Semilla Nueva Standard Report
Second Semester July – December 2022

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LETTER FROM THE DIRECTOR

The entire Semilla Nueva team couldn't be prouder and more motivated by what we've achieved in 2022. We learned to target the right farmers with our seed and passed the philanthropic break-even point (raising farmers' incomes more than what we spent). On average, our 20,505 farmers increased their incomes by $182. We showed that converting new high yielding seeds to become biofortified is feasible, and we have an improved seed to launch. Our subsidy program is working, and our partner seed companies will almost catch up to us in production and sales in 2023. The program is so successful that one of our partner seed companies is expanding sales internationally to El Salvador. We nearly doubled the number of families we reached, and we expect to nearly double again in 2023.

But I think that what's most important is how we were able to make this happen. 2022 saw us undertake the most aggressive staff overhaul we've ever done. We let go of staff members who too deeply valued the traditional values of large agribusinesses (prestigious sales and commercial recognition) and we promoted, nurtured, and hired team members who value impact, even if it means that others get the glory (like our partner seed companies) or that we will never have our own conventionally profitable company. We doubled down on creating and protecting culture, involving staff of all levels in planning, and making risky, counter-intuitive bets together. The results speak for themselves. A team of 33 people improved the nutrition of nearly 600,000 Guatemalans and improved the incomes of over 20,000 farm families.

We didn't do it alone, and we want to deeply thank the funders, Board members, Advisory Board members, and allies who have supported us. To me, Semilla Nueva has always felt like a promise – and in a way it also feels like a bit of a debt. So many people have believed and invested in our idea. I think our rate of growth, the simplification of our model (breeding + subsidy), the average impact per family, all show that we are starting to truly pay it forward. I've never felt as motivated as I do now, and I think our team has never been as aligned or clear on what we're trying to do. Thank you all for not just supporting us, but for being a real part of Semilla Nueva.

-Curt Bowen

EXECUTIVE SUMMARY

Impact Evaluation:

- In 2022, a total of 20,505 families planted Semilla Nueva's biofortified seed, 62% more families than in 2021. Nearly 600,000 people improved their nutritional intake, more than double 2021.
- Semilla Nueva's efforts to achieve a representative sample of farmers for economic analysis were successful. Farmers who purchased biofortified seed made an average of US$182 of additional income. Overall, Semilla Nueva increased farmer incomes by US$2.4-3M, a higher number than our total budget.
- 74% of farmers commented that their maize crops were impacted by climate shocks. In situations of drought, our F3 seed reduced farmers' rot damage by 14% while F5 reduced rot by 33%, contributing to 15-17% higher yields. For farmers who suffered severe storms, damaged plants and ears were reduced from 39% for farmers' normal seeds to 30% for F3 and 21% for F5. Yields were 24% higher on average.
- The International Center for Nutrition of Central America and Panama (INCAP) and Cornell University finished baseline data collection and started analyzing the baseline data for our first randomized controlled trial (RCT) looking at the impact of planting and consuming Semilla Nueva's maize on zinc and iron biomarkers for children and women.

Sales, Marketing, and Production:

- Semilla Nueva targeted the correct group of farmers. 98% of farmers participating in the field days were in the farmer segment where our seeds provide the most impact vs 52% in 2021.
- Sales increased 57%, from 3,637 bags in 2021 to 5,213 bags—and sold out after 7 months.
- Our new seed, F5, sold out within weeks. Farmers note significant improvements compared to F3. F5 production and sales will largely replace F3 in 2023.
- Repurchase rates improved from 39% in 2021 to 46% in 2022; 64% intend to repurchase in 2023.
- Farmer perception of our Fortaleza brand improved in 2022. Better yield and ear rot resistance in F5 should lead to further improved perception in 2023.
- Total seed production from Semilla Nueva and allied seed companies will increase from 7,218 bags in 2021-2 to 13,282 bags, an 84% increase.

Collaborations and International Expansion:

- Valle Verde increased sales of biofortified seed by 76%; sales will more than double in 2023 due to strong performance of our new seed, F5.
- One new seed company is producing biofortified seed for sale; three more are experimenting with seed and may begin sales by late 2023.
- Supported by our subsidy, Valle Verde will begin sales of our seed in El Salvador. This will be the first international expansion of our program.

Research and Development:

- Semilla Nueva will launch initial commercial sales of F7, the first hybrid fully developed by our breeding program. F7 has similar levels of nutritional quality to F3 and F5. Yields are intermediate between F5 and the market's leading high-segment hybrid.

- The first generation of experimental backcrossed hybrids maintained yields close to their original non-biofortified hybrid. Zinc levels are 43% higher than the original hybrid and 30% better than market competitors.
- Semilla Nueva imported and began backcrossing several of CIMMYT's most important openly available lines for eastern and southern Africa and is in process of importing over 30 experimental lines.
- Semilla Nueva is now evaluating genetic data produced in partnership with CIMMYT on over 100 of our lines and have discovered possible markers for predictive genes. Discovering the genes behind high zinc maize is one of our highest priorities and could radically decrease the cost and time to develop new biofortified seeds. Semilla Nueva also signed an agreement with Bayer to fully sequence the DNA of over 250 of our lines and make the information open source.
- The R&D team missed internal deadlines for creating an open database of our inventory and data and calibrating our protein quality lab's near-infrared spectroscopy equipment (*NIRs*). These issues were caused by a combination of external factors and staff bandwidth. They are being addressed by additional hiring.

Finance/Admin/HR:

- Semilla Nueva executed 95% of its US$2.3M budget.
- 69% of our 2023 US$2.88M budget is covered with cash on hand and committed funding.
- Our 2022 external audit will be issued by the firm Manuel Cervantes y Asociados based on *FASB, for not-for-profit organizations.* This new firm was selected by our Board of Directors to increase the rigor of the audit and prepare Semilla Nueva for larger institutional funders.
- Organizational culture improved significantly. Our composite *Great Place to Work®* score increased from 66% in 2021 to 87% in 2022, with *organizational pride* as our top dimension.

KEY TERMS

Throughout this report, we use terms to describe the maize market in Guatemala and our goals in breeding new biofortified seeds. While care has been taken to present the report using simple language, the nature of our work makes a few technical terms indispensable. We beg the readers' forgiveness and offer a preview of the terms which we have been unable to part with.

Low-segment farmers purchase a cheap but low- yielding hybrid seed produced by local companies. The seeds cost ~US$45 per 20kg bag and provide farmers with only slightly higher yields than non-hybrid seeds. We estimate 80,000 low-segment farmers produce 10% of Guatemala's maize.

Mid-segment farmers use moderately priced seeds produced and sold by national Guatemalan companies. The seeds cost ~US$71 per 20kg bag but only provide moderate yields. We estimate 40,000 mid-segment farmers produce 6% of the maize consumed in Guatemala.

High-segment farmers purchase the most expensive hybrid seeds every year. These seeds come from transnational seed companies. The seeds cost ~US$150 per 20kg bag but provide farmers with high yields. We estimate 40,000 high-segment farmers produce 14% of Guatemala's maize consumption.

Non-hybrid farmers do not purchase seed annually, but instead save and replant seeds from their previous harvests. These farmers typically use a limited amount of chemical fertilizer, herbicides, and seed treatment, which they purchase each year. Most only grow enough maize for home consumption, but some have large enough land holdings to produce enough maize to sell to the market. We estimate the 870,000 farmers who do not purchase seed produce 53% of the maize consumed in Guatemala[1].

Pure lines: Pure lines are seeds that have been bred to be genetically homogeneous. They have specific traits (yield, nutrition, disease resistance, etc) and are similar from generation to generation.

Hybrids: Most commercial maize seeds are hybrids. They result from pollinating one pure line with another. Commercial hybrids[2] generally have been bred for excellent yields and other positive traits. If a farmer buys a hybrid and saves seed from the grain produced, some traits, such as yield, become less pronounced with each generation. Depending on a farmer's economic and agroecological context, it can be highly advantageous to buy hybrid seed every year (or every few years).

Seed conversion: We use the team seed conversion to refer to backcrossing, a process to convert a pure line to have a new trait while maintaining as much of the genetics and desirable performance of the original line as possible. Imagine creating a golden retriever with poodle hair by crossing a golden retriever and a poodle, finding the puppies that are the most like golden retrievers but with full poodle hair. In the next generation, you cross those puppies with a golden retriever and pick the puppies that are even more like golden retrievers but still have poodle hair, etc. After several generations, you may have a few golden retrievers with poodle hair. Semilla Nueva backrosses (or converts) the lines of high yielding hybrids to have improved nutritional traits while maintaining their yield.

[1] In 2020, the Guatemalan government estimated 20% of maize is imported illegally from Mexico. In our model we estimate 17%.

[2] If a (simple) hybrid is itself crossed with another line or another hybrid, it forms a triple or double hybrid. Most commercial seeds in Sub-saharan Africa and Mesoamerica are triple or double hybrids.

