AGRONOMIC Spotlight

Technology Development & Agronomy by MONSANTO

Corn Seed Size, Plantability, and Germination Scores

Questions arise every year regarding effects of seed size and shape on plantability, germination, and yield potential. Following manufacturers' recommendations and considering tools to enhance plantability can help limit the risk of poor plantability. If plantability concerns related to seed size are managed properly, the effect of seed size should not significantly affect yield potential under most conditions.

Corn seed size or shape is not related to genetic yield potential. Research to evaluate the effect of corn seed size on yield potential has been conducted several times. A study from 1937 resulted in the same basic conclusions of several more recent studies: seed size does not affect yield potential under normal planting conditions[1]. There are always exceptions to normal conditions. To understand the effect seed size may or may not have on yield potential, it is important to: 1) understand how seed size is determined, 2) examine how it might affect emergence and early growth, 3) understand the importance of proper planter settings, and 4) know management techniques that may be used to help improve plantability of various seed sizes with different types of planters.

How is Seed Size Determined: Seed Production

Seed sizes from hybrid production will vary field to field, and year to year due to many factors. These include specific hybrid characteristics, parent tendencies, and growing conditions, especially during the pollination and fill period. Seed from a single ear falls into many size/shape categories. Large rounds usually come from the base of the ear, flats from the center, small flats and small rounds from the tip (Figure 1). Plateless seed usually comes from the base or the tip.

Effect on Emergence and Early Growth

Effect of Endosperm Size in Different Field Conditions. There have been minor differences in emergence noted under adverse planting conditions. Large seed can have slightly decreased emergence rates in dry soil conditions as the amount of moisture needed for germination and emergence is relative to the size of the seed. Small seed can have slightly decreased emergence in cool or crusted soils, as the amount of energy needed in those situations may exceed the amount stored in the endosperm. It has also been reported that differences in early growth related to seed size are not apparent by tasseling or soon after[1]. Even with the potential effect on emergence and reduced early vigor, the effect of seed size on yield potential was not significant if harvest populations were similar[1].

Effect of Processing on Emergence and Vigor of Different Grade Sizes. All Monsanto seed sold to our customers goes through cleaning, processing, and quality testing, which includes germination and vigor tests. While some seed sizes and shapes may be more susceptible to mechanical damage during cleaning and processing, the sample for germination and vigor tests is taken after all of the cleaning and processing is complete. All seed, regardless of grade, is subject to the same industry leading quality standards in place at Monsanto. See page 2 for some basics of germination testing.

Figure 1. Seed size and shape on a corn ear varies from large rounds (left; cob base), flats, to small rounds (cob tip).

Importance of Planter Settings

This is the area where seed size and shape does matter. Planter settings should be adjusted for intended population and accurate singulation. When set properly for the seed size, a planter can more accurately singulate and deliver seed. Planters that are not properly adjusted to seed size can deliver excessive numbers of doubles, triples, or skips, and can reduce grain yield potential by 3 to 10 bushels per acre[2]. Populations that are under the desired stand count increase the risk of not producing maximum yield potential.

Vacuum Planters in General. Depending on if the planter is equipped with cell or flat disks, adjustments can be made to the vacuum pressure, cell size, and seed singulation devices that can affect plantability. Additionally, the use of talc or graphite can help improve seed flow and drop. When planting small seed, consider increasing the talc or graphite rate to account for the increased surface area with small seed. The importance of talc or graphite increases with high rates of seed treatments and/or humid conditions. Mixing the talc or graphite well throughout the hopper or tank can help provide adequate coverage. Another component

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Germination Tests: A Few Basic Principles

Warm Germination Test. A standardized Warm Germination test was established by the Association of Official Seed Analysts (AOSA). The Federal Seed Act requires seed companies to report these Warm Germination Scores for all seed lots. Since all seed is tested using the same standardized testing procedures, a 95% Warm Germination score means the same thing, regardless of which company, lab, or seed regulatory agency conducted the test.

