Trends in U.S. Field Corn Plant Population

By

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Trends in U.S. Field Corn Plant Population

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ABSTRACT

Optimizing corn (*Zea mays* L.) plant population is crucial to achieving high yields while avoiding unnecessary seed cost and interplant competition. This study evaluated the optimum corn plant population for two Hubner corn hybrids at one field site in Virginia. The objective of this study was to compare yield for both hybrids over a range of seeding rates and determine the optimum population. Two Hubner corn hybrids, H4663 which is a fixed ear and H4563 which is a flex ear type were planted at 28,000, 32,000, 36,000, 40,000 and 44,000 seeds per acre. To estimate final plant population, the number of plants in 200 square feet of each hybrid by population treatment were counted shortly after emergence and again approximately one month later. Grain yield for the flex hybrid H4563 was linear over the range of plant population treatment and therefore the optimum population for this hybrid at this site was greater than 39,000 plants per acre, whereas the fixed hybrid H4663 had an optimum population of 35,000 plants per acre. There should be further research investigating the response of fixed and flex-type corn hybrids to seeding rate to improved recommendations for producers.
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INTRODUCTION

Optimizing plant population for field corn (*Zea mays* L.) is an important management consideration necessary to achieve high yields. Corn producers in the United States work to continually refine the most appropriate corn plant for their fields. In most areas, seeding rate has increased in recent years. Many claim recently that planting at a higher population and deeper into the soil will allow for a higher yield. The justification for higher corn populations within the last decade or more is due to improvements in genetics and seed treatments. For example, populations have risen from below 25,000 plants per acre to above 30,000 per acre in Northeast part of the U.S. (Pecinovsky, 2011). To take advantage of these higher populations, plants must withstand greater stress induced by plant-to-plant competition. Other advancements that allow higher plant populations result from the use of equipment that plants in narrower rows; which allows for more equidistant spacing and thus more plants per acre (Pecinovsky, 2011).

One corn population study was performed in 2018 at Cloverfield Farms near Champlain, Virginia on a Tetotum loam soil.

<table>
<thead>
<tr>
<th>Planting Date</th>
<th>Stand Count Date</th>
<th>Harvest Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 23, 2018</td>
<td>Two weeks after planting: May 8, 2018</td>
<td>September 11, 2018</td>
</tr>
<tr>
<td></td>
<td>After nitrogen side-dress: June 26, 2018</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Dates of planting, harvesting, and stand counting, Cloverfield Farms, 2018.

The two different Hubner® corn hybrids that were tested included ‘H4663;’ which is a fixed ear and ‘H4563;’ which is a flex ear. A flex-ear is a corn hybrid that can adapt to
growing conditions more easily than a fixed-ear can. A flex-ear has a smaller ear size as the population increases and are more sensitive at having an adequate amount of nitrogen (Eckelkamp, 2010). Each hybrid was planted at five different populations of 28,000, 32,000, 36,000, 40,000, and 44,000 seeds per acre using a Case IH 1245 12-row no-till planter. Each plot consisted of six, 30-inch rows 300 feet long planted without tillage into soybean stubble. A detailed chart of the amount of fertilizer applied is in the Materials and Methods section.

PURPOSE

The purpose of the corn population trial conducted at Cloverfield Farms was to identify the corn plant population that resulted in the highest yield, and the influence of population on grain moisture and kernel weight. When combined with other data and experience, these results will help Virginia farmers make educated choices about the optimum corn plant population on their farms.

OBJECTIVES

The objectives follow the purpose of this experiment which was to identify the corn seeding rate resulting in the highest yield. There were five different plant populations, both above and below the seeding rate commonly used in this field to provide wide range of populations for which to determine the optimum. One assumption that is made based on population and yield is that a higher population will result in a higher yield. Collecting data throughout the growing season and measuring kernel weight
for each population treatment at harvest will allow the determination of the cause of any yield differences.

