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M W. Perry

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Grain moisture and the weather—What can the records tell us?

"Season very extraordinary, has never been known here before in the memory of the oldest inhabitants, abundance of grass, all crops spoilt, practically no good wheat, hay all discoloured. Stock all fat."


By M. W. Perry, Research Officer, Plant Research Division, and P. A. Fievez, Adviser, Wheat and Sheep Division

The above quotation illustrates well that feature of the weather known so well to every farmer—its inevitable variability. It will, perhaps, sound even more familiar to primary producers south of the Stirling Ranges and east to Bremer Bay, where summer rain, although generally still insufficient for crop growth, has proven a major hazard.

Fig. 1—Annual rainfall.
Locations of rainfall recording stations and mean annual rainfall isohyets (mm). (1 in. is equivalent to 25.4 mm).
The expansion of cereal production in areas along the south coast has exposed harvesting problems associated with high grain moisture. A grain delivery standard of 12 per cent moisture means that, in the absence of grain drying facilities, harvesting times in the field are restricted to those hours when grain moisture falls below this figure.

Areas that normally experience moist summers also have problems with the quality of stubbles and dry pastures. Weather staining of barley is most severe in coastal areas receiving greater than 400 mm annually and has been associated with rainfall during grain ripening.

Grain moisture, however, remains the major problem and for planning purposes, producers require an estimate of the harvesting time available in a given year. This will depend on all the climatic variables which affect grain moisture. These include rainfall and dew which deposit water directly onto the ear, and more importantly the relative humidity of the atmosphere.

We are unable, at present, to give estimates of the likely number of harvesting hours but work is proceeding toward this end. In this article we discuss the patterns of rainfall and their possible consequences. Another article in this issue describes research in progress on relative humidity and grain moisture.

**Methods**

Our knowledge of the weather and our ability to predict future weather is based on experience. Daily weather forecasts base their predictions on the current state of the atmosphere and are, in general, relatively accurate over 24 to 48 hours. Over longer periods, however, we must fall back on historic weather records which allow us to predict the future from past events. Although inferior to daily forecasts in the short term, they allow us some insight into likely weather conditions at a particular location and time of year.

Table 1 lists the mean monthly and annual rainfall for the sites examined in this article, and Figure 1 gives the locations of the stations and the annual rainfall isohyets.

Mean rainfall figures, however, are only one side of the rainfall story. What is more important in considering weather patterns is the likelihood (or probability) of receiving a particular amount of rain in a certain period. Rainfall probabilities were calculated for the sites listed in Table 1 and the maps below have been prepared from these figures. (See Figs. 2 and 3.)

The number of wet days within a given period bears a general relationship to the amount of rain received. However, further interesting conclusions may be reached by examining the frequency of "rain-days" (Fig. 4).

**Discussion**

**Patterns of annual and seasonal rainfall**

Rainfall isohyets are shown in Figure 1. Annual rainfall varies from about 400 mm (16 in.) along the northern border to more than 1 000 mm (40 in.) in the extreme southwest of the region. Isohyets trend northwest to southeast but become roughly parallel to the coast over most of the region. West of Hopetoun, the 400 mm isohyet reaches within a few kilometres of the coast.

The centres of Amelup, Moana and Borden lie within the rainshadow of the Stirling Ranges and receive an annual rainfall somewhat less than other centres an equivalent distance inland. The Ravensthorpe hills also affect rainfall patterns, causing slightly higher than expected rainfall in the vicinity of Ravensthorpe. Local effects of

**Table 1—Mean monthly and annual rainfall and the standard deviation of the yearly total**

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topography will be evident in other areas but because of lack of recording stations may not show on regional rainfall maps.

As well as the mean monthly and annual rainfalls, Table 1 lists the standard deviation (SD) of the yearly total. The standard deviation is a measure of the variability of the recorded annual rainfall around the mean figure; about 68 per cent of all yearly totals fall within the range of the mean annual rainfall, plus or minus the SD.

For example, in 68 years out of 100 (nearly seven years in ten), Jerramungup (annual rainfall 394 mm, SD 81) will receive annual rainfall between 313 mm (394 — 81) and 475 mm (394 + 81). The range encompassing the mean plus or minus twice the standard deviation will include rainfalls expected in 95 of every 100 years.

Table 1 shows that although mean annual rainfall increases by nearly three times between the driest (Kaybalup 373 mm) and wettest (Albany 953 mm) centres, rainfall over the summer months is relatively uniform over the entire region, irrespective of position and mean annual rainfall. Variation in annual total is thus due to the large difference in the amount of winter rain.

Rainfall probabilities
The probability or likelihood of occurrence of an event is generally expressed as a figure between zero and one. A likelihood of occurrence of one year in ten would be expressed as 0.1, and of between six and seven years in ten as 0.65, and so on. Thus, in Figure 2a, a probability of 0.7 indicates that December rainfall will exceed 12.7 mm (50 points) in seven years in ten.

