Corn & Soybean News

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Martin-Gatton College of Agriculture, Food and Environment
Grain and Forage Center of Excellence

Revenue Insurance Payment Scenarios for Corn and Soybeans

October 31st marks the end of the harvest price discovery period for revenue protection crop insurance policies. The harvest price is used to calculate crop insurance indemnity payments and is the average December corn and November soybeans futures settlement prices during October. The projected price is released earlier in the year and uses the same methods during February. The 2023 harvest prices for corn and soybeans are $4.88 and $12.84, respectively. The corn harvest price fell 17% below the February projected price ($5.91), whereas the soybean harvest price fell 7% below the projected price ($13.76). Using the projected and harvest price, we can look at the impacts of 2023 farm yield loss on indemnity payments. We find that due to the larger price change between the projected and harvest price, indemnities are more likely to trigger for corn than soybeans.

Revenue Insurance

Two of the largest crop insurance policies are revenue protection (RP) and revenue protection with a harvest price exclusion (RP-HPE). RP, the more expensive product, allows the producer to "roll the dice" twice on price, meaning that if the harvest price is higher than the projected price, the indemnity payments adjust by using the higher harvest price in the revenue guarantee. RP-HPE only allows the producer to "roll the dice" once and calculates indemnities using the formula,

Indemnity = Revenue Guarantee - (Harvest Price x Yield) .

The revenue guarantee is calculated using the formula:

Revenue Guarantee = Coverage Level x Projected Price x APH ,

where APH is the "Actual Production History" for the operation. For example, corn insured with an 85% coverage level and APH of 180 bu/acre would result in a revenue guarantee of 0.85 x $5.91 x 180 = $904/acre. If the farm yield is 160 bu/acre, the indemnity would be $904 - (4.88 x 160) or $123.20/acre (Figure 1). No indemnity is received if the farm yield multiplied by the harvest price exceeds the revenue guarantee. Since the harvest price is lower than the projected price in 2023, both RP and RP-HPE will trigger the same indemnity payments.

Indemnities: Corn

With corn prices falling 17%, a 2023 RP policy with an 85% coverage level will trigger indemnity payments with farm yields slightly higher than APH. Assuming an APH of 180 bu/acre, indemnities will trigger at 185.3 bu/acre. Figure 1 indicates corn indemnity payments/acre increase as coverage level increases and farm yields decrease. Due to the large drop in harvest price, indemnity payments of $12.66/acre are triggered with a coverage level of 70% and a farm yield of 150 bu/acre. As of October 12th, USDA-NASS (2023) had Kentucky average corn yields at 183 bu/acre.

Indemnities: Soybeans

Since the soybean price only fell 7%, only farm yields lower than APH will trigger indemnity payments, regardless of coverage level. Figure 2 displays soybean indemnity payments as coverage level and farm yield change. For example, at an 85% coverage level, APH of 55 bu/acre, and a farm yield of 45 bu/acre, indemnity payments would be $65.48. As of October 13th, USDA-NASS (2023) had average Kentucky soybean yields at 54 bu/acre.

Figure 1: Revenue Insurance Payment Scenarios for Corn, 2023

[redacted]		Coverage	Revenue Guarentee	Yield to Trigger Payment	140	150	160	170	180	190	200
Corn											
Projected Price	$5.91	70%	$745	152.6	**$61.46**	**$12.66**	$0.00	$0.00	$0.00	$0.00	$0.00
Harvest Price	$4.88	75%	$798	163.5	**$114.65**	**$65.85**	**$17.05**	$0.00	$0.00	$0.00	$0.00
APH Yield	180	80%	$851	174.4	**$167.84**	**$119.04**	**$70.24**	**$21.44**	$0.00	$0.00	$0.00
[redacted]		85%	$904	185.3	**$221.03**	**$172.23**	**$123.43**	**$74.63**	**$25.83**	$0.00	$0.00

Figure 2: Revenue Insurance Payment Scenarios for Soybeans, 2023

[redacted]		Coverage	Revenue Guarentee	Yield to Trigger Payment	35	40	45	50	55	60	65
Soybeans											
Projected Price	$13.76	70%	$530	41.3	**$80.36**	**$16.16**	$0.00	$0.00	$0.00	$0.00	$0.00
Harvest Price	$12.84	75%	$568	44.2	**$118.20**	**$54.00**	$0.00	$0.00	$0.00	$0.00	$0.00
APH Yield	55	80%	$605	47.2	**$156.04**	**$91.84**	**$27.64**	$0.00	$0.00	$0.00	$0.00
[redacted]		85%	$643	50.1	**$193.88**	**$129.68**	**$65.48**	**$1.28**	$0.00	$0.00	$0.00