REVIEW OF LITERATURE

Figure 1. The United States trend for average yield and seeding rate (USDA-NASS, 2018).

Figure 1 shows the trend from 1985 to 2018 in United States average yield and seeding rate for corn.

There are several effects that plant population has on growth and development of corn. These effects can result in positive or negative impacts on corn yield. A detailed outline of several of the factors are listed below:

**Crowding:**

Profitable corn production requires an adequate, but not excessive plant population. As plant population increases at constant row width, competition among plants for resources increase. A higher population results in less sunlight, nutrients and
water available to each plant; which can result in lower yields if that competition is severe. However, a plant population that is too low will may not optimize grain yield per unit area due to not having as many plants per unit area. So the degree of competition that the corn plants experiences should be considered. For example, Duncan (1958) stated that when plant density per unit area rises, yield per plant is reduced. Corn grain yield per unit area is the product of yield per plant and the number plants there are per unit area. Therefore, when plant population is low, yield potential is limited by the scarcity of plants while an excessive plant population results in declining yield due to an increase in the number of unfertile stalks and unfertilized or aborted kernels (Hashemi et al., 2005).

In recent years, studies demonstrated that newer hybrids are more tolerant to crowding stress than older hybrids mainly due lower lodging frequencies. Planting newer corn hybrids at higher populations with less stress allows for greater nitrogen use efficiency, higher photosynthesis rates in leaves; which is more efficient under water stress situations along with stomatal conductance (Hashemi et al., 2005).

Physiologically, there are critical stages of corn development when competition has greatest negative effects on grain yield potential. When it comes to corn plants competing for essential growth needs, there are certain times throughout the growing season when each corn plants need certain nutrient amounts. For example, when corn competes for the vital nutrients after flowering, it may cause yield decline more than if competition was great during the vegetative growth stages. To go along with that point, studies shown that less than 10% of grain yield is attributable to assimilates which are formed before the silking period which may create sink capacity (Hashemi et al., 2005).
Photosynthesis:

Photosynthesis is an essential plant process that uses sunlight energy to convert carbon dioxide and water into carbohydrates and sugars (Franic, 2015). At greater corn plant population, shading from adjacent plant leaves may reduce photosynthesis potential. Shading results in decreased photosynthesis rates; which slows growth, reduces vigor and limits an individual plant’s ability to compete for essential nutrients and water. Photosynthesis is the base of yield formation; therefore, photosynthesis is crucial for corn to have optimum growing conditions (Franic, 2015).

The rate and extent of corn grain fill after ovule fertilization occurs depends in large part on the photosynthetic capacity of the plant during this time. Over 90% of final grain weight comes from the photosynthates produced during the grain filling period (Tanaka and Yamaguchi, 1972). When choosing a corn plant population target, it is also important to consider hybrid leaf architecture and type. In a high population, it is better to have upright leaves so sunlight can reach into the canopy more in order to increase photosynthesis. A flex-ear type will allow the corn ear to increase in size under low plant density while fixed-ear types do not change the ear size much so they should be planted at a higher population rate in order to receive an optimum yield (Smith, 2013). The Virginia Cooperative Extension recommended a seeding rate of 22,000-26,000+ for yield potential of 120 bushels per acre or more (Thomason, 2005).

Respiration:

Respiration is a process of converting sugars to plant energy that happens at night following photosynthesis. During the day, sugar and starches are produced and stored so that at night they can be used by cells to complete many functions that make the corn
plant grow. Oxygen is used by the plant to oxidize carbohydrates that are stored within the plant for cell growth (dark respiration), cell maintenance, and cooling. Dark respiration is affected by temperatures and is most efficient at nighttime temperatures below 70F. At higher temperatures, the plant must use sugars for cooling instead of growth, making the conversion process much less efficient. As dark respiration rate increases, more energy is used by the plant. During the night, the process does not slow down much and the plant will continue to metabolize sugars; which causes the plant to finish grain fill and mature quicker. High grain yield requires large carbohydrate amounts. Therefore, it is important for the corn plant to maximize photosynthesis and minimize dark respiration for high yields (Brien, 2011).

