POLLINATION CYCLES OF SOME GRASSES IN OKLAHOMA

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By

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

INTRODUCTION

In the improvement of grasses it is essential that the breeder be familiar with their breeding behavior in order to apply effective breeding techniques. Of primary concern to the grass breeder is the characteristic pollen shedding habits of the different grasses which he seeks to improve. It is necessary to know the time of day and the number of days that a given grass sheds pollen, inasmuch as this is the only time that adequate quantities of viable pollen can be obtained for breeding work.

The purposes of these investigations were to obtain information on the time of day and number of days that certain grasses shed pollen at Stillwater, Oklahoma. Some attention was given to variations in meteorological conditions which apparently affect the periodicity of pollen shedding.

REVIEW OF LITERATURE

In a study of 29 grasses at Lincoln, Nebraska in 1944 and 1945, Jones and Newell (4)[1] found that in most of these grasses, 2 to 6 hours in each of several successive days were required for the completion of pollen shedding. When meteorological conditions were optimum for blooming, these daily pollination periods occurred rather regularly at the same time of day for any specific grass.

The daily regularity of blooming and pollen shedding has been designated the "daily pollination cycle" by Jones and Newell (4). They define "seasonal pollination cycle" as the period of blooming and shedding of a single infloresence which lasts for several days. These designations are used with the same meaning in this paper.

Under field conditions, blooming was observed to occur twice during the day by Beddows (1) in Bromus arvensis L.; by Sando according to Vinall and Hein (7) in Agropyron elongatum (Host) Beauv.; and by Fruwrith (2) in Arrhenatherum elatius (L.) Mert. and Koch., Phleum pratense L., and Dactylis glomerata L.

In Nebraska the average duration of pollen shedding for individual corn plants was 6 days in 1914 and 1915 (5).

Wolfe (8), working with orchard grass in Virginia, found that on the average 6.7 days were required for all flowers on a single head to bloom, and 13.6 days for all flowers on a single plant to bloom.

The number of days of blooming and pollen dispersal in grass inflorescences appeared to average 7 to 8 days for most of the species studied by

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[1] Figures in parenthesis refer to "Literature Cited", p. 36.

Jones and Newell (4) with 4 and 12 days being the extremes. They state that the number of days that a grass sheds pollen is increased where the plant material is genetically heterogeneous. Where there is uniformity of plant type and uniformity of soil conditions the pollination cycle is shortened.

Several investigators have made studies concerning the effect of humidity, light, wind and temperature on the time of day of pollen shedding. Godron (3) reports that fog, heavy dew, and moistening of the buds by rain just before blooming time delays the hour of blooming. Shading delays the time of blooming while dryness particularly accelerates dehiscence of the anthers. He also found that low temperatures may delay blooming several hours or even until another day.

As a result of experiments conducted on the effect of artificial light on pollination, Fruwirth (2) concluded that lack of light greatly reduces rather than prevents blooming of the grass florets. If there is sufficient heat and no light, blooming is only somewhat delayed.

In the work of Jones and Newell (4) it was found that the daily pollination cycle of 13 grasses occurred partially or entirely during periods of darkness while 16 others normally shed pollen in daylight. In regard to wind they point out that anthesis, dehiscence and pollen dispersal are speeded up by wind movement.

Stephens and Quinby (6) conclude that light conditions are very important in governing the time of blooming of sorghum in Texas. In reference to wind they state that, "in the absence of wind to disturb the sorghum panicle blooming was retarded for an undetermined period of time."

Temperature is the most important external factor affecting the time of pollination in grasses according to Jones and Newell (4). Their work is summarized as follows: "Observations during this investigation show that

the time of day of blooming of grass florets is the result of the interaction of inherent and external factors. When florets have reached the blooming stage the exact time of blooming is determined by existing meteorological conditions."

MATERIALS AND METHODS

Several grasses were studied at Stillwater, Oklahoma in 1946 and in 1947 to determine the time of day and number of days that pollen shedding occurs. The grasses that were studied are as follows:

Common Name	Scientific Name	Variety or Strain
Switchgrass	Panicum virgatum L.	Okla. Expt. Sta. No. 1
Side-oats Grama	Bouteloua curtipendula (Michx.) Torr.	El Reno
Johnson Grass	Sorghum halepense (L.) Pers.	
Sweet Corn	Zea saccharata Sturt.	Golden Cross Bantam
Weeping Lovegrass	Eragrostis curvula Shrad and Nees	
Rye	Secale cereale L.	Balbo
Bromegrass	Bromus inermis Leyss.	Achenback
Tall Fescue	Festuca elatior var. arundinacea (Schreb) Wimm.	Alta
Bermuda Grass /2	Cynodon dactylon (L.) Pers.	
Sorghum /2	Sorghum vulgare Pers.	Darso

These grasses were growing in areas of approximately 0.25 acres except tall fescue which had been broadcast on a plot 10 by 30 feet. Bermuda grass was in a solid stand. Weeping lovegrass, side-oats grama, switchgrass, and bromegrass were grown in 36-inch rows. Corn and Sorghum were grown in 42-inch rows.

The fields selected for study were isolated by distance or by time of

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/2 Time of day was not studied.

shedding from other species or varieties having pollen grains of similar size and shape. Isolation by time of shedding and differences in size and shape of pollen grains in various species has been pointed out by Jones and Newell (4). They also state that grass pollen is easily differentiated from the chief contaminants which are pollen of other families of plants, dust particles, and rust spores.

The amount of pollen being shed by each species was determined by the use of microscope slides which were coated with a thin film of vaseline. The slides were placed in metal holders that were attached to specially made weather vanes at an angle of 45° and were exposed at about the height of the plant in the center of selected grass fields (Fig. 1). This method of exposure kept the vaseline-coated side of the slide facing into the prevailing wind for catching the pollen as it was blown against the slide or as it fell as a result of gravitation. The total number of pollen grains on 10 random low-power microscope fields (16 sq. mm. total area) per slide was used throughout this investigation as a measure of the amount of pollen shed.

To study the time of day of pollen shedding for each grass, preliminary exposures were made every 3 to 4 hours during the first days of pollen shedding. After determining the general time of day when pollen was shed, more frequent exposures were continued for 3 to 5 days. Four slides were exposed for 30-minute periods during the hours of daily pollen shedding. After pollen was no longer being caught, four other slides were left exposed until the beginning of shedding on the following day. Counts of pollen from the 30-minute slide exposures constitute the record of daily pollen shedding.

In the study of the number of days of pollen shedding, the date of initial emergence of the infloresence from the boot was used as an indicator of approaching maturity of the florets and pollen shedding. The anthers

Fig. 1.—Slide exposure from a special weather vane in a field of side-oats grama at Stillwater, Oklahoma, as used in the study of pollen shedding.

were examined from day to day and the apparent degree of maturity was used in estimating the date of initial seasonal pollen shedding. On the first day of noticeable blooming in the field, slide exposures were made at 24-hour periods and were continued on succeeding days until blooming and shedding ceased. The danger of water disturbing the pollen count made it necessary to expose slides more frequently on rainy days.

EXPERIMENTAL RESULTS

Daily Pollination Cycles

In presenting the results obtained in the investigation of the daily pollination cycles, the peak of daily pollen shedding is emphasized. Stress was placed on the peak of daily shedding because it appears to be the most reliable index to knowing when pollen could be obtained in sufficient quantities for making crosses. The time of initial shedding and the duration of shedding was not as reliable; since, in the field of each grass studied, a few plants bloomed and shed pollen earlier in the day than the majority of plants. Likewise, there were plants which bloomed and shed pollen later.

Switchgrass

The daily pollination cycle of switchgrass was studied June 23 to 26 inclusive and on July 11 in 1946, and in 1947 from August 12 to 16 inclusive.

As an average in 1946, pollen shedding began between 9:30 and 10:00 a.m. with the period of maximum pollen shedding occurring between 11:00 and 11:30 (Fig.2). Heavy shedding continued until noon, thereafter reducing in rate rapidly. Rarely were pollen grains caught after 2:00 p.m.

In 1947, very little blooming was observed before 10:30 a.m. (Fig. 2). During the period from 10:30 to 11:30 blooming increased somewhat and a small, though increasing amount of pollen was caught. In contrast to pollen shedding in the 1946 season, heavy shedding began between 11:30 a.m. and 12:00 noon and continued until 2:00 p.m. The maximum period of shedding took place between 12:30 and 1:00 p.m. with shedding decreasing thereafter until between 3:00 and 5:00 p.m. when only a small amount of pollen was caught.