Sources:

USDA-NASS. Crop Production Report. (2023) https://downloads.usda.library.cornell.edu/usda-esmis/files/tm70mv177/6395xr873/p2678f18x/crop1023.pdf

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The Face of Agriculture in 2050

Droughts, deluges, and high temperatures are harbingers of a changing climate. Agricultural systems must change, perhaps radically, to counter climate change and continue feeding the world. What systems will produce our food in 2050?

Proposed systems include organic agriculture, agroecological farming (based on ecological principles), sustainable intensification, regenerative agriculture (attempts to replenish and strengthen the soil), permaculture (emphasizes perennials and polyculture), and local food production to reduce 'food miles'. Completely new approaches to food production include vertical farming (growing food crops in completely controlled environments), eating insects, using fermentation to produce fats, proteins, and lab grown meat. Reducing food waste and adopting plant-based diets are touted as ways to increase food supplies in the face of a changing climate. Each of these schemes have enthusiasts that promote their reduced effects on climate and their ability to sustainably feed the world.

Which system or systems will represent the agriculture of the future? Will it be a more sustainable version of our current high-input system, a radically different system that has little in common with current systems, or something in between? No one knows, but we do know that the system(s) of the future will have to, first, provide adequate supplies of nutritious food to the world's population. They must do this while operating in environments less suitable for crop production than our current environments. Secondly, the system(s) must not be labor intensive. The systems of tomorrow must minimize labor requirements while maintaining high productivity.

The good news is that the population is growing slower. The United Nations Population Group recently estimated that 66 countries have population growth rates below replacement levels. Some experts suggest that the world population may peak at 9.7 billion by 2050 and then start to decline (UN estimates place the peak closer to 2100). Reducing the rate of population growth will make it easier for any system to meet the demand for food. But the effect of the declining growth rate could be partially offset by an increase in the consumption of meat by more affluent societies.

Many of the proposed production systems minimize off- farm inputs in an attempt to create a self-sustaining system. These approaches usually result in lower yield. Lower yield means more crop land is needed to feed the population or, as described by George Monbiot in his 2022 book (Regensis: Feeding the World Without Devouring the Planet), an increase in agricultural sprawl. Expanding the crop land base usually involves bringing new land into production and cutting down forests which increases the greenhouse gas (GHG) emissions that fuel climate change. Lower yields require higher prices to economically sustain these systems. Low-yield agriculture systems may not be the best choice for the agriculture of the future.

Many of the proposed systems are labor intensive compared with the high-input agricultural systems common today. The world is rapidly urbanizing with nearly 70% of the world's population projected to live in urban areas by 2050 (compared with 30% in 1950). This long- standing trend of movement of people from farms to the city may reflect the poverty, unrelenting hard labor, and the lack of opportunity often associated with small share-holding agricultural systems.

It is unrealistic and unfair to expect food producers to live in poverty to supply cheap food to the rest of society. On the other side of the coin - will society tolerate high food prices to ensure that low-yield, labor-intensive production systems provide adequate income for the practitioners? It seems unlikely that labor-intensive systems will be feeding the world in 2050.

Will entirely new forms of food production replace conventional agriculture, based on green plants growing in the soil and animals that convert plants into high quality protein, by 2050? Vertical farms are insulated from a changing climate and require much less water than conventional agriculture, but so far, they seem to be limited to producing greens and they seem to have trouble showing a profit. High capital and energy costs (we are, after all, replacing the sun with electric lights) seem to limit these systems.

Fermentation and lab grown meats are currently receiving a lot of attention, but the scalability, GHG emissions, and consumer acceptance remain to be determined. Plant based 'meats' that increase the efficiency of food production by replacing animals are available to consumers, but their acceptance seems to be faltering.

What will be the face of agriculture in 2050? There are clearly many options; some are proven systems in operation while others range from concepts still on the laboratory bench to proposals requiring significant changes in dietary habits. No one has a crystal ball that is clear enough to predict which system(s) will prevail in 2050, especially given the complications and uncertainties imposed by climate change.

