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Something to Sneeze At: Nebraska's Airborne Pollen

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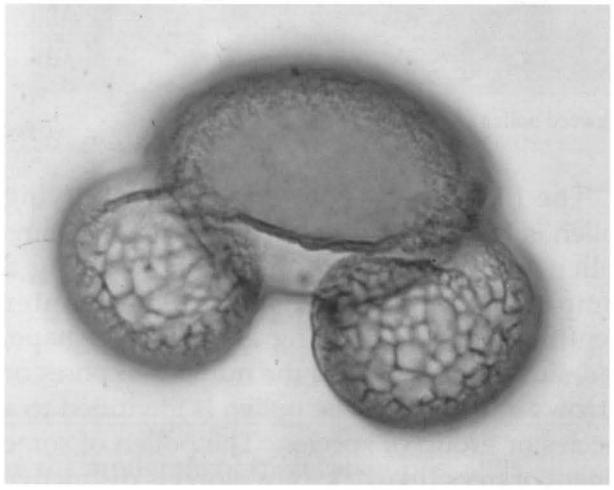
For those of us whose noses know (and don't like) pollen, late October is a time for celebration in Nebraska because it is the end of the hay fever season. When one's nose is a sensitive bio-detector of the presence of pollen, one's brain usually appreciates putting a name to whatever is causing the itchy eyes and runny nose. The job of putting names on the types of pollen in the air has been done by a dedicated team of pollen counters in the Division of Botany, University of Nebraska State Museum. This group, led by Curator Peg Bolick, has been catching, counting, and identifying these allergens since 1990. They do this five days a week from late February through mid-October each year.

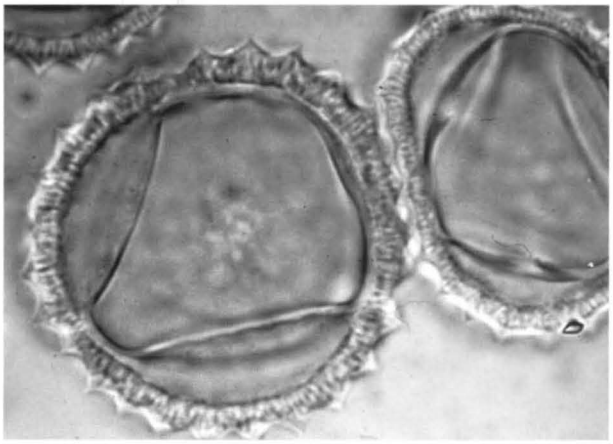
Problem pollen almost always comes from plants that use wind to transport their pollen to another plant. The chance of an individual grain finding the flower of another plant of the same species is much smaller with wind pollination than it is with animal pollination. Wind-pollinated plants compensate for the lack of precision by producing millions of extra pollen grains, some of which land in noses. Pollen from animal-pollinated plants is sticky, usually forming clumps that are too large to remain in the air very long. However, Nebraska's strong winds occasionally strip these sticky grains from flowers and carry them to noses or pollen samplers. Air-borne pollen has a more restricted size range than that carried by animals. Pollen grains are measured in microns, a unit that is one millionth of a meter. The largest pollen grains, produced by plants that use animals for pollination, are barely visible to the naked eye at about 250 microns (one fourth of a millimeter). The size range for pollen that is transported by wind is an order of magnitude smaller. Unless it has air bladders like pine pollen, grains that are much larger than 100 microns (the size of corn pollen) usually fall out of the air before traveling more than a few meters. At the other end of the scale, a pollen grain smaller than ten microns (the size of ragweed pollen) cannot be caught efficiently by plant stigmas, the part of the flower that leads to the ovule for fertilization.



Pine pollen (*Pinus* spp.).