IMPACT EVALUATION

Summary:

- In 2022, a total of 20,505 families planted Semilla Nueva's biofortified seed, 62% more families than in 2021. Nearly 600,000 people improved their nutritional intake, more than double 2021.
- Semilla Nueva's efforts to achieve a representative sample of farmers for economic analysis were successful. Farmers who purchased biofortified seed made an average of US$182 of additional income. Overall, Semilla Nueva increased farmer incomes by US$2.4-3M, a higher number than our total budget.
- Semilla Nueva's efforts to achieve a representative sample of farmers for economic analysis was successful due to good coordination between the M&E and operation teams.
- 74% of farmers commented that their maize crops were impacted by climate shocks. In situations of drought, our F3 seed reduced farmers' rot damage by 14% while F5 reduced rot by 33%, contributing to 15-17% higher yields. For farmers who suffered severe storms, damaged plants and ears were reduced from 39% for farmers' normal seeds to 30% for F3 and 21% for F5. Yields were 24% higher on average.
- Using Innovations for Poverty Action's (IPA) Poverty Probability Index (PPI), we found that 58% of farmers using biofortified seeds live below the national poverty line (US$3.67/day).
- The International Center for Nutrition of Central America and Panama (INCAP) and Cornell University finished baseline data collection and started analyzing the baseline data for our first randomized controlled trial (RCT) looking at the impact of planting and consuming Semilla Nueva's maize on zinc and iron biomarkers for children and women.

Semilla Nueva exceeded its 2022 goal, reaching 20,505 families with biofortified maize

In 2022, 20,505 families planted biofortified seed provided by Semilla Nueva and its allies, exceeding our stretch goal of 20,200 families for the year by 1.5% (and our more recent conservative goal of 15,000 families by 37%). Those families produced enough biofortified grain to feed their family members (123,115 people) and sell excess production that feeds an estimated 473,200 consumers across the country. Compared to 2021, we increased the number of farmers buying biofortified seed from Semilla Nueva by 47%. Semilla Nueva reached 5,856 subsistence farm families through donations from partners such as the NGOs World Vision, TECHO[3] (a Guatemalan NGO that works to improve local living conditions and infrastructure) and others, increasing families reached by our partnerships program by 95%. Our partner seed company, Valle Verde's sales benefitted 2,620 families. It should be noted that Valle Verde nearly doubled the amount of seed sold, but reached fewer families than expected because their customers bought more seed on average than before.

[3] https://guatemala.techo.org/

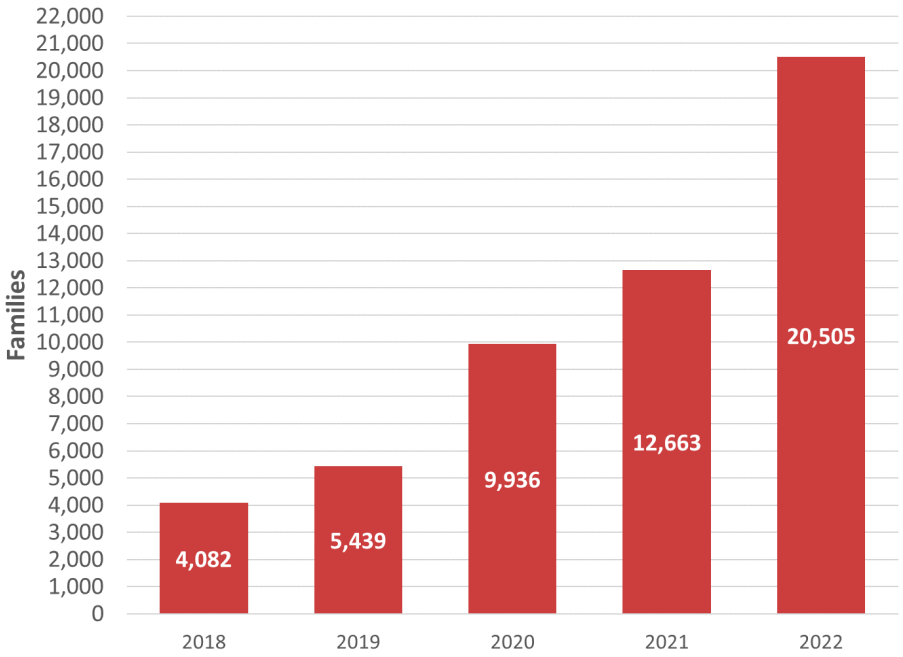

Figure 1: Families that planted Semilla Nueva biofortified maize seed (2018 – 2022)

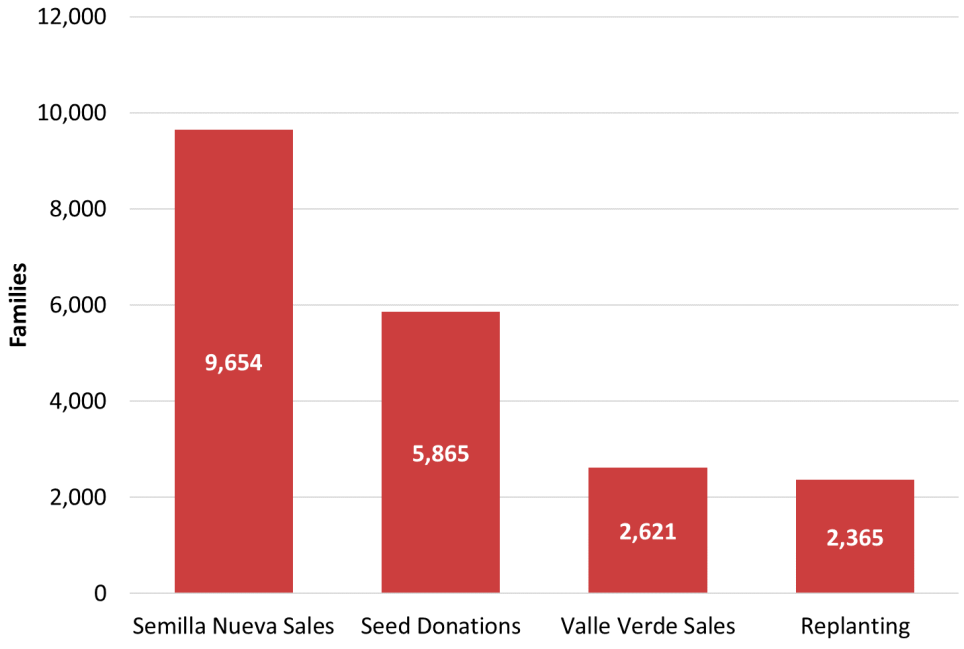

Figure 2: Breakdown of families planting biofortified maize in 2022 by source of seed

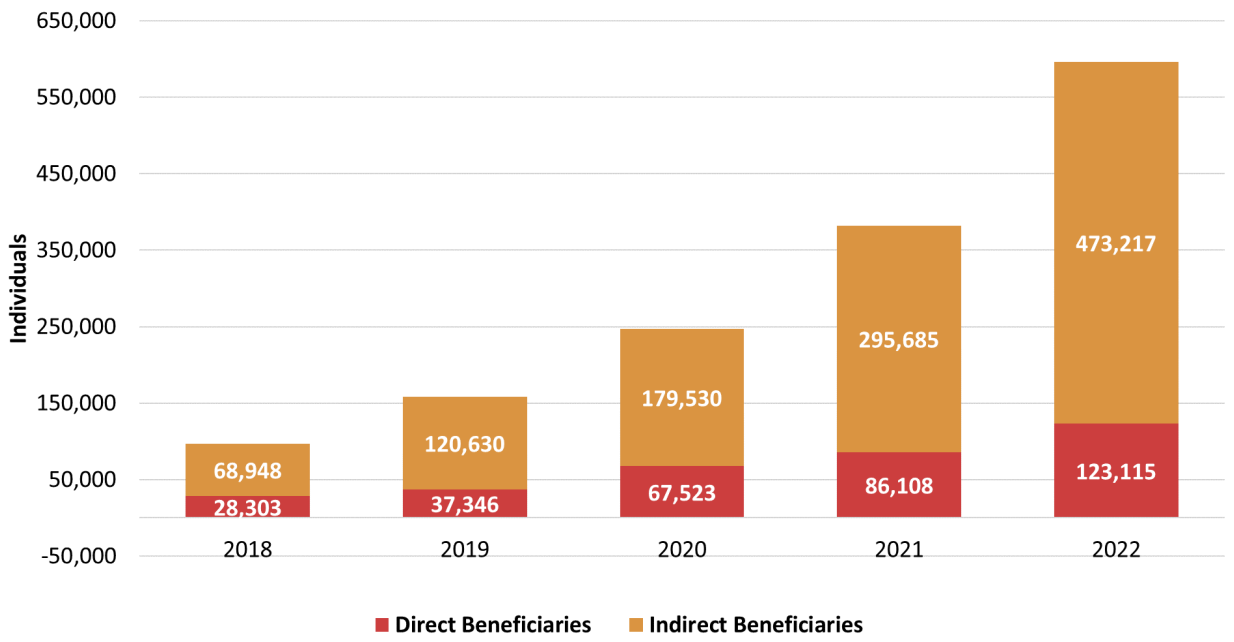

Figure 3: Number of direct[4] and indirect[5] beneficiaries per year

More than half of farmers who receive seeds from NGOs saved seed and replanted; we are now including these farmers in our impact estimates

In 2020 and 2021, Semilla Nueva received several reports that farmers who received our seeds from NGOs replanted the seed the following year. Our 2021 end of year survey identified that 37.5% of farmers who received free seed saved a portion of their biofortified maize to plant again in 2021. In our 2022 end of year survey, we recontacted the same farmers to determine if they had indeed planted, and contacted farmers who received seed in 2020 to determine how many had saved seed and replanted in both 2021 and 2022. Of farmers who received seed in 2020, 37% replanted in 2021 and 55% of that group replanted a second time in 2022 (20% cumulatively). 57% of farmers who received seed in 2021 replanted in 2022. Given this information, Semilla Nueva is now including these farmers in our impact estimates. In 2023, we will prioritize following up with purchasing farmers to determine the number who are replanting seeds and evaluate the nutritional quality and yields of these replanted seeds under farmer conditions. Semilla Nueva doesn't actively advocate farmers to replant hybrid seeds and will only do so if the economic impacts for them are positive.

