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Anatomy of rockcress pseudoflowers caused by *Puccinia consimilis*

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ANATOMY OF ROCKCRESS PSEUDOFLOWERS CAUSED BY *PUCCINIA CONSIMILIS*

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ABSTRACT.—*Arabis pulchra* plants infected by the crucifer rust fungus (*Puccinia consimilis*) develop pseudoflowers. These pseudoflowers are characterized by stems with short internodes and numerous closely spaced, bright yellow leaves coated with a sweet sugary substance. Pseudoflowers do not resemble normal *A. pulchra* flowers. Pseudoflowers, leaves, and stems of *A. pulchra* plants infected with *P. consimilis* and true flowers, stems, and leaves of uninfected *A. pulchra* plants were fixed, embedded, sectioned, and stained using standard microtechniques. Epidermal, ground, and vascular tissues of true leaves, true petals, and pseudopetals were examined and compared for anatomic differences. Examination of anatomic characteristics revealed that pseudopetals are modified leaves.

Key words: rockcress, Arabis pulchra, *fungus rust,* Puccinia consimilis, *pseudoflowers.*

Arabis species infected with the fungus rust *Puccinia consimilis* develop stems with short internodes and numerous closely spaced, bright yellow leaves. These structures are called pseudoflowers since they are brightly colored, have a sweet sugary substance, attract insect pollinators, but lack plant reproductive structures (Roy 1993). Instead, spermagonia of the fungus are embedded in pseudopetals and the nectarlike substance contains numerous spermatia. For fertilization (initially plasmogamy and, later in the rust life cycle, karyogamy) to occur, the haploid spermatia must be transferred to the receptive hyphae of another mating type. For the rust fungi, this transfer is accomplished by insects. In the *Arabis-Puccinia* interaction, the rust-induced morphological change to attract insect pollinators is more extensive than with other host-rust interactions (Roy 1994). The anatomic basis of this large morphological change was examined. Objectives of this research were to determine whether leaves of pseudoflowers are composed of modified true leaves as suggested by Roy (1993, 1994) or modified true petals. In addition, the extent of the modification at the anatomic level was examined.

MATERIALS AND METHODS

Pseudoflowers, leaves, and stems of *Arabis pulchra* plants infected with *Puccinia consimilis* and true flowers, stems, and leaves of uninfected *A. pulchra* plants were fixed in FAA (65% formaldehyde, 5% acetic acid, 30% ethanol) in the field on 10 March 1996 and 19 April 1997. The collection site is approximately 1 km northeast of the Moab, Utah, landfill. In the lab specimens were aspirated under slight vacuum and then placed in fresh FAA. As needed, subsamples of the specimens were removed, dehydrated in a graded, ethanol-tertiary butyl alcohol series and embedded in Paraplast. Sections 8–12 µm thick were cut on an AO "820" Spencer rotary microtome with a steel blade, mounted on glass slides, and stained with safranin and fast green (Berlyn and Miksche 1976). Hemo-De (Fischer Scientific, Pittsburg, PA) was substituted for xylene in the stain series. Slides were viewed and photographed on an Olympus BH-2 microscope mounted with an Olympus PM-10AK 35-mm camera. Voucher specimens of *A. pulchra* were deposited in the Weber State University Herbarium.

RESULTS

Leaves of healthy *A. pulchra* plants are green and lorate in shape. The adaxial and abaxial epidermises have numerous, multicellular branched trichomes (Fig. 1). The mesophyll tissue is 7–10 layers thick and is not differentiated into distinct palisade and spongy