High night temperatures above 70F, result in decreased net dry accumulation; which results in inefficient respiration. Higher night time temperatures allows for faster growing degree day (GDD) accumulation; which can lead to early corn ear maturity. However at lower night temperatures, there is a chance for more grain filling days which can increase plant dry matter and lead to higher yields (Thomison, 2010). The growing degree days it takes for a corn plant to reach each growth stage is represented in Table 2.

<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>GDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE (emergence)</td>
<td>100-120</td>
</tr>
<tr>
<td>V2 (2 fully emerged leaves)</td>
<td>200</td>
</tr>
<tr>
<td>V6 (growing near surface)</td>
<td>475</td>
</tr>
<tr>
<td>R1 (silking)</td>
<td>1135</td>
</tr>
<tr>
<td>R5 (dent)</td>
<td>2450</td>
</tr>
<tr>
<td>R6 (black layer)</td>
<td>2700</td>
</tr>
</tbody>
</table>

**Table 2.** The growing degree days (GDD) that are required to reach the specified corn growth stage (DEKALB, 2015).
**Hormones:**

Plant hormones are important in plant growth and development and in ensuring the dominance of a single ear. Auxin and cytokinin are important hormones that help control corn plant development and occur naturally at some points during the growing season. Cytokinins influence several cellular processes and stimulate cell division. The main role of auxins is to promote root elongation. Auxins are present in areas where there is rapid growth in shoot tissue, young leaves, and emerging seeds (Abendroth and Elmore, 2005).

Gibberellins (GAs) can regulate development of ears. When internode elongation is increased by an increase in GA, ear growth is inhibited. A study was done examining the relationship between ear growth and internodes using different methods using seven genotypes. Two of the genotypes were modified by plant hormones and population densities. The internode elongation was boosted by application of GA’s. At early stages of growth when the GA synthesis inhibitor was applied, internode length was condensed and ear size and number increased during silking. At higher populations there were longer internodes and fewer ears per plant while at lower densities it was the opposite (Xu et al., 2004).

**Height:**

Corn plant height is determined by genetics and environment and responds to both the quality and quantity of sunlight. A small plot research study from 2013 in Europe measured height differences in response to different corn plant populations on Chernozem soil which has a large amount of humus and phosphoric acids. As the plant population increased, so did plant height. Shortest plants were associated with a
population of 45,000 corn plants per acre. Researchers concluded that taller plants at the higher populations were caused by competition for light. They also concluded that row spacing did not significantly influence plant height (Murányi and Pepó, 2013).

In a study conducted by Dupont Pioneer evaluating treatments of 9,000, 27,000, 36,000, 45,000, 72,000 and 90,000 plants per acre, corn plant height reaction to plant population differences were similar to grain yield response. Plant height increased as the population increased up to 36,000 plants per acre; while height then decreased as the population surpassed 45,000 plants per acre representing a quadratic response. The height of the ear also increased as the population increased, but remained constant as the population exceeded 36,000 plants per acre (Jeschke et al., n.d).

**Stalk Size:**

A thicker stalk is preferred over a thinner one in order to prevent lodging. As plant population increases, stalk diameter usually decreases. Similar to the effect of ear size, increasing plant number per unit area increases competition and results in internodes that are longer and thinning that those at lower plant populations (Thomison, 2016). When emergence is delayed or uneven among plants in the same field, later emerging plants may have thinner stalks again due to competition, mostly for light. (Thomison, 2016).

