# BAR DIGEST

RESEARCH FOR DEVELOPMENT

The official quarterly publication of the Department of Agriculture-Bureau of Agricultural Research

## A-maize-ing! white corn products

## *Breeding improved native corn varieties*

## Cassava value chain in the Philippines

## *AND MORE!*

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This publication contains articles on the latest technologies, research results, updates, and breakthroughs in agriculture and fisheries R&D based from the studies and researches conducted by the member-institutions of National Research & Development System for Agriculture and Fisheries (NaRDSAF).

BAR R4D Digest welcomes comments and suggestions from readers.

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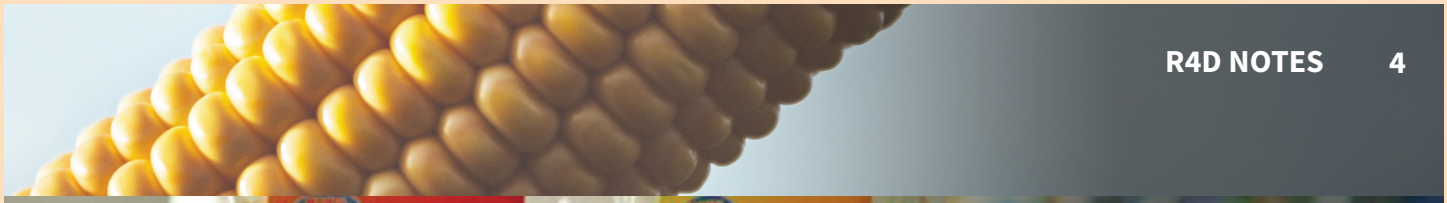

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# Pooling research initiatives to forward the country's corn and cassava industry

DR. NICOMEDES P. ELEAZAR, *CESO IV*

As the Department of Agriculture (DA) gears up for the New Paradigm under Agriculture Secretary William D. Dar, the role of the two major crops as alternative staple food to rice is recognized as very vital in the march towards attaining sustainable food supply in the country, while ensuring prosperity among farmers and fishers in the field.

Mandated to coordinate agriculture and fisheries research and development (R&D), the DA-Bureau of Agricultural Research (BAR) has been supporting the National Corn and Cassava Program as one of its banner programs. Through various provisions for R&D, information and technology that will help increase and improve productivity of corn- and cassava-producing areas across the country were supported throughout the years.

Some of the accomplishments of the program attained through R&D support include nutrient management techniques; researches on insect pests and diseases resistance and tolerance; various cultural management practices; and conservation and preservation efforts of traditional varieties, most of which were already adopted by various cooperators in the country.

This issue of BAR Digest centers on various successful initiatives and endeavors conducted to forward the corn and cassava industry of the country.

The DA-Cagayan Valley Research Center has developed and

introduced various products in the market, utilizing white corn grits as raw material. A new product line was also established in connection to the said initiative.

In Leyte, the Philippine Root Crops Research and Training Center (PhilRootCrops) of the Visayas State University (VSU) conducted a value chain assessment and development for the cassava industry, helping many micro- and small-level entrepreneurs unfold the potentials of the said commodity.

Another endeavor spearheaded by VSU was in collaboration with the DA-Bureau of Plant Industry where a database on cassava insect pests and diseases were developed.

The initiative of the University of the Philippines Los Baños (UPLB) through the Corn Germplasm Utilization through Advanced Research and Development master project of the Institute of Plant Breeding looked at breeding new and improved traditional corn varieties of the country.

In another study, UPLB looked at utilizing corn cobs which usually go to waste as new and potential source of fertilizer for crops to save farmers from incurring additional expenses by buying commercially available ones.

UPLB also looked at farmers' preferences in a study aimed at increasing their productivity using white corn varieties in the country.

PhilRootCrops worked on product development to push forward the availability of healthy extruded products from cassava to further boost the commodity's industry.

Meanwhile, VSU developed a handy, on-site testing kit to detect Phytoplasma Disease which is considered as one of the most economically-important diseases in the cassava industry.

Lastly, UPLB also conducted a study justifying the importance and relevance of utilizing crop rotation to be able to maximize crop productivity while ensuring that the soil does not lose all the necessary nutrients needed by crops. ###

> **R&D support [given] includes *nutrient management* techniques; researches on *insect pests and diseases* resistance and tolerance; various *cultural management practices*; and *conservation and preservation* efforts.**


# *A-maize-ing! White corn grit products with a twist*

CHANTALE T. FRANCISCO

Filipinos are known to be innovative in producing something out of the typical. With the Philippines having rich resources especially on agriculture, it was not impossible to apply it to crops and revolutionize product development and commercialization. These kinds of initiatives, with the help of R&D, not only help boost our economy but also capacitate farmers to increase their income and improve their crop production.

One crop that contributed greatly in the course of agriculture is corn. Considered as one of the major crops in the country, it is also a popular rice substitute because of its dietary and health benefits. Corn helps alleviate malnutrition, obesity, and diabetes mellitus. Unlike rice, it is much cheaper and has more nutritional content.

Despite these findings, the demand for white corn in the market is still low. Hence, farmers were having difficulties in selling their crops. Insufficient knowledge of product development and processing, poor quality storage, and the absence of local market-assemblers of corn grits were some identified causes of this problem.

These causes, therefore, led to the expansion and development of white corn-related projects in the Philippines. Spearheaded by the Department of Agriculture-Cagayan Valley Research Center (DA-CVRC), agricultural agencies in collaboration with the local government unit and small-scale farmers in the area conducted a project titled, "Enhancement of Developed Food Products from CVRC Open-Pollinated (OPV) White and Pigmented Corn in Region 2."

Funded by the DA-Bureau of Agricultural Research (BAR), this intervention aimed to increase the income of white corn farmers and improve the market value of white corn grits in Cagayan Valley. Moreover, this project also aimed to provide technical assistance on product development through the technology commercialization approach.

