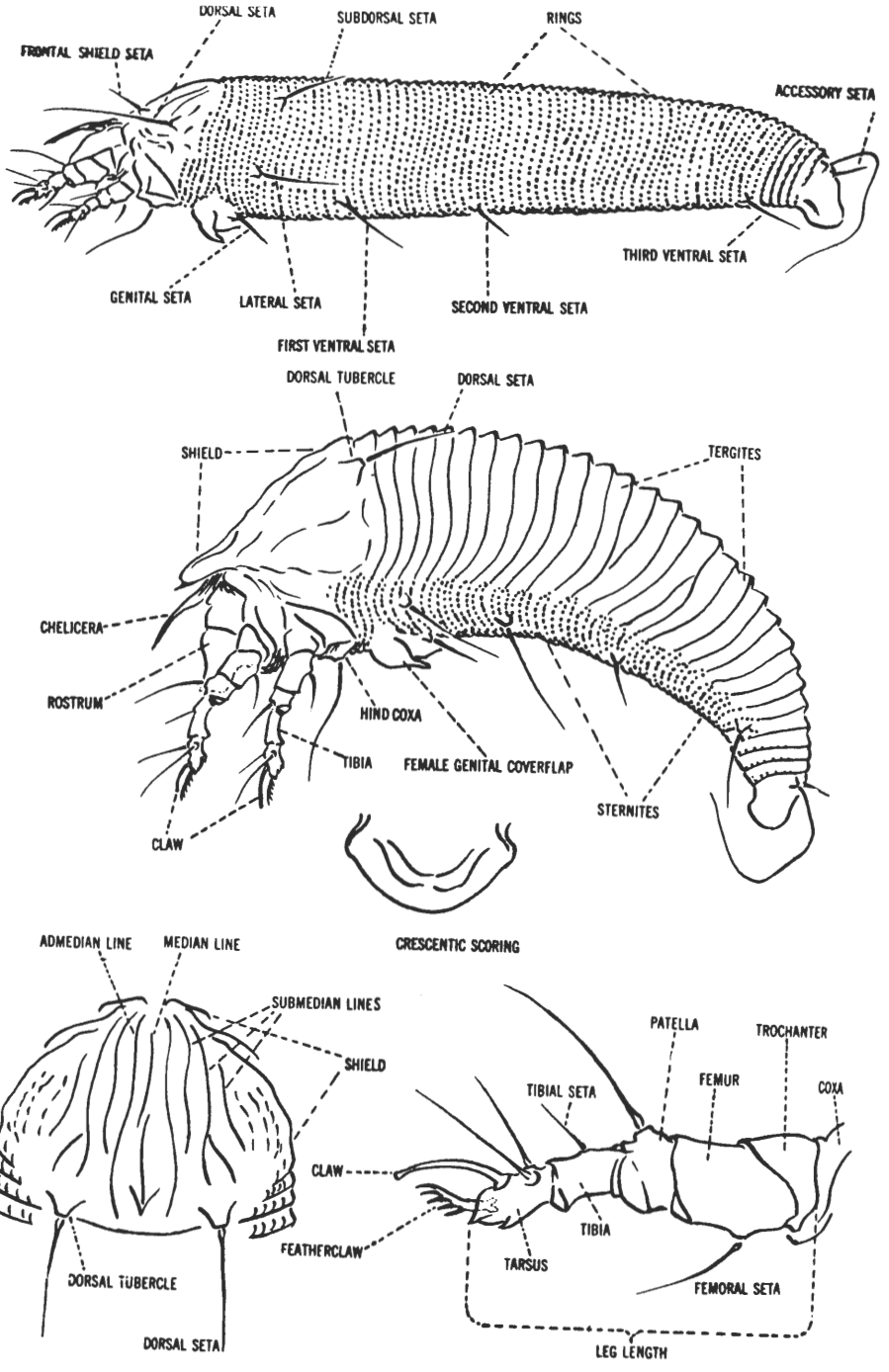


Figure 29. *Tetranychus canadensis.* (A) empodium I of female; (B) empodium I of male; (C) aedeagus. (From Reeves, 1963.)

207, 208, 209, 210, and 211, 8/6/64, LDW; Roberts County. Slide Nos. 212, 213, and 215, LDW; choke cherry *(Prunus virginiana)*, Turner County. Slide No. 379, 8/25/64, HCS; apple *(Pyrus malus)*, Fall River County. Slide No. 265, 7/29/64, LDW; Hughes County, Slide Nos. 234, 235, 236, and 237,


DORSAL SETA
SUBDORSAL SETA
RINGS
FRONTAL SHIELD SETA
ACCESSORY SETA
THIRD VENTRAL SETA
GENITAL SETA
LATERAL SETA
SECOND VENTRAL SETA
FIRST VENTRAL SETA
DORSAL TUBERCLE
DORSAL SETA
SHIELD
TERGITES
CHELICERA
ROSTRUM
HIND COXA
TIBIA
FEMALE GENITAL COVERFLAP
STERNITES
CLAW
CRESCENTIC SCORING
ADMEDIAN LINE
MEDIAN LINE
SUBMEDIAN LINES
SHIELD
CLAW
FEATHERCLAW
DORSAL TUBERCLE
DORSAL SETA
PATELLA
TROCHANTER
FEMUR
COXA
TIBIAL SETA
TIBIA
TARSUS
FEMORAL SETA
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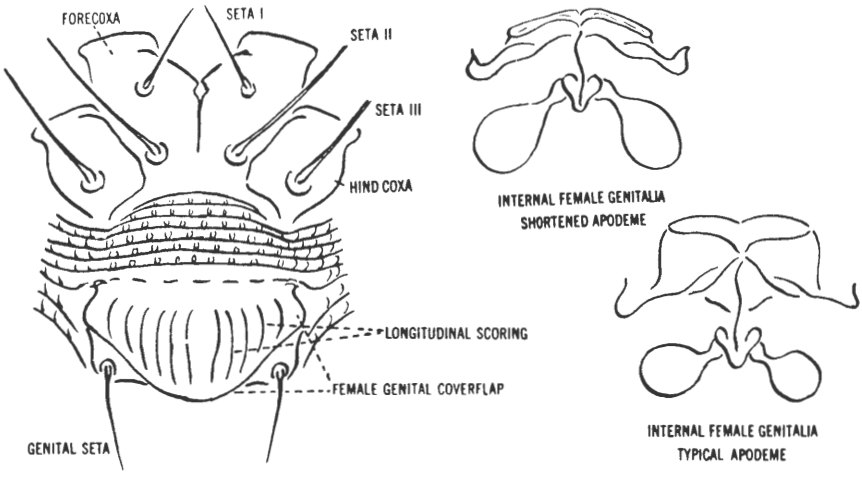

