Iran Agricultural Research, Volume 3, No. 1, 1984

NOTE

AGROCLIMATIC CHARACTERISTICS OF THE BAJGAH AREA, FARS PROVINCE OF IRAN[1]

E. Malek[2]

ABSTRACT

The agroclimatic characteristics of the Agricultural Experiment Station, Shiraz University at the Bajgah area (29° 32´ N, 52° 35´ E, altitude 1810 m, a sunny high-level valley in Fars province of Iran) were recorded at an agro-meteorological field station during a 16-y period. The homogeneity of the mean monthly values of temperature, humidity, wind, evaporation, and precipitation was tested. The probabilities of occurrence of the monthly and annual precipitation were given. The amounts of monthly incoming solar radiation and net radiation were estimated and finally a diagrammatic summary of the agroclimatic characteristics was presented. The usage incidence of the results are discussed.

تحقیقات کشاورزی ایران

جلدسوم شماره اول ۱۳۶۳

خصوصیات اقلیم- زراعی منطقه باجگاه، استان فارس، ایران

اسماعیل مالک

استادیار بخش آبیاری دانشکده کشاورزی دانشگاه شیراز

خلاصه

خصوصیات اقلیم- زراعی ایستگاه تحقیقاتی دانشکده کشاورزی دانشگاه شیراز واقع درمنطقه باجگاه (۲۹° و۳۲ عرض جغرافیائی شمالی، ۵۲° و۳۵ طول جغرافیائی شرقی، ۱۸۱۰ متر ارتفاع که یک محل مرتفع وآفتابگیردر استان فارس کشور ایران میباشد) با استفاده از داده‌های اقلیمی حاصله از یک ایستگاه هواشناسی کشاورزی مزرعه‌ای در یک دوره ۱۶ ساله موردارزیابی قرارگرفت. همگنی میانگین متوسط ماهیانه داده‌های اقلیمی مثل درجه حرارت، رطوبت، باد، تبخیروبارندگی بررسی شد و درصدهای مختلف احتمال نزول بارندگی ماهیانه وسالیانه ارائه گردید. مقادیر تشعشع خورشیدی رسیده وتشعشع خالص تخمین زده شدونهایتا "خلاصه‌ای شماتیک از خصوصیات

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1. Contribution from the Department of Irrigation, College of Agriculture, Shiraz University, Shiraz, Iran. Paper No. K-542-63. Received 20 June 1984.

2. Assistant Professor of Irrigation and Biometeorology.

اقلیم- زراعی منطقه یادشده رسم گردید. مواردا ستفاده این داده‌های اقلیم -زراعی موردبحث قرار گرفت.

INTRODUCTION

Knowledge of agroclimatic characteristics is essential for planning and designing purposes of irrigation scheduling, water supplying, date of planting, etc. in any agricultural area (4, 5). During the last ten to twenty years some very valuable examples of agroclimatic analysis have been undertaken by Brichambant and Wallen (1), Cocheme and Franquin (3) and Brown and Cocheme (2).

In this paper the agroclimatic data recorded at the Agricultural Experiment Station at the Bajgah area (29° 32´ N, 52° 35´ E, altitude 1810 m, a sunny high-level valley situated in south center of Iran) were analyzed. A summary of mean monthly extra-terrestrial, solar and net radiation, maximum, mean and minimum temperatures, different percentages of occurrence of rainfall, water budget, saturation deficit, and wind speed is reported.

