Project Number:	#1820-162-0141
Project Title:	High Oleic Soybean Varieties: Discovery, Proof and Introduction
Organization:	Schillinger Genetics, Inc.
Principal Investigator Name:	Bill Rhodes, Pedro Gonzalez, John Schillinger

Project Status - What key activities were undertaken and what were the key accomplishments during the life of this project? Please use this field to clearly and concisely report on project progress. The information included should reflect quantifiable results (expand upon the KPIs) that can be used to evaluate and measure project success. Technical reports, no longer than 4 pages, may be included in this section.

Key activities employed in totally integrated research grant directed toward the development and lab and field evaluating of soybean varieties containing above 75% oleic and below 2% linolenic acid contents included:

1. Producing over 1200 unique soybean crosses per year with one or more parent possessing the high oleic genetics
2. Advancing segregating genetic populations to F_2 generations in US and Puerto Rico
3. Leaf sampling each F_2 plant and testing each F_2 sample for the presence of five (5) molecular markers that indicate the presence of 1-5 oil genes for oleic and linolenic fatty acids
4. Selected F_3 plants were recombined to permit the combining of all oil genes by the $F_4 \rightarrow F_6$ generation
5. Each plant selected for the presence of the high oleic (2 genes) and linolenic (3 genes) were reconfirmed for the presence of desired oil genes
6. Seed of F_6 plants were grown in progeny rows and visually selected for desirable agronomic traits
7. The visually selected F_6 progeny rows were harvested and grown in six (6) locations and tested for yield
8. Approximately 10% of best yielding entries were reaffirmed for oil and protein content and retested for yield in 12-15 locations in the second year
9. The best yielding lines with high oleic/low linolenic oil were purified for phenotypic traits and increased for seed
10. After the third year of yield testing the seed increase of best lines were transferred to seedstock program and positioned for commercial seed release
11. In 2018, Schillinger commercially released three (3) high oleic soybean varieties and planted them on 10,000 acres
12. In addition to the three (3) HO varieties released commercially, Schillinger is growing 16 additional, new varieties in its seedstock program

Lot #	Shipped From	Stage Name	Variety Type	units returned	est units Fall 2018	Final US INC Loc	MATR	F	P	HC	PW	SCN	STS	PedId	notes
CH1812	Chile	10H996	HOLL	3	**150**	**BSI**	10	P	G	YL	B	R		2705847	
CH1819	Chile	11H909	HOLL	1	**50**	**BSI**	11	P	G	BF	B	R		2705872	
CH1820	Chile	11H909	HOLL	3	**150**	**BSI**	11	P	G	BF	B	R		2705872	
CH1821	Chile	12H913	HOLL	1	**50**	**BSI**	12	P	G	BF	B	R		2705865	
CH1822	Chile	12H913	HOLL	3	**150**	**BSI**	12	P	G	BF	B	R		2705865	
CH1823	Chile	13H919	HOLL	2	**100**	**BSI**	13	P	G	BF	B	R		2705867	
CH1824	Chile	13H919	HOLL	3	**150**	**BSI**	13	P	G	BF	B	R		2705867	
CH1813	Chile	13H902	HOLL	1	**50**	**BSI**	13	P	G	YL	B	R		2705849	
CH1814	Chile	13H902	HOLL	4	**200**	**BSI**	13	P	G	YL	B	R		2705849	
CH1818	Chile	13H988	HOLL	3	**150**	**BSI**	13	P	G	YL	B	R		2705860	
CH1804	Chile	16H914	HOLL	1	**50**	**BSI**	16	P	T	MX	B	R	A	2773035	
CH1805	Chile	24H930	HOLL	18	**900**	**BSI**	24	P	T	BR	B	R	n/a	2773037	
CH1808	Chile	24H937	HOLL	17	**850**	**BSI**	24	P	T	BR	B	R	n/a	2773042	
AR2544	Argentina	28H942	HOLL	9	**450**	**Baird**	28	W	L	BR	B	R		2773054	
QT17H103	Queenstown	49H906S	HOLL	2	**100**	**Stratton**	49	W	L	BL	B	R*R	A	2529535	Stuttgart
QT17S201	Queenstown	46H616	HOLL	12	**600**	**Brown**	49	W	L	BL	B	R	S	2212001	
QT17H102	Queenstown	51H969S	HOLL	3	**150**	**Stratton**	51	W	L	BL	B	R	A	2199880	Stuttgart
QT17H105	Queenstown	c48H924S	HOLL Coval	5.5	**275**	**Stratton**	48	W	T	BL	B	R*R	A	2529392	Stuttgart
QT17H105	Queenstown	c48H924S	HOLL Coval	6	**300**	**Brown**	48	W	T	BL	B	R*R	A	2529392	
			HOLL	**97.5**	**4875**										

13. The gas chromatograph is used to confirm fatty acid profile of each new line or variety
14. A table is presented at end of this section that indicates new HO varieties identified and the potential seed supply of each in 2019 and 2020

Photos below depict the procedure used to select high oleic soybeans:

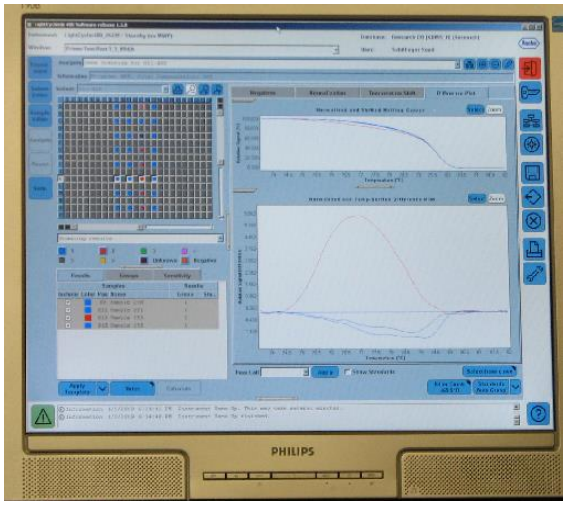
- Selecting for Oil Quality in Diverse Genetics

- Tools for Selecting Desired Oil Profile
    - Molecular lab
    - Gas Chromatograph

    - F_2 genetic population that contains high oleic genetics that are segregating among the F_2 plants

- SG Molecular Lab: Queenstown, MD

- Use of Molecular Lab
    - To detect five (5) genetic markers for key oil traits
    - For high oleic (2 markers) and low linolenic (3 markers)
    - To identify genotypes with desired oil profile and key traits, e.g. soybean cyst nematode



- Oil Quality Screening
    - Gas chromatograph – to measure key fatty acids, oleic, linolenic and saturates
        - Single plants
        - Seed from progeny rows
        - Yield trial entries from various tests

- Potential Seed Supply of SG High Oleic Soybean Varieties for 2018-2020

Variety ID	Maturity	Seed Units Fall 2018	Seed Units Fall 2019 After 2018-19 Winter Seed Production	Seed Units Fall 2019 w/o Winter	Seed Units Fall 2020
10H996*	6	100	100,000	4000	160,000
11H909*	8	250	300,000	10,000	400,000
12H913	9	250	300,000	10,000	400,000
13H902	10	250	300,000	10,000	400,000
13H919	12	250	300,000	10,000	400,000
13H988*	13	100	100,000	4000	16,000
16H914	15	100	100,000	4000	16,000
24H930	24	100	100,000	10,000	400,000
24H937	24	100	100,000	4000	16,000
28H942	28	250	300,000	4000	16,000
29H966	29	250	300,000	10,000	400,000
34H608*	34	60,000	-	1,200,000	2,400,000
37H937	37	720	320,000	36,000	3,200,000
45H907*	45	450	250,000	18,000	5,000,000
46H566	46	17,500	400,000	1,600,000	2,000,000
46H616	47	50,000	216,000	20,000	2,000,000
47H997*	47	500	216,000	20,000	2,000,000
49H906	49	720	400,000	28,800	1,600,000
49H994	49	180	200,000	7200	1,500,000
51H969	51	720	400,000	28,800	1,600,000

*Outstanding Candidate

MAXIMUM Seed Available			
With 2018-2019 Winter Production	4,702,000		23,924,000
No Winter Production total		3,038,800	

Did this project meet the intended Key Performance Indicators (KPIs)? List each KPI and describe progress made (or not made) toward addressing it, including metrics where appropriate.

1. 500+ US soybean growers plant 250,000 acres of high oleic and low linolenic acid by 2020. In 2018 there were approximately 10,000 acres planted to SG developed HOLL varieties. Two popular HOLL varieties were 34H608 and 46H616. Of 10,000 acres, 6,000 acres planted of these two varieties in 2019.
2. SG is estimating at least six (6) new improved HOLL varieties for 2019 with four (4) being by early maturities (maturity groups 0 to II).
3. SG is producing its first CoVal soybean variety in 2018-2019 with commercial release before 2020. The CoVal variety will have the composition as indicated on following table.

New CoVal Products with Dual Constituent Value

- Modified oil + enhanced feed value
- Grain composition of new CoVal varieties will be:

Meal %			Oil %		
Protein	**Oil**	**RS**	**Oleic**	**Linolenic**	**Saturates**
43.9	21	0.53	80	<2.0	<11.0

- Competitive field performance – in 2 or more years of field tests
- Seed production in US and winter in 2018

Expected Outputs/Deliverables - List each deliverable identified in the project, indicate whether or not it was supplied and if not supplied, please provide an explanation as to why.

See list of seed supply of SG's new HOLL soybean varieties. As can be seen, available commercial seed of these improved new HOLL varieties is large. Admittedly, the number and variety name of new HOLL varieties are not available until after harvest (November 2018).

In addition to the new HOLL varieties on the attached list there is a CoVal variety that also contains feed value (high protein and reduced carbohydrate raffino-stachyose. There will be about 500 seed units available in fall of 2018 for seed production in 2019.

Schillinger Genetics (SG) developed HOLL varieties are all non-GMO. However, SG is open to providing its HOLL genetics to other seed entities to insert GMO traits as preferred by US soybean farmers.

The project was overwhelmingly successful because of the experience, know-how and dedication of the SG research team. The USB grant was a wonderful motivator and enabled the SG team to succeed.

Describe any unforeseen events or circumstances that may have affected project timeline, costs, or deliverables (if applicable.)

No unforeseen circumstances

What, if any, follow-up steps are required to capture benefits for all US soybean farmers? Describe in a few sentences how the results of this project will be or should be used.

US soybean farmers will have access to non-GMO high oleic soybeans varieties for new export and domestic markets that want non-GMO high oleic oil.

Also, as indicated above, the acreage of HOLL varieties could be enhanced by cooperating companies that could add herbicide tolerance to the base genetics for HOLL and field performance.

List any relevant performance metrics not captured in KPI's.

The discovery and development of early maturity HOLL varieties will enable growth of the HOLL varieties with potential value enhancement for soybean producers in MN, ND, WS, MI and SD.