Figure 30 (above and facing page). Eriophyidae. Nomenclature of setae and general body features. (From Keifer, 1952.)

7/23/64, LDW; wild apple (P. sp.), Roberts County. Slide Nos. 227, 228, 229, 230, 231, 232, and 233, 8/13/64, LDW; dolgo crabapple *(P. baccata),* Roberts County. Slide Nos. 324, 325, 326, 327, 328, 329, 330, and 331, 8/13/64, LDW; whitney crab apple *(P. baccata),* Roberts County. Slide Nos. 178, 179, 180, 181, 182, and 183, 8/13/64, LDW; strawberry crab apple *(P. baccata),* Roberts County. Slide Nos. 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, and 368, 8/13/64, LDW; N. W. greening apple *(P. malus),* Roberts County. Slide Nos. 58, 59, 60, 61, 62, 63, 64, 184, 185, 186, 187, 188, 189, and 190, 8/13/64, LDW; yellow delicious apple *(P. malus),* Roberts County. Slide Nos. 65, 66, 67, 68, 69, 70, and 71, 8/13/64, LDW; harlson apple *(P. malus),* Roberts County. Slide Nos. 170, 171, 172, 173, 174, 175, 176, and 177, 8/13/64, LDW; red dutchess apple *(P. malus),* Roberts County. Slide Nos. 191, 192, 193, 194, 195, and 196, 8/13/64, LDW; wealthy apple *(P. malus),* Roberts County. Slide Nos. 343, 344, 345, 346, 347, 348, 349, 350, 351, and 352, 8/13/64, LDW; American elm *(Ulmus americana),* Roberts County. Slide Nos. 353, 354, 355, 356, and 357, 8/13/64, LDW; hollyhock *(Althaea rosea),* Roberts County. Slide Nos. 166, 167, 168, and 169, 8/13/64, LDW; green ash *(Fraxinus pennsylvanica),* Hughes County. Slide Nos. 238, 239, 240, 241, 242, 243, 244, 245, and 246, 7/23/64, LDW; rose *(Rosa* sp.), Hughes County. Slide Nos. 218, 219, 220, 221, and 223, 7/30/64, HCS; and Slide Nos. 222, 224, 225, and 226, 7/23/64, HCS; Roberts County. Slide Nos. 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, and 314, 7/14/64, HCS; Brule County. Slide Nos. 316, 317, 318,

319, 320, 321, 322, and 323, 8/5/64, LDW; and wild rose (*Rosa* sp.), Sanborn County. Slide No. 268, 8/6/64, LDW.

Eriophyidae Nalepa, 1898
eriophyid mites

Baker and Wharton (1952) provide the following description of eriophyids.

> The eriphyids are minute, worm like mites whose propodosoma is shield like and has distincitive, specific patterns. The hysterosoma is elongated and annulate. These mites do not possess a respiratory system. Two pairs of anterior legs are present in all stages and all tarsi have rayed claws. The genitalia are situated on the anterior, ventral portion of the body just behind the legs and the genital plate is a transverse rather than a longitudinal slit. Palpi are short and simple. The chelicerae are short-like for piercing. The anal opening is on the posterior of the body. These mites are either free living on plants or gall makers.

Taxonomic characters used in identification of the Eriophyidae are shown in figure 30.

Keifer (1965) has provided the key below for identification of eriophyed species known to occur in South Dakota.

Key to known adult species of Eriophyidae in South Dakota

1. Strong middorsal longitudinal abdominal ridge present; shield with moderately long anterior lobe over rostrum; bands of wax secreted by ridges; habit—living on leaf surfaces or in surface crenulations, a rust mite ..... *Abacarus hystrix*
1. Abdomen approximately circular in cross section, ridge if present, weaker than above 2
2. (1) Moderate lobe over rostrum; a short line forming an arc in front of each dorsal tubercle; weak dorsal longitudinal abdominal ridge; microtubercles on ring margins; habit – a rust mite ..... *Aculus dubius*
2. (1) Abdomen circular in cross section; no arc in front of dorsal tubercles 3
3. (2) Small shield lobe over rostrum base; microtubercles as beads on ring margins; body covered with dusty wax; habit—living in leaf crenulations, a rust mite ..... *Aculus mckenziei*
3. (2) Shield lobe over rostrum negligible; microtubercles pointed, set ahead of ring margins, in part projecting over margins; no wax; habit—living under cover in curled leaves or at leave bases ..... *Aceria tulipae*

Abacarus hystrix (Nal.), 1944
grain rust mite

The following description of the grain rust mite is provided from Keifer (1944).