This paved the way for the development of "Mangi MAXI," a product line generated by DA-CVRC, which utilizes white corn grits and lessen the production of surplus

using twelve open-pollinated white corn varieties. According to the agency, *Mangi* is an Ibanag term for corn, while MAXI stands for 'maximize'.

## Processing of Corn Grits

Starting off with the municipalities practicing the traditional cultivation of corn in Cagayan Province, DA-CVRC strengthened first the capacity of the farmers in product development and improvement. Laboratory trials were tested before releasing the products in the market. Milling operations, standardization of drying and cooking processes, and flavoring were the processes executed.

Preservation processes were also analyzed and evaluated in coherence with food safety packaging and standards. This is to improve and ensure the products' longer shelf life.

The products under Mangi MAXI that have potential for commercialization were Mangi Pansi (White and Purple Corn Noodles) that can be used in pasta dishes; Pastillas de Mangi, a corn pastillas product; Cracknic, a crunchy glutinous corn binatog; Café Bagga, a corn version of coffee; Corn-Rice Mix; Pure White Corn Grits; and Kornbi, a combination of glutinous and white flint corn grits.

These corn products aimed to increase corn consumption and address rice shortage and imports by being an additional Filipino staple food. With that, training on product development and processing were conducted by the DA-CVRC all over the region. To date, five training sessions were already completed with over 180 attendees.

These included lecture-type discussions and hands-on training led by the Department of Trade and Industry corn processors and other concerned agencies. Aside from corn processing, the lecturers also imparted their knowledge on basic financial management, marketing, labelling, product packaging, and good manufacturing practices to hone their processing practices in accordance with the safety food standards.

Product promotion and marketing towards food processors and white corn producers have also been done by the agency. And since Mangi MAXI corn grits product is a start-up brand, strategies like word-of-mouth advertising, radio promotion, print advertisements, presence in trade fairs and exhibits, and participation in various food festivals were incorporated to strengthen market linkages.

Moreover, marketing outlets were also continuously sought to ensure the constant trade of the products to the consumers and other potential interested customers.

In terms of investment cost production and profitability, the agency also raised awareness through training. According to DA-CVRC, based on the inflow from the entry sales of the beneficiaries, Mangi MAXI is a profitable business. With an initial investment of PhP 1,552,250, the projected IRR is 225.2% and an ROI of 63.27% within 1 year, 5 months and 10 days.

In collaboration with the local government of the City of Ilagan and the Municipality of Sta. Maria, Isabela, two processing partners – Cabisera 18 Farmers Credit Cooperative and Sta. Maria Green Ladies Organization – were identified to take part in technology adoption and product commercialization.

Through this initiative by DA-CVRC, value-adding technologies were introduced to the local farmers; thus, increasing their income and productivity. This project helped them gain knowledge and skills in product development and commercialization which can additionally help lessen the surplus of white corn.

Maximizing the potential of white corn through product development proves beneficial for both producers and consumers. With this intervention, buyers can enjoy white corn incorporated in palatable product varieties without sacrificing nutritional and dietary benefits. Locally-made products like these also empower people to buy and eat native food without worrying about quality and value for money. **###**

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PHOTO CREDITS: FEA/EASTERN SAMAR

# *Creating more opportunities for the cassava industry through value chain development*

JHON MARVIN R. SURIO

Cassava (*Manihot esculenta*) is a starchy tuberous crop that is considered staple food not only in the Philippines but also in many parts of Asia, Africa, and South America. It is cultivated across a wide range of agroclimatic conditions, and is used to make flour and breads, tapioca starch, and various snack food.

Apart from its popularity as a versatile root crop, cassava also has a remarkable nutritional profile. According to the Food and Nutrition Research Institute, cassava is a good energy source because of its high carbohydrate content but with low glycemic index. It also has considerable amounts of good quality fiber, vitamins, and minerals.

In the Philippines, cassava-based native products like *pichi-pichi*, *puto*, and *suman* are very popular snacks which transcended lifetimes being passed on from generation to generation as part of Filipino tradition and culture. Though it may vary from regions across the country, there will always be a cassava-based recipe known by people.

However, a recent assessment conducted by the PhilRootcrops of the Visayas State University (VSU) revealed that there are quite a number of cassava processors in the country that are not compliant to food quality and safety standards; hence, a wide range of quality diversity exists. Further, production areas fall short of productive efficiency, which resulted in high cost per unit production; thus, less profitability of cassava-based food systems.

Interventions were deemed necessary to improve productivity, marketability, and production and processing of cassava, especially for micro/small producers. Hence, a research on developing and improving cassava value chain in selected areas across the country using the Value Chain Approach was pioneered.

## Plans for the cassava industry

The challenges in the industry and the flour/starch-based food demand structure among Filipinos sparked the ideas of researchers to engage in the upgrading of cassava grates and flour systems, which can significantly contribute to the production of gluten-free flour and dried grates in the country. The abundance of cassava as raw materials and the availability of technologies in the country were seen as opportunities that can be taken advantage of, especially to benefit the growing number of health-conscious Filipinos while benefitting farmers.

Further, the production of cassava grates and flour was seen to be the key in addressing problems in flour supply, which stability could be threatened by climatic disturbances, adding to the risks on food and nutrient security.

The boosting of the availability of gluten-free flour/grates addresses the food needs of people suffering from allergens and a number of ailments due to the deficiency in absorbing nutrients due to celiac disease, which is triggered by the consumption of gluten richly found in wheat flour.

Other cassava-based food enterprises can also be established such as deriving pre-mixes and other forms that have export potentials to cater to the food needs of Filipino processors and consumers abroad. This further increases the profitability of a number of actors in the value chain. Hence, the urgent move to improve and expand existing cassava food value chains to meet this desired

end through improving production efficiency and profitability, and increasing its uses and applications.