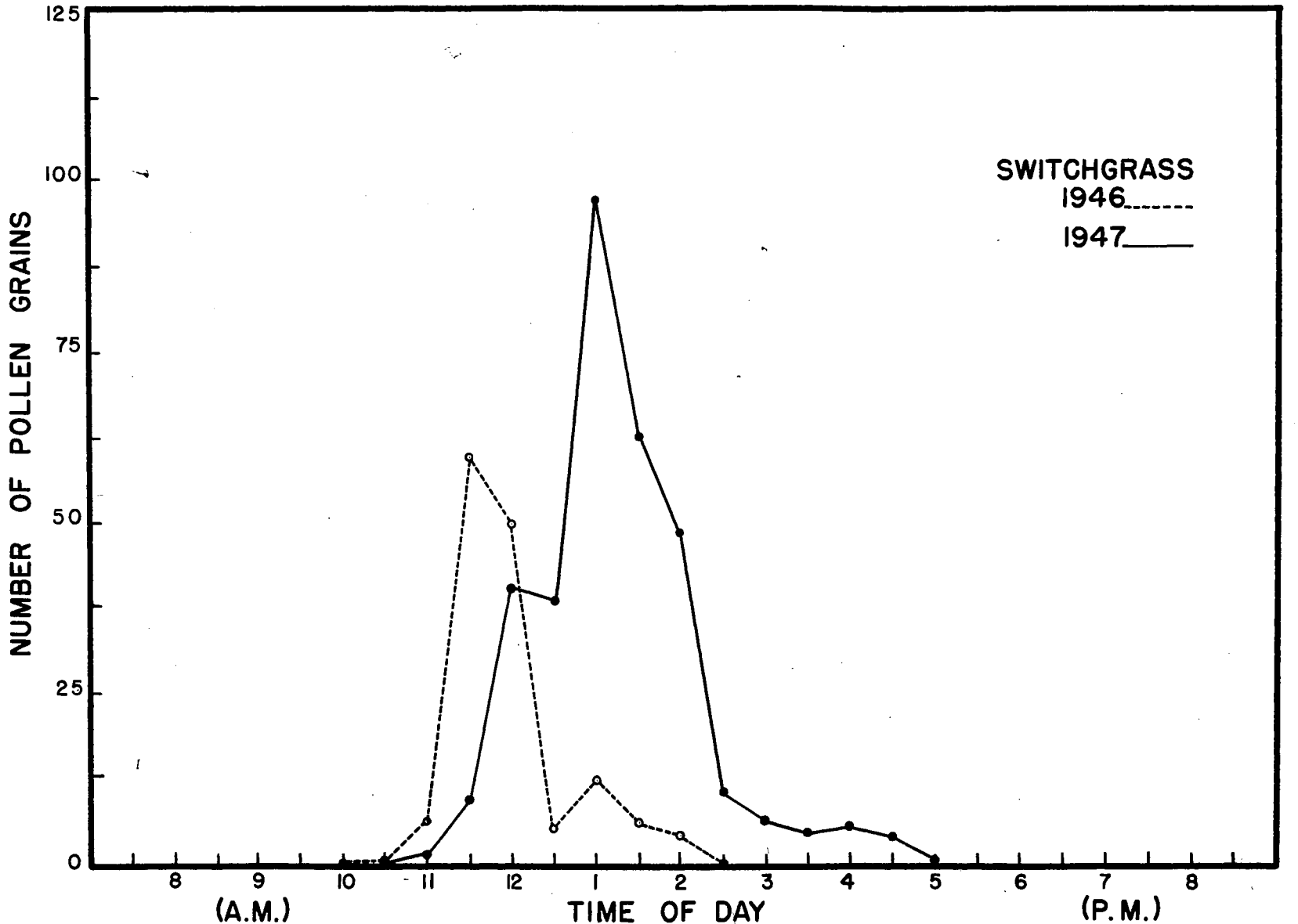

Fig. 2.--The average number of pollen grains of switchgrass caught on 16 sq. mm. areas of 4 microscope slides exposed in the center of the switchgrass field during 30-minute periods of the day. Averages for 5 days in 1946 and 5 days in 1947.

Side-oats Grama

For the period, June 12 to 15, inclusive, in 1946, initial blooming and shedding in side-oats grama occurred between 5:00 and 5:30 p.m. (Fig. 3). Heavy shedding lasted approximately 1.5 hours, beginning near 6:45, with the peak between 7:00 and 7:30 p.m. After 9:00 p.m. no pollen was caught except on June 15, when an average of 2 pollen grains was caught between 9:00 and midnight.

In 1947, side-oats grama was studied for 4 days in Mid-July. The daily pollination cycle followed the general pattern of 1946. Occasional plants bloomed and shed pollen between 5:00 and 5:30 p.m. The average peak of shedding occurred between 7:00 and 7:30 with but little pollen being caught after 9:00 p.m.

In both years of study this grass had an unusually short period of daily pollen shedding with approximately 4 hours being required from initial blooming to final shedding.

Pollen shedding was heavier in July, 1947 than in June, 1946, probably largely due to the more numerous culms which were mature at that later time in the season.

Johnson Grass

The majority of pollen that was shed by Johnson grass during 3 days in July, 1946 and 5 days in July, 1947, fell between 10:30 a.m. and 1:30 p.m. (Fig. 4).

Initial daily pollen shedding in the 1946 season occurred between 8:30 and 9:00 a.m. but the amount of pollen caught before 10:30 a.m. was very small. The period of heavy shedding extended from 11:00 a.m. to 1:30 p.m.

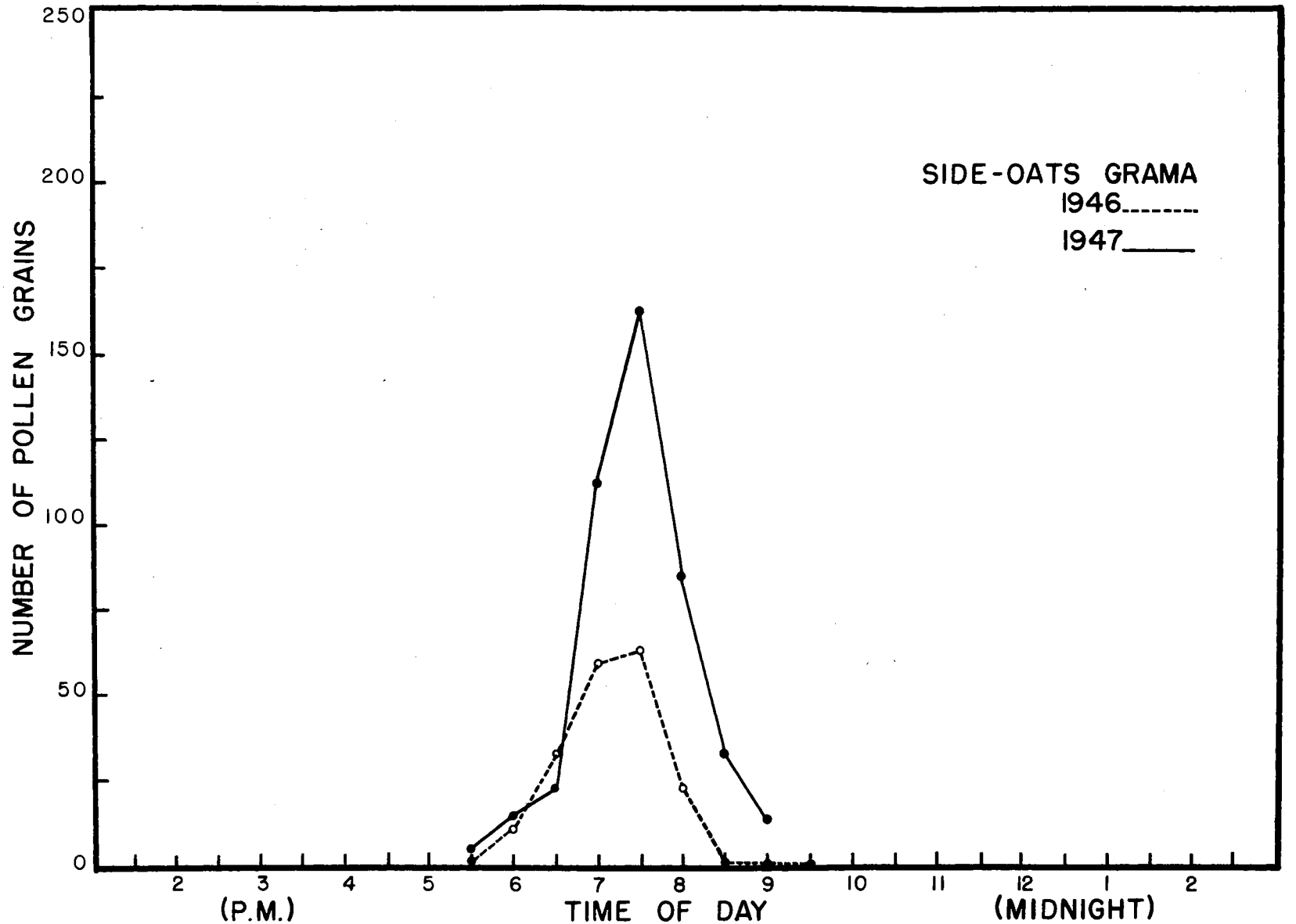

Fig. 3.—The average number of pollen grains of side-oats grama caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods of the day. Averages for 4 days in 1946 and 4 days in 1947.