> Female 180-200 microns long, 35-40 microns wide, 45 microns thick, whitish; in life with a central longitudinal stripe of wax, enclosed by a lateral band on each side. Rostrum 30 microns long, antapi-

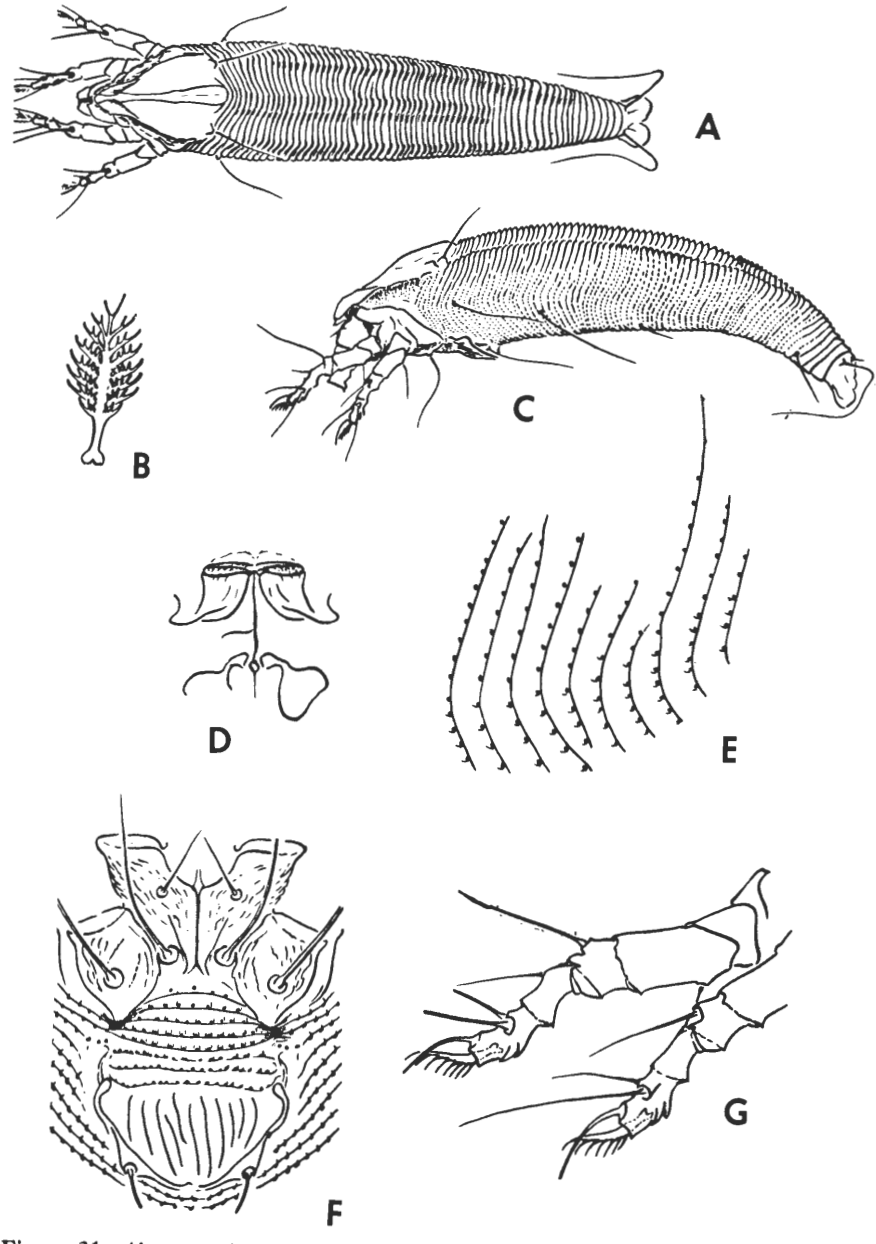

Figure 31. *Abacanus hystrix*. (A) dorsal view; (B) feather claw; (C) lateral view; (D) internal female genitalia; (E) lateral integeument structure; (F) female genitalia and coxae from below; (G) left leg. (From Keifer, 1952.)

cal seta 8.5 microns long. Shield 50 microns long, 35 microns wide; anterior lobe narrowed above, a spine below; shield with a central ridge, laterally granulate; dorsal tubercles 23.5 microns apart, on rear margin; dorsal setae 20 microns long, projecting caudad. Forelegs 36 microns long, tibia 8.5 microns long, tarsus 8 microns long; claw 9 microns long, curved tapering; featherclaw 8 rayed. Hindlegs 35 microns long, tibia 7 microns long, tarsus 7 microns long, claw 7.5 microns long, coxae with strong sternal line. Abdomen with sternites microtuberculate, the microtubercles suppressed or absent on tergites; the central longitudinal wax-bearing ridge ending in the dorsal trough on about the 46th tergite, supralateral wax-bearing ridges extending farther caudad; tergites about as numerous as sternites; sternites 60-65. Lateral seta 35 microns long, on about sternite 6; first ventral 36 microns long, on about sternite 21; second ventral 23 microns long, on about sternite 38; third ventral 27 microns long, on about 4 from rear; accessory seta present. Female genitalia deep basin-shaped externally, 21 microns wide, 16 microns long coverflap with about 12 furrows, set 40 microns long.

Male 170-190 microns long, 40 microns wide, 35-40 microns thick.

This mite is widely distributed on perennial grasses throughout the northern hemisphere and is considered of economic importance in several areas.

