## Cereal Grain Development Stages

By Zadoks, Feekes And Haun

<table>
<thead>
<tr>
<th>Zadoks Scale</th>
<th>Powel Scale</th>
<th>Haun Scale</th>
<th>Description</th>
<th>Zadoks Scale</th>
<th>Powel Scale</th>
<th>Haun Scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Germination</td>
<td>40</td>
<td>Dry seed</td>
<td>8-9</td>
<td>Booting</td>
<td>10</td>
<td>Flag leaf sheath extending</td>
</tr>
<tr>
<td>01</td>
<td></td>
<td>41</td>
<td>Start of imbibition</td>
<td></td>
<td>Boots just swollen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td>45</td>
<td>Imbibition complete</td>
<td>9.2</td>
<td>Seed</td>
<td>Flag leaf sheath opening</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td>47</td>
<td>Radicle emerged from seed</td>
<td></td>
<td>First awns visible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td>49</td>
<td>Coleoptile emerged from seed</td>
<td>10.1</td>
<td>Inflorescence Emergence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>0.0</td>
<td>50</td>
<td>Leaf just at coleoptile tip</td>
<td>10.2</td>
<td>First spikelet of inflorescence visible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 1</td>
<td>Seedling growth</td>
<td>53</td>
<td>First leaf through coleoptile</td>
<td>10.2</td>
<td>1/4 of inflorescence emerged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 1.1</td>
<td></td>
<td>55</td>
<td>First leaf unfolded</td>
<td>10.3</td>
<td>1/2 of inflorescence emerged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 1.2</td>
<td></td>
<td>57</td>
<td>2 leaves unfolded</td>
<td>10.4</td>
<td>3/4 of inflorescence emerged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 2.2</td>
<td></td>
<td>59</td>
<td>3 leaves unfolded</td>
<td>10.5</td>
<td>Emergence of inflorescence completed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 2.3</td>
<td></td>
<td>60</td>
<td>4 leaves unfolded</td>
<td>10.51</td>
<td>11.4</td>
<td>Beginning of anthesis</td>
<td></td>
</tr>
<tr>
<td>15 3.3</td>
<td></td>
<td>65</td>
<td>5 leaves unfolded</td>
<td>11.5</td>
<td>Anthesis half-way</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 4.4</td>
<td></td>
<td>69</td>
<td>6 leaves unfolded</td>
<td>11.6</td>
<td>Anthesis complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 5.5</td>
<td></td>
<td></td>
<td>7 leaves unfolded</td>
<td></td>
<td>Milk development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 6.6</td>
<td></td>
<td></td>
<td>8 leaves unfolded</td>
<td></td>
<td>Kernel watery ripe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 7.7</td>
<td></td>
<td></td>
<td>9 or more leaves unfolded</td>
<td></td>
<td>Early milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 8.8</td>
<td>Tillering</td>
<td>70</td>
<td>Main shoot only</td>
<td>10.54</td>
<td>Medium milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 2</td>
<td></td>
<td>71</td>
<td>Main shoot and 1 tiller</td>
<td>12.1</td>
<td>Late milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22 2.2</td>
<td></td>
<td>73</td>
<td>Main shoot and 2 tillers</td>
<td>13.0</td>
<td>Dough development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23 3.3</td>
<td></td>
<td>75</td>
<td>Main shoot and 3 tillers</td>
<td>11.1</td>
<td>Early dough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 4.4</td>
<td></td>
<td>77</td>
<td>Main shoot and 4 tillers</td>
<td>14.0</td>
<td>Soft dough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 5.5</td>
<td></td>
<td>80</td>
<td>Main shoot and 5 tillers</td>
<td>15.0</td>
<td>Hard dough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 6.6</td>
<td></td>
<td>83</td>
<td>Main shoot and 6 tillers</td>
<td></td>
<td>Ripening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 7.7</td>
<td></td>
<td>85</td>
<td>Main shoot and 7 tillers</td>
<td></td>
<td>Kernel hard (difficult to divide by thumbnail)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 8.8</td>
<td></td>
<td>87</td>
<td>Main shoot and 8 tillers</td>
<td></td>
<td>Kernel loosening in daytime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 9.9</td>
<td></td>
<td>90</td>
<td>Main shoot and 9 or more tillers</td>
<td>11.3</td>
<td>Overripe, straw dead and collapsing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 4-5</td>
<td>Stem elongation</td>
<td>92</td>
<td>Pseudo stem erection</td>
<td>16.0</td>
<td>Seed dormant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 6</td>
<td></td>
<td>93</td>
<td>1st node detectable</td>
<td></td>
<td>Viable seed giving 50% germination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 7</td>
<td></td>
<td>94</td>
<td>2nd node detectable</td>
<td></td>
<td>Seed not dormant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td>95</td>
<td>3rd node detectable</td>
<td></td>
<td>Secondary dormancy induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td></td>
<td>96</td>
<td>4th node detectable</td>
<td></td>
<td>Secondary dormancy lost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td>5th node detectable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td>6th node detectable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 8</td>
<td></td>
<td></td>
<td>Flag leaf just visible</td>
<td>97</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 9</td>
<td></td>
<td></td>
<td>Flag leaf ligule/ collar just visible</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**The Haun scale stages used in this example from boot through ripening are based on a seven-leaf plant.**

Table 2. Cereal grain development stages by Zadoks, Feekes and Haun.