**Yield:**

Corn plant population can have a great influence on grain yield as a result of many factors that differ as population changes. At proper plant population per specific variety, a high yield can be achieved. At higher plant densities, decreased ear length, ear
weight, kernel weight, number of kernels per row, and stalk area may occur. Compared to other yield components, kernel weight is the most stable at higher populations. There are source-sink relationships that are established during the grain filling stage which can affect kernel weight. Many stresses that occur at higher populations can also cause decreased yield, including nitrogen deprivation and inter-plant competition (Sher et al., 2017).

Declined aboveground biomass, increased barrenness, delayed reproductive processes, and lower kernel weight and number may occur at high plant densities. When corn is at higher plant populations, kernels may never develop in some hybrids due to poor pollination from a delayed silking period. There has been yield differences at varying plant populations which are attributable to different genetic potential. At higher population, increased plant sterility was realized along with a decrease in kernels per ear. Although scientists have found that increased corn plant population can lead to higher yields, it also leads to more competition for essential needs like water, sunlight, nutrients and morphological changes like plant height, tassel size, ear size, and leaf number (Sher et al., 2017).

Modern corn hybrids have responded to higher plant populations with higher yields due to genetic improvements in stress tolerance. Genetic improvements in drought tolerance, enhanced stalk and root strength, and disease/insect resistance enabled a positive interaction with higher seeding rates, resulting in high yield stability across a variety of environmental conditions. The maximum seeding rate that is recommended by seed companies to use on some hybrids in high-yield environments is 35,000-36,000 plants per acre (Thomison, 2011). Corn yield increases have been substantial from the
1930’s to the current day. From the 1930’s to about 1960 there was an average yield of around 26 bushels per acre, from 1960 to 2000 there was a 1.9 bushel per acre increase per year due to technology advancements (Nielsen, 2017).

**Kernel Number and Weight:**

Yield is the product of three factors, the number of ears per acre, the number of kernels per ear and kernel weight. At a fixed plant population, yield improvement is then attributable to kernel number and kernel weight. Both components can be dramatically affected by growing conditions during the silking period in corn. Kernel number is determined by conditions affected the crop during silking while kernel weight is determined during the end of the lag phase, 12-15 days after the initiation of grain filling (Chen, 2017).

Kernel number is closely related to the grain yield under stress conditions, such as nitrogen deficiency or water stress. When stress occurs especially around silking, the harvest index may be decreased as well as kernel number. Since the kernel number is determined by the stress response by different corn genotypes, it has been shown that newly developed hybrids are more tolerant to stress than ones developed many years ago (Tollenaar et al., 2000). If a lower plant population results in less plant stress, then it is more likely the corn plant will develop a larger ear with more kernels. It has been shown that there is a strong relationship between kernel number and yield (Lee and Herbek, 2005).

One negative result of higher populations is the decrease in nitrogen available per plant which decreases the overall biomass production and plant growth, especially during silking which is a vital time for kernel formation. At higher populations there is also a
reduction in nitrogen in leaves which can increase the rate of leaf senescence and lower the kernel weight. Therefore, adding more nitrogen to the plant can help kernel development and formation. Another negative component at higher populations is that plant-to-plant variability can also be increased which can decrease biomass transfers to ears at silking which can also reduce the kernel weight per plant (Chen, 2017).

When there is reduced sunlight during pollination there is a good chance that the kernel number per ear will decline, mostly due to kernel abortion on the tip of the corn ear. The kernel weight can also decline due to not enough solar radiation during early grain fill (McGriff, 2017). In a study conducted by DuPont Pioneer, the kernel row number and kernels per row declined as the population density increased from 27,000 to 90,000 plants per acre. Grain yield increased until the population reached 36,000 plants per acre, likely due to a greater number of ears per acre along with maintenance of kernel number, kernel weight or both. The decreased yield reported for populations over 36,000 plants per acre indicates that the higher populations were not capable of producing enough ears per unit area to overcome the smaller ear size (Jeschke, n.d.).