In South Dakota this mite has been collected on alfalfa *(Medicago sativa)*, county unknown, 6/7/56; orchard grass *(Dactylis glomerata)*, Jerauld County 4/26/56; blue grama grass *(Bouteloua gracilis)*, Perkins County. Slide Nos. 45, 46, and 47, 7/16/64, LDW; winter wheat *(Triticum aestivum)*, Roberts County. Slide Nos. 40, 41, 42, 43, and 44, 7/14/64, HCS; grass (species unknown), Hand County. Slide Nos. 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, and 39, 7/28/64, HCS; prairie cordgrass *(Spartina pectinata)*, Union County. Slide Nos. 79, 80, 81, 82, and 83, 8/26/64, LDW; Hanson County. Slide Nos. 73 and 74, 8/12/64, LDW; barley *(Hordum vulgare)*, Brown County. Slide Nos. 57, 58, 59, 60, and 61, 7/15/64, LDW; crested wheat grass *(Agropyron cristatum)*, Sully County. Slide Nos. 53, 54, 55, and 56, 7/29/64, HCS; Potter County. Slide Nos. 62 and 63, 7/28/64, HCS; and western wheatgrass *(A. smithii)*, Hand County. Slide Nos. 48, 49, 50, 51, and 52, 7/17/64, LDW; Sully County. Slide Nos. 66 and 67, 7/17/64, LDW.

Aculus (?) dubius

New record for South Dakota

Keifer (1965) reports this mite as a relatively new species, for which he has not yet published an original description. According to Keifer, the only previous record of this mite is from Idaho and in

Europe. The key to this species has been previously cited. There is some question on the genus pending further investigation.

In South Dakota, this mite was collected only once on western wheat grass *(A. smithii)*, Bennett County. Slide Nos. 71 and 72, 7/29/64, LDW.

Aculus mckenziei (Keifer) 1944
New record for South Dakota
(Figure 32)

The original description of *A. mckenziei* is provided from Keifer (1944).

> Female 170-210 microns long, 40-59 microns thick, wormlike, white; in life covered with white powdery wax. Rostrum 35 microns long, large downcurved, apical seta 12 microns long. Shield 46 microns long, 40 microns wide, the anterior lobe narrow and pointed; design of longitudinal lines curved to the rear; granules to the rear and sides. Dorsal tubercles 35 microns apart, on rear shield margin; dorsal setae 43 microns long, projecting caudad. Forelegs 36 microns long, tibia 9 microns long, tarsus 10 microns long; claw 11 microns long, curved, tapering; featherclaw 7-rayed. Hindlegs 33 microns long, tibia 6 microns long, tarsus 8.5 microns long, claw 12 microns long. Anterior coxae broadly contiguous; setae 1 opposite anterior point of junction. Abdomen completely microtuberculate and Eriophyiform, with the sternites slightly more numerous; microtubercles acuminate; sternites about 65 in number. Lateral setae 30 microns long, on about sternite 23; second ventral 26 microns long on about sternite 39; third ventral about 25 microns long, on about sternite 5 from rear; accessory seta present. Female genitalia 23 microns wide, 17.5 microns long, coverflap with about 12 long furrows, seta 25 microns long.
>
> Male 150-170 microns long, 35-40 microns thick.

The only host in South Dakota on which this mite has been collected is western wheat grass *(Agropyron smithii)*, Corson County. Slide Nos. 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27, 7/17/64, LDW; Potter County. Slide Nos. 15, 16, and 17, 7/17/64, LDW; Hyde County. Slide Nos. 7, 8, 9, 10, 11, 12, 13, and 14, 7/17/64, LDW; Tripp County. Slide Nos. 68 and 69, 7/31/64, LDW; Lyman County. Slide Nos. 64 and 65, 7/23/64, LDW.

Aceria tulipae (K.) 1944
wheat curl mite
(Figure 33)

Keifer (1938) provides the following original description of *A. tulipae.*

> Female spindle-form a little curved, whitish, 210-250 microns long, 50 to 65 microns wide. Rostrum 28 microns long, gently bent down. Shield but little curved above, subtriangular, slightly overlying the rostrum base, 39 microns long by 36 microns wide; de-

