

Volumetric ragweed pollen data for eight cities in the continental United States

David A Frenz*†

Background: A previous report presented volumetric ragweed pollen data for 23 cities in the continental United States. Although helpful, it did not represent all areas of the country.

Objective: The purpose of this present communication is to furnish ragweed pollen data for eight additional cities.

Methods: Ragweed pollen data were obtained from eight pollen sampling facilities in the continental United States. These data were analyzed to determine the length of the season in each city and its peak date.

Results: The ragweed pollen season was typically 2 or 3 months in duration. Ragweed pollen counts reached their annual maximum in late August or early September in cities in Minnesota, Nebraska, and South Dakota. The peak was achieved in late September or early October for two cities in Texas. The annual maximums for three remaining cities in Colorado, Utah and Alabama occurred in late August, early September and mid-September, respectively.

Conclusions: The findings of this investigation were consistent with previous reports about the north-south nature of the ragweed pollen season. These data, when combined with the results of the 23-city investigation, indicate when source avoidance is most critical in many areas.

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INTRODUCTION

A previous report presented volumetric ragweed pollen data from 23 cities in the United States.¹ Pollen records from 148 seasons were analyzed to determine the average dates that the ragweed season started, peaked and ended in each city. The results generally agreed with much earlier investigations conducted with gravimetric instruments^{2–6} and better resolved the timing of pollen events than a large, 1-year study that used volumetric samplers.⁷

The 23-city investigation did not represent all areas of the country, particularly in the western half of the United States. The purpose of this present communication is to furnish

volumetric ragweed pollen data for eight additional cities.

MATERIALS AND METHODS

Ragweed pollen data were obtained from eight pollen sampling facilities in the continental United States (Table 1). Participating study sites were required to meet three nominal requirements: (1) pollen data collected 24 h/day, 3 to 7 days per week; (2) pollen data collected for at least 3 years; and (3) pollen data collected with a rotating-arm impactor at the same location or locations in close proximity.¹

In seven cities atmospheric samples were collected at the same location during the study period. For the suburban Salt Lake City sites, samples were obtained for six ragweed seasons at a medical clinic in Murray. The sampler was moved approximately 12.5 km to an affiliated practice in West Valley in 1996. These data are thus presented as the Murray-West Valley location.

All sampling stations used a Rotorod Sampler (Sampling Technolo-

gies, Inc.; Minnetonka, MN). Models varied between locations and also between years at the same location, however, the performance characteristics of these devices was previously demonstrated to be similar.⁸

The average date of maximum ragweed pollen concentration—the so-called “peak date”—was determined for each location.¹ The date where the ragweed pollen concentration reached its maximum was located in each year. The mean and standard deviation of these dates were then calculated.

Data from each location were also analyzed to determine the length of the pollen season. Some have defined pollen seasons using mathematical criteria,⁹ however, for this investigation the approach was largely clinical. The threshold for ragweed symptomology is exceedingly low—estimated to be 1 to 3 grains/m³ by one author.¹⁰ Accordingly, the ragweed pollen season in this study was defined as a continuous series of days where the average ragweed pollen concentration exceeded 0 grains/m³ uninterrupted.¹ In many locations pollen appeared to be in the atmosphere before or was likely to remain beyond the period when pollen was sampled. In these cases, the first and last date that a sample was obtained are furnished.

RESULTS

Each city possessed a defined ragweed pollen season characterized by a well-resolved peak date and distribution curve (Fig 1). The number of years of data ranged from 3 to 8 years, with a mean of 5.3 years $\pm$ 2.0 (Table 2).

Four cities—Colorado Springs, Mankato, Papillion and Sioux Falls—presented peak dates that occurred within seven days of each other. The most westerly city (Colorado Springs) was a considerable distance from the three in

* Multidata, Inc.; 10801 Wayzata Boulevard; Suite 330; Minnetonka, Minnesota.

† School of Medicine; University of Minnesota, Duluth; 10 University Drive; Duluth, Minnesota.

