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SSNM Nutrient Expert®

– to boost yield and profitability in cassava production

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COVER PHOTO: UPLB

The site specific nutrient management (SSNM) approach was first adapted and pilot tested in rice and corn in the Philippines. This has shown capacity to increase yield and profitability through efficient use of nutrients. Thus, prompting the adaption of the SSNM-NE® technology for cassava-another staple food in the country.

Funded by DA-BAR, UPLB and regional focal persons implement the project to optimize and implement SSNM fertilizer recommendations in multiple locations across all regions.

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2007 Binhi Awards

Best News Magazine
2003 Gawad Oscar Florendo

R4D NOTES

Strengthening corn and cassava industry through R4D toward increased profitability and competitiveness

Joell H. Lales, DA-BAR OIC-Director

Innovative and adaptive research for development (R4D) strategies define the path that the DA-Bureau of Agricultural Research (BAR) envisions for the agriculture and fisheries sector. Utilizing this approach, the bureau highlights several R4D programs that are directed towards increasing the profitability of the corn and cassava industry as well as its market competitiveness.

Corn and cassava are listed among the major agricultural crops in the Philippines. A notable 1.48 million metric tons of corn production capacity has been recorded by the Philippine Statistics Authority for the period of April to June 2022– a value that shows a significant 3.3% increase from that of the previous year. Likewise, the cassava industry boasts a total of 591.06 metric tons during its production period from July to September 2022.

Recognizing the performance of these two commodities, the department's Corn R4D program has set its vision to increasing the production of quality corn and cassava for human consumption, feeds and industrial uses as well as empower the farmers and increase their income, thereby improving their quality of life. In general, strategy is to fast track the expansion of hybrid and white corn, cassava and other feed crops production to achieve food and feed self-sufficiency.

In addition to this is the need to enhance the competitiveness of the domestic livestock and poultry sectors through cheaper feed inputs, as well as generating jobs in rural communities.

To boost corn and cassava R4D towards increased profitability and competitiveness of the industry, the DA-BAR R4D Digest (October-December 2022) features different technologies on these crops to continuously provide farmers with technical know-how about appropriate technologies. It boasts the continuous efforts of the department's Corn and Cassava R4D program powered by the unceasing support from various partner R4D institutions and stakeholders—materializing into a balanced supply of corn and cassava.

SSNM Nutrient Expert®

– to boost yield and profitability in cassava production

Salvacion M. Ritual

The site specific nutrient management (SSNM) approach initially developed by International Rice Research Institute researchers and partners in Asia in the 1990s has come a long way. Initially adapted for rice and corn production systems, it has shown capacity to increase yield and profitability through efficient use of nutrients.

Recognizing the importance of cassava as staple food, feed ingredient and other industrial uses, the SSNM technology for cassava was developed and pilot tested in the Philippines. The limited information on quantitative response of cassava to fertilizers prompted experts to come up with SSNM approach for cassava.

"The demand for cassava continues to increase both for food and feed consumptions, from 2.13 up to 2.67 kilogram per year. As the market continues to beef up, the demand for cassava as a feed ingredient grows significantly creating competition with cassava food industry," said Jesse Descalsota, project leader from the University of the Philippines Los Baños (UPLB)-Institute of Plant Breeding.

He shared that in Southeast Asia, the Philippines ranks fourth and sixth in terms of area harvested and productivity, respectively. In addition, the 12.51 tons/hectare yield of cassava in the country is way below compared to the 32.68t/ha which is the highest in Southeast Asia. With this, SSNM might be an efficient approach in closing the yield gap to meet the demand of the growing cassava industry.

Meanwhile, advances in information and communication have now made it possible to develop decision support tools that enable extension workers and farmers to generate and disseminate recommendations using smartphone or other gadgets. Such decision support software is called "Nutrient Expert (NE)." Based on SSNM principles, this was developed by the International Plant Nutrition Institute (IPNI) that aims to generate reliable site-specific fertilizer recommendations for rice, corn, wheat, and soybean.

In addition, IPNI has developed the beta version of NE for cassava in the Philippines to help quantify fertilizer requirements for cassava including features in generating cost and return scenario to visualize probable income of production.

Funded by the DA-BAR, UPLB has implemented two interrelated projects titled, Field Validation of Nutrient Expert for Cassava – A Tool for Sustainable Yield Intensification of Cassava in the Philippines and Optimizing SSNM for Closing Yield Gap in Philippine Cassava Production through Farmers' Participatory Evaluation that aim to develop a SSNM based technology assisted by a mature nutrient expert for cassava.

These interventions ultimately target to sustainably enhance yield and profitability of cassava production.

Validation of SSNM-NE® for Cassava

The UPLB project team and regional focal persons have been implementing these three-year projects to optimize and implement SSNM fertilizer recommendations in multiple locations across all regions.

A total of 114 cassava farmer-partners benefitted from this technology.

Previous assessments on fertilizer trials in cassava have indicated that optimum yield and profitability in a sustainable cassava production can be attained using SSNM fertilizer recommendations. Hence, further optimization trials are being conducted to refine the beta version of SSNM-NE® for cassava.

According to Descalsota, "the SSNM prototype fine tuning does not only focus on nutrient management but also on other parameters to improve yield with optimum profitability through efficient fertilizer management resulting to sustainable cassava production."

The performance of SSNM-NE® for cassava was evaluated against the current national fertilizer recommendations, common fertilization practices and economic benefits as parameters.

Reaping the outcomes

Overall, the yield of cassava using SSNM-NE® can out-yield that of farmer's field practice and control. In both UPLB sites, 40 t/ha target yield for SSNM technology was attained or even surpassed it. The same trend was observed using the three test varieties. Also, the project team observed that cassava responds significantly to fertilizer application increasing yield greatly as compared with unfertilized control.

In terms of benefits, the UPLB team revealed that there was an increase in the annual income by around PhP 100,000 using SSNM-NE® cassava, even if the cost of production increased due to fertilizer applications. Specifically, the Binulak variety showed a wide difference in the annual income, of which PhP 300,000 and PhP 112,061 for SSNM-NE® and control, respectively.

Moreover, an increased in starch content in SSNM-NE® cassava across sites and varieties was noted. Descalsota mentioned that this is an important information especially for the industry that mainly process cassava for starch.

With this, the developed SSNM-NE® for cassava is a precision nutrient management that offers great significance in increasing crop yield, enhancing nutrient use efficiency and profitability. It is indeed a potential solution in closing the cassava yield gap using this decision support tool.

What's next

At present, on-station trials at the Institute of Plant Breeding (IPB), UPLB are already completed while the regional field validations in regions 7, 8, 12, and 13 are expected to be finished until April 2023.

The UPLB team and regional focal persons are now in the process of carrying out the remaining activities specifically, the farmers' participatory evaluation, useful to assess the tool and also enable farmers to make informed decisions on crop nutrient management. More favorable and useful findings are expected that can lead to a more productive and sustainable cassava production.

Finally, the project team is expected to disseminate the mature version of the nutrient expert for adoption by the cassava stakeholders to enable them to develop fertilizer recommendations tailored to a specific location or growing condition.

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Addressing abiotic, environment stresses through inbred lines of corn

Ma. Eloisa H. Aquino

PHOTO COURTESY OF UPLB

In a Philippine Star article titled, Demand and Supply, Philippines is the third most vulnerable country to climate change based on a 2017 world risk report. Environment stresses, climate change in particular, are serious hazards that affect limited growth and yield performance of crops, hence, reducing total productivity of the industry.

Further, Philippine soils also tend to be more acidic. As a drier country, there are also areas with calcareous soils that have low soil nitrogen and organic matter content resulting in zinc and iron deficiency. Citing as example is the lowest average corn yield in Cebu province and Central Visayas Region that can be attributed to low rainfall and the prevalence of calcareous soils in the region.