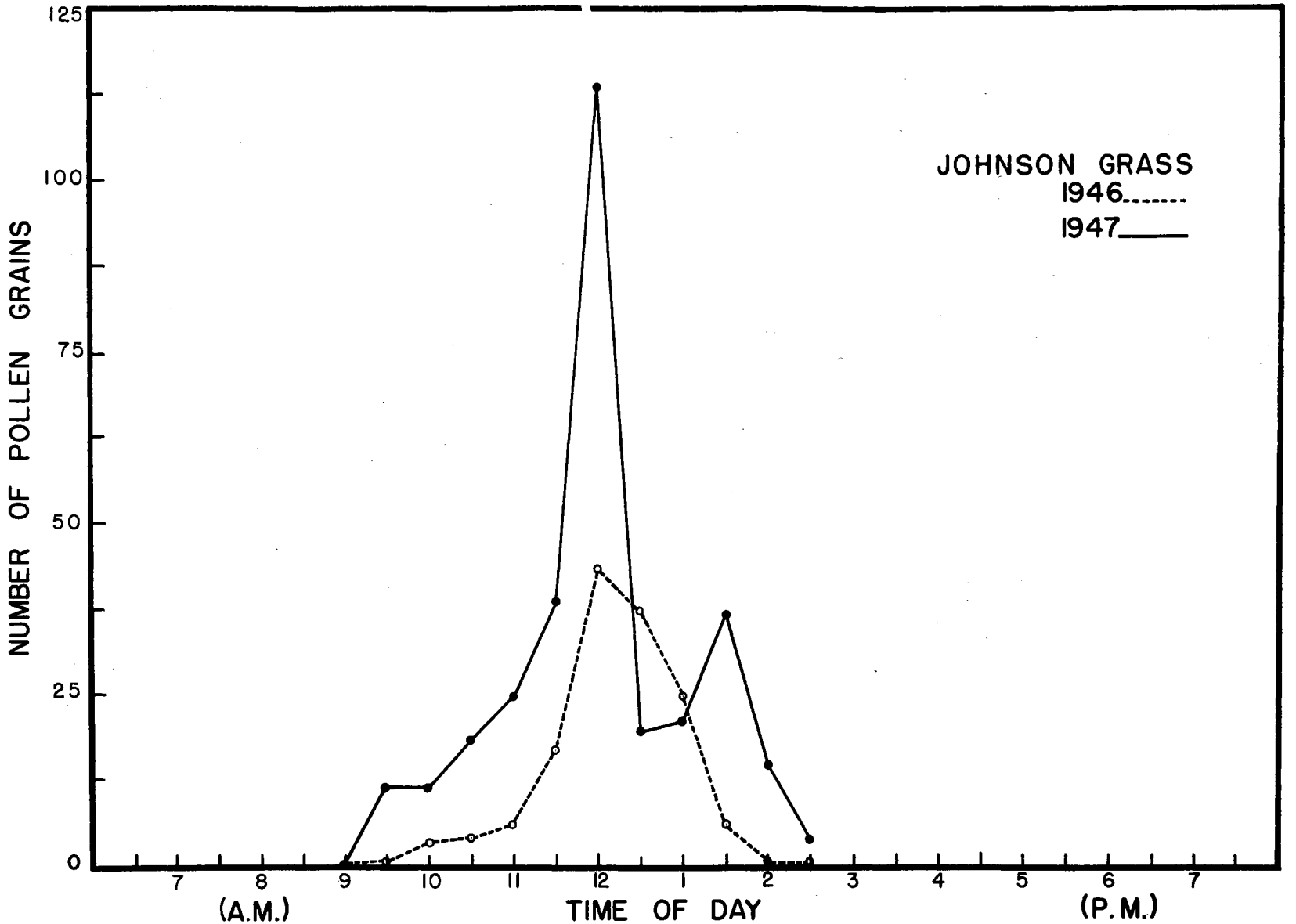

Fig. 4.—The average number of pollen grains of Johnson grass caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods of the day. Averages for 3 days in 1946 and 5 days in 1947.

with the peak near noon. Little pollen was caught after 2:30 p.m.

In 1947, initial shedding in Johnson grass began about 9:00 a.m. Shedding increased through the morning, and between 11:30 a.m. and noon the peak of pollen shedding occurred. During the remainder of the daily pollination period a decreasing amount of pollen was usually shed. After 2:30 p.m. practically no pollen was caught. The higher rate of shedding between 1:00 and 2:00 p.m. was greatly influenced by cloudiness and reduced temperature which delayed the time of the maximum rate of pollen shedding on July 10.

Sweet Corn

On slides exposed in the center of a field of sweet corn, on 4 days in late June and early July in 1946, the first few pollen grains were caught between 6:30 and 7:00 a.m. The rate of pollen shedding increased rapidly until the maximum was reached between 7:30 and 8:00 a.m. (Fig. 5). Heavy pollen shedding continued until 11:00 a.m. During the afternoon decreasingly lighter shedding occurred.

In 1947, slide studies were made on June 23, 24, and 25. Meteorological conditions and the daily pollination cycles were very similar on each of these days. The first few pollen grains were caught between 6:30 and 7:00 a.m. Heavy shedding extended from 8:00 to 11:00 a.m. with the peak of pollen shedding occurring between 8:30 and 9:00 a.m. The rate of shedding gradually decreased during the afternoon. Between 2:00 and 2:30 p.m. an average of 8 pollen grains was caught.

The maximum rate of pollen shedding occurred an hour earlier in 1946 than in 1947 probably due to the influence of the higher temperatures of the early morning on the days of study in 1946.

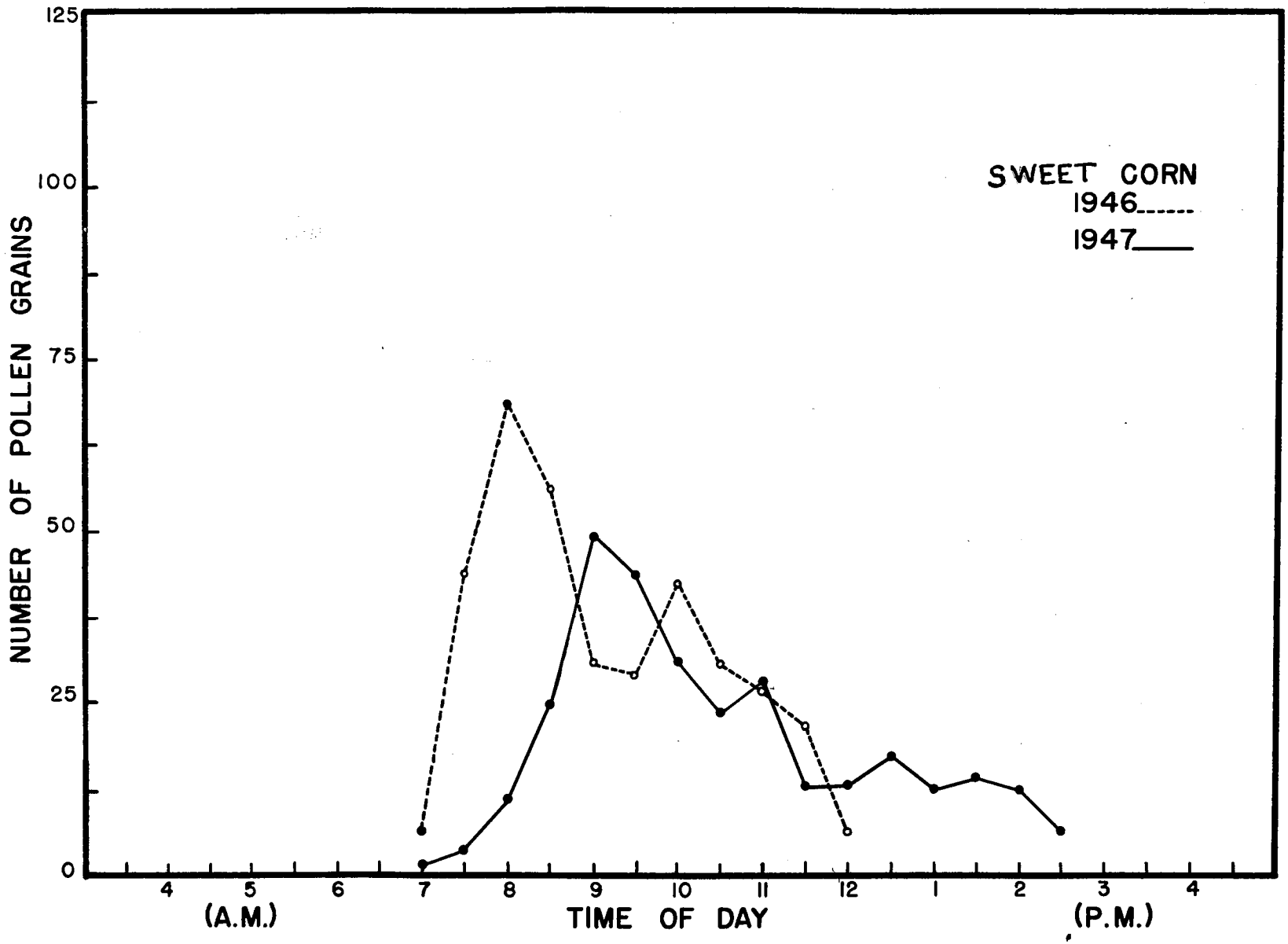

Fig. 5.—The average number of pollen grains of sweet corn caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods of the day. Averages for 4 days in 1946 and 3 days in 1947.

