

Soybean Pod Height

Influence of Genetics, Environment and Management

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SOYBEAN PLANTS POD low to the ground creating harvest difficulties and the risk of yield loss. Harvest difficulties stem from lowering the cutter bar enough to catch the lowest pods, leaving machinery more susceptible to rock and soil intake. Rocks can damage equipment and soil can impact seed quality in the form of earth tag. Out of fear of lowering the cutter bar too much, pods may be left behind on standing stubble at harvest, causing yield loss (Figure 1).

This leads us to question what influences soybean pod height and what we can do about it. This means, we must explore the impact of genetics, environment and management (G x E x M).

Figure 1. Soybean stubble loss at harvest, where pods below the cutter bar remain attached to standing stubble.



GENETICS

Soybean pod height set, or internode length, is a highly heritable trait. This means genetic advancements can be made by selecting soybean varieties with higher pods. However, a negative correlation exists between lowest pod height and seed yield, meaning there is a risk of declining soybean yield as we select for greater pod height.

Indeterminate soybean varieties that continue vegetative growth after flowering, like those grown here, produce more internodes than determinate varieties. These indeterminate types may continue to elongate their stems for about one month after the start of flowering. Determinate varieties stop elongation about 10 days from flowering.

How do our indeterminate, short-season varieties fair in Manitoba when it comes to pod height? Manitoba Pulse & Soybean Growers (MPSG) conducted research in 2016 to help answer this question. Pod heights were measured on 10 plants per plot at two variety trial locations – Morris and St. Adolphe. A significant interaction between variety and environment was found, meaning varieties behaved differently across locations.

Lowest pod heights ranged from 10.8 to 20.4 cm (4.3 to 8.0 inches), on average, across all varieties at St. Adolphe. At Morris, lowest pods ranged from 9.7 to 17.2 cm (3.8 to 6.8 inches) from the ground. Overall, pods were 0.8 inches higher at St. Adolphe compared to Morris across all varieties. Further analysis is needed to make conclusions between specific varieties. But these preliminary findings confirm pod height diversity exists within our pool of short-season varieties.

Preliminary results also confirm that environmental conditions can inhibit or enhance the ability of certain varieties to reach their pod height potential. For example, the variety that achieved a pod height of 8.0 inches at St. Adolphe reached only 4.8 inches at Morris.

A minimum pod height of 12 cm (4.7 inches), measured as the distance from the soil to the lowest pod-bearing node, is recommended to prevent stubble loss at the cutter bar. At St. Adolphe, 5/67 varieties and 10/67 at Morris

had pod heights <12 cm. Considering measurements were made from the bottom of the lowest pod to the soil in these trials, pod heights of our Manitoba-grown varieties were quite good in 2016.

ENVIRONMENT

Knowing that soybean internode length is set from the first node stage until flowering, it is this time period in which environmental conditions may play their role. The common theme from previous research is the influence of temperature and moisture extremes.

In Manitoba, cool temperatures during early growth are often blamed for lower pod height. Limited information is available to confirm this, especially under field conditions. However, cold temperatures can slow soybean development and increase the number of axillary buds.¹ Conversely, hot day/night temperatures (34/26°C to 42/34°C) have been shown to reduce internode length.²

Very wet and very dry conditions may also be blamed for lower pod height. Moisture was plentiful at both variety trial sites tested in 2016, but it was especially excessive at Morris where some plots were lost due to waterlogging. Research from Brazil looking at the impact of weather on agronomic factors reported that very dry conditions and widely variable rainfall contributed to lower soybean pod height.³ However, further investigation is needed to understand the exact influence moisture may have.

MANAGEMENT

A few management factors come to mind when we think about possible influences on pod height, such as planting date, plant population, row spacing, seed depth, tillage, plant growth regulators or harvest methods. Unlike genetics and environment, these are the factors we have the most control over.

