



# Illinois Seed News

## Special Edition

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### Soybean Services

The Illinois Crop Improvement Association offers a wide range of soybean services through its seed laboratory, greenhouse, processing lab and winter farm. In this special edition of the Illinois Seed News you will find articles and information relating to the bountiful and beautiful soybean. But first a bit more about the organization.

Illinois Crop Improvement provides two main services: information and seed. Information ranges from seed certification, germinations and processing characteristics to trait tests, greenhouse bioassays, winter growouts and nursery services. Illinois Crop does not own or sell seed, but our nursery, trait-introgression and small-plot services in Puerto Rico are committed to quality seed produced with integrity.

Illinois Crop Improvement's core values of quality and integrity are the company's soul, guiding it in good times and bad. They are essential for everyday business and for the continuous journey towards excellence. Illinois Crop strives to understand how the quality and integrity of our services affect your business.

Our core values will not tell us exactly what the organization will

be doing next year or in ten years. The organization may change in response to the needs of agriculture but its foundation will never shift from its core values. Illinois Crop Improvement is dedicated to quality and integrity and serves as a third-party to everyone in agriculture.

Nearly ninety years ago, the Ag Experiment Station and University of Illinois faculty and administrators were instrumental in establishing Illinois Crop as a freestanding, non-profit corporation to provide seed certification and crop improvement services in support of the state's agricultural economy. The vehicle chosen to positively affect the state's agricultural viability has been quality seed and, consequently, the grain derived from quality seed.

Our services are accessible and affordable to companies small and large. Illinois Crop provides a cost effective technical and service out-source business option. This business option encompasses ISO/IEC 17025:2005 laboratory accreditation and the Biotechnology Quality Management System (BQMS) in Puerto Rico. Illinois Crop has no stockholders and pays neither dividends nor patronage refunds. Should Illinois Crop ever be

dissolved for any reason, 100 percent of the assets will revert directly to the Illinois Agricultural Experiment Station to once again assure the assets will be used for the public benefit. Illinois Crop is allowed to generate and retain appropriate reserves to assure its ability to provide service to the industry during down business cycles. The reserves may be used to support the exploration and development of new services that may benefit the industry. Illinois Crop has used these reserves to establish and operate the Puerto Rico Farm in 1985, the Identity Preserved Grain Lab in 1988, and the Greenhouse Program in 1994. The Illinois Crop Improvement Association stands ready to serve your research, plant breeding and seed production needs wherever and whenever they add value to the improvement of crops.

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# Identity Preserved Grain Lab ~ Special Edition News

## Tests Offered

### Physical Characteristics

- Seed Count
- Foreign Material and Splits
- Damage
- Moisture Content

### Chemical Components

- NIR Proximate Analysis
- Protein Content - Combustion Method
- Oil Content - Either Extraction
- Moisture Content
- Sugar Profile - High Performance Liquid Chromatography
- Amino Acid Profile - High Performance Liquid Chromatography
- Fatty Acid Profile - Gas Chromatography
- Processing Characteristics
- Tofu and Soymilk Process Test
- Nitrogen Solubility Index (NSI)
- Protein Dispersibility Index (PDI)

## Test Information

**NIR Proximate Analysis:** Proximates are the major components of the grain. For soybeans, the NIR Proximate Analysis includes Oil Content, Protein Content, Fiber Content, and Moisture Content. The test does not include Ash Content. This procedure is nondestructive to the soybeans. Proximate Analysis is also available using wet chemistry methods for protein content, oil content, and moisture content but the sample must be ground.

Various end users have different demands for soybean composition. For example, a tofu manufacturer will usually want very high protein levels while operators of a large soybean crushing plant may want to balance the protein and oil content to fit their processing needs.

Results, other than Moisture Content, are reported on a dry basis percentage (% of non-water material). Moisture Content is reported “as is” (% of total sample weight).

