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Utilizing Weather-Stressed Corn in Swine Diets

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In most of the US and many parts of the world, corn is the largest single component of swine diets, providing the majority of the energy in the pig's diet. However, adverse weather conditions often result in reduced corn quality due to late plantings, a cool growing season, drought, and/or early frost. This stressed corn is often severely docked at the elevator, so the corn producer has the options of marketing the corn through the elevator at a reduced price or marketing it through livestock in an attempt to add value to it. The goals of this factsheet are to help pork producers better understand the nutritional value of weather-stressed corn, how to determine if it's economical to use, the potential of mycotoxin contamination, and how changes in bulk density affect feed mixing and transportation.

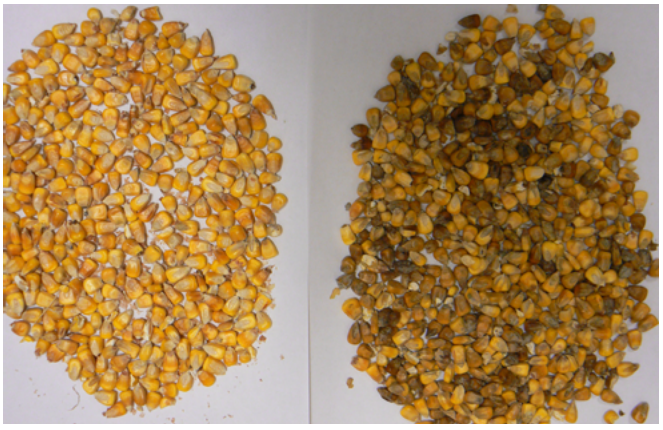
Nutrient Composition of Weather-Stressed Corn

Weather-stressed corn is typically lighter than the normal 56 lbs/bushel of #1 yellow corn because the kernel hasn't fully matured. Light-weight corn (LWC) is higher in protein, fiber, and ash than 56 lb corn, but is lower in starch and fat, which results in a lower energy content.

Since protein is one of the more expensive components of a swine diet, it is tempting to assume that the greater protein content of LWC also means a higher lysine content, thereby decreasing the need for soybean meal or synthetic amino acids to meet the pig's lysine requirement. However, research has shown that the % lysine in LWC increases at a slower rate than the increase in % protein (Johnston, 1995). Therefore, producers should continue to use the same % lysine content for corn in the diet formulation whether using 56 lb corn or LWC, in order to prevent an amino acid deficiency resulting in poorer performance.

If a producer decides to feed LWC, there can be a decrease in the metabolizable energy content of the final diet since both the starch and fat concentrations in LWC is reduced. However, this decrease is dependent on how light the corn is. The lighter the corn, the greater chance for lower energy concentrations, and that will result in poorer feed efficiency. Producers can add fat or oil to increase dietary energy level, but it is seldom economical to do so. Therefore, the options available are to blend LWC with 56 lb corn (if available) or to include only LWC in the diet and get a reduction in feed efficiency.

Interestingly, there is a poor relationship between corn test weight and nutritional performance. Multiple research stations have shown that corn test weight can be reduced down to 10% (50 lb corn) without affecting feed efficiency and that corn test weight can be reduced down to 25% (42 lb corn) before daily gain is affected.



Normal and damgaged corn

In response to the extremely poor quality of the 2009 corn crop in the Upper Great Plains, two trials were conducted in 2010 at the SDSU Southeast Research Farm to quantify the feeding value of locally produced, weather-stressed corn. The two types of corn (#2 yellow corn and weather-stressed corn) are shown in the picture below and the composition of both corn sources can be seen in Table 1. Both were locally raised, and the "Control" corn met all the grading standards for #2 yellow, and the weather-stressed corn was lighter, had significantly more damaged kernels, and also higher heat damage.

Trial 1 looked at pig performance from 100 to 260 lbs body weight and included damaged corn in the diets at 0, 15, 30, and 45% of the total corn component. Trial 2 looked at pig performance from 100 to 200 lbs body weight and included damaged corn in the diet at 0, 50, and 100% of the total corn component. As can be seen in Figures 1 and 2 below, there were no differences in pig performance in either trial due to % damaged corn in the diet. This lack of response can be attributed to several things – the pigs were older, both vomitoxin and zearalenone were under 1 ppm, and the damaged corn weighed 50 lbs/bu, still within the 10% reduction in test weight.

