SPECIAL EDITION

Beyond the Bean®

From seed to harvest. From the farmer to the world.

CHECKOFF SHOOTS FOR THE MOON

Lift off to a 60 Bu/A national yield average by 2025
*See more on page **4***

Mapped genomes could hold key to higher yield
*See page **6***

Epigenetics pushes yields into the space age
*See page **8***

Potential for big yields already exists
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From the soy checkoff chairman:

BREAKING THE 60 BU/A YIELD BARRIER

Like a lot of my fellow soybean farmers, I can remember my father farming the same land my sons and I do today. And one of the things I remember clearly is his average yield of about 20 bushels an acre.

That wasn't bad for the 1960s and 1970s in Madison, Minn. It's almost what south-central Illinois soybean farmer George Meyer (page 13) got on his family farm in the same period, a few hundred miles to the southeast of us.

But what's next? Your soy checkoff has set its sights on bumping up average soybean yields across the United States to 60 bushels an acre. We know that this is very doable since, like the Meyers', farming operations all over the country are getting much more than this now, especially under very tight management.

In this issue of *Beyond the Bean*, we take a look at what's next in soybean yields. We examine how soy-checkoff-funded research going on today is helping to create the building blocks for innovation tomorrow – innovation that we farmers count on for maximum profitability.

This innovation is important, but it won't do any good unless farmers apply basic management practices. Turn to page 15 to read about seven things farmers should be doing to maximize yield.

After all, it's innovation that got us here. New seed technologies, including enhancements through biotechnology, have played a major role, helping us produce more with less. Advancements in precision-ag equipment have helped us be much more efficient on our operations than our fathers could ever dream.

And at the rate we're going, I'm sure that the generations coming after us will be able to do things we can't imagine now. Just as I'm sure that my grandfather's generation couldn't imagine landing a man on the moon before Neil Armstrong took that "giant leap for mankind" on July 20, 1969.

So let's shoot for the moon, shall we? Your checkoff is. My 69 fellow soybean farmers entrusted with investing your checkoff dollars certainly are. They're investing in research at universities and extension programs all over the nation focused on fighting whatever stands between us and maximum yield. They're pushing the limits of what we think is possible today so our kids and grandkids can have a better future.

Isn't that what it's all about?

Jim Call, USB Chairman
Madison, Minn., soybean farmer

WHAT FARMING PRACTICES HAVE HELPED YOU INCREASE YIELDS?

FENCEPOST

Gregg Hora
Fort Dodge, Iowa

Planting in optimal conditions, plant spacing and evenness of plant emergence, in-season foliar plant nutrition, nitrogen types and rates, placement location and split timing.

Quint Pottinger
New Haven, Ky.

Using a harvest monitor last year, we were able to compare varieties specific to fields and field zones. Helping us diagnose problems on one field helps us be more proactive in preparing other fields on the crop rotation.

Dawn Scheier
Salem, S.D.

Utilizing test-plot results from not only multiple hybrids, but also plots showcasing different fertilizer rates and timing of nitrogen application, fungicide and other products.

CHECKOFF SHOOTS FOR THE MOON

Like JFK's goal to land a man on the moon by the end of the sixties, the checkoff aims for a 60 Bu/A national yield average by 2025 **By Margaret Reeb**

"The Eagle has landed."

With this iconic phrase, Neil Armstrong announced Apollo 11's touchdown on the moon on July 20, 1969. Moments later, Armstrong leapt onto the moon's cratered surface and planted an American flag.

It's a moment ingrained in history, an illustration of the will and intelligence of humankind. But it didn't come without work. It took years of planning to put Apollo 11 and its crew on the moon, as it does for many great achievements.

Right now, the soy checkoff is hard at work on its own groundbreaking mission: a 60-bushels-per-acre national yield average by 2025, about 20 bushels higher than the current average.

"Yield research has been the center of checkoff research since the organization was established," says Gregg Fujan, who leads the United Soybean Board's (USB's) supply program. "Projects have focused on expanding, as well as protecting, U.S. soybean yields."

As you read through the following pages, you'll learn about the checkoff's three-pronged research effort to harness the power of the sequenced soybean genome and bring about a dramatic increase in yield. As part of the effort, scientists are studying nested association mapping (NAM), RNA sequencing and epigenetics.

This work builds on a huge research achievement of the recent past: the mapping of the soybean genome. In 2008, with the help of checkoff-funded genomic tools, the soybean became the first major crop plant to have its genome sequenced. The genome has been helping researchers develop traits to benefit farmers ever since.

As the corporate sector drives innovation, the kind of public, exploratory research the soy checkoff helps fund often provides a starting point.

"Research and development, or R&D, are often used together, but they are really different things," says Joe Byrum, global head of soybean R&D at Syngenta. "Private companies are very focused on the development side, and public research conducts a lot of the basic research that becomes extremely valuable during development processes."

CROSSING ASIAN AND U.S. GERMPLASMS SPEEDS UP YIELD

A new biodiversity project, funded by the checkoff, is introducing exotic Asian soybean germplasms into U.S. breeding programs to advance genetic diversity and increase the speed of yield improvement. Farmers are leading the effort by visiting field locations to evaluate and select the next generation of crosses.

INPUT APPLICATION TIED TO YIELD

Preliminary results of year five of USB's Maximization of Soybean Yield Through Agronomics Project showed:

- Yields were more responsive to inputs in the North
- A wide variety of treatments did very little for yields
- A prophylactic insecticide application proved most successful in controlling insects

Steve Schnebly, senior research manager at DuPont Pioneer, agrees.

"I don't think there's anyone who would say public research efforts like mapping the genome haven't been extremely helpful to private companies," says Schnebly.

Like the genome mapping, the checkoff's current three-pronged research effort will help give researchers tools that could lead to higher-yielding varieties.

The first prong of research tackles NAM, a technique that allows researchers to understand how traits pass between generations of soybean plants. Multiple checkoff-funded projects are using this technique to create a database of "milestone markers," or genes responsible for leaps in soybean yield. Like NASA's Project Mercury, which sent a manned spacecraft into orbit and helped scientists prepare for future flights, these NAM studies will help speed up the breeding process of soybeans with better techniques to identify desirable traits.