[4] Direct beneficiaries are the farmers who planted Fortaleza (F3 and F5) seed and their families.
[5] Indirect beneficiaries are the estimated number of individuals who consumed biofortified maize by buying excess production from the market.

Table 1: Farmers saving seed and replanting

Segment	Farmers who saved seed and replanted in 2022 (%)	Farmers who saved seed and replanted in 2022 (#)
2020 Seed giveaway	20	626
2021 Seed giveaway	57	1739

Better farmer targeting and program growth led Semilla Nueva to reach philanthropic break-even; farmers make more extra income than what we spend in philanthropic capital

Our 2021 reports highlighted two main areas for Semilla Nueva's growth: improved farmer targeting and better monitoring of the economic impacts of our seed. Semilla Nueva achieved our goals in both areas, and it allowed us to reach philanthropic break even. Semilla Nueva spent US$2.2M and increased farmer incomes by over US$3M. Modifying our own data to more conservative estimates would decrease impact to $US2.4M, still higher than our expenditures. Semilla Nueva improved our economic impact and we have a reliable way to measure it. Semilla Nueva's methodology for measuring economic impact is different from other NGOs. It tries to take into account the high diversity that we encounter in the field and conduct the most accurate, annual measurement of impact based on all of these conditions. There are many different types of farmers, using different practices, buying or using very different types of seeds, experiencing dramatically different weather, soil and other growing conditions. Further, the farmers Semilla Nueva reaches change annually, the conditions they face change annually, their choices change annually, and the seeds Semilla Nueva offers (and the proportions of each) can change significantly from year to year. For this reason, our methodology is designed to blend the best aspects of randomized controlled trials, side-by-side farm trials and a population wide sample. We measure impact in the following ways.

Representative sample: Semilla Nueva paid a subset of agrodealers a small bonus to capture basic information (name, phone number, what seed farmers used the previous year, how much and which of our seeds they purchased) from each customer that purchased our seed. This program provided information on 2,543 farmers from all our major regions. Semilla Nueva's team then called those farmers, validated that the information was correct, and asked if farmers would be willing to participate in our monitoring program. 827 farmers moved on to this stage. The primary reason farmers didn't pass to this stage was inability to reach the farmers by phone. This group was then used for Semilla Nueva's monitoring and evaluation program. 229 of these farmers participated in our end of year survey on demographics, climate perception, and consumption/sales of biofortified maize.

Economic impact measurements from monitoring parcels: Semilla Nueva interviewed farmers to find those who planted both our seed and their traditional seed side-by-side. Our field staff then visited these farmers. If they planted the same seeds on the same planting date, used the same inputs and management in both parcels, and planted them in similar conditions, they were selected for economic evaluation. Of purchasing farmers, over 100 farmers passed to this level. Over 20 farmers who received seed for free from NGOs also passed to this level. Our staff visited three times during the growing cycle to collect data on input usage, farmer practices, and climate damage. If farmers continued to apply the same practices to both fields, they continued in our evaluation program. Our staff then visited before the harvest to take representative subsamples of the harvest from both fields.

Of over 100 farmers, only 49 farmers who purchased seed and 12 who obtained seed for free made it through this entire process. Some were disqualified because they harvested early, others because they used different practices on their traditional seeds vs. their biofortified seed.

By synthesizing the data collected, we were able to create estimates of the following:

1) Of the farmers purchasing our seed in 2022, how many farmers are in each farmer segment?
    a) (high-segment, mid-segment, low-segment, or non-hybrid seed based on the seed they used in 2022 and 2021)
2) For farmers who planted our seeds and the seeds of another segment and treated them the same, what was the difference in average costs, yield, and net-income?
3) By combining a) data on the average amount of seed purchased and planted by farmers b) the segmentation of purchasing farmers and c) the economic impact per segment, what was the average economic impact per farmer per segment in 2022?

Table 2: Segmentation of purchasing farmers, 2022 (%)

Segment	F3	F5
Non-hybrid	18	4
Low-segment	60	69
Mid-segment	10	12
High-segment	13	15

Table 3: Average economic impact per family (US$)

Segment	F3	F5
Non-hybrid	277	392
Low-segment	146	48
Mid-segment	259	228
High-segment	438	-211
Seed giveaway	135	–

The above results should be taken with some caution. Given the number of farmer segments and the seeds we are providing, we believe there is some noise in the data, especially in the following cases. High-segment seeds in F3 monitoring parcels performed atypically poorly, and it is not realistic to conclude that F3, on average, produced more income than high segment seeds. For farmers who purchased F3 and a low-segment or mid-segment seed, comparison parcels also performed poorly, leading to higher improved incomes for F3 than what we've seen in previous years.

In total, our data implies that Semilla Nueva's total economic impact across all farmer groups is US$3,035,239. While we feel more comfortable eliminating about 20% of this extra income (eliminating extra income for F3 high-segment farmers, for example), we do still recognize and celebrate the overall result and overall trend. Most of Semilla Nueva's farmers were in the correct farmer segments where we have historically increased incomes, and we were able to measure this impact far better than before. For the future, Semilla Nueva will work to significantly increase our sample size and complement this evaluation with small, focused, third party RCTs.

Non-hybrid farmers do see yield increases if they use our seed

It also is deeply important to note the results for non-hybrid farmers and farmers who received seed from NGOs. One of the deepest debates in Guatemala is whether providing hybrid seeds to poor farmers who normally don't purchase seeds is responsible. Experts from several agencies have argued that farmers who do not purchase seeds tend to not purchase inputs like fertilizer. They argue that hybrid seeds, without enough inputs will have low yields that decrease farmer net income. What we've found, however, supports our reports from previous years. First, 18% of the farmers purchasing our seed normally don't purchase seed and they increase their net income significantly. Second, the poorest farmers in NGO programs who receive seed for free (without any other inputs) also raise their net incomes significantly. This data is a critical justification for our efforts to continue using a subsidy program to make higher yielding biofortified hybrid seeds accessible to the poorest farmers. Additional data on costs, yields, income, and planting size per segment is provided in the annex below.

Figure 4: F5 resisted lodging from storms (left), the low-segment comparison seed (right) did not

F3 and F5 are more resilient than most seeds farmers use in terms of storms and drought

For years, farmers have mentioned that F3 is more resistant to weather events like high winds and drought, made more intense by climate change. Our *July-December 2021 Standard Report* summarized our first representative study on farmers' perceptions on climate change: 64% of all farmers surveyed reported that they were impacted by climate change. Among farmers who received seed for free, 61% said that F3 is more climate-resilient than seeds they have previously used, while 8% said that the seed that they normally plant is more climate-resilient than F3. In 2022 we wanted to repeat this study, but combine it with a more thorough study on the impacts of climate change on the performance of our seeds vs. those farmers normally use.

We incorporated questions and measurements regarding climate change into the data we captured from the monitoring parcels mentioned above. This allowed us to measure the difference between our biofortified seeds and farmers' normal seeds in terms of how many plants survived the growing cycle, ear rot damage, and yields, and to specifically analyze this data for the farmers who suffered storms or droughts. In 2022, 24% of the monitoring parcel farmers experienced drought damage while 34% experienced storm damage. Based on the data collected from our monitoring parcels, we found that F3 and F5 responded better to storm damage compared to conventional maize. On average, farmers who experienced significant storms lost 38-39% of their crop due to plants lodging (blowing over), ears rotting, or other problems. F3 only lost 30% and F5 lost 21%. This contributed to 24% higher yields on average for our seeds. Impacts on drought tolerance were also significant. F3 farmers had 14% lower rates of rotted ears compared to the seeds farmers normally planted. F5 farmers had 34% lower rates of rotted ears. F3 and F5 farmers had 17 and 15% higher yields respectively.

Tropical storms and droughts are becoming more and more common due to climate change, and our biofortified seeds can help farmers reduce their losses significantly. In addition to higher nutritional quality, our seeds' root systems, ear cover, and pest resistant traits (moreso for F5 than F3) improve outcomes for farmers suffering both storms and droughts. Semilla Nueva's program doesn't just improve health and livelihoods, but also climate resilience.

Poverty rates are largely similar across all farmer segments

Semilla Nueva conducted its second national study using Innovation for Poverty Action's (IPA) Poverty Probability Index (PPI). On average, 58% of farmers using our seed live below the national poverty line ($3.64/day), 72% live on less than $5.00/day, and 28% live on less than $2.50/day. To put this into perspective, in 2020, 47% of all Guatemalans lived below the national poverty line according to government data.

Table 4: Poverty Probability Index (PPI) for farmers purchasing F3 or F5 by segment and for NGO-assisted farmers

Segment	$2.50/day (%)	National Poverty Line[6] (%)	$5.00/day (%)
Non-hybrid	25	58	78
Low-segment	20	45	58
Mid-segment	18	55	77
High-segment	16	52	60
Farmers receiving seed from NGOs	40	74	87

[6] The Guatemalan National Poverty Line is $3.64/day

As expected, farmers who received free seed from NGOs ranked slightly higher in PPI than farmers who normally don't purchase seed but purchased this year (non-hybrid farmers) and the other commercial farmer segments. We were surprised that the PPI for all commercial segments of farmers are so similar. This may show that the high-segment farmers aren't as wealthy as we think – or it may show weaknesses in the PPI methodology. PPI estimates income based on the goods a family owns, and this proxy may not be as sensitive in Guatemala as in other contexts. Regardless, the data invites Semilla Nueva to investigate the economic situation more deeply, especially as we work towards understanding the economic conditions that may lead farmers to purchase seed.

