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SEPTEMBER 1959

AGRICULTURAL DROUGHT *in* *Alabama*

AGRICULTURAL EXPERIMENT STATION
of the ALABAMA POLYTECHNIC INSTITUTE
E. V. Smith, Director
Auburn, Alabama

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ERRATA

Errors occurring in Alabama Experiment Station Bulletin No. 316, "Agricultural Drought in Alabama," are herewith corrected.

Correction 1. The right hand total column, Table 5 page 24, is corrected to **year** and the data in this column are likewise revised.

Correction 2. The next to last sentence, first paragraph page 25, is corrected to read as follows: **In 5 out of 10 years, the annual excess in Alabama is 21 to 28 inches, except in the Gulf Coast area where the value is 34 inches.** This same correction also applies to the second sentence, top of page 31.

Correction 3. The last sentence, first paragraph page 25, should read: **In 1 out of 10 years, the annual excess in most areas is 30 to 40 inches of precipitation.**

TABLE 5. MONTHLY AND YEARLY EXCESS PRECIPITATION IN INCHES FOR 2-INCH BASE AMOUNT AND 4 PROBABILITIES BY DROUGHT AREAS

Area	Prob.	J	F	M	A	M	J	J	A	S	O	N	D	Year
		In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
A	1/10	10.1	8.9	6.3	3.9	2.5	1.9	2.8	2.2	1.6	2.0	4.6	8.4	36
	2/10	8.2	7.2	5.3	2.4	1.5	0.9	1.9	1.1	0.7	0.0	3.3	6.2	31
	3/10	6.8	5.9	4.6	1.9	0.7	0.1	1.2	0.9	0.0	0.0	2.3	4.7	27
	5/10	4.3	3.1	3.5	1.4	0.0	0.0	0.1	0.0	0.0	0.0	1.1	2.8	22
B	1/10	10.5	9.2	7.0	4.3	2.7	2.1	4.3	2.3	2.4	3.0	4.5	9.3	39
	2/10	8.1	6.7	5.8	3.0	1.6	1.0	2.8	1.6	1.6	1.0	3.2	6.4	34
	3/10	6.1	5.3	4.9	2.3	0.8	0.1	1.7	1.0	0.7	0.1	2.3	5.2	30
	5/10	4.2	3.6	3.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.9	3.5	24
C	1/10	9.8	7.7	7.3	4.6	2.9	1.7	4.0	3.5	2.4	2.8	4.4	8.9	37
	2/10	7.8	6.7	6.0	3.5	1.4	1.1	2.4	2.4	1.1	0.9	2.9	6.6	32
	3/10	5.8	5.9	5.1	2.7	0.8	0.3	1.9	1.8	0.2	0.0	2.0	5.0	30
	5/10	3.8	3.7	3.8	1.5	0.3	0.0	0.3	0.4	0.0	0.0	0.6	3.3	26
D	1/10	8.5	6.8	7.0	6.4	2.8	1.4	4.2	2.9	1.9	1.4	4.5	7.8	32
	2/10	5.2	5.4	5.5	4.0	1.7	0.7	2.5	1.6	0.9	0.0	2.2	5.9	29
	3/10	3.6	4.4	4.3	2.1	1.0	0.3	1.5	1.0	0.3	0.0	1.3	4.6	26
	5/10	2.5	2.8	2.8	0.9	0.2	0.0	0.4	0.2	0.0	0.0	0.0	2.8	21
E	1/10	7.0	6.2	7.7	6.3	2.3	1.9	4.3	3.1	2.3	1.6	3.3	7.4	32
	2/10	4.7	4.8	5.7	4.1	1.3	1.0	2.4	1.8	1.2	0.7	1.6	5.9	29
	3/10	3.7	4.1	4.5	2.5	0.6	0.3	1.4	1.0	0.7	0.0	0.8	4.8	26
	5/10	2.6	2.8	3.0	0.9	0.0	0.0	0.4	0.0	0.0	0.0	0.0	2.7	21
F	1/10	6.0	5.5	8.8	6.6	4.8	4.4	8.6	3.4	6.0	2.9	4.8	7.7	40
	2/10	4.5	4.3	7.2	4.5	3.3	2.3	5.7	1.9	3.8	1.2	2.5	6.1	35
	3/10	3.7	3.5	6.1	3.2	2.2	1.0	3.7	1.2	2.3	0.2	1.6	5.0	33
	5/10	2.8	2.3	4.2	1.5	0.5	0.0	1.6	0.3	0.8	0.0	0.0	3.2	28
G	1/10	7.9	6.5	9.1	5.9	4.1	2.4	7.3	5.2	4.8	2.1	6.4	7.2	43
	2/10	5.2	5.0	7.0	4.4	2.7	1.3	5.6	3.4	2.9	0.1	3.7	5.1	37
	3/10	4.1	3.8	5.7	3.5	1.6	0.5	4.0	2.4	1.7	0.0	2.0	4.0	33
	5/10	2.8	2.5	3.5	1.7	0.0	0.0	1.6	1.0	0.3	0.0	0.0	2.4	27
H	1/10	5.7	6.3	8.0	5.5	3.0	2.3	5.3	4.5	3.8	1.0	5.0	6.4	37
	2/10	4.4	5.0	6.1	4.0	1.5	1.0	3.7	3.2	2.3	0.0	2.4	4.8	31
	3/10	3.6	3.9	4.6	3.0	0.7	0.0	2.7	2.4	1.5	0.0	0.7	3.8	27
	5/10	2.4	2.2	2.7	1.4	0.0	0.0	1.2	1.2	0.3	0.0	0.0	2.3	21
I	1/10	6.9	6.4	9.9	8.7	5.6	7.5	12.7	8.8	7.3	5.0	6.0	6.7	51
	2/10	4.9	4.4	6.8	5.3	3.3	5.0	9.1	4.7	5.7	2.8	2.1	4.9	45
	3/10	3.9	3.3	5.0	3.6	2.1	3.3	6.1	3.3	4.4	0.0	1.1	4.0	41
	5/10	2.3	1.9	2.9	1.9	0.9	1.3	3.3	1.8	5.5	0.0	0.4	2.8	34

AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY

E. V. Smith, Director
Auburn, Alabama

AGRICULTURAL DROUGHT *in* Alabama*

HENRY S. WARD, *Botanist***
C. H. M. VAN BAVEL, *Principal Soil Scientist, U.S.D.A.*
J. T. COPE, JR., *Associate Agronomist*
L. M. WARE, *Head, Department of Horticulture*
HERMAN BOUWER, *Associate Agricultural Engineer****

PLANTS use enormous quantities of water that are absorbed from the soil. An acre of corn may require 16 inches or 500,000 gallons of water during a growing season. This 16 inches of water is equivalent to approximately 1,618 tons. Of this amount, 1,600 tons are returned to the atmosphere. The other 18 tons, or 1.1 per cent, of water is used by the acre of corn plants for chemical combination and cell hydration, which are essential for growth and development of optimum yield. The water from which this 1.1 per cent is to be obtained must be continuously supplied during the growing season for normal growth and development. However, a supply of this water in plants is maintained only if sufficient water is available from the soil for transpiration. When transpiration exceeds water absorption, a deficit of water results in decreased transpiration and rate of growth.

The water used by plants is absorbed from the soil moisture reservoir. The water in the soil moisture reservoir that is utilizable by plants is designated as **available soil moisture.** The available soil moisture is that held by the soil between field capacity (upper limit) and the permanent wilting percentage (lower level). Field capacity is the moisture percentage of a soil, expressed on a dry-weight basis, in the field 2 or 3 days after a thorough wet-

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** Resigned.

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ting of the soil profile by rain or irrigation water. Permanent wilting percentage is the moisture percentage of soil at which plants wilt and fail to recover turgidity. The amount of available soil moisture is dependent on the size and arrangement of the soil pores. Fine-textured soils will hold more available water than coarse soils. The available moisture varies from as little as 0.2 inch per foot in some sandy soils to as much as 3.0 inches in some loams and clays.

Thus, it is apparent that plants use large amounts of water by transpiration and the source of this water is the available moisture in soils. The supply in soils is absorbed into the plants at the tips of the root. The depth of root penetration determines how much of the soil reservoir is utilized for available moisture. The root zone is determined by physical, chemical, and biological properties of soils and by the kind of plant cover. The root zones of the various kinds of plant covers (crops, forest trees, etc.) that grow in the various soil types of Alabama are not accurately known. However, an estimate can be made of root occupancy in similar soil types on the basis of studies in other Southeastern States *(2,3,5,6,7,8,10,12)*. A summary of this information is given in Table 1.

The data on root occupancy in Table 1 show the root zones for only a few of the soil types in Alabama. In general, the plants have most of their roots distributed in the upper 12 inches of soil. Thus, the principal soil moisture reservoir is the top foot of soil.

Water is lost to air from the soil either by direct evaporation from the soil surface or by transpiration from plants. The sum of transpiration and evaporation is designated by the term **evapotranspiration.** Evapotranspiration occurs when water is available, energy is available to convert water to vapor, and the atmosphere as a whole has a saturation deficit. Van Bavel *(14)* points out that several investigators showed that various kinds of plant covers do not differ materially in their evapotranspiration rates. If water is available, the rate of evapotranspiration appears to be controlled by climatic conditions. Aslying *(1)* and Lull *(9)* in their extensive reviews of evapotranspiration studies concluded that, by using daily calculated evapotranspiration rates, the rate of movement of water from the soil reservoir can be accurately determined.

As long as available soil moisture is present in the root zone, evapotranspiration occurs and the water requirements of the plant cover are met without serious drought damage. However,

TABLE 1. ROOT OCCUPANCY OF SEVERAL KINDS OF PLANTS IN VARIOUS SOIL TYPES

Kind of plant	Type of soil	Depth of root growth	Principal zone of root occupancy
		Inches	*Inches*
Corn	Norfolk sandy loam	18	0 to 14
Corn	Cecil clay loam	18	0 to 14
Cotton	Marlboro sandy loam	16	0 to 8
Peanuts	Norfolk sandy loam	24	0 to 14
Alfalfa	Norfolk sandy loam	48	0 to 6
Alfalfa	Cecil clay loam	72	0 to 12
Bermudagrass	Norfolk sandy loam	35	0 to 8
Carpetgrass	Norfolk sandy loam	30	0 to 8
St. Augustinegrass	Norfolk sandy loam	35	0 to 8
Centipedegrass	Norfolk sandy loam	33	0 to 8
Bahiagrass	Norfolk sandy loam	35	0 to 8
Peach (Mikado)	Cecil clay loam	52	0 to 18
Tung tree	Ruston sandy loam	34	0 to 6
Longleaf pine	Ruston sandy loam	32	0 to 6
Loblolly pine	Alamance clay loam	37	0 to 5
Shortleaf pine	Alamance sandy loam	38	0 to 8
Red Oak	Georgeville clay loam	36	0 to 9
Sweetgum	Congaree sandy loam	49	0 to 19
Yellow poplar	Congaree sandy loam	49	0 to 19

when the available soil moisture is depleted, crops are in danger of drought damage unless the available soil moisture is replaced either by rainfall or irrigation. Van Bavel *(14)* defines **agricultural drought as a condition in which there is insufficient soil moisture available to a crop.** Agricultural drought probably occurs every year in Alabama, and with modern fertilizer practices these water deficits are the principal cause of failure to obtain maximum yields.

Realization of agricultural drought has resulted in much interest in irrigation in Alabama and the other states east of the Mississippi River. Irrigated acreage in 31 states of the humid region was 70 per cent greater in 1954 than in 1949, according to the 1954 Census of Agriculture.

The present study was made of agricultural drought in Alabama by using the procedure of Van Bavel *(14)*. Similar studies have been completed for North Carolina, Virginia, South Carolina, and Georgia *(15,16,17,18)*. The objectives of this study were:

1. To determine probable occurrence of drought conditions.
2. To evaluate need for irrigation and irrigation research.
3. To aid in establishment of general water policies for agriculture, industry, and municipalities.
4. To determine excess water and its relation to drainage, conservation, and flood control.

PROCEDURE

The methods for estimating drought occurrence are those of Van Bavel, and are given in detail in the North Carolina agricultural drought publication *(15)*. In brief, the method consists of combining existing data on daily rainfall with estimates of daily water losses through evapotranspiration and determining the number of times that available moisture in the soil is reduced to zero. A day when available moisture is zero is called a **drought-day.** Thornthwaite and Mather *(11)* have proposed a similar method of determining when to irrigate.

The estimation of soil moisture conditions from climatological data is determined by five distinct steps. These are the procure-

TABLE 2. LIST OF 27 RAINFALL STATIONS USED IN COMPUTATION OF DROUGHT INCIDENCE IN ALABAMA

Area and station		County	Number as given in Figures 1 and 2
Limestone Valleys, Appalachian Plateau, and Piedmont Areas			
Area A:	Decatur	Morgan	7
	Muscle Shoals	Colbert	18
Area B:	Guntersville	Marshall	13
	Madison	Madison	15
	Scottsboro	Jackson	24
Area C:	Anniston	Calhoun	1
	Birmingham	Jefferson	3
	Gadsden	Etowah	10
	Saint Bernard	Cullman	23
Black Belt and Coastal Plain Areas			
Area D:	Dancy	Pickens	6
	Greensboro	Hale	11
	Pushmataha	Choctaw	20
	Selma	Dallas	25
	Thomasville	Clarke	26
Area E:	Auburn	Lee	2
	Clanton	Chilton	5
	Montgomery	Montgomery	17
Area F:	Jackson Lock I	Clarke	14
	Mobile	Mobile	16
Area G:	Brewton	Escambia	4
	Greenville	Butler	12
	Riverfalls	Covington	21
Area H:	Dothan	Houston	8
	Eufaula	Barbour	9
	Ozark	Dale	19
	Troy	Pike	27
Area I:	Robertsdale	Baldwin	22

ment of rainfall data, estimation of evapotranspiration, estimation of moisture storage capacity of the soil, computation of daily soil moisture balance, and classification of data.

The daily precipitation data were taken from official United States Weather Bureau records, as furnished by the National Records Center in Asheville, North Carolina. The records of 27 stations in Alabama for a period of 25 years, 1930-1954, were used. These data were entered upon punch cards, together with any available data on maximum and minimum temperatures. The cards are stored by the Agricultural Experiment Station of The Alabama Polytechnic Institute, Auburn. The list of stations is given in Table 2 and their location is shown in Figures 1 and 2.

Estimated values for daily evapotranspiration were obtained with the formula proposed by Penman, and its use is discussed in detail by Van Bavel *(15)*. The formula gives maximum evapotranspiration from a large homogeneous plant cover of maximum occupancy and with ample available soil moisture. To use the Penman equation, one requires weather data on sunshine duration, air temperature, relative humidity, and windspeed. These data have been measured in Alabama at only four stations, namely Anniston, Birmingham, Montgomery, and Mobile. To offset the lack of data in Alabama, stations were taken in adjacent states. Stations in Georgia were Atlanta, Macon, and Thomasville, while other stations were Jackson, Mississippi, Pensacola, Florida, and Chattanooga, Tennessee. After an examination of the average daily evapotranspiration for each month for all of the stations, Alabama was divided into two areas. The northern area evapotranspiration values were averages of Chattanooga, Atlanta, Anniston, and Birmingham, whereas the southern area evapotranspiration values were averages of Macon, Thomasville, Jackson, Pensacola, Mobile, and Montgomery. The division of Alabama into two evapotranspiration areas is shown in Figure 1. Average daily evapotranspiration, and totals for each month and area are given in Table 3. Monthly averages for each year during the 25-year period are in Appendix Tables 1 and 2.

