

Probability of Moisture Available Periods for Groundnut Crop in Saurashtra Region*

K. R. Patel¹ and P. D. Mistry²

ABSTRACT

The probability of the moisture available days in different crop growth stages of the bunch and the spreading varieties of groundnut were worked out for Rajkot, Keshod, Mahuwa, Bhavnagar and Jamnagar stations. The critical period for the groundnut crop is characterised with respect to soil moisture availability and therefrom the suitability of groundnut variety in Saurashtra region is ascertained. The stations under study are ranked on the basis of moisture available days as Mahuwa, Keshod, Rajkot, Bhavnagar and Jamnagar in order.

(Received on Sept. 7, 1978)

INTRODUCTION

Meteorological data could profitably be exploited for the purposes of either the short term decision needs as well as the long term planning needs in agriculture. One of the most important applications of climatological research in agriculture lies in characterising more or less generalised features of important facts of climate encountered by specific crop in the region so that the information can gainfully be employed by an agriculturist in the planning and conduct of cultural practices and by a researcher in evolving suitable crop varieties.

Agricultural climatologist and plant scientist are interested in the probabilities of periods with little or no rain which lead to plant injury. Dec-ker (1957) suggested that the knowledge

of the seasonal variation in the expectancy of dry periods should assist the agricultural producer in planning production so that the critical periods of crop do not occur when there is a high dry period expectancy. Feyerherm and Den Bark (1964) derived initial and transitional probabilities of sequence of wet and dry days in Kansas. Ratnam *et al.* (1975) have observed that the frequency and the probabilities of dry spell might coincide with critical stages of the crop for the soil moisture resulting in adverse effect on the yields.

The day-to-day characterisation of moisture availability and then deriving the information on periods of moisture availability is useful not only from the point of view of crop growth, but also from the view point of breeding

*Paper based on the thesis submitted to GAU by the senior author in partial fulfilment of M.Sc. (Agri.) degree of Agricultural Meteorology.

1. Agronomist, All India Coordinated Research Project on Sugarcane, GAU, Navsari.

2. Professor of Agricultural Meteorology, GAU, Anand Campus, Anand.

for new varieties. With this view, an attempt is made to estimate the probability of moisture available periods to groundnut crop, which is a rainfed crop in the Saurashtra region of Gujarat State. One of the purposes of this study was to bring out weather-based information that could be of help to agricultural scientists particularly the plant breeder and the agronomist. Towards this end, the probabilities of moisture days have been worked out.

MATERIALS AND METHODS

Source of Data:

The temperature, rainfall, soil characteristics and plant characteristics data for Rajkot (lat. 22°. 18'N, long

70°. 47'E), Keshod (lat. 21°. 18'N, long 70° 15'E), Mahuwa (lat. 21°. 05'N, Long. 71°.47'E), Bhavnagar (lat. 21°. 45' N, long. 72°. 12' E) and Jamnagar (lat. 22°. 29'N, long. 70°. 04' E) were collected from India Meteorological Department, Poona, Director of Agriculture Gujarat State, Ahmedabad, the records of various trial-cum-demonstration farms situated in pertinent districts and the Oilseed Specialist, Junagadh, respectively for the period of 15 years (1960-74). Information regarding the duration of crop growth phases are given in Table 1 (based on personal communication from the Oilseed Specialist, Junagadh).

TABLE 1

Root depth at different phases of groundnut crop.

Sr. No.	Stage of plant growth	Bunch-type groundnut variety		Spreading type groundnut variety	
		Period, days	Root depth, cm	Period, days	Root depth, cm
1.	Germination and vegetative development	0-22	15	0-25	15
2	Flowring to pegging period	23-50	30	26-55	30
3	Full pegging to pod development	51-80	45	56-90	45
4	Maturity	81-100	60	91-110	60

Estimation of probabilities of moisture available days:

Water balance technique was used for working out the daily available soil moisture in which the potential evapotranspiration was considered as a major component of water loss in the water balance. Potential evapotranspiration was calculated by Thornthwaite (1948) formula and was adjusted for soil moisture storage. The number of moisture available days in each crop

growth stage for the bunch and the spreading type of groundnut varieties was worked out for all the stations. While calculating the daily soil moisture budget, the calculated value of the adjusted potential evapotranspiration was subtracted after correcting for the soil moisture storage from the total of soil moisture at the beginning of the day, whereas rainfall amount during the day was added. Excess of rainfall over field capacity was discarded as the combined loss in runoff,

percolation and deep drainage. (Carreker 1963, Lewin 1972). The day on which soil moisture storage reached a value greater than that held at permanent wilting percentage was considered as a moisture available day.