Feeding Recommendations

If the damaged corn is free of mycotoxins, it can be used in late grower, finishing and gestation diets. However, depending on how light the corn is, daily feeding level may have to be increased in gestation to compensate for the lower energy value of LWC. Because energy intake needs to be maximized in nursery, early grower, and lactation diets, it is recommended not to use LWC in these diets if possible.

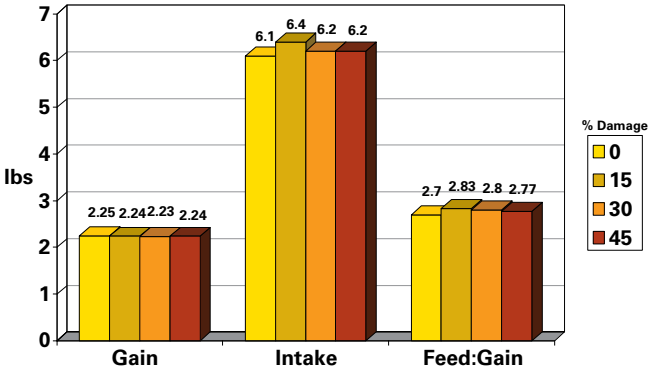


Figure 1. Trial 1 – Damaged Corn Trial (100-260 lbs)

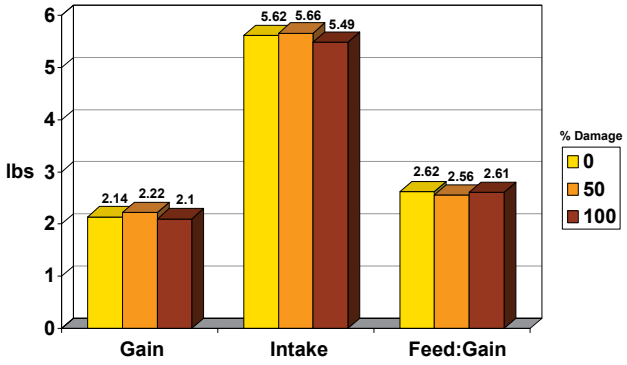


Figure 2. Trial 2 – Damaged Corn Trial (100-200 lbs)

Table 1. Composition of Control and Weather-stressed Corn

	Control - #2 Yellow Corn	Weather-Stressed Corn
Moisture, %	10.5	10.3
Protein, %	7.38	7.22
Fat, %	2.96	3.63
Fiber, %	2.25	2.22
Lysine, %	.225	.162
Starch, %	64.2	65.4
Metabolizable energy, kcal/lb (calculated)	1480	1480
Test weight, lbs/bu	54.2	50.0
Damaged kernels, total, %	.6	36.6
Broken corn & foreign material, %	.7	3.8
Heat damage, %	0	.2
Vomitoxin (DON), ppm	<.5	.9
Zearalenone, ppm	<.5	.6

Oftentimes the price dock at the elevator is greater than the reduced feeding value of the corn, so producers can potentially make money feeding LWC if the purchase price is low enough. A formula from the National Swine Nutrition Guide (Thaler and Reese, 2010) can help producers determine whether or not the poorer feed efficiency from feeding LWC is offset by the lower diet cost.

$$\frac{\text{New diet cost - Old diet cost}}{\text{Old diet cost}} \times 100 = \text{maximum \% reduction in feed efficiency allowable to use weather stressed grains}$$

If this value is greater than the % reduction in feed efficiency anticipated from using weather stressed corn, then the producer can make money feeding the LWC. However, if the % change in diet cost is less than the % change in feed efficiency, then the feedstuff should not be used.

For example, assume that using LWC will reduce total diet cost from $220/ton to $196/ton. That's an 11% reduction in feed cost so if the pig is only 6% less efficient, it is economically advantageous for the producer to use the LWC.

$$\frac{196 - 220}{220} \times 100 = -11\% \text{ maximum allowable reduction in feed efficiency}$$

Alternatively, if the reduction in feed efficiency was greater than the 11% maximum allowable reduction according the calculation, then the producer would lose money feeding the LWC in the pig diets.

As stated earlier, though, this equation and feeding recommendations are only valid if the LWC is free of mycotoxins. Also, if the LWC is <42 lbs/bu, then the cost of reduced pigs gains must be accounted for as well.