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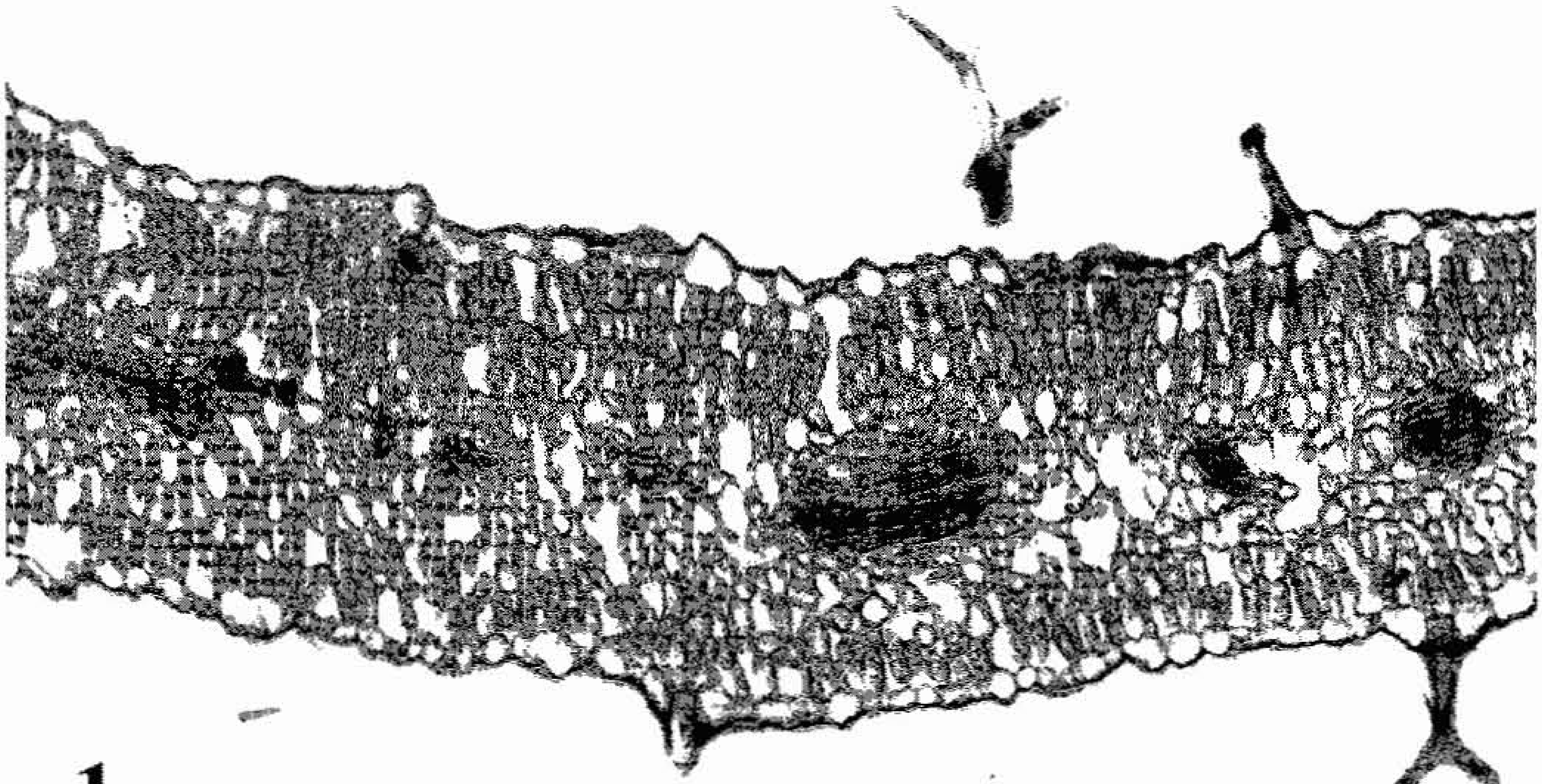