**Lodging:**

In Wisconsin, Stanger and Lauer (2007) reported that stalk lodging (below the ear) occurred when populations increased from 26,000 to 50,000 which had the highest occurrence of lodging. If stalk lodging occurs, then it may offset some yield improvements in higher populations at harvest (Coulter and Roekel, 2011). A five-year study over nine locations with varying climates in Ohio, evaluated corn yield response to population under high yield potential conditions and found that stalk lodging was greatest in 2008 when Hurricane Ike occurred. The study tested populations of 24, 30, 36, and
42,000 plants per acre and lodging was blamed for the lack of yield increase with plant populations of 30,000 or more, though there are other factors that could play a role in no yield response, such as late planting, drought, disease or insect injuries, or even harvest delays (Thomison, 2011). In this study, yields were optimized at 36,000 plants per acre. Due to the strong winds associated with Hurricane Ike, the plant population of 42,000 had the most stalk lodging (Thomison, 2011).

When plant population is greater than optimum a reduction in the amount of light in the crop’s canopy occurs, which results in a tall and thin corn plant. When corn stalks are thin, the strength of the stalk will be reduced considerably (Colville and Nielsen, 1988). Plant-to-plant competition for the essential resources like nutrients, water, and light makes competition for the carbohydrates between the stalk and the ear even greater. Therefore, the vigor of the cells in the stalk are reduced and make the plant more susceptible for stalk rot. One way to prevent this lodging from occurring is to use a seeding rate which still promotes high yield, but does not cause excessive competition for crucial resources (Colville and Nielsen, 1988).

From this study done on the Eastern part of Virginia it is anticipated that corn growers in this part of the county will use the yield data and optimum population sizes studied that is best for their farming practice. The research trial done on five different corn population sizes was done over the entire corn growing period from the end of April to September. The independent variable was the population size while the dependent variables were row width, planting date, amount of fertilizer across all the different population sizes, irrigation amount, and harvesting date. The ideal outcome for this project is to see what the ideal plant population is for this part of Virginia. However, if
testing in other growing areas the results may differ based on the area’s soil type, climate, and ideal planting date.

**MATERIALS AND METHODS**

**Projected Audience:**

The targeted audience for this research is corn growers and their advisers. The expected outcome is greater information on which growers of corn can use to choose the optimum corn population.

**Research Methodology:**

Research took place in a single irrigated field with Tetotum loam soil at Cloverfield Farms in Champlain, Virginia. The field was irrigated 3 inches in mid-July. Corn planting occurred April 23rd with a Case IH 1245, 12 row planter. Below are images of when the planting took place.

![Figure 2. Mallorie Wright (right) and Dr. Thomason (left) filling the planter with Hubner corn seed.](image-url)
Figure 3. Mallorie Wright (left) and Dr. Thomason (right) observing the planting operation.

Figure 4. Dr. Thomason discussing with Mallorie Wright (right) the next population setting.
There were five different populations tested; which included 28,000, 32,000, 36,000, 40,000 and 44,000 seeds per acre (Table 3). There were two Hubner corn hybrids, H4663 which is a fixed ear and H4563 which is a flex ear planted at each population. A flex-ear hybrid allows the plant to adapt to the growing conditions by altering ear size in response to either stress or ideal growing conditions (Eckelkamp, 2010). For example, as the population increases, the flex-ear variety is likely to have a smaller ear size since there is more competition. On the other hand, a fixed-ear hybrid typically does not change size in response to growing conditions (Eckelkamp, 2010).

<table>
<thead>
<tr>
<th>H4563</th>
<th>H4663</th>
<th>H4663</th>
<th>H4563</th>
<th>H4563</th>
<th>H4663</th>
<th>H4663</th>
<th>H4563</th>
<th>H4663</th>
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<tbody>
<tr>
<td>28K</td>
<td>28K</td>
<td>32K</td>
<td>32K</td>
<td>36K</td>
<td>36K</td>
<td>40K</td>
<td>40K</td>
<td>44K</td>
</tr>
</tbody>
</table>

Table 3. Experimental structure for corn plant population and hybrid trial, Cloverfield Farms, 2018

The experimental structure was a split plot design. There were five plant populations planted for both hybrids which means ten total treatments were tested representing all combinations of varieties and plant populations.