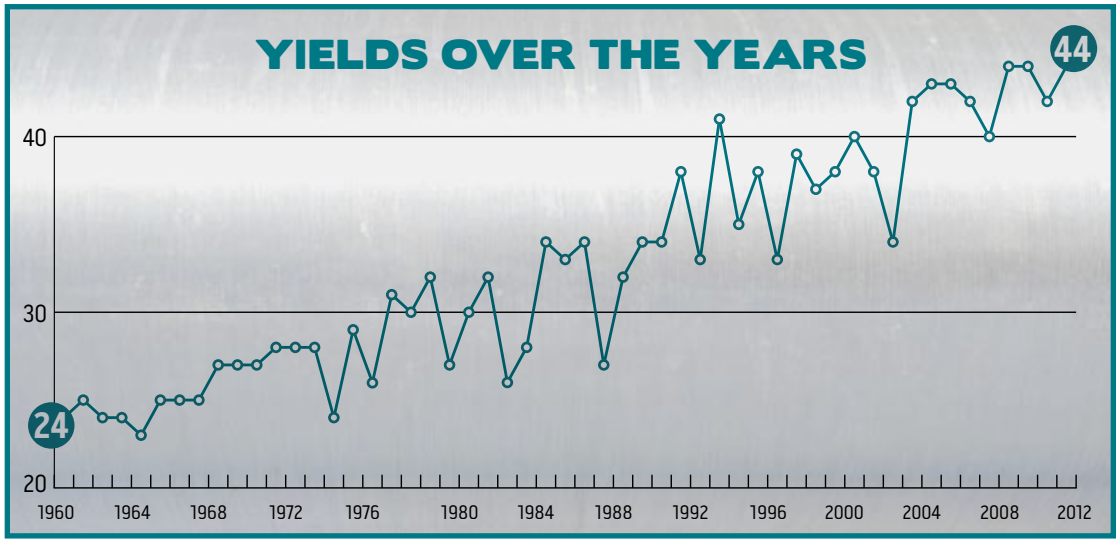
The second prong focuses on RNA sequencing. Just like NASA's Gemini Project helped scientists develop the docking procedures necessary for the success of a moon landing, this RNA-sequencing project will help soybean researchers determine how soybean gene function modifies plant growth. The results of these studies will be put into a database available to researchers exploring potential new traits who want to home in on specific areas of the soybean plant.


Gregg Fujan

Just like NASA's Apollo Mission pushed humankind further into the final frontier, the third checkoff research prong involves a new and expanding scientific field called epigenetics. Epigenetics research studies how genes are expressed. It also plays a role in determining how soybean plants respond to environmental factors. The checkoff project could enable breeders to exploit these epigenetic responses by engineering plants that respond better to the weather, disease, pests and more.

This 60-bushels-per-acre goal is an ambitious endeavor, much like the mission to put a man on the moon. But you only need to look at the farmers achieving extremely high yields now – in some cases, more than 100 bushels per acre – to know that the goal is achievable. For example, you'll read about Arkansas farmer Nelson Crow and other bin-busting farmers who appreciate the power soybeans can achieve with the best agronomic factors in play.

"Checkoff-funded production research is incredibly important to U.S. soybean farmers' profitability," says Fujan of USB. "With the advancements we help bring to market, the national trend line for yield should continue to grow at an even faster rate."



HIGH OLEIC SOYBEAN VARIETIES PROVIDE YIELD AND QUALITY

High oleic soybeans produce a better-functioning oil for baking and frying customers and perform comparable to farmers' other varieties in the field, so they don't have to choose between a product their customers demand and performance in the field.

- Monsanto Vice President for Industry Affairs Jim Tobin says, "If we can use high oleic to increase the value of the soybean oil segment, it will add to the overall value of the crop."
- DuPont Pioneer Vice President of Global Americas Alejandro Munoz says, "We want to make sure that every product that we put in the market space has elite genetics and agronomics."

NORTHERN AND SOUTHERN SOYBEAN TRAITS CROSSED TO IMPROVE YIELDS

Checkoff researchers at the University of Tennessee are crossing U.S. northern and southern soybean varieties to obtain genetic knowledge for yield improvement. Using the germplasm from this project, soybean breeders are developing higher-yielding varieties to meet customer needs.

THE START OF SOMETHING BIG

Scientists study mapped genomes for genes that impact yield **By Laura Smith**

Achieving big goals starts with first steps. Just like NASA's Project Mercury provided the United States with the groundwork for manned space travel and eventual moonwalks, two soy-checkoff-funded soybean research projects are building a launch pad for farmers to eventually reach a national yield average of 60-bushels-per-acre soybeans by finding the locations of genes responsible for yield.

In her lab at Iowa State University, U.S. Department of Agriculture researcher Michelle Graham and her team are sequencing the genomes of 100 soybean cultivars referred to as "milestone cultivars." A cultivar is a plant, in this case a soybean plant, selected for desirable traits. These soybeans represent yield improvements over the past 90 years and genetics that have been heavily adopted by U.S. soybean farmers.

"This project will generate hundreds of thousands of new molecular markers that will be released to public and private researchers for use in soybean improvement," says Graham. "We are developing cutting-edge visualization tools that will make this information easier for researchers to use."


Brian Diers, Ph.D.

To provide comparison, Graham's team is also sequencing the soybean lines that were originally introduced in the United States. By looking at these genomes side by side, the team will start to identify the genes and gene combinations that have been responsible for yield increases.

TWO SOY-CHECKOFF-FUNDED SOYBEAN RESEARCH PROJECTS ARE BUILDING A LAUNCH PAD FOR FARMERS TO EVENTUALLY REACH A NATIONAL YIELD AVERAGE OF 60-BUSHELS-PER-ACRE SOYBEANS.

At the University of Illinois, fellow soybean researcher Brian Diers, Ph.D., works with his team to delve into soybean varieties to find the location on chromosomes of important genes – such as those impacting yield and composition. Called nested association mapping (NAM), his project will help save time in field trials.

"Once we know their locations, we can do a much better job of selecting these genes," explains Diers. "Farmers want varieties with better yield and composition, and breeders want to deliver that. The more information we have about where genes controlling yield and composition are located, the better the job we can do to deliver these varieties."

As part of the checkoff's effort to reach a 60-bushels-an-acre average, these researchers are digging into the soybean genome in ways unimaginable to previous generations. And this work could help provide soybean farmers with opportunities their forefathers probably never anticipated.

"It is exciting how far genetic technology has advanced in even the last five years, and this project is one way we can harness this technology to improve soybeans," adds Diers. "We now have amazing technology that can be used to very precisely identify the locations of genes."