As 20% of the Philippine population eats white corn instead of rice, researchers in the country continue to develop inbred breeding lines with tolerance to different abiotic stresses. A research project led by Dr. Eureka Teresa M. Ocampo at the Institute of Plant Breeding of the University of the Philippines Los Baños (UPLB), dealt with developing new abiotic stress tolerant corn inbreeds through selection and characterization.

“Pure corn inbreds that are tolerant to selected abiotic stresses, namely: acidic soil, calcareous soil, waterlogging, drought, and high altitude; will be developed after a continuous planting cycle involving self-pollination,” Dr. Ocampo shared.

The research utilized individual plants with superior qualities chosen from open pollinated traditional Philippine cultivars collected and maintained by the Corn Germplasm Utilization through Advance Research and Development (CGUARD) program of UPLB and DA-BAR.

Prior to the CGUARD program, developed varieties were APN 622 S2 and double stress S9 inbreds that are resilient to waterlogging, while APN 141 S2 and APN S2 are resistant to drought. APN 7 S3 lines make up the materials that could stand acidic soil while those that could withstand calcareous soils are APN 44 S3 and APN 84 S1.

“Only by choosing desired qualities and diligently selfing to guarantee that the traits are not lost can inbred lines with specific traits be produced,” Dr. Ocampo explained.

To produce at least 20 pure inbred lines with resistance to abiotic stresses, the ten top-performing inbreds (S2 or S3) per APN from previous CGUARD collection under various stresses were used as starting materials.

“Entries were screened multiple times under the particular stress environments, undergoing selfing each time. After at least four rounds of selfing and thorough phenotypic evaluation, 32 SSR markers were used for the molecular analysis to identify lines exhibiting a high degree of homozygosity,” Dr. Ocampo explained.

Newer selfed populations were developed starting in November 2018 using selections from the CGUARD native corn collection. The CGUARD program is led by Dr. Artemio Salazar where at least 3,000 entries have been collected and approximately 600 lines were screened by the abiotic stress team by 2019. Under the CGUARD framework, the regional and provincial agencies were tapped in collecting the corn types that are grown in their regions. The regional submissions were then screened by IPB for different traits.

“The pandemic also led us to redirect the population development strategy to one where stress tolerant populations were developed from S2-S4 populations. These materials were reproduced in bulk for distribution to growers,” she added. For this, S2-S4 populations were used in recombination studies utilizing the minus-one technique to easily develop stress tolerant populations in the span of three seasons.

Field experiments for waterlogging tolerance were conducted for several seasons in Los Baños, Laguna and Sta. Barbara, Pangasinan. The waterlogging tolerant lines were selected from whence nine inbred lines have been developed. Selected inbreds have been tested for genetic purity and can be used for hybridization.

Screening for drought tolerance was also conducted in Pangasinan (Carasucan and Sta. Barbara) to select for native corn with drought tolerance. For each trial, top 10 entries were selected and forwarded to selfed populations. It was more difficult to conduct drought stress trials due to sudden rains even during the dry season in Pangasinan. The S3 populations were used for the development of improved populations during the pandemic.

Acidic soil stress screening posed more challenges as the area selected for the trials went through social and climatic upheavals. Siniloan, Laguna was hit by two strong storms successively in 2019 and 2020, followed by local government lockdowns in 2020 and even in 2021. Hence selection was significantly hampered, and all selections need to be verified. Screening for tolerance to calcareous soil was conducted at the Cebu Technological University in Barili, Cebu. Similarly, S3 populations have been developed.

“The Institute of Plant Breeding’s corn breeding program needs fresh inbreds in order to identify successful crossings and because they give breeders alternatives for developing new varieties and hybrids. Hence, crop variety and genetic variability are crucial for continual progress,” Dr. Ocampo said.

The pandemic has slowed down the selection and inbred development (except for waterlogging tolerance). Currently, the selfed populations for the other 3 stresses are at the S3 level but the desired level is at least S5. Waterlogging tolerant inbreds are being tested for use in hybridization, while the other materials are currently in storage pending use by the breeder group at IPB. ■

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Development of extruded products from cassava: Yuca puffs and Cacharon

Evelyn H. Juanillo

PHOTOS COURTESY OF VSU-PHILROOTCROPS

Snack time is our favorite time of the day. Many Filipinos prefer traditional native *kakanin* made from glutinous rice or from cassava such as suman, pichi-pichi, puto and cassava cake. Aside from being delicious, snacks made from cassava are also considered healthy. Cassava chips for example, was introduced as an alternative to commercial snacks available in the market because of its advanced health properties. More so, this snack found its way in supermarkets in recent years as processors leveled-up their packaging and product presentation.

Cassava or *Manihot esculenta* also called yuca is a woody shrub from the spurge family, Euphorbiaceae. A nutrient and calorie-rich food, it is consumed widely in many countries.

In the tropics, cassava is considered as the third most important source of calories next to rice and corn. It produces more weight of carbohydrate per unit area than other staple food crop under comparable agro-climatic conditions.

Recognizing the health benefits of eating cassava, the Philippine Rootcrops Research and Training Center (PhilRootcrops) and the Department of Food Science and Technology at the Visayas State University in Leyte implemented the project titled, Enhancement of Food and Nutrient Security through Food Diversification: Development of Extruded Products from Cassava. The project aimed to develop a 5.5 horsepower electric motor portable extruder for puffed products processing and a 5.5hp electric motor portable extruder (cooking and forming extruder) and conveyor system for cassava chippy product or cacharon production. This project included quality evaluation and shelf-life determination of extruded food products from cassava.

Extrusion technology

Used to make a wide range of food products, extruders are tailored depending on the intended application, from simple forming (for pasta products) to very short cooking (corn curls) to more complex and long involving multiple operations resulting to significant modification of the extruded material.

Material ingredients for extruder feed may be a single solid or many solids and liquid. Grains, pulse and root-based foods, sweeteners, minerals and vitamins are mostly the solid ingredients while water, oil, liquid sweeteners and colors are liquid ingredients. These ingredients are typically mixed, transformed into a dough, and formed into a desired product shape.

The advantages of extrusion technology as compared to other traditional food/feed processing method include: a) adaptability such that an ample variety of products are feasible by changing the minor ingredients and the operation conditions of the extruder; and b) extrusion process is remarkably adaptable in being able to accommodate the demand by consumers for new products.

A variety of shapes, texture, color, and appearances can be produced, which are not easily produced using other production method. Also, extruders are energy efficient, as it operate at relatively low moisture while cooking food products, so less re-drying is required; low-cost extrusion has lower processing cost than other cooking and forming processes and can save 19% raw material, 14% labor, and 44% capital investment. Extrusion processing also needs less space per unit of operation than other cooking systems. It can modify protein, starches, and other food material to produce a variety of new and unique snack food products.

There is continuous high-throughput processing; high product quality; and extrusion cooking at high temperature destroys anti-nutritional compounds such as trypsin inhibitors and undesirable enzymes such as lipases, lipoxidases and microorganisms; and no effluent or very few process effluents are produced.

Extruded products developed

One of the areas in food processing that is not particularly applied to cassava is the extrusion technology. This project procured and evaluated portable extruders which were modified and fabricated locally with all stainless steel materials.

The portable extruders are used to produce yuca puffs and cacharon. The yuca puffs processing system and the chippy products processing system (for the production of cacharon) were pilot tested at PhilRootcrops processing plant.

Yuca puffs are made from dried cassava crates with a mixture of water, oil, and salt. Further processing can produce variations with the addition of milk or cinnamon and fortification with *malunggay* or sweet potato leaves.

Cacharon is made from dried cassava grates added with water and loaded in the extruder for cooking and forming. The product is cut, dried, and fried. Product variations are plain and chili flavored.

Noodles are made from dried cassava grates and wheat flour. The dough is formed from the mixture and loaded to the extruder for precooking and forming. The formed noodles could either be boiled or fried.

