AN OVERVIEW OF UPLAND RICE RESEARCH

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FAVORABLE RAINFALL PERIODS IN UPLAND RICE REGIONS OF BRAZIL

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Upland rice cultivation which is of great economic and social importance to Brazil, represents about 60% of the total rice production of 8 million t/yr. Variable rainfall distribution, especially dry spells (veranicos), affects the crop negatively during the reproductive period. Upland rice is the second most risky crop in the country.

The Brazilian national upland rice research program (EMBRAPA 1981) recognizes two types of production in terms of risk: favorable and unfavorable. One aim Of this program is to accurately define favorable and unfavorable regions in order that research and development strategies may be designed for them.

Although a few maps show climatic areas suitable for rice based on monthly and annual average data, we require more precision (Camargo et al 1977).

This study compares favorable rainfall periods in several upland rice production regions. We will use the term favorable period when there is a 66% probability of more than 50 mm of rain in 10 days. This will make the comparison between stations easier. The same level sufficiently approximates the potential evapotranspiration of the localities Compared (Hargreaves et al 1979). Although 50 mm is a high level of demand, we chose it because dry spells often occur during the reproductive stage, when water demand and the potential for damage are highest. The 66% probability of success is a reasonable limit for upland rice.

We believe this preliminary study can begin to provide

- a methodology to use for zoning,
- rainfall distribution characteristics for favorable and unfavorable regions, and
- a potential varietal cycle and sowing date,

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METHOD

Computing rainfall probabilities and favorable periods

We concur with others (Thom 1958, Gigou 1973, Hargreaves 1973) that for short periods, rainfall probability follows the law of distribution of the incomplete gamma function. Newton's approximation method computed its parameters (Thom 1958). Therefore, for each calendar period, we adjusted the rainfall observed. We used Campo Maior data to compare real and estimated probabilities and found a correlation coefficient of 0.91 for 36 periods during the rainy season.

We plotted the distribution of the rainfall probability of >50 mm for 10-day periods with an increment of 5 days for 7 mo overlapping the growing season and then analyzed the graph to determine the favorable periods.

Rainfall stations

The stations we chose have at least 25 yr of daily rainfall observations and are in upland rice production regions. In western Brazil, however, few stations are that old and they cannot provide the daily data.

We checked the reliability of rainfall stations by comparing their annual rainfall data with others in the region and eventually selected 20 stations (Table 1).

Table 1. Stations studied for their rainfall frequency distribution.

Name	State	Latitude (S)	Longitude (W)	Altitude (m)	Number of years of data
Camp Maior	Piaui	4.49	42.11	125	47
Teresina	Piaui	5.05	42.49	74	40
Grajau	Maranhao	5.49	46.08	163	25
Carolina	Maranhao	7.20	47.28	193	29
Conc. do Araguaia	Para	8.16	49.17	150	27
Porto Nacional	Goias	10.43	48.25	237	28
Goiás	Goias	15.55	50.88	495	27
Caceres	Mato Grosso	16.04	57.41	118	26
Inhumas	Goias	16.81	49.30	800	29
Goiânia	Goias	16.41	49.16	729	27
Estrela do Sul	Minas Gerais	18.45	47.41	461	34
Tapirai	Minas Gerais	19.53	46.01	610	38
Terra Roxa	Sao Paulo	20.00	48.00	478	31
Aquidauana	Mato G. do Sul	20.28	55.48	207	28
Jaguariuna	Sao Paulo	22.42	47.00	–	34
Usina Rasgao	Sao Paulo	23.23	47.02	650	48
Buri	Sao Paulo	23.48	48.35	563	38
Santa Clara (Guarapuava)	Parana	23.38	51.58	740	28
Sao Mateus do Sul	Parana	25.52	50.23	760	42
Capinzal	Santa Catarina	27.21	51.37	447	27

Ways of comparison

We sampled the stations and compared them on an east-west, north-south axis and in the cerrados region. This grouping allowed better visualization of the variability.

RESULTS

East-west variation in three Northeast Brazilian states

We compared four stations between 5°S and 8°S latitude. The easternmost is Campo Maior, longitude 42°W, and farther west is Conceição do Araguaia, longitude 49°W (Fig. 1).