ONE GIANT LEAP FOR YIELD

RNA sequencing helps locate the genes responsible for yield and other desirable traits **By Laura Smith**

In the story of space travel, NASA's Gemini Program was a necessary middle step between knowing that manned spaceships were feasible and stepping on the surface of the moon. A genetic technique known as RNA sequencing provides a similar middle step between current soybean yields and the next phase of the soy checkoff's work to increase the national soybean yield average to 60 bushels per acre by 2025.


Gary Stacey, Ph.D.

In every cell that makes up a soybean plant, all of that plant's genes are present. For example, a soybean leaf cell has the genes in it to be a flower or a pod or a stem. The difference is that only the genes relevant to that part of the plant – in this case, the leaf – get expressed. The expressed genes produce RNA, and by sequencing the RNA, researchers are able to find out what genes are expressed in each area of the plant.

At the University of Missouri, Gary Stacey, Ph.D., works with a team of researchers to grow soybeans under various stressful conditions – heat, drought, pathogen infections and others. They then take samples of the different parts of these soybean plants and isolate the RNA. They send the isolated RNA to the Department of Energy Joint Genome Institute for sequencing to show how the plants react under these environmental stresses.

This information is all recorded and mapped to provide what Stacey refers to as a "soybean genome atlas." He explains that researchers can use this information the way a driver would use a road atlas. If a researcher has an idea of which gene might be responsible for a particular response, such as drought tolerance, that researcher can check the genome atlas and quickly narrow down where those genes are expressed in the plant. This map will save researchers time in finding the genes that are responsible for yield and other desirable traits.

"When we sequenced the genome, we thought of it as a big step forward, because it enabled other things to happen," adds Stacey. "These are resources we are developing to enable us to do more research more quickly and efficiently."

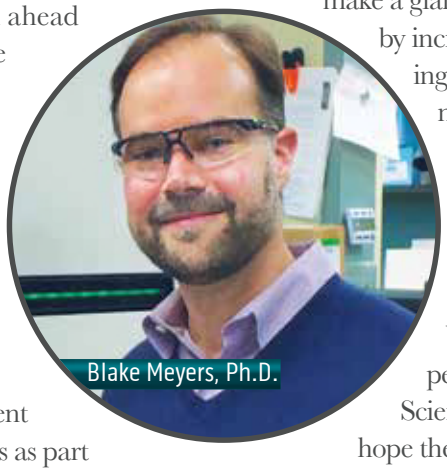
Just as the Gemini Program has been deemed a bridge to the moon, RNA sequencing is providing researchers with the map to 60-bushels-per-acre soybeans.

"THE SOYBEAN HAS AT LEAST 45,000 GENES. OF THOSE 45,000, ONLY A SMALL SUBSET ARE GOING TO BE IMPORTANT FOR AGRONOMIC TRAITS – THINGS LIKE YIELD AND DROUGHT RESISTANCE BUT ALSO OIL OR PROTEIN CONTENT. SO ANYTHING THAT ALLOWS US TO MORE RAPIDLY IDENTIFY THESE GENES WILL ALLOW US TO DO A LOT OF USEFUL THINGS."
- Gary Stacey, Ph.D.

YIELD AT WARP SPEED

Epigenetics can help control expression from gene to gene to boost yield **By Jeff Brown**

When NASA launched its Apollo space program in 1961, the culmination of all previous American work to land man on the moon, it wasn't exactly sure what those first astronauts would find if they got there. But the program forged ahead anyway to make sure Americans were the first to achieve the feat.


Blake Meyers, Ph.D.

Similarly, soybean scientists are now studying a genetic component called epigenetics as part of a larger effort to increase U.S. soybean yields. They're not really sure what they'll find as they continue exploring, but they think it might help bring about the kind of overall soybean-yield improvement that farmers currently stare off into space dreaming about.

Right now, epigenetics is a black box that scientists are still learning how to use, says University of Georgia soybean researcher Scott Jackson, Ph.D.

Epigenetics can be compared to a dimmer switch that can turn lights on and off as well as change their brightness. Likewise, epigenetics serves as a switch that determines whether a soybean plant expresses certain genes, as well as the intensity with which those genes are expressed.

Research to better understand epigenetics is part of a major soy-checkoff-funded project to help U.S. soybean farmers make a giant leap by increasing the national soybean yield average to 60 bushels per acre. Scientists hope their research will reveal lots of switches inside the box and shine a light on the path to higher soybean yields and a brighter future for U.S. soybean farmers.

"The goal of the checkoff project is really to understand how many of those switches are there in the background that we don't know about," says Jackson, a collaborator on the checkoff project.

Researchers have determined that epigenetics plays a role in how plants respond to pathogens and pests, according to Jackson. Continued research could help scientists predict those genetic responses and use them to farmers' advantage, such as by engineering plants for better protection against a virus, for example.

"HAVING SOYBEANS THAT CAN RESPOND TO THE WIDEST RANGE OF ENVIRONMENTS WILL BE CRITICAL TO ACHIEVING THAT GOAL OF 60 BUSHELS AN ACRE."
- Blake Meyers, Ph.D.

Yield is a combination of genetics and the environment, says University of Delaware Professor Blake Meyers, Ph.D., another collaborator on the checkoff's yield project. And the key to higher yields is knowing which genetics to deploy in a given environment.

"The environment is not easy to predict, if it can be predicted at all," says Meyers. "So having soybeans that can respond to the widest range of environments in a beneficial way – drought tolerance, for example – will be critical to achieving that goal of 60 bushels an acre."


Scott Jackson, Ph.D.

TO INFINITY AND BEYOND

Yield contest winners prove soybean potential

By Nicole Kraus

Eleven. That was the average number of soybean bushels per acre U.S. farmers harvested in 1924. For those farmers, reaching today's national average yield of 43 bushels per acre may have sounded as crazy as sending a man to the moon.

But NASA did send a man to the moon, and the soy checkoff hopes to propel farmers past current yields, to their own lunar landmark: a 60-bushels-per-acre national yield average by 2025. Although this may seem like a distant goal, it's actually closer than you might think.

Below, you'll read about a farmer who excelled in his state soybean-yield contest this year. As you'll see, the soybean genetics available now are capable of producing out-of-this-world yields. But there's still a lot of room for exploration into how to unlock that yield potential on a broader scale.