In order to compute the daily balance of available soil moisture, the maximum storage capacity in the root zone must be estimated. As previously pointed out, the maximum storage capacity depends upon the field capacity, depth of the root zone, and soil moisture content at the lower limit of availability. The value may vary from less than 1 to several inches, depending

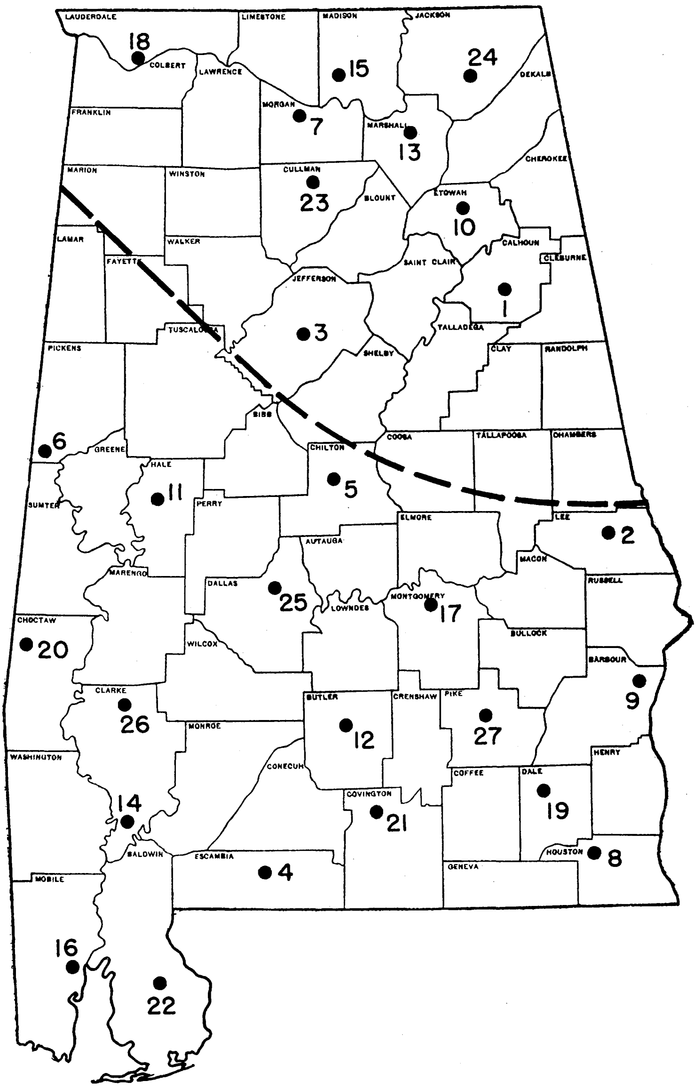

FIGURE 1. The northern and southern areas for evapotranspiration, with location of precipitation stations in Alabama.

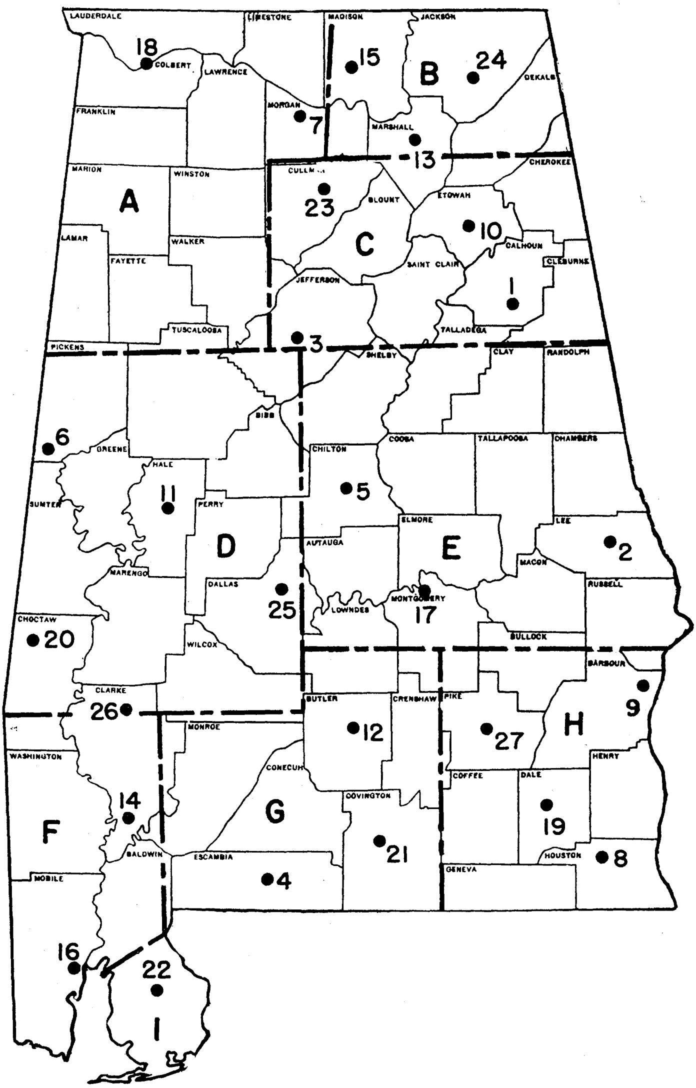

FIGURE 2. Areas used for monthly and 10-day-period drought probabilities, excess moisture, and irrigation requirements, with location of precipitation stations in Alabama.

TABLE 3. AVERAGE MONTHLY EVAPOTRANSPIRATION FOR NORTHERN AND SOUTHERN AREAS OF ALABAMA, 1930-1956

Month	Northern area		Southern area	
	In./day	*In./mo.*	*In./day*	*In./mo.*
January	.026	.81	.041	1.27
February	.048	1.34	.066	1.85
March	.067	2.08	.086	2.67
April	.107	3.21	.130	3.90
May	.142	4.40	.160	4.96
June	.173	5.19	.185	5.55
July	.154	4.77	.162	5.02
August	.141	4.37	.158	4.90
September	.120	3.60	.134	4.02
October	.080	2.48	.100	3.10
November	.043	1.29	.060	1.80
December	.024	.74	.038	1.18
TOTAL PER YEAR		34.28		40.22

upon the value of the foregoing 3 factors. Therefore, the maximum amount of water that a soil can hold and make available to a crop was used as a variable in this study. The amounts used were 1, 2, 3, and 5 inches. By computing the drought-days for each of these values, the results may be used to cover most soil conditions.

The number of drought-days was determined by computation of the daily soil moisture balance. It was assumed that the amount of water in the root zone is at its maximum value at the beginning of the year, January 1. From then on, on each day a new balance was computed by adding any rainfall that occurred and subtracting the estimated amount of evapotranspiration. This procedure was followed for the 27 stations in the State for each of the 25 years. Average daily evapotranspiration values used for each month were those for the year involved, as given in Appendix Tables 1 and 2.

The daily soil moisture balance estimates were subject to two conditions. First, by cancelling any occurring excess, the daily balance was not allowed to exceed the base amounts, i.e., 1, 2, 3, and 5 inches; and second, by cancelling any amount below zero, the balance was not allowed to become negative. Incidence of zero or negative amounts marks the occurrence of a drought-day and the total number is recorded for each day, and the total number is recorded for each month and 10-day period within a month. No account is taken of surface runoff and the dependence of evapotranspiration upon soil moisture content. These computations are approximations of what happens under field conditions, but the errors involved are not sufficiently large to affect results appreciably. A more detailed discussion is given by Van Bavel *(15)*.

The calculation as outlined was done for each of the four basic amounts by using electronic computers and related equipment. The procedure involved use of a single punch card for each day, upon which were recorded the daily rainfall, pertinent value of evapotranspiration, and results of the calculation for the four soil storage values. Tabulations were prepared from the punch cards by printing the monthly moisture excess, monthly total of drought-days, and 10-day total of drought-days for each month of record and for each station. Annual totals of each characteristic were also obtained.

From the machine tabulations, frequency distributions were computed of the total number of drought-days during March through November and the annual value of excess moisture of each of the 27 stations in Alabama. These frequency curves were interpolated at probability levels of 1, 2, 3, and 5 out of 10 to yield the minimum number of drought-days for each station and each of the 4 base amounts. The data were then plotted on a map of Alabama and lines of equal drought incidence drawn.

Frequency curves were made for monthly and 10-day totals of drought-days for each base amount. However, these were based upon the aggregated data of several stations. For this purpose the state of Alabama was divided into **nine areas,** within which monthly drought probabilities were similar. These 9 areas are outlined in Figure 2. For each area, therefore, a set of frequency curves was prepared and these were interpolated at probabilities 1, 2, 3, and 5 out of 10. A similar procedure was followed for the monthly totals of excess precipitation.

The inches of irrigation water required to prevent occurrence of drought-days was obtained by taking the expected minimum number of drought-days for each month and each area at odds of 1 out of 10 and multiplying this amount by the estimated daily evapotranspiration. These figures represent an amount of water that will exceed the demand in 9 out of 10 years and will be short of the demand only in the remaining year. Irrigation requirements applying to odds of 7 out of 10 years and 5 out of 10 years were computed in a similar manner.

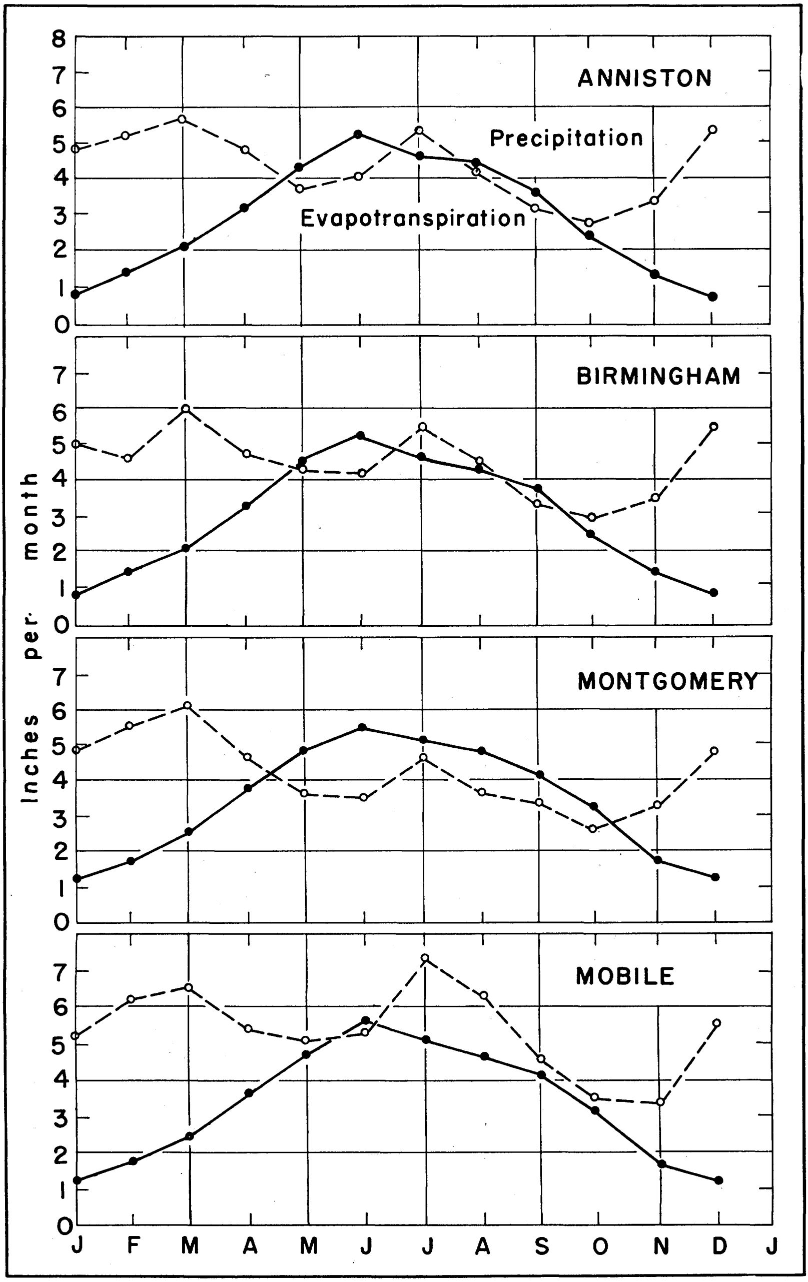

FIGURE 3. Monthly precipitation and monthly evapotranspiration at four stations in Alabama.

PRECIPITATION and EVAPOTRANSPIRATION

A qualitative picture of the sufficiency of rainfall for crop production in Alabama can be obtained by comparing average values of monthly rainfall with average values of monthly evapotranspiration. This is illustrated by the data shown in Figure 3 for the four stations, Anniston, Birmingham, Montgomery, and Mobile. With the exception of Mobile, average evapotranspiration is higher than average rainfall during May, June, and September. The graphs indicate definite shortages of soil moisture or droughts during the summer months and an excess during the winter. Summer drought is particularly pronounced at Montgomery.

OCCURRENCE of DROUGHT-DAYS

Number per Season

Each of the 27 stations had frequency distributions prepared of the total number of drought-days during the months of March through November. These are not all presented but, instead, 9 stations were selected, one for each of the areas indicated in Figure 2. The frequency distributions are shown in Appendix Figures 1 through 9. On the horizontal axis, these graphs show the minimum number of drought-days and on the vertical axis the associated value of the probability expressed in per cent. A reasonably fitting straight line could be drawn through the points without much difficulty. The lines were fitted by eye. Separate lines are shown for each of the four base amounts of soil moisture.

The effect of the storage capacity of soils for available water upon drought incidence is apparent from the data in Appendix Figures 1 through 9. Often an increase of 1 inch in storage capacity means a decrease of 50 per cent in the chances for a similar drought occurrence.

To facilitate use of information concerning the expected number of drought-days per season, it is presented in the form of maps rather than graphs, Figures 4 through 7. These maps show the minimum number of drought-days expected for the period March through November at four probability levels and at the base amounts of 1 and 2 inches of available root zone moisture. Maps for the 3- and 5-inch base amounts are not presented. Research information available at present by Cooper et al. *(4)*

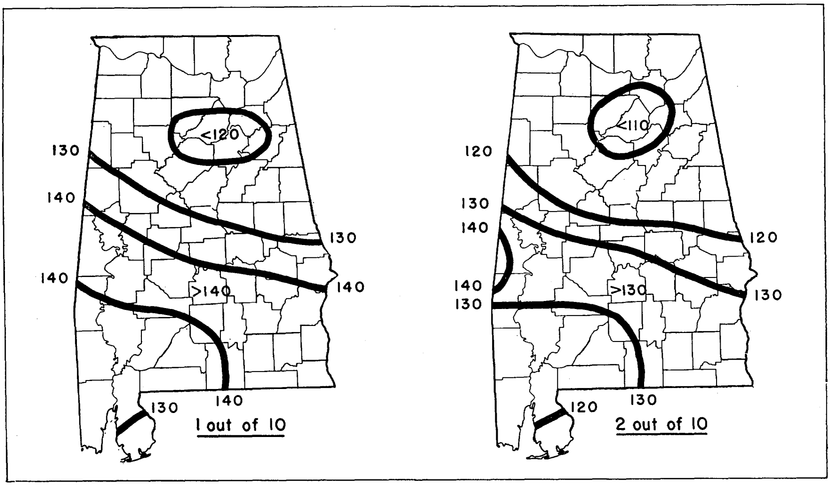

FIGURE 4. Probability of 1 and 2 out of 10 years for the minimum number of drought-days to occur in the period of March through November for 1 inch of soil moisture capacity.

