Summer and autumn rainfall in relation to epidemics of wheat stem rust in Western Australia

W A. Shipton
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SUMMER AND AUTUMN RAINFALL IN RELATION TO EPIDEMICS OF WHEAT STEM RUST IN WESTERN AUSTRALIA

By W. A. SHIPTON, Ph.D., Plant Pathologist

High summer and autumn rainfalls, followed by rust infection of volunteer plants and favourable conditions during late winter and spring, lead to rust epidemics.

WIDESPREAD outbreaks of wheat stem rust are rare in Western Australia.

Stem rust is not usually detected until September or October when ideal weather conditions for rust development are prevalent. However, these ideal conditions seldom persist for a sufficient period for rust development to be of much consequence.

The detection of rust in autumn and winter is usually regarded as serious as it indicates that rust development and spread may commence much earlier in the season, with the consequent possibility of serious crop losses.

Five major rust epidemics have been recorded in the State, namely, in 1915, 1917, 1934 and 1943 (Cass Smith, 1948), and in 1963. Localised outbreaks of stem rust may, however, cause serious damage to crops in years when the incidence of the disease is low. These outbreaks may be restricted to one or two farms or may be spread over a much wider area, as occurred at Esperance in 1962.

In late March, 1960, stem rust was found on self-sown and out-of-season wheat at Borden. Above-average rainfall was recorded from October to January as shown in Table 1, making conditions ideal for seed germination and volunteer plant growth. Rust infection was evident on volunteer wheat and barley grass throughout the winter months, but the infection was apparently still restricted to the Borden area in early September. There is no evidence that rust spread to a great extent into other districts or that it was of serious consequence to crops at Borden.

The main source of rust inoculum in the State in 1960-61 appears to have originated in the Geraldton area. The apparent failure of the disease to reach epidemic proportions in the Borden area is thought to be principally due to the lower winter and early spring temperatures in the area compared with those normally experienced in the Geraldton and Esperance areas (Table 2), and also to the low rainfall in August (Table 1).

During the 1962 season a severe rust epidemic occurred in the Esperance area. Rust was first apparent on self-grown Gabo
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Table 1.—Influence of rainfall on rust outbreaks

Monthly rainfall in "rust" years compared with average monthly rainfall, for a number of centres. The asterisk marks the month when stem rust was first detected.

RAINFALL (points)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Borden</td>
<td>404</td>
<td>150</td>
<td>219</td>
<td>131</td>
<td>242</td>
<td>123</td>
<td>154</td>
<td>77</td>
<td>187</td>
<td>82</td>
</tr>
<tr>
<td>Esperance</td>
<td>106</td>
<td>234</td>
<td>51</td>
<td>167</td>
<td>164</td>
<td>83</td>
<td>162</td>
<td>132</td>
<td>169</td>
<td>136</td>
</tr>
<tr>
<td>Grass Patch</td>
<td>302</td>
<td>132</td>
<td>135</td>
<td>128</td>
<td>48</td>
<td>88</td>
<td>40</td>
<td>73</td>
<td>111</td>
<td>77</td>
</tr>
<tr>
<td>Northampton</td>
<td>66</td>
<td>168</td>
<td>149</td>
<td>97</td>
<td>13</td>
<td>35</td>
<td>140</td>
<td>22</td>
<td>140</td>
<td>35</td>
</tr>
<tr>
<td>Salmon Gums</td>
<td>197</td>
<td>121</td>
<td>88</td>
<td>111</td>
<td>8</td>
<td>79</td>
<td>213</td>
<td>78</td>
<td>117</td>
<td>78</td>
</tr>
</tbody>
</table>

Table 2.—Influence of temperature on rust outbreaks

Monthly temperatures in "rust" years compared with average monthly temperatures, for a number of centres.

AVERAGE MONTHLY TEMPERATURE (°F)

<table>
<thead>
<tr>
<th>Month</th>
<th>Katanning (1960); Esperance (1962)</th>
<th>Esperance (1963); Geraldton (1963)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Mean</td>
</tr>
<tr>
<td>January</td>
<td>66.7</td>
<td>71.1</td>
</tr>
<tr>
<td>February</td>
<td>70.4</td>
<td>70.8</td>
</tr>
<tr>
<td>March</td>
<td>64.3</td>
<td>67.0</td>
</tr>
<tr>
<td>April</td>
<td>57.4</td>
<td>61.8</td>
</tr>
<tr>
<td>May</td>
<td>52.3</td>
<td>55.6</td>
</tr>
<tr>
<td>June</td>
<td>50.5</td>
<td>51.7</td>
</tr>
<tr>
<td>July</td>
<td>48.4</td>
<td>49.9</td>
</tr>
<tr>
<td>August</td>
<td>49.1</td>
<td>50.7</td>
</tr>
<tr>
<td>September</td>
<td>52.6</td>
<td>53.9</td>
</tr>
<tr>
<td>October</td>
<td>58.2</td>
<td>57.3</td>
</tr>
<tr>
<td>November</td>
<td>60.8</td>
<td>63.9</td>
</tr>
<tr>
<td>December</td>
<td>69.6</td>
<td>68.3</td>
</tr>
</tbody>
</table>