Probabilities of moisture available periods:

The growing periods in both the groundnut varieties were grouped in terms of number of days after sowing on week basis, in different crop growth stages. The growing periods, could, however, have been considered in terms of standard climatological weeks also. But the commencement of qualifying rain did not occur in the same standard

week throughout the 15-year period and hence it was deemed desirable to consider number of days after sowing. The total number of moisture available days was counted and their probabilities were determined by using the following relation:

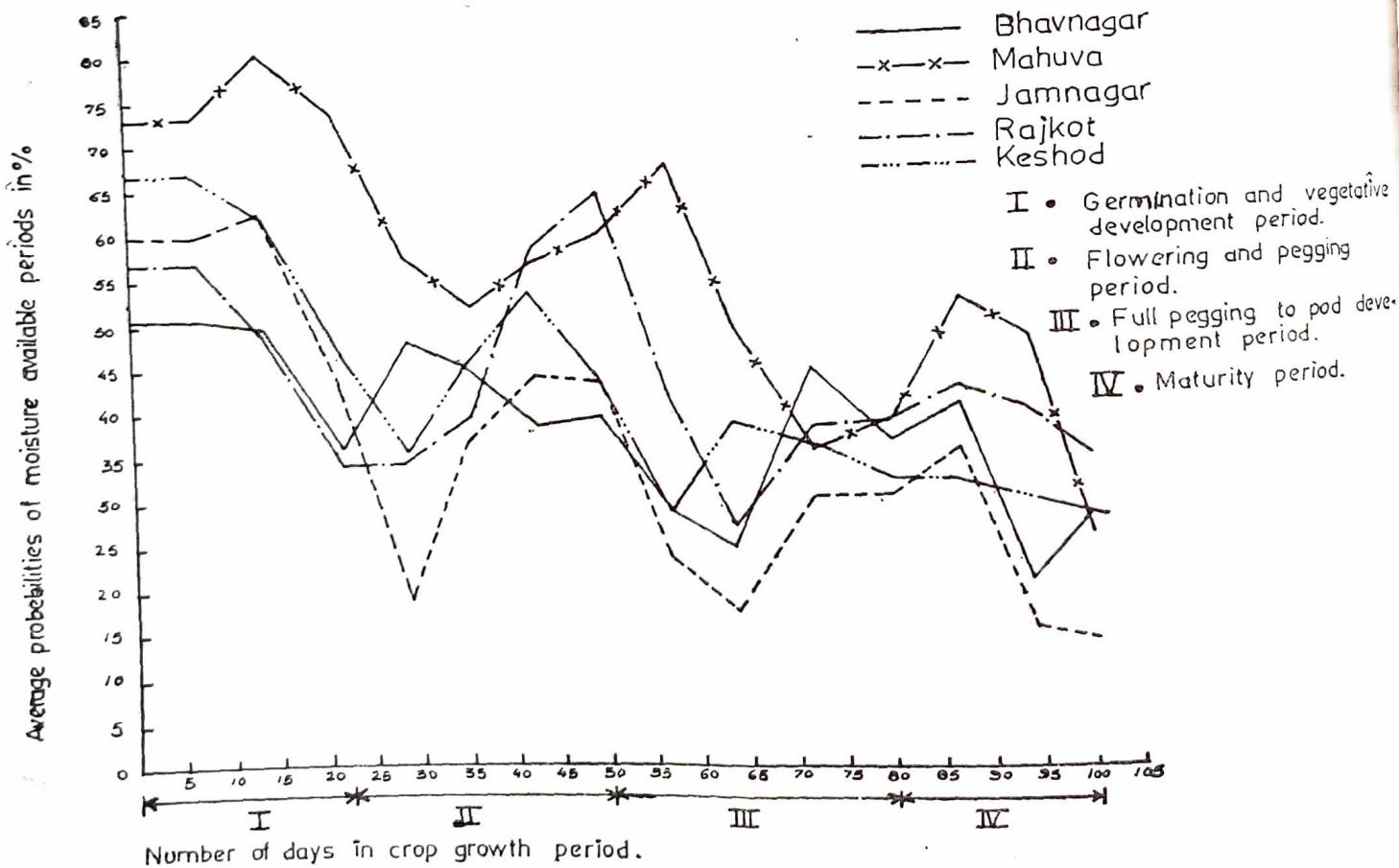
$$P_i = \frac{a_i}{n_i}$$

Where:

P_i = Probability of occurrence of moisture available days in the i th period.

a_i = Actual number of moisture available days in the i th period.