MATERIALS AND METHODS

The 16-yr (1968-1983) climatic data of an agro-meteorological field station situated in the middle of a four-h alfalfa (*Medicago sativa* L.) field were analyzed to determine the agroclimatic characteristics of the Bajgah valley. This arable area is about 22 km^2 and is surrounded by relatively high mountains. The climatic data namely maximum, mean and minimum air temperatures (T_{max}, T_{mean} and T_{min}, respectively) in °C were measured by precise mercury-in-glass or spirit-in-glass thermometers and the relative humidity (RH) in percent, was measured by a dry and wet bulb psychrometer in a Stevenson Screen at 2 m height. These four factors were also recorded by a thermo-hydrograph. Relative humidity is usually expressed as the ratio of e_a/e_s multiplied by 100, where e_a and e_s are actual and saturation vapor pressure in mb, respectively. The saturation vapor depends on temperature (7), so the amount of e_s-e_a or saturation deficit, which is a usefull expression of the air humidity was also computed. Wind speed at 2 m height (U_2) in m sec^{-1}, was measured by a totalized three-cup anemometer. The free water surface evaporation, E_p in mm day^{-1}, was measured by a class A pan. The amount of rainfall (P) in mm, was determined by a standard raingauge. Sunshine duration (n) in h, was measured by a Campbell-Stokes sunshine recorder. The amount of incoming solar radiation (insolation) or global radiation (R_s) in cal cm^{-2} day^{-1} was recorded by a solarimeter from 1970 to 1975. During the period when the solarimeter was not in operation, R_s was computed using the following equation which was derived for the Bajgah Area by Malek (8).

$$R_s=R_A(0.31+0.55\ \frac{n}{N}) \qquad [1]$$

where R_A in cal cm^{-2} day^{-1} and N in h are the extra-terrestrial radiation (radiation out of the atmosphere) and the maximum possible duration of daylength, respectively. The values of R_A and N which depend on time of the year and latitude of the station, could be found from meteorological tables (7).

Analyses of the 5-yr (1972-1976) climatic data showed that Bajgah climatic type is arid, megathermal, with little or no water surplus during the winter (9), therefore, the following equation could be used for computation of net radiation (R_n) in cal cm^{-2} day^{-1} over the alfalfa field (5, 6)

$$R_n= 0.77\ R_s-(1.2\ \frac{R_s}{R_{so}}-0.2)\ R_{lo} \qquad [2]$$

where R_{so} is the mean solar radiation for cloudless skies (7), and R_{lo} is the net outgoing long wave radiation on a clear day. R_{lo} is calculated by the following general equation:

$$R_{lo} = (0.39-0.055\sqrt{e_a})\ 11.71 \times 10^{-8}\ T^4 \qquad [3]$$

where e_a is in mb, T mean daily screen temperature in °K, and R_{lo} in cal cm^{-2} day^{-1}. The amount of net emissivity (ε=0.39-0.055 $\sqrt{e_a}$) in equation [3] is also calculated by using the average daily temperature at screen height (ε') for this area (6). The correlation coefficient between E and E′ is 0.98.

Previous investigation showed that the modified Penman equation was best suited for estimation of potential evapotranspiration (ET_p) in the Bajgah Area (9), therefore, the same equation was used for estimation of ET_p (5):

$$ET_p = c\ [W.R_n + (1-W)(0.27+0.0027U_2)\ (e_s - e_a)] \qquad [4]$$

where c is adjusted factor to compensate for the effect of day and night weather conditions and ranged from 0.95 in December to 1.08 in March and April and W is temperature-related weighing factor, and ranged from 0.49 in January to 0.76 in July for this area. The other terms were defined previously, and R_n has to be in mm day^{-1}(1 mm depth of water= 59 cal cm^{-2} day^{-1} at 10° to 30° C). Having the computed ET_p and the measured P during the 16-yr period, the root depth, the soil texture, the amount of water surplus (WS) and water deficit (WD) were determined (9, 11).

To test whether or not there is any trend (increasing or decreasing continuously) or shift in the record of mean monthly climatic data, a simple quick method so-called 'run test' method, was used (4, 10). The frequency analyses were used to determine the probability of occurrence of monthly and yearly rainfall during the period of 1968-1983 (4, 5). After plotting the rainfall data on the probability-normal papers, the regression method was used to draw the best fit lines.