The agricultural systems that prevented a Malthusian disaster for the last 100 years, when the world population increased more than four-fold (from 1.8 billion in 1920 to 7.8 billion in 2020), exhibited steady increases in yield and declining labor requirements. The systems feeding us in 2050 will have to, in some form, continue increases in productivity and lower labor requirements. And, above all, they will have to be economically viable – providing a living wage to the producer of food that all consumers can afford. I am optimistic that human ingenuity will, barring complete and total disaster from climate change, find systems that will meet these requirements and feed the world.

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How Many Grain Loads to Core a Bin?

Broken grain and trash/foreign material tend to accumulate in the center of grain bins during filling. Air will not pass through this area very well, so the best management practice is to remove this material from the bin (often referred to as 'corning') and either store it separately or feed or sell it quickly to avoid potential problems during storage. This raises the question of how many bushels of grain are in the cone-shaped center peak, but this varies by type of grain and the filling angle of the grain surface (the angle of repose). The UK storage volume calculator includes a table for different size bins that shows the number of bushels of corn, grain sorghum, soybeans, or wheat in the center peak. For example, a 36-ft diameter bin holds between 4160 to 7390 bushels, depending on the type of grain and angle of repose (see table below). Other bin sizes are also shown and more are available at https://www.uky.edu/bae/grain-storage-systems.

Table 1. Amount of various grains (bushels) in the center peak of round grain bins.

	Angle of	Bin Diameter, ft								
Grain	Repose	18	24	30	36	42	48	60	72	90
		bushels								
Corn	23	260	617	1,205	2,082	3,306	4,936	9,640	16,658	32,535
Soybeans	25	286	678	1,324	2,287	3,632	5,422	10,590	18,299	35,741
Wheat	29	340	806	1,574	2,719	4,318	6,445	12,588	21,753	42,486

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Crop Rotation – Soil Health Gift That Keeps on Giving

One basic soil health concept is that of plant diversity – a diversity of plant species grown in your fields will benefit soil health. Crop rotation is a well applied example of that soil health concept. The impacts of crop rotation on weeds, diseases and insects are numerous and help to explain how rotation raises yield of corn and soybean. I remember that in the 1980s, Johnsongrass control in soybean benefited the following corn crop. Take-all disease has long prevented growing wheat after wheat. Soybean cyst nematode reduces our ability to grow soybean after soybean. Corn rootworm can hinder continuous corn production.

When changes in weed, disease and insect pressure don't explain the 'rotation effect', changes in soil chemical (pH), physical (aggregation/tilth), and fertility (available N, P and S) properties are often talked about. But the 'rotation effect' can occur in the absence of all the previously described causes/mechanisms – this means that the effect is probably due to differences in soil microbiology that are induced by rotation versus monocrop cultivation. The differences in soil microbiology associated with this phenomenon are not well understood, but a buildup in mycorrhizal fungi is suspected by some researchers (Johnson et al., 1992; Hendrix et al., 1995).

What does this mean in Kentucky? Before I came to Princeton, I used to manage (Dr. Hanna Poffenbarger has that pleasure now) a grain crop rotation research trial at the Spilndletop research farm near Lexington. Besides continuous corn, continuous soybean, and the 2-year corn-wheat/double crop soybean rotation, there was a 4-year corn-corn-soybean-soybean rotation. All crop rotation components were grown every year. I'm going to use those yield results to illustrate some long-term observations.

Corn benefits a great deal from rotation. Figure 1 illustrates the 'rotation effect' in the context of corn grain yield response to fertilizer N. In this figure, three corn rotation components are shown: 1st year corn after 2 years of soybean, 2nd year corn after 1 year of corn and 2 years of soybean, and continuous corn. Corn yield rises and then levels off as the N rate rises. The 'rotation effect' is shown at the far-right side of Figure 1, where 1st year corn exhibited greater maximum yield potential (203 bu/acre) than 2nd year corn (193 bu/acre) and continuous corn (191 bu/acre). Interestingly, the larger portion of the 'rotation effect' was lost with 2nd year corn, whose maximum yield potential was not very different from that for continuous corn. And as noted by many, more fertilizer N was needed to achieve maximum yield in the corn after corn systems; 141, 169 and 177 lb N/acre for the 1st year, 2nd year and continuous corn, respectively. That said, the greater corn after corn fertilizer N requirement did not overcome the 'rotation effect'.