Cold Germination Test. Contrastingly, Cold Germination or "Vigor" tests are not required for compliance with state and federal seed law, nor is there a standardized test across the seed industry. Many companies, universities, and independent seed testing labs have developed and implemented various forms of Cold Germination tests to help establish and differentiate the quality of their seed beyond the legal testing requirements. Monsanto has developed and deployed a proprietary, internal vigor (Cold Germination) test in an effort to better predict emergence potential across environments. The results of this test are used internally as an integral part of the quality management system to help provide only the highest quality seed to our customers. This information is not shared outside of the quality review team, as the scores generated by the test are ultimately irrelevant in the context of other tests. For example, an 85% test result from the proprietary test Monsanto utilizes may be an equivalent or better indication of stress emergence than a 90% test result from a different, less rigorous test. Unfortunately, even if all of the variables were fully understood for each testing procedure, making a comparison of results across the tests could be misleading since it would be based on making various assumptions. **The bottom line - there is no way to know the actual difference between Cold Germination scores from various testing sources in the absence of an industry standard.**

Similar to a Cold Germination test, there is not a procedure standardized across the industry for the "Saturated Cold Germination" test. Therefore, testing procedures and test results are likely to vary by lab.

Monsanto has a great deal of confidence in the Cold Germination test utilized internally. The validity of this test has been proven across millions of acres for numerous seasons. That being said, germination scores are only indicators of potential and not absolute measures of performance. They are the best indicators available to predict the experience a grower will ultimately have when seed is planted; however, they are not perfect and there will always be exceptions. Monsanto takes seed quality very seriously and strives to deliver the most consistent, highest quality seed a farmer can buy.

to examine regardless of disk type is the way the disk is adjusted relative to the meter housing. Having the disk rub the housing with light contact can help improve singulation, reduce seed damage, and help load the planter drives, improving their consistency.

Vacuum Planters with Cell Disks. Historically, cell disks were standard with several vacuum planters. Seed is partially held in place by the cell and partially by the vacuum pressure.

To aid plantability, different cell sizes and vacuum pressures can be combined to fit a given seed size and shape. Running a disk with cells that are on the larger end of the acceptable range for a given seed size may increase the potential for doubles, even if the vacuum pressure is on the lower side of the acceptable range. Additionally, running low vacuum pressures increases the risk that seed could be shaken off of the disk when planting over rough ground, resulting in increased skips. A preferred tactic is to use a disk with cells that are on the smaller end of the acceptable range and running vacuum pressures on the higher end of the acceptable range. The latter option helps reduce doubles as well as skips.

Vacuum Planters with Flat Disks. Recently, the adoption of the flat disk has increased as they are less sensitive to various seed sizes and shapes, thereby providing more consistent plantability with less need to adjust vacuum pressure. Two examples of flat disks include the John Deere® ProMAX 40 Flat and the eSet® system from Precision Planting. Generally there is an additional component or two that is needed for singulation when using flat disks. The ProMAX 40 Flat disk requires a double eliminator and a knock-out wheel. The eSet system uses a non-adjustable singulator. While there are differences between the systems, they both greatly reduce the need to adjust vacuum pressure to account for seed size and shape variations, thereby improving the plantability of various seed sizes and shapes versus cell disks[4]. Please note that flat seed disks may need a slightly different working environment than cell disks. New flat disk users may benefit by visiting their equipment dealer for inspection and testing of their seed meters.

Finger Pick-up Planters. Planter speed is a major component of calibration and accurate seed placement. Planting at speeds faster than recommended in the owner's manual may result in poor seed singulation and placement, which can adversely affect yield potential. Likewise, planting at speeds lower than the recommended range may result in a lower than intended population. Simulated planter speeds for the plantability studies conducted at Waterman were 5.5 miles per hour.

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Keeping a finger pick-up planter well maintained is a good way to help minimize planting errors. Some items to evaluate and adjust to manufacturer's specifications include:

- Proper tension on the fingers
- Meter brushes in good condition
- Carrier plate condition
- Seed delivery belt pliability
- Seed baffle cleaned
- Proper lubrication (graphite) rate
- Good alignment with meter drive and the lugs on the unit drive sprocket
- Well maintained and lubricated drive chains

Summary

Overall, seed size does not affect genetic yield potential. Having a planter set properly can improve the opportunity to achieve an optimal stand by minimizing skips, doubles, and triples. Focusing on genetic yield potential, seed quality, increasing populations, and identifying planter settings that optimize plantability is helpful in increasing yield potential.