RESULTS AND DISCUSSION

The results of 'run test' showed that all recorded climatic data were homogeneous. The probabilities of occurrence of the monthly and yearly rainfall, the most variable climatic factor, are shown in Figs 1 and 2. Figure 1 refers to January and graphs for the other months are omitted. A diagrammatic summary of the main agroclimatic characteristics of the Bajgah Area such as radiation, temperature, rainfall, water budget, wind speed and saturation deficit is shown in Fig. 3. The results in Fig. 3a indicated that outside, global and net radiation were maximum in June and minimum in December, but maximum and minimum temperatures occurred one month later , namely in July and January, respectively (Fig. 3b). This means that the time of maximum and minimum temperatures lagged about one month behind the time of maximum and minimum insolation in this area. Analysis of the temperature data showed that the absolute highest and lowest temperatures during the period of 1968-1983 were 44.4°C and -25.6°C and occurred in August 10, 1970 and January 7, 1972, respectively. The average date of last temperature below zero in spring was May 1, and the average first occurrence of such temperature in fall was October 8 during this period (159 frost-free days). This means the planting and harvesting dates could be late April and late October, respectively. The maximum and minimum amounts of monthly and yearly rainfall (obtained from the 16-yr data) and those equalled or exceeded 20%, 40%, 60%, and 80% (obtained from the probability of occurrence analysis from the related graphs such as Figs. 1 and 2) were presented by successive horizontal lines (working downward in Fig. 3c, d), respectively. The dashed regions show the depths of rainfall in ralation to the most efficient crop production (probability of occurrence below 60% and over 40%). The mean monthly potential evapotranspiration and