#### Oil Content

Possible Values 16-25%  
Typical Results 18-23%

#### Protein Content

Possible Values 36-50%  
Typical Results 38-45%

#### Fiber Content

Possible Values 3.5-5.6%  
Typical Results 4.0-5.0%

#### Moisture Content

Possible Values 5-35%  
Typical Results 8-15%

#### Protein Content-Combustion Method:

The Combustion (Dumas) Method can be used to measure the protein or nitrogen content in a wide range of substances. It has replaced the slow, dangerous, and environmentally unfriendly Kjeldahl procedure for most applications. The combustion method is an approved method and has become the most common reference (“wet chemistry”) method for NIR calibrations for protein content. The combustion method is typically employed for samples for which no NIR calibration exists. The IPG Lab does offer protein content for soybean using NIR however, there are situations in which the combustion method may be the most suitable.

In this test, a 50-300 mg representative sample (liquid or ground solid) is burned at a high temperature

in a sealed system. The nitrogen in the sample is converted to nitrogen gas, separated from the other chemical components, and measured by thermal conductivity. The nitrogen content can be converted to protein content by using a conversion factor (typically 6.25 x nitrogen) to obtain the “as is” protein percentage. This test is performed in duplicate, and the moisture content in the original sample is determined by the air oven method to convert the protein content to dry basis. Protein contents measured by the combustion method can range from very low 0.1% to 90+%.

**Oil Content-Ether Extraction:** Ether Extraction can be used to quantify the amount of fat or oil in a sample. The Ether Extraction Method is an approved method and is a common reference (“wet chemistry”) method for NIR calibrations for oil content. The Ether Extraction Method is typically employed for samples for which no NIR calibration exists. The IPG Lab does offer oil content for soybeans using NIR. There are situations in which ether extraction may be the most suitable method for oil measurement.

In this test, a representative sample is ground and extracted in refluxing petroleum ether. Extracted oil is captured in a boiling flask. The oil is separated from the ether and weighed to determine the percentage of the original sample weight collected as oil to obtain the “as is” oil percentage. This test is performed in duplicate, and the moisture content in the original



# Identity Preserved Grain Lab ~ Special Edition News

sample is determined by the air oven method to convert the protein content to dry basis.

Oil contents measured by the ether extraction method can range from very low 0.2% to 50+%.

**Sugar Profile-High Performance Liquid Chromatography:** The sugar profile measures the quantities of seven sugars in a sample. While applicable for a number of products, soybeans are the most common request for the IPG Lab.

For soybeans, sugar contents are expressed on dry basis:

## Sucrose

Possible Values 3.0-9.0%  
Typical Results 4.0-7.0%

## Glucose (dextrose)

Possible Values 0.0-0.5%  
Typical Results 0.0-0.1%

## Maltose

Possible Values 0.0-0.5%  
Typical Results 0.0-0.3%

## Lactose

Possible Values 0.0%  
Typical Results 0.0%

## Fructose

Possible Values 0.00-0.1%  
Typical Results 0.0-trace%

## Raffinose

Possible Values 0.2-1.6%  
Typical Results 0.5-1.2%

## Stachyose

Possible Values 2.0-6.5%  
Typical Results 3.5-5.5%

High levels of sucrose (“table” sugar) are often desired to mask the beany flavor in soyfoods. Low amounts of the oligosaccharides raffinose and stachyose are wanted. These sugars are not digested in the upper digestive system and are fermented in the intestine. The gases produced in fermentation can cause the discomfort and flatulence associated with some foods from soybeans.

**Amino Acid Profile-High Performance Liquid Chromatography:** The High Performance Liquid Chromatography (HPLC) method can be used to quantify the amount of various amino acids in a sample. The HPLC method is an approved method and is a common reference (“wet chemistry”) method and is typically employed for samples for which no NIR calibration exists. Various procedures must be employed depending on the amino acids of interest. The moisture content in the original sample is determined by the air oven method to convert the amino acid contents to dry basis.

**Fatty Acid Profile-Gas Chromatography:** The Gas Chromatography (GC) method can be used to quantify the amount of various fatty acids in a sample. The GC method is an approved method and is a common reference (“wet chemistry”) method for NIR calibrations for fatty acid contents. The GC method is typically employed for samples for which no NIR calibration exists. The IPG lab does offer fatty acid profile for soybeans using NIR. Various procedures may be employed depending on the fatty acids of interest. The moisture content

in the original sample is determined by the air oven method to convert the fatty acid contents to dry basis.