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Table 1. Contributors of Ragweed Pollen Data, Including Institutional Affiliation

Location	Contributor	Institutional Affiliation
Colorado Springs, CO	William Storms	Asthma and Allergy Associates
Corpus Christi, TX	Gary Smith	Corpus Christi Allergy and Dermatology Associates
Dallas, TX	Jeffrey Adelglass	Allergy Testing and Treatment Center
Huntsville, AL	Debra Hopson	City of Huntsville; Department of Natural Resources and Environmental Management
Mankato, MN	John Jacobsen	Mankato Clinic
Murray-West Valley, UT	Edwin Bronsky, Duane Harris	Intermountain Allergy and Asthma Clinic
Papillion, NE	Linda Ford	Asthma and Allergy Center
Sioux Falls, SD	Lowell Hyland	High Plains Asthma and Allergy

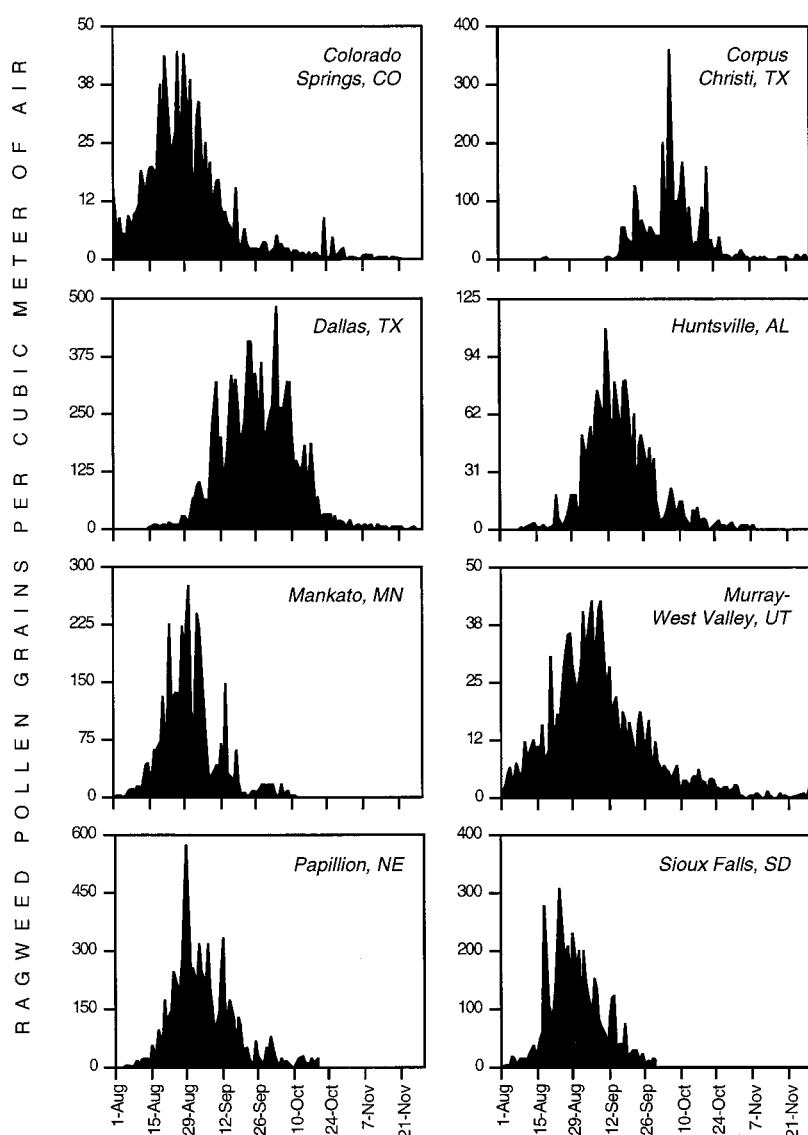


Figure 1. Mean daily ragweed pollen concentration in 8 United States cities.

the east, however, all fell within a band less than six degrees latitude wide.