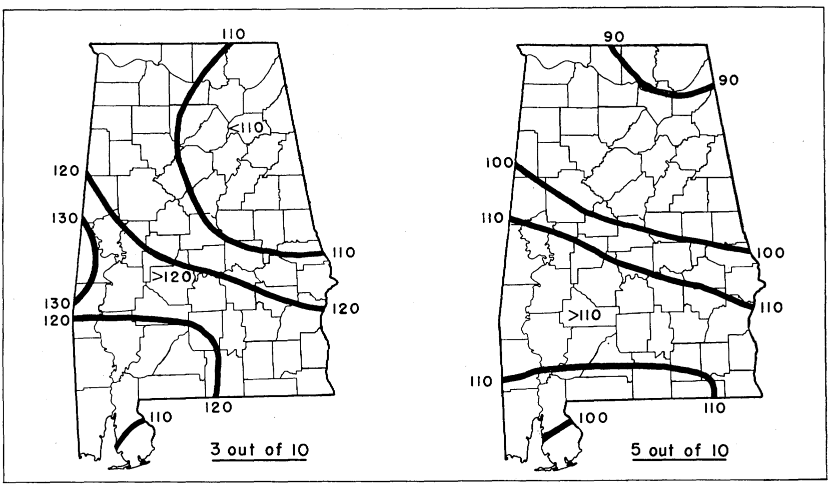

FIGURE 5. Probability of 3 and 5 out of 10 years for the minimum number of drought-days to occur in the period of March through November for 1 inch of soil moisture capacity.

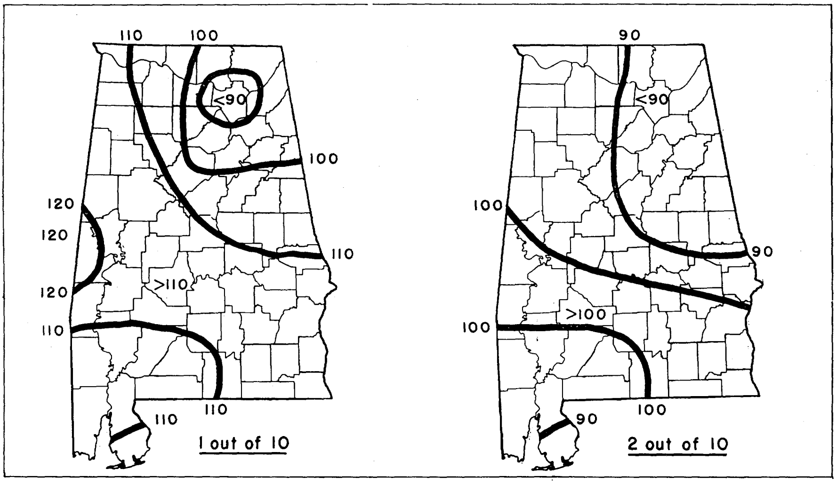

FIGURE 6. Probability of 1 and 2 out of 10 years for the minimum number of drought-days to occur in the period of March through November for 2 inches of soil moisture capacity.

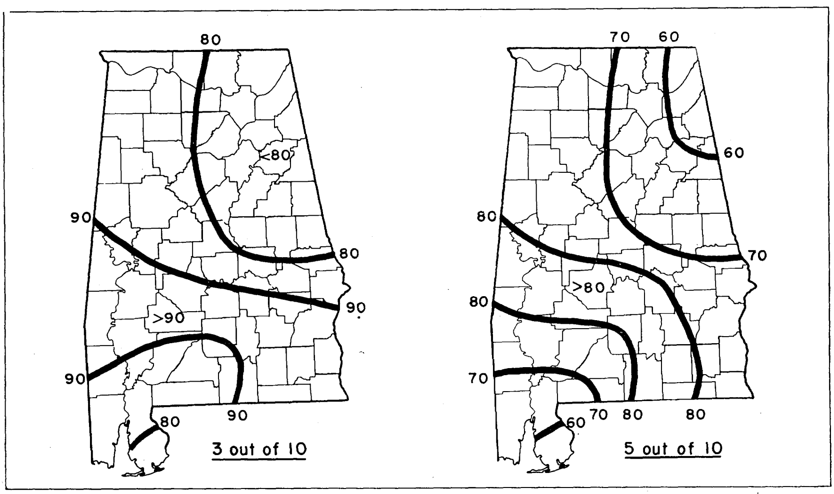

FIGURE 7. Probability of 3 and 5 out of 10 years for the minimum number of drought-days to occur in the period of March through November for 2 inches of soil moisture capacity.

indicates that most soils in Alabama do not hold more than 1 and 2 inches of available moisture in the root zone of crop plants.

In interpreting the state maps, Figure 4, for example, shows that for a soil storage capacity of 1 inch of available water in central and southeastern Alabama there will be at least 140 drought-days in 1 out of 10 years. Under the same conditions in northern Alabama, there will be between 120 and 130 drought-days. From Figure 5, the corresponding values to be expected in 5 out of 10 years, or every other year, are 110 days in the central and southeastern sections and 90 to 100 days in the northern section.

Number per Month

For individual crops, an interpretation of data on a seasonal basis is too general. Therefore, the same procedure used for the entire season was used to determine the distribution of the number of drought-days for each month. In order to condense the information, Alabama was divided into nine areas as indicated in Figure 2. Data from all 27 stations were used with several stations combined for each area. The minimum number of drought-days for 4 base amounts of soil moisture storage capacity and 4 probabilities were prepared for each area and each of 9 months.

The results are given in Appendix Table 3. In order to use this table, it is necessary to refer to Figure 2 for the key to the area designations. For example, the southeastern section of Alabama is designated as Area H. Appendix Table 3 shows that in 2 out of 10 years there will be 21 or more drought-days during June in that area if the maximum soil moisture storage capacity is 2 inches. The corresponding value for 5 out of 10 years is 14 drought-days.

Number per 10-Day Period

The same procedure that was followed for determining the number of drought-days for the entire season and for each month was used to obtain the number of drought-days for each 10-day period from March through November. Appendix Table 4, therefore, gives for the nine areas indicated in Figure 2 the minimum number of drought-days at four levels of probability and for the four base amounts of soil moisture.

The distribution of drought-days at 10-day intervals permits a better application of the data to crops. By combination of the proper 10-day intervals, the number of drought-days can be related to the growth period of a crop either for the entire period or for stages of growth particularly affected by water deficits. However, addition of 10-day interval drought-days does not give an exact estimate of the expected number of drought-days for a larger period. The addition of 10-day intervals over-estimates drought incidence, so that merely adding 10-day intervals results in "safe" values. The distribution of drought-days by 10-day periods for 5 out of 10 years when the available root zone soil moisture is 1 and 2 inches is plotted for each of 8 areas of Alabama in Figures 8 through 15. In general, the graphs show that drought occurrence is concentrated in May and June with noticeable declines in July and the first 10 days of August. Drought is severe in October in areas, D, E, F, G, and H (southern Alabama), whereas lower drought incidence occurs in October in areas A, B, and C (northern Alabama).

AMOUNT of WATER REQUIRED for IRRIGATION

By multiplying the expected number of drought-days in a month as given in Appendix Table 3 by the average daily evapotranspiration data of Table 3, the amount of water needed for irrigation can be computed. These irrigation water requirements for the nine different areas of the State are given in Table 4. This table lists for the 4 base amounts of soil moisture for each month the quantities of water required that will not be exceeded in 9 out of 10 years. Use of these data assumes that the water is applied to the land without any waste and all soil moisture deficiency is eliminated. However, in estimating actual water requirements, some allowance, about 30 per cent, should be added to compensate for distribution and application losses. In determining water storage requirements for irrigation, estimated seepage and evaporation losses must be added to the quantities of water required for irrigation. The monthly irrigation requirements by areas and base amounts can be computed for the other probabilities by multiplying the drought-days shown in Appendix Table 3 by the average monthly evapotranspiration presented in Table 3.

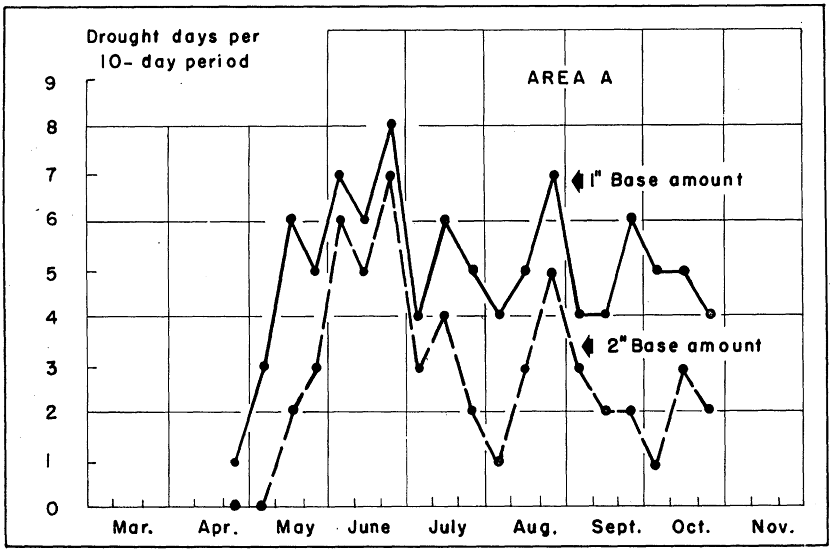

FIGURE 8. Minimum number of drought-days to be expected in Area A for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

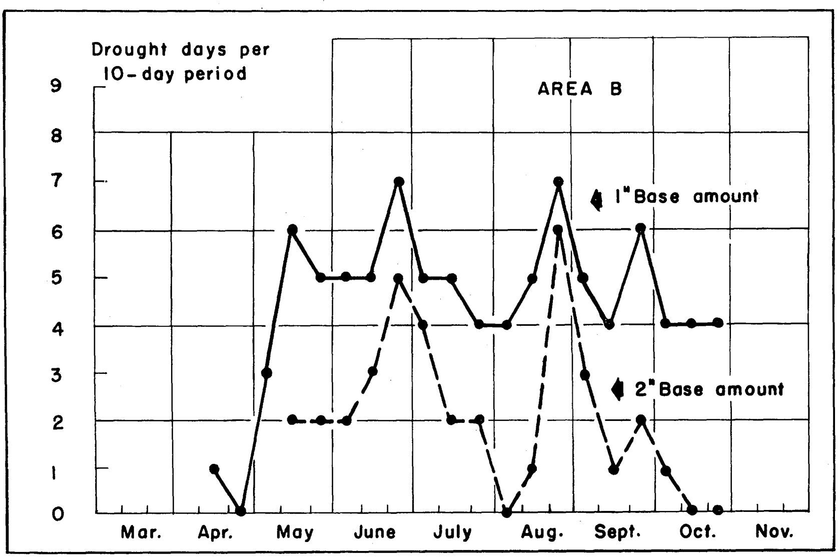

FIGURE 9. Minimum number of drought-days to be expected in Area B for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

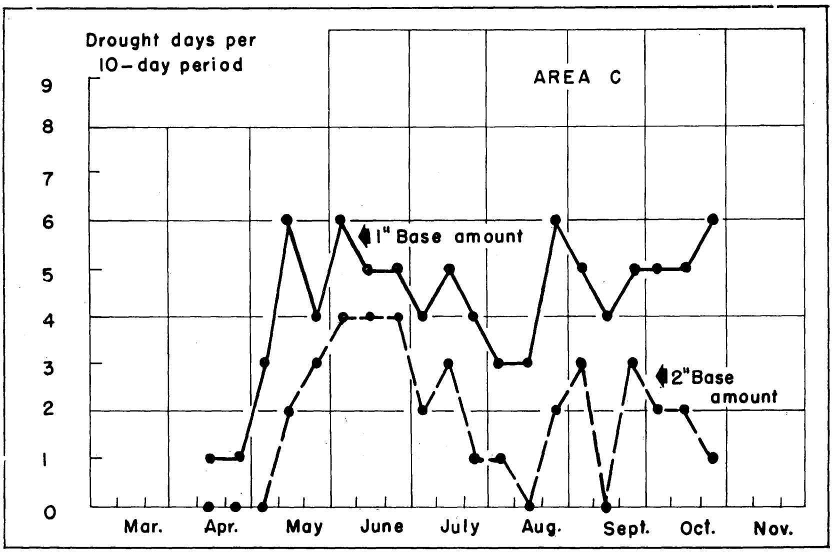

FIGURE 10. Minimum number of drought-days to be expected in Area C for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

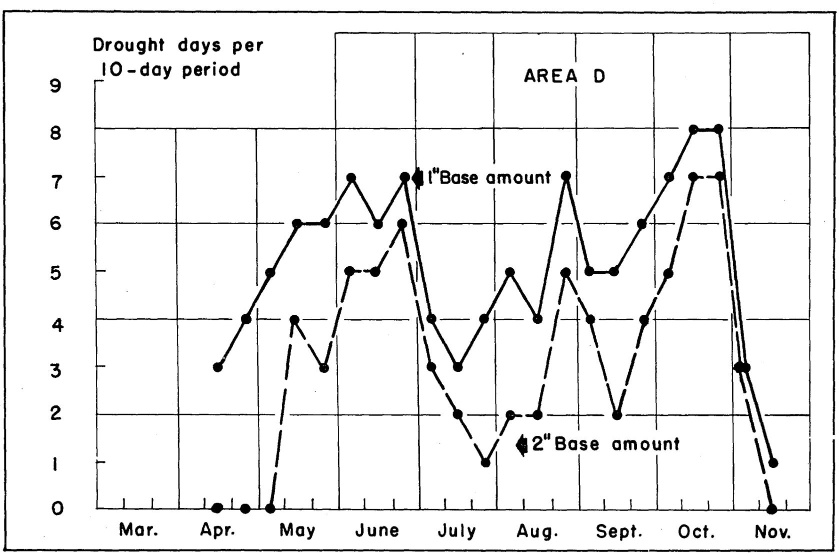

FIGURE 11. Minimum number of drought-days to be expected in Area D for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

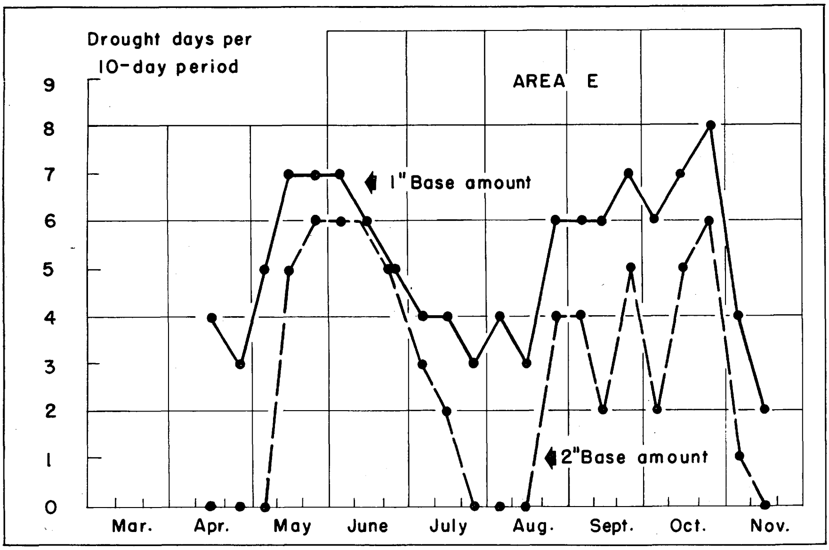

FIGURE 12. Minimum number of drought-days to be expected in Area E for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