Sources: [1] Elmore, R. and L. Abendroth. April 8, 2005. Do corn kernel size and shape really matter? Crop Watch Newsletter. University of Nebraska-Lincoln.

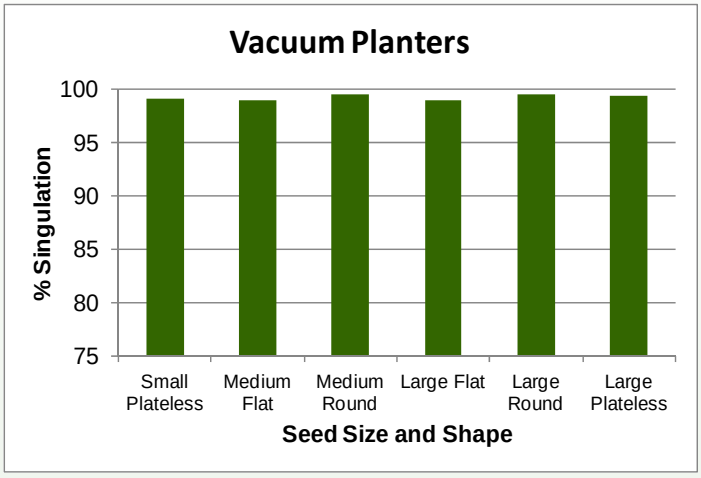
[2] Nielsen, R. 1996. Seed size, seed quality, and planter adjustments.

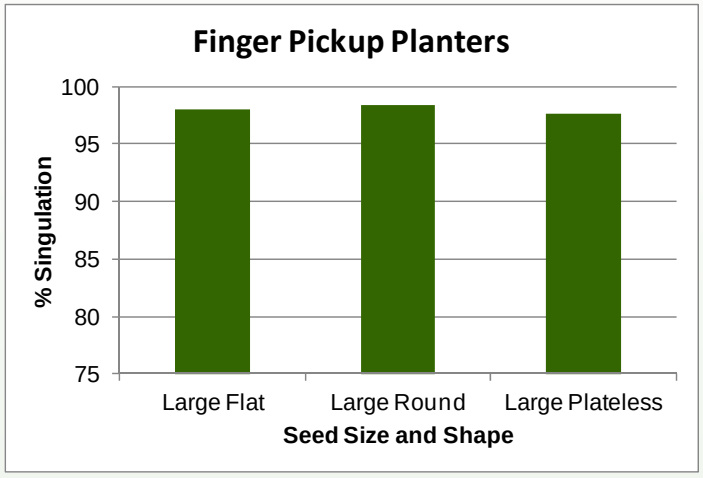
[3] Shillington, S. Senior Sales and Service Representative for Planters. John Deere Seeding Group. Moline, Illinois. October 22, 2010.

[4] Monsanto data. 2011. Brian Urban, Waterman, IL. Seed Technology Center.

Plantability Studies Conducted at the Monsanto Seed Technology Center in Waterman, Illinois

At the Monsanto Seed Technology Center in Waterman, Illinois, plantability tests have been conducted to provide planter setting recommendations for seed lots. The results of the tests conducted are represented in terms of percent singulation, which is the percentage of single seeds that are released by the seed meter at the proper time. If the seed sensor detects two seeds, where only one should be, then it is called a multiple. If the seed sensor detects nothing, where a seed should be, then it is considered a skip. Therefore, percent singulation is calculated by taking 100% properly timed single seed drops and subtracting the percent multiples and percent skips.





The graphs above present singulation data from the Monsanto Seed Technology Center in Waterman, Illinois for vacuum or finger pickup planters and various seed sizes and shapes. Vacuum planter units represented in the data include Case IH ASM, John Deere® Pro-Series XP with ProMAX 40 disk, John Deere® MaxEmerge™ with cell disk, Kinze® EdgeVac® with cell disk, and the eSet® flat disk from Precision Planting. Finger pickup units from John Deere®, Kinze®, and Precision Planting are represented in the data. The finger pickup units were calibrated for larger seed, therefore the data for smaller seed sizes and shapes are not presented. Simulated planter speed was 5.5 miles per hour. (Data collected using seed harvested in 2004 through 2010 for planting seasons in 2005 through 2011, respectively.)