Nelson Crow

Broken Bushel Barrier: Arkansas Farmer Tops 100 Bushels/Acre

For Nelson Crow, the 2013 growing season was literally one for the record books. The southeast Arkansas soybean farmer became the first farmer in the state's history to break the 100-bushels-per-acre barrier.

But despite all the hard work Crow put into his fields this year, his excitement extended to other generations.

"I think I was more excited for my grandfather than for me," says Crow. "He told me he didn't think he would see that in his lifetime. I was really proud that I broke the record on his field and he was there to see it."

Crow, who grows soybeans, corn and rice, didn't set out to beat the 100-bushel mark at the beginning of the year. He planted a 3.9-maturity-group soybean, which he didn't think had the ability to yield that high. However, proper management and some extra attention to this particular field went a long way.

Crow's actions prior to planting paid off during the growing season. He used a fall burndown program on the field after harvest in 2012 to keep weeds in check. "When we planted in April, we had just a few winter weeds," he recalls. "The herbicides did a great job of keeping weeds out of the field, and starting with a clean field was important for reaching high yields."

He also samples soil from all of his fields on a two-year rotating basis. Based on the test results, he did not apply fertilizer on the record-breaking field last April.

After emergence, Crow was vigilant about applying fungicides and benefited from the relatively cool weather in the South last summer.

Then, Crow used another trick up his sleeve, applying non-food-grade sugar to the field twice while he applied fungicide at a rate of one pound per acre. "Once you get over 80 bushels per acre, the additional sugar proteins help prevent the plants from dropping their pods." He also applied urea to the field to increase available nitrogen in the soil.

Crow's successful equation included timely irrigation. He began irrigating the field 57 days after emergence and then irrigated every seven days after, assuming it had not rained.

Out of a 207-acre field, Crow marked a 40-acre plot for his trials. And while the plot reached the 100-bushel mark, the rest of the field still averaged 85 bushels per acre.

Because of the time and financial investment needed to intensely manage his plot this year, Crow doesn't plan to replicate his 2013 actions across all of his fields in 2014. However, he does plan to use the plot as a learning tool for what can be done to continue increasing yields.

"We plan to put some of the practices into effect on other fields to see what we can do to sustain yields at 80 to 90 bushels per acre," he says.

He's not finished reaching for 100-plus yields yet. Crow has plans for three trial locations in 2014 to experiment again.

A SOYBEAN AND SPACE ODYSSEY

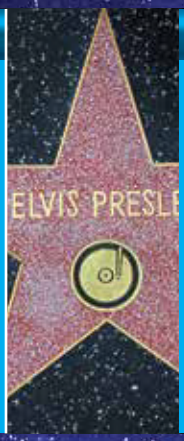
The first soybeans came to the United States before the Civil War. And as the country has grown into a superpower that puts men on the moon and rovers on Mars, soybeans have taken root, becoming an integral part of state and national economies. Soybeans have also become an integral part of American culture, growing in fields along rural roads, feeding families or fueling cars. Take a look back though historic and cultural milestones and watch soybeans and space programs grow.

1929

10,000 soybean varieties are imported from China for U.S. researchers to study. Their findings help the United States quickly become the world's leading producer of the oilseed.

1955

McDonald's is founded.



1956

On September 9, 1956, Elvis made his first appearance on The "Ed Sullivan Show."

1957

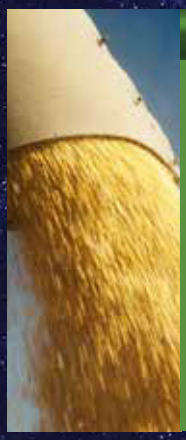
The Soviet Union launches Sputnik 1, creating ripples around the world.

1958

The National Aeronautics and Space Administration (NASA) is established.

1959

Brazil ends a decade of increasing soybean production with a record harvest of 5 million bushels. It later becomes one of the United States' major soy competitors.



1968

Annual U.S. soybean production reaches 1 billion bushels.

1969

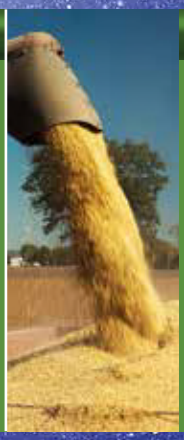
Apollo 11 touches down on the moon, and astronauts Neil Armstrong and Buzz Aldrin take a stroll on the surface.

1970

In 1970, bacon was 95 cents a pound. Today, animal agriculture is the No. 1 customer for U.S. soy, consuming about 97 percent of U.S. meal.

1973

U.S. soybean exports are worth about 5 percent of all exports.



1977

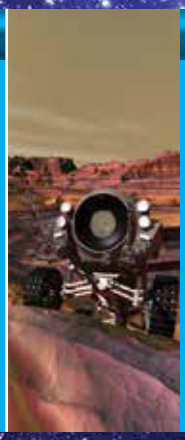
U.S. farmers' soybean yields reach a national average of 30 bushels per acre for the first time.

1994

Glyphosate-resistant soybeans gain commercial approval for use in the United States. The national soybean yield average reaches 40.

1995

The Internet becomes popular and will soon be incorporated into nearly every aspect of life.



1997

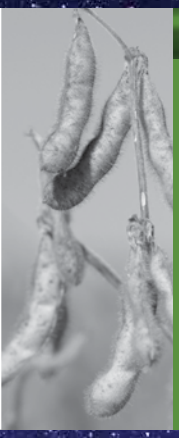
Pathfinder sends back images of Mars.

2001

John Deere uses check-off-funded technology to manufacture soy-based polymer for rear combine panels.

2003

The checkoff partners with the USDA to develop an early-warning system for soybean rust.

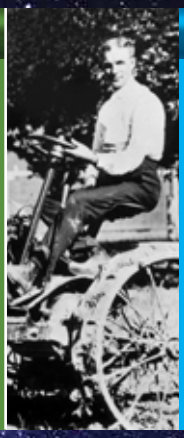


1939

U.S. soybean production reaches 91 million bushels annually.

1940s

World War II creates a shortage of domestic oils and fats. As a result, commodity prices zoom upward.



1941

Henry Ford smacks the bumper of his "Soybean Car" to demonstrate the durability of soy-component automotive panels and parts.

1945

World War II ends, leaving the United States and the Soviet Union as the world's only superpowers.

1952

Because of its availability and protein content, soybean meal becomes a staple in poultry and livestock feed. Demand for the oilseed balloons.

1960

Alfred Hitchcock's "Psycho" hits theaters, and the United States televises presidential debates for the first time.