It was determined that the yuca puffs and cacharon have the potential for commercialization since these entail simple processing operations, acceptable sensory qualities, and market acceptability.

Financial indicators

For the feasibility indicators, the yuca puffs processing system has an internal rate of return (IRR)of 76% and payback period of 1.2 years. The cacharon products processing system, on the other hand, has an IRR of 72% and payback period of 1.3 years only.

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Calibrating corn farmers' yield through Nutrient Expert® for maize

Angelo N. Padura

What if there's a computer-based tool which can aid farmers in setting, but even moreso, calibrating their yield based on their location and resources?

In an article published on 2 January 2022, former DA National Corn Program director Milo delos Reyes stated that the total corn production in 2021 was projected to reach 8.24 million metric tons, of which 72% or 5.92mmt is yellow corn, while 28% or 2.32mmt is white corn. About 20% of the population in the country uses white corn as their food staple second to rice which is even more favorable for its health benefits. However, overall production using open pollinated varieties and traditional varieties is low and inefficient.

In 2010, the research team, spearheaded by Dr. Apolonio M. Ocampo, launched the Nutrient Expert® for Hybrid Maize (NEHM) in yellow corn. After the successful run of the project which basically recommended fertilizer management, the researchers thought of expanding the scope of the software making white corn the next target.

"*Naisip ng grupo namin na bakit hindi gumawa ng* Nutrient Expert *para sa* white corn *sapagkat ito 'yong kinakain? Kapag ginamit kasi ang* NEHM *ng* yellow corn *sa* white corn, *hindi siya magbibigay ng* recommendation *dahil hindi siya aabot sa* minimum yield *na pwedeng bigyan ng* fertilizer recommendation *ng* Hybrid Maize which is 4 tons *kasi mababa talaga ang* yield *ng* white corn," Ocampo shared.

In response, the University of the Philippines Los Banos (UPLB), in collaboration with International Plant Nutrition Institute (IPNI), launched the DA-BAR-funded project titled, Development and Promotion of Quick Guide and Nutrient Expert® for White Corn. Efforts in increasing yield of white corn through Site Specific Nutrient Management (SSNM) approach involving the strategy of closing yield gap were done by UPLB in collaboration with the DA-BAR, and IPNI.

The Nutrient Expert®, a nutrient decision support software that uses the principles of site-specific nutrient management SSNM, enables farm advisors to develop fertilizer recommendations tailored to a specific field or growing environment. Moreover, it enables local researchers and extension workers to develop science-based fertilizer recommendations, without needing experimental data for specific fields or locations.

The software recommends fertilizer management using the principles of 4R - Right Source, Right Amount, Right Timing and Right Application, otherwise known as SSNM.

PHOTO: RBERNARDO

"*Halimbawa ay may dating inaani ang* farmers, *mayroong mga* targets *at ang inaani lang nila dati ay* 3t. *Sa pamamagitan ng pagpasok ng mga* specific farmer's field data *sa* program, *pwede siyang mag-*target *ng* 4-7t. *Ang gagawin ng magsasaka ay kung ano ang kaya ng bulsa niya o kayang gastusin sa bukid, iyon ang susundin niya. Halimbawa ay mataas ang* fertilizer requirement *at hindi niya kaya, pwede siyang magbaba ng* target *at makukuha n'ya ang minimithing ani at kita*," Dr. Ocampo explained.

The software has five modules relating to the farmers' current nutrient management practices and the yield obtained for a specific growing season; planting density and plant spacing; generation of fertilizer N, P, and K requirements for a selected yield goal taking into account the expected yield responses to fertilizer; translation of the recommended NPK rates into locally-available single-element or compound fertilizer sources that will satisfy the SSNM guidelines for optimal fertilizer splitting; and comparison between the expected or actual benefits between the farmer's current practice and the recommended practice.

"*Nakita ko ang kanilang* fertilization rate ay mababa. *Para sa akin, kung ma-i-*adjust *mo iyong nutrisyon ng halaman, hindi lamang* 5t *ang magiging* potential yield, *maaring maging mas mataas ng* 1 *hanggang* 2t *ang* potential yield *nito. Kapag nagawa mo nang tama ang* fertilization, *maaring umaabot ng* 6-7t *ang* yield white corn," Dr. Ocampo added.

Another new added feature in Nutrient Expert® for Maize is the Net-Profit Analysis. Using this feature, farmers will be able to monitor and compute for the other costs acquired like hiring a laborer, renting tractors and land, among others.

"*Maganda ang naging resulta. Noong matapos ang proyekto noong* 2017, *mayroong* 124 farms *sa* 13 regions *ang lumahok sa* farmer's participatory evaluation trial. *Sa* 124 *na* farms, 119 *iyong* farms *na nagtala ng* 96% *na* attainable yield *na mas mataas kumpara sa* yield *gamit ang dating* farmer's fertilization rates," Dr. Ocampo reported.

In the next years to come, the research team looks forward to expanding the scope of the software by making it applicable to more crops, especially those that are mainly produced by the Filipino farmers. In this way, the technology can contribute to the long envisioned food security and increased farmers' income in the country. ■

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KSM inoculant biofertilizer:

A technology for cassava farmers, communities, and sustainable agriculture

Lea B. Calmada, Dr. Marilyn B. Brown, and Dr. Mannix S. Pedro

Potassium (K) is one of the most important nutrients for plant growth affecting physiological and biochemical regulations leading to increase and quality yield. Potassium is abundant in the soil but 90-98% exists in unavailable mineral form while only 2-10% is available for plant use. Availability and utilization of potassium can be enhanced through microbial actions. They have the ability to mobilize the mineral nutrients in soil, thus, making it available for efficient plant uptake.

In 2019, DA-BAR funded the project titled, Development of a Potash-Mobilizing Inoculant for Cassava, under the leadership of Dr. Marilyn B. Brown aimed to develop a microbial inoculant capable of solubilizing and mobilizing unavailable potassium compounds or potash ameliorant in the soil.

Why cassava (*Manihot esculenta* Crantz)? It is the most grown root crop in the Philippines, supplying the carbohydrate needs of hundreds of million people also in other countries. It is adaptive to arid conditions and acidic soils, requiring minimal soil fertility and land preparation yet producing sizeable yields. Furthermore, a beneficial rootcrop that can contribute to a sustainable agriculture sector in terms of productivity and profitability. Thereby helping greatly in addressing poverty, hunger, and malnutrition in the countryside that could significantly contribute to DA-BAR's Research for Development Agenda and Program.

However, Dr. Brown said that growing cassava requires relatively high quantities of potassium, especially in an intensive farming setting or under monocropping systems for successive years, where potassium deficiency becomes the most limiting nutritional constraint.

What is the role of potassium in root crops? She added that cassava is mainly a root crop with high carbohydrate producing capabilities but requires a large amount of potassium which is essential in carbohydrate synthesis and translocation. Abundant K supply favors the primary processes of photosynthesis regulating the balance between carbon fixation and respiration in a way that improves net carbon assimilation.

Dr. Brown underscored that development of a potash-mobilizing inoculant for cassava is aimed at developing a technology – a biofertilizer containing effective potassium solubilizing microorganisms (KSM) which is applicable mainly for cassava, corn, and rice to reduce farmers' dependency on using chemical fertilizer, thereby increasing their income vis-à-vis prevent soil quality degradation.

PHOTOS COURTESY OF UPLB-BIOTECH

The research included the collection of rhizospheric soil samples from several areas particularly in Laguna, Cavite, and Quezon. Among the 200 microorganisms derived from the soil samples, 56 KSM were isolated, 41 of which are potassium solubilizing bacteria (KSB) and 15 are potassium solubilizing fungi (KSF).