Sites identified by the project included the cassava-producing provinces of Isabela, Pampanga, Quezon, Rizal, Leyte, and Southern Leyte where cassava-based enterprises abound. Later, Zamboanga del Norte, Eastern Samar and Cotabato were included as well due to their high potential as exhibited in the cassava value chain assessment, and as response to requests.

Value chain approach initiatives included value chain assessments in the selected focus sites; results of which became the basis of value chain improvement action plans. The latter was comprised of systematic provision of interventions (i.e. technological, commercial, and institutional interventions), and adequate business development services (e.g. technologies, business registration, safety compliance, BFAD registration, assessment and provision links of facilities, packaging, social marketing, among others) from farm to user; interventions from research and development outputs (e.g. appropriate varieties, provision of quality planting materials, crop management, and product development); and capacity development efforts, such as processing skills, business skills, and organization and management.

## Empowering micro/small entrepreneurs

Upgrading the value addition along the value chain of cassava-based products was seen with significant potentials, highly appropriate and fitting to micro/small entrepreneurs and even household enterprises. The project aimed to improve the adoption of cassava technologies, and the commercialization of cassava food value chains in the country, promoting inclusive growth to benefit the poor and micro/small entrepreneurs. Because cassava is a drought-tolerant root crop and can adapt to a wide range of environment, it is considered a less risky venture.

Based on the value chain assessments, it was revealed that cassava food value chains do exist in different types and degrees of connectedness to markets/users, as well as differing stability and efficiency to their suppliers of tubers. This is only true for traditional food products like *pichi-pichi*, *puto*, *suman*, and cassava pudding. There was none for cassava flour or dried grates. Cassava starch is an industrial product, and about 50 percent are imported mainly from Vietnam and Thailand.

Specifically, the project targets to enhance and develop the identified cassava food value chains through the provision of relevant business development services from production to utilization; strengthen capacities of partners to implement cassava value chain development, and ensure continuing improvements and sustainability; and develop and document useful models of value chain development.

Cooperators involved in the project include the following groups: in Isabela, the Linglingay Integrated Farmers Association of Gamu, Isabela (LIFAGI) and the Cassava Hills Growers Association; in Pampanga, the Tomo Women's Group; in Quezon, the Cadig Farmers' Group and the Rural Improvement Club (RIC), Brgy. Women POs, and household-based enterprises; in Rizal, Nutri-Pros; in Southern Leyte, the Little Children of the World (LCW) and the Visayas Agricultural College Alumni Association (VACAA); in Leyte, the Fatima Multipurpose Cooperative (FMPC); in Davao, the Malagos Farm Haven, Inc.; in South Cotabato, the Polo Samahang Nayon Multipurpose Cooperative (Polo SN MPC); and in Eastern Samar, the Farmer's Entrepreneur Association (FEA) and the Alyansang Samahan Para sa Kaunlaran at Pangkabuhayan ng

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Brgy. Gahoy (ASAPKAPA). Then, the Dapitan City Cassava Growers and Processors Association (CAGAPA) was included as cooperator providing needed business development support service from production, to processing improvements, market development through cassava festivals, and accessing for facilities enhancement.

**Project milestones**

Initial assessments conducted by the project revealed that cassava production in project sites can be differentiated by farm size, land preparation, cultural management practices, by market use and use orientation, and by agro-ecological location that resulted in a wide range of productivity. Production cost per kilogram ranged from PhP 1.75 to PhP 9.00. The cut-off cost for profitability could range from PhP 2.00-4.00 depending on the product, which implies needed interventions at the supply chain.

Despite the said disparities and inadequacies, research showed that cassava food value chains were thriving in all of focus sites in micro-, small-, or big-scale level, even some potential for export or novel niche markets. In value addition, interventions for improvements meant product quality, packaging, and market linkaging.

Food processing proved to be beneficial as it showed relatively higher value addition. Researchers claim that this pathway can be introduced or further upgraded because different stakeholders in project sites were seriously interested in improving the value chains using cassava technologies.

To date, project sites that already have cassava grates-flour processing system are Naguilian, Isabela; FEA of Eastern Samar; and Maasin of Southern Leyte. While, South Cotabato's Polo SN MPC has ordered the set of equipment. The said equipment helps in the process of improving grating, dewatering, pulverizing, drying, and milling.

Cassava processors were also found to have positive feedback in using cassava dried grates and flour. The products from the enterprises and value chains developed by the project are now starting to emerge in bigger markets. The FEA of Eastern Samar, for example, is now marketing dried grates/flour to Nutri-Asia which is used by the company.

Further plans to establish cassava grates and flour processing in strategic areas with interested cooperators were also mapped out. This include Naguilian, Isabela; Guinayangan, Quezon; Antipolo, Rizal; Dapitan, Zamboanga del Morte; Calubian, Leyte; Southern Leyte; Malagos and Davao City, Davao; Polomolok, South Cotabato; and Salcedo, Eastern Samar.

Researchers are now on the process of carrying out succeeding steps with the hopes of taking advantage of the project's success. Details are still being prepared and refined but these will focus on building facilities for cassava processing. The project showed evidence that using the value chain approach increases the likelihood of greater enhancements and sustainability of developing or improving cassava-based enterprises. ###

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PHOTO CREDITS: FEA/EASTERN SAMAR

> *The Farmer's Entrepreneur Association (FEA) is now marketing dried grates/flour to Nutri-Asia which is used by the company as raw materials for some of their high-end products.*

# *Developing the country's database on cassava insect pests and diseases*

RENA S. HERMOSO

When cassava turned from being a subsistence crop to a commercial one, challenges on the occurrence of pest and diseases became more pronounced.

The Cassava Phytoplasma Disease (CPD) (*Phytoplasma candidatus asteris*) or Cassava Witches' broom, poses a great threat to the industry. With CPD, there could be losses on both yield and starch quality.

Leyte-based Philippine Root Crops Research and Training Center in collaboration with the Department of Agriculture-Bureau of Plant Industry (DA-BPI) and various regional offices of DA conducted a research to address the problem on CPD.