Table 4 presents the amount of nutrients including nitrogen, phosphate, potash, and sulfur applied to the field, the date it was applied, the rate (gallons per acre) at which it was applied, and which method. The field had potassium applied earlier in the winter.

The field was irrigated with 3” in mid-July using a center pivot irrigation system.

<table>
<thead>
<tr>
<th>Date</th>
<th>Source, N-P-K-S</th>
<th>Rate applied</th>
<th>Method applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/12/2018</td>
<td>15-0-0-7.5</td>
<td>20 gal/ac</td>
<td>Broadcast</td>
</tr>
<tr>
<td>04/23/2018</td>
<td>30-0-0</td>
<td>15 gal/ac with 10% Boron (1 qt/ac)</td>
<td>2X2 with planter</td>
</tr>
<tr>
<td>04/23/2018</td>
<td>11-37-0</td>
<td>3 gal/ac with 9% Zinc (1 qt/ac)</td>
<td>In furrow</td>
</tr>
<tr>
<td>05/26/2018</td>
<td>24-0-0-3</td>
<td>66 gal/ac</td>
<td>Side-dress</td>
</tr>
</tbody>
</table>

Table 4. Nutrient rate, application method and date applied to corn, Cloverfield Farms, 2018.
On May 8, 2018, at two weeks after planting, all plants in a 10 foot section of two adjacent row in four different, randomly selected locations in each hybrid by population treatment were counted. Plant counts were used to estimate final plant population. An average value for plant population was also calculated for each population (twelve rows) over hybrid. Evaluating the plant stand count shortly after planting allowed producers to observe any factors in the field that may have caused poor- or no-emergence; i.e. wet or low spots in the field and pivot tracks. On June 26, a second count was performed in the same manner to evaluate any plant losses that occurred after emergence and final plant population was calculated.

Corn harvest occurred on September 11, 2018. Each 6-row treatment of hybrid by population was harvested separately using a Case IH 9240 combine and grain from the length of the plot weighed via weigh wagon with digital scales. Grain moisture was determined from each strip using a dickey-John GAC plus portable tester and test weight determined via a hanging scale and standard-size cup. Grain dry matter mass was determined and corn grain yield calculated at a consistent 15.5% moisture for all plots. A representative one quart subsample of grain was collected from each plot and two 250-seed aliquots weighed to determine kernel weight.
### RESULTS AND DISCUSSION

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Seeds/acre</th>
<th>Plants/acre</th>
<th>Standard deviation</th>
<th>Percent establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 4563</td>
<td>28000</td>
<td>25483</td>
<td>2072</td>
<td>91%</td>
</tr>
<tr>
<td>H 4663</td>
<td>28000</td>
<td>21998</td>
<td>2904</td>
<td>79%</td>
</tr>
<tr>
<td>H 4663</td>
<td>32000</td>
<td>26136</td>
<td>4137</td>
<td>82%</td>
</tr>
<tr>
<td>H 4563</td>
<td>32000</td>
<td>26644</td>
<td>4043</td>
<td>83%</td>
</tr>
<tr>
<td>H 4563</td>
<td>36000</td>
<td>31726</td>
<td>2716</td>
<td>88%</td>
</tr>
<tr>
<td>H 4663</td>
<td>36000</td>
<td>29693</td>
<td>4526</td>
<td>82%</td>
</tr>
<tr>
<td>H 4663</td>
<td>40000</td>
<td>34340</td>
<td>4557</td>
<td>86%</td>
</tr>
<tr>
<td>H 4563</td>
<td>40000</td>
<td>35719</td>
<td>3733</td>
<td>89%</td>
</tr>
<tr>
<td>H 4563</td>
<td>44000</td>
<td>38405</td>
<td>2116</td>
<td>87%</td>
</tr>
<tr>
<td>H 4663</td>
<td>44000</td>
<td>35356</td>
<td>3332</td>
<td>80%</td>
</tr>
</tbody>
</table>

**Table 5.** Seeding rate, plants per acre measured at two weeks after planting, standard deviation and relative percent establishment for two Hubner corn hybrids, Cloverfield Farm, 2018.