Mycotoxins

The weather conditions that stress corn are the same weather conditions that make the corn susceptible to mold growth and mycotoxins. Producers need to keep two main points in mind when thinking about molds and mycotoxins. First, molds produce mycotoxins, and it's these mycotoxins that can be detrimental to pig performance. Secondly, not all molds are bad. Some of the black, smutty molds look bad, but have no detrimental effect on pig performance.

The main mycotoxins that affect pig performance in the US are aflatoxin (suppressed immune system & death), zearalenone (reproductive issues), vomitoxin or deoxynivalenol (DON) (feed refusal), and fumonisins (respiratory issues). Typically, aflatoxins are found in the warmer, southern regions of the US while zearalenone, DON, and fumonisins are found in the cooler, wetter regions of the traditional Corn Belt.

Once corn is contaminated with mycotoxins, very little can be done to remove or inactivate the mycotoxins. Pellet binders have been shown to reduce the impact of aflatoxins, but there are few products that consistently inactivate the other mycotoxins. Mold inhibitors can be added to prevent any new mycotoxin production, and mycotoxin binders and adsorbents can be added to the diets to potentially lessen the impact of mycotoxins (Menegat et al., 2019).

When dealing with mycotoxins, the first step is to determine which mycotoxins are present and at what level. The producer needs to take corn samples from at least 10 different locations in the bin or truck, mix the samples, and then send a representative subsample in a paper or cloth bag to a certified lab for a mycotoxin screen. One such lab that has a long history of mycotoxin analysis is the NDSU Veterinary Diagnostic Laboratory (https://www.vdl.ndsu.edu/tests/mycotoxin-lc-ms-ms-screen/). However, mycotoxin production in a corn field is extremely variable, and it can be difficult to get a representative sample.

Once the type and concentrations of mycotoxins in the LWC are known, a producer can develop a plan on how to use them in their feeding program. It is strongly recommended to keep all mycotoxin-contaminated grains out of the nursery and breeding herd diets. The goal is to keep the total mycotoxin level in grower and finishing diets below the values shown in Table 2, as this will reduce or eliminate any negative impact on animal performance.

Table 2. Maximum Recommended Mycotoxin Concentrations in Grower & Finishing Pig Diets. (Thaler and Reese, 2010).

Mycotoxin	Maximum Concentration
Aflatoxin	200 ppb in finishing diets
Zearalenone	1 ppm in grower diets & 3 ppm in finishing diets
Vomitoxin or DON	1 ppm in grower & finishing diets
Fumonisins	5 ppm in grower & finishing diets

If the mycotoxin levels in the LWC are higher than those listed in Table 2, the producer will then need to blend the mycotoxin-contaminated corn with "clean" corn to get the mycotoxin levels of the total diet below the maximum recommended mycotoxin concentrations.

Impact of Bulk Density of Weather Stressed Corn

Because LWC has a lower bulk density than normal corn, that can impact feed mixing, delivery, and storage. It takes fewer pounds of LWC to fill up a given volume than heavier, denser #1 corn. For example, 4,000 lbs of 56 lb corn will fill up a two-ton mixer, but it takes only 3575 lbs of 50 lb corn to fill up that same volume (Thaler and Reese, 2010). Therefore, it is essential that LWC be added to the mixer based on weight, and not volume, to get the right amount of corn in. When using an auger system to mix feed, producers will need to re-calibrate their auger when using LWC to make sure it is adding the correct amount of corn to the diet.

The other problem with lower density LWC is that it reduces the number of tons of feed that a feed truck can haul and, likewise, the amount of feed that can be stored in bulk bins. When first using LWC, it is critical that the feedmill understands what these differences mean to feed manufacturing and transportation to avoid any problems.

Summary

Adverse weather conditions can reduce the quality of corn produced, but weather stressed corn can be an acceptable feedstuff for pigs. A key point, though, is only using LWC in diets with the least amount of risks, mainly the late grower and finishing diets. Pig performance will be unaffected with corn down to 50 lb/bu, and gains unaffected down to 42 lbs/bu. Depending on the price of corn and reduction in feed efficiency (and gains for corn < 42 lbs/bu), feeding LWC can be economically advantageous to producers. However, with weather stressed grains, producers also have to watch out for mycotoxin contamination, and manage accordingly. Finally, bulk density does affect feed milling, transportation, and storage, and needs to accounted for in the feed milling, transportation, and storage processes.

References

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