Several field trials were conducted to evaluate microbial-cassava interaction effects on growth and yield. Results from the field set-ups showed that the inoculation of KSB + 0.5 RRC is statistically similar to the application of potassium fertilizer and a full rate of chemical fertilizer for corn and cassava under marginal soils. The use of the KSM inoculant can translate into a savings of approximately PhP 3,350 for cassava (Lakan variety) and PhP 23,300 for corn (Sweet Pearl F1). Generally, the KSBs tested under field conditions were also found to improve plant growth attributes of cassava and corn. These tested top isolates can be developed into inoculants that will be widely available for cassava and corn farmers in the near future.

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BREAKING THE BROOM CURSE:

Efforts to control the Witches' Broom Disease in cassava

Kathleen Mae B. Bulquerin and Robert A. Nepomuceno

If you are a fan of milk tea, chances are you have come across tapioca pearls before. These small, translucent balls add a unique texture to the drink, making it both fun and satisfying to sip. But have you ever wondered what tapioca is made of? The answer may surprise you: tapioca is made from cassava, a starchy, root vegetable that is grown in many parts of the world, including the Philippines.

Scientifically known as *Manihot esculenta*, cassava is a hardy, drought-tolerant plant that is easy-to-grow and can be found in a variety of dishes, from crispy chips to savory stews. It is a good source of carbohydrates, fiber, and essential vitamins and minerals, making it an important part of a balanced diet.

Aside from its culinary uses, cassava also has many industrial applications. The roots of the cassava plant contain a high concentration of starch, which can be extracted and used in a variety of products, such as adhesives, paper, and biofuels. The leaves of the plant are also a rich source of protein and can be eaten as a vegetable or used as animal feed.

Furthermore, cassava is a critical component of the Philippine food security system. It is a low-cost, low-input crop that can be grown easily and sustainably, providing a reliable source of food and income for farmers. This can help to reduce poverty and improve the health and well-being of people in the country.

The mass production of cassava, while potentially profitable, can be harmful to the environment. Monoculture and large-scale cultivation can disturb the natural balance of soil, leading to the emergence of diseases. These practices are often seen as unsustainable and damaging to the environment. Such is the case with the cassava phytoplasma disease (CPD).

One of the main reasons for the rapid spread of this disease is the widespread use of high-yielding varieties of cassava. These varieties are highly susceptible to the disease, which can spread rapidly through a monoculture of cassava plants. When large areas of land are planted with the same variety of cassava, the disease can spread easily from one plant to another, leading to widespread infection and crop loss.

The threat of the witches' broom disease

CPD, also known as witches' broom disease, causes infected plants to exhibit symptoms like yellowing of leaves and having purplish coloration.

The cassava plants with CPD also exhibit shortened internodes and a bunchy top look, giving it an appearance of a witch's broom.

Starch content and root production are both severely decreased by the illness. If the symptoms start to manifest at the beginning of crop establishment, a total yield loss may happen.

When CPD signs emerge four to six months after planting or in the middle of the growth season, yield might be reduced by roughly 50 to 70%. When infection occurs within the first three months of planting, yield might be cut to 100%.

Although it has long been known to exist in the country and has been identified as such, dependence on ancestral varieties and subsistence farming methods allowed the illness to be stopped before it could spread further.

Development of BioPlasma

A research team from the National Institute of Molecular Biology & Biotechnology (BIOTECH), University of the Philippines Los Baños (UPLB), led by Dr. Marilyn B. Brown, conducted a project titled, Development of Biofertilizer-based Biocontrol for Cassava (*Manihot esculenta*) Phytoplasma Disease.

The project aimed to develop a biofertilizer-based pre-planting treatment for the biocontrol of CPD using plant growth-promoting microorganisms in tandem with mycorrhizal inoculant. Thus, this technique enhances microbial inoculants compatible with the isolated microorganisms with biocontrol activity against CPD such as Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI) and BIO GREEN.

End-users of BioPlasma are expected to save at least PhP 350 while earning an additional PhP 7,000 when treatment with 2 packs of Bioplasma + 1 pack of VAMRI is used over streptomycin treatment in a hectare of CPD-infected cassava plantation.

PHOTO COURTESY OF UPLB

According to Dr. Brown, director of UPLB-BIOTECH, BioPlasma works as a pre-planting treatment for cassava cuttings.

"*Ang* inoculant *kasi*, or in this case, *'yong* BioPlasma, works as a biofertilizer-based inoculant. It could be a different way to increase the crop yield of both diseased and healthy cassavas," said Dr. Brown.

"However, further research is required to develop less expensive and more sustainable agricultural techniques for cultivating and managing illnesses in plants like cassava," she added.

Given the challenges to stick to the established work plan due to the pandemic and lockdowns, the research team still managed to develop BioPlasma which has an ongoing product registration with the Fertilizer and Pesticide Authority.

End-users of BioPlasma are expected to save at least PhP 350 while earning an additional PhP 7,000 when treatment with 2 packs of Bioplasma + 1 pack of VAMRI is used over streptomycin treatment in a hectare of CPD-infected cassava plantation.

In the field trial put up in Victoria, Laguna, applying the recommended rate of BioPlasma (two 100g pack per ha) can reduce the chemical fertilizer to half and still be able to obtain yield like the cassavas applied with a full dose of chemical fertilizers. This results in farmers saving at least PhP 6,000 on their production cost and still be able to obtain up to PhP 38,800 from their cassava harvest.

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Streptomycin Sulfate as pre-planting treatment for Cassava Phytoplasma Disease

Cassava Phytoplasma Disease (CPD)

Phytoplasma is a specialized bacteria attacking cassava that causes reduced yield and poor quality planting materials.

Streptomycin Sulfate

Streptomycin is an antibiotic to control CPD, applied as pre-planting treatment for cassava to lower mortality, initiate higher and faster germination rate, and produce higher root yield.

TapioGard, a branded Streptomycin Sulfate, was approved by DA-Fertilizer and Pesticide Authority in 2017. It is solely distributed by Verca Agrochem.

Selection and Preparation of Planting Materials

Select the mature cassava stem and discard the succulent part

Cut stem into 8-10cm with 3-4 viable nodes using hacksaw

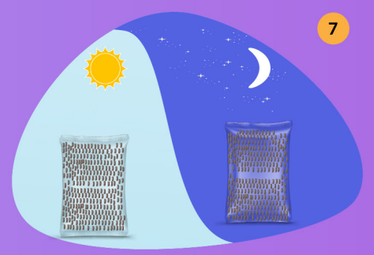
Place cassava materials in nylon net sack

Preparation of Antibiotic Solution

Pour 100 liters of water into a 200L drum and add 10g of streptomycin sulfate (10 vials of 1g), mix well

Soak planting materials in the antibiotic solution for six hours

Remove the nylon net sack from the drum and drip dry



Place the planting materials inside a plastic bag and incubate it overnight

Plant the treated materials within 48 hours

REMINDER:
Repeat pre-planting treatment every three cropping cycles

For more information, please contact **Dr. Erlinda Vasquez** of Visayas State University through **erlinda.vasquez@vsu.edu.ph**
For interested buyer, please contact **Verca Agro Chem, Inc** through **vercaagrochem@gmail.com** or **(0945) 644 2140; (0995) 458 7467**

Prepared by **Lino Norman D. Reyes**

DA-PHilMech village-type corn mill improved corn grits quality through the years

Rena S. Hermoso

Nine years ago, a research project implemented by the DA-Philippine Center for Postharvest Development and Mechanization (PHilMech) addressed the need to design and fabricate a compact village-type corn mill that satisfies the minimum main product recovery of 64% and degerminator efficiency of 80%.

At that time, there was a downward trend of corn consumption partially owing to its unpopularity in Metro Manila as a result of high price and poor product quality and palatability. While there were initial efforts by local manufacturers to fabricate village-type corn mills that meet the standards, none succeeded.

"Low degerminator efficiency indicates that the corn mill produces poor quality corn grits given the high presence of pericarp and germ in the product, while low product recovery of corn grits indicates the incidence of high postharvest losses during milling operation," explained project leader Dr. Michael A. Gragasin.