1961

Soviet Yuri Gagarin orbits the Earth and becomes an international hero. Three weeks later the U.S. completes the country's first human space flight.

1962

Soybeans and soybean products have been the leading U.S. agricultural export earner since 1962.

1963

Martin Luther King Jr. delivers his "I Have a Dream" speech on the National Mall.

1966

The popular television series "Star Trek" premieres.

1981

Columbia is the first shuttle to successfully leave Earth. It will make 27 more trips into space before disintegrating while reentering the Earth's atmosphere in 2003.

1987

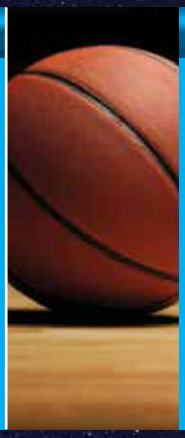
An Iowa newspaper successfully tests soybean oil in a practical printing run. About one quarter of commercial printers in the U.S. use soy ink today.

1989

The Berlin Wall falls.

1990

The Hubble Telescope is launched. Because of its size and versatility, the machinery will prove an indispensable research tool.

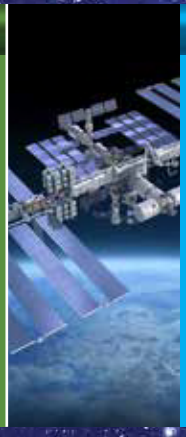


1993

Michael Jordan retires from the NBA to play minor league baseball. (He later returns to the NBA.)

2004

Annual U.S. soybean production reaches 3 billion bushels.



2008

International Space Station launches with the mission of serving as a laboratory, observatory and factory in space.

2009

Using tools funded by the checkoff, The National Science Foundation maps the soybean's full genetic code.

2012

Checkoff-funded research identified a key genetic structure for resistance to the billion-dollar yield robber, soybean cyst nematode (SCN).

20??

Average soybean yields in the United States reach 60 bushels per acre.

LET'S TALK ABOUT YIELD

Farmers discuss yields today and the challenges they face **By Nancy Hallahan**

With 2014's planting season underway, farmers everywhere are making plans and preparations to maximize their next harvest. Depending on where you farm, in recent years you've undoubtedly been challenged by floods – or drought – or an unusually wet spring. In some states, possibly all in the same season. But throughout it all, farmers are resilient, keeping their focus on maximizing yields.

We invited farmers to join yield-related discussions on the United Soybean Board's Facebook page, and it didn't take long for farmers to start talking about their favorite topic.

Thanks for sharing your thoughts about yield – the good, the bad and the challenges it creates. Here's a sampling of these conversations:

SCAN THIS PAGE
TO JOIN THE CONVERSATION ON THE USB FACEBOOK PAGE.

If you could invent one new technology to help you maximize soybean yields, what would it be? (The sky's the limit!)

- A weather machine. **(Gabrielle M.)**
- Improved pest resistance. **(Kevin H.)**
- Improved water optimization. It never seems to rain at the right time. **(Adam W.)**
- Starter fertilizer seed coatings. And more insect- and fungus-resistant crops. **(Tanner B.)**
- Drought tolerance. **(Mark B.)**

How do you celebrate high yields on your farm?

- Hopefully, with a check from the elevator. **(Bryan S.)**
- Purchase ground. **(Mark N.)**
- Depends on how high the yields. Usually high yields = more profits. On our farm, when we have high profits we trade our older equipment. It's a win-win. **(Derek D.)**
- Out here we like to do the yield bump! Not a fist bump. **(Zach F.)**
- Put the money into savings. **(Rusty M.)**
- Have a beer with other area farmers! **(Dave M.)**

What is the biggest roadblock you face keeping your yields from skyrocketing?

- Weather **(Chris M.)**
- Length of growing season **(Peter K.)**
- Sudden death **(Kyle P.)**
- Rain **(Bryan V.)**

THE YIELD GENERATION GAP

Yield conversations take place not only in farming communities, but between generations of farm families as well. The Winsor family has been farming since the early 1940s, when Jim and Helen Winsor began farming in Grantville, Kan. Son Russell and daughter-in-law Pat joined in the 1960s. Their sons, Andy (with wife LaVell) and Ben (with wife Emily) followed in the 1990s and 2000s. The three generations recently compared their thoughts on yield.

If you had a crystal ball allowing you to see into the future, where would you predict national soybean yields will be in 25 years? What about on your farm?

LaVell: "I would predict around 55."

Russell and Andy: "100." The Winsor family members all expect their farm to be on par with national soybean averages, no matter what they are.

If you could invent one new technology to help you maximize soybean yields, what would it be? (The sky's the limit!)

The Winsor family was unanimous on this one – a machine to control the weather! Agronomists always name weather as a top factor contributing to or reducing yield, but it's something we can't do anything about.

How would you describe the soybean yields you are seeing today versus a generation ago?

Russell: "In 1970, we saw 30 bushels per acre."

Andy: "Which increased to about 40 when I was in high school."

Russell: "I remember a yield in the mid-1990s – a dryland farm yield of 72 bushels per acre."

Three generations of the Winsor family

GENERATION YIELD

Farm family tracks soybean yield growth through five decades **By Lisa Mills**

It's not often that three generations agree on what the future holds, but that's exactly what happened when the owners of Meyer Farms recently discussed where they think soybean yield is headed. The Meyer family farms approximately 1,300 acres of soybeans near Carlisle, Ill. All three farmers in the family – George Meyer; his son, David; and grandson, Matthew – not only anticipate plenty of future opportunities to keep increasing yield, but also agree on the biggest obstacle: Mother Nature.

George Meyer, who has been farming for 55 years, thinks advancements in plant health and standability have positively impacted yield.

"Genetics and breeding have come a long way since I started farming, and now I look forward to seeing what new varieties are developed each year," he says. "When I started farming in the sixties, I was pretty pleased when my soybean yield averaged 25 to 30 bushels an acre. Yields began to increase when we first started blending bean varieties in the same field. I anticipated seeing yield continue to increase, but the growth has exceeded my initial expectations."

Active in the farming operation since 1983, David Meyer says he has watched yield steadily increase by five to seven bushels an acre since the early '80s and won't be surprised if farmers see a noticeable yield jump in the next few years.

After graduating from the University of Missouri with degrees in agricultural economics and agriculture systems management, Matthew Meyer came back to work the family farm full time about two years ago. Agreeing with his father, he anticipates bumping up yields significantly in the near future.