All farmers who used biofortified seed planted maize on the majority of their land (61%), but only farmers buying seed got the majority of their income from maize

As shown below, nearly all farmers using our seed planted maize on the majority of their land, independent of the farmer segment. The total amount of land planted, however, is lower for farmers who received free seed from NGOs and highest for farmers typically planting high-segment seeds. In addition, there is a significant difference between the percent of farmers who historically get the majority of their income from maize for farmers who purchase seed normally compared to farmers who bought for the first time or received seed from an NGO.

Table 5: Land planted with maize (F3 farmers)

Segment	% of land planted	Hectares planted	Maize is their primary income source (%)
Non-hybrid	64	0.83	22
Low-segment	57	1.34	78
Mid-segment	54	0.81	50
High-segment	75	1.97	40
Farmers receiving seed from NGOs	60	0.4	14

We think this data adds some granularity to the opportunity for long-term economic impact. On one hand, given that most farmers plant the majority of their land with maize, there is significant opportunity for improving farmer incomes by switching from low-yielding seeds to higher yielding ones. On the other hand, there are large numbers of farmers (such as those served by our NGO partners) where low land size will be a limitation on the total amount of extra income farmers can generate.

INCAP and Cornell began our first third-party RCT on biofortified maize nutritional impact

The first RCT on the nutritional impact of Semilla Nueva's biofortified maize seeds is currently underway. For more background on the study, please review our *January-June 2022 Standard Report*. World Vision provided our biofortified seed to a randomized subgroup of its partner farmers in Eastern Guatemala in May and April 2022. Thanks to generous funding from the Light a Single Candle Foundation, the Institute of Nutrition of Central America and Panama (INCAP) identified 53 families with children under two who qualified for the study, including both families who received seed and those who didn't. In August and September 2022, INCAP collected baseline data, blood samples and fecal samples from 53 families. INCAP shipped the samples, and Cornell began data analysis in late 2022. The mid-line study is currently underway by INCAP.

There is, however, one important setback in the study. Due to droughts and pest attacks, many farmers didn't harvest enough F3 for their entire annual consumption. Semilla Nueva staff is currently assisting INCAP in doing an inventory of the amount of maize farmers did harvest, measuring its nutritional quality, and assisting in a modification of the study to provide additional biofortified maize to families who will run out during the course of the study. This problem may affect the study's results and also highlights a potential error in study planning. The goal of the study was to see the impact our biofortified maize can have for farmers planting, but the study was conducted with the poorest 10% of farmers we serve, who are the most vulnerable to the shocks mentioned above.

Endline data will be collected in April and May with final results expected in fall 2023. We do want to align our audience on expectations. RCTs for nutrition impact is a very difficult undertaking and this initial study was designed to better understand our impact and the ability to measure it. As explored in our previous report, this study was designed primarily to explore a new method of measuring zinc status that is currently being pioneered by Cornell – and to use this data to plan a more statistically powerful study for the future. More definitive RCTs on health impacts of agricultural nutrition interventions normally cost between US$1-3M, and this study is primarily a precursor to a more statistically powerful, longer term study.

SALES & MARKETING

Summary

- Semilla Nueva targeted the correct group of farmers. 98% of farmers participating in the field days were in the farmer segment where our seeds provide the most impact vs 52% in 2021.
- Sales increased 57%, from 3,637 bags in 2021 to 5,213 bags—and sold out after 7 months.
- Our new seed, F5, sold out within weeks. Farmers note significant improvements compared to F3. F5 production and sales will largely replace F3 in 2023.
- Repurchase rates improved from 39% in 2021 to 46% in 2022; 64% intend to repurchase in 2023.
- Farmer perception of our Fortaleza brand improved in 2022. Better yield and ear rot resistance in F5 should lead to further improved perception in 2023.

Before 2022, Semilla Nueva largely targeted the wrong farmers. Fixing this problem required significant changes in strategy, staffing, and culture

As mentioned in our *July-December 2021 Standard Report*, Semilla Nueva's growth in sales slowed significantly in 2021, largely because we targeted farmers in the wrong segment. Semilla Nueva's operational leadership and sales team had largely come from large transnational seed companies and knew how to market to the largest, commercial and wealthy maize farmers. They had difficulty targeting the poorer, low-segment and non-hybrid farmers where our first seed, F3, is competitive and beneficial. Addressing this issue was the highest priority of 2022. It involved significant changes in personnel, culture and management strategies, and execution of our field days and other farmer promotion strategies.

As mentioned in our *January-June 2022 Standard Report*, from December 2021 to March 2022, we replaced the entire operations leadership structure: sales coordinator, marketing coordinator, operations manager, production coordinator, and operations director. Several replacements were brought in from our sales team and others were hired externally. Instead of prioritizing direct industry experience in seeds, we prioritized strong cognitive skills, willingness to learn, and work ethic. In the words of one of our favorite leadership authors, Lencioni, we looked for people who were hungry, humble, and smart.

Our sales team improved performance by establishing and implementing protocols for all major functions, such as demonstration parcels, field days, agrodealer trainings and visits. These protocols were combined with real time and transparent reporting through Google Docs, which allowed for consistent supervisor feedback and peer monitoring and mentoring. Results of key metrics, such as the number of low-segment and non-hybrid farmers attending field days, were tied to significant quarterly bonuses for our technicians and their managers. These bonuses responded to one of the staff's biggest complaint areas in 2021 (lower salary and benefit levels compared to transnational seed companies) in partnership with staff efforts to embrace new and difficult goals in alignment with Semilla Nueva's mission. Our biggest cultural change was moving from a centralized decision making process to a more decentralized and consensus-based model that was rooted in significant investments by the leadership team in explaining the reason behind the changes. Ultimately, staff who stayed decided to embrace being part of an organization where the primary metric was increased income and nutrition for the poorest farmers, not the prestige of selling the highest priced or most profitable goods to the highest profile farmers. This process of building new systems together, financially incentivizing positive steps to make these new systems, and deeply exploring the mission of

the organization, created a cycle of trust and improved performance that drove a deeper sense of belonging and cohesion.

The new team members created several new strategies which proved highly impactful. The staff improved the loyalty of agrodealer employees by offering a small financial incentive to promote our brand, and we increased our technical assistance to farmers and agrodealers via more weekly in-person visits. We increased brand visibility by ensuring promotional materials were highly visible in 100% of agrodealers, and we increased inventory reviews at agrodealers to weekly or biweekly and thereby assured that no agrodealers were without stock during the main sales season.

98.4% of farmers at field days in 2022 were our target low-segment and non-hybrid farmers vs. 52% in 2021; we reached 2,422 farmers at field days in 2022 compared to only 941 in 2021
The combination of strong financial incentives and daily data reporting led the sales team to actively seek out new communities where target farmers lived, work with community leaders to establish demonstration parcels, and obtain the maximum attendance in each field day. These results are important because they show that with the right organizational culture and tools, we can motivate staff to do activities that are not traditionally encouraged or accepted in Guatemalan agribusiness culture. Reaching the poorest farmers (against the conventional wisdom that they won't buy your products) is a positive step that indicates that we can build programming that breaks other cultural barriers as well, such as incorporating more women in field days and other activities in the future.

Sales increased 57%, from 3,637 bags in 2021 to 5,213 bags in 2022–and sold out after 7 months
Increased demand for Semilla Nueva's seeds came from several sources. Increased promotion, mentioned above, played a significant role in driving sales. The war in Ukraine also affected demand for our seed. Farmers reported that in a time when fertilizer prices had increased dramatically (77% according to our surveys), many couldn't afford more expensive seeds.

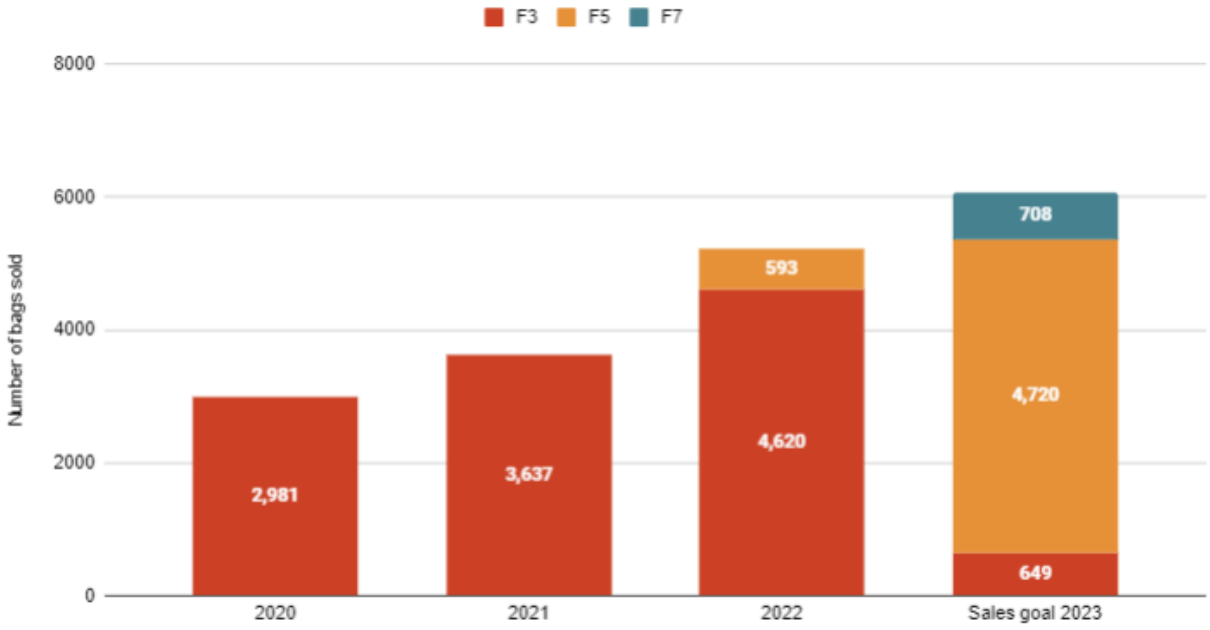

Figure 5: Semilla Nueva F3, F5 and F7 sales by year (20kg bags)

