What Can We Expect from Soybeans After a Dry Year or Two?

The Bean Report
Your source for soybean and pulse crop agronomy and research.

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DROUGHT STRESS WAS the reality for many soybean farmers in 2018 and, to a lesser extent, 2017. Signs of this included wilted plants, flipped leaves and rapid maturity. This was perhaps the first time that soybean farmers experienced two consecutively dry growing seasons in Manitoba. But what impact did this have on the crop? And how do we mitigate our risk in the future?

YIELD

Moisture extremes account for 71% of yield loss in all crops, according to long-term Manitoba Agricultural Services Corporation (MASC) data. For soybeans, excess moisture was responsible for 91% of yield loss in 2016 and drought for 90% in 2017 (Figure 1). This gives an estimate of the proportion, not the actual amount of yield lost. But it certainly points to the impact of moisture extremes in Manitoba.

Looking back at the past three growing seasons, we can see differences in the general performance of legumes under different moisture levels. Manitoba recorded its highest average soybean yield of 42 bu/ac under the wet conditions in 2016. Whereas dry conditions in 2017 and 2018 resulted in 34 and 32 bu/ac yield averages, respectively (Table 1). The opposite is seen for peas and beans, which performed better in dry years, on average.

Assessing numbers province-wide can only tell us so much. What really influenced yield in 2018 was the timing and amount of precipitation. For pulses and soybeans, the need for water increases as the season progresses and the most critical period to have water available is from flowering to pod-fill. So if you didn't get timely rainfall from July to August, your soybean crop likely suffered. See Table 2 for the cause of soybean yield loss based on the timing of drought and heat stress during the critical time of water uptake.

Figure 1. Post-seeding causes of soybean yield loss in 2016 and 2017 (MASC).

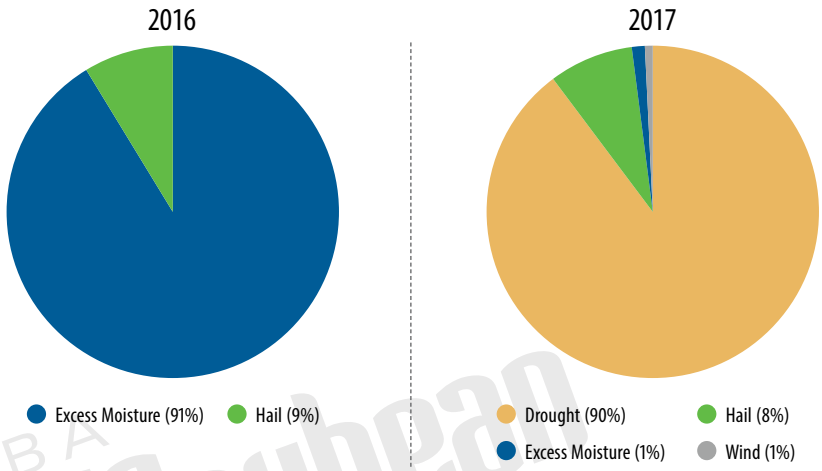

Table 1. Average yields of soybeans, field peas and dry beans in Manitoba from 2016–2018 (MASC).

	2016 Yield	2017 Yield	2018 Yield
		bu/ac	
Soybeans	42	34	32
Field Peas	35	53	49
		lbs/ac	
Pinto beans	1,658	2,116	1,961
Navy beans	1,870	2,009	1,815
Black beans	1,606	1,997	1,723
Kidney beans	1,207	1,892	1,504

Table 2. The cause of soybean yield loss based on the time of drought and heat stress.

Time of Drought and Heat Stress		Cause of Soybean Yield Loss
Full flower (R2)	Mid-July	• Plants abort flowers • Flowering period shortened
Early pod (R3)	Late July	• Plants abort flowers and pods
Pod elongation (R4) Seed development (R5)	Early to Mid-August	• Number of pods per plant reduced • Number of seeds per pod reduced • Seed size reduced
Full seed (R6)	Late August	• Seed size reduced

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For years, farmers and agronomists have noticed that soybeans perform well in wet conditions. Research by Dr. Ramona Mohr at AAFC has helped explain these observations. Her study tested the impact of excess, rainfed and deficit moisture on soybeans grown at Carberry and Portage from 2014 to 2017. Excess moisture treatments yielded the same or better than rainfed soybeans in all cases, despite visible symptoms of stress from excess moisture. Deficit moisture, on the other hand, reduced soybean yield by 16–32%. This suggests that deficit moisture is the extreme we should worry about more for soybean production. For more information on this study, see *Pulse Beat: The Science Edition, Issue 3*.

