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The Number of Days with Adequate Moisture and the Yield of the Rangelands in Arid Zone of Khorasan (Islamic Republic of Iran)

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Abstract: Under natural condition, the accumulation of green matter in rangeland plants is closely related to the level of the heat and moisture supply to a territory of special interest are combined agrometeorological parameters characterizing the growth and development of plants during the vegetation period. The results of this study showed that in 34% of areas plants growing start in January and 48% in February and only 18% in March. According to the observations of 41 meteorological stations conducted in the period of 20 years, it was established that the duration of the vegetation period of ephemeral on average is 93 days. Of this period, the number of days with adequate moisture is 22 days. The relative fraction of days with adequate moisture supply during the vegetation period is everywhere from 14 to 30 %. Results of this study showed that in arid zone of Khorasan there are moderate and strong drought.With a strong drought, there are less than 12-16 days during the vegetation period with adequate water or 13-17.2% and over 76-91 days with a drought. The yield –of the pasture ephemeral is 125-158 kg/ha.A moderate drought is characterized by 22-29 days with and adequate water supply, or 25-27% and 64-77 days with a drought. The yield of the ephemeral stand is 196-249 kg/ha. Analysis of the data for many years shows that moderate and great droughts are observed different in various regions of Khorasan. The distribution of the repetition of the various degrees of drought is of a regular nature. In the given case, the years with little water and low yields repeat more often (35-43%), the moderate years repeat less (29-36%). This indicates that during the last 20 years in most regions of the Khorasan,the pastures are experiencing desertification to a various extent. The further development of these negative factors in the future may lead to an irreversible, catastrophic state of the pastures.

Key words: Adequate moisture · Khorasan rangelands · Ephemeral production · Arid zone

INTRODUCTION

Khorasan province with more than 12 million hectares of pasture is among the regions, where have important share in providing forages for livestock [1].Under natural condition, the accumulation of green matter in rangeland plants is closely related to the level of the heat and moisture supply to a territory of special interest are combined agrometeorological parameters characterizing the growth and development of plants during the vegetation period. The precipitation and the air temperature are the main factors determining the degree of development of rangeland plants [2]. Analysis of the weather characteristics of the deserts reveals that every year in arid zone of Khorasan condition are observed that inhibit and stop the growth, development and especially,the accumulation of the green matter in rangeland plants. This is why it is very important to determine the agrometeorological parameters that can estimate the weather conditions affecting adversely the formation of a harvest of ephemeral and to obtain quantitative characteristics of moisture and heat positively acting on plants for their differential consideration and prediction [3&4]. The vegetation

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period of a rangeland ephemeral stand is divided into days with adequate heat and moisture and drought period (days with droughts). The days with adequate heat and moisture during the vegetation period are potential evaporation *(Eo)* expressed in mm during a long period of time if a field has sufficient moistening is determined by the radiation balance:

$$E_o = \frac{R}{L}$$

where R is the radiation balance calculated for a moistened surface, J cm-2 and L is the latent heat of evaporation or the expenditure of heat for evaporation, taken equal to about 2500 J g^{-1} [5& 6].

The potential evaporation during a period with a temperature of the air above 5°C calculated by this formula was 270 mm for Archangelsk, 350 mm for Leningrad and 400 mm for Gorki and Sverdlovsk. The sum of the temperatures during this period was 1400, 1800, 2100 and 2200°C, respectively [5]. We see that the sum of the temperatures is about five times greater than the potential evaporation. Consequently, on an average, the evaporation of 1 mm of water *(Eo)* from the surface of a field having an optimal supply of moisture and a moist surface requires about $0.2\Sigma t$, or $E_o = 2t_{dec}$, where t_{dec}. is the average decade temperature of the air during the vegetation period.

The total evaporation (E_{tot}) from an active surface of agricultural fields consists of two components: (i) evaporation of moisture from the surface of the plants (transpiration plus evaporated from the wetted surface of the plants) and (ii) evaporation from the surface of the soil. In recent years,most scientists studying the evaporation of water from the surface of agricultural fields arrived at a single opinion that these consumptions of moisture are mainly equivalent. Consequently, the potential transpiration $E_{pot} = 0.5E_{tot} = t_{dec}$ approximately equals the average decade temperature of the air [7]. However,under the natural conditions of a desert, especially of a study one,the moist surface of soil even with the optimal amount of moisture remains for only a short time. After rainfall, in dry weather the surface layers of the sand rapidly dry up and form a dry mulching layer that diminishes the evaporation of moisture from the soil and violates the relation between the theoretical and actual total evaporation of moisture[8]. Studying the consumption of water by ephemerae rangelands of the study deserts of the Centeral Kara Kum area, for three years (1972-1974), performed stationary observations of the total evaporation from the active surface of rangelands during the period of intense development of the ephemeral stand in spring. The observations were performed with the aid of evaporators GGI- 500×50 in which monoliths with pure sand and a ephemeral stand and control ones(monoliths with sand without vegetation [6]. Referring to Loginov *et al.* [3] and Ostrovesky [9] stresses that a drought is a combination of such a lack of precipitation and increased evaporation that with the absence of the required level of agricultural practices a lack of agreement between the demand of plants for moisture and its supply from the soil. This lowers the yield of agricultural crops and rangeland plants.