## Soybean Processing Characteristics

**Tofu and Soymilk Process Test:** The Tofu and Soymilk Process Test gives a soybean processor information on the yield and quality of the products they could expect from a particular variety or sample of beans. Data is collected from the raw soybeans, the soymilk made from those beans, and the silken (non-pressed) tofu product made from that soymilk. The whole soybeans are evaluated using the NIR Proximate Analysis and Seed Count tests. A sample of the beans are ground into a powder and blended with hot water. The resulting slurry is then steam-cooked and put through a juice extractor. Lastly, insoluble solids (okara) are removed by filtration through a series of cloths and refrigerated. The total volumetric yield is determined after the sample has sat overnight and warmed to room temperature. The solids content of the soymilk is also measured using the Air Oven Method and reported. A portion of the soymilk is mixed with a coagulant and cooked in a hot water bath to make the tofu product. Glucono-delta-lactone (GDL) is the standard coagulant, although the traditional nigari (magnesium chloride) is available as an option. The finished tofu is weighed to measure product yield and the moisture content is determined using the Air Oven Method.

*Article continued on page 4*



# Identity Preserved Grain Lab ~ Special Edition News

## *Tofu and Soymilk Process Test Continued*

The color of the soymilk and tofu are measured using the Hunter Lab color scale:

**"L"**

measure of lightness  
(0 = black to 100 = white)

**"a"**

measure of greenness  
(larger negative number)  
to redness  
(higher positive value)

**"b"**

measure of blueness  
(larger negative number)  
to yellowness  
(higher positive value)

The protein content of the soymilk and tofu are measured using the combustion method.

### **Soymilk Yield**

(liters per kg of dry soybeans)  
Possible Range 4.7-6  
Typical Results 5-5.5

### **Soymilk Protein (d.b)**

Possible Range 38-57%  
Typical Results 41-51%

### **Soymilk Solids**

Possible Range 10-11.5%  
Typical Results 10.5-11.3%

### **Soymilk Color L**

Possible Range 70-85  
Typical Results 77-82

### **Soymilk Color a**

Possible Range (-2.0)-(-0.3)  
Typical Results (-1.7)-(0.75)

### **Soymilk Color b**

Possible Range 10-15.5  
Typical Results 12-15



**Examples of Tofu and Soymilk  
Process Test**

### **Tofu Yield**

(kg per kg of dry soybeans)  
Possible Range 5-7  
Typical Results 5.5-6.5

### **Tofu Protein (d.b)**

Possible Range 36-58%  
Typical Results 41-52%

### **Tofu Moisture**

Possible Range 87-89.5%  
Typical Results 87.5-89%

### **Tofu Color L**

Possible Range 77-81.5  
Typical Results 78-81

### **Tofu Color a**

Possible Range (-1.5)-0.7  
Typical Results (-1.0)-0.4

### **Tofu Color b**

Possible Range 11-15  
Typical Results 12-14

**Nitrogen Solubility Index (NSI):** The Nitrogen Solubility Index, or NSI, is a measure of the solubility of soybean protein in water. High solubility is very important to manufacturers of soymilk and tofu, as their job is to extract as much protein from the soybean as possible. For this test, a sample of soybeans is ground, mixed in a specific ratio with water, and stirred at a set speed (120 rpm) in a constant-temperature (30°C) water bath for a specific time (2 hours). The nitrogen content of the ground soybeans and of the extract are determined using the combustion method. The NSI value is the quotient of the nitrogen content of the extract divided by the nitrogen content of the original bean.

Possible Values 50-95  
Typical Results 70-90

**Protein Dispersibility Index (PDI):** The Protein Dispersibility Index, or PDI, is another measure of the solubility of soybean protein in water. High solubility is very important to manufacturers of soymilk and tofu, as their job is to extract as much protein from the soybean as possible. For this test, a sample of soybeans is ground, mixed in a specific ratio with water, and blended at a set speed (7500 rpm) for a specific time (10 minutes). The nitrogen content of the ground soybeans and of the extract are determined using the combustion method. The PDI value is the quotient of the nitrogen content of the extract divided by the nitrogen content of the original bean.