F5 sales will largely replace F3 in 2023

F5 sales will reach 4,720 bags in 2023 compared to 593 in 2022. F5 quickly sold out within weeks in April 2022 due to its higher yields, increased disease tolerance, and better adaptability in lower coastal regions. Farmer acceptability for F5 was higher than that of F3, and yields in promotional parcels averaged 16% higher than F3 in early 2022 (5.2 mt/ha vs 4.7 mt/ha). Aside from better yields, customers surveyed in our brand study rated F5 higher in key attributes when compared to Dekalb, Valle Verde, and other hybrids, as shown by Figure 6 below. A small amount of F3 will still be sold in higher altitude regions where it occasionally provides higher yields than F5.

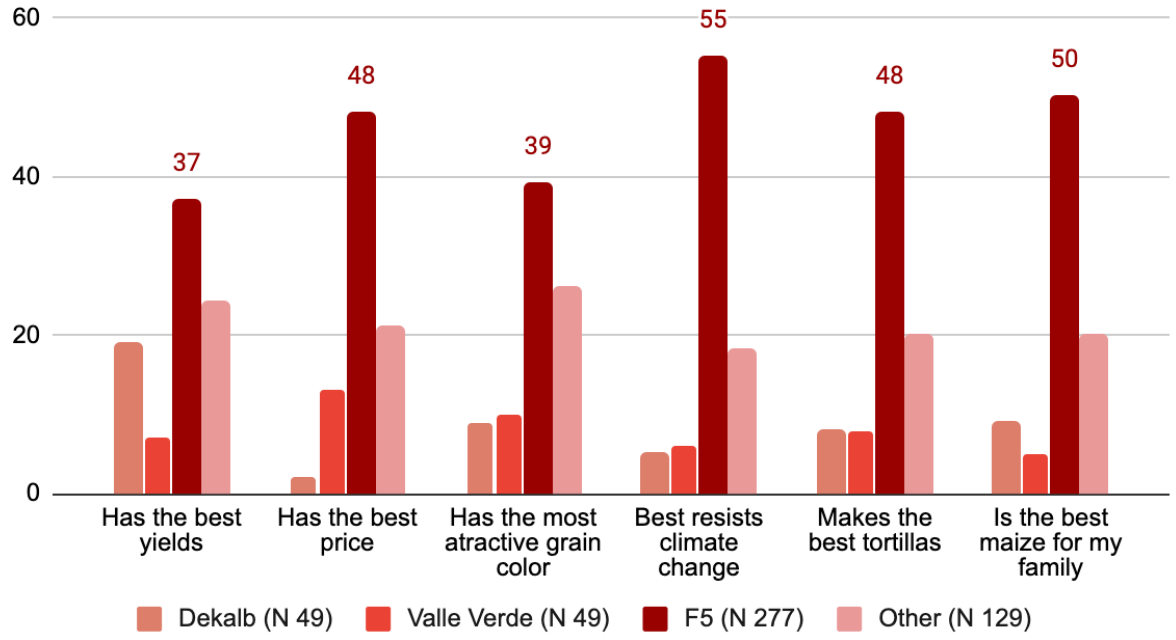

Figure 6: Fortaleza F5 farmer brand perception (%)

Farmer repurchase improved from 39% in 2021 to 46% in 2022; 64% intend to repurchase in 2023

Semilla Nueva's low repurchase rate in 2021 was indicative of our significant challenges in targeting the correct farmers. Farmers who are used to the most expensive, highest yielding seeds purchased F3, were unsatisfied by the lower yields, and did not purchase the seed again. While our 2022 repurchase rate did improve, the results of changes in farmer targeting won't be evident until we measure the repurchase rate of the following year. Based on our third party net promoter score (NPS) survey, 64% of farmers who purchased Fortaleza this year intend to purchase again in 2023, which is a positive sign.

Market research showed that improved farmer targeting led to improved perceptions of F3

The third party survey of 441 farmers showed a significant improvement in Fortaleza's net promoter score (NPS). Net promoter scores range from 100 (all users would give the product a 10/10 rating when recommending to friends) to -100. Fortaleza's rating increased 36 points, from 2 in 2021 to 38 in 2022. This places our seed in a similar position to our top competitors in the low/mid segment seed market (CB, Valle Verde, ICTA and La Abundancia). It is important to note that Fortaleza has one of the highest rates of detractors (those who would rate the brand 6 out of 10 or less), an issue which we will explore below.

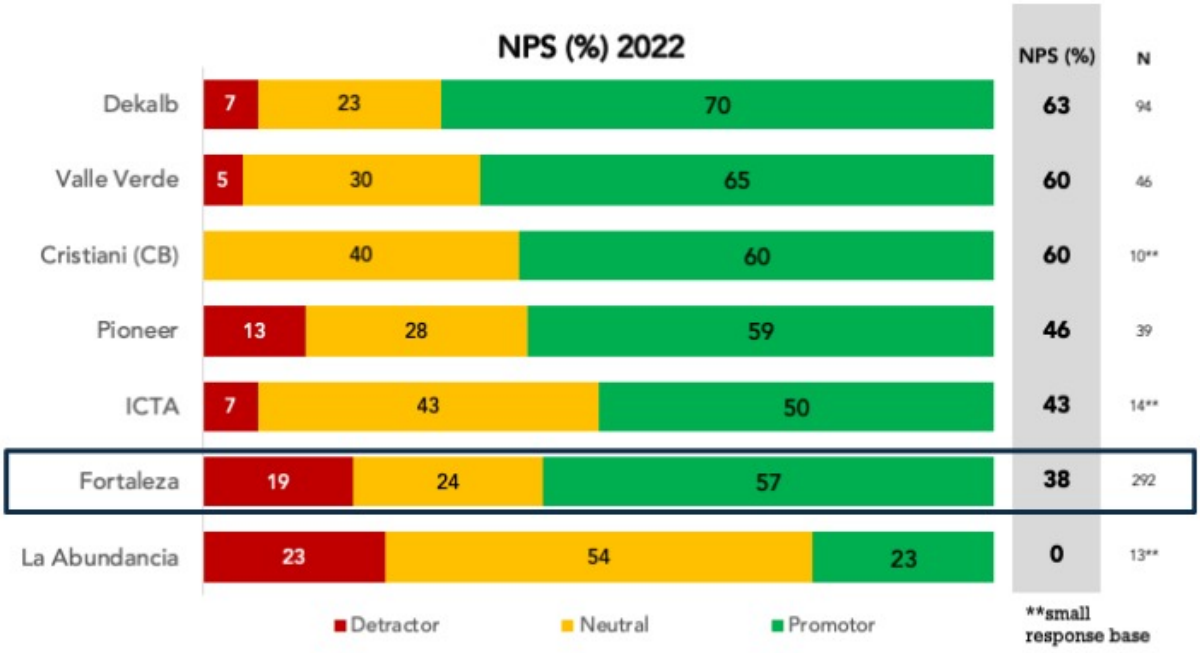

Figure 7: Comparison of net promoter score (NPS) across leading seed brands. Figure shows the percent of detractors, neutral and promoters for farmers with experience with each brand.

The most positive perceptions of Fortaleza came from farmers who produce maize entirely for home consumption (NPS 37) or who consume more than they sell (NPS 50). These farmers tend to be either in the non-hybrid and low segment groups. This confirms the importance of our farmer targeting efforts; promoting to these farmers will increase the number of brand promoters and repeat customers. Farmers who have planted Fortaleza two times or more gave Fortaleza an NPS score of 73, a signal of strong future brand loyalty and future purchases.

The table below breaks down the most common comments associated with Fortaleza seeds between brand detractors (who scored the brand 0-6 out of 10), neutral (7-8) and promotores (9-10).

The key to understanding the results in Table 6 is to return to the different segments of farmers. For farmers who normally use high segment seeds and sell the majority of their harvest to intermediaries, F3 has lower yields, higher rot, and often challenging grain to sell. These farmers become detractors. For farmers who normally use cheaper, lower-yielding seeds with higher levels of rot, they experience F3 as an improvement in nearly all aspects. As we increase sales of higher yielding, reduced rot seeds like F5 or F7, more and more of these detractors could potentially become neutral or even promoters.