The village-type compact corn mill developed by DA-PHilMech has a milling capacity of 155 kilograms per hour, an output capacity of 160.8kg/h, and degerming efficiency rate at 94.7%. Through the research, they developed the degerming mechanism of the corn mill using hexagonal screen huller with counter flow auger, innovated the grading assembly by introducing a three-layer rotary slotted hole perforated sheet cylinder, and improved hammer mill with 36 spokes that is made of flat steel bars, sharpened at one side.

The technology is economically viable with a financial internal rate of return of 68.63% and payback period of 3.93 years. The cost of milling is PhP 0.95/kg output and PhP 0.60/kg input, with a net income of PhP 1.05/kg.

"It significantly improved the quality of corn grits given the higher degerminator efficiency of more than 80% [based on Philippine Agricultural Engineering Standard] while fully complying with the product recovery," shared Gragasin.

"The technology is now being used by corn farmers nationwide as early as 2016. To date, there are more than 400 farmer cooperatives that use the technology nationwide. There are now 4-5 licensed local manufacturers nationwide with around 400 units sold with a total value of around PhP 220M," he added.

DA-PHilMech, as the agency mandated to accelerate the mechanization of the agriculture and fisheries sector, continuously improves the village-type corn mill in collaboration with ACT Machineries, their licensed local manufacturer.

"DA-PHilMech and our company always work together in order to improve our collaborative technology. We often seek the suggestions of our clients and address it … most [especially] if it [is for] improvement," shared ACT Machineries president Samuel Paul L. Babas.

The village-type corn mill can now be driven with a diesel engine instead of an electric motor alone. As such, model units can be purchased with diesel engines, which is useful in areas where electric supply is not stable.

To remove impurities such as stone, corn cobs, and stalk particles, dirt, from the corn grain before milling, a pre-cleaner has been incorporated to the unit. An elevator was also added to ensure the continuous flow of corn from pre-cleaner to the corn mill, which will eventually reduce the labor cost during milling.

Milling mechanism was also improved to increase the product recovery.

ACT Machineries have sold approximately 300 units of the village-type corn mill. As such, they have heard a lot of stories of appreciation from farmers who use corn as staple food, especially those who reside in the rural and remote areas.

"It is a growing Pinoy technology," noted Babas. ■

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PHOTO COURTESY OF DA-PHILMECH

Establishing a corn grits processing enterprise for farmer cooperators

Maria Elena M. Garces

PHOTO COURTESY OF DA-PHILMECH

Filipino health buffs prefer eating complex carbohydrates like corn instead of rice. Why? Reports showed that one medium ear of corn (about ½ cup kernels) contains less than 100 calories, is virtually fat-free (only 1 gram) and a good source of fiber (2g). Corn has a low glycemic index which lessens the risk of diabetes and hints toward high antioxidant levels-meaning, healthy cells are protected from damaging free radicals, due to its many colors like yellow, black, purple and even blue.

In 2021, the Philippine Statistics Authority stated that the production volume of corn amounted to over eight million metric tons and remains among the leading crops produced in the country, and is considered as another staple crop aside from rice.

In the past years, DA has aggressively distributed corn processing facilities like the mechanical dryers and corn mill for farmers to engage in value-addition and further increase their income.

But the DA-Bureau of Agriculture and Fisheries Engineering reported very low rate of utilization of these postharvest facilities, because it does not provide support mechanism on how to properly use the machine to be useful and beneficial to the farmers.

The solution, according to DA-Philippine Center for Postharvest Development and Mechanization (PHilMech), is to provide not only the machine but the whole package of technology (POT) and system for the recipients, where the machine should be operated as a business enterprise to recoup even just its operating cost. The POT included 1) hands on training on the operation and maintenance of the machine including provision of operator's manual as ready reference to the operator, 2) business plan to make use of the machine as a business enterprise, 3) business operational system to run the business using the machine, and, 4) coaching and mentoring during the initial operation of the business.

Project leader, Dr. Michael Gragasin, described the framework as input-process-output-outcome approach.

He said, "the input for the establishment of model corn grits processing enterprise (CGPE) are the necessary support system to set up and operate the CGPE such as the provision of corn mill with pre-cleaner, a business plan, and organization and training of the management team that will be responsible in the day-to-day operation of the enterprise; assist them until 'graduation' in such manner that they are financially stable and have the capability to survive in the outside competitive environment (process). The model enterprise as the major final output and shall serve as demonstration center/learning site (outcome) for other individual or group of farmers interested to start a corn grits processing business using the PHilMech-developed corn mill and pre-cleaner technologies."

Setting up of CGPE

Potential cooperators were evaluated and selected. Information on the profile of their operation were also validated. They were recommended by the Department of Agrarian Reform Provincial Office in Quirino and Corn Program of the DA-Central Luzon. The Agrarian Reform Beneficiaries and Developers-Multipurpose Cooperative (ARBD-MPC), whose members are planting yellow corn, were engaged in providing agricultural inputs like fertilizers, certified seeds, and others to their members.

A series of meetings on the implementation and agreements were conducted before deploying the corn mill facilities in their area and establish the corn grits processing enterprises. As agreed and reiterated, ownership of the corn mill and pre-cleaner shall remain with the DA-PHilMech, but with the option to own the facility.

Dr. Gragasin further explained that, "to ensure the efficient performance of the machines during operations, debugging and fine-tuning were conducted, and modifications were done at the degermer assembly and pre-cleaner to warrant high degerminator efficiency and continuous flow of corn grains during the pre-cleaning."

"Appropriate setting for the continuous operation of milling were also established during testing, particularly the control mechanism of the elevator, degermer, and the rotary mill assemblies," he added.

The development of the Operator's Manual is an effective medium in educating the cooperators who underwent several hands-on trainings on the operation, repair, and maintenance of the corn mill technology.

In the market research conducted, a total of 2,442kg/week of corn grits products and by-products at PhP 23.84/kg at an average are required in the nearby municipalities of Aglipay, Quirino.

Actual business performance of the CGPE: ARBD-MPC case study

With the machine and business plan in place, the CGPE immediately started the procurement and processing of corn grains. During its four months of operation, the ARBD-MPC procured 1,737kg corn grains at PhP 25,707.60 on November-December 2019 and 1,574kg corn grains at PhP 20,157.50 on January-February 2020 only.

But because of strict quarantine restrictions in Luzon during the COVID-19 pandemic, the ARBD-MPC sourced their corn grains among the farmer members of the cooperative, and were able to process all the procured corn grains to corn grits. Actual operations yielded an average milling recovery of 70.34%.

The processed corn grits were sold to identified customers, while walk-in customers were accommodated at the ARBD-MPC office where transactions were done on-site. On the other hand, the 40kg packed corn was delivered to partner stores under consignment agreement. The ARBD-MPC CGPE generated total sales of PhP 45,857.50 in its four-month business operation, which shows that the established CGPE is financially viable based on the financial analysis in the business plan.

To strengthen the project cooperators, collaborative linkages with PhilMaize, the DA-Cagayan Valley Research Center, and DAR-Quirino, were forged to assist the cooperators in the corn production, marketing, and marketing strategies.

The model corn grit processing enterprise serves as a learning site of PHilMech using the developed modules in the promotion and commercialization of the PHilMech corn mill and pre-cleaner technologies to revitalize the agricultural sector even after the pandemic. ■

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Friendly mold as beneficial enemy against armyworms

Diwa J. Velasquez

One of the pressing concerns faced by our Filipino farmers is the infestation of pests and diseases of various crops and rice fields resulting in loss of income and yield vis-à-vis livelihood opportunities. Relevant to this, it prompted the Department of Agriculture (DA) and its research for development (R4D) partners to launch and generate R4D technologies that will help in controlling and preventing such outbreaks in the country.