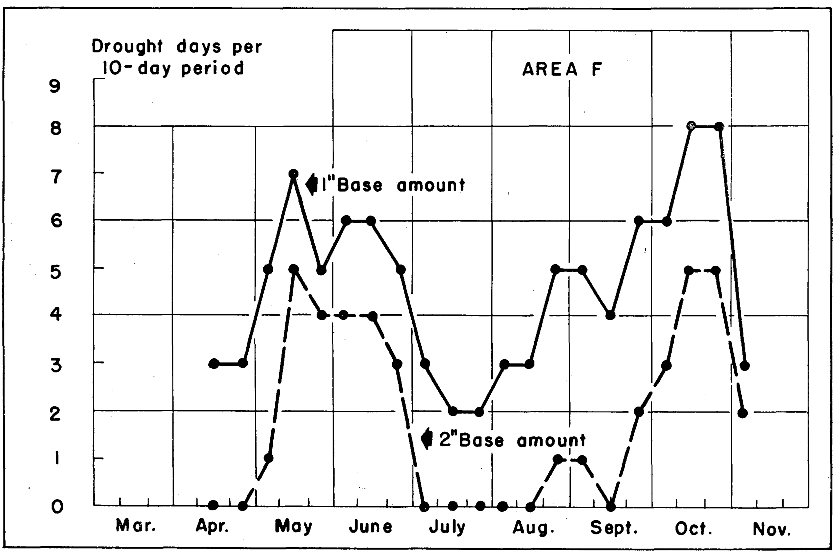

FIGURE 13. Minimum number of drought-days to be expected in Area F for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

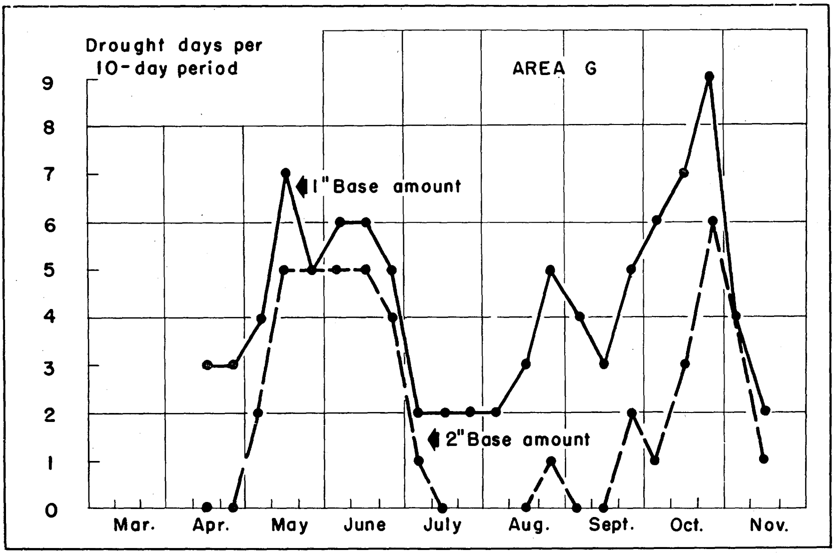

FIGURE 14. Minimum number of drought-days to be expected in Area G for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

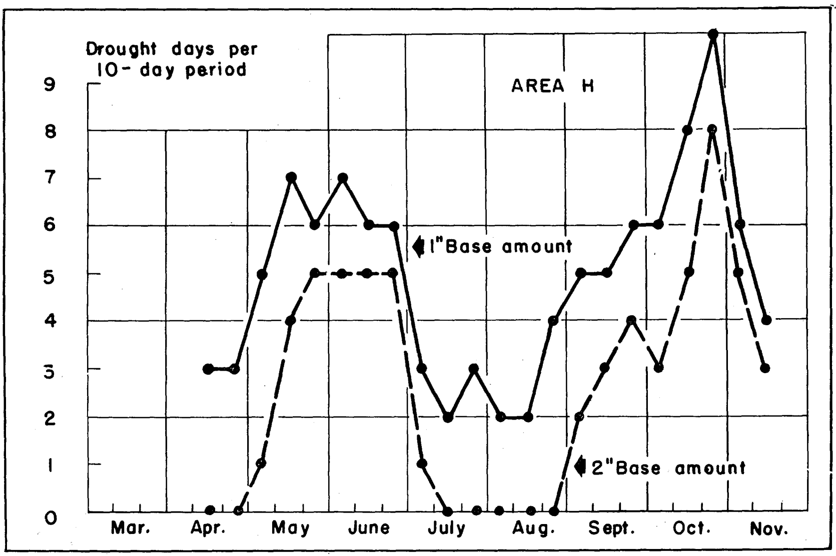

FIGURE 15. Minimum number of drought-days to be expected in Area H for 1- and 2-inch soil moisture capacities in 5 out of 10 years during 10-day periods from March through November.

TABLE 4. MINIMUM MONTHLY IRRIGATION REQUIREMENTS IN 9 OUT OF 10 YEARS FOR 4 BASE AMOUNTS BY DROUGHT AREAS (AVERAGE FOR THE 25-YEAR PERIOD)

Area	Basis	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
A	1	0	0	1.61	3.55	4.67	3.54	3.67	3.00	2.00	.34	0
	2	0	0	1.07	3.12	4.67	3.54	3.38	2.88	1.84	.30	0
	3	0	0	0	2.27	4.32	3.39	3.24	2.88	1.84	.30	0
	5	0	0	0	.14	3.81	3.23	3.24	2.64	1.76	.26	0
B	1	0	0	1.50	3.41	4.32	3.70	3.52	3.12	2.00	.39	0
	2	0	0	.54	2.84	4.15	3.54	3.10	2.88	1.84	.30	0
	3	0	0	0	2.13	3.98	3.54	2.68	2.76	1.76	.30	0
	5	0	0	0	.57	3.29	3.08	2.26	2.40	1.76	.30	0
C	1	0	0	1.50	3.41	4.32	3.54	2.96	3.00	2.00	.52	0
	2	0	0	.54	2.98	4.32	3.39	2.54	2.88	1.84	.47	0
	3	0	0	0	1.99	4.32	3.08	2.12	2.64	1.76	.39	0
	5	0	0	0	.14	2.94	2.62	1.83	2.28	1.68	.34	0
D	1	.40	.69	2.08	4.16	4.81	3.56	4.42	3.35	2.80	1.20	.15
	2	0	0	1.17	3.36	4.62	3.24	4.11	3.35	2.80	1.14	.08
	3	0	0	0	2.40	4.26	3.08	3.79	3.22	2.70	1.14	.08
	5	0	0	0	.80	3.52	3.08	3.48	2.81	2.70	1.02	.04
E	1	.40	.60	1.95	4.00	4.62	3.56	3.48	3.48	2.60	1.08	.15
	2	0	0	.91	3.36	4.62	3.24	2.84	3.35	2.60	1.08	.04
	3	0	0	0	3.04	4.44	3.24	2.69	3.22	2.60	1.02	.04
	5	0	0	0	1.12	3.88	2.92	2.53	2.81	2.60	.96	.04

Continued

TABLE 4 (CONT'D). MINIMUM MONTHLY IRRIGATION REQUIREMENTS IN 9 OUT OF 10 YEARS FOR 4 BASE AMOUNTS BY DROUGHT AREAS (AVERAGE FOR THE 25-YEAR PERIOD)

Area	Basis	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
F	1	0	.86	2.08	4.16	4.62	3.40	3.16	3.21	2.80	1.26	.23
	2	0	0	1.17	3.52	4.26	3.24	2.37	2.81	2.70	1.02	.12
	3	0	0	0	2.88	4.26	3.08	1.90	2.81	2.70	.96	.12
	5	0	0	0	.96	3.70	2.43	1.58	2.14	2.60	.48	.08
G	1	0	.69	2.08	3.68	4.81	3.08	3.00	2.95	2.80	1.26	.30
	2	0	0	1.17	3.36	4.44	2.75	2.37	2.68	2.50	1.20	.23
	3	0	0	0	2.72	4.26	2.75	1.90	2.28	2.50	1.20	.23
	5	0	0	0	1.12	3.52	2.43	1.26	1.47	2.20	.96	.15
H	1	.46	.69	2.21	4.16	4.62	3.08	3.00	3.62	2.80	1.38	.38
	2	0	0	1.30	4.00	4.44	2.59	2.37	3.48	2.70	1.32	.23
	3	0	0	0	3.84	4.44	2.59	1.74	3.22	2.60	1.32	.23
	5	0	0	0	1.76	3.88	2.43	1.58	2.14	2.40	1.26	.08
I	1	.59	1.12	2.73	3.52	4.26	2.11	2.69	3.08	2.60	1.08	0
	2	0	0	1.82	3.36	4.07	1.78	1.74	2.28	2.20	1.02	0
	3	0	0	0	3.20	3.70	1.78	1.11	1.88	1.90	.90	0
	5	0	0	0	1.92	2.40	1.13	.95	.27	1.40	0	0

EXCESS of PRECIPITATION

Excess precipitation as used here means all rainfall that occurs after the soil has attained field capacity. This excess is disposed of by surface runoff and deep percolation. The relative magnitude of runoff and percolation for a given watershed depends on watershed infiltration characteristics and on the distribution of the rainfall occurrences and intensity.

TABLE 5. MONTHLY AND TOTAL ANNUAL EXCESS PRECIPITATION IN INCHES FOR 2-INCH BASE AMOUNT AND 4 PROBABILITIES BY DROUGHT AREAS

Area	Prob.	J	F	M	A	M	J	J	A	S	O	N	D	Total
		In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
A	1/10	10.1	8.9	6.3	3.9	2.5	1.9	2.8	2.2	1.6	2.0	4.6	8.4	55.2
	2/10	8.2	7.2	5.3	2.4	1.5	0.9	1.9	1.1	0.7	0.0	3.3	6.2	38.7
	3/10	6.8	5.9	4.6	1.9	0.7	0.1	1.2	0.9	0.0	0.0	2.3	4.7	29.1
	5/10	4.3	3.1	3.5	1.4	0.0	0.0	0.1	0.0	0.0	0.0	1.1	2.8	16.3
B	1/10	10.5	9.2	7.0	4.3	2.7	2.1	4.3	2.3	2.4	3.0	4.5	9.3	61.6
	2/10	8.1	6.7	5.8	3.0	1.6	1.0	2.8	1.6	1.6	1.0	3.2	6.4	42.8
	3/10	6.1	5.3	4.9	2.3	0.8	0.1	1.7	1.0	0.7	0.1	2.3	5.2	30.5
	5/10	4.2	3.6	3.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.9	3.5	17.5
C	1/10	9.8	7.7	7.3	4.6	2.9	1.7	4.0	3.5	2.4	2.8	4.4	8.9	60.0
	2/10	7.8	6.7	6.0	3.5	1.4	1.1	2.4	2.4	1.1	0.9	2.9	6.6	42.8
	3/10	5.8	5.9	5.1	2.7	0.8	0.3	1.9	1.8	0.2	0.0	2.0	5.0	31.5
	5/10	3.8	3.7	3.8	1.5	0.3	0.0	0.3	0.4	0.0	0.0	0.6	3.3	17.7
D	1/10	8.5	6.8	7.0	6.4	2.8	1.4	4.2	2.9	1.9	1.4	4.5	7.8	55.6
	2/10	5.2	5.4	5.5	4.0	1.7	0.7	2.5	1.6	0.9	0.0	2.2	5.9	35.6
	3/10	3.6	4.4	4.3	2.1	1.0	0.3	1.5	1.0	0.3	0.0	1.3	4.6	24.4
	5/10	2.5	2.8	2.8	0.9	0.2	0.0	0.4	0.2	0.0	0.0	0.0	2.8	12.6
E	1/10	7.0	6.2	7.7	6.3	2.3	1.9	4.3	3.1	2.3	1.6	3.3	7.4	53.4
	2/10	4.7	4.8	5.7	4.1	1.3	1.0	2.4	1.8	1.2	0.7	1.6	5.9	35.2
	3/10	3.7	4.1	4.5	2.5	0.6	0.3	1.4	1.0	0.7	0.0	0.8	4.8	24.4
	5/10	2.6	2.8	3.0	0.9	0.0	0.0	0.4	0.0	0.0	0.0	0.0	2.7	12.4
F	1/10	6.0	5.5	8.8	6.6	4.8	4.4	8.6	3.4	6.0	2.9	4.8	7.7	69.5
	2/10	4.5	4.3	7.2	4.5	3.3	2.3	5.7	1.9	3.8	1.2	2.5	6.1	47.3
	3/10	3.7	3.5	6.1	3.2	2.2	1.0	3.7	1.2	2.3	0.2	1.6	5.0	33.7
	5/10	2.8	2.3	4.2	1.5	0.5	0.0	1.6	0.3	0.8	0.0	0.0	3.2	17.2
G	1/10	7.9	6.5	9.1	5.9	4.1	2.4	7.3	5.2	4.8	2.1	6.4	7.2	68.9
	2/10	5.2	5.0	7.0	4.4	2.7	1.3	5.6	3.4	2.9	0.1	3.7	5.1	46.4
	3/10	4.1	3.8	5.7	3.5	1.6	0.5	4.0	2.4	1.7	0.0	2.0	4.0	33.3
	5/10	2.8	2.5	3.5	1.7	0.0	0.0	1.6	1.0	0.3	0.0	0.0	2.4	15.8
H	1/10	5.7	6.3	8.0	5.5	3.0	2.3	5.3	4.5	3.8	1.0	5.0	6.4	56.8
	2/10	4.4	5.0	6.1	4.0	1.5	1.0	3.7	3.2	2.3	0.0	2.4	4.8	38.4
	3/10	3.6	3.9	4.6	3.0	0.7	0.0	2.7	2.4	1.5	0.0	0.7	3.8	26.9
	5/10	2.4	2.2	2.7	1.4	0.0	0.0	1.2	1.2	0.3	0.0	0.0	2.3	13.7
I	1/10	6.9	6.4	9.9	8.7	5.6	7.5	12.7	8.8	7.3	5.0	6.0	6.7	91.5
	2/10	4.9	4.4	6.8	5.3	3.3	5.0	9.1	4.7	5.7	2.8	2.1	4.9	59.0
	3/10	3.9	3.3	5.0	3.6	2.1	3.3	6.1	3.3	4.4	0.0	1.1	4.0	40.1
	5/10	2.3	1.9	2.9	1.9	0.9	1.3	3.3	1.8	5.5	0.0	0.4	2.8	25.0

For each of the nine areas in Alabama, yearly totals and monthly totals of daily excess of precipitation were computed for four different base amounts of soil moisture and four different odds. These data show that the effect of the base amount of soil moisture upon the annual and monthly excess was small. Therefore, monthly excess of soil moisture or precipitation for the 2-inch base amount is presented in Table 5. These data, as do the drought-day graphs in Figures 8 through 15, clearly show that most of the excess precipitation in Alabama occurs during the period of December through March. In 5 out of 10 years, the annual excess in Alabama is 12 to 18 inches, except in the Gulf Coast area where the value is 25 inches. In 1 out of 10 years, the annual excess in most areas is 50 to 70 inches of precipitation.

APPLICATION of DATA

The usefulness to farmers of the data presented is dependent on proper application of the drought data to individual crops and soil types. The variations in moisture-holding capacity between soils makes an understanding of this characteristic of any soil necessary in determining its susceptibility to drought. The available moisture-holding capacity of soils is dependent on texture, structure, organic matter content, and depth of the plant root zone. It is measured in inches of water per foot of soil. Values taken from the Sprinkler Irrigation Guides for Alabama *(13)* for most of the commonly occurring soils in the State are presented in Table 6.

Names of soil types at any location can be found in the county soil survey reports. The approximate available moisture-holding capacity per foot of soil can be determined from Table 6. In cases of soils not listed in this table, the information on other soils of similar texture and other moisture characteristics may be used. The principal zone of root occupancy varies between soils and between crops. Information on this characteristic of several crops and soils is presented in Table 1. For most soils and crops it varies from 1 to 2 feet. To determine the total available moisture that a soil will hold, the amount held per foot must be multiplied by the number of feet in the root zone. This figure may then be applied to information presented on drought to determine the probabilities of drought for this soil and location throughout the year.