Weeping Lovegrass

In weeping lovegrass much of the blooming and shedding was in progress during the darkness of early morning (Fig. 6). Pollen shedding usually extended from shortly after midnight through the periods of lower temperatures of early morning until the atmosphere became warmer and dryer around 8:00 a.m.

On May 28 and for 3 days in the first week of June in 1946, the first pollen grains were caught between midnight and 12:30 a.m. The rate of shedding gradually increased until a peak of shedding occurred about 2:00 a.m. Moderate shedding continued until 3:00 a.m. After this time considerable dew was present and shedding was at a lower rate until 5:00 a.m. In a warmer atmosphere with the dew evaporating, a second period of increased shedding occurred between 5:00 and 6:30 a.m. with a peak about 5:45 a.m. Blooming decreased and a reduced rate of shedding continued until 8:00 a.m. after which time practically no pollen was caught.

Slide studies that were made in the first week of June in 1947 show that as an average of 4 days, the pattern of shedding was somewhat similar to that in 1946. Peaks of shedding occurred a little over an hour after midnight and a greater peak near dawn (Fig. 6). In both years of study, heavy dew, which bent the plants almost to the ground, persisted from shortly after 2:00 a.m. until after sunrise. Druing this time the rate of shedding usually was low, apparently being influenced by the amount of dew present. The time of the maximum rate of shedding each morning appeared to vary more or less directly with the duration of dew. Relatively little dew and a fairly high wind velocity of 25 mph allowed an unusually high rate of maximum shedding to occur between 4:30 and 5:00 a.m. on June 4, 1947.

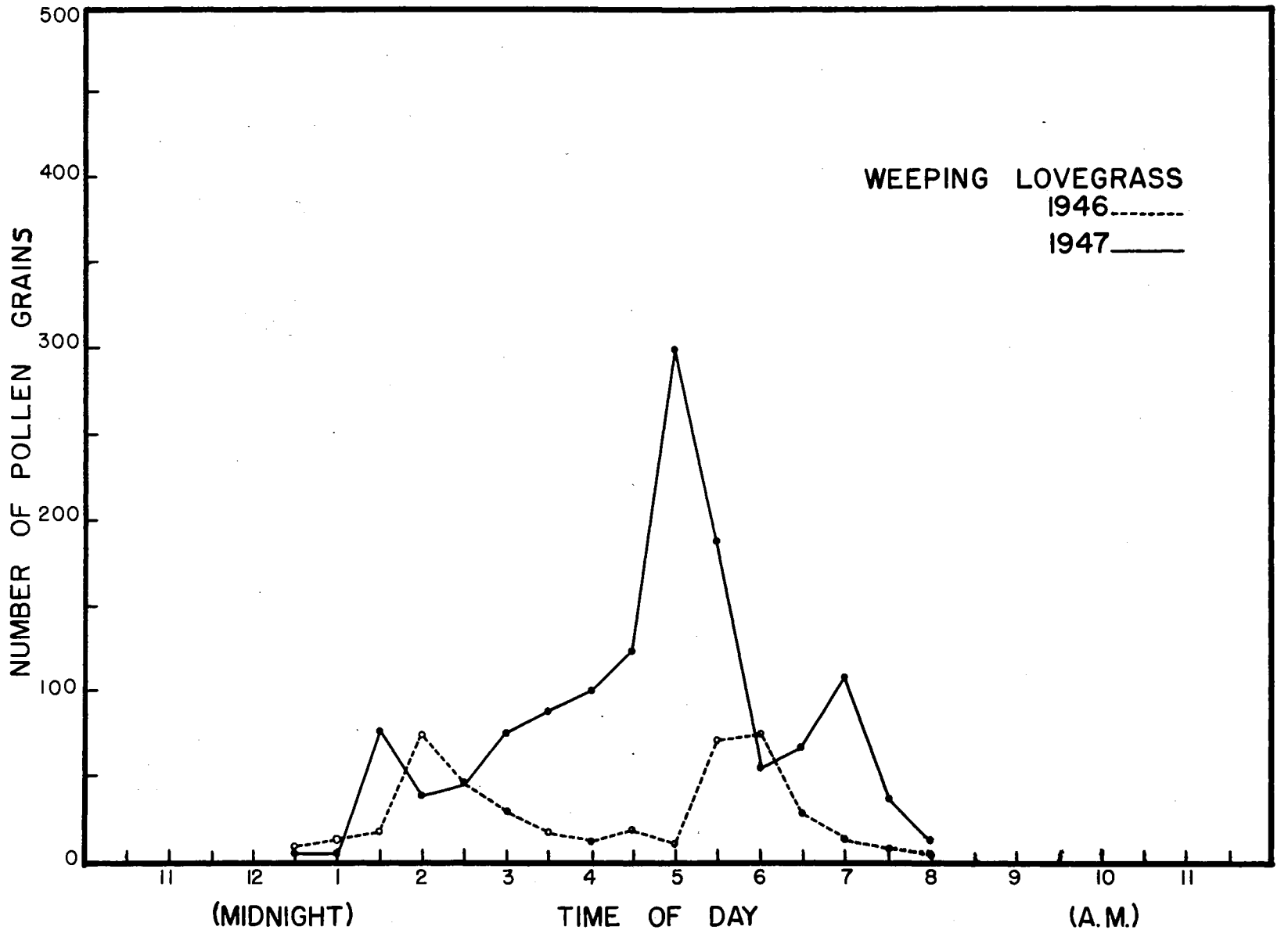

Fig. 6.—The average number of pollen grains of weeping lovegrass caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods of the day. Averages for 4 days in 1946 and 4 days in 1947.

The abundance of pollen caught on this date, which was during the height of seasonal shedding (Fig. 12), is largely responsible for the greatest peak of pollen shedding shown in Figure 6.

Rye

The Balbo variety of rye was studied for 3 consecutive days in the first week of May in 1946 and in 1947. In both years heavy pollen shedding extended from 8:00 a.m. to 12:00 noon (Fig. 7).

As an average in 1946, initial pollen shedding began between 6:30 and 7:00 a.m. Shedding increased gradually through the morning until the peak was reached between 10:30 and 11:00 a.m. A decreased rate followed shortly with a renewed increase a few minutes before noon. After noon, shedding decreased until the amount of pollen caught was very small.

Fog, cloudiness, and low temperature appear to have delayed the initial blooming and the peak of shedding in rye on May 3 and 4 in 1946. A few random plants bloomed at 8:00 a.m. The peak of shedding on May 3 occurred between 10:00 and 10:30 a.m. and on May 4 between 10:30 and 11:00 a.m. May 5 was a warmer, clearer day at sunrise, with the dew soon evaporating. The first blooming was evident at 7:00 a.m. an hour earlier than on the cooler days of May 3 and 4. The peak of shedding was also earlier, occurring between 9:30 and 10:00 a.m.

As an everage in 1947 initial shedding began between 6:30 and 7:00 a.m. About 8:15 a.m. an abrupt increase in shedding occurred and continued stronger until the peak of shedding occurred between 9:30 and 10:00 a.m. Heavy shedding continued although decreasing in rate until 1:00 p.m. On each day a slightly increased rate of shedding occurred between 1:00 and 1:30 p.m. Shedding decreased thereafter until little pollen was caught