Table 5 above illustrates the average plants per acre for each seeding rate and the standard deviation of each data set, showing the variation of the plants per acre in stands counted for each seeding rate. For example, at the seeding rate of 28,000, the total amount of variance in population size could be 2,488 more or less than the population size 23,740. This table also shows the percent establishment for each hybrid. At 28,000 seeds/ac, approximately 15% of seeds planted did not emerge.
Average plants per acre for each seeding rate, the standard deviation, and percent establishment for each data set is presented in Table 6 measured after Nitrogen was sidedressed.

Comparing Tables 5 and 6, population estimates were higher at the second stand count which was nine weeks after planting. This could be an artifact of counting different plants at different times or it could represent late-emerging plants. Across the two stand counts there was a higher percent establishment for H4563 at 90% compared to H4663 at 85% which was an average of each hybrid from both stand counts. This result was unexpected and could be due to many factors, however seed quality and seed vigor likely played a key role.
Figure 5. The number of kernels per ear for both hybrid at each seeding rate.

Figure 6. The kernel weight in grams for both hybrids at each seeding rate.

Figure 5 and Figure 6 represent the final kernel number and weight for both hybrids at all five seeding rates. The number of kernels per ear decreased with higher
seeding rate for both hybrids. Based on the slope, kernel number declined at approximate the same rate for both hybrids. This is common to find a relative consistent effect among hybrids.

Kernel weight, however responded differently to increasing population for the two hybrids. Kernel weight declined significantly for H4663 as seeding rate declined. While the slope of the linear regression equation for H4563 was negative, the relationship was not significant, demonstrating no real decline with greater seeding rate.

Figure 7. Effect of final plant population on grain yield for two Hubner corn hybrids, H4563 and H4663, Cloverfield Farms, 2018.

Figure 7 shows the average yield for H4563 to be 233 bushels per acre over all five populations while H4663 averaged 225 bushels per acre. At the highest population, which was over 39,000 plants per acre, the hybrid H4563 was steadily increasing in yield which indicated maximum or ideal population was above the greatest value used in this study for this hybrid. The hybrid H4563 was a “flex” hybrid which means it should have
adapted to the environment and growing conditions. Therefore, results for this hybrid were unexpected. It was expected that the hybrid would produce a high yield at low populations because the hybrid should have produced larger ears. Similarly, it would have been expected to produce a reduced yield at higher population sizes since the ears are likely to be smaller with more competition. The hybrid H4663 which was the “fixed” hybrid showed a quadratic response to plant population, exhibiting a decreasing yield as the population increased which was expected. The optimum population for H4663 was estimated to be 35,000 plants per acre.

CONCLUSION

When testing two different hybrids at the same seeding rates, expected results may be somewhat different since they are genetically different; resulting in yield differences. However, the flex H4563 hybrid that was expected to adapt to environmental and growing conditions had an unexpected result. The flex H4563 hybrid did not have a determined optimum planting population due to a linear increase in yield as final plant population increased. Therefore, further research is needed on this hybrid with higher seeding rates to determine a maximum optimum planting population. Fixed hybrid 4663 had an estimated optimum planting population of 35,000 plants per acre; which is best to be used when growing this hybrid on the Eastern part of Virginia where this study was done. This optimum population is more than the recommend population by Virginia Cooperative Extension, which was a seeding rate up to 26,000 for a yield above 120 bushels per acre.
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