One example of this infestation was in 2019 in Piat, Cagayan where the first incidence of fall armyworm (FAW) was detected. Similar to true armyworm (TAW), they can bring danger and crop damage, especially to corn. Likewise, onion armyworm (OAW) damages onion causing severe outbreak in 2016.

To further prevent this kind of infestation, DA-BAR and the National Crop Protection Center (NCPC)-College of Agriculture and Food Science (CAFS) of the University of the Philippines Los Baños (UPLB), has implemented the project titled, Characterization, Mass Production, and Utilization of Metarhizium sp. for Increased Potency against Armyworms. *Metarhizium rileyi* shall serve as an effective biological control agent against armyworms.

Where it all started

In 2017-2019, UPLB-NCPC-CAFS worked on OAW in the areas of Nueva Ecija, Pangasinan, and Tarlac. The pest damages onions before farmers can even harvest them. A species of friendly mold, *M. rileyi*, from infected OAW larvae was collected, isolated, characterized, and discovered pathogenic to this pest. Along with other beneficial organisms such as species of Braconidae, *Telenomus*, earwigs, and nucleopolyhedrovirus (NPV) have the potential to manage this pest in the field.

"*Ang nag*-motivate s*a amin ay 'yong* outbreak *ng mga harabas sa sibuyas*, DA-BAR approached NCPC to conduct this kind of project," project leader and scientist Marcela M. Navasero said in an interview.

This friendly mold is a biological control agent and safe to animals and people. The *M. rileyi* has global distribution that can be found in soils and plants as an endophyte and is known for being a potent entomopathogen. More than 60 species of arthropods such as cotton bollworm, planthopper, whitefly, aphid, diamondback moth, Asian corn borer, and rice leaf folder have been reported susceptible to *M. rileyi.*

Infective propagules of this friendly mold infect the armyworm by attaching to the insect cuticle to cause infection. *M. rileyi* continuously infects the armyworm, thus, preventing growth and development and ultimately kill the pest. Infected worms harden and white mold called mycelia cover the insect body. Within 24 hours, the mold sporulates producing light olive green spores. At this point, the dead armyworm is mummified or mycosed.

Meanwhile, scientist Navasero also explained that when FAW infestation reaches about 20% at 10 to 12 days after sowing corn, *M. rileyi* can be applied. This friendly mold can be integrated with other practices such as release of natural enemies and other beneficial organisms and products for a more effective management of FAW.

M. rileyi on corn fields

"This project aims to elucidate the efficacy of this friendly mold against FAW, OAW, and TAW which are considered invasive and global in distribution," scientist Navasero added.

Series of laboratory experiments were conducted to determine the efficacy of *M. rileyi* to different stages of FAW, OAW, and TAW.

Effective concentration, lethal time, and susceptible stage were identified in these tests. Initial experimental field trials in sweet corn of *M. rileyi* resulted in reduced infestation and damage of FAW when applied weekly for 5 consecutive weeks starting at 10 to 12 days after sowing.

Currently, FAW has replaced the Asian corn borer as the worst pest in the field in the Philippines. Navasero explained that FAW is an early invader. As early as 10 days after sowing, FAW attacks the corn plant while Asian corn borer at 21 days after sowing. Due to its cannibalistic nature and larger in size, it has the competitive advantage over the Asian corn borer.

"Early intervention at 10-12 days after sowing is recommended to minimize severe damage," she added.

Future plans and sustainability

At present, *M. rileyi* is not yet commercially available in the Philippines.

"Mass production and formulation processes are being optimized to produce viable infective propagules," said plant pathologist Melissa P. Montecalvo.

"At present, further research is necessary to improve initial formulations. Once there is a formulated product in powder or liquid form, we will pursue product registration and seek partners to market this product. We are targeting that the cost will also be competitive with insecticides," Montecalvo added.

Currently, NCPC is moving forth on conducting webinars and extension services across regions. Further, field trials are tentatively scheduled in 2023 in combination with other practices such as NPV and friendly nematodes among others.

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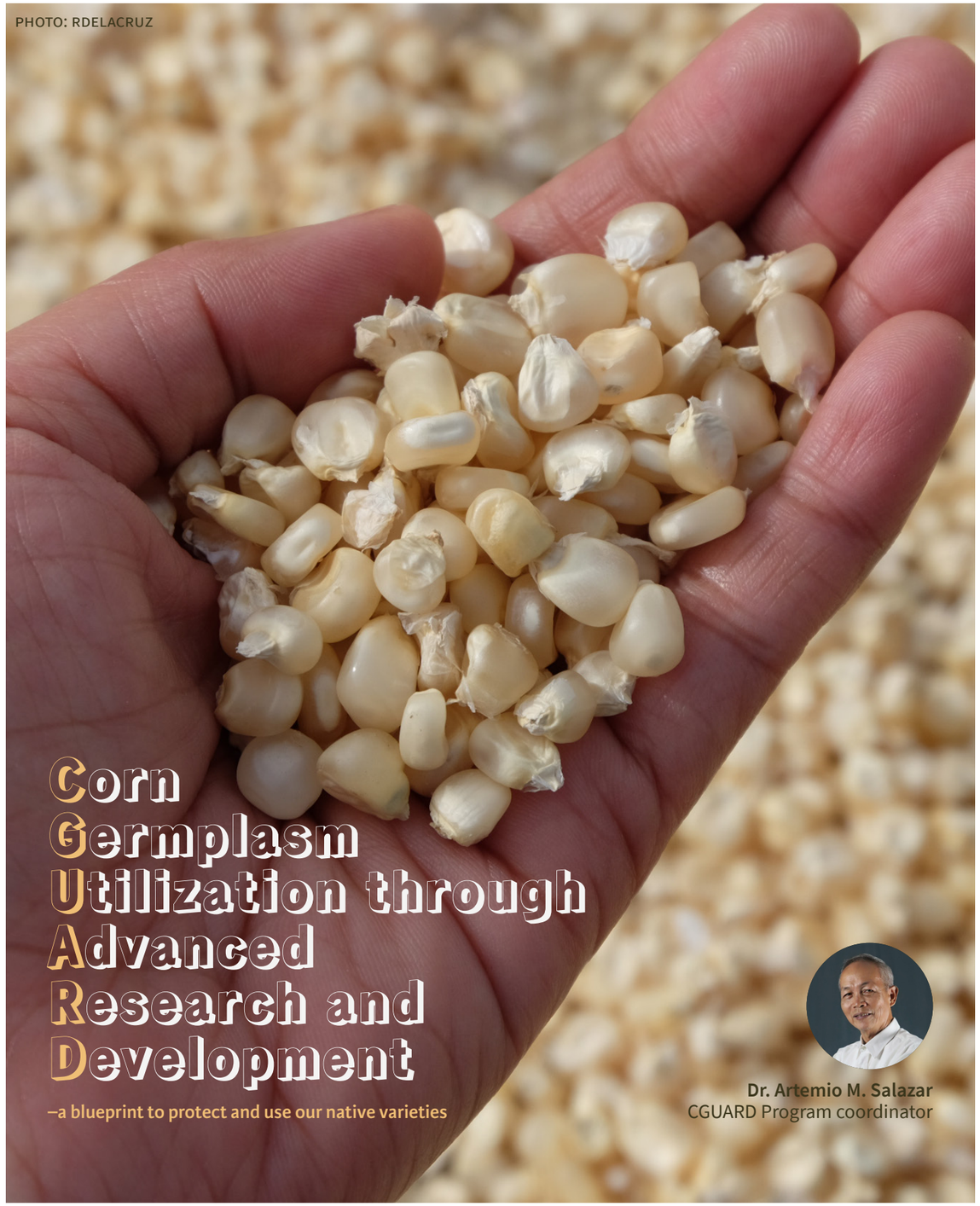
PHOTO COURTESY OF UPLB-NCPC



Corn Germplasm Utilization through Advanced Research and Development

–a blueprint to protect and use our native varieties

Dr. Artemio M. Salazar
CGUARD Program coordinator

After a trip to Thailand of some DA officials and PhilMaize officers, the Corn Germplasm Utilization through Advanced Research and Development (CGUARD) was conceived in 2014.