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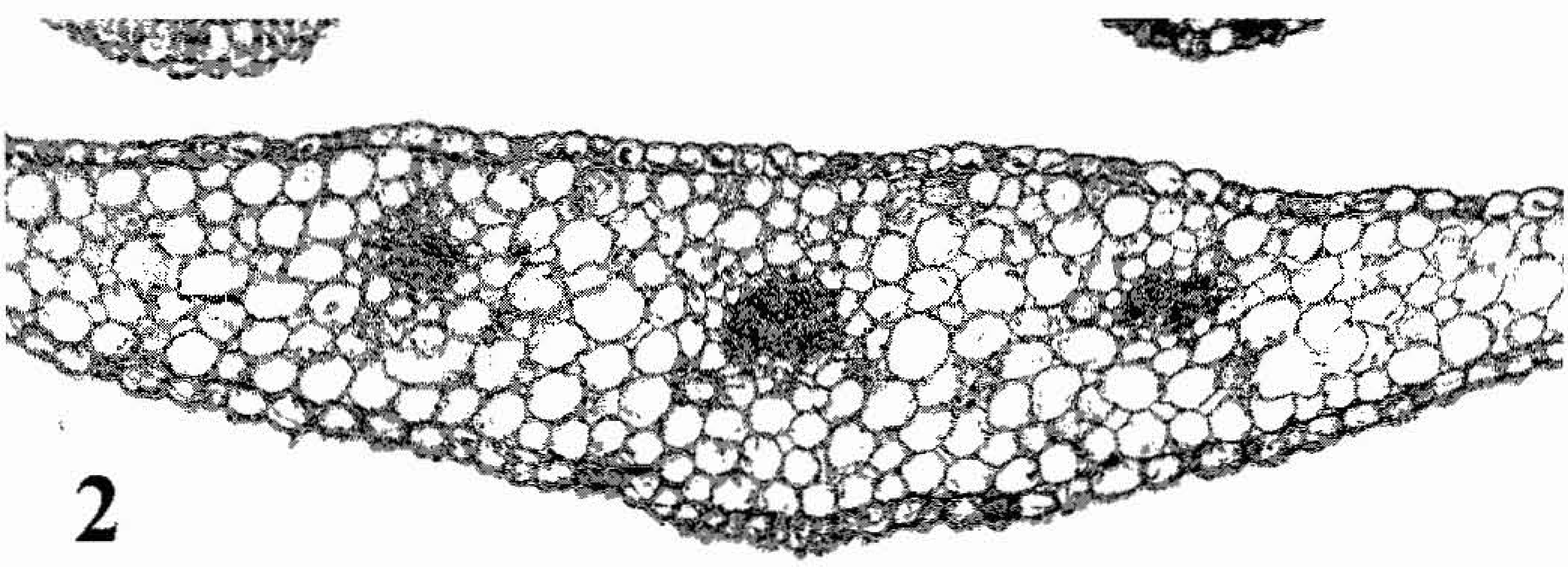

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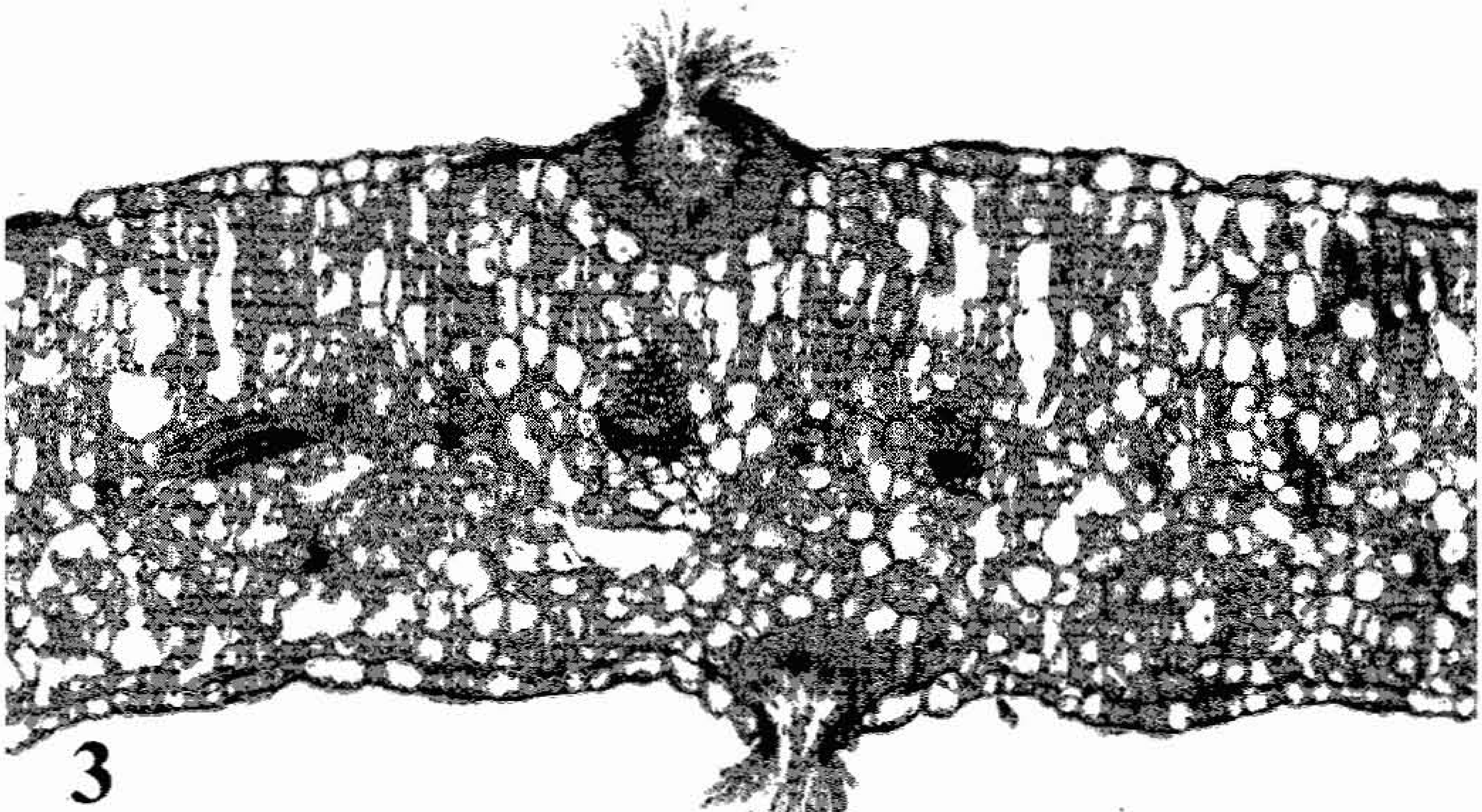