In this long-term field study, the continuous corn and corn-wheat/double crop soybean systems have been around for the longest time, over 25 years. Corn yields in each of these systems, as related to the seasonal/yearly average yield in the trial, are shown in Figure 2. The negative impact of continuous corn was *generally* apparent across all seasons – good, average, and bad – though not all.

There were years where continuous corn outyielded corn after wheat/double crop soybean. The impact was greater in the better seasons. In a 50 bu/acre season the yield loss is nearly 11 bu/acre. In a 250 bu/acre season the yield loss is around 21 bu/acre.

For those of you considering an expansion is soybean acres next spring - full season soybean is not immune to the 'rotation effect'. Figure 3 exhibits the 1st year, 2nd year, and continuous full season soybean yield as related to the seasonal/yearly average yield for the 11 years that all 3 rotation components were present. This long-term field study area does not have soybean cyst nematode (I regularly took soil samples for cyst nematode detection). Again, there were some years when soybean after soybean outyielded soybean after corn. However, the general yield trends indicate that soybean after soybean yield potential was inferior to that for soybean after corn and that the rotation effect was larger with a greater seasonal yield potential. Again, 2nd year soybean yield potential was not very different from that for continuous soybean.

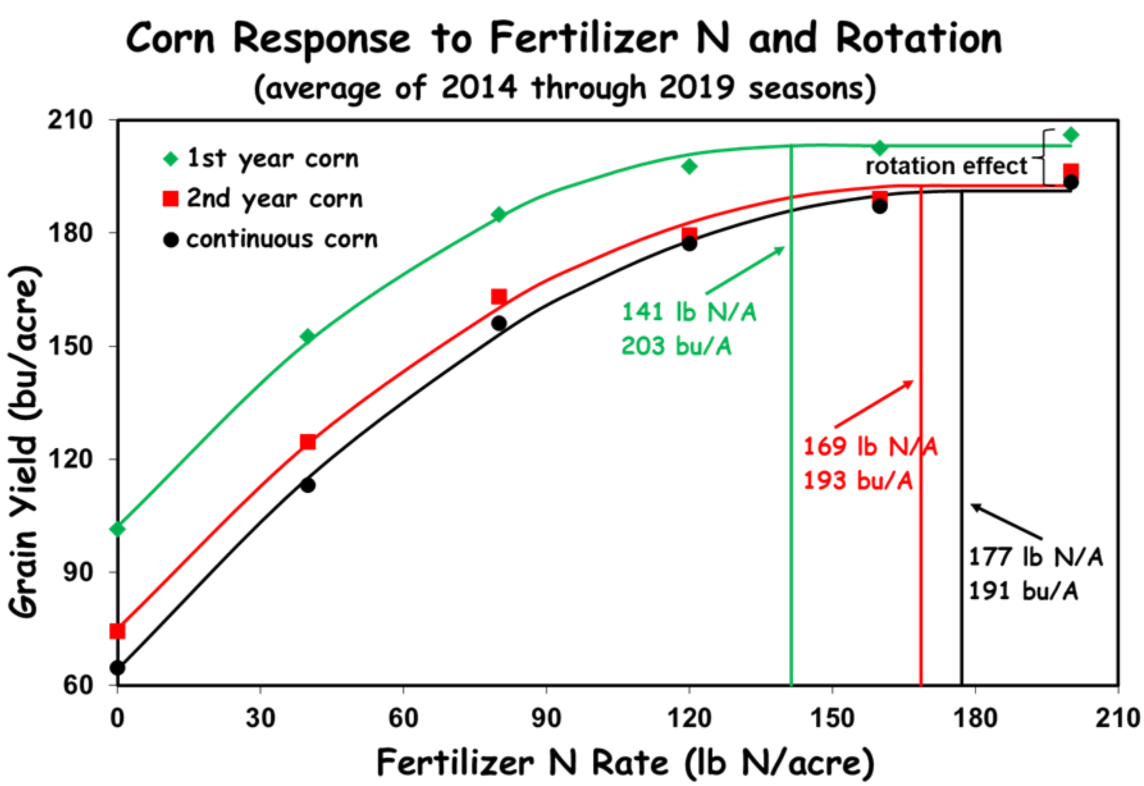

Figure 1. Corn grain yield response to fertilizer N rate and crop rotation.
2014-2019 Lexington, KY