The UNSM pollen counting team has its sampling station on the roof of the annex between Nebraska Hall, home of the Museum's research collections, and Walter Scott Engineering Center on the UNL campus. The sampling is done with a small machine consisting of a timer that operates

an electric motor that rotates two rods made of translucent plastic for one minute every ten minutes. These rods are one millimeter square in cross section by roughly 28 mm long and are coated with a thin layer of silicon grease on the leading edge. The silicon grease traps pollen, mold spores, and an amazing array of other types of microscopic debris. The speed of the motor and the amount of time the sampler is running give the number of revolutions through which the rods turn. This figure, when combined with the circumference of the circle the rods traverse and the number of square millimeters of the rod's surface that is exposed during sampling, gives the number of cubic meters of air sampled each day. Using this calculation, the number of pollen grains in the air can be quantified and compared with pollen counts from other sampling stations in the country.



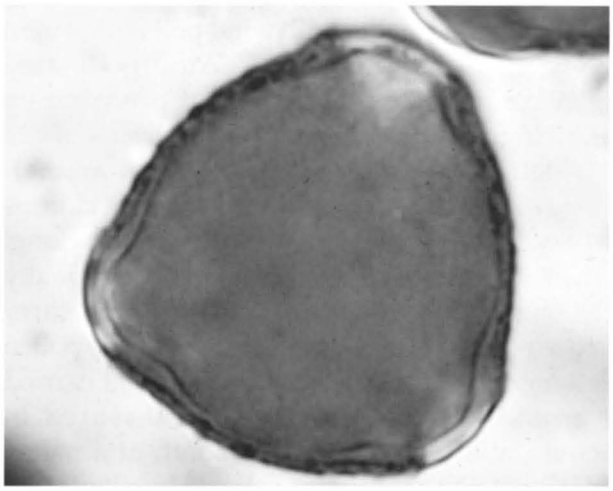
Ragweed pollen (*Ambrosia* spp.).

The first task in counting and identifying pollen is to add a red dye that selectively stains pollen but not mold spores or dirt. Using a compound microscope, the pollen counter identifies each grain, using features like shape, size, surface pattern, and the number of pores or furrows in the wall. The pollen is identified to a species or group of species. The pollen of some genera of trees (like oak or willow) is distinctive while the pollen of some weeds and grasses can be distinguished only to groups of genera, family or, in the case of Russian thistle, pigweed, and goosefoot, to a grouping of two families. The pollen counter keeps a tally of each type of pollen until at least 200 pollen grains are counted.

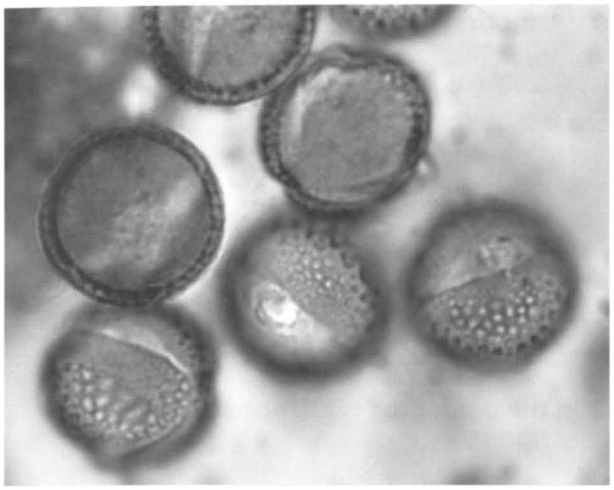
The American Academy of Allergy, Asthma and Immunology sponsors the National Allergy Bureau (NAB) that compiles pollen counts from all over the United States. The NAB's web site lists standards for classifying the number of pollen grains captured per cubic meter of air as low, moderate, high, or very high for the categories of trees, grasses, and weeds. A moderate pollen count is greater than half of the counts recorded in the United States; a high count is greater than 75% of the counts, and a very high count is greater than 99% of the counts. The number of pollen grains per cubic meter of air varies for each category of plant (trees, grasses, weeds; Table 1). The NAB web site also provides a chart to predict allergy symptoms from pollen counts (Table 2).

How much pollen does Nebraska get during the growing season? When does it start and how long does it last? Nebraska's pollen season, like its weather, isn't easy to predict. The variation from year to year is large enough that one needs data from several years to get a reliable estimate of what pollen is in the air at a given time of year. A look at twelve years of counts by the University of Nebraska State Museum's pollen counting team does show definite patterns, however.