Between these limits, moving westward, the favorable periods tend to lengthen the season but not always. Season length can even decrease, as in Carolina.

Variation from north to south in Central Brazil

To clarify variations in the number of favorable periods from North to South, we selected six stations between 47°W and 51°W. The northernmost is Conceição do Araguaia and the southernmost is Santa Clara (Guarapuava) in Paranā (Fig. 2).

There is no favorable period in Santa Clara although it rains from October to April. But during the whole season the probability of having >50 mm/10 days is less than 50%.

In between, from north to south, the number of favorable periods decreases, even if there are some irregularities as in Porto National. Although this station is farther north than Goiânia, it has fewer periods.

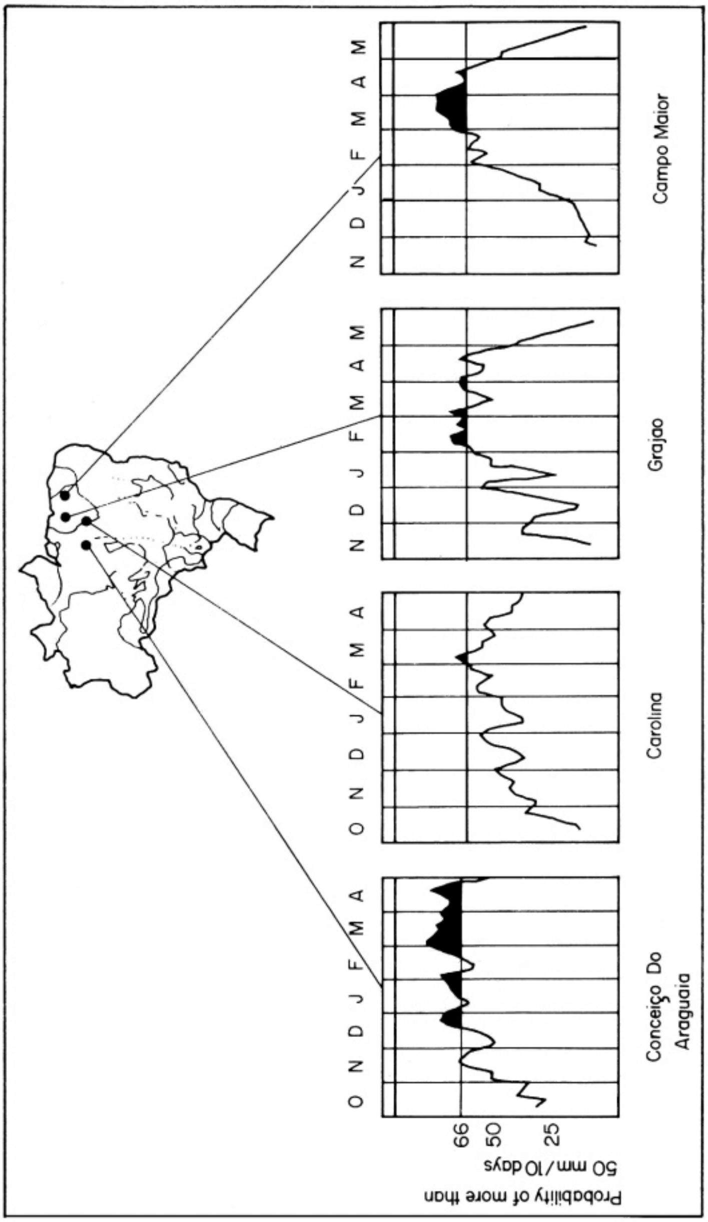
Variations in the cerrados

In the central cerrados region, which grows more than half of Brazil's upland rice, vegetation is savannah-type.