Cassava's growing economic importance for food and industrial uses posits a challenge to identify varieties and best farming practices, and to catalogue information on its pests and diseases.

## Nationwide survey on cassava insect pest and diseases

DA-BPI, therefore, initiated another research to characterize cassava phytosanitary threats and potential drivers of its spread, and to establish and strengthen monitoring, surveillance, and management system of cassava pests and diseases.

Funded by DA-Bureau of Agricultural Research, the DA-BPI project ultimately aims to develop a regional profile and establish an e-database for cassava pests and diseases and to provide its effective management.

The said project covered two cropping seasons from July 2016 to June 2018.


Data and samples were gathered from 16 regions with a total of 619 samplings sites in 2017 and 505 sites in 2018.

DA-BPI found that continuous cropping of cassava contributes to the high incidence of insect pests and diseases.

Dry season influence incidence of insect pests and CPD while wet season does the same for cassava diseases.

## Top cassava insect pests and diseases

Red spider mites (*Tetranychus kanzawai*), spiraling whitefly (*Aleurodicus dispersus*), and mealybugs (*Ferrisia virgata, Phenacoccus manihoti*) were the most prevalent arthropod pests from 2017-2018.

These insects pierce the leaves and suck out sap causing dehydration. It was observed the heavy rains helped in regulating their population.

As for the prevalent diseases from 2017-2018, cassava brown leaf spot (BLS) (*Cercosporidium henningsii*), cassava blight leaf spot (*Cercospora vicosae*), and cassava bacterial blight (CBB) (*Xanthomonas axonopodis pv. manihotis*) earned the top spots.

Caused by a fungus, the brown leaf spot causes leaves to fall prematurely. Meanwhile, bacterial blight spot causes death of leaves and stems.

Brown leaf spot and blight leaf spot are caused by fungal plant pathogens. A typical symptom can be manifested by the infected plant on the leaf surface. BLS disease lesions are small brown spots and dark border being limited by the major leaf veins. In severe infections, the leaf spots are surrounded

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by a yellow halo and eventually, the lesions coalesce then cause premature defoliation. Blight leaf spot or Diffuse leaf spot disease is characterized by the presence of large spots with undefined margins and defoliation may occur in susceptible cultivars.

CBB is a bacterial plant pathogen with a typical symptom of small angular, aqueous leaf spots found on the lower surface of the leaf blade. As the disease develops blight, wilt, dieback and bacterial gummy exudates appear in young stems, petioles causing the death of the leaves and stems. It can cause total crop loss in a severely infected area.

### Incidence of CPD

Rayong 5, Rayong 72, and KU 50 varieties were observed to be susceptible to CPD.

The national average incidence was recorded high during the stress months of the dry season.

Highest incidence and damage rating were recorded in Central Visayas, particularly in Bohol. This is due to the recycling of planting materials in the infested areas.

CPD is classified as plant disease of quarantine concern which means its presence is limited and surveys and control measures are applied.

### Recommended planting technologies

Therefore, DA-BPI encourages cassava growers to follow the recommended planting technologies: fertilizers should be applied at the right time and quantity to minimize the incidence and damage to the cassava; planting distance should be 100 cm x 100 cm; and pest-free planting material should be used and synchronous planting observed.

DA-BPI also recommends to use resistant and high-yielding varieties adapted to a specific location. It was also suggested that planting materials should be sourced from nurseries accredited by DA-BPI to ensure its quality. ###

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> **DA-BPI recommends *use* of *resistant and high-yielding varieties* adapted to a specific location and the use of *quality planting materials* sourced from their *accredited nurseries*.**

# Breeding *new* and *improved* native corn varieties

JHON MARVIN R. SURIO

Corn germplasm collection initiatives in the country were pioneered many years back to safeguard native (traditional) corn varieties found in the country. Germplasm collection is particularly done as preservation efforts for when specific crop varieties are needed most in the future so that we have genetic materials to go back to. With the looming threats posed by climate change and other factors, this activity is crucial.

Because nobody can really predict how the effects of climate to agriculture will progress in the country, time and circumstances will reveal the utility of what there is to keep. As such, the Corn Germplasm Utilization through Advanced Research and Development (CGUARD) project was formed.

The initiative is a collaboration between the Department of Agriculture (DA) National Corn Program, the Institute of Plant Breeding (IPB) of the University of the Philippines Los Baños (UPLB), and DA regional field offices, funded through the DA-Bureau of Agricultural Research. Primarily, CGUARD aims to conserve native/traditional corn varieties in the country.

As an offshoot from the initiative, projects were then founded which aimed to develop improved

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PHOTO CREDITS: CGUARD-IPB/UPLB


*white maize*


*orange maize*


*yellow maize*


*glutinous maize*


*yellow maize*


*deep purple maize*


*purple maize*


*red maize*


*red maize*


*maize with purple and white kernel*


*deep red maize*


*white flint maize*

> ***Germplasm collection is particularly done as preservation efforts for when specific crop varieties are needed most in the future so that we have genetic materials to go back to.***

breeding materials from native corn varieties that are resistant to different biotic and abiotic stresses present in corn-growing regions in the country.

Some of the economically-important biotic stresses identified include diseases like Philippine downy mildew, bacterial stalk rot, and Fusarium ear rot; insect pests such as the Asian corn borer and corn weevil; and abiotic stresses caused by harsh environment conditions like drought, waterlogging, acidic soil, and calcareous soil.

### Screening native corn varieties with promising traits

The native varieties collected mainly by regional partners that exhibited varying degrees of resistance or tolerance to specific stresses were utilized in population development and improvement to further increase their level of resistance.

All materials that showed outstanding results are then subjected to population improvement to facilitate development of genetic materials with much improved performance for the identified stresses.

As this is being conducted, inbred lines will be developed and will be turned over to a genomics lab to identify the specific genes responsible for the resistance or tolerance trait. The said lines can also be used to develop hybrids.