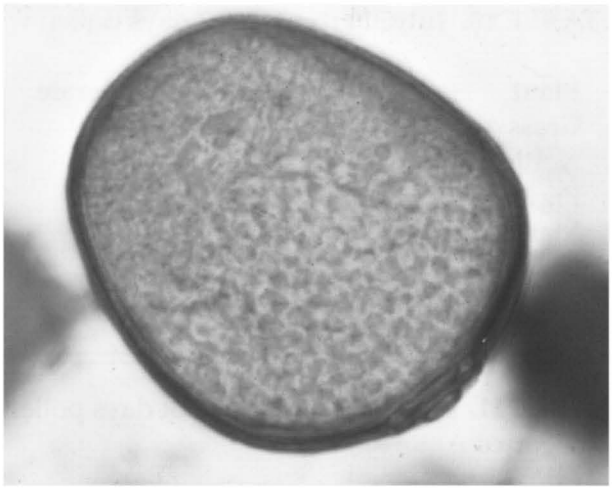
The pollen season begins with tree species, and its exact start date varies from late February to early March. Many of the trees that flower in early spring need a certain number of day's exposure to warm temperatures before they flower, so the milder the winter, the earlier the onset of pollination. Although Nebraska's list of native, introduced, and cultivated tree species is large, only 12 species or groups of species produce more than moderate amounts of airborne pollen on a regular basis. When the trees are grouped, those



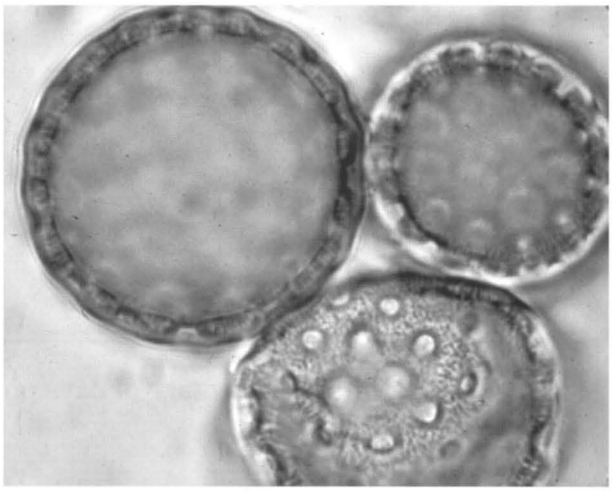
Oak pollen (*Quercus* spp.).



Willow pollen (*Salix* spp.).



Grass pollen (family Poaceae).



Pigweed type pollen (families Chenopodiaceae and Amaranthaceae).

that produce the largest amount of pollen (moderate or higher counts for more than one-third of a month) are elm, juniper, ash, cottonwood, oak, mulberry, and pine. Hackberry produces moderate amounts of pollen about 15% of the time it is in flower during April. The remaining trees, (maple, birch type, willow, and walnut) produce moderate amounts of pollen less than 10% of the time. Tree pollen season peaks in April and May when tree pollen counts reach moderate level or above 85% of the time (Table 3).

Overlapping with the trees, the grass pollen season begins in May at the peak of tree pollen output. The cool season grasses like blue grass hit their maximum flowering in June when more than three-fourths of the days have grass pollen counts at or above the moderate level. The early summer weeds (cattail, dock, and clover type) peak in June, but all three reach a moderate level only a small part of the time. There is a slight break for allergy sufferers in July when the trees have finished, the grass pollen counts drop significantly, and the weeds haven't yet started to bloom (Table 4). The misery index hits its high for the year in August and September when the warm season grasses and the late summer weeds flower (Table 5). Nebraska is home to four major groups of late summer weeds: nettle, marijuana, pigweed type, and ragweed. In August and September these weeds hit or exceed moderate levels more than 93% of the time; about 7% of the time they reach high levels, exceeding 99% of the weed counts in the United States. By October, pollen counts drop rapidly as weeds pass their peak flowering time. For allergy sufferers, the first killing frost is a blessing that ends the year's hay fever season.

For the convenience of victims of hay fever who would like to monitor their symptoms, the yearly progression of pollen types in Nebraska is summarized in Tables 6-12. During the pollen season, the UNSM's Division of Botany's pollen counts can be found at www.unl.edu/pollen.