"In the last couple of years, I've noticed seed companies focusing a lot of research back on beans," says Matthew, who represents the fifth generation to farm the Meyer land. "I think continuously improving genetics and seed treatments will be huge players in increasing soybean yield. With the growing variety of soybeans currently available, farmers can maximize yield by picking and choosing beans that are just right for every different area of the farm."

"GENETICS AND BREEDING HAVE COME A LONG WAY SINCE I STARTED FARMING 55 YEARS AGO."
- George Meyer, Carlisle, Ill.

In addition to the weather, he anticipates major challenges to yield growth will continue to be disease and weed pressure.

"Some of our fields are getting new weeds that we've not had in our area before," says Matthew. "Weeds that used to be found only in one area of the country are on the move, so we have to remain vigilant and flexible."

The Meyers, who currently average 50 to 60 bushels an acre, won't be surprised to see yields pushing toward 70 or 80 bushels an acre and don't think 100-bushels-an-acre yields will be out of the question in good years.

"I've watched yield steadily improve over the last 50-plus years, but I sure didn't think we'd be talking about 80 bushels an acre in my lifetime," says George Meyer. "Yield growth has exceeded my all my expectations."

Matthew, David and George Meyer (from left) have been tracking changes in technology and yield on their farm for three generations.

AIMING FOR THE STARS

Soy checkoff fellows are the bright stars who advance soybean improvement **By Paul Spooner**

The soy checkoff invests a major portion of its budget every year in research to protect and increase U.S. soybean yields, but a few years ago, the checkoff noticed a shortage in the number of researchers to carry out these studies.

Thus, to continue to move the industry forward and provide farmers with applicable soybean research, the checkoff created a fellowship program to cultivate the next generation of soybean researchers.

This graduate-level scholarship attracts the brightest young minds to soybean-research-related careers to ensure valuable soybean production research continues long into the future.

Eleven fellows later, the program has seen many success stories with individuals pursuing positions from plant breeding at major seed companies to postdoctoral research at land-grant universities, all aimed at ultimately helping drive yields.

We caught up with a few of these fellows to find out where they are now.

CAROLYN FOX, PH.D.

- ***Past Fellow (Started 2008, University of Illinois)***
- ***Postdoctoral Researcher in the Department of Crop Sciences***
- ***University of Illinois at Urbana-Champaign***

Q: What research are you currently conducting?

A: My research is part of the SoyNAM (nested association mapping) project to map soybean physiological traits, such as canopy coverage, leaf nitrogen and photosynthetic efficiency (leaves' ability to turn light into energy), to determine how much energy the plant has available for growth and yield production. The purpose of this research is to find new breeding targets and help develop higher-yielding soybeans.

Q: Why is it important to help cultivate the next generation of soybean researchers?

A: As world populations grow, the demand for soybean products is increasing rapidly. It will be the next generations of researchers that are responsible for meeting the yield needs of the future while also dealing with rising environmental and disease stresses.

LANDON RIES

- ***Past Fellow (Started 2009, University of Minnesota)***
- ***Soybean Molecular Breeding Scientist***
- ***DuPont Pioneer***

Q: How are you contributing to higher soybean yields?

A: As soybeans continue to be a major source of animal feed protein and oil for food and industrial use, future industry growth must rely on innovative research to advance crop productivity. During my fellowship, I studied seeding density and maturity effects on yields, and in my current position, I develop new breeding strategies for northern U.S. soybean breeding programs.

Q: How is the fellowship program recruiting soybean scientists and building partnerships?

A: While it is not a requirement for folks in the program to pursue a career in the soybean industry, I believe people are naturally attracted to what is familiar. Even if they don't end up working directly in the field, having a trained soybean scientist working on another species will still help to educate their colleagues on soybean topics and indirectly promote soy.

LEAH RUFF

- ***Current Fellow (Started 2013, University of Nebraska)***
- ***Soybean Drought Tolerance Researcher***
- ***Researched soybean breeding for M.S. degree***

Q: What soybean research are you working on during your fellowship?

A: I am testing hybrids under different water treatments and evaluating genetic and physiological characteristics. This will help identify and predict populations in a breeding program that are more drought-tolerant and contribute to increased yield in extreme weather conditions.

Q: How is the fellowship program moving the soybean industry forward?

A: The experience I gain through this program will help further the industry as I take that knowledge into postdoctoral research, continue it through additional research in teaching or apply it to develop improved commercial cultivars. It's important to build strong breeding knowledge in the next generation of soybean researchers because we need somebody to take on the world's challenges.

To apply or learn more about the program, visit *www.agronomy.org* or *www.UnitedSoybean.org* and search "USB Fellowship."

COUNTDOWN TO YIELD

Seven tips to help your soybean yield skyrocket each season **By Robin Miller**

Boosting soybean yields doesn't have to seem as far-fetched as a trip to the moon. It begins by understanding the needs of the soybean plant and its environment, then adopting the best agronomic practices and technology to optimize yield.

Ed Anderson, Ph.D., executive director of the North Central Soybean Research Program and senior director of supply and production systems for the Iowa Soybean Association, offers the following checklist to propel soybean yields:

1. **Select the highest-yielding genetics and maturity groups.** Consult with seed reps and crop advisers to plant varieties with the highest yield potential and the best defensive traits for your fields and environment.

2. **Use best practices for production and management.** Consider various tillage and conservation practices and plant full-season varieties early. Use a seed treatment to protect the seed and give the plants good emergence and stand while protecting the roots. Speak with sales advisers, commodity group staff, university researchers and extension specialists, or conduct your own experiments to find out which spacing and seeding rates work best in your soil and growing conditions.

3. **Analyze seed treatment needs and applications.** Data indicate that many fungicides are consistently beneficial, but plant health and other seed treatments depend on your operation.

4. **Optimize soil organic matter and fertility.** In the past, few farmers thought about adding nitrogen to soybeans. However, there is some data now to indicate that in high-yielding environments, soybeans may benefit from more nitrogen. Farmers should look at the overall soil health and determine if it is optimal for higher yields before deciding to add nitrogen.

5. **Manage traits, genetics, chemistries and the environment.** Sustainability and consistently high yields depend on integrated approaches to preserving the effectiveness of genetics, traits and chemistries for weed, insect and pathogen control; nutrient management; and soil and foliar chemistry applications. Farmers must continually manage different modes of action, production practices and genetics, because constant exposure to any one chemistry or trait is never a good thing. Ask yourself whether you are managing your acres to allow for the most effective, long-term yield success.