From all the native corn populations screened so far by different CGUARD component projects, a total of 45 varieties were found with promising resistant or tolerant characteristics

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PHOTO CREDITS: CGUARD-IPB/UPLB

towards biotic and abiotic stresses. Of these, 37 varieties were resistant or tolerant to a single stress; seven were resistant or tolerant to two stresses; and one was resistant or tolerant to three stresses.

Specifically, for diseases, four varieties exhibited promising resistance to Downy Mildew with less than 30 percent disease incidence; three were resistant to Bacterial Stalk Rot with disease incidence of less than 20 percent; and one variety resistant to Fusarium Ear Rot with less than 20 percent disease incidence.

Meanwhile, for insect pests, six accessions were found to be resistant/tolerant to Asian Corn Borer; and two more which were resistant/tolerant to Corn Weevil with less than or equal to five percent grain damage.

### Increasing level of resistance/ tolerance of native corn varieties

The level of resistance in a breeding population is enhanced by self-pollinated families and recombining the resistant ones. This process is repeated until the desirable level of resistance or tolerance is achieved in the population.

Out of the 45 populations with promising traits, 39 were planted for the extraction of S1 families. However, only 16 have reached the targeted 50 S1 lines/population: two for downy mildew resistance; two for bacteria silk rot resistance; one for Asian corn borer resistance; two for corn weevil resistance; four for calcareous soil tolerance; three for drought tolerance; and two for waterlogging tolerance.

From the collected and screened resistant/tolerant materials, recurrent selection resulted to the development of some open-pollinated varieties. But inbred lines as well had been developed. Inbreds at S6 stage had been developed for downy mildew resistance. For most stresses, the inbreds are only at S2. At present, researchers are still exploring more entries from the germplasm being collected by partners in the regions. More favorable and useful findings are expected that can lead to more stable and productive corn production in the countryside despite climatic changes. **###**

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> **CGUARD is a long-term project launched in 2015 that aims to *conserve* native/traditional *corn varieties* in the country.**

# UPLB eyes *corn cob* as *potash source*

RENA S. HERMOSO

PHOTO CREDITS: WCABRAL

**"Generated *corn cobs* based in 2018 corn production could *produce ash* equivalent to 833 bags of K20, *valued at PhP 2,165,800* which could be *considered as savings by the farmers* and national government in terms of imported fertilizers."**

Imagine yourself on a lazy day anticipating the roaming vendor selling *nilagang mais*. Then you heard the distinct voice saying, "*Mais! Mais kayo riyan!*" You run out of the house to get yourself one. After happily munching on the kernels, you are left with the cob. As you were about to throw it, your mom stops you saying she will use them to scrub the pots.

Corn cobs are also simmered to produce stock which is often used as soup base. Livestock breeders grind the cobs to make feeds.

There are indeed many ways to utilize corn cobs from addressing our kitchen needs to powering industrial products.

The University of the Philippines Los Baños (UPLB) has recently found that corn cob is a promising material as a potassium source for white corn fertilization.

"One part of maize that is not fully utilized is the corn cobs," said Dr. Apolonio M. Ocampo, project leader.

With funding support from the Department of Agriculture-Bureau of Agricultural Research, UPLB conducted a research to evaluate the effectiveness of corn cobs and cobs' ashes as substitute source for potassium fertilization of white corn.

"Maize plants or the cereal crops are known to be high user of nutrients," said Dr. Ocampo.

He shared that high cost of commercial inorganic fertilizers is one of the problems encountered by corn farmers.

"Nitrogen, phosphorus, and potassium are the major elements needed by the maize crop to produce the target yield aside from other minor elements.

Solving the problem on availability of nutrients for maize, even one at a time, through the use of alternative or organic source could help the farmers reduce production cost and increase net return," explained Dr. Ocampo.

**Testing the hypothesis**

The UPLB project team conducted a four-season experiment to determine the long-term effect of corn cobs on corn yield, potassium availability, and other nutrients in the soil.

A pot experiment was also facilitated to figure out the incubation time needed for the corn cobs to release the available potassium for plant use.

They also did field trials in Bukidnon, Isabela, and UPLB to test the efficacy of corn cobs and ashes obtained from commercial corn dryers as potassium source for corn

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production.

They also tried concocting liquid mixture made from corn cobs and corn cob ashes from biomass dryer soaked in water at a given ratio for a certain period of time.

The mixture served as foliar spray for corn pot experiment to determine the ability of the solution to provide potassium.

### Reaping the results

UPLB found that immediate results for using corn cobs as potassium fertilizer source for open pollinated varieties could be attained by using 10-15 tons of cobs per hectare, while hybrid requires 20 tons of per hectare.

Ashed corn cobs from furnace would give best results in terms of growth and biomass production.

Extracts from cobs soaked in water could be used as foliar spray after soaking for 4-5 weeks.

"However, further studies are needed to determine the right amount of dilution and time of application that is economically feasible," said Dr. Ocampo.

### Moving forward

"At present, potassium analysis of corn cobs is not available or studies are not being conducted. If analysis could be made to determine the amount of potassium content in corn cobs and this material could be incorporated in the soil as organic fertilizer source, this could be a great relief to farmers especially those who have small landholdings or those who are dependent on the 'middle man' for financing," said Dr. Ocampo.

He further explained, "Generated corn cobs based in 2018 corn production could produce ash equivalent to 833 bags of K20, valued at PhP 2,165,800 which could be considered as savings by the farmers and national government in terms of imported fertilizers."

This UPLB project is the first step forward.

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# Increasing white corn productivity through assessing farmers' preferences

CHANTALE T. FRANCISCO

Corn is one of the most popular and major crops in the Philippines. As one of the country's staple food, it dominated around a million hectares of land area in the country in different kinds of varieties. White corn is one variety that has been greatly utilized by Filipino farmers and consumers. Aside from its resiliency and ability to be grown all year round, white corn grits have been a potential rice substitute and has been proven to alleviate malnutrition and help in attaining food security.