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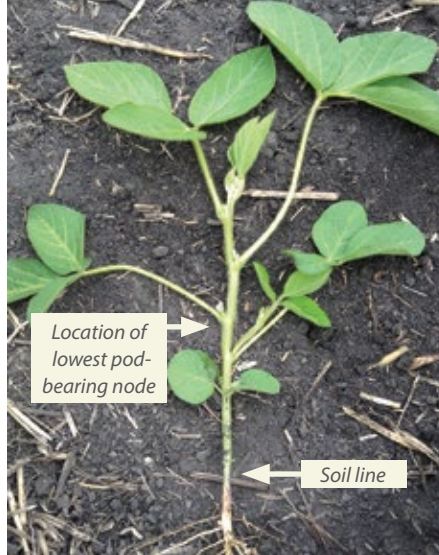
Planting date

Information on soybean pod height response to planting date is available from a University of Manitoba (U of M) study conducted by Dr. Yvonne Lawley and me. In this study, planting date (ranging from April 27 to June 12) did not influence soybean pod height. Lowest pod heights ranged from 9 cm to 14 cm (3.5 to 5.5 inches), on average. However, a significant site-year by variety interaction meant varieties behaved differently at different locations (Figure 2). We can speculate that longer dry periods and variable rainfall during internode elongation at Melita in 2014 and Morden in 2015 may have contributed to lower pod height (Figure 2).

MPSG-funded research conducted by Agri-Skills Inc. at Carman from 2012 to 2014 also found a lack of pod height response to soybean planting dates (May 12 to June 4).

Plant population and row spacing

Information on soybean pod height response to plant population is available from another U of M study conducted by Dr. Yvonne Lawley and me. Results showed that pod height increased with increasing population (Figure 3). For each plant population increase of 1,000 plants/ac (ranging from 46,000 to 298,000 plants/ac), pod height increased by 0.02 cm. However, plant population explained only 21% of this response and there is a great deal of variability in the data, meaning other factors also played a role in pod height set.



Location of the lowest pod-bearing node relative to soil line on a soybean plant.

Another MPSG-funded study conducted by Agri-Skills Inc. examined pod height response to soybean seeding rate (123,000 to 205,000 seeds/ac) and row spacing (8-inch to 30-inch rows). This study found soybean pod height to be unresponsive to both seeding rates and row spacings. Pod height ranged from 2 to 3 inches off the ground overall, depending on the year.

Seed depth

Lowest pod height was measured in a soybean seed depth experiment conducted by U of M/MPSG Research Agronomist Kristen P. MacMillan. At Carman and Arborg in 2018, seed depths ranging from 0.25 to 2.25 inches did not influence pod height. However, pod height was significantly greater at Carman (11.9 cm, on average) compared to Arborg (8.6 cm, on average).

Tillage

An on-farm study conducted by Dr. Lawley and Patrick Walther (U of M) at Haywood and MacGregor in 2016 found pod height differences between corn residue management treatments. Strip-till produced the lowest pods compared to the double-disc, vertical till low disturbance and vertical till high disturbance treatments. However, distance from the soil to the bottom of the lowest pod ranged only from 6.0 cm to 6.9 cm, suggesting this difference is of little agronomic importance.

Research in Brazil found no differences in pod height between soil management treatments in 13/14 site-years. These treatments included no-tillage, reduced tillage, disk plowing plus disking and mouldboard plowing plus disking.³

Plant growth regulators

Manipulation of plant hormones, or the use of plant growth regulators (PGRs), may be one possible way to alter pod height. An MPSG-funded study is currently underway by Dr. Belay Ayele (U of M), looking at the impact of PGRs on soybean internode length. This study is focused on three different PGRs applied at different concentrations to soybean varieties with a range of pod heights. Stay tuned for results from this project.

Harvest methods and equipment

Harvest methods and equipment will not influence pod height set, but will they

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Figure 2. Height of the lowest pod-bearing node at Carman, Melita and Morden from 2014 to 2015, averaged across a range of planting dates (April 27 to June 12) and two varieties (23-10RY; 25-10RY) (Tkachuk, 2017).