6. **Conduct in-season field scouting for economical and effective insect and disease management.** Although you can't control the weather, you can control factors such as insect and disease pressure. Know when to treat for those pressures or ask for help.

7. **Utilize crop rotations.** Consider effective yield-increasing rotations such as corn/soy and corn/soy/cover crop/hay. These rotations work nicely to break insect and disease cycles; allow more efficient management of weeds; and enhance soil health, water management and crop yields.

To increase yield and learn how to experiment with different management practices on your farm, contact your state commodity association staff, university soybean researchers and extension specialists, crop advisers and your seed and chemical sales and agronomy experts.

FARMING THROUGH GLASS

Farmers study how the next tech trend can impact agriculture **By Gina Presley**

It's a bird. It's a plane. It's a farmer using Google Glass? The new wearable technology allows users to see and control a projected computer screen to the right of center in the user's field of vision. In other words, imagine viewing a little computer screen on the inside of your glasses.

Superhuman? Maybe not. The next tech trend farmers can use to potentially boost yield? Possibly.

Bruce Rasa, an agricultural consultant who owns a farm in Missouri, serves as a volunteer to help farmers explore ways they could use Google Glass.

"With Google Glass, farmers can give consumers a glimpse inside the cab of their planters, sprayers or combines to see that their food is grown in a safe, environmentally responsible way," says Rasa. "These glasses could help create transparency in food production."

Ron Heck, a soybean farmer from Iowa, was one of the more than 500 farmers who tested the device.

"I've been seeing things like Google Glass in science fiction movies and comic books my whole life, but it is still a shock when you use it for the first time," says Heck.

Sure, Google Glass gives users a unique experience, but how does it differ from the technology farmers use today?

Its features are equivalent to a smart phone – but this smart phone is on your face, freeing your hands for things like repairing machinery and scouting fields. Google Glass has the same processor, memory and onboard storage as an iPhone, including a high-definition camera.

Rasa and Heck say Google Glass also helps connect them with others.

"Many farmers find a pest or disease in the field that may be difficult to describe to an agronomist," says Heck. "Google Glass eliminates that problem and allows farmers to instantly connect with others or record the field issue with the built-in camera. The best part – everything is viewed from the farmer's line of vision whether the connection is live or recorded."

While these farmers agree it's not for everyone, they do think the technology could have a place in the farm fields. "Looking into the future, I can see Google Glass providing instant information that will be terrific for farmers and their advisers and will contribute to a healthy yield," Heck predicts.

SCAN THIS PAGE
TO SEE GOOGLE GLASS IN ACTION.

Bruce Rasa

THE ECONOMICS OF 60-BUSHEL SOYBEANS

By Pat Westhoff, director, Food and Agricultural Policy Research Institute at the University of Missouri

A lot of people are working hard to develop ways to sharply increase soybean yields. If these people are someday successful in increasing the national soybean yield average to 60 bushels per acre, the economic implications would be profound.

If yields do rise, simple math shows that net producer revenues will increase if there is no change in production costs or prices. As producers take advantage of the new technology, they will see increased profits and, in turn, will likely expand their soybean production.

But it's not quite that simple. High-yielding technologies that are clearly beneficial to soybean producers when just a few people use them have much more complicated implications when they are more broadly adopted. For example, if the national average yield rises, the resulting increase in supply will reduce the price of soybeans. If demand is growing fast enough, faster yield growth will moderate price increases. If demand is growing more slowly, faster yield growth will actually result in lower prices.

Lower U.S. soybean prices would make our products even more competitive than they already are in world oilseed markets, resulting in increased U.S. exports of soybeans and soybean meal and oil. Livestock producers would benefit from lower feed costs and would increase the amount of soybean meal they use in feed rations. More soybean oil would be used in everything from cooking oil to biodiesel. Consumers around the world would benefit from lower food prices.

"IN A COMPETITIVE WORLD, IT IS IMPORTANT TO REMAIN AT THE CUTTING EDGE WHEN IT COMES TO NEW TECHNOLOGY."

The net impact on soybean farmers depends on just how much prices change. If only a few producers adopt higher-yielding genetics, the resulting increases in global soybean production and declines in soybean prices would be fairly small. That would mean producers adopting the new technology would benefit as long as the increase in yields more than offsets any reduction in soybean prices or increase in per-acre production expenses.

However, suppose the new technology is adopted by soybean producers around the world. The resulting increase in global soybean production would be likely to result in a much larger decline in soybean prices. Any individual farmer would still have an incentive to use the new technology, provided the new technology has a lower cost per bushel than the old. However, farmers as a group will not benefit if the decline in prices is proportionally greater than the increase in yields.

For U.S. soybean farmers, the worst of all worlds would be if other countries develop and use new high-yielding technologies that are not available in this country. That would mean lower prices for U.S. farmers with no offsetting benefits. In a competitive world, it is important to remain at the cutting edge when it comes to new technology.

Patrick Westhoff is the director of the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri-Columbia and a professor in the MU department of agricultural and applied economics. He has degrees from the University of Iowa and the University of Texas, and a Ph.D. in agricultural economics from Iowa State University.

PUTTING HIGH YIELDS ON THE MAP

Across the country, the soy checkoff is making investments and hosting events to help boost farmers' yields. Here's a snapshot of some of the exciting, yield-bumping progress taking place in your area:

ALABAMA: The Alabama Soybean Producers provided funds to Auburn University to evaluate fungicides that could control soybean rust.

ARKANSAS: The University of Arkansas, with funds from the Arkansas Soybean Promotion Board, is working on a project to provide farmers with real-time recommendations concerning weeds, pests and diseases that hurt soybean production.

DELAWARE: The Delaware Soybean Board funded research by Joanne Whalen and Bill Cissel, from the University of Delaware, to help farmers address brown marmorated stink bug challenges. They found that herbicide treatments around field edges can prevent these bugs from ruining soybean yields, saving farmers from the time and expense of field-wide applications.

GEORGIA: The Georgia Agricultural Commodity Commission for Soybeans is supporting the University of Georgia's efforts to identify superior high-yielding soybean varieties.