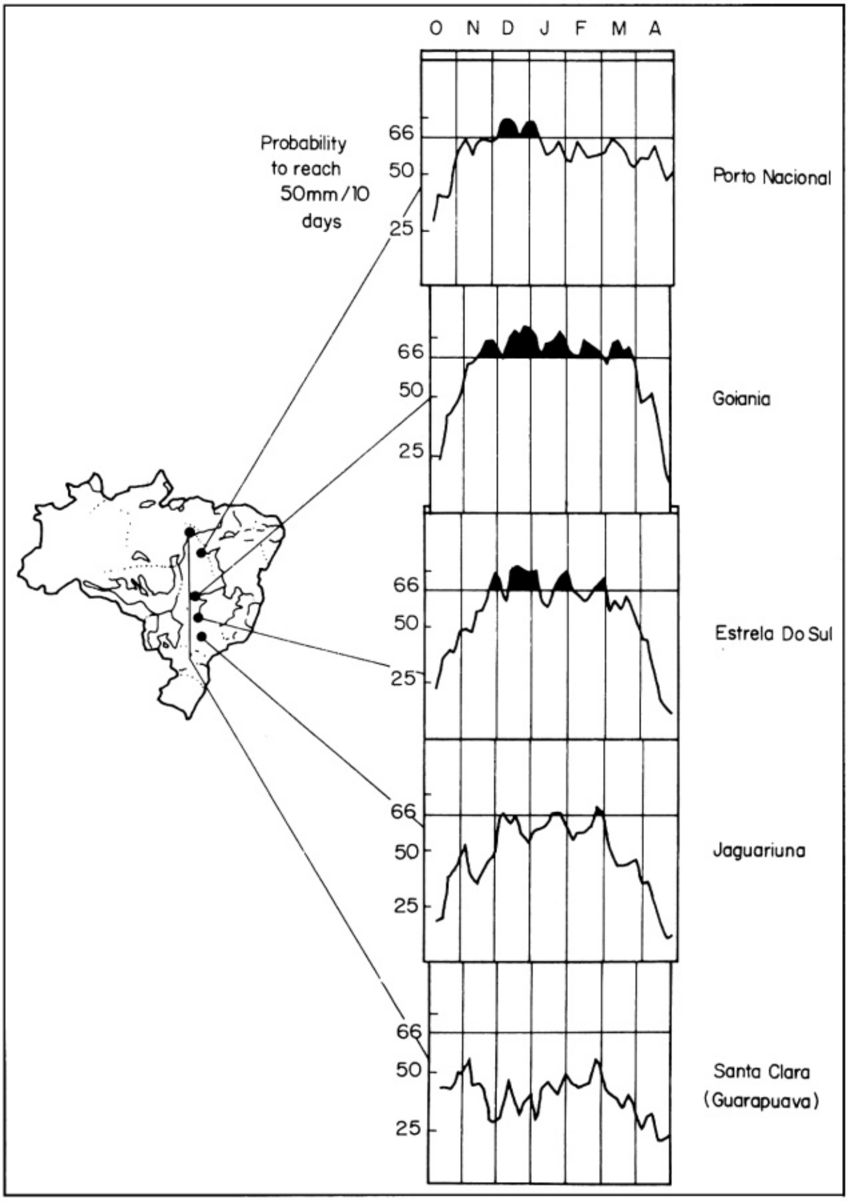
Most stations in Figures 1 and 2 are in the cerrados. As we observed variations inside the region, we saw another pattern which we did not try to identify. For example, both Caceres, a station in the western part, and Aquidauana in the southwest, have favorable periods from mid-December to late February. But Goiás, similar to Goiânia, and Tapirai, slmilar to Estrela do Sul, follow the variation pattern already described (Fig. 3).

DISCUSSION

The distribution of the probability of >50 mm/10 days varies among the stations compared. The number and