With that, studies and projects that aim to increase the productivity of white corn have been launched by various organizations and academic institutions. Hence, the University of the Philippines Los Baños (UPLB) together with the Bicol Integrated Agricultural Research Center (BIARC), Eastern Visayas Integrated Agricultural Research

Center (EVIARC), Zamboanga Peninsula Integrated Agricultural Research Center (ZAMPIARC), Caraga Integrated Agricultural Research Center (CARIARC), and local government units (LGUs) conducted a project titled," Considering Farmers' Preferences in the Adaptation and Dissemination of White Corn as Staple Food".

Funded by the Department of Agriculture-Bureau of Agricultural Research (DA-BAR), this initiative further underscored the need to also increase farmers' yield and income where white corn is thriving while utilizing the participatory varietal selection (PVS) approach and technology innovation systems. PVS, as a bottom-up approach, helps and involves the farmers in identifying the best varieties according to their preferences and farm conditions.

In this project, PVS parameters namely preference analysis, grain yield evaluation, sensory/taste evaluation, milling recovery, and storability evaluation of corn varieties were incorporated to ensure accuracy and reliability of results.

The project started with site and farm selection that followed a set of criteria. These criteria include farmer's fields that are (1) regularly growing white corn which are processed and cooked as corn grits, (2) accessible to vehicles for easy monitoring, and (3) considered as representatives of white corn areas in the community. With that, selected barangays in Masbate, Leyte, Zamboanga Peninsula, Davao, and CARAGA region were chosen as farm sites for the project.

Soil samples were then obtained and tested from these identified farm sites. Baseline surveys were also conducted to assess the farmers' existing management practices and agricultural resources.

From there, it was observed that the main cropping system in the selected farm sites is corn-corn and the majority of the farmers use commercial fertilizers such as urea and complete. Determining these conditions and practices is essential as they reflect possible soil constraints, crop productivity, and can be the basis of improvements for nutrient sources, application procedures, and proper placements.

Eleven corn varieties were tested during field trials including the current white corn cultivars used by the farmers. Using the established scaling system, the farmers were tasked to rate and rank each corn variety according to the criteria set for each PVS parameter. From the results, a final score or a Selection Index (SI) was derived.

Among the 11 varieties tested, the highest-scoring variety was *Northland white* for the farmers in Masbate. This is because of its high yield, high preference, and storability. In Leyte, the *Northland White* variety was also the most favored variety because it scored the highest in grain yield evaluation, preference analysis, sensory/taste evaluation, and milling recovery. *Kalimpos* followed the ranks, which is the local corn variety used by the farmers.

For the farmers in Zamboanga del Norte, *Northland white* still led the ranking system. It scored the highest among the PVS parameters but fell short in the milling recovery. Furthermore, farmers from Agusan del Norte also showed a great preference for the *Northland white*. However, they gave more importance to its taste and shelf life.

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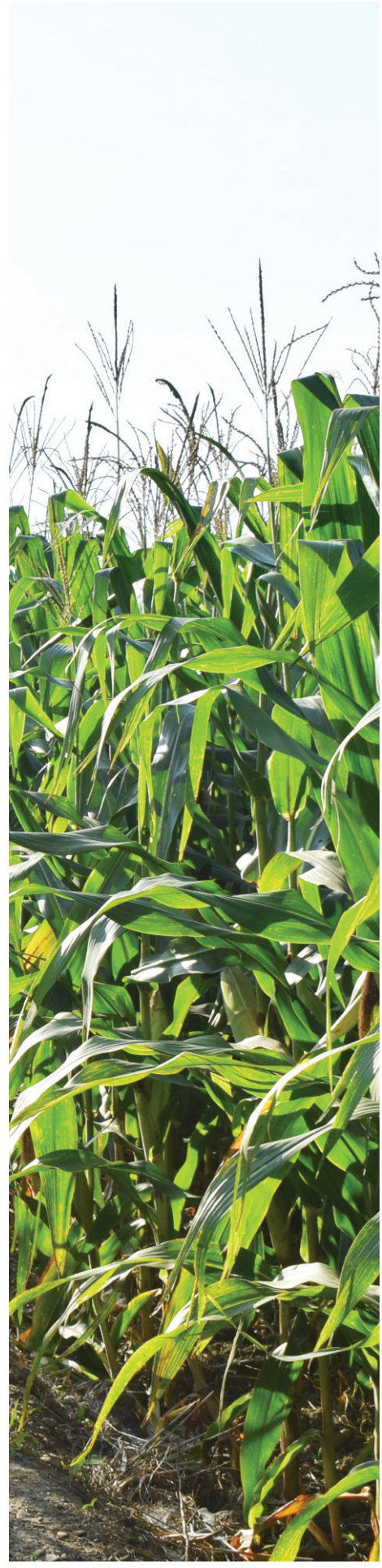

Unlike the mentioned areas, the variety that thrived in Davao was the IES 89-12. The farmers gave it high rankings in terms of yield, taste, and preference.

From the results of the SI, it was shown that most of the areas gave priority to a variety's grain yield when selecting white corn which the *Northland white* has shown during the field trials. But this crop's productivity still depends on the climatic conditions and soil properties of the area as it did not gain uniform results from each of the farm sites.

On the other hand, during the consumer tests that determined the preferences of consumers in terms of the cooking and eating quality of pure white corn grits, Northland white garnered the highest rankings in all testing sites except in Zamboanga del Norte wherein they still prefer their traditional rice variety, *Tiniguib*. In the rice-corn combo tests, diverse results emerged during the tests.

Including the farmers during the decision-making was also essential to the completion of the project. During its conduct, the farmers' participation reflected their eagerness and willingness to adopt the varieties suited for their farm sites and farming practices.

Farmers witnessed the results first-hand making the diffusion of innovation faster. Using the selection index, in this case, also made the results of the study unbiased and favorable for the farmers' preferences.