Over the past two years, we have observed that soybeans appear to be good at accessing soil moisture. Under drought stress, plants can sacrifice aboveground growth to put more resources into root growth. This means an improved ability of roots to search for soil water. The benefit of increased rooting depth was likely more pronounced in 2017 due to leftover soil moisture from 2016 and better-than-expected yields in the face of dry conditions. However, the drawdown of soil moisture reserves and lack of precipitation throughout 2017 made it harder for plants to access soil water in 2018.

SOIL MOISTURE CONSERVATION

What dictates moisture deficit in Manitoba is the amount of soil water present from the previous year. Over the long-term, precipitation at most locations in Manitoba actually falls short of the soybean water requirement. Therefore, management practices that maintain soil moisture will help mitigate the risk of drought stress. Think of soil moisture as an investment in next year's crop.

Moisture conservation starts with soil management. Reduced and no-till have been adopted by many farms in Manitoba with great success over the years. Maintaining crop residues at the soil surface improves crop water use efficiency, water infiltration, organic matter and microbial activity in the soil. Surface residue will also provide a barrier to soil water evaporation and protect the soil from intense rainfall energy and excessive solar radiation.

Flipped soybean leaves due to drought stress in late July 2018.

Reducing tillage of low-residue pulse and soybean crops was discussed in last issue's *Bean Report*, highlighting results from Dr. Yvonne Lawley's University of Manitoba (U of M) soybean residue management study. This on-farm experiment confirmed that tillage is not a necessity for soybean residue and that the lack of tillage had no negative impact on subsequent wheat and corn yields. If you feel that no-till isn't quite right for you, consider reducing your tillage – especially in dry years. Or reach out to your fellow farmers who are seeing the benefits of less tillage.

PLANT ESTABLISHMENT

Establishing a strong crop in spring is possibly the best method to combat a multitude of stressors throughout the growing season, including moisture stress. This is true for any crop. It may be tempting to reduce seeding rates to save money, but seed is your best investment. If you are looking to save money, aim to cut costs not investments.

In the dry spring of 2018, farmers were faced with seeding depth decisions — to plant at the current recommendation of ½ to 1 ½ inches deep or to chase soil moisture and plant deeper. Recent research results from Kristen P. MacMillan's lab at the U of M has shed some light on this decision. Results of this study can be found on page 20 – *Soybean Seeding Decisions – Seeding Window and Seeding Depth Trial Results from 2017 and 2018*.

Estimating seed survival is a key component in determining the best seeding rate. This varies with seeding equipment, seed lot quality and environmental conditions. Under dry conditions, survival may be reduced. Keeping records of plant stand assessments is a great way to accurately estimate seed survival over time. But if you are looking for a starting point this spring, we have a few tips:

- Assume 70–75% survival if planting with an air seeder and 80–85% with a planter. Assume lower survival if you are expecting dry planting conditions.
- Conduct germination and soak tests. Soak test: Place 200 seeds in water and calculate the percentage of seed coats that slough off. Seeds that lose their seed coat will not produce a viable plant.
- Use the *Bean App Seeding Rate Calculator* and *Plant Stand Assessor* with research-based recommendations.

Adequate plant stands will improve crop resiliency against pest pressure. Take weeds for example. Soybeans are already poor competitors and placed at greater risk of yield loss if plant stand is reduced.

Research conducted by Dr. Rob Gulden at the U of M on the critical period of weed control (CPWC) has found that soybeans must remain free of weeds until the V2–V4 stages, on average. However, the CPWC ranged anywhere from VE–R1, meaning yield loss can occur until flowering in some cases. This work also found that narrow rows and higher seeding rates can reduce the CPWC by one to three growth stages. This means that a more competitive crop will be better suited to handling stress and, in this case, save time and money spent on weed control. For more information on this project, see *Pulse Beat: The Science Edition, Issue 3*.

APPROACHING SPRING 2019

The 2019 growing season is projected to be wetter than the past two years, which is good news for soybeans and overall soil moisture replenishment. Improved varieties and stronger agronomic decisions mean soybeans are becoming more adapted to our prairie environment. We can't do much about Mother Nature, but we can manage our investments. ■