Although the Murray-West Valley location also resides in this same band, its peak date occurred a bit later. The ragweed pollen season reached its maximum nine days later than in Colorado Springs, despite a difference of less than two degrees latitude.

The peak dates for the three cities in the south occurred considerably later than locations in the north. On average, ragweed pollen counts reached their maximum in mid-September in Huntsville and in late September in Dallas. The peak in the remaining city, Corpus Christi, occurred in early October—over one month later than the earliest peak date in the north (Sioux Falls).

In general, the difference between the earliest and latest recorded maximum ragweed pollen count (maximum variance) for a city was about two weeks or less (mean: 14.8 days $\pm$ 6.6). The smallest difference occurred in Papillion (1 day), while the greatest was found in Dallas (21 days). There was no agreement on the variation in the timing of this maximum between cities. The earliest date that the ragweed pollen season reached its annual maximum occurred in 1996 in four cities; in three other cities that same year represented the latest date the maximum was achieved.

The shortest ragweed pollen season that could be explicitly determined was 62 days (Huntsville). The longest season occurred in Dallas (99 days). Ragweed was apparently flowering in five cities in July as indicated by the average pollen concentration on 1 August. Estimates for the length of the ragweed

Table 2. Years Data, Latitude, and Ragweed Pollen Season Characteristics for Each Location

Location	Years	Earliest*	Peak	MV†	Latest*	Length‡	Latitude (°N)
Colorado Springs, CO	1991–96	(1 Aug)	30 Aug ± 5.6 days	15 days	31 Oct	(92 days)	38.49
Corpus Christi, TX	1994–96	3 Sep	2 Oct ± 7.5 days	13 days	16 Nov	75 days	27.48
Dallas, TX	1990–96	11 Aug	28 Sep ± 7.7 days	21 days	17 Nov	99 days	32.45
Huntsville, AL	1993–96	20 Aug	16 Sep ± 8.8 days	20 days	20 Oct	62 days	34.44
Mankato, MN	1994–97	(1 Aug)	2 Sep ± 8.0 days	17 days	3 Oct	(64 days)	44.10
Murray-West Valley, UT	1990–97	(1 Aug)	8 Sep ± 7.8 days	20 days	3 Nov	(95 days)	§
Papillion, NE	1994–96	(1 Aug)	28 Aug ± 0.6 days	1 day	(19 Oct)	(80 days)	41.09
Sioux Falls, SD	1990–96	(1 Aug)	27 Aug ± 3.6 days	11 days	(30 Sep)	(61 days)	43.33

* Earliest and latest dates that ragweed pollen was consistently recovered in atmospheric samples; dates in parenthesis are estimates.

† Maximum variance; the difference between the earliest and latest dates that the ragweed pollen season reached its annual maximum.

‡ Length of the ragweed pollen season; values in parenthesis are estimates because either the Earliest or Latest values (or both) are estimates.

§ Murray = 40.40°N (1990–95); West Valley = 40.70°N (1996–97).

pollen season in these locations are furnished, however, these data should be cautiously interpreted.

The termination of the ragweed pollen season could be determined for six cities and was estimated for the remaining two. Ragweed pollen was consistently recovered from the atmosphere into October in all eight cities. Ragweed pollen persisted through the middle of November in Dallas and Corpus Christi.

DISCUSSION

Determining the ragweed season for a particular city is a necessary step in mitigating its public health impact.¹¹ An analysis of volumetric ragweed pollen records for 23 locations in the continental United States was previously published.¹ This present investigation augments that information with ragweed pollen data for eight additional cities.

Ragweed is a short-day plant^{12–14} that begins to form flowers when nights become longer. Its range and distribution are presumably limited by day length and frost: the optimum latitudes for ragweed growth in North America appear to lie between 30° and 45°N.¹⁵ Pollen shed occurs first in the northern end of this zone.