Possible Values 50-95  
Typical Results 70-90



# Puerto Rico Winter Farm ~ Special Edition News

## Soybean & Dry Bean Breeder Services

Illinois Crop offers a number of soybean programs in Puerto Rico. Soybean quality is good in PR, but yields can be less because of a shorter day length. However, in the case of a generation advance or single seed descent, yield does not matter as much because only one pod is usually picked per plant to go into a following generation. In the case of an increase, two generations can be grown during one winter season, increasing the amount of seed available for seed stock in the summer.

All Plots are planted on raised beds, drip irrigated and include:

- Land, labor and management
- All agronomic services
- Harvest and shelling  
(all soybeans leaving PR must be shelled)
- Lights are available

## Crossing Service

Illinois Crop will quote project-by-project crossing services based upon; number of crossing technicians, rows planted, number of attempts, desired number of crosses/seeds, maturity groups, sampling, testing, stewardship requirements, etc. A general outline of services is provided below.

### Crossing Regulatory Compliance

IL Crop offers industry leading stewardship services by working with trait providers to effectively deliver compliance requirements for licensees and researchers. Custom compliance packages will be quoted on a project-by-project basis.

### Crossing Light Services

Optimum light quality serves 2/10 acre. Extra crossing/increase rows may be planted at prevailing rates in fringe areas having lower quality light. Approximately 1450' of row equals 1/10 A.



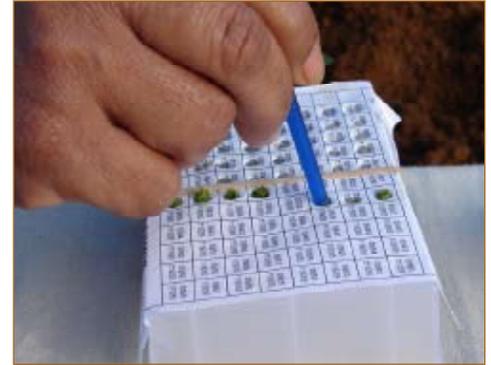
### Crossing Technicians

The intent is for each technician to make 100 crosses per day. The service is all-inclusive (training, management, supplies, labor).



### Crossing Tissue/Seed Sampling

IL Crop will quote tissue/seed sampling and tissue lyophilization on a project-by-project basis. Molecular testing is available through IL Crop's headquarters in Champaign, IL and can be included in the crossing service package.



### Crossing Harvest, Shelling and Packaging

Is based upon standard labor rate estimates for general and supervisory labor depending upon client requirements and can be included in the crossing quote.

### Crossing Miscellaneous Services

Additional labor, materials, supplies, fumigation, shipping charges, field or phytosanitary inspections, cold storage etc. will be charged at standard rates.

### Genetically Modified Organisms (GMO's)

**Regulated GMO material requires IL Crop's written preapproval.** A completed GMO Declaration Form is required for all soybean seed shipped to our Puerto Rico farm. This applies to non-GMO, GMO and regulated GMO material. Prices will vary for all materials subject to additional stewardship requirements stipulated by the trait developer or owner. Submit your Acreage Request Form along with handling, planting and shipping (to and from) protocols, a minimum of 4 weeks prior to the anticipated

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### *Genetically Modified Organisms (GMO's) Continued*

shipping date. If you anticipate sending Regulated GMO material to our farm, please remember to contact us early enough for pre-approval and farm location so that you may apply to the USDA or USEPA for your movement and planting permits. All permits must be current and specific for our farm location before shipping this material to Puerto Rico. Contact us for GPS coordinates.

### **Hill Plots**

F1 "hills" are actually hand planted 2' rows (12 seeds or less) with an alleyway. Hills are bulk harvested (as F2 generation) and shelled, unless other harvest arrangements are made in writing.

### **Generation Advance Plots**

These can be planted in either a 15' or a 28' row, depending on the quantity of seed available. Usually 100 seeds or less will go into the shorter row, whereas 100-200 seeds will go into the longer row. We prefer that all of your rows fit into one or the other and not be randomized for different row lengths. A onetime pod pick is included as well as a per row bulk shelling of those pods. Other harvest scenarios such as bulk harvest of the entire row will incur additional charges. All soybeans leaving Puerto Rico must be shelled.