A specific example is used here to demonstrate how this information may be applied to any field in Alabama. The Experiment Station Agronomy Farm at Auburn is used in this example. The Lee County Soil Survey Report *(19)* identifies the soil as a

TABLE 6. CLASSIFICATION OF SOME SOILS OF THE GENERAL SOIL AREAS OF ALABAMA BY THEIR AVAILABLE MOISTURE-HOLDING CAPACITY IN INCHES PER FOOT

	Limestone Valley Soils	
1.2 inches	*1.6 inches*	*2.0 inches*
Baxter Cherty silt loam	Colbert silt loam	Abernathy silt loam
Fullerton Cherty silt loam	Cumberland silt loam	Egam silty clay loam
Clarksville Cherty silt loam	Decatur silt loam	Humphreys silt loam
Minvale Cherty silt loam	Dewey silt loam	Huntington silt loam
Pace Cherty silt loam	Dowellton silt loam	Linside silty clay loam
	Etowah silt loam	Lobelville silt loam
	Hermitage silt loam	Locust fine sandy loam
	Hollywood silty loam	Locust silt loam
	Talbott silt loam	Melvin silt loam
	Talbott silty clay loam	Prader silt loam
		Staser silt loam
	Appalachian Plateau Sandstone Soils	
	1.6 inches	*2.0 inches*
	Enders fine sandy loam	Allen fine sandy loam
	Waynesboro loam	Atkins silt loam
		Hanceville fine sandy loam
		Hartsells fine sandy loam
		Holstun fine sandy loam
		Linker fine sandy loam
		Jefferson fine sandy loam
		Philo silt loam
		Pope silt loam
		Pope fine sandy loam
		Tillsit fine sandy loam
		Tillsit silt loam
	Piedmont Soils	
1.2 inches	*1.3 inches*	*2.0 inches*
Lloyd clay loam	Wickham sandy loam	Madison sandy loam
Davidson clay loam	Altavista sandy loam	Appling sandy loam
		Cecil sand loam
	Black Belt Soils	
	1.6 inches	*2.0 inches*
	Octibbeha fine sandy loam	Catalpa clay loam
	Octibbeha clay loam	Houston clay
	Sumter clay	West Point (Bell) clay
	Tuscumbia fine sandy loam	
	Tuscumbia clay loam	
	Vaiden fine sandy loam	
	Vaiden clay loam	
	Wilcox fine sandy loam	
	Wilcox clay loam	

Continued

TABLE 6 (CONT'D). CLASSIFICATION OF SOME SOILS OF THE GENERAL SOIL AREAS OF ALABAMA BY THEIR AVAILABLE MOISTURE-HOLDING CAPACITY IN INCHES PER FOOT

	Coastal Plain Soils	
0.7 inches	*1.0 to 1.2 inches*	*1.3 to 1.6 inches*
Americus (Red Bay) loamy sand	Akron sandy loam	Bladen sandy loam
Amite loamy sand	Atwood sandy loam	Chewacla sandy loam
Eustis (Ruston) loamy sand	Cahaba sandy loam	Congaree sandy loam
Huckabee (Kalmia) loamy sand	Carnegie sandy loam	Coxville sandy loam
Independence (Cahaba) loamy sand	Faceville sandy loam	Dunbar sandy loam
Lakeland (Norfolk) loamy sand	Greenville sandy clay	Irvington sandy loam
Orangeburg loamy sand	Kalmia sandy loam	Yuka sandy loam
Scranton loamy sand	Lynchburg sandy loam	Marlboro sandy loam
	Magnolia sandy loam	Ocklockonee sandy loam
	Norfolk sandy loam	Tifton sandy loam
	Ora sandy loam	Unnamed soil (potato land)
	Orangeburg sandy loam	
	Prentiss sandy loam	
	Red Bay sandy loam	
	Ruston sandy loam	
	Savannah sandy loam	
	Shubuta sandy loam	
	Tilden sandy loam	

Chesterfield fine sandy loam. From Figure 16 it is determined that Auburn is in the Coastal Plain. Although the Coastal Plain soils listed in Table 6 do not include Chesterfield, its moisture characteristics are known to be similar to those of Norfolk, Magnolia, and Orangeburg sandy loams listed. Therefore, the moisture-holding capacity is about 1.0 to 1.2 inches of water per foot of soil in the root zone. The principal crops grown on this farm are corn and cotton. Information in Table 1 indicates that the normal depth of the soil moisture reservoir for cotton and corn is from 1 to 1.5 feet. Combination of this figure with the moisture-holding capacity per foot shows that the expected total moisture-holding capacity of this soil would be between 1 inch and 1.8 inches.

Figures 4, 5, 6, and 7 show the probable number of drought-days that may be expected from March through November on 1-inch and 2-inch soil moisture capacity soils in Alabama. At Auburn on 1-inch soil in 2 years out of 10, at least 120 drought-days would be expected, Figure 4. As many as 100 drought-days would occur 5 years out of 10, Figure 5. On a 2-inch capacity soil, the expected number of drought-days would be about 90 and 70 for these probabilities, Figures 6 and 7. Therefore, crops on this soil at Auburn may be expected to suffer from drought quite frequently.

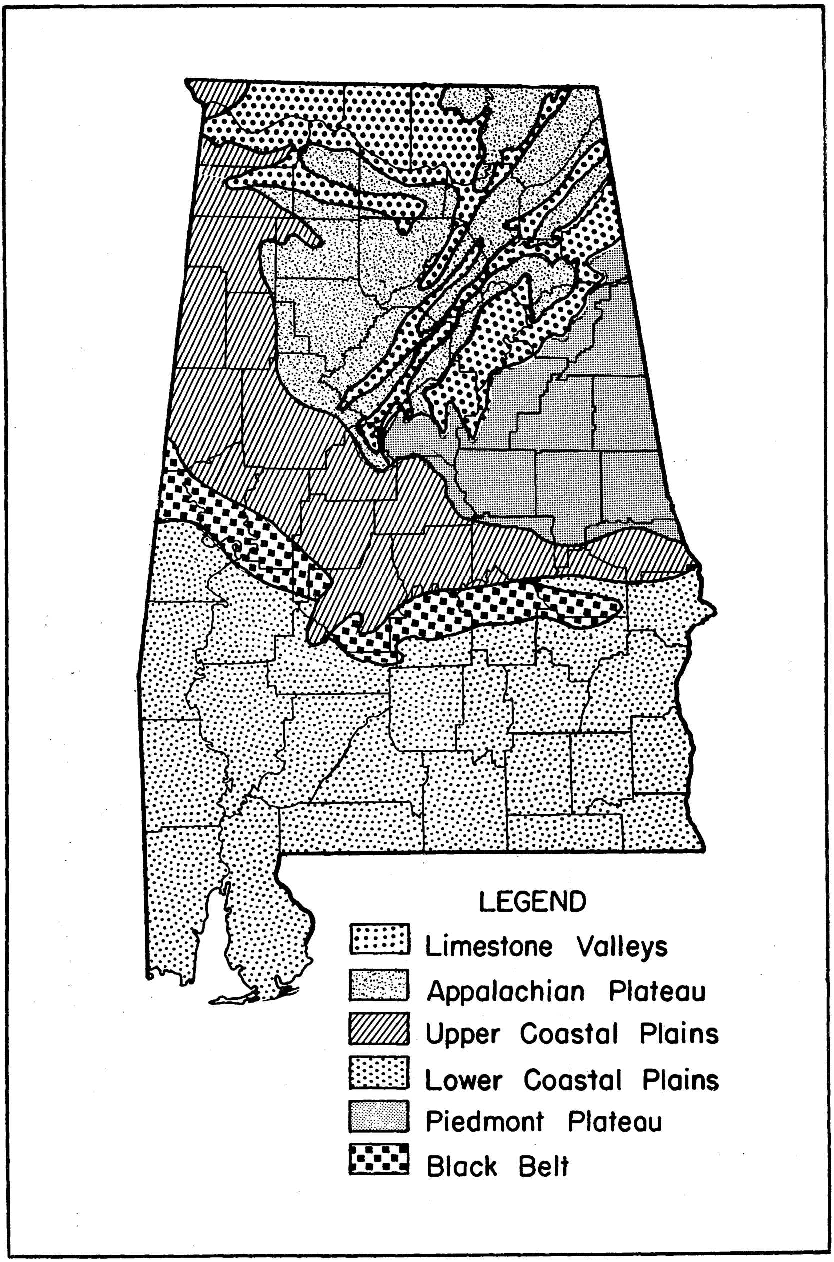

FIGURE 16. General soils map of Alabama.

In order to determine when drought-days may be expected, one must determine from Figure 2 in which drought area one resides. In the case of Auburn it is Area E. Data on Area E are based on 25 years of records from Auburn, Clanton, and Montgomery, Table 2. The distribution of drought-days by 10-day periods for 1- and 2-inch base soils in Area E is presented in Figure 12. The number of drought-days shown is the minimum that may be expected in 5 years out of 10. The greatest probability of drought is in May and October. The May drought is the most serious for summer crops and the fall drought is serious for fall-planted crops. In 1 out of every 2 years on a 1-inch soil, 7 days out of 10 in late May may be expected to be drought-days. During June the frequency of drought gradually drops off to 4 days out of 10 in the first 10 days of July. From about July 5 to August 15 the probability of drought is 3 or 4 days out of 10. About the middle of August, it begins to go up again and reaches a maximum of 8 days out of 10 in late October. Then it drops rapidly until the frequency of any drought is less than 5 years out of 10 in late November.

On 2-inch base soils, the pattern of drought expectancy is the same but the frequency is less. Droughts occur 6 days out of 10 in late May and early June but drop off during June and July. Probability of drought is less than 5 chances in 10 during late July and early August for soils that will hold 2 or more inches of available water. Drought increases on these soils in late August, September, and October.

Information on the occurrence of drought can be useful only if it helps to find ways to reduce damage caused by drought. How then, can the data presented here be used? The most direct method of reducing damage from drought is by irrigation. Drought frequency data can be used to indicate the need for irrigation. These data give the odds on the need for supplemental water on the various soils and locations. They also indicate the season of the year when drought is most likely to occur. Such information is useful in determining the best time to plant certain crops in order to obtain good stands and to make the period of maximum water needs by a crop coincide with periods when rain is most likely. Planning of other operations, such as land preparation and harvesting, should be more effective if this information is properly used.

SUMMARY and CONCLUSIONS

An estimate of drought occurrence in Alabama was made on a basis of past climate records. The 25-year record (1930-1954) of daily precipitation from 27 stations was used in this study. Estimated values of daily evapotranspiration were calculated by use of the Penman formula. The state was divided into northern and southern evapotranspiration areas. By use of the precipitation and evapotranspiration data, daily soil moisture balances were computed and the daily soil moisture balances were used to determine the number of drought-days.

Drought occurrence was described in terms of number of drought-days for four root zone soil moisture storage capacities (base amounts) and at four probabilities. The base amounts were 1, 2, 3, and 5 inches and the odds were 1, 2, 3, and 5 years out of 10. Drought-days were classified on an annual, monthly, and 10-day period basis. Monthly and 10-day period drought-days were summarized by dividing Alabama into 9 areas. The same nine areas were used as a basis of summarizing data on excess moisture occurrence and on irrigation water requirements.

Based on the estimated number of drought-days occurring yearly, it may be seen that drought is quite common in Alabama. In 1 year out of 10 on soils that will hold an inch of available water, 140 drought-days may occur in central and southeastern Alabama, and in 5 years out of 10 the expected number is more than 110 drought-days. Northern and southwestern Alabama have fewer expected drought occurrences.

On a monthly basis, drought-days occurred in all months from April through October. The numbers of drought-days are greatest during May and June throughout the State, whereas southern Alabama has an equally large number in October.

At odds of 5 years out of 10, or every other year, with 1-inch base amount of soil moisture in most areas of Alabama, more than one-half of the days in the 2nd and 3rd 10 days of May and August were drought-days. In all 10-day periods in June, one-half or more of the days were drought-days. Lowest numbers of drought-days in most areas were in the 2nd and 3rd 10 days of July, the 1st 10 days of August, and in the 2nd 10 days of September. In general, it can be expected that crops will be subjected to serious droughts in Alabama during the summer growing season.

The moisture excess occurs primarily during the months of December through March. In 5 out of 10 years, an annual excess of 12 to 18 inches of precipitation is found in all areas of the state except near the Gulf Coast where the excess is 25 inches. To provide a sufficient supply of water for the numerous periods of drought during the summer months, the excess precipitation must be made available for irrigation purposes from impounded waters, deep wells, and streams. The amount of water required for irrigation that would suffice for 9 out of 10 years is presented in Table 4 for the 4 base soil moisture amounts for each of the 9 areas in Alabama.

This study has clearly shown that drought occurrence is to be expected during the summer and fall in Alabama. As a result there are even odds that optimum crop yields cannot be attained because of this drought hazard. The data also reveal that drought occurrence depends markedly upon the amount of water available in the root zone. This suggests that some of the drought hazard can be removed by growing varieties of crops with extensive root systems and by using soil management practices to improve soil properties for optimum root growth. For example, the available water would be increased from 1 to 2 inches if the principal root occupancy zone were increased from 1 to 2 feet. Thus the number of drought-days would be reduced approximately 50 per cent.

While crop varieties with more extensive root systems and soils with properties for better root growth would decrease drought occurrence, supplemental water will still be required in producing maximum yields. This means that a source of water for irrigation is needed. To provide water for irrigation will require long-range planning for utilization of the water resources of Alabama. Such plans, which include industrial and municipality needs, must be considered together with present day projects for development of water resources to generate electricity and to provide navigable streams.