COMPARISON OF AVERAGE PROBABILITIES OF MOISTURE AVAILABLE PERIOD FOR THE BUNCH TYPE VARIETY OF GROUNDNUT AT RAJKOT, KESHOD, MAHUWA, BHAVNAGAR AND JAMNAGAR STATIONS.



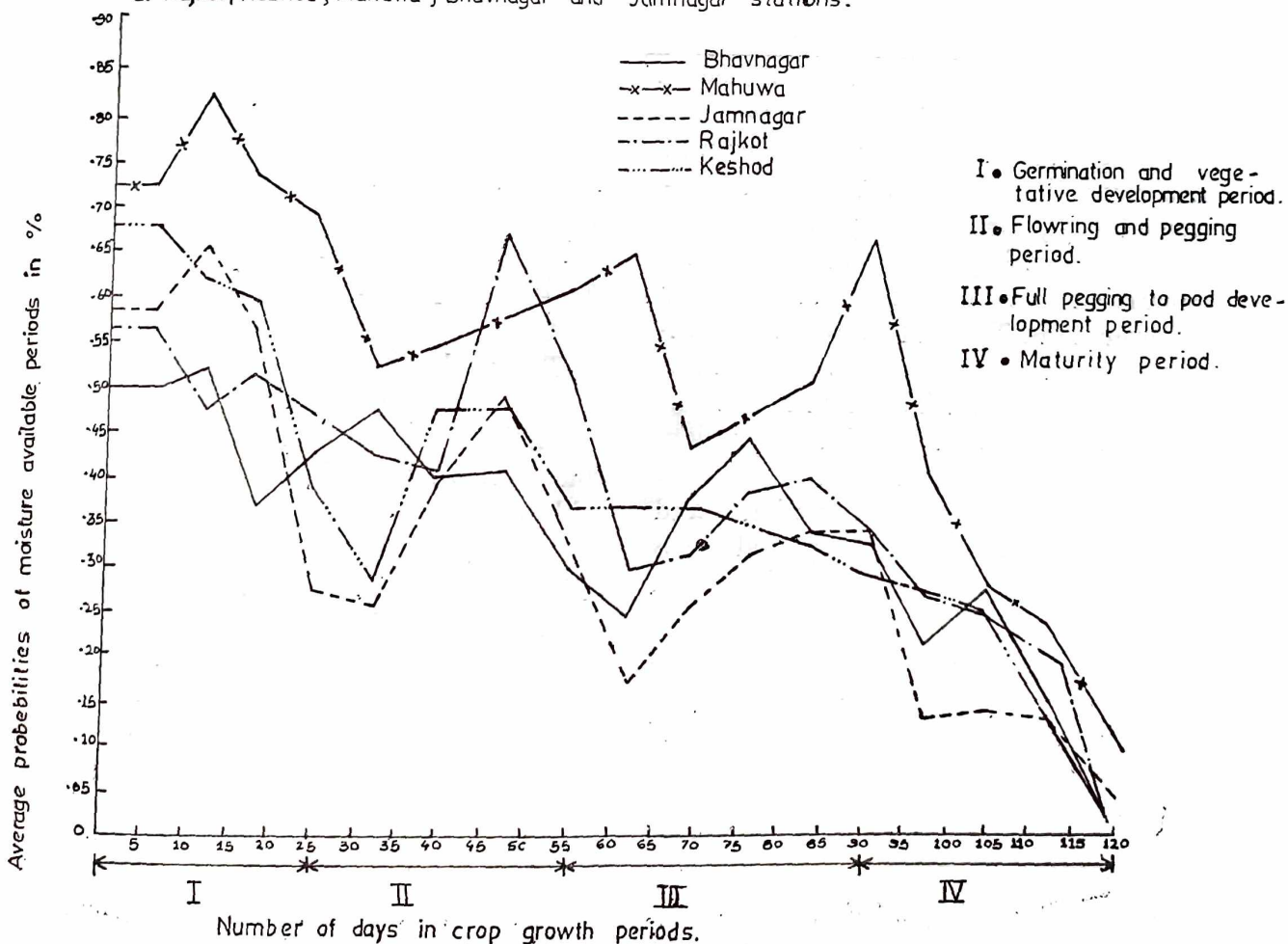
n_i = Possible number of moisture available days in the i th period. cent probabilities of encountering runs were determined.