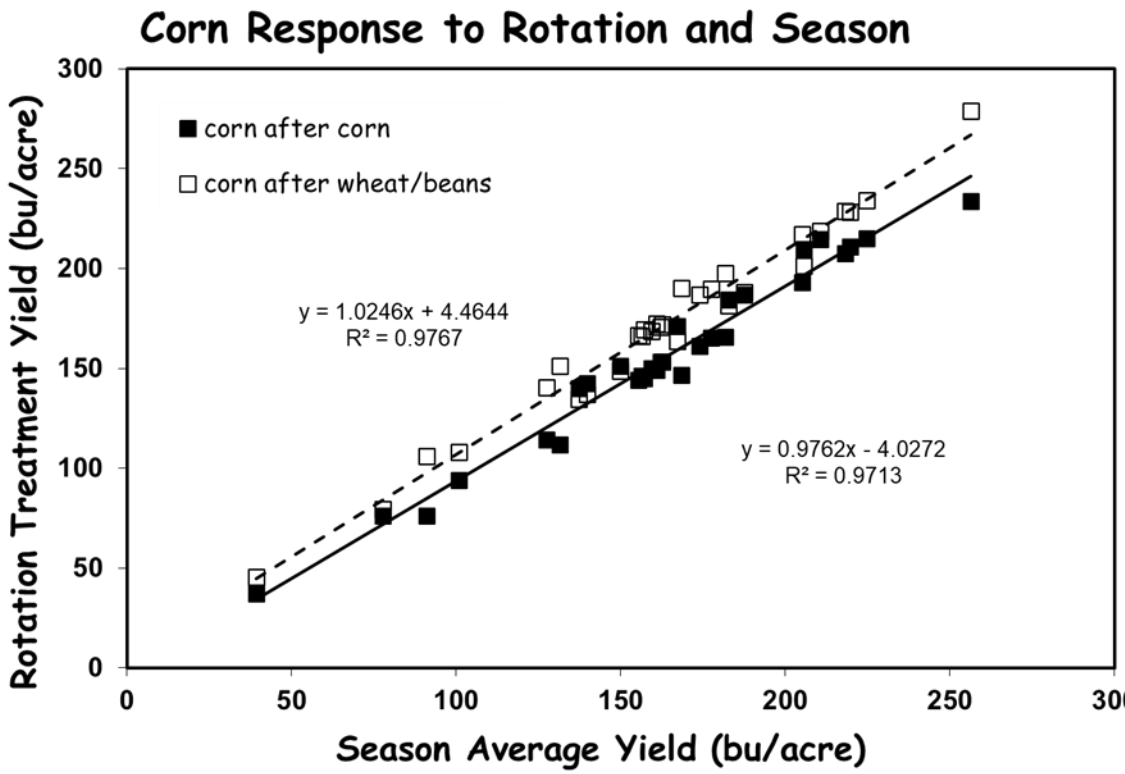

Figure 2. Corn grain yield response to season/production year and crop rotation. 2014-2019 Lexington, KY .