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Figs. 1–3. Transverse sections of a healthy *Arabis pulchra* leaf (Fig. 1), true petal (Fig. 2), and pseudopetal showing 2 erumpent spermagonia (Fig. 3).

layers. In general, mesophyll cells are slightly columnar (i.e., 1.5–2 times taller than wide) and have numerous chloroplasts. The midvein is surrounded by rib tissue but lateral veins are generally embedded in mesophyll and lack rib tissue. All vascular bundles are collateral and laterals are surrounded by a single layer, parenchymous bundle sheath (Fig. 1).

True petals of uninfected plants are white to pale violet colored and are ephemeral. Petals lack trichomes and the epidermis is composed of more uniformly shaped cells than the leaf epidermis (Fig. 2). Mesophyll cells are isodiametric and lack chloroplasts. Vascular bundles are collateral, entirely embedded in mesophyll, and are surrounded by a single layer, parenchymous bundle sheath (Fig. 2).

Pseudopetals are yellow colored and spatulate to obovate in shape. Thus, they are shorter and broader than uninfected leaves. Pseudopetals have few to no trichomes. When present on infected plants, branched multicellular trichomes are restricted to areas with few to no spermagonia. The mesophyll tissue is 7–10 layers thick and is not differentiated into distinct palisade and spongy layers (Fig. 3). Mesophyll cells of pseudopetals are generally wider than mesophyll cells of healthy leaves. The midvein is surrounded by rib tissue but lateral veins are generally embedded in mesophyll and lack rib tissue. All vascular bundles are collateral and laterals are surrounded by a single layer, parenchymous bundle sheath (Fig. 3).

DISCUSSION

This study verified what Roy (1993, 1994) suggested. Pseudopetals of *A. pulchra* plants infected with *P. consimilis* are modified leaves. Here I show similarities to leaves based on similarities in ground epidermal cell shape, multicellular trichomes, mesophyll cell shape, number of mesophyll cell layers, and rib tissue surrounding the midvein. Anatomic features of true petals are distinct from both true leaves and pseudopetals. Major effects of *P. consimilis* infection are a change in leaf shape and a decrease in internodal distance. Except for a large reduction in number of trichomes, anatomy is not greatly different between true leaves and pseudopetals. The lack of significant anatomic differences between true leaves and pseudopetals is noteworthy as the rust-induced morphological change to attract the insect pollinators is more extensive than with other host-rust interactions (Roy 1994).

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LITERATURE CITED

BERLYN, G.P., AND J.P. MIKSCHE. 1976. Botanical microtechnique and cytochemistry. Iowa State University Press, Ames. 326 pp.

ROY, B.A. 1993. Floral mimicry by a plant pathogen. Nature 362:56–58.

______. 1994. The use and abuse of pollinators by fungi. Trends in Ecology and Evolution 9:335–339.

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