* Nearest township to Borden where temperature is recorded.

wheat at Gibson in early July. A study of the rainfall figures shows that above-average rainfall fell in December, February, and March (Table 1), which was sufficient to enable volunteer wheat to grow. Surrounding districts showed a similar rainfall pattern, particularly in February. By mid September, rust was widespread in the area and spread slowly to the main wheat growing areas of the State, where it was present in trace amounts.

1963 Epidemic

The 1963 rust epidemic apparently began in both the Northampton and Esperance-Salmon Gums areas.

The 1962-63 rainfall figures show that...
Table 3.—Localities of origin of rust outbreaks

The first localities at which stem rust was detected in the years 1959-65, and the date on which the observations were made. Rust is considered to have originated at or near the localities given.

<table>
<thead>
<tr>
<th>Year</th>
<th>Localities where rust was first detected</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1959</td>
<td>Northampton</td>
<td>October 23*</td>
</tr>
<tr>
<td>1960</td>
<td>Indarra, North Tenindewa, Tardun</td>
<td>September 27</td>
</tr>
<tr>
<td>1960</td>
<td>Borden</td>
<td>March 25</td>
</tr>
<tr>
<td>1961</td>
<td>Carnarvon, Nabawa</td>
<td>September 25, 27</td>
</tr>
<tr>
<td>1961</td>
<td>Esperance</td>
<td>October 20</td>
</tr>
<tr>
<td>1962</td>
<td>Gibson</td>
<td>July 13</td>
</tr>
<tr>
<td>1963</td>
<td>Northampton</td>
<td>May 23</td>
</tr>
<tr>
<td>1963</td>
<td>Esperance, Salmon Gums, Scaddan</td>
<td>April 24</td>
</tr>
<tr>
<td>1964</td>
<td>Mingenew, Eradu</td>
<td>September 28–October 2</td>
</tr>
<tr>
<td>1965</td>
<td>Wongoondy</td>
<td>September 28</td>
</tr>
</tbody>
</table>

* Widespread at the time of detection.

at each locality where rust was found in the autumn the rainfall was abnormally high in January and February (Table 1). These rains were sufficient for volunteer wheat to flourish. Infected volunteer wheat was found at Northampton in late May and Esperance-Salmon Gums in early April.

From these two focal areas rust gradually spread and by late September it had been detected in most of the wheatbelt. In a normal season rust is still localised by late September.

It has been estimated that the loss in yield caused by the 1963 rust epidemic was in the vicinity of $20 million (Reeves, 1964).

Influence of Weather

It is clear from a study of weather records that the occurrence of unusually high summer and autumn rainfall alone does not ensure that a rust epidemic will occur. From the instance mentioned above it is also evident that an autumn build-up and winter carry-over of rust on volunteer plants need not mean that a spring epidemic will occur. As mentioned previously this failure was probably due to late winter and early spring conditions unfavourable to rust.

It would appear that the occurrence of high rainfalls, especially in January and/or February, as noted above, and in March, as noted by Cass Smith (1948), when followed by rust infection of volunteer plants and favourable late winter and spring conditions, leads to rust epidemics.

Table 3 shows that in a normal season rust is usually only evident by late September to early October. Rust most commonly originates in the Geraldton and Esperance areas.

Table 4.—Hosts of stem rust

A list of hosts, other than wheat, on which stem rust (Puccinia graminis tritici Erikss. & Henn.) has been found in Western Australia.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea wheat</td>
<td>Agropyron distichum Beauv.</td>
<td>Chambers (1960)</td>
</tr>
<tr>
<td>Swamp wallaby grass</td>
<td>Amphibromus neesii Steud.</td>
<td>Chambers (1960)</td>
</tr>
<tr>
<td>Sea barley grass</td>
<td>Hordeum hystrix Roth.</td>
<td>Chambers (1960)</td>
</tr>
<tr>
<td>Barley grass</td>
<td>H. leporinum Link</td>
<td>Mac Nish (1964)</td>
</tr>
<tr>
<td>Barley</td>
<td>H. vulgare L.</td>
<td>Chambers (1960)</td>
</tr>
<tr>
<td>Rye</td>
<td>Secale cereale L.</td>
<td>Chambers (1961)</td>
</tr>
</tbody>
</table>
Stem rust has, in most instances, been found to over-summer and to build-up in the autumn on volunteer wheat. However, a number of plants other than wheat are known to be hosts to stem rust in this State (Table 4), and could thus be of importance.

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