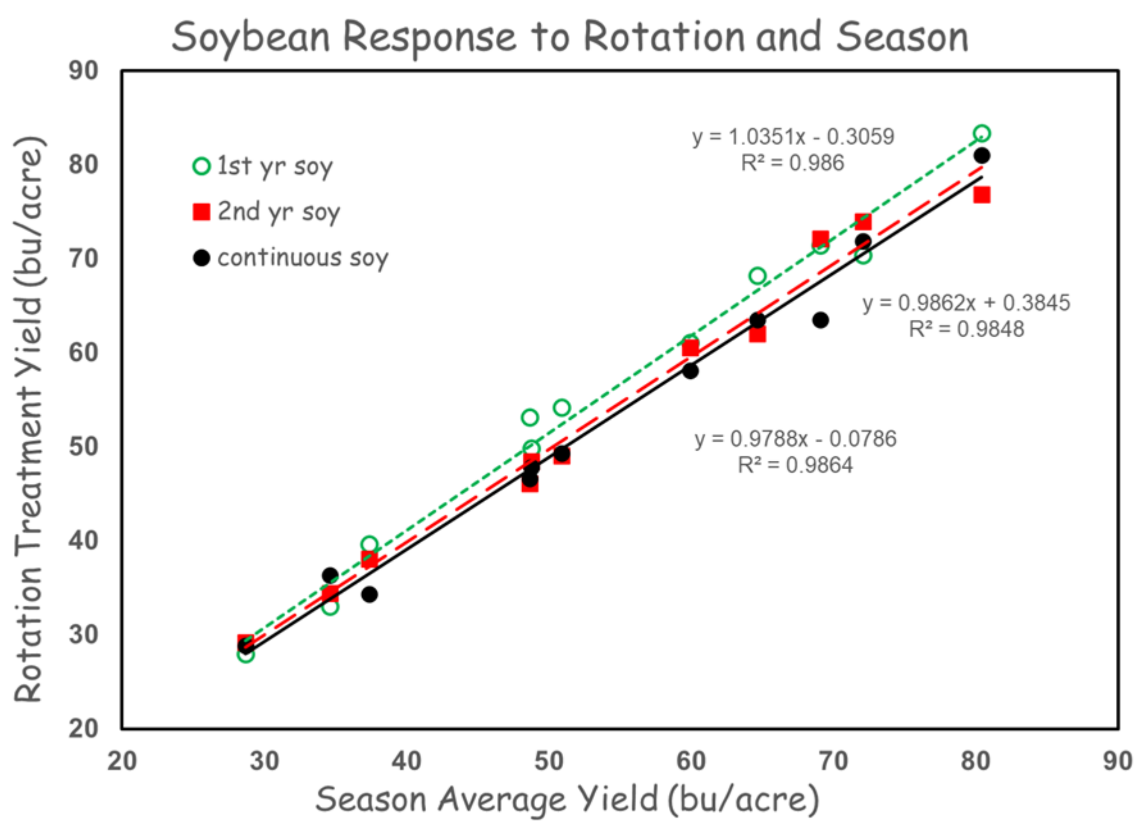

Figure 3. Soybean grain yield response to season/production year and crop rotation. 2014-2019 Lexington, KY.

The ‘rotation effect’ is one of the earliest known manifestations of soil health – reported in ancient Roman agricultural texts. Most of us understand the benefits of crop rotation without knowing exactly how/why the ‘rotation effect’ occurs. The ‘rotation effect’ is derived from the soil, likely a change in soil microbiology brought on by changing the crop species production sequence and thereby improving soil health and increasing grain crop productivity. Most grain producers are promoting soil health every production season.

Hendrix, J.W, B.Z. Guo, and Z.-Q. An. 1995. Divergence of mycorrhizal fungal communities in crop production systems. *In* The Significance and Regulation of Soil Biodiversity. Eds. H.P. Collins, G.P. Robertson, and M.J. Klug. pp. 131-140. Kluwer Academic. The Netherlands.

Johnson, N.C., P.J. Copeland, R.K. Crookston, and F.L. Pfleger. 1992. Mycorrhizae: Possible explanation for yield decline with continuous corn and soybean. Agron. J. 387-390.

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Save the Date

Feb. 01, 2024

UK Winter Wheat Meeting

James E Bruce Convention Center
Hopkinsville, KY

Increasing Availability of Renewable Diesel with a High Oil – Low Protein Soybean Variety

We all know that greenhouse gas (GHG) emissions must decrease rapidly to limit global warming and prevent catastrophic climate change. The transportation sector is a big contributor to GHG emissions (approximately 30% of the US total emissions) and biofuels can play a significant role in reducing these emissions. Biodiesel and renewable diesel made from vegetable oils can replace petroleum diesel in long-haul trucks and shipping. Biodiesel blended with petroleum diesel and renewable diesel are 'drop-in fuels' that can be used without modifications of diesel engines.

The U.S. Energy Information Administration expects the production of renewable diesel in the U.S. to reach 1.8 billion gallons per year by 2024 (compared to 0.6 billion gallons per year in 2020). Diverting that much vegetable oil to fuel production will greatly increase the competition between food and fuel production. The development of a high oil – low protein soybean variety would provide a partial solution to this dilemma. A high oil – low protein variety would increase oil production per acre, reducing the acres needed to meet the potential demand for renewable diesel.

Breeding for high seed oil concentration in soybean is difficult because higher oil concentrations are directly related to lower protein concentrations and protein contributes significantly to the commercial value of soybean seed. When breeders increase oil concentration, protein concentration usually goes down resulting in a variety that is unacceptable for routine production. It should be possible, however, to significantly increase oil concentration if the protein concentration is allowed to decrease. Historical data describing the inverse relationship between oil and protein concentrations suggests that the oil concentration could reach 35% if the protein concentration dropped to 5% (current varieties are about 20% oil). This approach would produce a unique new variety- essentially a new crop - that would be grown only for its oil and segregated from commodity soybean. This 'new crop' could be given a new name to help differentiate it from commodity soybean.