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TABLE 1. Number of pollen grains per cubic meter of air for each category and pollen group.

	Trees	Grasses	Weeds
Low	>0 - 15	>0 - 5	>0 - 10
Moderate	>15 - 90	>5 - 20	>10 - 50
High	>90 - 1500	>20 - 200	>50 - 500
Very High	>1500	>200	>500

TABLE 2. Correlation of amount of pollen and symptoms.

Pollen Amount	Symptoms
Absent	No symptoms.
Low	Individuals extremely sensitive to these pollens will experience symptoms.
Moderate	Many individuals sensitive to these pollens will experience symptoms.
High	Individuals with any sensitivity to these pollens will experience symptoms.
Very High	Almost all individuals with any sensitivity at all to these pollens will experience symptoms. Extremely sensitive people could have severe symptoms.

TABLE 3. Tree pollen. Percentage of days pollen will fall in the moderate or high categories.

Month	Moderate	High
March	51.6	28.6
April	86.1	45.7
May	86.6	49.3
June	31.9	1.4

TABLE 4. Grass pollen. Percentage of days pollen will fall in the moderate or high categories.

Month	Moderate	High
May	42.6	23.0
June	77.6	46.7
July	24.9	1.8
August	60.0	11.5
September	32.3	4.5

TABLE 5. Weed pollen. Percentage of days pollen will fall in the moderate, high, or very high categories.

Month	Moderate	High	Very High
May	13.4	1.0	0
June	23.3	1.0	0
July	23.9	2.3	0
August	93.1	74.8	7.3
September	95.0	66.2	7.5

TABLE 6. March. Percentage of days pollen will fall in the moderate or high categories.

Tree	Moderate	High	Very High
Elm	39.6	14.3	0
Juniper	35.7	18.1	1.1
Maple	4.4	0	0

TABLE 7. April. Percentage of days pollen will fall in the moderate or high categories.

Tree	Moderate	High
Ash	44.7	15.9
Cottonwood	42.3	11.5
Oak	29.8	11.1
Juniper	19.2	2.4
Hackberry	14.9	3.8
Elm	11.1	3.4
Mulberry	11.1	2.9
Birch type	5.8	0
Willow	5.3	0
Maple	1.4	0

TABLE 8. May. Percentage of days pollen will fall in the moderate or high categories.

Plant	Moderate	High
Mulberry	61.2	33.0
Oak	45.0	16.3
Grass	42.6	23.0
Pine	34.4	3.8
Ash	9.6	0
Dock	8.6	0
Willow	6.7	0
Walnut	6.2	0
Cottonwood	2.4	0
Hackberry	2.4	0
Birch family	1.0	0

TABLE 9. June. Percentage of days pollen will fall in the moderate or high categories.

Plant	Moderate	High
Grass	77.6	46.7
Mulberry	13.3	0
Cattail	7.1	0
Pine	6.2	0
Clover type	1.5	0
Walnut	1.4	0
Dock	1.0	0

TABLE 10. July. Percentage of days pollen will fall in the moderate or high categories.

Plant	Moderate	High
Grass	24.9	1.8
Nettle	10.8	1.4
Pigweed type	2.8	0
Marijuana	2.3	0
Cat tail	1.4	0

TABLE 11. August. Percentage of days pollen will fall in the moderate, high, or very high categories.

Plant	Moderate	High	Very High
Nettle	80.3	19.3	0
Pigweed type	77.1	28.4	0
Marijuana	72.5	5.5	0
Ragweed	66.5	45.0	1.4
Grass	60.0	11.5	0
Marsh elder	7.3	0	0
Sagebrush	6.0	0	0
Cocklebur	1.4	0	0

TABLE 12. September. Percentage of days pollen will fall in the moderate, high, or very high categories.

Plant	Moderate	High	Very High
Ragweed	87.1	57.7	3.8
Pigweed type	78.6	22.4	0
Grass	32.3	4.5	0
Nettle	27.9	2.0	0
Marsh elder	15.9	1.0	0
Sagebrush	13.4	0	0
Marijuana	6.5	0	0
Cocklebur	1.0	0	0