Caught by surprise, Thailand is spending ThB 400M (equivalent to PhP 250M) to conserve their native corn varieties and… they are profiting from a native variety collected in the Philippines, marketed as purple glutinous hybrid! It was a somber call to meaningful action in our country. A year later, CGUARD was funded by the Department of Budget and Management as a program of DA through the Bureau of Agricultural Research.

The blueprint or technical framework basically involves collection of native corn varieties by DA Regions and developing then improving their level of performance with technical assistance of the Institute of Plant Breeding (IPB) at College of Agriculture and Food Sciences at University of the Philippines Los Banos. And improvement is not only in special traits but in yield as well.

It also included developing the capability of the DA Regional Research units to develop and subsequently commercialize their own improved varieties, open pollinated varieties (OPV) at first, using their own native varieties. The scenario is that there will be genetic diversity at the national level because the Regions have different highly adapted corn varieties. This should lead to sustained productivity in farmers' fields no matter what the field constraints are, including the so-called climate change factors.

All the regions participated in the collection effort at different magnitude of results. To date, there are 4,002 collections, and counting. This, as the regions continue to respond to the call. Without the difficult work at the field level, these varieties would have simply 'disappeared' as commercial hybrids and their advanced generations, mostly GMOs – with engineered genes resistant to herbicide and corn borer, gain inroad even in the far uplands.

Three regions in Mindanao (SOCCSKSARGEN, Zamboanga Peninsula, and CARAGA), two in Visayas (Western and Central) and two in Luzon (Cagayan Valley and Bicol) have started to develop their own CGUARD OPVs. Some have even entered their work in the National Cooperative Test. One in Mindanao (SOCCSKSARGEN) will shortly be most likely accredited because of its superior agronomic performance.

Within one year, we'll see more from the Regions. IPB started with one nationally accredited downy mildew resistant OPV (IPV Var DM1). Some entries have also been officially registered at the Germplasm Technology Registration and Release Office because of their nutritional attributes. Breeding populations with resistance to different pathogens and insects as well as physiological stress (low and much moisture and also extreme pH) have been developed and continuously improved. These as per the CGUARD breeding framework.

But the credible test of the pudding is of course in the tasting, so it goes. And we are now starting to bite, albeit piece by piece. Again, in a year's time we'll have more from the regions and IPB, which is also for the regions. Then, the biting and relishing will be more satisfying.

But probably lurking in the mind of some is: will this not lead to decline in our overall corn production because native varieties yield low? Hybrids are definitely much better.

But come to think of it: all the hybrids ultimately find their very source in open pollinated type of varieties. All! The world of corn did not start with hybrids. Without this type of materials, continuously generating variability to cope with environmental stresses (biological and physiological), where shall we find the source of genetic stability across places and time?

The big seed companies who know how to manipulate those genes will certainly corner the seed source. How about our small farmers who could not afford it and who bequeathed even the source genetic material, albeit raw?

CGUARD is not therefore romanticizing native varieties. It makes logical sense to conserve, and protect our very own genetic resources. These were nursed by our farmers across generations for good reasons and with good results. Kudos to our unsung farmers!

By doing so, we'll be more future proof (to borrow the phrase from UPLB) to provide this important grain in generations beyond us. All these of course, using the modern tools of science. A number of scientific papers and research reports have been made attesting to the rightness of this direction.

Incidental but prophetic maybe is the name of this program: Corn Germplasm Utilization through Advanced R&D!

EXPERTS CORNER

Developing biofertilizers, biostimulants, and microbial pesticides for improved corn production

Dr. Marilyn B. Brown, ***UPLB-BIOTECH director***
with Jonalyn M. Mangaban and Robert A. Nepomuceno

The National Institute of Molecular Biology and Biotechnology (BIOTECH) at the University of the Philippines Los Baños (UPLB) which was established in 1979 has been responding to the challenges brought about by energy crisis, fertilizer importation, environmental degradation, and climate change.

One of the programs created by the institute was on the Nitrogen Fixation and Mycorrhiza Program (NFMP) aimed to lead in the development of biofertilizers as an alternative source of N through microbial N fixation and by harnessing mycorrhizae to assists the roots in absorbing water and nutrients and aid in the solubilization and mobilization of other nutrients for plant use. Biofertilizers, biostimulants, and microbial pesticides (BBM) for corn and its intercrops such as BioN and NitroPlus, Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI), BIO FIX, and BIO Quick, were developed ten years after its inception.

Why BBM for corn?

Aside from the macronutrients; N, P, and K, Ca, Mg, and S, micronutrients, Fe, Mn, Zn, Cu, B, Mo, and Cl are also needed for the growth of corn plants. Of the micronutrients, corn has the highest sensitivity to Zn deficiency. Most of these nutrients can be abundant in the soil but only 2 to 10% are readily available for plant use.

Removal of nutrients from soil due to its continuous cultivation may reach up to 47, 5.5, and 62 kg ha^{-1} for NPK, respectively. Replenishment can be done through the application of BBM other than chemical fertilization. Recently, the urgent need to develop other BBM products as an alternative/substitute for NPK and Zinc, for corn was recognized. With the funding support from DA-BAR and with the technical expertise from BIOTECH, several BBM products were developed within the span of five years.

These newly developed BBM products include: PhosphoLink, MycoLink and NitroLink that are also a VAMRI enhancer containing phosphorus solubilizing microorganisms (PSM) and Nitrogen-Fixing Bacteria (NFB). Other BBM products are BioSol-P containing PSM for corn, Oryzinc with Zinc-Solubilizing Bacteria (ZSB) for rice while Maizinc is composed of ZSB for corn, K-SolB which contains potassium mobilizing bacteria for corn and cassava, and Fermented Plant Juice (FPJ) which is a starter inoculum for the production of high-quality biological extract effective for corn.

Promotion of BBM-developed products for corn

As early as ten years after BIOTECH inception, also with the support of government funding agencies such as the DA-BAR, DA-BIOTECH, DA-PhilRice, and DOST-PCAARD, and other international funding agencies such as USAID, AFACI-RDA-KOREA, JSPS, JICA and ASTIF, BIOTECH has been promoting the use of BBM for corn production in many regions in the country.

Research Development and Extension of BBM products for corn was further hastened by the creation of "The National Corn-based Farmer-Scientists RDE and Training Program" under executive order 710.

Utilization of new products was being maximized through its continuous promotion to various corn farmers in different areas in the country.

Renewal of DA-Fertilizer and Pesticide Authority registration of these biofertilizers is underway and will be open for investments of private industries.

Recommendations for Policies, Strategies, and Programs

BIOTECH only develops products and had no capacity to mass produce them. The pilot scale BBM production however will be optimized at BIOTECH prior to transfer to private companies thus we still need funds for the biofertilizer's large-scale production.

PHOTO COURTESY OF UPLB-BIOTECH

The institute fully supports the DA which crafted a strategic corn industry development roadmap for 2021 to 2040. This covers intensification of the use of cost-reducing technologies by encouraging the use of bio-fertilizer, biocontrol agents, and organic fertilizers; and incentivization of private sector participation and investment in the corn sector for the production, distribution, and marketing of BBM products for nationwide application.