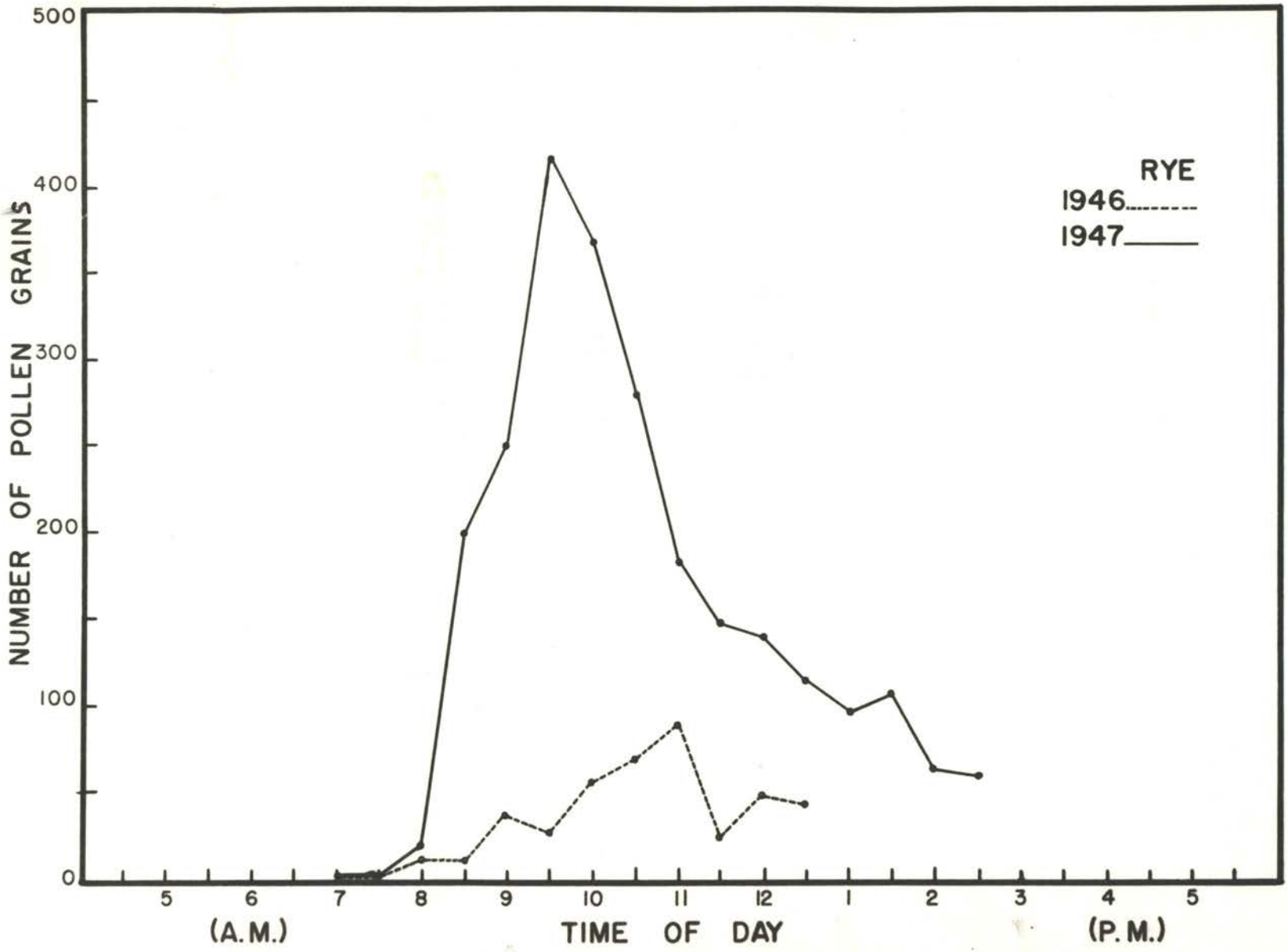

Fig. 7.—The average number of pollen grains of rye caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods of the day. Averages for 3 days in 1946 and 3 days in 1947.

after 2:30 p.m. The more abundant shedding in the morning and the earlier peak of shedding in 1947 appeared to be due to the higher temperatures, less cloudiness and less dew.

Bromegrass

In the investigation of the daily pollination cycle of bromegrass slide exposures were made on 4 days in the second and third weeks of May in 1946, and during early June in 1947. The majority of pollen in both years was caught during the late afternoon and early evening (Fig. 8).

In 1946, initial pollen shedding began between 1:30 and 2:00 p.m. and a gradual increase in rate of shedding followed except for a temporary rapid increase about 3:30 p.m. The peak of pollen shedding occurred between 5:00 and 5:30 p.m. After the peak, the rate of shedding decreased quickly. Little pollen was caught after 7:00 p.m.

Pollination was inhibited for a 72-hour period, May 11 to 13, inclusive, by reduced temperatures, the maximum and minimum temperatures for the period being 68° and 38° F., respectively. An abundance of shedding followed on May 14 when maximum and minimum temperatures of 78° and 64° F., respectively, were recorded.

In 1947, bromegrass was studied on June 4 to 7 inclusive, and on June 9. An average of the 5 days indicates that the initial shedding began between 3:30 and 4:00 p.m. About 5:00 p.m. heavy shedding began and continued beyond the peak, between 6:30 and 7:00 p.m., until near 7:15 p.m. Very little pollen was caught after 8:00 p.m.

The days on which studies were made in 1947 were warmer than those in 1946. Clear skies, low relative humidity, and strong winds were common. The temperatures between noon and 4:00 p.m. increased each successive day. The

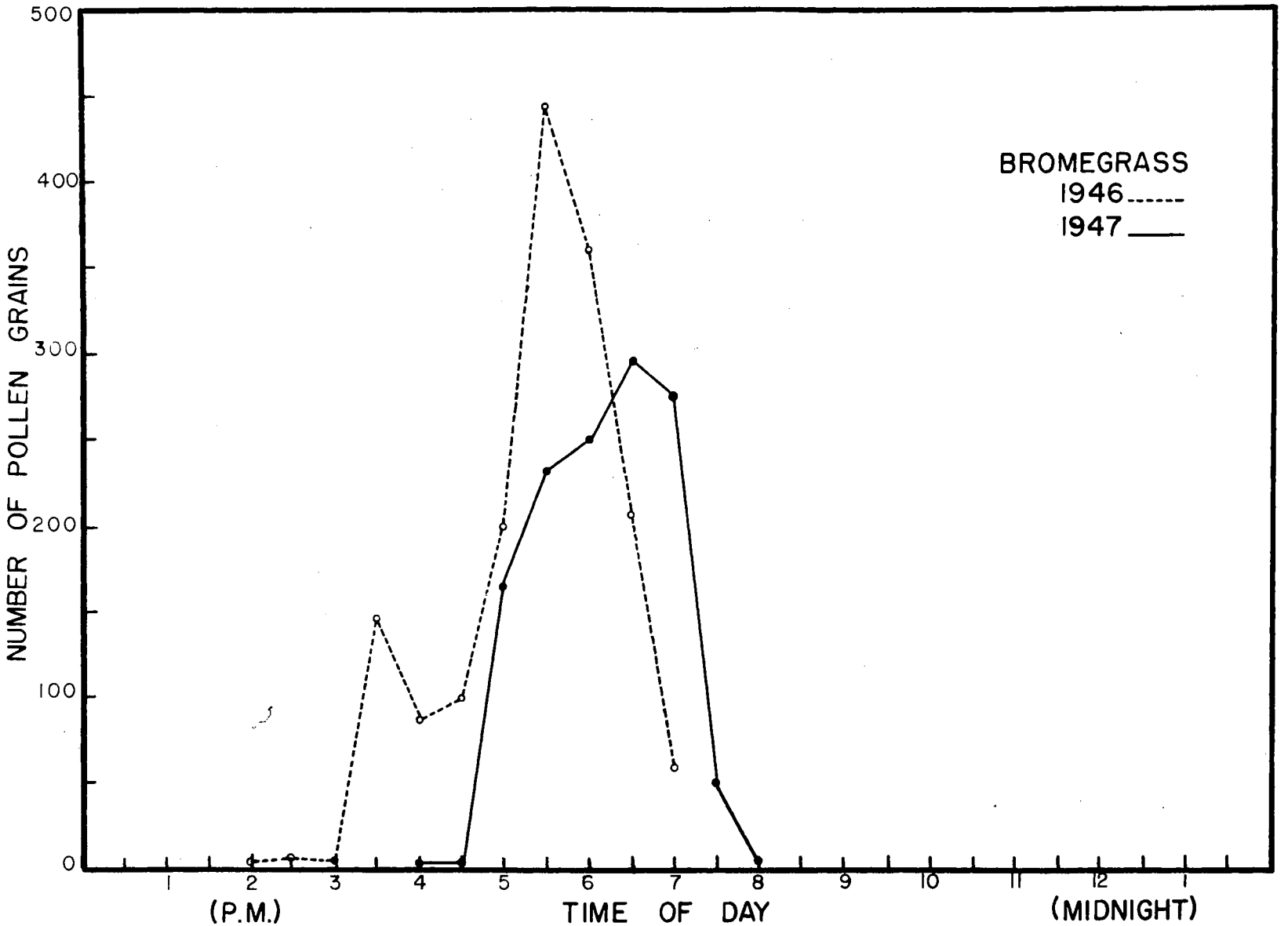

Fig. 8.--The average number of pollen grains of bromegrass caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods. Averages for 4 days in 1946 and 4 days in 1947.

time of the maximum rate of daily pollen shedding each successive day was consistently later by approximately 30 minutes (Table 1). The data presented in Table 1, indicate that possibly high temperatures delayed the time of the maximum rate of shedding each day after June 4. These data show that even though optimum temperatures for blooming and shedding prevailed near noon no shedding occurred at this time. Apparently the duration of light and heat had not been sufficient by then to mature the anthers. If the anthers were matured during such high temperatures, apparently blooming was delayed until the optimum temperature for blooming occurred in late afternoon and early evening.

Table 1.—Temperatures during and immediately proceding the time of the maximum rate of daily pollen shedding in a field of bromegrass near Stillwater, Oklahoma, in 1947.