The introduction of this project to the farmers has made great impacts on the selection of appropriate crops. This did not only give them the liberty to choose their

preferred varieties but also enough information on how these crops grow. They were also able to survey the general public's demand on white corn variety, thus, further aiding them in crop planting and production.

In addition, the success of the project implies that their farming practices will not just be based solely on their judgments, climate conditions, and traditional crops but also on the crop's market value and productivity accompanied by research. ###

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# Promoting the *availability* and *health benefits* of extruded products from *cassava*

LEOVELIZA C. FONTANIL


PHOTO CREDITS: PHILROOTCROPS/VSU

Packaged dry pasta, breakfast cereals, puffed snacks, penne, confectionaries, and breadsticks are among the list of extruded food products in the market that we love and enjoy. The crispy, golden yellow, and crunchy or airy, fiery-spiced and bright-colored products bring some delicious and tasty foodstuff that blow our minds when we eat it.

Locally, extruded food products have been extensively used in the food industry. Most of them are made from corn and wheat but not yet from cassava. Compared to corn and wheat, cassava is mostly a source of starch and has been successfully identified as an alternative source of gluten-free flour.

Today, an increasing number of consumers are becoming sensitive to gluten found in wheat flour which subsequently results in celiac diseases. Celiac disease is a digestive disease that damages the small intestine and interferes with absorption of nutrients from food. People who have celiac disease cannot tolerate gluten, a protein in wheat, rye, and barley. Hence, cassava flour has a functional advantage over wheat flour in certain food because it absorbs

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*extruded cassava*

*cassava chippy*


*yuca puffs*


*cassava grates*


*various cassava products*

more water and has more fragile consistency.

While there is a growing awareness of the health benefits of eating root crops, particularly cassava, the per capita consumption of cassava for food is still very low at about 3 kilograms. The Department of Agriculture (DA) aimed to increase the per capita consumption to 6 kilograms by 2019, apparently to reduce the consumption of rice which has been continually increasing, requiring much importation. This will also be for the benefit of cassava farmers so that they increase their production and income.

In 2015, cassava is identified under the DA's Food Staple and Stability Program as an alternative major source of food in the country aside from rice and corn. As one of the staple crops in the attainment of the "Food Staple Sufficiency Plan" the department is promoting products from cassava.

In support to DA's advocacy, the Philippine Root Crops Research and Training Center (PhilRootcrops) of the Visayas State University led by Dr. Daniel Leslie S. Tan implemented a project titled, "Enhancement of Food and Nutrient Security through Food Diversification: Development of Extruded Products from Cassava," which aimed to develop technologies for the enhancement and nutrient security of extruded food products toward increasing utilization of cassava as a major source of food. Specifically, the project aimed to develop a portable mechanized processing system for the production of at least three cassava extruded food products.

As a result of study, various extruded products were developed from dried cassava grates namely: yuca

puffs, cassava chippy or "cacharon", extruded noodles, and grains. Dr. Tan accentuated that the yuca puffs and the chippy products have the potential for commercialization due to the simple processing operations, acceptable sensory qualities, and acceptability in the market. Optimum processing conditions were established for the production of yuca puffs using the developed portable extruder for puff products. Two flavors of the yuca puffs (milky and cinnamon flavors) were developed and found acceptable.

The yuca puffs and chippy products processing system were pilot tested at PhilRootcrops processing plant which resulted in further improvement of the processing system, like the fabrication of accessory devices which include the conveyors, devices used to mount and unmount the extruder conveyors. Furthermore, cutter for the yuca puffs are already designed and fabricated, as well as the pre-drying conveyor and cutter for the chippy products processing system. Machines also have been fabricated for the identified extruded products. The machines were: 1) the portable extruder for puffed products, 2) extruder for cooking and forming (cacharon, noodles, and grains), and 3) conveyor system with different label designs. The designs include nutritional information about the products.

For the feasibility indicators, in the financial analysis, the yuca puffs processing system has a return on investment of 816.18%, and a payback period of 0.72 years, while the chippy products processing system has a return on investment of 94.94%, and a payback period of 2.89 years.

The next phase of the project includes the following: to have extruders with an automatic temperature control system; optimize the extruded products and further improve the packaging materials; and determine shelf-life of the products.

Dried cassava grates and flour are being produced continuously at PhilRootcrops to supply the demand mainly for chips production, cookies, and cassava cake. These products also increase the utilization of cassava for food. As Dr. Tan says, "The more the range of products that are available in the market from cassava, the more it could be utilized as food. Developing a variety of new cassava food products and commercializing the production of these products would surely increase the consumption of cassava as food, and consequently increasing food security." **###**

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PHOTO CREDITS: PHILROOTCROPS/VSU

# Kit to detect Phytoplasma disease in cassava developed

LEOVELIZA C. FONTANIL

Cassava is one of the important sources of food, feeds, and starch among Filipinos. In fact, according to the Philippine Statistics Authority, an average of around 2,806,700 metric tons of cassava each year are utilized, and are projected to increase annually. It is planted each year in about 120,000 hectares of agricultural land in the Philippines, producing about 2% in the gross value-adding in agriculture. As a commercial crop, demand for cassava is increasing and this trend is expected to continue.

Cassava is known to perform well even under unfavorable growing conditions, but its biggest challenge is the occurrence of pests and diseases. According to various studies, this is attributed to the constant changes in planting conditions which create very conducive areas for pests and diseases development.

Before, the incidence of pests and diseases was not a problem because cassava was grown as a backyard crop. But since it is now being produced on a commercial scale, growers are encountering problems that have mainly resulted from a monoculture system of cassava growing. One of them was the phytoplasma-associated diseases which cause production and economic damages on a wide variety of cultivated wild plants.

**Phytoplasma, an ominous cassava disease**

Cassava phytoplasma disease or (CPD) is a current serious threat to the country's cassava industry. CPD is a defying causal organism of cassava known for cassava witches' broom which causes high yield reduction to nearly total crop loss and low quality of tuberous roots. The symptoms are triggered by bacteria-like organisms that can only survive inside the vascular systems of plants. They are mainly spread by the feeding habits of some insects that sack the sap of cassava plants, among other mealybugs. Another way of its transmission is through the transport of infected plant material between fields or areas.