One of the advantages of this approach is that this 'new crop' would still be soybean with the high yield and improved agronomic characteristics resulting from 100 years of intense breeding activity. The management practices, herbicides, and pesticides for the production of this 'new crop' are already available along with a large pool of experienced growers.

Another advantage stems from the fact that soybean is a legume and does not require N fertilizer. Eliminating N fertilizer and the GHG emissions associated with its production reduces the carbon footprint of renewable diesel providing soybean with an advantage over other oil crops (such as canola, carinata, pennycress and camelina) that require N fertilizer.

Increasing production of conventional soybean varieties to meet the forecast demand for renewable diesel could result in a glut of soybean meal on the market. This new high oil – low protein soybean variety would not produce 48% soybean meal, so it would help reduce excess meal supplies.

A high oil-low protein variety will increase the oil production per acre but is not realistic to expect it to meet the enormous demand (currently 46 billion gallons per year) for diesel fuel by the U.S. transportation sector. Growing a new high oil variety (35% oil) on the entire U.S. soybean acreage (84 million acres, average for 2018 – 2022) and assuming an average U.S. yield (2018 to 2022) would produce only roughly 20% of the U.S. yearly diesel consumption. Clearly, a high oil soybean cannot supply the total needs of the transportation sector, but it can help the sector transition to greener fuels (hydrogen, green ammonia, electricity). Changes in agricultural production systems and dietary habits as society adjusts to a changing climate may make more land available for biofuel production. For example, a shift to a plant-based diet or reduced demand for ethanol due to an increase in electric cars could significantly reduce corn production, making more land available for oil production.

Our current knowledge of the genetics of soybean seed composition suggests that it may be possible to produce a high oil – low protein variety. Such a variety would fit right into current production systems and the increased oil production per acre would contribute to the shift away from fossil fuels that is needed to avoid climate catastrophe.

Adapted from Egli, D.B. 2023. Expanding the Availability of Soybean Oil for Renewable Diesel with a High Oil – Low Protein Cultivar. Crop Science (https://doi.org/10.1002/csc2.21133).

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KCHC
Kentucky Crop Health

Feb. 8, 2024 - National Corvette Museum - Bowling Green, Ky.

Speakers include University of Kentucky Extension Specialists
and invited nationally prominent Extension Specialists from across the United States

Thomas Butts
University of Arkansas

Topic: Drone Herbicide Applications: What Do We Need to Know for Success?

Nicholas Seiter
University of Illinois Urbana-Champaign

Topic: Above- and below- ground traits for insect management in corn – new tools, old pests, and resistance

Gregory Tylka
Iowa State University

Topic: Soybean Cyst Nematode: Past, present, and future

Carl Bradley
University of Kentucky

Topic: Red Crown Rot of Soybean: Disease Management and Potential Impacts of this New Disease on Soybean Production in Kentucky

Travis Legleiter
University of Kentucky

Topic: Dealing with the Stretch - Early Planted Soybean and Weed Control

Raul Villanueva
University of Kentucky

Topic: Abundance of Emergent Pests in the 2022-23 Corn and Soybean seasons in Kentucky

Kiersten Wise
University of Kentucky

Topic: It's always something! New corn disease concerns for Kentucky

Martin-Gatton
College of Agriculture, Food and Environment
University of Kentucky.

National Corvette Museum

Tickets on sale now - breakfast and lunch included
Scan QR Code or visit: https://kchc2024.eventbrite.com
(non-refundable after Jan. 25, 2024)

CREDITS — CCA: 5 CEUs, IPM — PAT: 6 CEUs Category 1A (Ag Plant); 1 CEU Category 11 (Aerial)

UPCOMING EVENTS

2023 Fall Crop Protection Webinar #4
Dr. Villanueva
November 30, 2023

2024 Winter Wheat Meeting
February 1, 2024

Kentucky Crop Health Conference
February 8, 2024

Italian Ryegrass Control Field Tour
March 28, 2024

Wheat Field Day
May 14, 2024

Pest Management Field Day - IPM Grain Crops
June 23, 2024

Corn, Soybean & Tobacco Field Day
July 23, 2024

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LEXINGTON, KY 40546

Disabilities accommodated with prior notification.