Figures 2a, b and c show the probabilities of rainfall exceeding 12.7 mm (50 points) for the months of December, January and February when most harvesting takes place.

As expected, probability lines follow a pattern similar to the annual rainfall isohyets. Rainfall probabilities are higher along the coast and in the southwest but do not decrease greatly inland. Jerramungup, for example, has a probability of 0.5 of exceeding 12.7 mm (50 points) rainfall in January. Thus, five years in ten will exceed 12.7 mm.

January is the driest month and probability of exceeding 12.7 mm are never higher than 0.5 except in the extreme southwest of the region. Probabilities are marginally higher in February, but still below the December figures. Figures 3a, b and c give the probabilities of monthly rainfall exceeding 25.4 mm (100 points) for the same months. Probabilities are lower, but even for the driest month (January); on average the region will receive 25.4 mm or more at least two years in ten.

Rainday probabilities
Figures 4a, b and c illustrate the likelihood or receiving seven or more "rain-days" in the months December-February. (A rain-day is a day when 0.25 mm (1 point) or more rain is recorded.)

Comparison with Figures 2 and 3 demonstrates the marked gradient in rain-day probabilities from the coast inland. This is in sharp contrast to the relatively uniform rainfall probabilities previously discussed. Thus, coastal and inland centres receive similar amounts of summer rain but coastal centres tend to receive it spread over many more rain-days.

It is difficult to predict the effects of traces of rain on grain moisture levels, but one can assume that a rain-day will be unsuitable for harvesting. Rain-days are usually associated with increased and prolonged cloud cover, lower temperatures, higher humidities and consequently higher grain moisture.

Coastal areas with more summer rain-days than inland areas can therefore expect bigger harvesting problems.

Conclusions
In the short term, future weather events may be at variance with predictions based on long-term records. Nevertheless, farming enterprises are normally long-lived and must come to terms with the climatic environment in which they operate.

In the long term, cropping enterprises must take account of likely limitations due to the restricted harvesting period. Strategies available include smaller crop areas, greater harvesting capacity and grain drying facilities, but all of these depend upon some estimate of the likely (most probable) period available for harvest.

Work is progressing towards combining rainfall analyses and relative humidity records so that the most probable number of harvesting hours can be estimated. In the interim, some conclusions drawn from the present study will help producers to understand the environment they confront and perhaps help them plan their operations:

- Unlike the winter rainfall, summer rain is relatively uniform over the entire region.
- January is the driest month, but on average the region will receive more than 12.7 mm in four to five years in ten and more than 25.4 mm in at least two years in ten in this month.
- The expected number of rain-days varies markedly over the region. For January, one year in three will have seven or more rain-days along the coast, but further inland only one year in ten will receive this number.

Individual producers, with their own knowledge of past weather patterns and harvesting difficulties, may wish to work out rainfall and rain-day probabilities for other months and other rainfall totals. These figures can be obtained from the authors.

However, grain moisture remains a complex problem and only a combined knowledge of rainfall, relative humidity and other weather phenomena will allow usable predictions of harvesting time.
Fig. 2—The probability of monthly rainfall exceeding 12.7 mm (50 pts)

(a) December

(b) January

(c) February

Fig. 3—The probability of monthly rainfall exceeding 25.4 mm (100 pts)

(a) December

(b) January

(c) February
FOOTSCALD NOW A SEPARATE STOCK DISEASE

Benign footrot, a mild disease of the feet of sheep and cattle, will be known as footscald under new Department of Agriculture policy as from April, 1974.

No action will be taken over footscald under the footrot section of the Stock Disease (Regulations) Act.

Quarantine restrictions will continue to apply to a flock while there is any suspicion whatever that footrot is present in the sheep.

If the disease proves to be footscald the flock will be released from quarantine and the owner advised about control methods. Where footrot (which causes severe foot damage) is confirmed the eradication of the disease will be supervised and quarantine restrictions lifted only when it is certain that footrot has been eradicated.

Fewer than 20 flocks will remain in quarantine under the new policy. Inspectorial staff released from the arduous task of detecting, controlling and eradicating footscald will have more time to work on the detection and eradication of footrot.

The change in policy follows a close study of footscald which showed it to be a separate disease from footrot.

Footscald causes minor damage to the foot and there is no evidence that damage becomes severe as with typical footrot. While affected sheep can be lame there is little, if any, effect on production. Footscald may disappear completely from a flock during the summer and not reappear in the next spring.

In cattle the disease damages the feet and can result in lameness. It tends to persist during the summer. Cattle can infect sheep when they are run together during the spring. The disease is relatively common in cattle in the South-West and is difficult to detect and eradicate.

Footrot is still regarded as a serious disease and sheep owners are required to report lame sheep suspected of having footrot to their nearest stock inspector.

The incidence of footrot is low, with all quarantined flocks now in the South-West high rainfall area. This position is a result of an eradication programme started in the early 1950’s. Every effort will be made to achieve the aim of complete eradication of footrot.

The recognition of footrot and footscald as separate diseases followed research at Manjimup Research Station which began in 1967.