ILLINOIS: In 2010, the Illinois Soybean Board began investing in a research project by the University of Illinois at Urbana-Champaign and the University of Illinois at Chicago to determine if applying the nontoxic amino acid phenylalanine directly to soybean seeds or leaves would repel Japanese beetles. Findings indicated that, while yield-robbing Japanese beetles will feed on untreated leaves until there's nothing left, they are indeed much less likely to feed on the phenylalanine-treated leaves.

INDIANA: Purdue University is conducting research, funded by the Indiana Soybean Alliance, to improve soybean yield in the state by using field surveys to identify limitations.

IOWA: With help from the checkoff, Iowa State University is researching ways to make soybeans more tolerant of sudden death syndrome (SDS).

KANSAS: With funding from the Kansas Soybean Commission (KSC), agronomists and plant pathologists at Kansas State University are determining starter- and foliar-fertilization requirements for improving soybean yields in double-crop systems following wheat. In addition, Wichita State University is using KSC funds to determine the genetic role in a plant's resistance to charcoal rot disease.

KENTUCKY: With support from the Kentucky Soybean Promotion Board, the University of Kentucky is researching ways to increase soybean yields in dry seasons on fragipan soils.

LOUISIANA: With help from the Louisiana Soybean and Grain Research and Promotion Board, Louisiana State University produced pocket field guides to help farmers identify soybean pests, weeds and diseases.

MARYLAND: The Maryland Soybean Board is funding a project at the University of Maryland to find the frequency, timing and significance of soybean vein necrosis virus.

MICHIGAN: The Michigan Soybean Promotion Committee supports Michigan State University in developing at least five soybean varieties that are resistant to soybean cyst nematode (SCN), SDS and Liberty® herbicide.

TO LEARN ABOUT CHECKOFF-FUNDED RESEARCH PROJECTS IN YOUR STATE, VISIT *www.SoybeanCheckoffResearch.org*.

MINNESOTA: Minnesota Soybean Research and Promotion Council is helping the University of Minnesota see what effect organic and chemical fertilizers and tillage have on SCN and soybean yields.

MISSISSIPPI: With assistance from the Mississippi Soybean Promotion Board, Mississippi State University is researching the effect deer depredation can have on soybean fields.

MISSOURI: With funding from the Missouri Soybean Merchandising Council, the University of Missouri is offering farmers, extension agents and crop consultants recommendations for best practices pertaining to herbicide-resistant weed prevention and management.

NEBRASKA: The Nebraska Soybean Board (NSB) is funding the University of Nebraska's efforts to create soybean varieties with high resistance to SCN. Along with the University of Nebraska-Lincoln extension, NSB will also mail research results from their Soybean Management Field Days in the March issue of *SoybeaNebraska* magazine. Results will also be posted at ***www.cropwatch.unl.edu***.

NEW JERSEY: The New Jersey Soybean Board (NJSB) is diversifying its projects by applying for a broader array of grants. These grants will leverage checkoff funds that NJSB invests in helping soybean farmers increase yield and profitability. NJSB is also funding a project at Rutgers University that will produce transgenic soybeans resistant to SCN.

NORTH CAROLINA: North Carolina State University, with funds from the North Carolina Soybean Producers Association, is researching stink bug damage to soybeans in the state. The project also seeks to determine the point at which the crop is most vulnerable to the pest.

NORTH DAKOTA: North Dakota State University (NDSU) extension specialists are developing the NDSU Pest Management app for mobile devices. The app will feature tools and information from the annual *Weed Control, Fungicide and Insecticide Guide* in a dynamic and searchable format. This project is supported by the North Dakota Soybean Council, which also partnered with NDSU to create controls for the state's major soybean diseases and determine which prevention practices are best to use.

OHIO: After receiving support from the Ohio Soybean Council, the Ohio State University created soybeans resistant to alfalfa mosaic virus, bean pod mottle virus and soybean mosaic virus.

OKLAHOMA: Oklahoma State University is conducting research to see if plant population, row spacing and variety selection play a role in increasing yield when planting soybeans late. The Oklahoma Soybean Board helped fund this project.

PENNSYLVANIA: The Pennsylvania Soybean Board (PSB) recently met with more than 35 researchers from across the commonwealth to identify research and technology gaps and collaborate on future checkoff-funded research needs. Also, Penn State University, with assistance from the PSB, is researching the effect the brown leaf beetle and Mexican bean beetle have on soybean yields.

SOUTH CAROLINA: The South Carolina Soybean Board supports a project at Clemson University to create soybean cultivars that have improved yield, pest resistance and seed composition.

SOUTH DAKOTA: With assistance from the South Dakota Soybean Research and Promotion Council, South Dakota State University is evaluating foliar fungicides, miticides and aphid-resistant varieties with the goal of informing farmers how they can control them.

TENNESSEE: The Tennessee Soybean Production Board is funding a project at the University of Tennessee to help farmers with early detection and treatment methods for soybean rust.

TEXAS: Texas A&M University is creating and publishing a Soybean Insect Management Guide for Texas soybean farmers with help from the Texas Soybean Board.

VIRGINIA: Virginia Tech University graduate student Kevin Dillon completed a multiyear, multilocation project designed to improve double-crop soybean yields. Initial results indicate that foliar fungicides and improved nitrogen management can help increase yield. The Virginia Soybean Board is providing assistance to Virginia State University to develop disease-resistant soybeans that are high-yielding.

WISCONSIN: Recent projects funded by the Wisconsin Soybean Marketing Board (WSMB) suggest that some newly released soybean varieties respond positively to an earlier planting date. This can lead to a potential increase in yield, which could increase profits for Wisconsin farmers. With funding from WSMB, the University of Wisconsin is researching the pathogen, *Fusarium virguliforme*, in order to help predict outbreaks of SDS.

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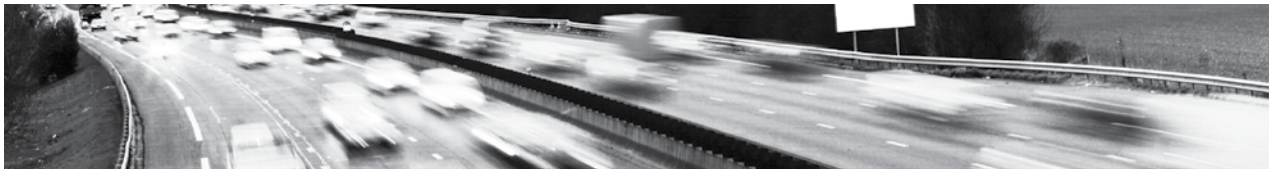

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