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Trends in wheat protein/yield relationships

By Graham Crosbie¹, Harry Fisher² and Bryan Whan³

The major concern of wheat breeders in Western Australia has been to increase grain yield while maintaining quality at an acceptable level. There has been no conscious effort to select for protein content. It is of interest, therefore, to compare the relationship between yield and protein of varieties which have been prominent in Western Australia at various times, to see what effects yield increases have had on protein content and the extent of any variation which might exist.

The relative yields of varieties have risen progressively from less than 90 per cent of Gamenya with the older varieties Bencubbin and Bungulla, to 110 per cent of Gamenya with Kulin, the most recently released variety (Table 1). This increase in yield appears to have had only a minimal effect on protein content. The total amount of protein taken up by the grain of varieties released in this period has actually risen steadily as indicated by their grain protein yields per hectare (the product of grain yield and protein content).

The release of some varieties has been accompanied by apparent increases in both yield and protein content, for example, Gabo over Bungulla, and Gamenya over Insignia. Kulin has a substantial improvement in both grain yield and grain protein yield over Gamenya, resulting in only a minor reduction in protein content. This is an important achievement, as there was no selection to raise or maintain protein content in the development of this variety.

There appears to be some variation in conventional varieties for protein accumulation that can be used in wheat breeding programmes. However, this variation is not great and can only be used in avoiding an excessive fall in protein content as grain yield is increased. Achieving substantial improvement in protein content depends on introducing new genes, specific for high protein, into our breeding material. This is discussed in "Increasing protein content of wheat by breeding" on page 132 of this Journal.

Acknowledgements
We thank Mr V. Martinek for compiling the data used in this study and Mrs J. Speijers who provided the statistical analyses.

Table 1. Protein/yield relationships in wheat varieties in trials from 1961/62 to 1985/86 (excluding 1963/64 when stem rust was prevalent)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Year of release</th>
<th>No. of trials</th>
<th>Grain yield</th>
<th>Grain protein</th>
<th>Grain protein yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bencubbin</td>
<td>1929</td>
<td>10</td>
<td>86.5 *</td>
<td>102.2 NS</td>
<td>88.0 NS</td>
</tr>
<tr>
<td>Bungulla</td>
<td>1939</td>
<td>75</td>
<td>88.1 **</td>
<td>96.0 **</td>
<td>84.8 **</td>
</tr>
<tr>
<td>Gabo</td>
<td>1945</td>
<td>31</td>
<td>92.7 ***</td>
<td>102.1 ***</td>
<td>94.6 **</td>
</tr>
<tr>
<td>Insignia</td>
<td>1946</td>
<td>132</td>
<td>93.4 ***</td>
<td>97.2 ***</td>
<td>90.4 ***</td>
</tr>
<tr>
<td>Gamenya</td>
<td>1960</td>
<td>83</td>
<td>100</td>
<td>98.1 ***</td>
<td>97.8 NS</td>
</tr>
<tr>
<td>Halberd</td>
<td>1969</td>
<td>204</td>
<td>99.9 NS</td>
<td>99.1 *</td>
<td>100.7 NS</td>
</tr>
<tr>
<td>Gutha</td>
<td>1983</td>
<td>86</td>
<td>101.6 NS</td>
<td>98.6 **</td>
<td>109.0 ***</td>
</tr>
<tr>
<td>Kulin</td>
<td>1986</td>
<td>204</td>
<td>110.7 ***</td>
<td>98.6 **</td>
<td></td>
</tr>
</tbody>
</table>

NS - not significantly different from Gamenya (100 per cent)
* , ** , *** - significantly different from Gamenya (100 per cent) at P<0.05, P<0.01, P<0.001 levels, respectively.

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