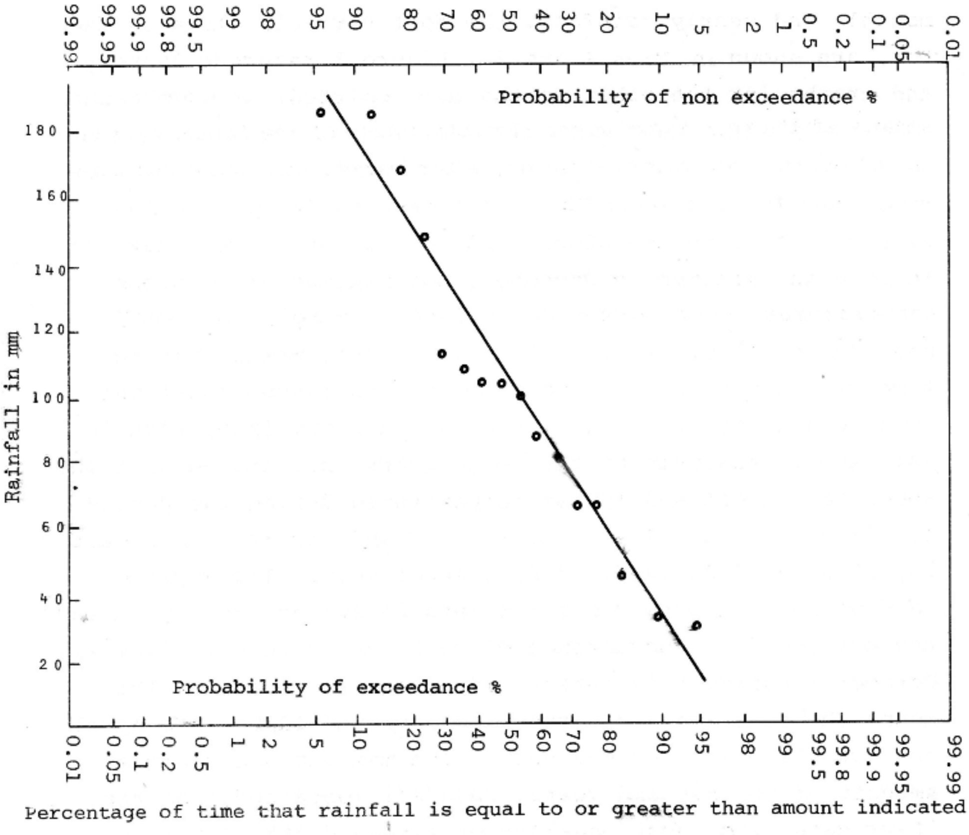

Fig. 1. January rainfall probability

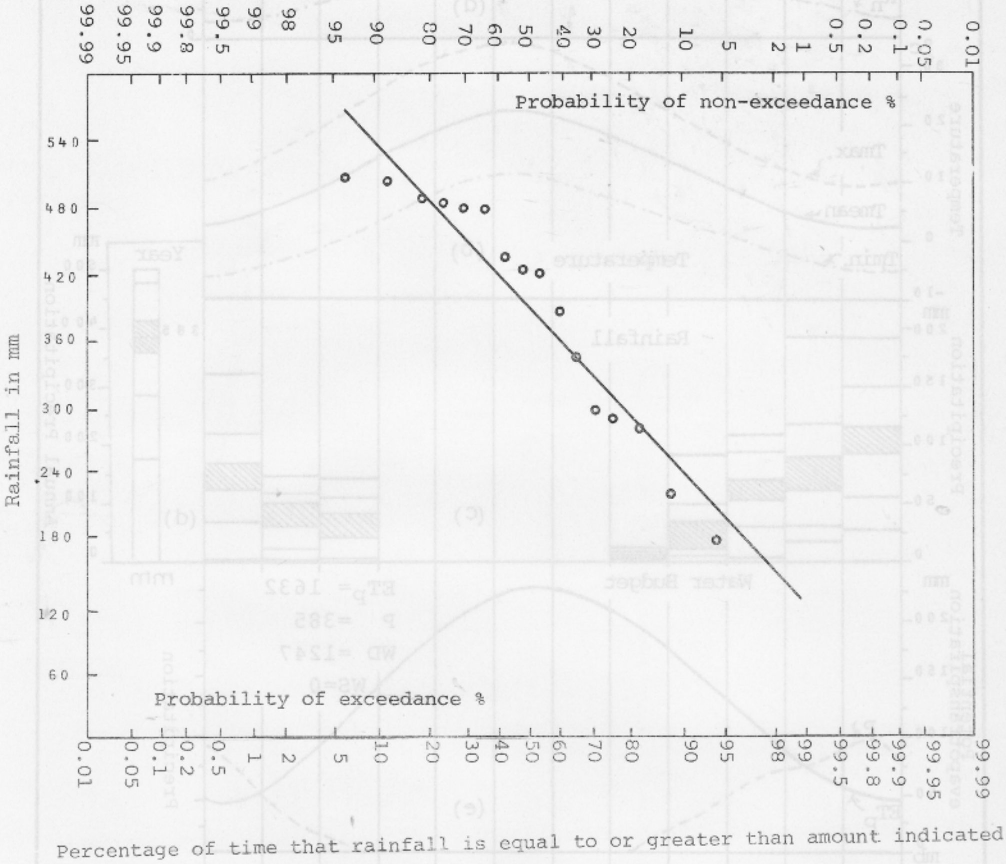

Fig. 2. Yearly rainfall probability.