The occurrence of runs of moisture available days, viz., one day, two day runs, three day runs etc. were determined in percentage on week basis for each station in different crop growth stages for the bunch variety of groundnut. On this basis, the sequential per

RESULTS AND DISCUSSION

The probability of moisture available days for each crop growth period in the bunch and the spreading varieties of groundnut were partitioned in approximately weekly period and were plotted respectively in fig. 1 and 2.

Comparison of average probabilities of moisture available periods for the spreading type variety of groundnut at Rajkot, Keshod, Mahuva, Bhavnagar and Jamnagar stations.



The per cent probability of getting moisture available days was more at Mahuva station throughout the whole period of crop growth. In this respect Mahuva is followed by Keshod, Rajkot,

Bhavnagar and Jamnagar stations in order.

Comparative figures for the range of probabilities at the different stations for the bunch and the spreading varie-

TABLE 2

Range of per cent probabilities of moisture available days in the bunch and the spreading variety of groundnut at various stations in each growth period.

Station	Range of per cent probabilities of moisture available days during various crop growth periods.									
	Germination and vegetative development period		Flowering and pegging period		Full pegging to pod development period		Maturity period		Total crop growth periods	
	B	S	B	S	B	S	B	S	B	S
Rajkot	34-57	22-57	34-64	41-67	27-41	30-40	34-42	1-28	27-64	1-67
Keshod	47-67	39-68	36-53	29-48	29-39	30-37	29-32	10-27	29-67	10-68
Mahuwa	72-80	69-82	51-59	52-61	35-67	50-67	25-51	12-41	22-80	12-80
Bhavnagar	36-50	37-52	38-48	30-48	25-44	25-45	21-40	0-28	21-50	0-52
Jamnagar	43-68	28-65	18-44	26-49	17-30	17-34	14-35	4-14	14-63	4-63

—B refers to the bunch variety of groundnut.

—S refers to the spreading variety of groundnut.

ties of groundnut were worked out and are given in Table 2. The figure revealed that, for all the phases for the spreading variety, the range is wider compared to that for the bunch variety of groundnut. This indicates that spreading groundnut which is a long duration variety would be less suited in this area as compared to bunch variety which is of short duration. Moreover, the range for the germination and vegetative development period was maximum followed by flowering and pegging period, full pegging to pod development and the maturity period in sequence. This showed that sowing should possibly be carried out as early as possible with the commencement of qualifying rains. Further delay in sowing would possibly result in lower probabilities of moisture available days in the total crop growth period.

It is also evident from the Table 2 that, in both the groundnut varieties, the per cent probabilities of moisture available days were low during full pegging to pod development period, which showed that in this stage, there

were more chances for the crop to suffer on account of moisture stress, which ultimately would be reflected on final yield of the crop. Similar findings have also been reported by Ratnam *et al.* (1975).

The probabilities of runs of occurrence of moisture available days at all the stations for the bunch variety of groundnut on week basis are given in Table 3.

On an average, at all the stations during 51 to 64 day period after sowing i.e. during the first two weeks of the period of the full pegging to pod development, the probabilities of runs of occurrence of 5 or more moisture available days were found to be less than 30%. This meant that the crop would suffer in this period for want of sufficient availability of soil moisture and ultimately this would affect the yield of the crop.

Secondly, on an average, at all the stations except at Mahuwa, the probabilities of occurrence of runs of more than 3 consecutive moisture available days were found to be relatively

TABLE 3

Per cent probabilities of runs of occurrence of moisture available periods in the growing season of the bunch variety of groundnut at Rajkot, Keshod, Mahuwa, Bhavnagar and Jamnagar Stations (1969-74)