Data from this present investigation agree with this north-south pollen season that has been demonstrated elsewhere.^{1,6} The peak date occurred earlier in Sioux Falls and other cities in

the north compared to Huntsville and the two Texas locations.

For many cities, this investigation represents the first systematic treatment of the ragweed pollen season using volumetric data. Other pollen surveys were conducted in some locations, but the results are limited by shorter periods of record and the various liabilities of gravimetric instruments.^{16,17}

Mankato, Minnesota

Ellis and Rosendahl included flowering data for ragweed in an exhaustive catalog of allergy-causing plants in Minnesota. Short ragweed (*Ambrosia artemisiifolia*) flowered from 5 August to 15 October; the season for giant ragweed (*A. trifida*) was 1 month shorter (2 August to 15 September).¹⁸ A later gravimetric survey in Minneapolis and St. Paul found ragweed pollen in atmospheric samples starting early in July with a seasonal peak occurring between 23 and 30 August.¹⁹ Similar data were obtained in Rochester by other investigators.^{20,21}

Our data for Mankato generally agree with data obtained for these other Minnesota cities. Ragweed pollen was consistently recovered in atmospheric samples in early August and persisted into early October. The peak date occurred a bit later than in Minneapolis, however, the annual maximum differed by over two weeks for the years studied.

Sioux Falls, South Dakota

An early publication indicated that short ragweed was common in the eastern part of South Dakota.²² The flowering periods for both this species and giant ragweed were similar to data for Minnesota.

Durham reported that the length of the ragweed pollen season in Pierre was 30 days.⁵ The peak date for the southeastern corner of the state was estimated to occur around 1 September,⁶ although it was unclear how this was derived. Volumetric data obtained in Yankton during a 1-year investigation found the season peaked during the last week of August, however, no samples were obtained during the next 2 weeks.⁷

Our data for Sioux Falls demonstrated a peak date in late August for the period of record. The variability in the maximum between years was considerably smaller than for other cities studied.

Interestingly, our estimate for the length of the ragweed season was over twice Durham's value. The discrepancy with his data can be explained by both the relative insensitivity of gravimetric instruments^{16,17} and the method used to define the ragweed pollen season in this study.

Papillion, Nebraska

Durham demonstrated that the 1929 ragweed pollen season began in Omaha in early August and extended

through late September; the maximum pollen concentration appeared to occur around 30 August.²³ He later placed the length of the season at 50 days⁵ with a peak on 29 August in 1933.⁶ A subsequent survey in Lincoln reported that ragweed was the most abundant pollen type in atmospheric samples, sometimes persisting into October.²⁴

Our data for Papillion, a city immediately south of Omaha, agreed with Durham's estimate for the beginning of the season but not its termination. During this study, ragweed pollen was still recovered from the atmosphere in mid-October when the final samples for the year were collected. This finding was similar to the more recent volumetric work conducted in Lincoln.

The annual maximum of the ragweed pollen season in Papillion varied by only one day for the three years examined. The resulting peak date was largely equivocal to Durham's findings.

Colorado Springs, Colorado

Early reports from Colorado indicated that short ragweed was not abundant.²⁵ A later botanical survey conducted around Colorado Springs uncovered three species of ragweed: short ragweed was confined to roadsides and flowered August through October; western ragweed (*A. psilostachya*) and giant ragweed were more common and pollinated from July through October.²⁶

Durham indicated that the peak of the ragweed season for most of Colorado occurs around 25 August, although this appears to be a generalized result from data for Denver.⁶ Later authors, while agreeing with these flowering periods and peak, did not supply further data.^{27,28}

Our data for Colorado Springs agree with these flowering data. Ragweed pollen was already present in atmospheric samples in early August and persisted through the end of the October. The length of the season was over three months.

The peak date during our study period was a bit later than Durham's

value. The standard deviation of the underlying six maximums encompasses the earlier estimate, so the difference does not appear to be material.