Date	Time of maximum rate of daily pollen shedding (p.m.)	Temperature during time of maximum shedding	High and low temperatures between noon and 4:00 p.m.*
June 4	4:30-5:00	87°F.	85°-88°F.
June 5	5:00-5:30	86°F.	85°-89°F.
June 6	5:30-6:00	88°F.	86°-90°F.
June 7	6:00-6:30	87°F.	87°-92°F.
June 9	6:30-7:00	87°F.	89°-92°F.

*The highest temperature each day occurred near 2:00 p.m. except on June 6, when it occurred at 4:00 p.m. The lowest temperature occurred at noon except on June 7, when it occurred at 5:00 p.m.

Tall Fescue

Tall fescue was studied on 5 days in the latter part of May, 1947 (Fig. 9). The data obtained indicate that pollen shedding began between

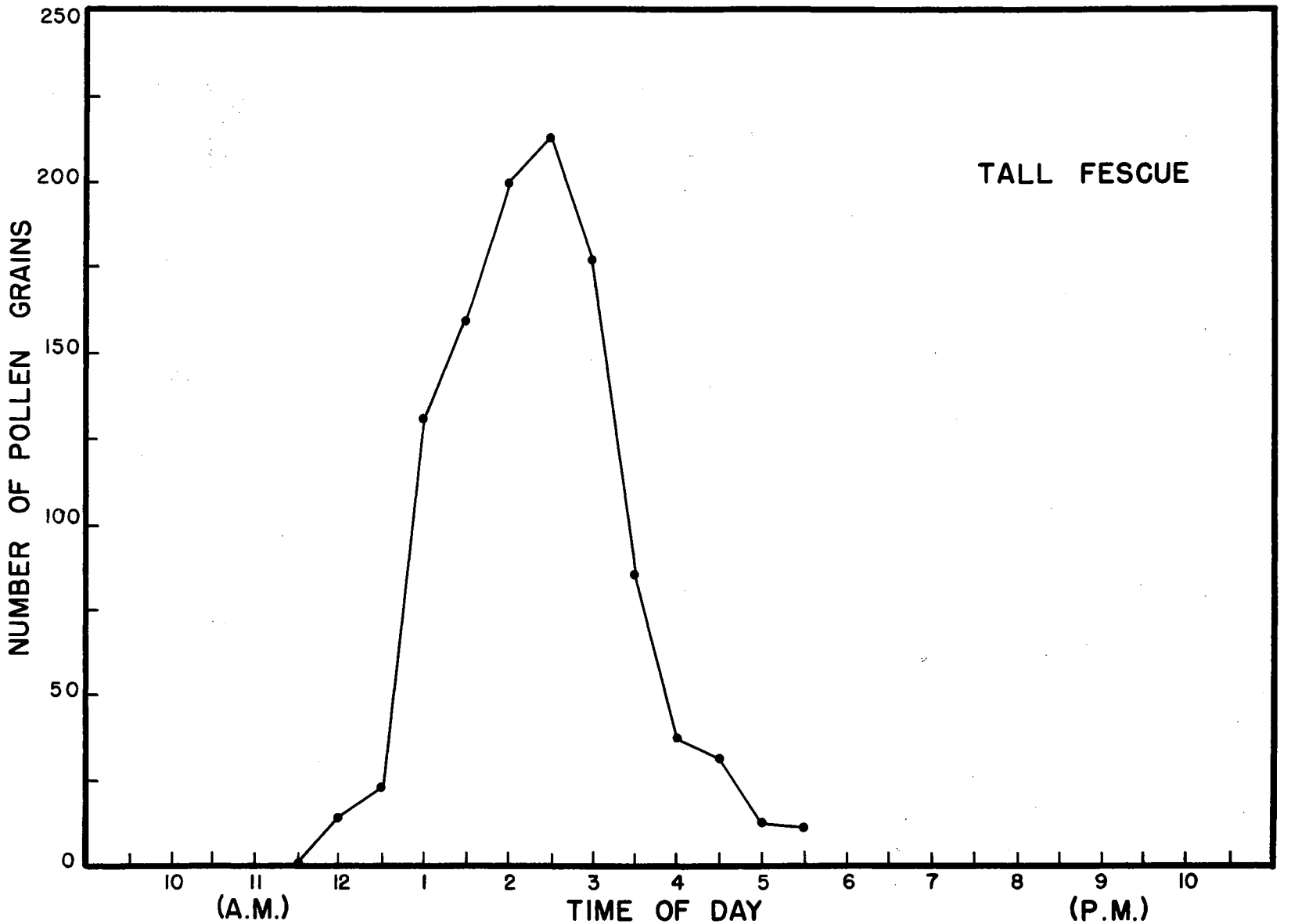

Fig. 9.—The average number of pollen grains of tall fescue caught on 16 sq. mm. areas of slides exposed in the center of the field, during 30-minute periods of the day. Average for 5 days in 1947.

11:00 and 11:30 a.m. The peak of shedding occurred between 2:00 and 2:30 p.m. Heavy to moderate shedding continued from 12:30 to 4:00 p.m. After 5:30 p.m. practically no pollen was caught.

Pollen shedding occurred at temperatures between 72° and 83°F. The majority of shedding occurred, however, at 77°F. Pollen shedding was inhibited at temperatures lower than 70°F. on May 23 and May 24. Initial pollen shedding was delayed slightly over 3 hours on May 30 until the temperature rose to 72°F. The amount of pollen caught on this relatively cool day was small.

Successive Days of Pollen Shedding per Field

Switchgrass

The successive days of pollen shedding in a field of switchgrass were studied in July and August, 1947 (Fig. 10).

After observing that a majority of the heads in the selected field was approaching maturity, spikelets were taken from random plants and the anthers observed for degree of maturity. Previous to initial blooming slides were left exposed in the center of the field. These slides were collected about 6:00 p.m. each day after the cessation of daily pollen shedding. The first few pollen grains were caught on July 29 and from this date until August 6 the amount of pollen caught during each 24-hour period increased gradually. On August 6 the number of pollen grains caught had increased to an average of 141 per 16 sq. mm. total area per slide. On the following day an abrupt increase to 326 pollen grains occurred.

On August 8, the average number of pollen grains caught was reduced to 126. On August 9 and 10, general field shedding was apparently inhibited.

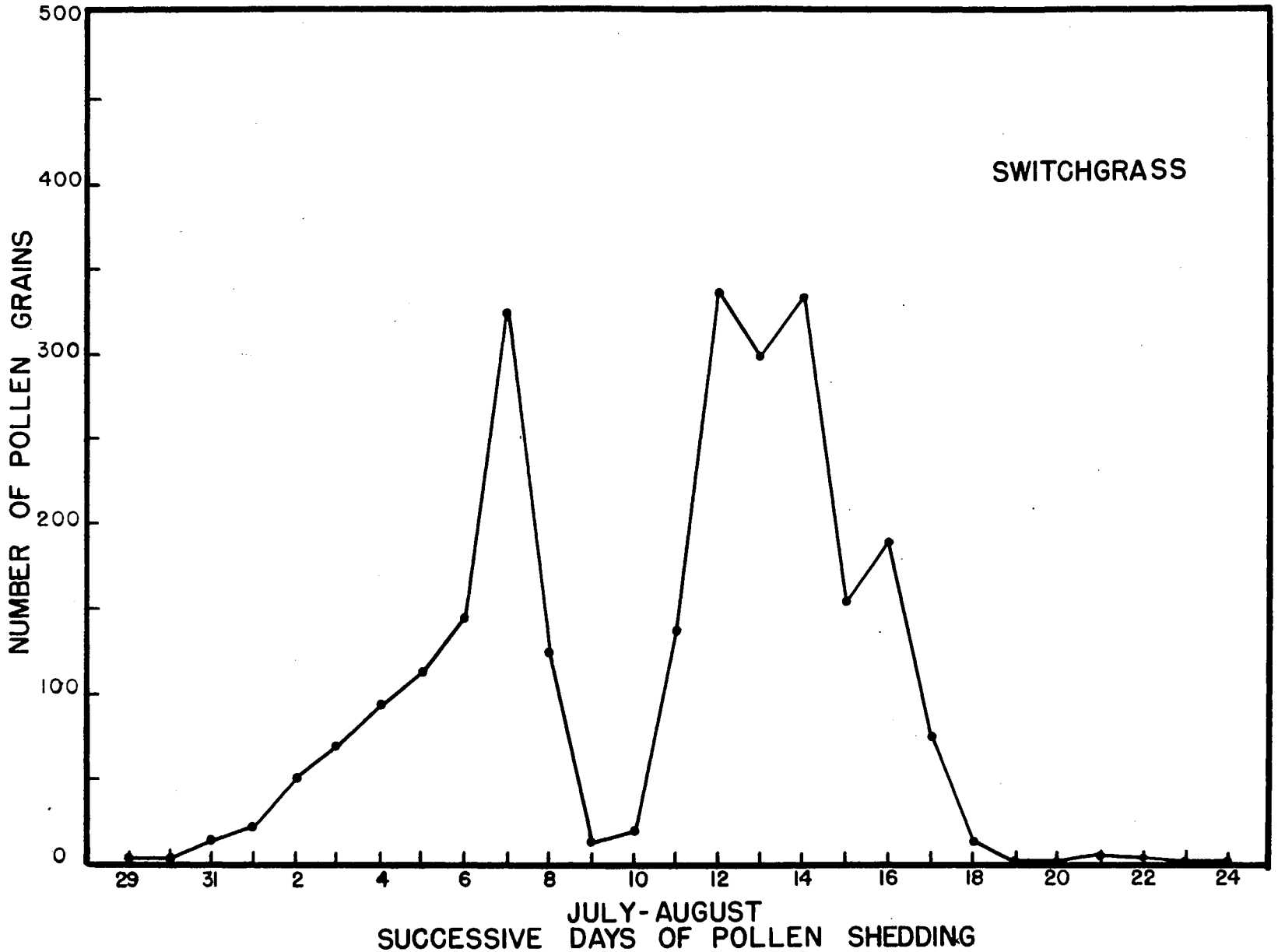

Fig. 10.—The average number of pollen grains of switchgrass caught on 4 slides exposed on successive days in the center of the field during 1947.