Station	Runs of moisture available periods in days	Per cent probabilities of runs of occurrence of moisture available periods at different crop growth phases													
		Germination and vegetative development period		Flowering and pegging periods		Full pegging to pod development period		Maturity period							
No. of days after sowing															
		1-7	8-14	15-22	23-29	30-36	37-43	44-50	51-57	58-64	65-72	73-80	81-87	88-94	95-100
Rajkot	1	57	49	34	34	39	58	64	41	27	37	38	42	39	34
	2	48	41	29	28	37	52	61	38	25	34	36	37	37	31
	3	44	35	25	23	36	47	59	35	24	32	33	33	35	28
	4	42	30	21	18	35	43	57	32	23	29	33	32	32	27
	5	38	24	17	13	33	40	53	29	22	25	33	29	27	23
	6	30	17	15	13	33	40	50	27	20	20	33	27	20	20
	7	20	13	13	13	33	40	47	27	20	17	33	27	13	—
	8	—	—	13	—	—	—	—	—	—	13	33	—	—	—
Keshod	1	67	62	47	36	46	53	43	29	38	36	32	32	30	29
	2	65	58	43	31	42	49	38	26	37	33	30	27	27	27
	3	63	56	39	27	37	46	33	24	36	30	27	24	26	23
	4	57	54	36	23	36	43	30	21	34	27	24	20	25	19
	5	52	50	32	21	33	38	29	21	33	27	21	17	24	14
	6	43	43	29	21	32	36	25	21	31	26	21	14	21	14
	7	7	43	29	21	29	36	21	21	29	25	21	14	21	—
	8	—	—	9	—	—	—	—	—	—	—	21	—	—	—

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mahuwa	1	73	80	72	57	51	50	59	67	49	35	37	51	47	25
	2	67	77	70	52	49	50	58	65	47	32	36	48	43	21
	3	59	73	69	47	41	49	57	64	44	30	35	45	41	18
	4	52	70	68	43	45	47	57	63	42	28	35	43	38	15
	5	44	67	67	38	42	42	55	62	38	28	33	42	35	13
	6	37	63	64	33	37	33	53	60	33	27	31	40	33	13
	7	27	60	63	33	33	33	47	53	33	27	27	27	33	—
	8	—	—	60	—	—	—	—	—	—	27	27	—	—	—
Bhavnagar	1	50	49	36	48	45	38	39	29	25	44	36	40	21	28
	2	41	43	25	43	40	32	37	23	22	42	37	38	19	27
	3	35	39	18	41	36	28	35	20	20	39	28	35	19	25
	4	27	35	12	40	33	23	33	17	17	37	24	33	17	22
	5	20	31	10	38	29	22	47	13	13	37	22	31	20	20
	6	17	27	9	37	23	20	27	10	13	35	20	27	17	13
	7	13	27	7	33	20	20	13	7	13	33	20	27	13	—
	8	—	—	—	—	—	—	—	—	—	33	20	—	—	—
Jamnagar	1	60	63	43	18	37	44	43	24	17	30	30	35	21	14
	2	54	58	41	15	33	42	39	23	15	29	28	34	19	13
	3	51	53	39	10	32	40	36	23	13	28	25	33	16	13
	4	42	45	36	9	32	40	32	22	13	27	24	33	15	13
	5	35	47	32	7	31	40	27	20	13	24	22	33	10	13
	6	23	47	27	7	30	40	23	20	13	24	22	33	10	—
	7	7	47	27	0	27	40	20	20	13	23	20	33	7	—
	8	—	—	27	—	—	—	—	—	—	20	20	—	—	—

low. This information would be helpful to the research worker in planning out supplemental irrigation.

According to the probabilities of occurrence of runs of moisture available days (Table 3), the probabilities at Mahuwa station remained high as compared to those at the rest of the stations. The stations under study ranked in this respect, in the order Mahuwa, Keshod, Rajkot, Bhavnagar and Jamnagar.

REFERENCES

- Carreker, J. R., 1963. The Relation of solar radiation to evapotranspiration from Cotton, *J. Geophy. Res.* **68** (16): 4731-41.
- Decker, W. L., 1957. The likelihood of extended dry periods in Northeast Missouri.

Bull. America Meteorological Society, **38** (10): 615-17.

Feyerherm, A. M. and L. D. Bark, 1964. Probabilities sequences of wet and dry days in Kansas. North Central Regional Research Publication 161. Tech. Bull. 139 a, Agricultural Experimental Station, Kansas.

Lewin, J. 1972. A simple soil, water simulation model for assessing the irrigation requirement of wheat, *Israel J. Agri. Res.* **22** (4) : 201-214.

Ratnam, B. P., D. M. Hegde and S. N. Joshi. 1975. Frequency and probability of dry spell at Dharwar, *Annals Arid Zone*, **14** (3) : 201-5.

Thronthwaite, C. W., 1948. An approach toward a rational classification of climate. *Rev.* **38** : 55-94.