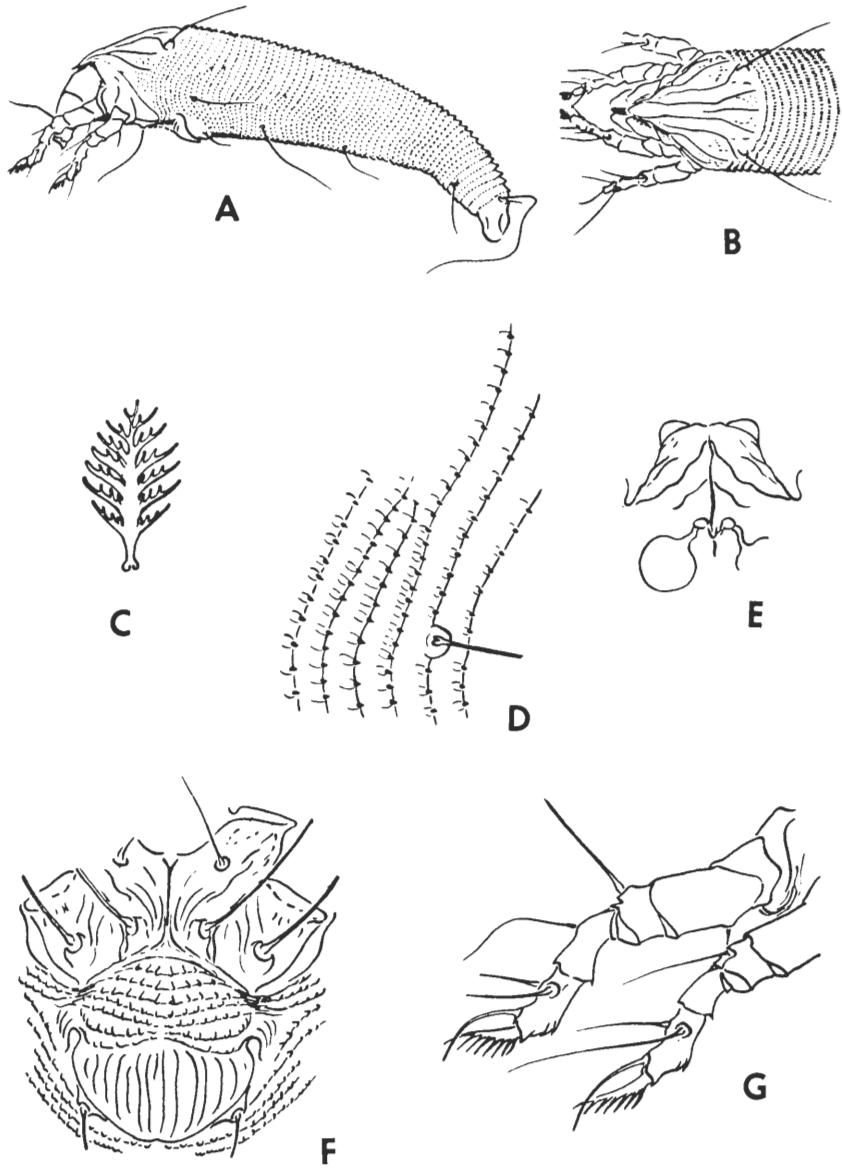

Figure 32. *Aculus mckenziei.* (A) dorsal view; (B)dorsal view of shield; (C) feather claw; (D) lateral integument structure; (E) internal female genitalia; (F) female genitalia and coxae from below; (G) left leg. (From Keifer, 1952.)

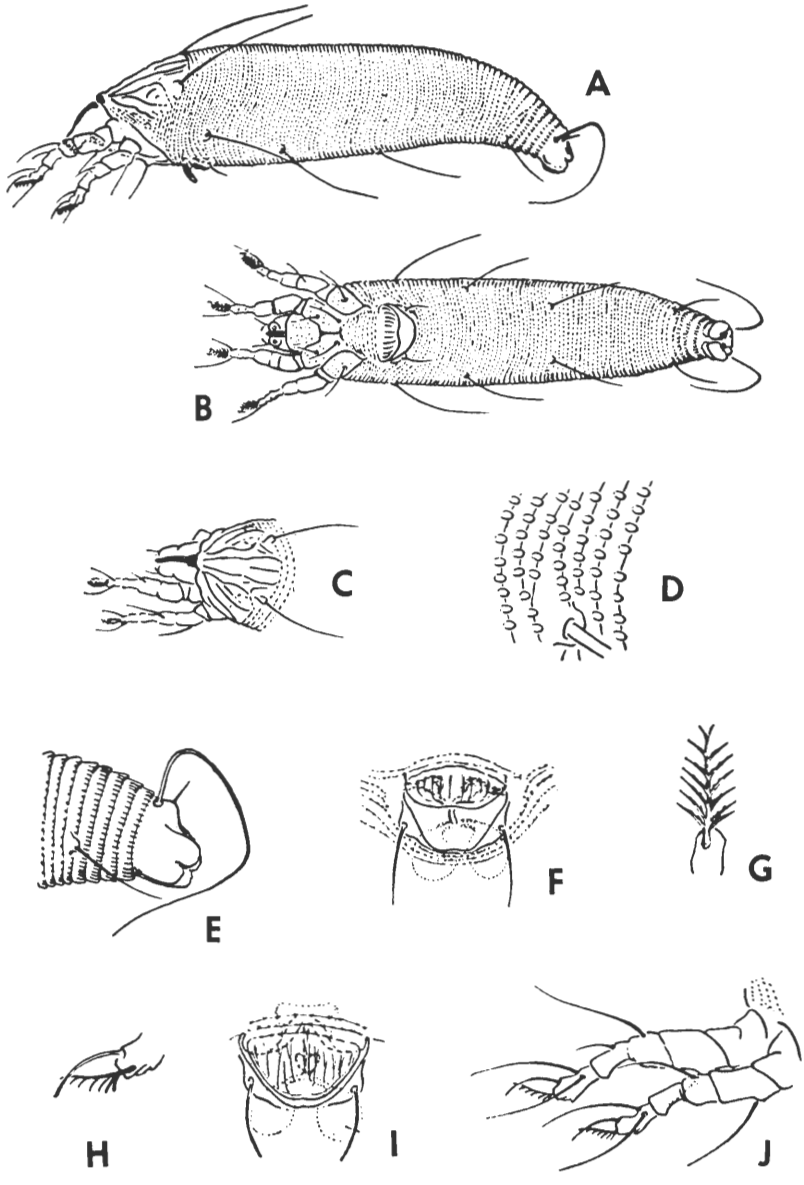

Figure 33. *Aceria tulipae*. (A) lateral view; (B) ventral view; (C) dorsal view of shield; (D) lateral integument structure; (E) lateral view of posterior section; (F & I) ventral view of female genitalia; (G) feather claw; (H) tarsus; (J) left legs. (From Keifer, 1938.)

sign clear and in disc basically of five diverging lines, the shield sides with curved lines and band of granulations above edge; dorsal tubercles moderate in size on rear margin, 23 microns apart, the setae projecting backward over 60 microns long. Legs moderately long and slender. Forelegs 40.5 microns long, patella 8 microns long, tibia 9 microns long; patellar seta 28.5 microns long; claw rather strongly downcurved, slender, about 10 microns long; featherclaw 7-rayed. Hindleg 36 microns long, patella 8 microns long, tibia 8 microns long, patellar seta 14 microns long, claw 11 microns long. Anterior coxae touching, sternal ridge forked; coxae and suboral plate minutely granulate; seta of second coxa 40 microns long. Abdomen with 85 to 90 rings, some ventrad reduction in number; rings about 2 microns wide, the microtubercles partly resting on rear edge of each ring; last 5 or 6 rings with microstriations. Lateral seta on about ring 10, above genital seta, 35.5 microns long. First ventral seta about ring 27, and 54 microns long. Second ventral 35 or more microns long and on ring 50. Third ventral 31 microns long, 5 or 6 from rear. Caudal seta about 80 microns long; accessory seta 4.5 microns long. Female genitalia 24 microns wide, 17.5 microns long, subcordate, coverflap longitudinally furrowed, seta 12 microns long.