To a large extent, Dr. Brown's team have made significant contributions to the proliferation of information and development of products for environment-friendly agriculture while ensuring the enhancement of income for corn farmers. ■

APN 124 (Tiniguib Plantaj)
Northern Mindanao

APN 95 (Diket Abra D)
Cordillera Administrative Region

APN 88 (Malagkit Salt)
MIMAROPA

PHOTOS COURTESY OF UPLB

APN 37 (Señorita Pangantukam)
Northern Mindanao

Asian corn borer resistance found in traditional white corn varieties

Angelyn D. Marmeto, Bernard B. Panabang, Ayn Kristina M. Beltran, Merdelyn C. Lit, and Dr. Artemio M. Salazar

The Asian corn borer (ACB, *Ostrinia furnacalis* Guenée) remains one of the most destructive pests of maize with a considerable loss of 20% up to a total crop loss, especially for open-pollinated varieties. Chemical pesticide is the most commonly used method of ACB control; however, the extensive use results in harmful effects on both humans and the environment.

The drawbacks of using pesticide encouraged the application of modern biotechnology by developing Bt corn. This leads to boost corn productivity and revenue particularly in yellow hybrid production for feed use. Though yellow corn hybrids dominate the production, there is still no information yet in the development of GM events for white corn.

The "Corn Germplasm Utilization through Advanced Research and Development" or CGUARD Program was spearheaded by the Institute of Plant Breeding in collaboration with DA-Regional Field Offices. CGUARD aims to conserve and make use of traditional maize varieties, develop breeding populations, and improve levels of resistance and tolerance to environmental stresses.

The CGUARD team collected 3,400 maize accessions all over the country as of this date. Since 2015, more than 1,500 maize accessions have already been screened for ACB resistance, and (20 accessions exhibiting potential resistance against ACB.

Initial screening was conducted by growing the test maize entries in the field. Young leaves of the different accessions were harvested 25-30 days after planting and fed on second instar ACB larvae using leaf disc bioassay method. The number of dead larvae after five days were counted and expressed as a percentage. The higher the percentage of dead larvae means that the accession is resistant. Stalk resistance screening was conducted by harvesting corn stalks 45 days after planting. These were cut into 3.5cm sections and fed on 5-day old ACB larvae. The stalk portions were then dissected after five days and tunnel length was measured. The longer the tunnel means that the accession is susceptible.

Four traditional maize (APN 88-Malagkit Salt, APN 37-Señorita Pangantukam, APN 95-Diket Abra D, and APN 124-Tiniguib Plantaj) were found to have potential resistance to ACB leaf and stalk feeding. APN 37 and APN 95 are resistant to leaf feeding and stalk feeding, respectively, while APN 88, a glutinous accession, and APN 124 are resistant to both leaf and stalk feeding. The accession was found to have low ACB larval survival at both vegetative and reproductive stages of maize.

These accessions were collected in MIMAROPA (APN 88), CAR (APN 95) and Northen Mindanao (APN 37, APN 124). They can be utilized as an alternative carbohydrate source which are healthier and affordable. APN 37 was found to have both high starch and protein content in one of the CGUARD projects focusing on nutritional components of traditional maize.

Majority of the potential populations were used as parents to develop composites resulting in high yielding varieties. Initial selections for ACB resistance, grain yield, and grain quality showed promising results.

Further selections and host plant resistance trials to attain the desired traits will be made in the program. The future varieties will be produced and distributed in the respective regions to address ACB concerns.

In addition, it is assured that these varieties have the potential to withstand adverse conditions like ACB since the sources of resistance are locally adapted and survive through time. These promising accessions should also be tested for the presence of resistance against the recent invasive insect pest of maize, the fall armyworm (FAW, *Spodoptera frugiperda* Smith).

With the emerging concerns in climate change resulting in stronger typhoons, pest outbreak, and pandemic, the CGUARD program will provide significant research by preserving the genetic diversity of the traditional corn varieties and exploring more novel traits to address these problems. The challenge is to sustain the program to face the challenges of food security and livelihood of our Filipino corn farmers.

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MAISarap na, MAISustansya pa!

Savoring the benefits of Nixtamalized Philippine Corn for Filipino households

Clarissa B. Juanico and Patricia Isabel K. Ramos, UPLB

Corn is the second most important crop in the Philippines, yet it is underutilized for human consumption. The usual method of corn preparation known to Filipinos is boiling which does not maximize its nutritional potentials. Unless prepared using specific methods, the nutritional value of corn is left marginal and people depending on it as a main food resource may suffer from malnutrition. Hence, a technique that would enhance its nutritional value is essential.

This inspired the research team led by Dr. Clarissa B. Juanico, a registered nutritionist-dietitian from the Institute of Human Nutrition and Food, College of Human Ecology, University of the Philippines Los Baños (UPLB) to conduct a project titled, Development of Nixtamalized Philippine Corn for Food, Health, and Nutrition through the DA-BAR funding.

The said project sought to improve the nutritional quality of two locally available corn, namely IPB Var 6 and Lagkitan, through the process of cooking and steeping in an alkaline solution known as nixtamalization.

Nixta-MAIZE-ation

Nixtamalization, a process where corn is softened using alkaline solution was found to enhance its nutritional profile. The research team applied the technology and developed various corn products.

Nixtamalized Philippine Corn or what the project members referred to as "PhiNixC" were used in the form of kernels, grits, and flour. PhiNixC products were standardized and are now ready for commercialization. Some of the PhiNixC products developed were pancake/muffin mix, loaf bread, pan de sal, puto, fermented corn beverage, espasol, palitaw, buchi, and rice- corn blend.

Assistant Professor Arvin Paul P. Tuaño, from the Institute of Chemistry, College of Arts and Sciences, UPLB, was able to optimize the ecological nixtamalization protocol of the two Philippine corn varieties using a relatively shorter period of cooking and steeping time while still yielding acceptable levels of protein, fat, and amylose.

Delicious and nutritious nixtamalized corn

Physicochemical and nutritional qualities of the food products were determined as well as their sensory characteristics, acceptability, and shelf-life.

PhiNixC products were found to have improved nutritional content—evidenced by the improved proximate composition and mineral content. The PhiNixC products contain higher calcium than its non-nixtamalized counterpart. The kernels also showed higher in vitro availability of calcium or the calcium that can be absorbed by the body.

PHOTOS COURTESY OF UPLB

PhiNixC products were also acceptable to consumers with sensory profiles comparable to its original counterparts. The nixtamalized corn and corn products in crude and hydrolyzed forms were also found to have the potential to lower blood lipid through cholesterol micellar inhibition.

The whole study reflects that the nixtamalization technology was able to maximize the nutritional benefits of two Philippine corn, IPB Var 6 and Lagkitan.

Towards a healthier community

Currently, there is an ongoing worldwide food shortage and the outputs of this project can be used to aid the Filipinos in providing healthier alternative staples in their diet.

Increased consumption of corn and corn products will help improve the nutrition and health status of Filipino communities.

This can be achieved if the technology will be adopted by local government units or food manufacturers who can apply the process of nixtamalization in a larger scale.

As part of the team's effort to spread the technology, a seminar in collaboration with the Municipal Nutrition Action Office in Los Baños was held highlighting the benefits of consuming the nixtamalized Philippine corn varieties. PhiNixC products were also showcased in the event through product tasting and cooking video demonstration.

"*Salamat sa panibagong kaalaman tungkol sa kahalagahan ng mais at ang mga benepisyong makukuha sa pag*-nixtamalize *nito*," Evangeline Domaguin, one of the Barangay Nutrition Scholars, said.

"*Magagamit ang mga* PhiNixC corn products *para mapababa ang bilang ng mga* malnourished children *dito sa'min*," Evelyn Abadines, another scholar, stated.

Overall, the goal of this research was to contribute to the attainment of food and nutrition security through utilization of corn cultivars in the Philippines. This is part of the DA's RDE agenda on creation of innovative usage and product lines.

"Development of high-value nixtamalized corn products that are nutritionally rich and have health-promoting potentials can be an innovative way to promote corn as an alternative food source as a strategy to augment the supply of rice commodities," Dr. Juanico said. ■

MAISARAP NA, MAISUSTANSYA PA!

Savoring the benefits of Nixtamalized Philippine Corn for Filipino households

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