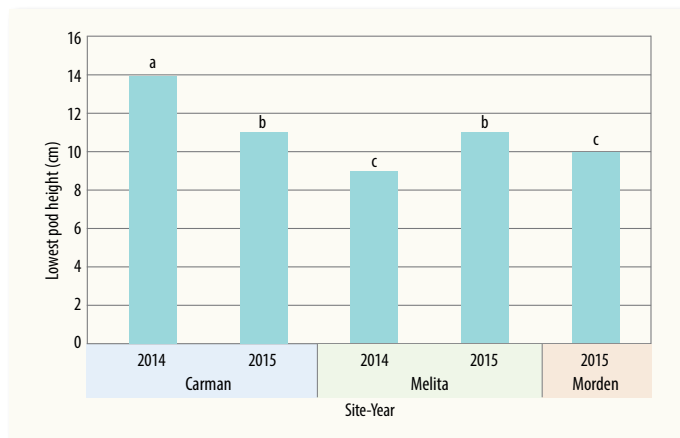
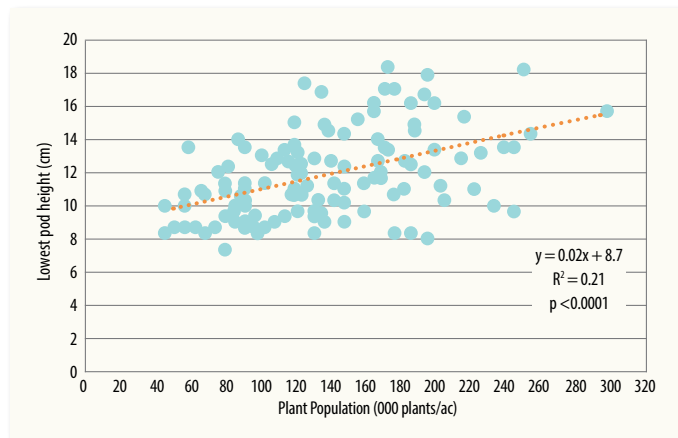


Figure 3. Height of the lowest pod-bearing node response to plant population at Carman, averaged across 2014 and 2015 (Tkachuk, 2017).



influence the amount of soybean stubble loss? A local study by PAMI did not find differences in stubble loss between harvest speeds ranging from 2 mph to 5 mph. Stubble loss in this study was very minor compared to other types of seed losses at the header. Research from the 1950s and 60s in the U.S. Midwest reported yield losses of up to 14% for a cutter bar height of 15 cm. However, today's flex headers make it easier to lower the cutter bar and reduce this type of yield loss.

The real risk associated with lowering the cutter bar is rock and soil intake. According to Canadian Grain Commission specifications, the presence of soil in a harvest sample is classified as "foreign material other than grain," of which only 0.3% is allowed for No. 2 Canada

soybeans. Rolling is one way to minimize this issue.

SUMMARY

- Genetics play a big role in soybean pod height set. Further genetic selection for pod height must be done carefully to avoid loss of seed yield potential.
- Environmental conditions will dictate whether pod height potential is reached. Temperature and moisture extremes from emergence to flowering are expected to have the greatest influence on this trait.
- Management practices such as planting date, row spacing, seeding depth and harvest speed did not influence soybean pod height. Tillage had little to no impact. Increased plant population may play a role in raising lowest pod height. ■

References

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- ² Hartwell Allen Jr., L., L. Zhang, K.J. Boote and Hauser, B.A. 2018. Elevated temperature intensity, timing and duration of exposure affect soybean internode elongation, mainstem node number and pod number per plant. *The Crop J.* 6(2):148-161.
- ³ Pereira dos Santos, H., R.S. Fontaneli, S.R. Silva, A. Santi, A.C. Verdi and A.M. Vargas. 2015. Long-term effects of four tillage systems and weather conditions on soybean yield and agronomic characteristics in Brazil. *Aust. J. Crop Sci.* 9(5):445-452.