A. tulipae is a well known vector of wheat streak mosaic virus. This disease has been especially serious in the central Grain Belt States and Canada. Extensive research has been conducted on the wheat curl mite and its role as a virus vector. (Slykhuis, 1959, 196l, del Rosario, et. al, 1964, and Connin, 1956).

In South Dakota, *A. tulipae* has known distribution in virtually all winter wheat growing areas, (West River Counties). This pest has also been reported in counties along the eastern edge of the Missouri River (S. D. Ins. Surv. Rpt., 1962b and 1964).

Confirmation is awaited from Keifer on possible *A. tulipae* collected during the 1964 survey.

Abacarus (new species)

Among the eriophyids collected in South Dakota is a new species (Keifer, 1965), from *Sporobolus* for which we have no specific description at this time, but which is in the genus *Abacarus* and is closely related to *A. hystrix*.

This mite was collected only on alkali sacatan *(Sporobolus airoides)*, Sanborn County. Slide Nos. 1, 2, 3, 4, 5, and 6, 8/6/64, HCS. These mites are presently in the possession of H. H. Keifer.

Tarsonemidae Kramer, 1877

(Figure 34)

The tarsonemid mites are treated in exhaustive detail by Beer (1954) from which the following partial description is extracted.

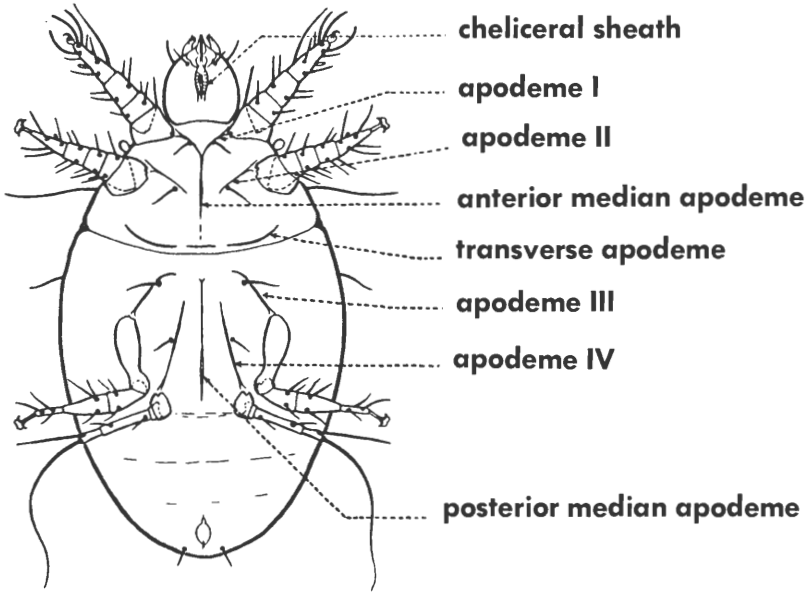

Figure 34. Tarsonemidae. Taxonomic structures. (From Beer, 1954.)

Tarsonemid mites are very small, ranging in length from one tenth to one third of a millimeter. The integument is relatively hard in the mature forms and has a shiny surface. The body is rather sparsely beset with setae as are the hind appendages. The anterior pairs of legs, especially their terminal segments, are more densely clothed with setae and often are equipped with specialized sensory setae of various configurations and sizes.

Pronounced sexual dimorphism is characteristic. The males are not only much smaller in size than females of the same species, but the general body contour is markedly different. In the female the usual condition is an ovoid body shape with the anterior pairs of legs separated from the posterior pairs by a distinct interval and the dorsum of the body convex. A group of species in the genus *Steneotarsonemus* has apparently undergone much modification in respect to general body contour, no doubt related to the adaptation for their particular habitats. Females of these species are quite elongate, with the anterior and posterior pairs of legs widely separated. In addition, the mites of both sexes are dorsoventrally depressed which is indeed a configuration quite suitable for their activities in the confined

spaces between the sheaths and stems of the grasslike hosts.

The body of a tarsonemid mite is divided into three well-defined portions and may be further dividied by the use of established terminology as defined below. The mouthparts are contained in a distinct capsular head called the capitulum. The remainder of the body comprises the idiosoma which is transected by a definite and distinct suture, called the main body suture, between the anterior and posterior pairs of legs. The unsegmented area anterior to the main body suture is called the propodosoma and the portion of the idiosoma behind the main body suture is the hysterosoma. The propodosoma is a single, more or less continuous body region, which in some species has the dorsum prolonged anteriorly forming what is called a cephalothoracic or rostral shield which is sometimes separated from the remainder of the dorsal propodosoma by a suture. Such a prolongation or forward extension of the dorsum of the propodosoma, which occurs in many families of mites, has also been designated by various authors as the cephalothoracic hood or rostral hood. The hysterosoma may be further divided into anterior and posterior portions or that portion from the main body suture to the hind margins of coxae IV and the portion behind the legs. Names applied to these two regions of the hysterosoma are the metapodosoma and the opisthosoma, for the anterior and posterior portions respectively.