Table 6: Number of detractor, neutral and promoter farmers and the most frequent comments by each group about the Fortaleza brand (%)

Detractor Farmers (N=55)	**Neutral Farmers (N=80)**	**Promoter Farmers (N=134)**
Low yields (42)	Higher yields (19)	Good yields (57)
Grain rot (22)	Small grain size (18)	Good harvest (42)
Cob/grain is small (16)	More climate resistance (15)	Climate resistance (20)
Color is too yellow/creamy (15)	Requires high inputs (9)	The tortilla is soft/good flavor (15)
Drought damage (11)	Grain rot (8)	Good grain size (14)
Does not adapt to climate change (8)	Small cob size (5)	Short plants (wind resistance) (10)
Few cobs (7)	Resistant to weevils (5)	Strong roots (wind resistance) (9)
Bad quality (7)	Grows slowly (4)	Good price (8)
Not resistant to excessive rain (6)	Nutrition/higher quality grain (4)	The grain is heavy (7)
No technical assistance (4)		Clean grain (6)
		Doesn't rot (6)
		Nutrition/has vitamins (4)
		Good technical assistance (3)

The NPS survey also offered several interesting insights to guide our future promotion. Nutrition is only associated as a positive characteristic of the brand by 4% of neutral farmers and promoters, while the taste and texture of tortillas was spontaneously mentioned by 15% of promotor farmers. One surprising finding is that even though Fortaleza seeds are the least expensive on the market, and the value of the seed is a central point of promotion, only 8% of promoters mentioned good prices as something they associated with the brand. This point invites us to explore more deeply the elasticity of seed price in determining farmer purchasing behavior, which will have significant implications as we continue to grow our seed subsidy program.

Semilla Nueva should invest less in mass media and more in agrodealers and field days

Farmers learned about our seed from agrodealer staff, who have their own or are invited to Semilla Nueva field days (48%), Semilla Nueva sales technicians (27%), recommendations from friends and family (26%), and field days (7%). See Figure 8. Given this trend, in 2023 we will decrease our expenditures on mass media and increase programs to incentivize and increase support to agrodealers to promote Fortaleza seeds. During the primary promotion season (February-April), we will reach 2,000 farmers through 84 field days, compared to 1,425 farmers reached through 51 field days during the first months of 2022.

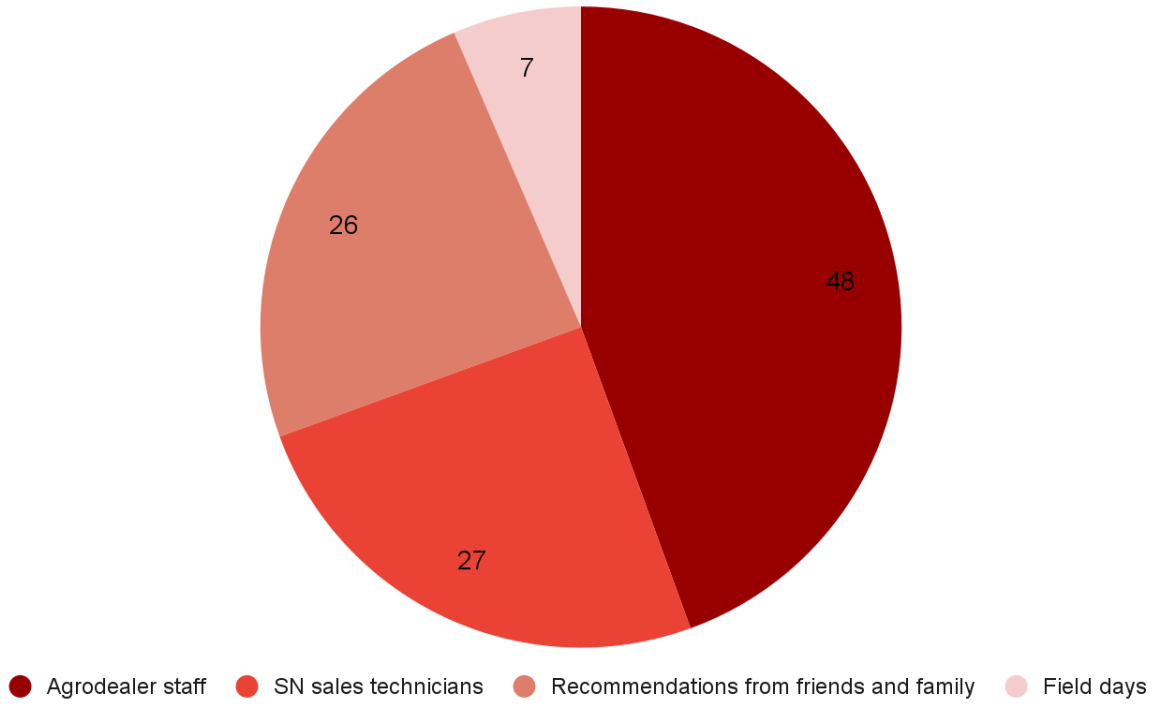

Figure 8: Sources from which farmers learned about Fortaleza brand (%) n=395

Conclusions and Plans Going Forward

In 2022, Semilla Nueva fixed its most significant field problem of the last five years. We fully shifted our field activities to target the right farmers and expanded our loyal customers. Combining this farmer targeting with our new higher-yielding and lower rot seed, F5 (and eventually F7 and other seeds), will allow Semilla Nueva to continue to increase farmers' use of biofortified seeds for the foreseeable future.

Addressing these two biggest concerns will allow the operations team to focus on its next phase. Instead of our field team being one that promotes the Fortaleza brand of seeds and measures its success based on how many farmers buy seeds from us, we will begin to measure our success based on 1) demand for biofortified seeds (with more produced by other companies than us), and 2) the pressure these satisfied farmers place on the Guatemalan government to institutionalize the subsidy program that is helping them access these improved seeds.

In 2023, the operations team will focus on deepening our successes with farmer targeting and promotion while simultaneously researching, exploring, and experimenting with new ideas to move to a more general role of promotion and systems change.

SEED PRODUCTION

Summary

- Total seed production from Semilla Nueva and allied seed companies will increase from 7,218 bags in 2021-2 to 13,282 bags, an 84% increase.
- F5 production is replacing the majority of F3 production.

Combining Semilla Nueva and allied seed companies, total planned biofortified seed production increased 84% in the 2022-3 production season. All seed has been planted between September and November and harvests are expected between February and April, 2023. To make this increased production possible without increasing production staff, Semilla Nueva's new production coordinator implemented a new system of ISO-inspired protocols and quality control guides, utilizing Google Drive for real time monitoring and reporting.

Table 7: Seed production 2021-2 vs 2022-3, 20kg bags

	2022			2023 in process			
Seed Company	**F3**	**F5**	**Total**	**F3**	**F5**	**F7**	**Total**
Semilla Nueva	4,620	593	**5,213**	649	6,035	1,098	**7,782**
Valle Verde	400	1,605	**2,005**	-	3,000	1,000	**4,000**
Semillas del Trópico	-	-	**-**	-	400	100	**500**
Valle Verde (El Salvador sales)	-	-	**-**	-	1,000	-	**1,000**
TOTAL	5,020	2,198	**7,218**	649	10,435	2,198	**13,282**

Historically Semilla Nueva has produced commercial seed in three different regions of the country, southern, eastern, and northern Guatemala. In 2023, we will consolidate production. Semilla Nueva will work directly with outgrowers in eastern Guatemala, which has produced the best quality seed at the lowest prices. Another portion of Semilla Nueva's production will be subcontracted directly to Valle Verde in northern Guatemala, given their low costs and in-house quality control systems. This decision will allow our single production coordinator to continue without increasing staff time while managing more production, and simultaneously shift more commercial activities to our allied seed companies.

COLLABORATIONS - INTERNATIONAL EXPANSION

Summary

- Valle Verde increased sales of biofortified seed by 76%; sales will more than double in 2023 due to strong performance of our new seed, F5.
- One new seed company is producing biofortified seed for sale; three more are experimenting with seed and may begin sales by late 2023.
- Supported by our subsidy, Valle Verde will begin sales of our seed in El Salvador. This will be the first international expansion of our program.

Valle Verde nearly doubles sales of biofortified seed

Valle Verde, completed its second year of subsidized seed sales. They increased their sales from 1,129 bags of F3 in 2021 to a total of 2,005 bags of F3 (sold as JC-Proteico) and F5 (sold as JC-5) in 2022. Given the improved performance of F5, Semilla Nueva and Valle Verde agreed to double the sales goal for 2023, to 4,000 bags of seed. Overall, Valle Verde reports that customer feedback from F5 sales have been very positive. Farmers reached yields of over 100 qq/mz (6.7 mt/ha) with little to no cited problems with diseases. Valle Verde's ownership is satisfied with F5 and excited for new hybrids such as F7. They plan to continue expanding their biofortified seed offering for the foreseeable future.

One new seed company signs on, three more may by mid 2023

Another of Guatemala's largest seed companies, Semillas del Trópico, joined the subsidy program in 2022. They are currently producing 500 bags of F7 for sale in April-June 2023. Pending results, they plan to expand their participation in the subsidy program. They will sell F7 under their own brand and with a seed name they have yet to determine. In addition, three additional seed companies are currently testing F5, F7 and production of both seeds. Based on results, all three companies have expressed interest in producing seed during the off season for sales in late 2023.