MATERIALS AND METHODS

The study site was located in arid and semi-arid rangelands of Khorasan province in Iran. In the rangelands it was firstly selected 3 regions under observation of the meteorological stations including elevation to 1000 m, 1000 - 1500 m and 1500 m and more, then was determined reference, key and critical area in each regions,then transects with 150-200 m long and 2 m wide and 300-400 m long and 4 m wide (depending on density of vegetation) were placed in each area. Sampling plots were established along each transect every 10 m systematically. Data were collected for 4 years (1996-1999) from a total of plots of 1 m2 along the flowering period of dominant plants. Ephemeral productions (weight of dry and wet forage), percentage of canopy cover of the vegetation were evaluated in each plot. Obtained statistical information various factors such as daily, monthly, seasonal and yearly rainfall and daily, monthly, seasonal and yearly (minimum, maximum and absolute) temperatures, etc.from 41 stations for 20 years (1979-1999). For studying the consumption of water and phenology by ephemeral pastures,we performed stationary observations of the total evaporation from the active surface of pastures during the period of intense development of the ephemeral stand in spring. The observations were performed with the aid of evaporators GGI- 500×50 in which monoliths with pure sand and a ephemeral stand and control ones (monoliths with sand without vegetation).

For calculating the number of days with adequate moisture during the vegetation period every decade or every month with a view to the amount of atmospheric precipitation and the average decade air temperature,we used of Nurberdyev model:

$$S_{md} = \frac{S_0 K}{t_{dec.5-16}} n$$

where S_{md} is the sum of the days with sufficient moisture (the number of days when the transpiration of the plants is provided with moisture), S_o is the sum of the precipitation for a decade (or month), K is the coefficient of utilization of the precipitation by the ephemeral stand, $t_{dec.5\text{-}16}$, is the average decade air temperature during the period from +5 to 16, and n is the number of days in the decade (or month) [7].

RESULTS AND DISCUSSION

As shown in Table 1 in 34% of areas plants growing start in January and 48% in February and only 18% in March. Whereas the average amount of rainfall in each above mentioned area are 101,95,111 mm in a year respectively. Nurberdyev [7] showed in Kara kum in 67% of areas plants growing start in February and 33% in March [7]. According to the observations of 41 meteorological stations conducted in the period of 20 years, it was established that the duration of the vegetation period of ephemeral on average is 93 days. Of this period, the number of days with adequate moisture is 22 days. Average of days with adequate and drought during period of vegetation of plants in 33-55 years in 12 meteorological station in Turkmenistan was 13 and 37, respectively [6].

For a comprehensive estimate and characteristic of a drought, it is essential to work out its criteria with a view to the physic geographical features, condition of water and heat supply to the locality and the physiological features of the pasture ephemeral stand. The duration and intensity of a drought are quite important factors here.

