

A Century of Crop Research and Loss Procedure Development

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2023 marks 100 years since the first crop insurance industry-sponsored agricultural research project. At the turn of the last century, crop loss adjustment procedures were mostly based on adjuster knowledge and anecdotal evidence of what others had experienced. Forward thinking industry leaders understood the need for a research-based approach to adjusting crop losses and so the crop insurance industry embarked on what is now a century of progress to develop fair and accurate loss adjustment methods. During the last 100 years, National Crop Insurance Services (NCIS) and its predecessor organizations have conducted more than 400 research projects in 35 states resulting in the development and refinement of Crop-Hail loss instructions for 54 crops ranging from alfalfa to wild rice.

In the Beginning

The first crop insurance industry-sponsored project was initiated at Clemson University on American Upland Cotton (AUP) cotton. At the time, researchers and extension agents were trying to grasp how best to grow cotton so the Clemson research project, and the research initiated the following year at Alabama Polytechnic Institute, were focused on planting dates and row spacing. A few years later the hail insurance industry's focus shifted to corn. Around this time, researchers at South Dakota State University independently evaluated corn defoliation and wrote a bulletin for growers. Hail insurance representatives became aware of the bulletin and requested 2,000 copies for claims managers and adjusters. Soon after, the industry began experiments "as to the ultimate yield of corn following injuries to the plant from hail." The resulting experiments began



A mule-drawn cultivating team in the 1910's. Around the time this photo was taken, National Crop Insurance Services' predecessors initiated the agronomic research program that still strives to understand the impact of nature's perils on crops.

in 1928 at Iowa State College of Agriculture and Mechanic Arts—known today as Iowa State University—and the following year at the University of Nebraska. The Iowa work led to an Experiment Station Bulletin in 1935 titled: *Effect of Injury in Imitation of Hail Damage on the Development of the Corn Plant*. Further work initiated in 1930 at Iowa State on barley, oats, and wheat resulted in an accompanying Bulletin titled: *Effect of Injury in imitation of Hail Damage on the Development of Small Grains*.

In 1938, the first international crop insurance research project was initiated at the University of Saskatchewan on wheat. This work was a continuation of the Iowa work that began earlier in the decade on plant cut-offs, head bruising, and stem breakage, but also included the first research on wheat recoverable

heads—commonly referred to as hangers.

During the 1920s and 1930s a relatively new crop was garnering interest among farmers—soybean. Acreage expanded from just under two million acres in 1924 to nearly 12 million acres in 1940. The entry of the United States into World War II, and the disruption of global trade, created a steep increase for the demand of domestic edible oils, lubricants, and plastics. As a result, soybean acreage and crop value greatly increased in the early 1940s. Seeing this unfold, an industry representative wrote to an Iowa State University researcher stating the industry was "in the position of writing considerable insurance on soybean crops without knowing a great deal about the plant or the effects on the plant when it is damaged by hail." Thus, research on soybean began in 1943 in Iowa and Illinois on stand reduction,



Imitating hail with an ice blowing machine. The crop insurance industry funded the development of these machines in the 1980's to create realistic crop damage for loss adjuster schools and they are still in use today.

defoliation, and shatter loss. The year 1943 also marked the first research on onions at Texas A&M University, and, in the late 1940s, flax and wheat and sugar beet research began at North Dakota State University and Montana State University, respectively. The 1940s closed with a flurry of research on wheat at Kansas State University, corn at Iowa State, and additional soybean research at Iowa State and the University of Illinois.

Agricultural Productivity and Crop Insurance Agronomic Research Comes of Age

The 1950s ushered in a golden era of agriculture. Mechanization and crop protection became widely embraced, land-grant university research and crop breeding greatly expanded, and nitrogen fertilizer production fueled crop yield improvement. Crop insurance research was astride of these advances and, during the 1950s, 41 research projects were initiated. Soybean continued to garner attention with projects focused on defoliation, stand reduction, stem bruising, and

cutoffs and culminated in the first thorough set of loss instructions titled "Soybean Hail Loss Survey Sheet Instructions." During this time, AUP cotton and sugar beet were heavily researched, and the research portfolio expanded to many other crops. Of the new crops, grain sorghum and potatoes received the most attention, but research on food crops such as lettuce, tomato, snap bean, and dry bean were started. The decade also saw the first research on tobacco and Pima cotton.