The mouth parts consist of stout, paired palpi of indistinct segmentation inserted on the apical portion of the capitulum, and slender, styliform, paired chelicerae, the bases of which are inserted just medially to the bases of the palpi. Situated medially and internally in the capitulum are paired, tubelike structures which are referred to in this paper as cheliceral sheaths.

Tarsonemids are characterized by the pronounced development of apodemes on the ventral portion of the body. The apodemes have been designated by the present writer as follows: apodemes I, which have their anterolateral termina in the region of the anterior margins of coxae I; apodemes II, which have their anterolateral termina in the region of the anterior margins of coxae II; anterior median apodeme, which is medial in position on the propodosoma; transverse apodeme, which is associated with the main body suture; apodemes III, which terminate posterolaterally in the region of the anterior extremities of coxae III; apodemes IV, which terminate posteriorly near coxae IV; posterior median apodeme which

occupies a median longitudinal position on the metapodosoma.

The males are equipped caudally with a rather unique structure which Ewing and other authors refer to as the genital papilla. The papilla is situated terminally on the opisthosoma in living specimens but in microslide preparations it usually tilts to appear in a dorsal position with the dorsal margin thus appearing as the anterior margin and the ventral margin projecting caudad beyond the apex of the opisthosoma. It contains within its clearly defined limits the paired, styliform aedeagi as well as other accessory genital organs and appendages, the exact identity of which are as yet unknown. Another structure, referred to in this paper as the anal plate is often quite conspicuous in slide-mounted specimens. Its position in living males is subterminal on the ventral opisthosoma just anterior to the ventral margin of the genital papilla, although in microslide mounts this normal position is not often apparent. The plate is lacking in clearly defined lateral limitations, the most conspicuous portion of the structure being a central disc or aperature from which fingerlike apodemes radiate. The usual number of anal apodemes is three, two of which extend anterolaterally for a short distance from the anterolateral margins of the disc and the third projecting caudally from the posteromesal margin of the disc. However, in some species there may be four anal apodemes, two projecting from the anterior margin of the disc and two from the posterior margin, and one species has one apodeme projecting forward from the disc and two projecting caudad.

Females are characterized by the possession of specialized organs located dorsolaterally between coxae I and II. These organs, which vary somewhat in size and shape are of uncertain function and have been called clavate sense organs or pseudostigmatic organs by various workers. The term pseudostigmatic organs is used by the present writer although the applicability of this name is questionable. Probably these paired structures are highly modified sensilla trichodea and are more properly referred to as specialized sense organs, since they seem to have no relationship to the tracheal system.

Classification of the family Tarsonemidae has been based largely upon characters of the hind pair of legs of the males, this being a logical method of separation because of the variability of these appendages.

Key to the Genera of the Family Tarsonemidae

1. Palpi of both sexes prolonged anteriorly forming an elongate beak ..... *Rhynchotarsonemus**

1. Palpi of both sexes projecting slightly beyond apex of capitulum but never forming an elongate beak 2

2. (1) Males without claws, empodia or knoblike arolia on tips of legs IV ..... *Xenotarsonemus**

2. (1) Males with legs IV terminating in a claw or knoblike pretarsal element 3

3. (2) Males with body laterally compressed; tibia and tarsus or tibiotarsus IV slender, elongate, more than three times as long as basal width of tibia or tibiotarsus ..... *Hemitarsonemus**

3. (2) Males with body dorsoventrally depressed; tibia and tarsus or tibiotarsus IV at most two and one-half times as long as basal width of tibia or tibiotarsus 4

4. (3) Males with large, flangelike expansion on inner margin of femur IV or if absent then fourth dorsal propodosomal seta in linear arrangements with setae of three preceding pairs or capitulum broader than long ..... *Steneotarsonemus*

4. (3) Males with inner flange on femur IV absent or greatly reduced in size; fourth dorsal propodosomal seta always laterad from third seta or capitulum longer than broad ..... *Tarsonemus**

Genus ***Steneotarsonemus*** Beer (1954)

The males with one exception all have the dorsal propodosomal setae in linear arrangement, the usual number being four pairs, femora IV usually have the inner margins highly modified to form a flangelike process, never with a spurlike projection; the capitulum is usually subcircular, often as broad as or broader than long, never with extremely long palpi. Females never with a conspicuous transverse apodeme near main body suture; body often elongate, with anterior pairs of legs widely separated from posterior pairs; capitulum, as in male, usually as broad as or broader than long, first pair of ventral propodosomal setae usually in front of apodemes I; tracheae often with large conspicuous bilobed pouches or atria situated medially between legs I and II. The members of this genus are all phytophagous (Beer, 1954).

Steneotarsonemus hyaleos
Beer, (1954)
New record for South Dakota
(Figure 35)

This is the only tarsonemid species collected to date in South Dakota. The male can be recognized from other *Steneotarsonemus* species by having the inner margin of femur IV with a flangelike expansion, a propodosoma with four pairs of dorsal setae (the fourth pair being longer than the other three), and coxae III densely punctuate over most of their surfaces.