Table 1: Average meteorological parameters of ephemeral vegetation period

No.	Meteorological station	Vegetation period beginning	Vegetation period end	No. of days	Days with drought	No. of days with adequate moisture	Period with sufficient moisture %	Period with drought %	Yield Kg/ha
1	Abshar	25 March	26 June	92	73	19	20.7	79.3	202
2	Aghmazar	19 January	15 May	116	89	27	23.3	76.7	257
3	Arask	24 January	26 April	93	77	16	17..2	82.8	158
4	Bar	7 March	28 May	82	52	30	36.6	63.4	286
5	Asadabad	18 February	9 May	90	73	17	18.9	81.1	150
6	Bajestan	3 February	5 May	91	73	18	19.8	80.2	174
7	Barbarghaleh	4 March	7 June	94	73	21	22.3	77.7	207
8	Birjand	30 January	7 May	96	68	28	29.2	70.8	242
9	Bojnord	3 March	29 May	86	62	20	23.3	72.1	233
10	Boshrueh	18 January	19 April	90	76	14	15.6	84.4	134
11	Chamanbid	22 February	5 June	103	74	29	28.2	71.8	270
12	Chakodar	9 February	6 May	86	56	30	34.9	65.1	288
13	Musavieh	11 January	5 May	114	90	24	21.1	78.9	209
14	Daroneh	5 January	10 April	95	71	24	25.3	74.4	249
15	Deihok	16 January	30 April	105	88	17	16..2	83.8	156
16	Efin	3 February	16 May	103	77	26	25.2	74.8	231
17	Friman	5 March	20 June	105	79	26	24.8	75.2	246
18	Ferdous	25 January	2 May	97	72	25	25.8	74.2	220
19	Ghaen	11 February	22 May	100	80	20	20	80	183
20	Ghochan	6 March	30 May	85	58	27	31.8	68.2	275
21	Golmakan	28 February	21 May	82	62	20	24.4	75.6	200
22	Gonabad	3 February	29 April	86	68	18	20.9	79.1	172
23	Halvan	1 February	16 April	106	91	15	14..2	85.8	136
24	Khosh(Esfaraen)	22 February	16 May	83	63	20	24.1	75.9	194
25	Kortian	26 February	26 May	90	60	30	33.3	66.7	297
26	Malekabad	29 January	6 May	97	68	29	29.9	20.1	271
27	Mashad	19 February	19 May	89	58	31	34.8	65.2	304
28	Mazinan	23 January	30 April	98	78	20	20.4	79.6	191
29	Mehneh	16 January	1 May	105	76	29	27.6	72.4	238

Table 1: Continued

30	Neishabur	24 February	19 May	84	66	18	21.4	78.6	169
31	Mozdoran	20 February	17 May	86	64	22	25.6	74.4	196
32	Sabzevar	24 January	26 April	93	69	24	25.8	74.2	227
33	Serakhs	26 January	30 April	94	69	25	26.6	73.4	231
34	Sarbisheh	27 February	30 May	93	73	20	21.5	78.5	180
35	Sadeh	21 February	11 May	79	61	18	22.8	77.2	189
36	Shirvan	6 March	4 June	88	66	22	25	75	211
37	Tabas	1 January	4 April	92	80	12	13	87	125
38	Taibad	22 January	8 May	106	84	22	20.8	79.2	216
39	Torbat heidarieh	27 February	17 May	79	52	27	34..2	65.8	266
40	Torbat jam	11 February	13 May	91	71	20	22	78	191
41	Olang	18 February	23 May	95	70	25	26.3	73.7	238

The relative fraction of days with adequate moisture supply during the vegetation period is everywhere from 14 to 30 %,and the fraction of days with a drought- from the ephemeral stand yield in desert (Table1). Thus, the average yield of ephemeral is 134-304 kg/ha.To form the criteria of a drought, from the available information for many years we singled out the favorable, average,and most unfavorable years. The main factors for determining the criteria of droughts were their duration, amount of available moisture and the ephemeral yield.In years with a slight drought, during the vegetation period depending on the region. Over 40%of the vegetation period, the plants have sufficient moisture and under 60% they develop under conditions of a drought. In Turkminestan In years with a slight drought, during the vegetation period is 17-20 days [6]. Results of this study showed that in arid zone of Khorasan there are moderate and strong drought. With a strong drought, there are less than 12-16 days during the vegetation period with adequate water or 13-17.2% and over 76-91 days with a drought. The yield –of the pasture ephemeral is 125-158 kg/ha. A moderate drought is characterized by 22-29 days with and adequate water supply,or 25-27% and 64-77 days with a drought. The yield of the ephemeral stand is 196-249 kg/ha. Nurberdyev *et al*. 1997 indicated that in Kara kum deserts, strong and moderate droughts there are less than 8-12 and 12-16 days during the vegetation period with adequate water,respectively [6]. As a result of prolonged investigation, we established that the green matter of the pasture ephemeral stand in desert accumulates during the period when the average decade temperature of the air is within 12-16 °C and the amount of available moisture in the soil layer from 0 to 5 cm is at least 15 mm. Such conditions are considered to be favorable for the accelerated development and accumulation of the yield of spring ephemeral.Consequently, an agroclimatic or agricultural drought is the degree of disproportion of moisture and heat at which lowering of the moisture needed for transpiration begins together with a smaller growth in the green matter of the pasture plants.An important factor in the formation of the yield of pasture plants is the repetition of droughts. Analysis of the data for many years shows that moderate and great droughts are observed different in various regions of Khorasan. The distribution of the repetition of the various degrees of drought is of a regular nature.

In the given case, the years with little water and low yields repeat more often (35-43%), the moderate years repeat less (29-36%).

This indicates that during the last 20 years in most regions of the Khorasan,the pastures are experiencing desertification to a various extent. The further development of these negative factors in the future may lead to an irreversible, catastrophic state of the pastures.

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