Corn research came of age in the 1960s with projects occurring each year of the decade. The 1961 Corn Loss Instructions were revised in 1968. The research during this era included determining the leaf area of individual corn leaves.

In the late 1970's and early 1980's sunflower research was prolific in North Dakota. The research culminated in loss adjustment factors for stand loss and defoliation. North Dakota is still a favorite research location because it is the northernmost location for many widely planted crops.



Based on this research, vegetative growth stage descriptions were expanded to include each leaf stage. Tobacco research was also prominent later in the decade as was the first research on determinate soybean varieties in Arkansas. The first research projects on grapes and sunflower were conducted and additional research on sugar beet, lettuce, dry bean, and spring and winter wheat took place. The wheat research of the decade was instrumental in developing the recoverable head loss charts and wheat zone maps that were added to the wheat loss instructions in the mid 1970's. The cotton research also culminated in the release of new Cotton Loss Instructions in 1975.

Corn defoliation, stand reduction, and stem damage research continued into the 1970s and once again the crop was researched each year of this decade resulting in another revision of the loss instructions in 1975. Soybean was also researched each year and expanded to include the states of Missouri and Minnesota. This research led to the release of revised loss instructions in 1979 with updated growth stage descriptions, and updated defoliation and stand reduction tables. AUP cotton was extensively researched again with projects in Georgia, Arkansas, and Texas that focused on stand reduction, cutoffs, and agronomics of plant density and populations. This cotton research led to significant loss instruction revisions in 1975 and again in 1977. Tobacco, dry bean, field peas, sunflower, winter wheat, and tomato were also a focus during this time, and oats and barley research resumed after several decades. The 1970s also saw the first research on chile peppers and safflower.

By the 1980s corn research slowed but research on soybean flourished. The research led to the addition of plant cut-off and determinate soybean defoliation loss tables to the loss instructions in 1985, and further revisions in 1991. Pima cotton research resulted in the addition of boll

and cut-off factors, and a limbs-destroyed chart to the 1987 Cotton Loss Instructions. Several crops, including rice, apples, muskmelon, seed corn, popcorn, pickling cucumbers, and cabbage were researched for the first time in the 1980s.

While research continued with many crops through the 1990s, the decade is highlighted by research on new crops, new crop management, and new crop genetics. Canola was recently introduced to U.S. growers and acreage ballooned ten-fold from 1991 to over 1.5 million acres by decades end. Research was initiated on this new crop in 1990 and by 1993 loss instructions were developed. Additional canola research updated the Canola Loss Instructions in 1997 and 2002. Corn research ramped up again and focused on determining if management practices, such as higher plant populations or narrower rows, resulted in different responses to hail damage. Further research on *Bt* and high-oil corn determined that these new genetics did not affect their response to damage. Soybean management practices, such as solid seeding, drilled seed, and higher planting populations were researched to determine if these variables affected stand reduction loss and to expand the stand reduction tables. Potato research evaluated hail damage on newer varieties, including chipping and processing types. Mint and pumpkin research led to new loss instructions for these crops in 1997 and 1998, respectively.



The crop insurance industry has maintained a strong research portfolio for the past 100 years. The research is furthered by outreach that translates and transfers results to both industry personnel and the agriculture industry.

Research on new corn biotechnology continued in the 2000s to determine if new YieldGard and RoundUp Ready traits affected response to hail damage, and further corn research was conducted on the TopCross Blend system. Corn stand reduction research that resulted in the 11-17-leaf stand reduction table was also conducted. Multi-state soybean node removal research, resulting in updated node-cutoff tables, began in 2003. In the early 2000s, the industry introduced potato research on newer, widely planted varieties like ‘Shepody’ and ‘Russet-Norkotah.’ This potato research was expanded to several other states in the early 2010s and resulted in changes to growth staging definitions and plant damage tables. The research relationship with the University of Saskatchewan was rekindled in 2006 with Lentil research, and again with peas

in 2009. In 2010, pea research was expanded to North Dakota and Washington resulting in Dry Pea Loss Instruction revisions issued in 2018.