Semilla Nueva will support Valle Verde in expanding sales to El Salvador

Valle Verde presented Semilla Nueva with an opportunity to expand sales to Honduras and El Salvador in 2023. Semilla Nueva reviewed the market and Valle Verde's partners in each country. With a grant from Dovetail and funding from grassroots donors, Semilla Nueva agreed to fund the registration costs to bring the seeds to El Salvador in 2023 and potentially Honduras in 2024. Semilla Nueva will provide the same subsidy to Valle Verde who will in turn take charge of promotion and sales in the new country. Semilla Nueva will expand its monitoring and evaluation to El Salvador to monitor impact.

Table 8: Third party subsidized sales of biofortified seed

Description	2021	2022			* Goal 2023		
Hybrid	F3	F3	F5	Total	F5	F7	Total
Valle Verde Guatemala	1,129	400	1,605	2,005	3,000	1000	4,000
Valle Verde El Salvador				0	1,000		1,000
Semilla del Trópico Guatemala				0		500	500
TOTAL	**1,129**	**400**	**1,605**	**2,005**	**4,000**	**1,500**	**5,500**

RESEARCH AND DEVELOPMENT

Summary:

- Semilla Nueva will launch initial commercial sales of F7, the first hybrid fully developed by our breeding program. F7 has similar levels of nutritional quality to F3 and F5. Yields are intermediate between F5 and the market's leading high-segment hybrid.
- The first generation of experimental backcrossed hybrids maintained yields close to their original non-biofortified hybrid. Zinc levels are 43% higher than the original hybrid and 30% better than market competitors.
- Semilla Nueva imported and began backcrossing several of CIMMYT's most important openly available lines for eastern and southern Africa and is in process of importing over 30 experimental lines.
- Semilla Nueva's new hybrid program successfully implemented double haploid technology.
- Semilla Nueva is now evaluating genetic data produced in partnership with CIMMYT on over 100 of our lines and have discovered possible markers for predictive genes. Discovering the genes behind high zinc maize is one of our highest priorities and could radically decrease the cost and time to develop new biofortified seeds. Semilla Nueva also signed an agreement with Bayer to fully sequence the DNA of over 250 of our lines and make the information open source.
- The R&D team missed internal deadlines for creating an open database of our inventory and data and calibrating our protein quality lab's near-infrared spectroscopy equipment (*NIRs*). These issues were caused by a combination of external factors and staff bandwidth. They are being addressed by additional hiring.

Semilla Nueva's first internally developed hybrid passed important trials and will go through an initial commercial launch to continue evaluation

The R&D team included our new seed, F7, in a dozen trials in late 2022. In these trials, yields ranged from similar to our current best hybrid, F5, to 10-15% higher, statistically comparable to the most popular high-segment hybrid in the market. The team produced enough parental seed to produce approximately 2,000 bags of F7. The first commercial production of F7 is currently underway by Semilla Nueva's production team and two of Guatemala's leading national seed companies, Valle Verde and Semillas del Trópico. By late December 2022, Semilla Nueva's operation team launched over 40 side-by-side trials of F7 and F5 with farmers throughout Guatemala for initial promotion.

Semilla Nueva's seed conversion efforts passed their most significant milestone to date. Trials showed that a partially backcrossed hybrid (75% converted lines) increased zinc levels by 43% compared to the original non-biofortified hybrid, and largely maintained yields

Semilla Nueva's first attempt to backcross zinc and iron traits into a conventional hybrid (F17) were successful. In our *July-December 2021 Standard Report*, we detailed that we had partially backcrossed three lines of a highly competitive conventional hybrid. In 2022, we used these lines to recreate over a dozen experimental hybrids and tested them throughout Guatemala. These new hybrids maintained high zinc levels in field trials and showed yields and agronomic traits comparable to the original hybrid.

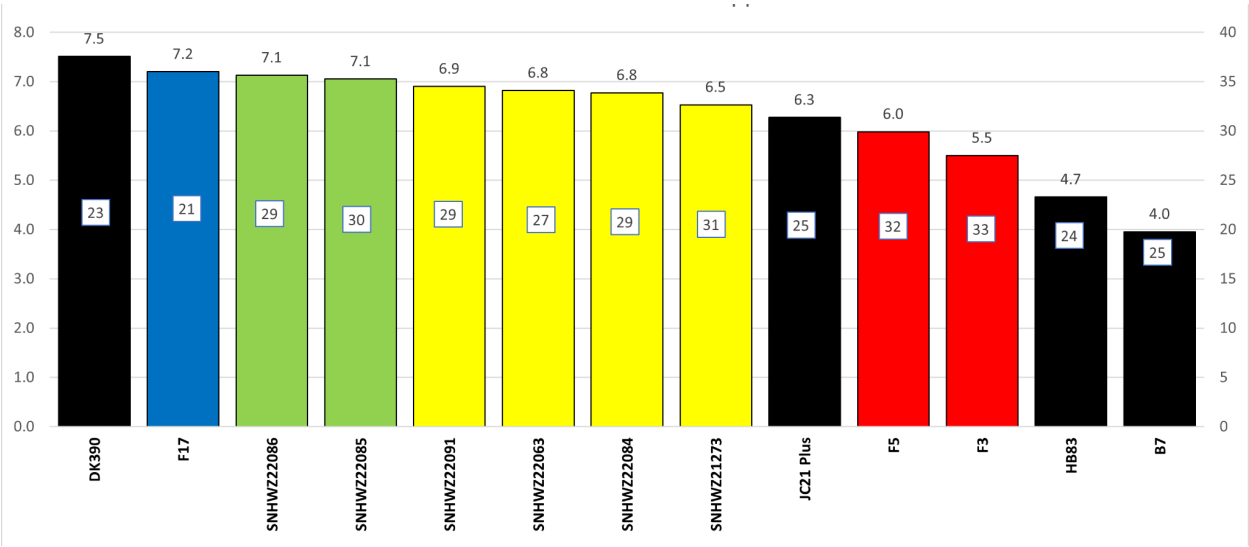

Figure 9: Yield (left axis, mt/ha) and zinc levels (right axis, PPM) of Semilla Nueva's first converted hybrid seeds

We've organized the figure in order to allow the reader to understand the justification of our backcross program and the implications of its achievement.

- **Red**: Semilla Nueva's first and second seeds (F3 and F5), originated from CIMMYT. These seeds are mostly competitive vs. low-segment and non-hybrid seeds but have high zinc.
- **Black**: From left to right, leading seeds in the high segment (DK390) and (JC21), low segment (HB83), and the most common non-hybrid seed provided by the Guatemalan government (B7). These allow the reader to contextualize how our current seeds (red) compare against the seed we were seeking to convert (blue).
- **Blue**: the non-biofortified hybrid seed that Semilla Nueva selected to convert. Note its similar yield to the best seed in the study, DK390, but has zinc that is below nearly all of the non-biofortified seeds.
- **Green**: the two converted seeds with similar yields to the original hybrid and far higher zinc.
- **Yellow**: four of the several dozen converted seeds which won't be advanced.

What should be understood from this graph is that Semilla Nueva was able to identify a non-biofortified seed that had excellent yield and after three years of conversion, create biofortified versions of it that are almost the same in yield and retain the majority of the additional zinc of our current biofortified seeds.

This milestone, however, is still an intermediate step. Only a few of the new hybrids reached a combination of both similar high yield and significantly higher zinc. They also lack high protein quality. Semilla Nueva is now working to include protein quality in our next generation of backcrossed hybrids and more fully convert them. Regardless, these results were enough to lead Semilla Nueva to acquire several of the most important lines used in CIMMYT's breeding program in eastern and southern Africa. Semilla Nueva has begun the backcrossing process and requested additional experimental lines that will likely be featured in later hybrids CIMMYT will create for Africa.

Semilla Nueva implemented new breeding techniques

Semilla Nueva successfully created its first double haploid (DH) lines using a licensed inducer from CIMMYT in our own lab in Guatemala. This technical accomplishment will significantly reduce the time

to create new novel lines and hybrids, as well as potentially increase the speed and efficiency of our backcrossing efforts in Guatemala. Only three dozen DH lines were created, but plans to create more than 2,000 are underway for 2023.

Gene identification in process and agreement signed with Bayer

Semilla Nueva received our first genotyping data from CIMMYT in November, 2022. The data is under initial evaluation, but we have identified 5 gene locations that show a strong influence on the zinc of the seeds we develop and will work with our advisory board to prepare next steps.

After nearly a year of exploratory technical and legal conversation, Semilla Nueva and Bayer Crop Science have signed an agreement as part of Bayer's Open Innovation program to accelerate Semilla Nueva's efforts to develop biofortified maize for small holder farmers. Bayer will sequence experimental lines from Semilla Nueva in order to lay the groundwork for identifying the loci responsible for improved zinc. These results will be open to Semilla Nueva and other partners to push forward the field of biofortification via plant breeding.

While both of these efforts are early-stage, they represent the first steps in the second phase of Semilla Nueva's breeding program (document available upon request). Identifying the likely location and eventually the nature of specific genes for zinc will allow far more efficient efforts to convert new lines and hybrids and will eventually open the possibility of cost-effective and innovative approaches such as gene editing. It is important to note that while gene editing regulations in Central America and sub-Saharan Africa are in early stages, initial regulations indicate that most countries are considering that gene editing using genes from the same species (cis-editing) will not be considered GMO, preventing both significant PR and regulatory difficulties in using this approach to mainstream biofortified traits.