Murray-West Valley, Utah

Anderson included short ragweed in a list of the allergy-causing plants of Utah.²⁹ He indicated that ragweed flowered from August through October—a substantially longer period than Durham's estimate for the length of the ragweed pollen season in Salt Lake City (33 days).⁵ Another author confirmed the longer flowering period based on several years of phenologic observations in the late 1920s.³⁰ An atmospheric pollen survey performed at multiple locations in 1957 demonstrated that the peak of the ragweed pollen season occurred between 5 and 20 September.³¹

Like other cities, our estimate for the length of the ragweed pollen season in the Salt Lake City area is considerably longer than Durham's value for reasons explored earlier. The pollen records from this study agree closely with the ragweed flowering data published for Utah.

The peak date derived from the eight years considered in our study occurred in the early range of values obtained by a previous investigator. Since we noted a difference of 20 days between years in our pollen records, it appears the data generally agree.

Dallas, Texas

Scheppegrell reported that short and giant ragweed flower in the southern United States from August through November.³² A later author indicated that the length of the season was limited by frost with the peak occurring in September.³³

Gravimetric surveys conducted in Dallas by Durham^{23,34} and in Fort Worth by Hulsey³⁵ characterized the ragweed pollen season in this area. Ragweed began to flower in August and continued into October. The peak atmospheric pollen concentration occurred between 24 and 30 September, depending on the year. Similar esti-

mates were obtained much later during a 1-year study in Dallas using volumetric instruments.⁷

Our data demonstrated that Dallas experienced the longest ragweed pollen season of the eight cities studied. The length of the season agreed with flowering data for Texas but not the early gravimetric surveys.

The peak date obtained for Dallas for the period of record was similar to the findings of previous investigators. On average, the ragweed pollen season reached its maximum near the end of September, fully one month later than the cities studied in the north.

Corpus Christi, Texas

Durham's early work in Corpus Christi demonstrated that ragweed was abundant in the area although little pollen was found in atmospheric samples prior to 15 September.³⁶ He placed the peak of the season for this region of Texas close to 1 October,⁶ a finding that was subsequently confirmed with volumetric instruments during a 2-year survey.³⁷

Our data found that the ragweed pollen season was almost one month shorter in Corpus Christi than in Dallas. The start of the pollen season was reasonably consistent with Durham's observations despite the greater sensitivity of the volumetric instrument employed for this study.

The peak date determined from the three years of pollen records was similar to the findings of other investigators. The value for Corpus Christi (2 October) was the latest of any city included in this present study but did not exceed peak dates obtained for Tyler (4 October) and Houston (11 October) in a prior investigation.¹

Huntsville, Alabama

Weil indicated that ragweed was found in Alabama and began to form flowers in late August.³⁸ Short and giant ragweed were the principal species with pollen shed starting around 1 September; the length of season was limited by frost.³⁹ The peak of the season appeared to occur in the first or second

week of September, although it is unclear how these estimates were derived.^{6,40} A later atmospheric survey conducted in Birmingham generally agreed with these data; the peak in 1965 occurred around 15 September.⁴¹

Our data demonstrated that the ragweed pollen season in Huntsville was relatively short (62 days) compared to other southern cities. The reasons for this were not clear. An analysis of climate data for Huntsville was unrevealing.

During our study period the ragweed season reached its maximum in mid-September. This finding was similar to the data published for Birmingham and agreed closely with the peak date obtained for Tulsa, Oklahoma (16 September), in a prior investigation.¹

Conclusions

Ragweed pollen records for 31 US cities have been analyzed: 23 in a prior investigation¹ and eight in the present effort. These data indicate the length of the ragweed pollen season and the peak date in various areas of the country. Although certain regions of the nation are still not well represented (eg, Florida, Georgia, California, Nevada and Arizona), this information should nonetheless prove useful to allergists and ragweed-sensitive individuals.

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Request for reprints should be addressed to:
David A. Frenz
Vice-President/Director of Research
Multidata, Inc.
10801 Wayzata Boulevard
Suite 330
Minnetonka, MN 55305-1533