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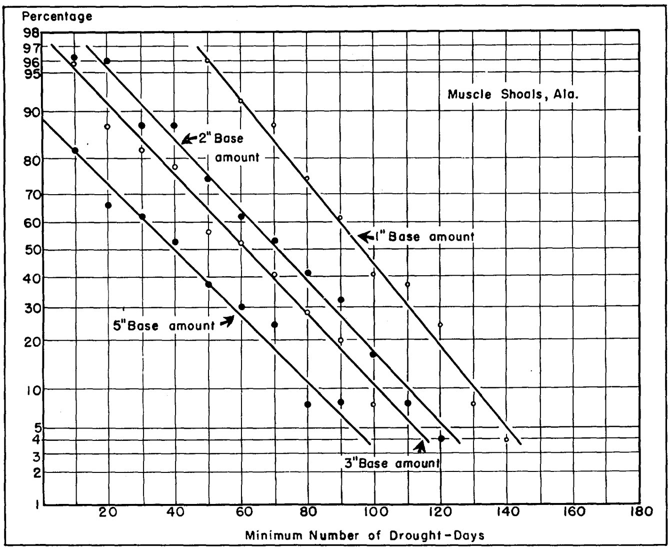
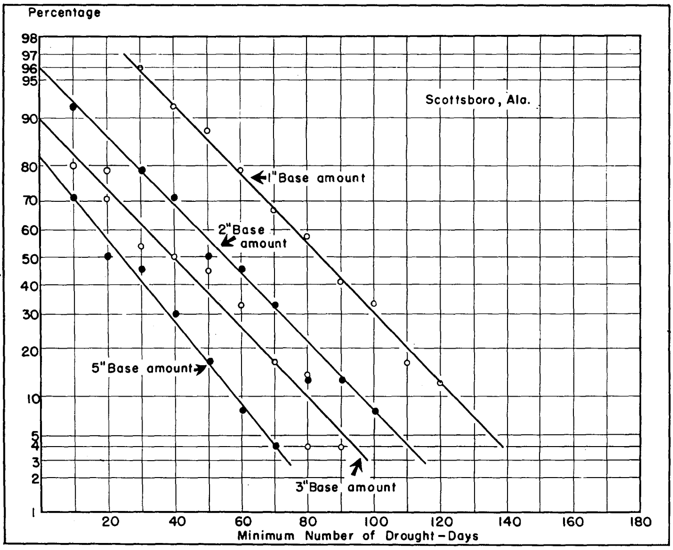
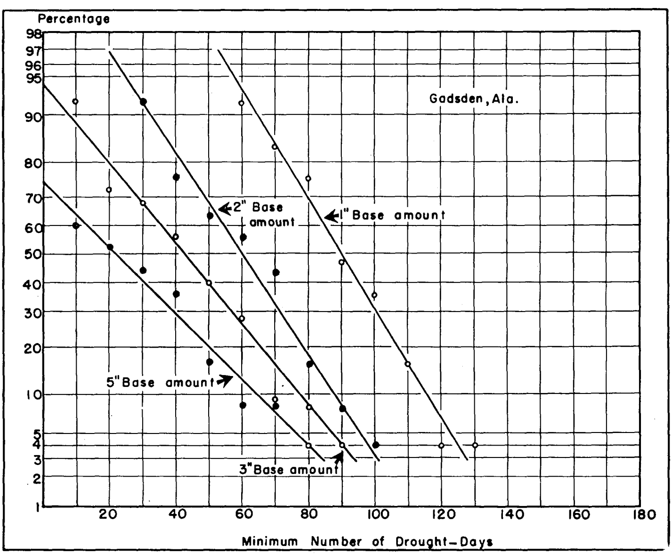
APPENDIX



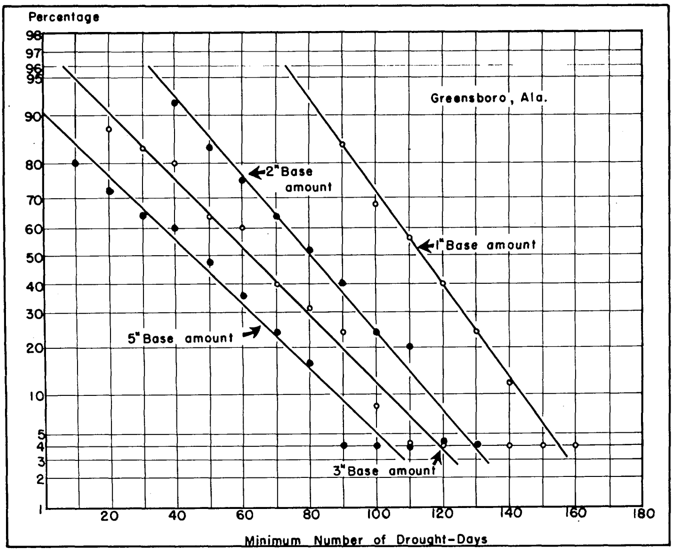
APP. FIGURE 1. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Muscle Shoals, Ala. (Area A).



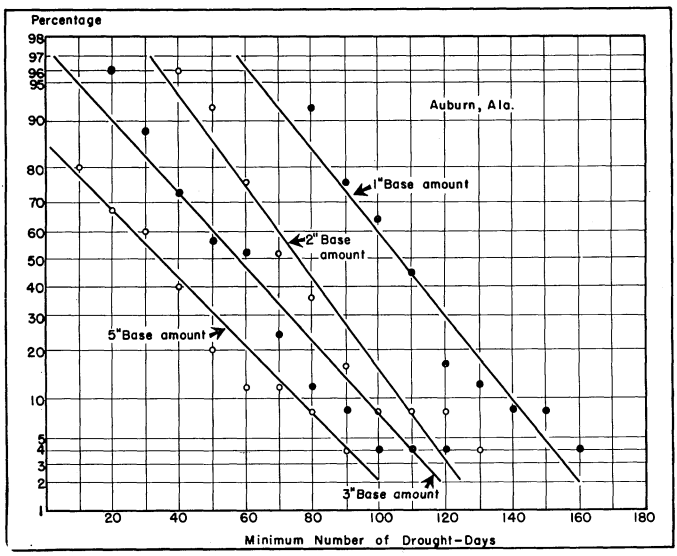
APP. FIGURE 2. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Scottsboro, Ala. (Area B).



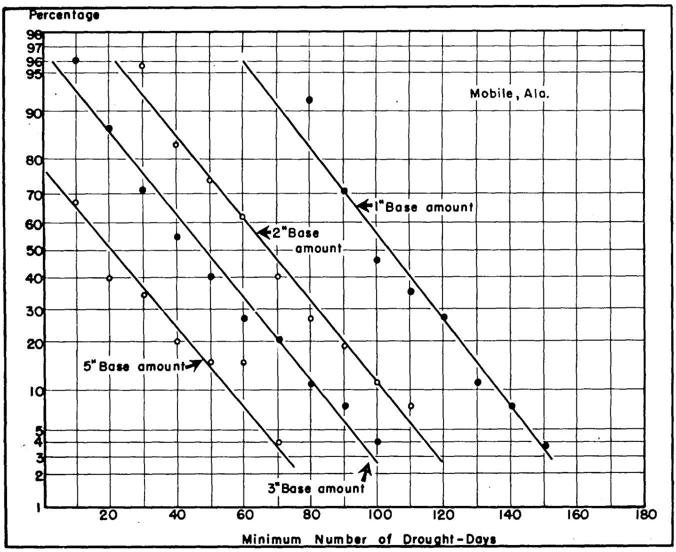
APP. FIGURE 3. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Gadsden, Ala. (Area C).



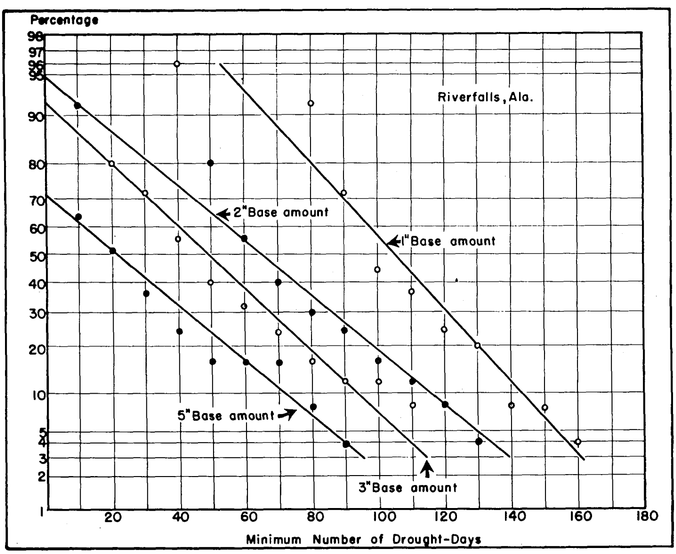
APP. FIGURE 4. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Greensboro, Ala. (Area D).



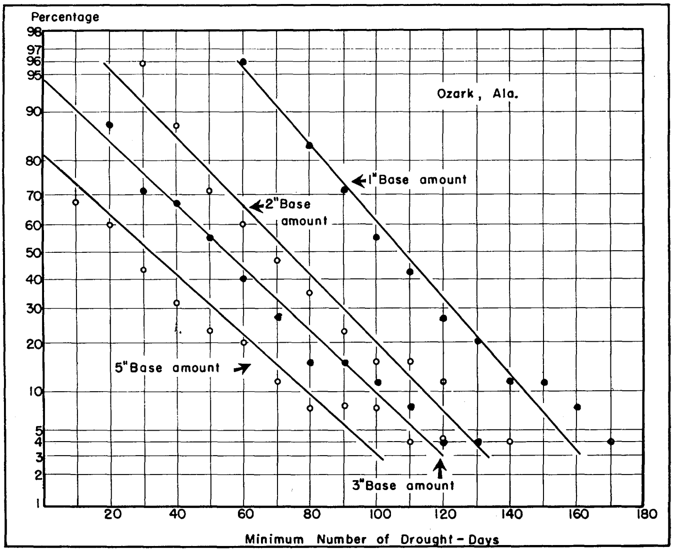
APP. FIGURE 5. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Auburn, Ala. (Area E).



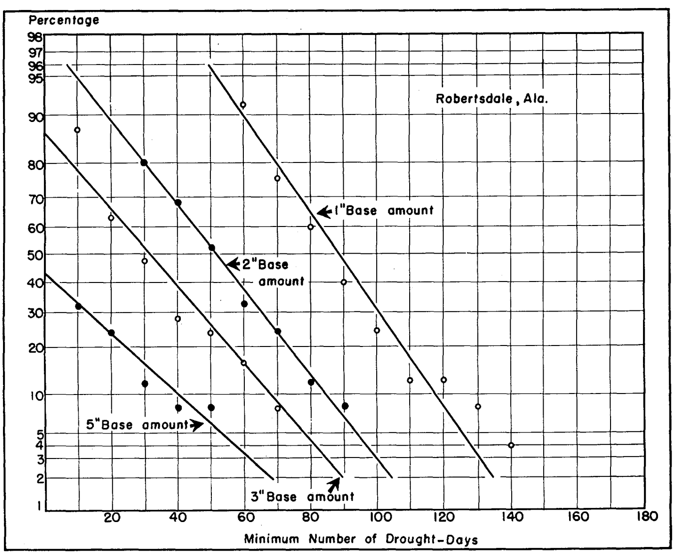
APP. FIGURE 6. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Mobile, Ala. (Area F).



APP. FIGURE 7. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Riverfalls, Ala. (Area G).



APP. FIGURE 8. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Ozark, Ala. (Area H).



APP. FIGURE 9. Probability for minimum number of drought-days to occur in period March through November for 4 different values of soil moisture capacity in inches, Robertsdale, Ala. (Area I).

APPENDIX TABLE 1. AVERAGE DAILY EVAPOTRANSPIRATION IN INCHES OF WATER FROM SELECTED STATIONS[1] FOR THE NORTHERN AREA OF ALABAMA, 1930-56

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
1930	.027	.068	.067	.136	.137	.192	.190	.149	.102	.076	.040	.022
1931	.032	.056	.061	.108	.142	.207	.167	.146	.158	.094	.057	.024
1932	.030	.050	.065	.117	.149	.175	.180	.153	.118	.072	.040	.018
1933	.032	.036	.072	.103	.174	.194	.147	.133	.138	.082	.053	.032
1934	.031	.050	.067	.099	.150	.180	.161	.123	.122	.088	.054	.022
1935	.026	.046	.074	.087	.148	.169	.173	.152	.107	.087	.041	.024
1936	.026	.042	.084	.100	.178	.210	.160	.157	.120	.070	.044	.024
1937	.018	.047	.080	.111	.144	.180	.166	.148	.124	.065	.040	.026
1938	.032	.058	.077	.118	.146	.163	.146	.166	.124	.104	.053	.031
1939	.036	.055	.084	.117	.124	.162	.176	.143	.139	.094	.040	.032
1940	.024	.036	.065	.096	.151	.174	.142	.163	.146	.096	.043	.026
1941	.032	.042	.054	.111	.170	.163	.147	.139	.151	.082	.045	.030
1942	.034	.037	.071	.130	.139	.167	.147	.124	.115	.072	.050	.022
1943	.029	.058	.061	.116	.152	.188	.134	.153	.106	.070	.052	.024
1944	.029	.045	.068	.104	.151	.196	.155	.120	.108	.088	.037	.019
1945	.024	.033	.071	.106	.115	.142	.119	.142	.105	.068	.042	.016
1946	.019	.052	.076	.108	.100	.144	.108	.113	.090	.079	.040	.030
1947	.019	.053	.050	.090	.130	.142	.156	.138	.117	.072	.030	.024
1948	.018	.031	.058	.119	.148	.180	.144	.141	.111	.071	.035	.020
1949	.020	.041	.065	.091	.142	.133	.138	.103	.104	.050	.049	.022
1950	.017	.052	.058	.101	.110	.156	.114	.120	.093	.080	.035	.016
1951	.026	.041	.050	.092	.162	.152	.167	.157	.112	.076	.032	.027
1952	.024	.043	.066	.102	.143	.196	.190	.123	.115	.081	.042	.025
1953	.028	.051	.063	.104	.129	.177	.152	.163	.128	.098	.048	.024
1954	.028	.068	.065	.120	.112	.194	.184	.162	.143	.075	.042	.023
1955	.027	.040	.071	.123	.145	.159	.147	.163	.120	.076	.043	.024
1956	.023	.040	.076	.114	.147	.165	.161	.157	.131	.069	.046	.031
Av.	.026	.048	.067	.107	.142	.173	.154	.141	.120	.080	.043	.024

[1] Anniston and Birmingham, Ala., Chattanooga, Tenn., and Atlanta, Ga.

APPENDIX TABLE 2. AVERAGE DAILY EVAPOTRANSPIRATION IN INCHES OF WATER FROM SELECTED STATIONS[1] FOR THE SOUTHERN AREA OF ALABAMA, 1930-56

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
1930	.039	.082	.074	.146	.155	.192	.182	.155	.113	.094	.045	.033
1931	.044	.082	.090	.138	.135	.207	.170	.166	.161	.107	.073	.032
1932	.042	.065	.083	.135	.151	.188	.188	.141	.124	.088	.052	.020
1933	.038	.047	.095	.117	.176	.195	.144	.160	.164	.098	.072	.054
1934	.044	.066	.087	.118	.142	.184	.169	.145	.142	.101	.069	.040
1935	.048	.072	.095	.128	.171	.189	.158	.145	.140	.118	.068	.034
1936	.039	.055	.096	.126	.166	.215	.159	.177	.146	.099	.060	.032
1937	.031	.058	.087	.135	.175	.184	.182	.144	.128	.083	.052	.040
1938	.040	.081	.101	.128	.147	.170	.137	.167	.133	.109	.065	.042
1939	.050	.062	.098	.135	.137	.163	.165	.139	.136	.104	.060	.048
1940	.035	.048	.078	.100	.171	.157	.138	.162	.147	.113	.052	.033
1941	.046	.054	.063	.124	.167	.140	.138	.144	.128	.094	.054	.036
1942	.048	.054	.076	.146	.158	.162	.172	.143	.130	.102	.072	.033
1943	.041	.080	.078	.143	.168	.184	.166	.174	.115	.098	.070	.035
1944	.042	.064	.088	.115	.180	.200	.170	.142	.133	.115	.059	.040
1945	.046	.060	.111	.136	.166	.200	.146	.167	.144	.092	.066	.030
1946	.033	.079	.098	.151	.146	.183	.147	.145	.106	.105	.053	.056
1947	.033	.076	.081	.127	.163	.172	.189	.166	.147	.095	.043	.034
1948	.035	.048	.079	.149	.174	.196	.166	.153	.123	.094	.047	.034
1949	.037	.054	.080	.108	.170	.158	.140	.148	.123	.075	.072	.036
1950	.042	.082	.080	.123	.162	.183	.131	.166	.117	.099	.061	.072
1951	.046	.071	.076	.120	.176	.181	.182	.189	.117	.105	.056	.039
1952	.039	.060	.083	.134	.152	.222	.183	.155	.122	.099	.053	.032
1953	.044	.052	.078	.120	.157	.184	.162	.157	.140	.108	.057	.030
1954	.038	.085	.085	.144	.135	.210	.172	.201	.164	.108	.059	.041
1955	.037	.056	.094	.126	.162	.187	.152	.162	.128	.097	.054	.030
1956	.037	.055	.082	.120	.147	.150	.154	.162	.127	.084	.064	.042
Av.	.041	.066	.086	.130	.160	.185	.162	.158	.134	.100	.060	.038

[1] Mobile and Montgomery, Ala., Macon and Thomasville, Ga., Jackson, Miss., and Pensacola, Fla.