In 2015, research was initiated on corn green snap up to the tassel growth stage. The results led to follow up stand reduction research up to the tassel stage that was completed in 2022. By 2017, a nearly decade-long research effort on AUP cotton stand reduction, limb removal, node cut-offs, and terminal removal was completed that resulted in changes to procedure that will be introduced to the industry this year and implemented in 2024. New crop research continued in the last decade with projects on hemp and “little” creamer potatoes. Also, research will begin this year on hops—a new crop for the research program. The NCIS research program has resulted in many dynamic and

In the 1950’s, semi-dwarf wheat varieties were being developed that now account for nearly all the wheat grown worldwide. National Crop Insurance Services agronomic research has grown with the rise of Land-Grant University research and kept abreast with technological advances that often change how crops respond to plant damage.



This poster shows the broad reach of the research program in 1981. Cotton, sunflower, corn, potatoes, grain sorghum, peas, soybean, and safflower were researched that year.



Aerial imagery of NCIS grain sorghum stand reduction research. Today, new technologies have created different ways of capturing data and viewing crops.

important changes to crop loss adjusting in the past 100 years and the mission to develop and revise adjusting procedures continues this year as NCIS will conduct 14 research projects in 11 states and Canada.

The Benefits do not End with Crop Insurance

From the beginning, hail researchers understood the level of intensity and the crop stage of development as primary factors in the ability of crops to recover from damage. Although researchers often described a crop's growth stage when publishing research, for most crops, there were no standardized growth stage descriptions. Because of crop insurance research, growth stage descriptions for many crops were developed. The first were created for potatoes at the University of Idaho in 1959. Twelve years later, one of the most widely cited articles published in *Crop Science* described new growth stage descriptions for soybean. A follow up publication titled *Stages of Soybean Development* was released in 1977 that



Popcorn stand reduction research in Nebraska is chronicled to show what the crop looks like near harvest.

included descriptions and drawings for both indeterminate and determinate soybean—some of which are still in the NCIS Soybean Loss Instructions. Using the soybean descriptions, original common bean growth stages developed from industry supported research in 1959 were further refined in 1974 using the soybean descriptions published in 1971. Sunflower research in the 1970s led to growth stage descriptions published in *Crop Science* in 1981. While our industry cannot take credit for the development of all growth stage descriptions, industry-supported research could be considered the catalyst for standardized crop growth stages.

The Next 100 Years

It is difficult to imagine agriculture when hail research began in the 1920s—that corn was open pollinated, planted in hills, and cultivated by mule teams. Now, corn hybrids with biotech traits are the norm, corn is rarely cultivated, seeding rates have doubled, and the crop is planted in varying row spacings, and often with different hybrids in the same fields. Since the first research projects, new crops, new management practices, new growing regions, and new genetics have constantly evolved. Today's crops are more resilient and produce higher yields than their predecessors. Behind these advances are dynamic physiological events that affect how these crops cope with stress, damage, and general environmental conditions. Crop insurance agronomic research has kept astride of these changes since the beginning. Our industry continually adapts to these changes through its grassroots research framework that relies on input from field adjusters, managers, and independent university researchers. The mission is the same as then—to develop procedures that are as accurate as possible so that insureds are indemnified fairly.

We are grateful for the long-standing support of the NCIS membership, including the NCIS Board of Directors who approves annual funding for the agronomic research projects and the members of the NCIS Regional/State Committees who provide input on new crops to study and suggestions on needed improvements to the current loss adjustment procedures.



A researcher caring for peanut stand reduction research plots in Georgia. While most agronomic researchers make every attempt not to damage research plots, National Crop Insurance Services research is focused on damaging crops and determining their response to damage.