Setbacks and growth

Semilla Nueva experienced setbacks in two of our breeding goals for 2022. We were unable to fully implement a new data system that would allow our advisers to review our data and make recommendations and we didn't finish calibration of our new Near-Infrared Spectrometry (NIRs) equipment to analyze protein quality. These setbacks were caused by: 1) external factors (our database software wasn't designed to accommodate nutritional data and the original calibration curves provided by the NIRs manufacturer didn't work) and 2) a lack of staff bandwidth to address these issues. To solve this problem, Semilla Nueva is expanding the R&D department in early 2023. Semilla Nueva's production coordinator, who has over a decade of experience managing breeding field programs, will take over day-to-day field operations, freeing our R&D manager to address the challenges listed above and dedicate more time to partnerships and gene discovery. We also hired a UC Berkeley PhD student specializing in gene editing to assist in our gene identification program.

FINANCE, ADMINISTRATION, AND HUMAN RESOURCES

Summary

- Semilla Nueva executed 95% of its US$2.3M budget.
- 69% of our 2023 US$2.88M budget is covered with cash on hand and committed funding.
- Our 2022 external audit will be issued by the firm Manuel Cervantes y Asociados based on *FASB, for not-for-profit organizations.* This new firm was selected by our Board of Directors to increase the rigor of the audit and prepare Semilla Nueva for larger institutional funders.
- Organizational culture improved significantly. Our composite *Great Place to Work®* score increased from 66% in 2021 to 87% in 2022, with *organizational pride* as our top dimension.

2022 budget vs actual

As of December 31st, Semilla Nueva executed 95% of the total approved budget (US$2.3M). As shown in figure 10, we spent more than anticipated on R&D and balanced it by lower spending in other departments. Underspent budgets largely came from delays in filling new positions.

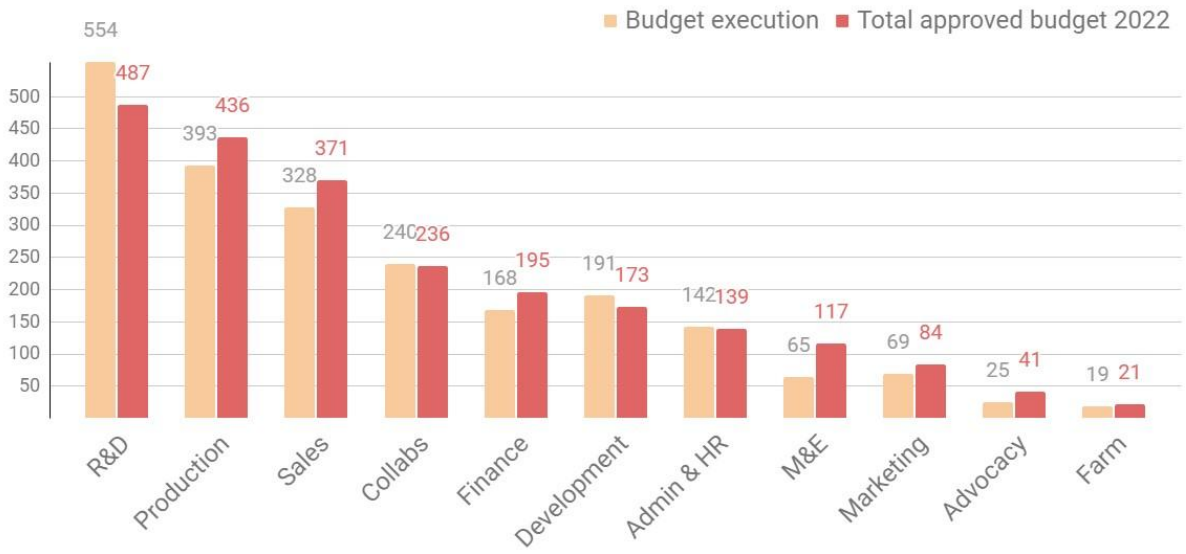

Figure 10: Semilla Nueva 2022 budget vs. actual (US$1,000s)

The fiscal year 2022 will be audited by the auditing firm Manuel Cervantes y Asociados

With support from our Finance and Administration Committee of the Board of Directors, Semilla Nueva began a process to significantly improve our accounting and financial standards, in preparation for potential grants from large institutional funders. This began with a project to bring all financial systems into compliance with the Financial Accounting Standards Board (FASB) and their most recent publication on *Presentation of Financial Statements of Not-for-Profit Entities (Topic 958).* To support this process, we changed auditors, with the Board selecting to utilize the auditing firm Manuel Cervantes y Asociados, partners of LEA Global. This auditing firm is listed within the "List of Eligible Audit Firms" by funders such as the Inter-American Foundation and USAID. We expect to have the final audit report by March 31st. A copy of the report will be circulated in early April.

Semilla Nueva's 2023 budget will be US$2.88M, a 31% increase over 2022 expenditures

The 2023 annual budget proposes a 31% increase over 2022 actual expenditures. 69% of funding is committed or on hand. Including likely renewals, 89% of our budget is covered, with 11% left to raise. The largest increase in the budget comes from an increase in seed production and additional subsidies for other seed companies, with secondary increases due to salary adjustments to offset Guatemala's 7% inflation in 2022.

Semilla Nueva is increasing the cost-effectiveness of our impact; a 31% increase in budget will cover nearly doubling the number of farmers reached and expansion to a second country

Each year, Semilla Nueva significantly improves the number of farmers reached per dollar spent. Semilla Nueva's budget covers an 84% increase in seed production (from SN and partner companies), expansion to a second country, and takes into account 7% inflation. Still the budget has only increased 31%. With the effectiveness of the subsidy, we see ourselves as having passed a major cost-effectiveness inflection point.

Our organizational culture survey showed significant improvements in employee engagement and organizational health

For five years, Semilla Nueva has conducted an anonymous survey to measure our general organizational health which included the Great Place to Work® methodology. In 2022, the general appreciation rate increased from 66% to 87%. We feel this is due to how team culture has been prioritized in new hires, efforts by the leadership team to hire from within the organization and invest in staff development, and inclusion of the whole staff in more organizational planning. In 2023, we'll shift our focus to improving fairness and respect, by continuing to prioritize opportunities and raises for our lowest earning staff and involving staff more deeply in planning and decision making. Malcom Gladwell once quoted a study saying that the US had the most individualistic country in the world while the most communitarian was Guatemala. We're working to develop an organizational culture that pulls some of the best aspects from both.

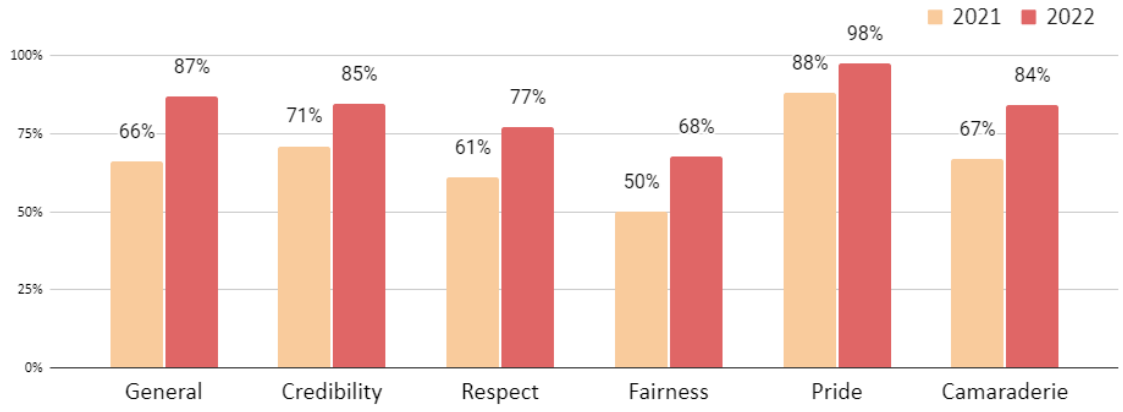

Figure 11: Semilla Nueva Great Place to Work® results by dimension 2021 vs 2022

Semilla Nueva also participated in the first Organizational Health Index (OHI) for non-profits study led by the McKinsey & Company, Inc. The study involved a questionnaire to all staff which focused on organizational alignment, execution, and performance. Our overall health score was 81 out of 100. Semilla Nueva scored within the second quartile according to the non-profit benchmark.

We have also participated in McKinsey's webinars about best practices on the steps, tools and actions needed to interpret the results, identify and set health priorities and to finally move to action with a specific plan including proven approaches to identify key mindset shifts and framework to enable sustainable behavior change.

ANNEX

Table 9: Average Yield by Segment (mt/ha)

Segment	F3	F3 Control	F5	F5 Control
Non-hybrid	4.23	2.69	4.24	2.90
Low-segment	4.66	4.02	4.92	4.38
Mid-segment	3.31	1.91	4.36	3.66
High-segment	3.75	2.11	5.14	6.27
Seed giveaway	4.13	2.11	–	–

Table 10: Average Net Income by Segment ($/ha)

Segment	F3	F3 Control	F5	F5 Control
Non-hybrid	1,370	602	1,100	456
Low-segment	1,094	687	1,277	1,197
Mid-segment	695	-25	815	440
High-segment	790	-426	1,573	1,919
Seed giveaway	1,675	822	–	–

Table 11: Average Input Costs by Segment($/ha)

Segment	F3	F3 Control	F5	F5 Control
Non-hybrid	1,107	1,014	1,254	1,170
Low-segment	1,400	1,446	1,370	1,177
Mid-segment	1,009	1,005	1,305	1,334
High-segment	1,245	1,393	1,008	1,163
Seed giveaway	968	1,065	–	