Twelve pollen grains were caught on August 9, and seventeen on August 10. On these 3 days of reduced shedding the sky was clearer than on the preceding 3 days and on the following 3 days. August 8 had a maximum temperature of 104°F. On both August 9 and 10, the maximum temperature was 105°F. On no other day in the switchgrass shedding season was the maximum temperature as high as on these 3 days.

On August 11, an average of 134 pollen grains were caught. On the following 3 days more pollen was caught than on any other 3 days of the season. These days of heaviest shedding were among the coolest of the season of study. August 12, and 13 had maximum temperatures of 92°F. August 14 had a maximum temperature of 94°F. and on this day the only rainfall of the pollen shedding season occurred.

Following these relatively cooler days of heavy shedding, the more nearly normal maximum temperatures, fluctuating near 99°F. prevailed through the remainder of the season. A more or less regular rapid decrease in the daily amount of pollen caught occurred between August 14 and 18. On August 18 shedding was reduced to an average 18 pollen grains. Less pollen was caught on each succeeding day until August 24, when exposures were discontinued.

Sorghum

The successive days of pollen shedding in sorghum was studied in August 1947 (Fig. 11).

Extreme fluctuations in the amount of pollen shed daily were not as evident in sorghum as they were in switchgrass, even though sorghum was subject to the same meteorological conditions as switchgrass.

The first pollen in sorghum was caught on August 4. On this day, an

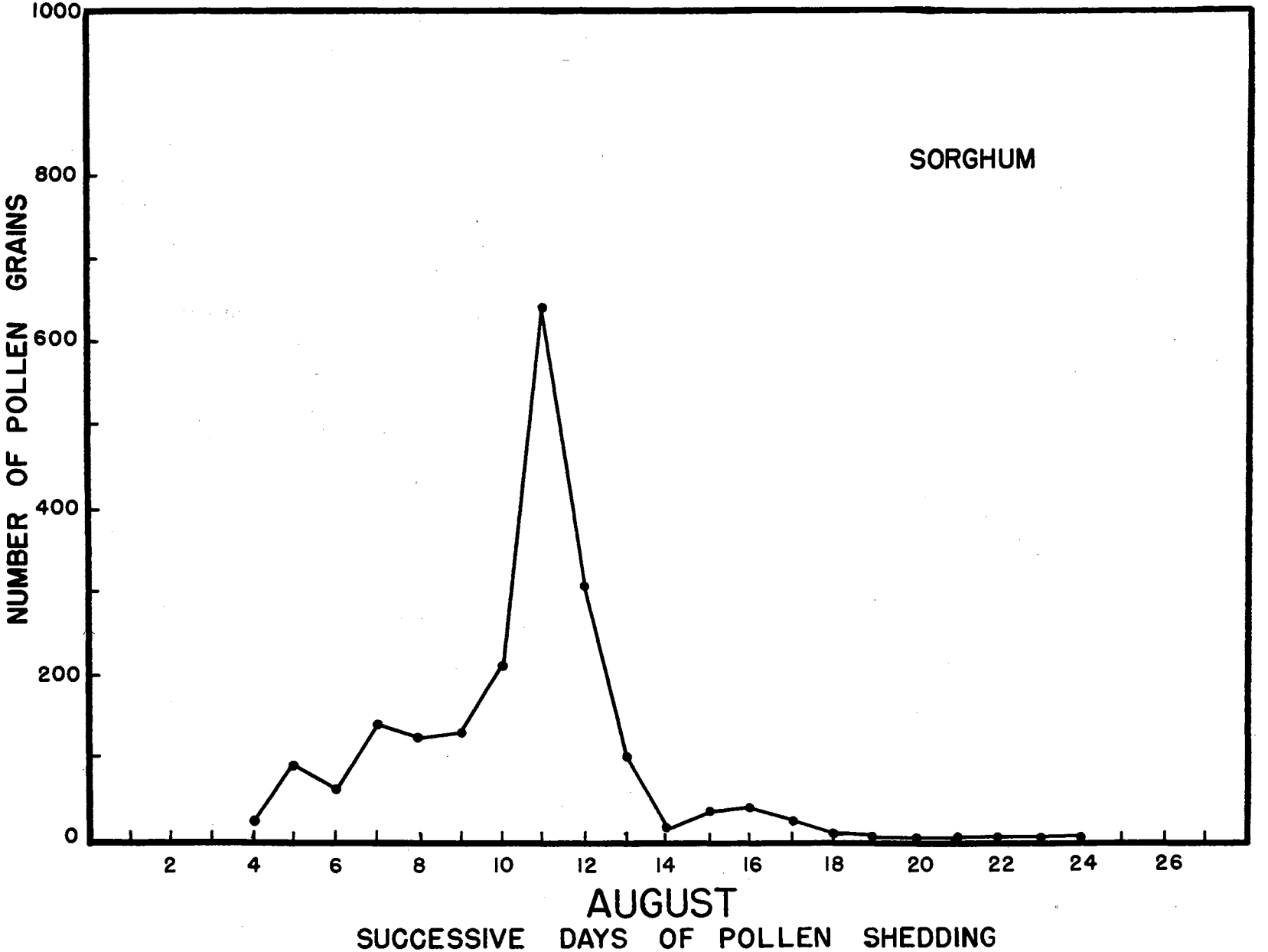

Fig. 11.—The average number of pollen grains of sorghum caught on 4 slides exposed on successive days in the center of the field in 1947.

average of 22 pollen grains was caught. The amount of pollen shed on the succeeding days increased more or less regularly. By August 10, shedding had increased until a count of 214 pollen grains was obtained. The heaviest rate of shedding occurred on August 11 when 645 pollen grains were caught. This amount of pollen is more than the combined amount of pollen caught on the preceding day and on the following day, August 12, when 306 pollen grains were caught. Further decrease in shedding occurred on August 13, when 102 pollen grains were caught. On August 14 the amount of shedding dropped to a count of 15 pollen grains.

After a slight increase in shedding to 31 pollen grains on August 15, and 38 on August 16, shedding gradually decreased for the next few days until only 2 pollen grains were caught on August 20, when slide exposures were discontinued.

Meteorological conditions were generally uniform during the days that sorghum was shedding except for two periods of extremes in temperatures. The 3 days preceding August 11 were the hottest days and the three days following were among the 4 coolest days of the sorghum shedding season (temperatures given on page 26). These extremes in temperatures probably influenced the amount of pollen shedding on August 11, which was the greatest amount shed during a single day.

Weeping Lovegrass

The successive days of pollen shedding in weeping lovegrass extended from May 26 to June 15, 1947 (Fig. 12).