Appendix Table 3. Minimum Number of Drought-Days in Alabama by Areas for Different Months, Soil Storage Capacities, and Probabilities, 25-Year Average

Month	Prob.	Area A				Area B				Area C				Area D				Area E			
		Base amounts				Base amounts				Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days																			
Feb.	1/10	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	6	0	0	0
	2/10	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Mar.	1/10	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	7	0	0	0
	2/10	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	4	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	15	10	0	0	14	5	0	0	14	5	0	0	16	9	0	0	15	7	0	0
	2/10	11	6	0	0	11	0	0	0	11	0	0	0	14	6	0	0	12	5	0	0
	3/10	8	2	0	0	8	0	0	0	9	0	0	0	12	3	0	0	11	2	0	0
	5/10	3	0	0	0	4	0	0	0	5	0	0	0	8	0	0	0	8	1	0	0
May	1/10	25	22	16	1	24	20	15	4	24	21	14	1	26	21	15	5	25	21	19	7
	2/10	21	17	11	0	20	15	10	1	21	16	8	0	23	18	12	0	23	18	14	4
	3/10	18	14	7	0	17	11	6	0	18	12	4	0	21	15	10	0	21	16	11	1
	5/10	14	9	2	0	12	6	0	0	14	6	0	0	18	11	6	0	17	12	6	0
June	1/10	27	27	25	22	25	24	23	19	25	25	25	17	26	25	23	19	25	25	24	21
	2/10	25	24	21	17	22	20	18	12	22	20	19	11	24	22	20	15	23	22	20	16
	3/10	23	22	18	12	19	17	15	7	19	17	15	7	22	20	18	12	20	19	18	12
	5/10	19	17	13	3	15	12	9	0	16	12	8	1	19	16	13	6	17	14	13	6
July	1/10	23	23	22	21	24	23	23	20	23	22	20	17	22	20	19	19	22	20	20	18
	2/10	20	19	18	15	20	18	17	13	20	17	15	12	18	16	15	14	18	17	16	14
	3/10	18	16	15	11	18	14	12	9	17	13	11	8	16	13	12	11	16	13	13	11
	5/10	14	11	9	4	13	8	5	1	13	7	5	1	12	8	6	5	12	9	7	5

Continued

APPENDIX TABLE 3 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN ALABAMA BY AREAS FOR DIFFERENT MONTHS, SOIL STORAGE CAPACITIES, AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	Area A				Area B				Area C				Area D				Area E			
		Base amounts				Base amounts				Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days																			
Aug.	1/10	26	24	23	23	25	22	19	16	21	18	15	13	28	26	24	22	22	18	17	16
	2/10	23	20	17	16	21	17	13	11	18	14	11	7	24	21	17	15	19	14	12	10
	3/10	20	16	14	11	19	14	10	7	16	11	7	3	21	16	12	9	17	12	8	6
	5/10	16	11	8	4	15	8	5	2	13	6	2	0	16	10	4	0	14	8	3	0
Sept.	1/10	25	24	24	22	26	24	23	20	25	24	22	19	25	25	24	21	26	25	24	21
	2/10	21	19	18	16	21	19	18	15	21	19	16	13	21	21	19	16	22	20	20	15
	3/10	18	15	14	12	19	15	14	11	18	16	12	8	19	18	16	11	20	17	16	10
	5/10	13	9	7	6	14	9	7	5	14	10	5	0	16	11	8	2	16	12	8	3
Oct.	1/10	25	23	23	22	25	23	22	22	25	23	22	21	28	28	27	27	26	26	26	26
	2/10	21	20	19	18	21	17	16	16	21	18	17	15	26	25	25	23	24	23	22	22
	3/10	18	17	15	14	17	12	10	10	18	15	12	10	24	23	21	19	22	20	18	16
	5/10	13	10	5	0	12	4	0	0	14	9	6	3	21	18	15	11	19	14	8	1
Nov.	1/10	8	7	7	6	9	7	7	7	12	11	9	8	20	19	19	17	18	18	17	16
	2/10	6	4	2	1	5	0	0	0	8	5	4	2	16	14	14	12	16	15	14	12
	3/10	5	4	0	0	3	0	0	0	4	2	0	0	13	11	11	9	13	12	11	8
	5/10	4	2	0	0	0	0	0	0	0	0	0	0	6	5	4	1	8	7	4	0
Dec.	1/10	0	0	0	0	0	0	0	0	0	0	0	0	4	2	2	1	4	1	1	1
	2/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 3 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN ALABAMA BY AREAS FOR DIFFERENT MONTHS, SOIL STORAGE CAPACITIES, AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	Area F				Area G				Area H				Area I			
		Base amounts				Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days															
Feb.	1/10	0	0	0	0	0	0	0	0	7	0	0	0	9	0	0	0
	2/10	0	0	0	0	0	0	0	0	5	0	0	0	7	0	0	0
	3/10	0	0	0	0	0	0	0	0	3	0	0	0	5	0	0	0
	5/10	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Mar.	1/10	10	0	0	0	8	0	0	0	8	0	0	0	13	0	0	0
	2/10	7	0	0	0	5	0	0	0	6	0	0	0	8	0	0	0
	3/10	5	0	0	0	3	0	0	0	4	0	0	0	4	0	0	0
	5/10	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Apr.	1/10	16	9	0	0	16	9	0	0	17	10	0	0	21	14	0	0
	2/10	13	5	0	0	13	5	0	0	13	7	0	0	17	9	0	0
	3/10	11	2	0	0	11	3	0	0	11	4	0	0	14	6	0	0
	5/10	9	0	0	0	7	0	0	0	8	1	0	0	9	1	0	0
May	1/10	26	22	18	6	23	21	17	7	26	25	24	11	22	21	20	12
	2/10	23	18	15	4	20	18	14	0	23	20	18	4	20	18	15	1
	3/10	21	16	12	2	18	16	11	0	20	17	12	0	18	16	12	0
	5/10	17	12	7	0	16	12	6	0	17	11	3	0	15	12	6	0
June	1/10	25	23	23	20	26	24	23	19	25	24	24	21	23	22	20	13
	2/10	22	19	18	15	22	20	19	15	23	21	21	17	21	18	15	8
	3/10	19	16	15	11	20	17	16	12	21	19	18	13	18	15	11	5
	5/10	15	12	10	5	16	13	11	7	17	14	12	3	13	9	5	0
July	1/10	21	20	19	15	19	17	17	15	19	16	16	15	13	11	11	7
	2/10	17	14	13	10	15	13	12	10	16	15	14	10	10	5	1	0
	3/10	14	10	9	7	13	9	8	4	13	9	9	7	7	0	0	0
	5/10	11	7	5	4	7	2	0	0	9	5	4	2	2	0	0	0