Collections of this mite in South Dakota were scattered and few. They include: rough dropseed *(Sporobolus asper)*, Meade County. Slide Nos. 445 and 446, 8/19/64, LDW; big blue stem grass *(Andro-*

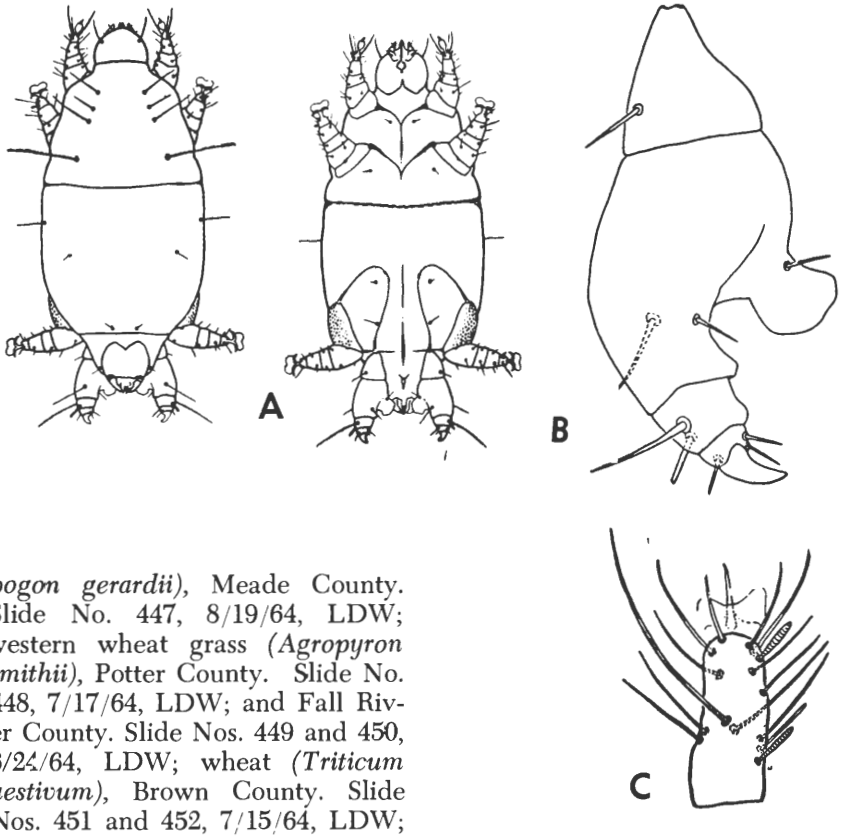

Figure 35. *Steneotarsonemus hyaleos.* **(A) dorsal and ventral aspects of male; (B) hind leg; (C) tibiotarsal segment of leg I of female. (From Beer, 1954.)**

pogon gerardii), Meade County. Slide No. 447, 8/19/64, LDW; western wheat grass *(Agropyron smithii),* Potter County. Slide No. 448, 7/17/64, LDW; and Fall River County. Slide Nos. 449 and 450, 6/24/64, LDW; wheat *(Triticum aestivum),* Brown County. Slide Nos. 451 and 452, 7/15/64, LDW; and blue grama grass *(Bouteloua gracilis),* Lyman County. Slide Nos. 453 and 454, 7/24/64, LDW; and Stanley County. Slide No. 455, 7/23/64, LDW.

Miscellaneous Mite Collections

A few instances were noted of mites found in association with the usual plant feeders other than those previously cited in this study. These collections are listed below. Reference is made to Baker and Wharton (1952) for general information on these mite groups.

Mesostigmata

The mesostigmatids collected during this survey were all members of the family Phytoseiidae. Although no attempt was made to determine species, the family is generally recognized as beneficial due to the presence of predaceous species.

South Dakota collection records include mesotigmatids from wild plum *(Prunus americana),* Roberts County. Slide Nos. 214 and 216, 8/13/64, LDW; plum *(P. domestica),* McCook County. Slide Nos.

478 and 479, 8/12/64, HCS; hollyhock *(Althaea rosea),* Roberts County. Slide No. 489, 8/13/64, LDW; choke cherry *(Prunus virginiana),* Turner County. Slide Nos. 380, 381, and 382, 8/25/64, HCS; apple *(Pyrus malus),* Fall River County. Slide Nos. 371, 372, 373, 374, 375, 376, 377, and 378, 7/29/64, LDW; Roberts County. Slide Nos. 481, 482, and 484, 8/13/64, LDW; Slide No. 485, 8/14/64, LDW; American elm *(Ulmus americana),* Roberts County. Slide No. 483, 8/13/64, LDW; oats *(Avena sativa),* Hand County. Slide No. 486, 7/7/64, HCS; Deuel County. Slide No. 487, 7/1/64, HCS; and big blue stemgrass *(Andropogon gerardii),* Meade County. Slide No. 488, 8/19/64, LDW.

Trombidiformes

In addition to the trombidiformes previously covered, a few less important species were also collected during 1964. These scattered collections include representatives of three families: *Tydeidae, Stigmaeidae* and *Erythraeidae.*

Tydeidae. Collections from this family are represented by the genus *Pronematus* on prairie cordgrass *(Spartina pectinata),* Hutchinson County. Slide Nos. 266 and 267, 8/20/64, HCS; wild rose *(Rosa* sp.), Faulk County. Slide Nos. 383, 384, 385, and 386, 7/22/64, LDW; and rose bush *(Rosa* sp.), McPherson County. Slide No. 468, 7/21/64, HCS.

Stigmaeidae. The only collection from this family was *Agistemus fleschneri* on apple *(Pyrus malus),* Brookings County. Slide Nos. 403, 404, 405, 406, 407, 408, and 409, 9/20/64, LDW.

Erythaeidae. In this family only one specimen *(Balaustium* sp.) was collected on whitney crab apple *(Pyrus baccata),* Roberts County. Slide No. 480, 8/13/64, LDW.

Sarcoptiformes

The sarcoptiformes collected during this survey were of undetermined nymphal species of the Oribatei Group. They were from a single collection on wheat *(Triticum aestivum),* Brown County. Slide Nos. 367 and 370, 7/15/64, HCS.

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