The general pattern of pollen shedding during this season was one of more or less regular increase during the first 10 days of the season,

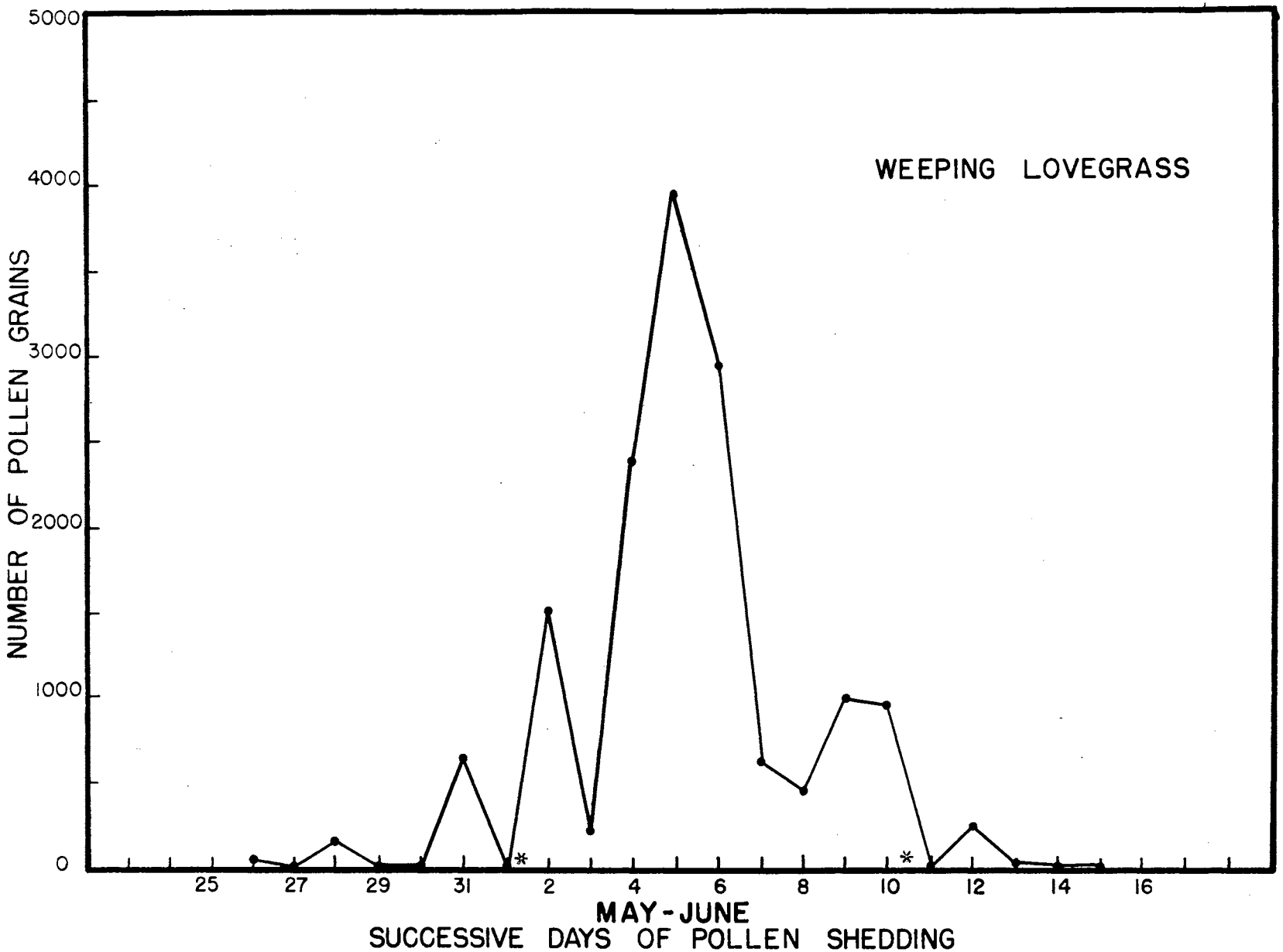

Fig. 12.—The average number of pollen grains of weeping lovegrass caught on 4 slides exposed on successive days in the center of the field during 1947.

*Rain removed the vaseline from the slides on June 1 and 11.

culminating in the peak of shedding on June 5, and thereafter, decreasing at a similar rate of shedding during the last 10 days. However, some variations in shedding occurred.

On May 26, the first day of shedding, a count of 47 pollen grains was obtained and light shedding also followed on May 27 and 28. Pollen shedding was inhibited on May 29 and 30. The range of temperature between midnight and 8:00 a.m. on May 29 was 44° to 54°F. and on May 30 from 49° to 59°F. The time given for the ranges of temperature is the typical period of daily pollen shedding in weeping lovegrass (Fig. 6). No other day had ranges of temperature so low in this season.

An average of 627 pollen grains was caught on May 31. Rain on June 1, destroyed the pollen count. The pollen count on June 2 went up to an average of 1518 pollen grains. The amount of pollen caught on June 3, was reduced to 209 pollen grains. On this date heavy dew prevailed through most of the shedding period.

The heaviest shedding of the season occurred on June 4, 5, and 6. On the peak day of shedding, June 5, an average of 3870 pollen grains were caught. During the time of heaviest shedding on June 5 the weather was warm, windy, and with very little dew. Meteorological conditions varied little from this on the following daily shedding periods of June 6 and 7, except that on June 7, there was practically no air movement. The amount of pollen caught on June 7 was reduced to a count of 632 pollen grains.

On June 8 the pollen count was 438. On the two following days pollen counts were higher. Rain washed the vaseline from the slides on June 11, and no count could be made. An average of 269 pollen grains was caught on June 12. Less pollen was caught on each of the following days until June 15, when an average of 2 pollen grains was caught. Slide exposures

discontinued after this date.

Number of Days of Blooming per Infloresence

The number of days of blooming per infloresence in certain grasses was studied in 1947.

After initial field blooming had started for each grass, paper tags were placed on 15 random infloresences which were approaching the first day of blooming. Observations of the tagged infloresences were made each day. The date of the first day of blooming was recorded on each tag, as well as the date of each succeeding day of blooming. The dry anthers were removed from the plant by hand at the end of each daily shedding period. After the last day of blooming of the tagged infloresences, 10 tags were collected from undamaged plants of each grass. The data obtained for the 10 infloresences are given in Table 2.

Table 2.--The average and range of the number of days of blooming in 10 infloresences of each of 8 grasses grown near Stillwater, Oklahoma in 1947.

Species	Number of Days of Blooming	
	Average	Range
Bermuda Grass	3.1	3-4
Rye	4.5	4-5
Sweet Corn	6.2	6-7
Bromegrass	7.2	7-8
Side-oats Grama	8.1	7-9
Sorghum	8.6	6-10
Johnson Grass	9.5	8-11
Weeping Lovegrass	10.5	10-11

In general, there appears to be a direct relationship between the number of florets per infloresence and the number of days of blooming. Plants with a larger number of florets require a greater number of days to mature and bloom.

DISCUSSION

The 8 grasses studied to determine the time of daily pollen shedding showed that the duration and maximum daily pollen shedding occurred at approximately the same time of day provided meteorological conditions were uniform. Apparently, the inherent factors of each species determined widely different periods of the day for pollen shedding.

There were variations in the regular pattern of shedding due to daily fluctuations in the seasonal meteorological conditions. High temperature, low temperature, dew, and rain all appear to have delayed and reduced anthesis, dehisence, and subsequent shedding. To a less extent cloudiness, high humidity, and lack of wind appeared to have delayed and reduced the rate of shedding. Low temperature was the only factor which inhibited pollen shedding completely for a day or longer. High temperature reduced pollen shedding on several days to the point that sufficient pollen could not be obtained for making crosses. An attempt to collect pollen for a very large number of crosses on very damp cloudy days hardly seems practical.

Inherent characteristics of each grass and environmental conditions affecting growth appeared to determine the period of seasonal pollen shedding. This period was approximately 2 to 3 weeks for the grasses studied on a field basis. During this time pollen shedding could occur on successive days as long as meteorological conditions were favorable. Random plants, perhaps genetic variants, bloomed and shed pollen several days before and after this general period. Heavy shedding, during which time an abundance of pollen could be collected, lasted for 7 to 9 days.

SUMMARY

Investigations to determine the time of day and number of days that certain grasses shed pollen were made at Stillwater, Oklahoma, in 1946 and in 1947.

Vaseline-coated microscope slides, attached to the windward end of special weather vanes, were placed in the center of selected grass fields to catch pollen for 30-minute and 24-hour periods during pollen shedding. The total number of pollen grains on 10 random low-power microscope fields (16 sq. mm. total area) per slide were used as a measure of the amount of pollen shed.

Eight grasses were studied for 3 to 5 days in 1946 and in 1947 to determine the time of day that each shed pollen. This time of shedding depended largely on the species. Switchgrass and Johnson grass shed the majority of their pollen about noon whereas shedding occurred during late afternoon in side-oats grama. Sweet corn and rye shed most of their pollen in mid-morning. Weeping lovegrass shed some pollen in the darkness of early morning, although most of its shedding occurred about sunrise. Bromegrass shed pollen during late afternoon and early evening. Tall fescue shed the majority of its pollen in early afternoon.

The duration of daily pollen shedding was from 5 to 6 hours in 5 of the grasses. It was slightly over 7 hours in weeping lovegrass, corn, and rye.

The number of days of pollen shedding was studied in two ways. One method was by successive days of shedding per field, and the other method was by the number of days of pollen shedding per infloresence.

Plants in fields of switchgrass, sorghum, and weeping lovegrass shed pollen for approximately 2 to 3 weeks, although, heavy shedding occurred from only 7 to 9 days.

In the study of the number of days of pollen shedding per inflorescence, most of the grasses shed pollen from 6 to 8 days, with extremes of 3 to 11 days.

Each grass appears to have an inherent periodicity of pollen shedding which is further limited by environmental factors, particularly temperature. Low temperatures delayed or inhibited blooming in each of the grasses. Extremely high temperatures delayed and decreased blooming in switchgrass and bromegrass. In most of the grasses, dew, rain, lack of wind and cloudiness appeared to delay pollen shedding, but did not inhibit it.

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