Continued

APPENDIX TABLE 3 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN ALABAMA BY AREAS FOR DIFFERENT MONTHS, SOIL STORAGE CAPACITIES, AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	Area F				Area G				Area H				Area I			
		Base amounts				Base amounts				Base amounts				Base amounts			
		1″	2″	3″	5″	1″	2″	3″	5″	1″	2″	3″	5″	1″	2″	3″	5″
		Minimum drought-days															
Aug.	1/10	20	15	12	10	19	15	12	8	19	15	11	10	17	11	7	6
	2/10	17	12	7	3	16	11	8	1	16	11	6	4	13	7	0	0
	3/10	15	10	4	0	14	8	4	0	14	8	3	0	11	4	0	0
	5/10	12	6	0	0	10	3	0	0	10	4	0	0	8	0	0	0
Sept.	1/10	24	21	21	16	22	20	17	11	27	26	24	16	23	17	14	2
	2/10	21	19	18	14	19	16	11	4	21	18	15	9	17	12	8	0
	3/10	18	16	14	3	17	12	7	1	18	14	10	4	13	7	4	0
	5/10	14	9	0	0	13	7	0	0	14	9	5	0	6	1	0	0
Oct.	1/10	28	27	27	26	28	25	25	22	28	27	26	24	26	22	19	14
	2/10	25	23	20	15	25	21	20	14	26	25	22	18	23	19	12	0
	3/10	22	19	14	5	22	18	16	6	24	21	18	10	21	16	7	0
	5/10	18	13	4	0	18	14	6	0	21	15	10	0	17	10	0	0
Nov.	1/10	21	17	16	8	21	20	20	16	23	22	22	21	18	17	15	0
	2/10	15	11	11	4	18	17	15	7	20	19	18	15	14	12	10	0
	3/10	11	8	7	1	15	14	12	0	17	16	15	10	11	7	6	0
	5/10	4	3	2	0	9	8	4	0	12	9	8	0	6	1	0	0
Dec.	1/10	6	3	3	2	8	6	6	4	10	6	6	2	0	0	0	0
	2/10	1	0	0	0	3	1	0	0	5	0	0	0	0	0	0	0
	3/10	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX TABLE 4. MINIMUM NUMBER OF DROUGHT-DAYS IN AREA A BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	0	0	0	0	1	0	0	0	2	0	0	0
	2/10	0	0	0	0	0	0	0	0	0	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	2	0	0	0	8	0	0	0	9	4	0	0
	2/10	0	0	0	0	6	0	0	0	6	0	0	0
	3/10	0	0	0	0	4	0	0	0	4	0	0	0
	5/10	0	0	0	0	0	0	0	0	1	0	0	0
May	1/10	10	8	5	0	10	9	6	0	11	11	11	1
	2/10	8	4	0	0	10	7	2	0	10	8	7	0
	3/10	6	0	0	0	8	6	0	0	8	6	3	0
	5/10	3	0	0	0	6	2	0	0	5	3	0	0
June	1/10	10	10	10	7	10	10	10	10	10	10	10	10
	2/10	10	9	9	4	10	9	9	8	10	10	10	9
	3/10	9	8	7	1	8	8	8	6	10	9	9	7
	5/10	7	6	4	0	6	5	4	0	8	7	5	3
July	1/10	9	9	9	8	10	10	10	9	9	9	9	8
	2/10	7	7	7	5	10	9	8	7	8	7	6	6
	3/10	6	6	5	3	9	7	6	5	7	6	5	3
	5/10	4	3	2	0	6	4	3	0	5	2	1	0
Aug.	1/10	10	10	9	8	10	8	8	8	11	11	11	11
	2/10	9	8	7	5	8	7	6	6	11	11	11	9
	3/10	8	6	5	3	7	5	4	4	10	9	8	6
	5/10	4	1	0	0	5	3	0	0	7	5	3	0
Sept.	1/10	10	10	10	9	10	9	9	9	10	10	9	9
	2/10	8	8	7	6	8	8	8	8	10	7	6	6
	3/10	6	6	5	4	7	6	6	6	8	5	4	4
	5/10	4	3	2	1	4	2	0	0	6	2	1	0
Oct.	1/10	10	9	8	8	10	10	10	9	11	10	10	10
	2/10	10	7	6	6	9	8	8	7	9	8	7	7
	3/10	8	5	4	3	8	7	6	5	7	6	5	5
	5/10	5	1	1	0	5	3	2	0	4	2	0	0
Nov.	1/10	8	7	6	6	3	0	0	0	0	0	0	0
	2/10	5	4	3	2	0	0	0	0	0	0	0	0
	3/10	3	2	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA B BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	0	0	0	0	0	0	0	0	0	0	0	0
	2/10	0	0	0	0	0	0	0	0	0	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	2	0	0	0	8	0	0	0	9	0	0	0
	2/10	1	0	0	0	6	0	0	0	6	0	0	0
	3/10	0	0	0	0	4	0	0	0	3	0	0	0
	5/10	0	0	0	0	1	0	0	0	0	0	0	0
May	1/10	9	7	4	0	10	9	6	0	10	10	9	3
	2/10	7	4	1	0	9	7	3	0	8	7	5	0
	3/10	6	0	0	0	8	5	0	0	7	5	3	0
	5/10	3	0	0	0	6	2	0	0	5	2	0	0
June	1/10	10	10	9	6	10	10	9	7	10	10	10	10
	2/10	9	9	7	2	9	7	7	4	10	10	9	8
	3/10	8	7	5	0	7	6	5	1	9	9	7	4
	5/10	5	2	0	0	5	3	1	0	7	5	4	0
July	1/10	9	9	9	9	10	9	9	8	11	10	10	10
	2/10	8	7	7	6	9	7	7	4	9	7	7	6
	3/10	7	6	5	3	8	5	3	2	6	5	4	2
	5/10	5	4	1	0	5	2	1	0	4	2	1	0
Aug.	1/10	10	10	10	9	10	8	6	5	11	11	11	9
	2/10	8	7	6	5	8	6	3	2	11	10	9	6
	3/10	6	5	4	2	7	4	2	1	9	8	6	1
	5/10	4	0	0	0	5	1	0	0	7	6	1	0
Sept.	1/10	10	10	10	9	10	10	10	9	10	10	10	9
	2/10	9	8	7	6	9	8	8	6	9	9	8	7
	3/10	7	6	5	3	8	7	6	4	8	7	6	5
	5/10	5	3	1	0	4	1	1	0	6	2	0	0
Oct.	1/10	10	9	9	9	10	9	9	9	11	10	10	10
	2/10	9	6	6	6	9	7	6	5	9	7	7	6
	3/10	7	4	3	3	7	5	2	2	7	4	4	3
	5/10	4	1	0	0	4	0	0	0	4	0	0	0
Nov.	1/10	8	6	6	5	3	0	0	0	0	0	0	0
	2/10	4	3	1	0	0	0	0	0	0	0	0	0
	3/10	2	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA C BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	0	0	0	0	0	0	0	0	0	0	0	0
	2/10	0	0	0	0	0	0	0	0	0	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	3	0	0	0	8	1	0	0	10	4	0	0
	2/10	2	0	0	0	6	0	0	0	6	1	0	0
	3/10	0	0	0	0	4	0	0	0	4	0	0	0
	5/10	0	0	0	0	1	0	0	0	1	0	0	0
May	1/10	9	7	3	0	10	9	5	0	11	10	9	1
	2/10	7	3	0	0	10	7	2	0	9	8	5	0
	3/10	5	1	0	0	8	6	0	0	8	6	3	0
	5/10	3	0	0	0	6	2	0	0	4	3	0	0
June	1/10	10	10	10	5	10	10	10	9	10	10	10	9
	2/10	9	9	8	1	9	8	7	5	9	9	9	6
	3/10	8	7	6	0	8	7	5	2	7	5	5	1
	5/10	6	4	3	0	5	4	3	0	5	4	2	0
July	1/10	9	8	8	7	10	10	10	8	10	9	9	8
	2/10	7	7	6	4	9	7	7	6	8	7	6	4
	3/10	6	5	4	2	8	6	5	4	6	5	4	1
	5/10	4	2	1	0	5	3	1	0	4	1	0	0
Aug.	1/10	9	9	8	6	8	7	6	5	11	9	8	6
	2/10	8	6	4	2	7	5	4	2	10	8	5	2
	3/10	6	4	2	0	5	3	1	0	8	5	3	0
	5/10	3	1	0	0	3	0	0	0	6	2	0	0
Sept.	1/10	10	10	9	8	10	10	10	9	10	10	10	10
	2/10	9	8	7	4	10	9	8	5	10	8	7	6
	3/10	8	6	4	1	8	6	4	2	9	7	5	3
	5/10	5	3	0	0	4	0	0	0	5	3	0	0
Oct.	1/10	10	10	9	9	10	10	10	9	11	10	10	9
	2/10	9	7	7	6	10	8	6	5	10	8	8	8
	3/10	7	6	5	2	8	6	4	2	9	7	7	5
	5/10	5	2	0	0	5	2	0	0	6	1	0	0
Nov.	1/10	10	9	8	7	4	2	1	0	2	0	0	0
	2/10	6	5	4	1	0	0	0	0	0	0	0	0
	3/10	2	1	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA D BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	2	0	0	0	4	0	0	0	2	0	0	0
	2/10	0	0	0	0	2	0	0	0	1	0	0	0
	3/10	0	0	0	0	1	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	5	0	0	0	8	2	0	0	10	7	1	0
	2/10	3	0	0	0	7	1	0	0	8	4	0	0
	3/10	2	0	0	0	5	0	0	0	6	2	0	0
	5/10	0	0	0	0	3	0	0	0	4	0	0	0
May	1/10	10	9	7	0	10	10	7	0	11	11	10	3
	2/10	9	7	2	0	10	8	5	0	10	9	8	0
	3/10	7	5	0	0	9	6	3	0	8	7	5	0
	5/10	5	0	0	0	6	4	0	0	6	3	1	0
June	1/10	10	10	10	8	10	10	10	8	10	10	10	10
	2/10	10	9	9	5	10	10	9	5	10	9	9	8
	3/10	9	8	7	2	9	8	7	4	9	8	8	6
	5/10	7	5	4	0	6	5	4	0	7	6	6	2
July	1/10	10	9	9	9	10	9	9	9	9	9	9	9
	2/10	8	7	7	6	8	7	7	6	8	6	6	6
	3/10	6	5	5	4	6	5	5	4	6	4	3	3
	5/10	4	3	2	1	3	2	1	0	4	1	0	0
Aug.	1/10	10	9	8	8	10	10	9	8	11	11	11	11
	2/10	9	7	5	5	9	8	7	4	11	10	10	8
	3/10	7	5	3	1	7	6	4	1	9	8	7	5
	5/10	5	2	0	0	4	2	0	0	7	5	0	0
Sept.	1/10	10	10	9	8	10	10	10	9	10	10	10	10
	2/10	9	8	7	6	9	9	8	7	10	9	9	8
	3/10	8	6	5	3	8	7	7	3	9	7	6	4
	5/10	5	4	2	0	5	2	1	0	6	4	1	0
Oct.	1/10	10	10	10	10	10	10	10	10	11	11	11	11
	2/10	10	9	8	8	10	10	10	9	11	11	11	10
	3/10	9	8	7	6	10	9	9	7	10	10	9	8
	5/10	7	5	2	0	8	7	5	2	8	7	7	5
Nov.	1/10	10	10	10	10	9	9	9	9	7	6	6	5
	2/10	8	8	8	7	7	7	7	6	4	3	3	1
	3/10	6	6	6	5	5	4	3	2	0	0	0	0
	5/10	3	3	2	1	1	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA E BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	1	0	0	0	4	0	0	0	3	0	0	0
	2/10	0	0	0	0	2	0	0	0	0	0	0	0
	3/10	0	0	0	0	1	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	5	0	0	0	8	2	0	0	9	6	0	0
	2/10	3	0	0	0	6	1	0	0	6	3	0	0
	3/10	1	0	0	0	5	0	0	0	5	1	0	0
	5/10	0	0	0	0	4	0	0	0	3	0	0	0
May	1/10	10	9	7	0	10	10	8	0	11	10	9	5
	2/10	8	7	3	0	10	9	6	0	9	9	8	1
	3/10	7	3	0	0	10	8	5	0	8	8	7	0
	5/10	5	0	0	0	7	5	1	0	7	6	5	0
June	1/10	10	10	10	9	9	9	9	8	10	10	10	10
	2/10	10	10	9	7	8	8	8	6	9	9	9	7
	3/10	9	9	8	4	7	7	7	4	8	7	7	6
	5/10	7	6	5	0	6	6	5	0	5	5	5	3
July	1/10	10	9	9	9	9	9	9	8	8	8	7	7
	2/10	8	8	8	7	8	7	7	6	6	6	5	5
	3/10	7	6	6	5	6	5	5	4	5	4	3	2
	5/10	4	3	3	1	4	2	1	0	3	0	0	0
Aug.	1/10	9	8	8	8	9	8	7	6	11	10	9	7
	2/10	8	6	4	4	7	5	4	2	10	8	6	4
	3/10	6	4	2	0	6	3	1	0	9	7	4	1
	5/10	4	0	0	0	3	0	0	0	6	4	1	0
Sept.	1/10	10	10	10	10	10	10	10	9	10	10	10	10
	2/10	10	9	8	7	9	8	8	5	10	10	9	7
	3/10	8	8	6	4	8	6	5	0	9	8	6	4
	5/10	6	4	2	0	6	2	0	0	7	5	3	0
Oct.	1/10	10	9	9	8	10	10	10	10	11	11	11	11
	2/10	9	8	7	7	10	9	8	7	11	10	10	9
	3/10	7	6	6	5	9	7	6	5	10	9	8	6
	5/10	6	2	0	0	7	5	2	0	8	6	3	0
Nov.	1/10	10	10	10	10	9	8	8	7	6	5	4	3
	2/10	9	9	9	7	7	6	6	5	3	2	1	0
	3/10	7	7	6	4	6	4	3	1	1	0	0	0
	5/10	4	1	0	0	2	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA F BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	4	0	0	0	5	0	0	0	5	0	0	0
	2/10	1	0	0	0	3	0	0	0	2	0	0	0
	3/10	0	0	0	0	1	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	5	0	0	0	8	3	0	0	10	7	2	0
	2/10	3	0	0	0	7	0	0	0	7	5	0	0
	3/10	2	0	0	0	6	0	0	0	6	3	0	0
	5/10	0	0	0	0	3	0	0	0	3	0	0	0
May	1/10	10	10	8	0	10	10	9	0	11	11	10	6
	2/10	9	7	4	0	10	9	7	0	10	10	8	0
	3/10	8	5	0	0	10	8	5	0	8	8	7	0
	5/10	5	1	0	0	7	5	2	0	5	4	3	0
June	1/10	10	10	10	8	10	10	10	8	10	10	10	8
	2/10	10	8	8	6	10	9	9	7	9	8	8	5
	3/10	8	7	7	3	9	8	6	5	7	7	5	4
	5/10	6	4	3	0	6	4	3	0	5	3	2	0
July	1/10	8	8	8	7	9	8	8	8	9	8	7	6
	2/10	7	6	6	4	8	6	6	5	6	4	3	2
	3/10	5	4	4	2	6	4	2	0	4	2	1	0
	5/10	3	0	0	0	2	0	0	0	2	0	0	0
Aug.	1/10	9	5	5	3	8	7	3	0	11	10	7	3
	2/10	7	4	0	0	6	4	0	0	9	7	4	0
	3/10	6	2	0	0	5	2	0	0	7	5	2	0
	5/10	3	0	0	0	3	0	0	0	5	1	0	0
Sept.	1/10	9	9	9	4	10	10	9	7	10	10	9	9
	2/10	8	8	6	0	9	8	7	2	9	7	7	6
	3/10	7	7	2	0	7	5	4	0	8	6	5	0
	5/10	5	1	0	0	4	0	0	0	6	2	0	0
Oct.	1/10	10	10	10	10	10	10	10	10	11	11	11	11
	2/10	10	9	7	6	10	10	9	8	11	11	9	6
	3/10	9	6	3	1	10	8	5	0	10	10	7	1
	5/10	6	3	0	0	8	5	0	0	8	5	0	0
Nov.	1/10	10	10	9	5	9	6	6	2	8	6	2	0
	2/10	8	8	7	2	6	2	2	0	5	3	0	0
	3/10	6	5	5	1	3	0	0	0	2	0	0	0
	5/10	3	2	0	0	0	0	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA G BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	3	0	0	0	4	0	0	0	5	0	0	0
	2/10	1	0	0	0	2	0	0	0	1	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	5	0	0	0	8	3	0	0	10	7	1	0
	2/10	3	0	0	0	7	1	0	0	8	4	0	0
	3/10	1	0	0	0	5	0	0	0	6	2	0	0
	5/10	0	0	0	0	3	0	0	0	3	0	0	0
May	1/10	10	10	7	0	10	10	9	0	11	11	10	4
	2/10	9	7	3	0	10	8	7	0	9	9	8	0
	3/10	7	4	0	0	9	7	5	0	8	8	6	0
	5/10	4	2	0	0	7	5	1	0	5	5	3	0
June	1/10	10	10	10	8	10	10	9	8	10	10	10	10
	2/10	9	8	8	6	10	8	8	6	9	8	8	8
	3/10	8	7	7	3	8	7	6	5	8	7	7	5
	5/10	6	5	5	0	6	5	4	0	5	4	3	0
July	1/10	10	9	9	9	8	7	6	5	7	7	7	6
	2/10	7	6	6	4	6	5	4	2	5	4	2	0
	3/10	5	4	3	2	4	3	2	0	4	2	0	0
	5/10	2	1	0	0	2	0	0	0	2	0	0	0
Aug.	1/10	9	7	6	5	8	7	4	0	10	10	8	4
	2/10	7	3	0	0	6	3	1	0	9	7	4	0
	3/10	5	0	0	0	5	0	0	0	7	4	0	0
	5/10	2	0	0	0	3	0	0	0	5	1	0	0
Sept.	1/10	9	9	8	7	10	8	6	2	10	10	9	4
	2/10	8	6	4	1	8	6	3	0	10	6	5	0
	3/10	6	4	2	0	6	4	0	0	8	5	3	0
	5/10	4	0	0	0	3	0	0	0	5	2	0	0
Oct.	1/10	10	10	9	6	10	10	10	9	11	11	11	11
	2/10	9	8	6	1	10	10	7	4	11	11	10	9
	3/10	8	7	3	0	10	8	5	0	11	10	8	2
	5/10	6	1	0	0	7	3	0	0	9	6	2	0
Nov.	1/10	10	10	10	8	9	9	9	7	6	6	6	4
	2/10	9	9	9	4	8	8	8	3	4	4	3	0
	3/10	8	7	7	0	7	6	6	0	2	1	1	0
	5/10	4	4	0	0	2	1	0	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA H BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th Base amounts 1"	2"	3"	5"	11th to 20th Base amounts 1"	2"	3"	5"	21st to 31st Base amounts 1"	2"	3"	5"
						Minimum drought-days							
Mar.	1/10	2	0	0	0	6	0	0	0	4	0	0	0
	2/10	0	0	0	0	3	0	0	0	0	0	0	0
	3/10	0	0	0	0	1	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	4	0	0	0	8	2	0	0	10	8	1	0
	2/10	2	0	0	0	6	1	0	0	8	5	0	0
	3/10	1	0	0	0	5	0	0	0	6	2	0	0
	5/10	0	0	0	0	3	0	0	0	3	0	0	0
May	1/10	10	10	8	0	10	10	9	2	10	10	10	9
	2/10	9	8	5	0	10	8	7	0	9	9	8	4
	3/10	8	6	2	0	10	7	3	0	8	7	6	0
	5/10	5	1	0	0	7	4	1	0	6	5	4	0
June	1/10	10	10	10	9	10	9	9	7	10	10	9	9
	2/10	9	9	9	6	9	8	7	6	9	9	8	8
	3/10	8	8	7	3	8	7	6	4	8	8	8	6
	5/10	7	5	4	0	6	5	3	1	6	5	5	1
July	1/10	10	10	10	10	8	7	7	5	7	6	6	4
	2/10	8	7	7	7	6	5	4	3	6	4	3	2
	3/10	5	5	5	4	5	3	3	1	5	2	0	0
	5/10	3	1	1	0	2	0	0	0	3	0	0	0
Aug.	1/10	8	6	4	3	8	7	4	1	11	9	7	5
	2/10	6	3	0	0	7	4	0	0	9	6	3	1
	3/10	4	1	0	0	5	1	0	0	7	4	1	0
	5/10	2	0	0	0	2	0	0	0	4	0	0	0
Sept.	1/10	10	10	9	8	10	9	8	7	10	10	10	7
	2/10	9	8	7	4	9	8	6	1	9	8	7	3
	3/10	7	6	4	0	8	6	2	0	8	6	4	0
	5/10	5	2	0	0	5	3	0	0	6	4	0	0
Oct.	1/10	10	10	9	8	10	10	10	9	11	11	11	11
	2/10	9	8	7	6	10	9	8	6	11	11	11	9
	3/10	8	7	5	0	10	8	6	0	11	10	9	6
	5/10	6	3	0	0	8	5	0	0	10	8	5	0
Nov.	1/10	10	10	10	10	10	10	10	9	8	7	7	6
	2/10	10	10	9	7	9	9	8	6	5	5	5	3
	3/10	8	8	8	4	8	7	6	2	3	3	2	0
	5/10	6	5	4	0	4	3	2	0	0	0	0	0

Continued

APPENDIX TABLE 4 (CONT'D). MINIMUM NUMBER OF DROUGHT-DAYS IN AREA I BY 10-DAY PERIODS FOR DIFFERENT SOIL STORAGE CAPACITIES AND PROBABILITIES, 25-YEAR AVERAGE

Month	Prob.	1st to 10th				11th to 20th				21st to 31st			
		Base amounts				Base amounts				Base amounts			
		1"	2"	3"	5"	1"	2"	3"	5"	1"	2"	3"	5"
		Minimum drought-days											
Mar.	1/10	5	0	0	0	6	0	0	0	5	0	0	0
	2/10	3	0	0	0	2	0	0	0	2	0	0	0
	3/10	0	0	0	0	0	0	0	0	0	0	0	0
	5/10	0	0	0	0	0	0	0	0	0	0	0	0
Apr.	1/10	6	0	0	0	9	6	0	0	10	9	6	0
	2/10	4	0	0	0	7	3	0	0	8	7	2	0
	3/10	3	0	0	0	6	1	0	0	7	5	0	0
	5/10	0	0	0	0	4	0	0	0	5	1	0	0
May	1/10	10	10	8	0	10	10	8	4	11	10	9	6
	2/10	9	8	5	0	10	9	6	0	9	8	6	1
	3/10	7	6	2	0	9	6	4	0	8	6	5	0
	5/10	5	3	0	0	6	3	1	0	6	4	2	0
June	1/10	10	10	9	2	10	9	8	7	8	8	8	6
	2/10	9	7	7	1	9	8	7	5	7	6	6	3
	3/10	8	5	0	0	7	6	5	2	5	4	4	1
	5/10	4	1	0	0	4	3	0	0	3	1	0	0
July	1/10	7	5	5	5	5	4	3	2	4	3	2	1
	2/10	5	3	2	0	3	2	1	0	3	1	0	0
	3/10	4	2	0	0	3	0	0	0	2	0	0	0
	5/10	1	0	0	0	1	0	0	0	1	0	0	0
Aug.	1/10	8	2	0	0	6	2	0	0	9	8	4	0
	2/10	6	0	0	0	5	0	0	0	7	5	0	0
	3/10	5	0	0	0	3	0	0	0	5	2	0	0
	5/10	2	0	0	0	1	0	0	0	3	0	0	0
Sept.	1/10	9	7	0	0	10	10	6	0	10	7	7	0
	2/10	6	3	0	0	7	5	3	0	7	4	2	0
	3/10	5	1	0	0	4	1	0	0	6	2	0	0
	5/10	1	0	0	0	0	0	0	0	3	0	0	0
Oct.	1/10	10	9	6	2	10	10	7	6	11	11	10	5
	2/10	10	7	3	0	10	7	2	0	11	10	7	0
	3/10	8	4	0	0	9	4	1	0	11	9	5	0
	5/10	4	0	0	0	6	1	0	0	8	4	0	0
Nov.	1/10	9	9	8	1	8	7	6	0	8	4	4	1
	2/10	7	7	5	0	6	4	4	0	5	2	1	0
	3/10	5	5	3	0	4	0	0	0	3	1	0	0
	5/10	3	2	0	0	1	0	0	0	0	0	0	0