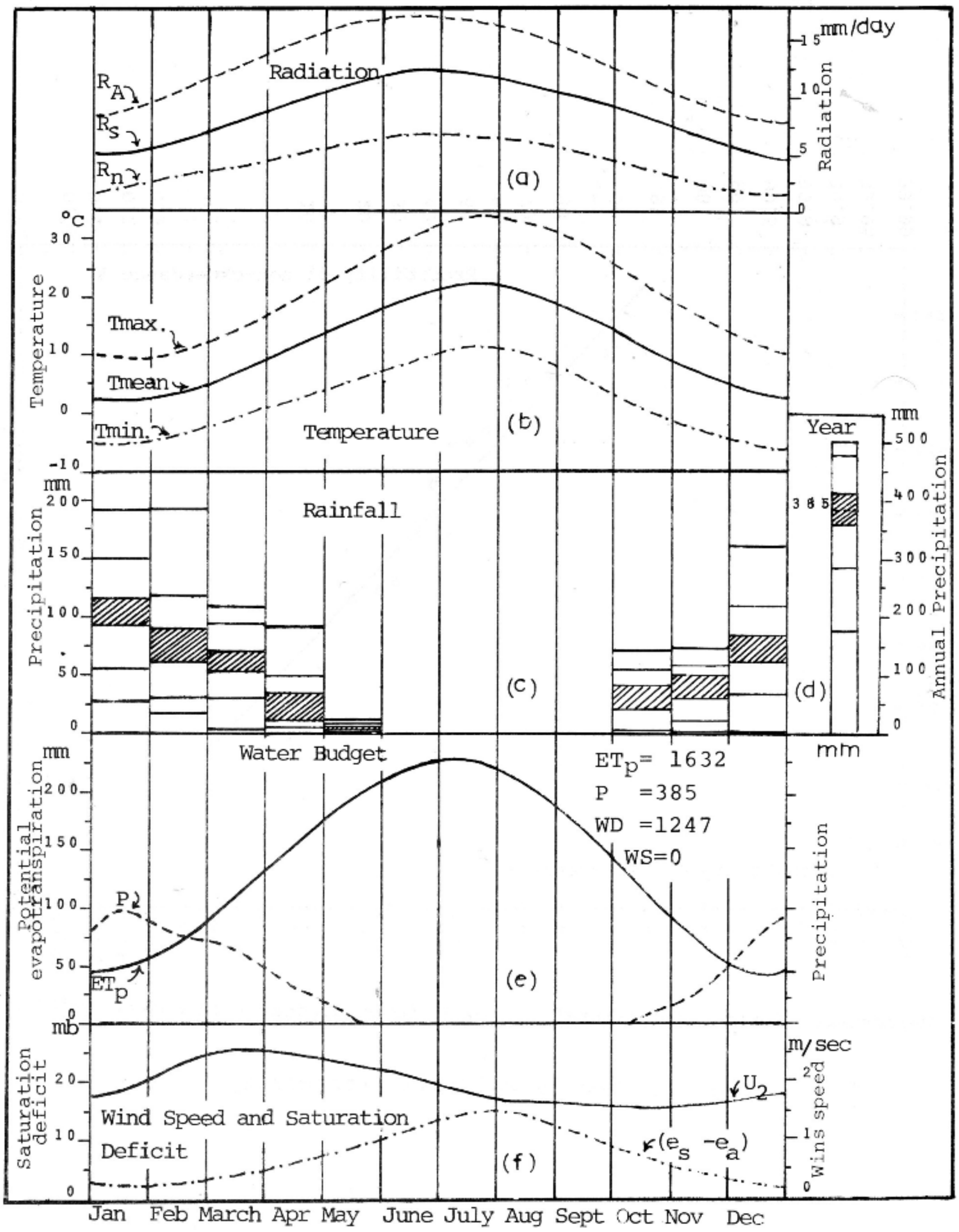

Fig. 3. Diagrammatic summary of the main agroclimatic characteristics of the Bajgah area (29° 32´ N, 52° 35´ E altitude 1810 m), Shiraz, Iran.

precipitation along with the amounts of average yearly water deficit and water surplus have been plotted in part e of Fig. 3. The results indicated that there was a completely dry period from May through October and the water stored in the soil from the beginning of December till the middle of February was depleted during March and April. These results confirmed those reported by Malek (9).

The mean monthly saturation deficit was shown in Fig. 3f and was the highest in July. Its variations during the different months followed the same trend as that of temperature. This means that the highest and lowest water demands occurred in July and January, respectively.

The wind speed was highest during March, the most windy conditions during the year, and was the lowest during August (Fig. 3f).

Knowing the agroclimatic characteristics of the Bajgah Area is very valuable in irrigation scheduling and water supplying. This can be achieved by determining number of irrigation net depth of water, interval of irrigation (provided root depth and soil texture were known) for each month and field irrigation supply of crops during the growing season. For example the average annual needed water for a crop such as alfalfa is about 1250 mm. Besides, these data could be used for adjusting and completing of the climatic data of adjacent areas with climatic type similar to Bajgah area, i.e. arid, megathermal, with little or no water surplus during the winter (4).

ACKNOWLEDGEMENT

The climatic data for this research were recorded in the Bajgah Agroclimatic Field Station. The author would like to thank Mr. N. Saadikhani and A.M. Esfandiari for their assistance during the course of this investigation.

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