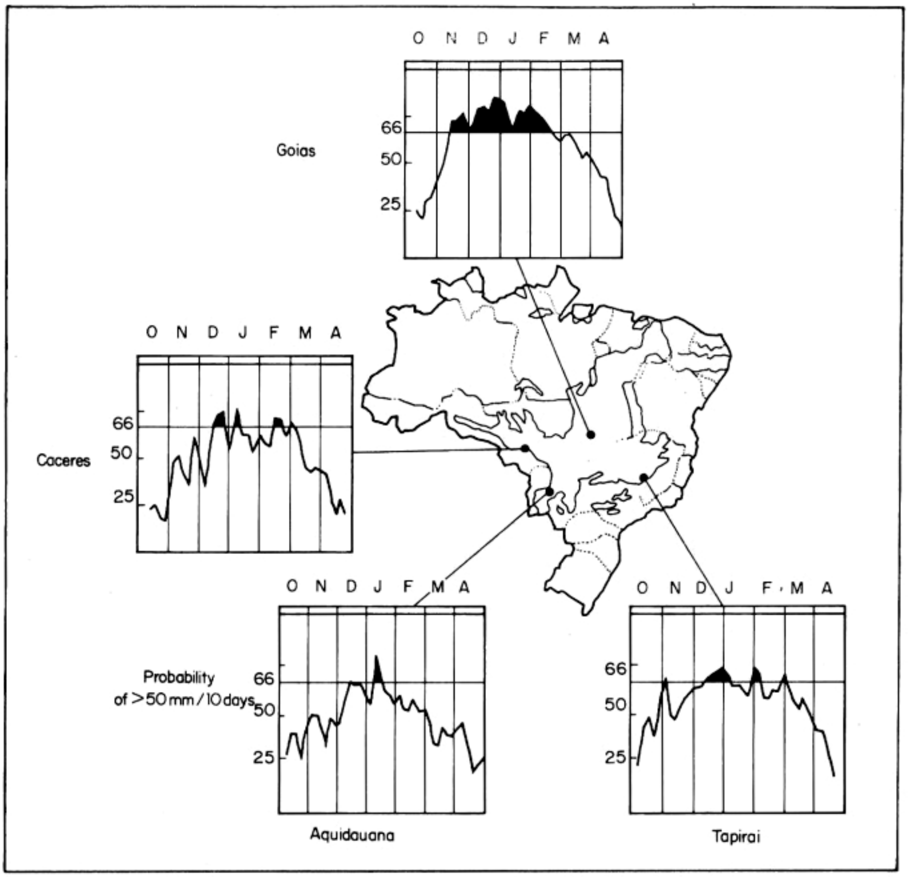
1. East-West variations in Brazilian states of the probability to reach 50 mm/10 days during the growing period of upland rice. Periods are 10 days with increments of 5 days. Dashed periods are favorable for upland rice.



2. North-South variations in Brazilian states of the probability to reach 50 mm/10 days during the growing period of upland rice. Periods are 10 days with increments of 5 days. Dashed periods are favorable for upland rice.

sequence of favorable periods also vary. Because of the low number of stations in this study, it is impossible to define favorable and unfavorable regions.

The southern part of the upland rice area (Aquidauana or Guarapuava station of Santa Clara) has fewey favorable periods than the northern areas (Coiania or Conceicão do Araguaia) .



3. Variations in the Brazilian cerrados of the probability to reach 50 mm/10 days during the growing period of upland rice. Periods are 10 days with increments of 5 days. Dashed periods are favorable for upland rice.

This method of comparing rainfall regimes allows us to evaluate the suitability of the area for growing rice. We could nof do this using monthly rainfall data. For example, Goiańia seems more favorable than Carolina or Porto Nacional, but comparison of the monthly rainfall data indicates the opposite.

The distribution probabilities of the two stations (Table 1) in ,the states of Paranā and Santa Catarina in the south, are of the same type as that in Guarapuava (Fig. 2). With practically no favorable period, this region has a very high climatic risk. Because upland rice production in this region is important, we should look for an explanation.

This methodology defines the most appropriate varietal cycle for a region. For example, Carolina or Jaguariuna stations should use short-duration varieties of about 100 days. With a longer rainfall season, the choice of variety duration will also depend on the best planting time. To choose this, we can also use frequency distribution to minimize the risk of having a dry spell during the reproductive phase.

CONCLUSION

The use of rainfall distribution frequency to compare 20 climatic stations in upland rice production regions of Brazil permits us to define favorable and unfavorable regions for this crop. The data confirm the assumptions of the national upland rice research program.

The rainfall frequency approach for short periods will be an efficient tool in defining favorable climatic zones for upland rice. However, evapotranspiration and soil water-holding capacity need more accurate estimation.

We can also apply this principle in crop management to help choose varieties with long or short duration, planting times, or any other agronomic techniques that depend on rainfall regime.

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