### **Soybean Increases**

Increases are planted on a raised bed at a seeding rate of approximately 90,000 seeds per acre. In addition

to the standard services offered in Generation Advance Plots, fields are rogued of obvious off-types and the seed is cleaned and spiraled to remove debris. Bagging is also included, but bagging supplies are extra.

### **Additional Flowering and/or Pubescence Notes**

Experimental projects and single-plant or extra harvest scenarios can be performed if we are notified ahead in writing. Work will be billed at our standard hourly labor rate in addition to our regular row or hill pricing. Please feel free to contact us about your soybean or dry bean requirements.

## Seed Lab and Greenhouse ~ Special Edition News

### **Testing Options**

**T**he Illinois Crop Improvement Seed Laboratory and Greenhouse, located in Champaign IL, offers soybean services to seed producers and plant breeders alike. The Seed Lab conducts routine germination tests as well as vigor and stress procedures such as cold tests and accelerated aging. Older biochemical tests such as peroxidase are also offered as prescribed by the Association of Official Seed Analysts Cultivar Purity Handbook.

The Greenhouse focuses on trait testing by offering seed producers herbicide tolerance tests while serving plant breeders and researchers with assessing more complex traits such as sulfentrazone, metribuzin and other bioassays. It has the capability of performing disease screening such as Phytophthora root rot and also handles adventitious presence (AP) and non-GMO testing for seeds and grains. Bioassays are used to evaluate the viable portion of seed samples with immunoassays and

PCR offerings depending on the purpose and destination of the material.

Our scope of services in the Seed Lab and Greenhouse include:

- Seed Germination and Purity
- Seed Vigor - Cold Test
- Seed Vigor - Accelerated Aging
- Seed Viability - Tetrazolium (TZ)
- Herbicide Tolerance - RR, LL, STS, etc.
- Herbicide Resistance - Sulfentrazone, Metribuzin
- ELISA - RR, LL, and AP Testing
- PCR - AP Testing and Fingerprinting

For more information on Illinois Crop Improvement's services and capabilities visit us at [www.ilcrop.com](http://www.ilcrop.com) or give us a call today at 217-359-4053.



# Puerto Rico Winter Farm Pricing

## Puerto Rico Winter Farm Pricing

Established 6/15/2016

### SOYBEAN PRICING

Activity	Item	Price/Quantity	Minimum Charge
Crossing	0.2 Acres Land & Light Conventional Crossing Nursery <sup>1</sup>	5900.00 / light tower	-
Crossing	Land & Light Conventional Shared Light <sup>1</sup>	3900.00 / 0.20 acre	0.15 acre
Crossing	General Labor - Tissue Sampling, Hand Harvest, Packaging, etc.	29.00 / hr	1 hr
Crossing	Supervisory Labor - Sampling, Rouging, Notes, Reports, etc.	39.00 / hr	1 hr
Crossing	Pollination Labor	195.00 / day	0.5 day
Hills	Conventional 2 foot row (up to 12 seeds) bulk harvest of F2 seed	15.00 / row	100 hill min
Threshing	Single Plant Thresh -Per Plant	0.90 / each	200 plant min
Gen. Advance	Conventional 15 foot row (100 seeds) with pod pick	16.50 / row	100 rows
Gen. Advance	Conventional 28 foot row (100-200 seeds) with pod pick	18.50 / row	100 rows
Gen. Advance	Bulk Harvest - Per Row	5.00 / each	25 rows
Increase	Conventional, 0.1 or more acres <sup>1</sup>	600.00 / 0.1 acre	-
Increase	Conventional, one or more acres <sup>1</sup>	5000.00 / acre	-

