**Corn Kernel Development**

**What you need to know**
Learn more about what is happening inside corn kernels during the main growth stages of development.

**KERNEL GROWTH STAGES**

<table>
<thead>
<tr>
<th>Kernel growth stage</th>
<th>Days after silking</th>
<th>Approximate moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 Silking</td>
<td>0</td>
<td>n/a</td>
</tr>
<tr>
<td>R2 Blister stage</td>
<td>10-14</td>
<td>85%</td>
</tr>
<tr>
<td>R3 Milk stage</td>
<td>18-22</td>
<td>80%</td>
</tr>
<tr>
<td>R4 Dough stage</td>
<td>24-28</td>
<td>70%</td>
</tr>
<tr>
<td>R5 Dent stage</td>
<td>35-42</td>
<td>55%</td>
</tr>
<tr>
<td>R6 Maturity</td>
<td>55-65</td>
<td>30%</td>
</tr>
</tbody>
</table>

Nielsen R.L. 2001
R2 – Blister Stage
The kernel ovule has been pollinated and is beginning to grow by cell division. The kernel contains an embryo (tiny immature plant that will germinate once planted) and an endosperm that will provide the energy needed for the seed to germinate and emerge from the soil.

R3 & R4 – Milk and Dough Stages
The kernels are well into a period of rapid starch accumulation that happens when sugars made from photosynthesis in the leaves travel down to the kernel and are converted into starch. Cell division within the kernel (endosperm) is mostly complete, and the embryo or immature corn plant is still growing. The kernel grows mostly from cell expansion and when the cells fill with starch. Starch in the endosperm provides an energy for the germinating seedling, and makes a good source of starch for many other purposes. Final yield depends on number of kernels that develop and the final size and weight of the kernel.

R5 – Dent Stage
At R5, all the kernels are dented and the shelled cob is dark red in colour. The kernels are drying down now. Dry down begins at the top of the kernel where a small hard white layer of starch is forming. This starch layer appears shortly after denting as a line across the kernel. As the kernel matures, the hard starch layer and line advance toward the base of the kernel (toward the cob). The accumulated starch is hard above the line, but still soft below the line.

R6 – Mature Stage
R6 is reached when all the kernels on the ear are at their maximum dry weight (or maximum starch accumulation) and is commonly measured by the presence of black layer. The black layer forms once the hard starch layer has advanced completely down the kernel to the cob, causing a black abscission layer to form at the base of the kernel. Black layer formation in the kernels begins at the top of the cob and works its way down the ear, signalling the end of kernel growth for the season. The husks and many leaves on the plant are no longer green at this stage. The average kernel moisture content at R6 is 30-35%, but this varies among hybrids and environmental conditions. The grain is not ready for safe storage, which requires 13-15% moisture level for shelled corn. Most farmers choose to let the crop dry down partially in the field, and the rate of field drying depends on the hybrid and environment.

WHY DO SOME KERNELS HAVE A WRINKLED CAP?
There are two causes of wrinkled kernel caps – one is genetic and the one is physiological. Hybrids with genetically wrinkled kernel caps will always have a wrinkled cap, but the degree of the wrinkle will vary depending on the environment. Wrinkled kernel caps also occur when the growing conditions limit the amount of photosynthesis that occurs within each plant during the growing season. Another factor is the number of kernels that have formed on the cob during pollination. Each kernel acts as a ‘sink’ where the plant pours sugars produced in the upper leaves of the plant during photosynthesis. If pollination conditions are excellent and many kernels have formed on the cob, the amount of photosynthesis needed to fill each kernel will not change. But the total number of kernels has increased, and the total amount of photosynthate (sugars) needed to fill all the kernels will increase.

FIELD OBSERVATIONS
In cool summers with lots of cloudy days, there is less photosynthesis and reduced overall sugar produced in the canopy. In northern regions, the light intensity decreases due to the angle of the earth away from the sun. Light intensity also decreases with the degree of cloud cover on a given day. The net result is a decrease in the amount of sugars that can be produced by photosynthesis each day. And as temperatures drop below 10°C, the rate of photosynthesis slows down, further decreasing the rate of photosynthesis. Northern adapted hybrids typically are able to yield and fill kernels with the available amount of sunlight. But pollination can be affected and stressed, and areas where kernels per cob exceed the amount of sugar available – and kernels are not as full as normal – cap ‘wrinkling’ can result.

SUMMARY
When corn plants run out of resources, the environment tells the plant to shut down and kernels are not being completely filled. This can produce varying degrees of ugly kernels in the fall with test weights lower than anticipated. This varies with the amount of kernels left unfilled, but yields will still be good.

References:
http://www.soilcropandmore.info/crops/Corn/How-Corn-Grows/