### REGULATED AND STEWARDSHIP PRICING

Activity	Item	Price/Quantity	Minimum Charge
Crossing	Regulated or Stewardship 0.2 Acres Land & Light Crossing <sup>1</sup>	6900.00 / light tower	-
Crossing	Regulated or Stewardship Shared Land & Light <sup>1</sup>	4900.00 / light tower	0.15 acre
Threshing	Regulated Single Plant Thresh	1.25 / each	200 plant min
Hills	Regulated 2 foot row (12 seeds or less) bulk harvest of F2 seed	18.50 / row	50 row min
Gen. Advance	Regulated 15 foot row (100 seeds) with pod pick	18.25 / row	100 rows
Gen. Advance	Regulated 28 foot row (100-200 seeds) with pod pick	20.50 / row	50 row min
Gen. Advance	Regulated Bulk Harvest - Per Row <sup>1</sup>	6.75 / each	25 rows
Increase	Regulated, 0.1 or more acres <sup>1</sup>	810.00 / 0.1 acre	-

<sup>1</sup> Client is responsible for labor, supplies and shipping costs.

*As a result of on-farm trials, all seed sent to Puerto Rico for planting must be treated with a commercially available fungicide such as Mefenoxam & Fludioxonil (ApronMaxx - Syngenta)*



## Soybean ~ Special Edition News

### A Look Back at Soybeans

**S**oybeans originated in Southeast Asia and were first domesticated by Chinese farmers around 1100 BC. By the first century AD, soybeans were grown in Japan and many other countries.

Soybean seed from China was planted by a colonist in the British colony of Georgia in 1765. Benjamin Franklin sent some soybean seeds to a friend to plant in his garden in 1770. Soy sauce had been popular in Europe and the British colonies in America before soybean seeds arrived. It wasn't until 1851 that soybean seeds were distributed to farmers in Illinois and the corn belt states. This seed was a gift from a crew member rescued from a Japanese fishing boat in the Pacific Ocean in 1850. In the 1870s soybeans increased in popularity with farmers who began to plant them as forage for their livestock. By the turn of the century, the United States Department of Agriculture was conducting tests on soybeans and encouraging farmers to plant them as animal feed.

George Washington Carver discovered that soybeans are a valuable source of protein and oil. He also realized the benefits of soybeans for preserving good quality soil. Mr. Carver encouraged cotton farmers to "rotate" their crops in a three-year plan so that peanuts, soybeans, sweet potatoes or other plants would replenish the soil with nitrogen and minerals for two seasons, and then the third year farmers planted cotton.

To the surprise of many farmers, this produced a far better cotton crop than they had seen for many years!

In 1919 William Morse co-founded the American Soybean Association and became its first president. At the time farmers used only 20 proven varieties of soybeans. Morse recognized that there was much potential to be discovered in the soybean plant. In 1929, Morse spent two years gathering soybeans in China. He brought back more than 10,000 soybean varieties for agricultural scientists to study. Morse understood that new, improved varieties meant better production for farmers.

Henry Ford is known for producing automobiles but did you know that he once made a car with plastic bodywork made from soybeans? Ford owned a large research facility. He came to the lab one day with a bag of soybeans. He dumped them out on the floor and told the scientists, "You guys are supposed to be smart. You ought to be able to do something with them." In time, the scientists in Ford's lab made a strong enough plastic for the gearshift knobs, horn buttons, window frames, accelerator pedals, light-switch assemblies and ignition-coil casings. They also fashioned the exterior of an automobile from "soybean plastic." By 1935 Ford was using one bushel of soybeans for every car he manufactured.

It wasn't until the 1940's that soybean farming really took off in

America. Soybean production in China, the major supplier at that time, was halted by World War II and internal revolution. When the United States entered the war, the steep increase in demand for oils, lubricants, plastics and other products greatly increased the demand for soybeans. United States farmers produced the needed soybeans.

Following the Second World War, the United States experienced a period of increasing prosperity. Demand for meat consumption increased as people's diets improved. Livestock producers found that soybean meal was the preferred source of protein at an affordable cost. Chickens, turkeys, cattle and hogs were fed diets containing tens of millions of tons of soybean meal each year. This increase in the use of soybean meal for livestock feed began in the 1950's and soybean meal has been the preferred choice ever since. Thirty-one U.S. states have a soybean production industry. The top producers are the states of Iowa, Illinois, Indiana and Minnesota.

*Source: NCSoy.org*