When the plant is infected with CPD, it causes normally dormant shoots

to grow, producing small leaves, slight swellings of lower stems may occur, as well as curling and the appearance of mottled green and yellow pattern on the leaves. Roots may grow thin and woody, with thick outer layers, and deep cracks, among other symptoms, until the plant eventually dies.

CPD can reduce yield to about 40-50 percent when its symptoms appear as early as two to three months after planting or during the middle of the growing season. Yield can be reduced to 100 percent as there will be no more production of roots when infection ensues during the first six months from planting.

Becoming prevalent and continuing to spread in several parts of the country, CPD threatens cassava supply amidst its high demand for food, feeds, and industrial uses. Worse, it is also feared to decrease its contribution to the Philippine economy, with 217,000 Filipino farmers dependent on cassava production.

**Early detection of CPD using the LFIA kit**

Researchers of the Philippine Root Crops Research and Training Center of the Visayas State University have developed a technology that can provide an alternative method for detecting the phytoplasma disease in cassava. The method is handy, easy-to-use, and provides quick detection of the disease. The technology was generated through the project, "Development of Lateral Flow Immunosorbent Assay (LFIA) Detection Kit for Phytoplasma in Cassava," funded by the Department of Agriculture-Bureau of Agricultural Research (DA-BAR).

According to Dr. Erlinda Vasquez, project leader, CPD is practically present in all cassava growing areas in the country and is spread due to the unregulated movement of infected cassava planting materials

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***Phytoplasma disease as seen in cassava plant.*** *(Photos from PhilRootCrops/VSU)*

and planting asymptomatic phytoplasma-infected cassava stakes. Accurate detection of the disease and its causal organism is a prerequisite for the management of the disease.

"Unfortunately, not all infected plant shows recognizable symptoms making it difficult to detect by plantation workers and quarantine officers. Detection and identification of bacterial plant pathogens present in the whole plant and propagative materials have been possible by employing isolation culture media and metabolic fingerprinting methods. The problem of these are that they are labor-intensive and require a long time to get the results," Dr. Vasquez explained.

Several diagnostic methods have proven very effective in the detection and quantification of phytoplasma bacteria which include Polymerase Chain Reaction (PCR) and Loop-mediated Isothermal Amplification (LAMP) which was developed from previous funded researches. However, these methods are still time-consuming, need expensive equipment, and require a specialist to conduct a detection assay making these methods unsuitable for point-of-care diagnosis.

The new LFIA has gained increasing interest to overcome those problems. The ground-breaking feature of the modified LFIA offers a low-cost, rapid and sensitive detection, user-friendly operation, and easy storage; thus, eliminating the need for expensive equipment.

LFIA kit is a serological diagnostic tool widely employed in the diagnosis of plant pathogens and considered an efficient tool used for 'point-of-care' or 'in-field' pathogen detection. Its advantages include being low-cost, simple to use, and long shelf life from which results can be obtained just within 10 minutes. Moreover, tests can be performed on-site by local farmers.

LFIA typically contains a control line to confirm the test is working properly, along with one or more target or test lines. They are designed to incorporate intuitive user protocols and require minimal training to operate. They can be qualitative and read visually, or quantitative when combined with reader technology. The addition of a liquid sample from the suspected plant would initiate and complete the test used in the detection of pathogens in plants.

After two years of project implementation, half of the budget from the project are designed to come up with the end product which is the LFIA Kit.

The technology aimed to avoid the spread and outbreaks of CPD for the production of quality cassava planting materials that will benefit commercial cassava growers, cassava nursery operators, and regulatory government for certifying clean cassava planting materials.
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**LFIA is a serological *diagnostic tool* widely employed in the diagnosis of plant pathogens and considered an *efficient* tool used for "point-of-care" or "*in-field*" pathogen detection... which is *low-cost*, *simple to use*, and has a *long shelf life* from which *results* can be obtained just *within 10 minutes*.**


PHOTO CREDITS: PHILROOTCROPS/VSU

# *Crop rotation* towards a *sustainable* corn *productivity*

LEOVELIZA C. FONTANIL

In major corn-producing countries, crop rotation has always been a normal practice. Usually, a leguminous crop is alternated with corn in varying frequencies. Leguminous crops act as nitrogen fixer which proved to enhance soil fertility and, therefore, is an effective way of soil restoration and improving crop production.

As stated by Dr. Artemio M. Salazar, agricultural scientist and expert of the University of Philippines Los Baños (UPLB), the sustainability of corn production practices in the Philippines is becoming a serious concern. Continuous mono-cropping and frequent torrential rains due to climate change intensify soil degradation.

"It has been a general knowledge that rotating legumes with cereals can improve soil fertility and enhance total crop productivity, but there is no comprehensive data in our country," Salazar explained. "Sustaining and enhancing farm productivity and income of the poor farmers necessitates that we have to take now the critical initiatives in the

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field. We need to show convincingly that crop rotation has distinct advantages compared to continuous mono-crop farming, especially for the poorer class of farmers," he said.

In 2015, the Institute of Plant Breeding of UPLB led by Dr. Salazar embarked on a project, "Corn Productivity and Increasing Farmers Income through Crop Rotation." Supported by the Department of Agriculture-Bureau of Agricultural Research (DA-BAR), the project focused on the advantages of crop rotation in corn areas in terms of soil fertility and its soil properties. The project also intended to compare the total crop yield and farmer's income under continuous corn cropping versus corn-legume crop rotation system.

In its three years of implementation, the project was able to assess and identify the yield performance of corn using leguminous crops such as mungbean, soybean, and peanut under four cropping pattern treatments in three sites: Isabela, Cebu, and Bukidnon. The team observed that there is a 10 to 25 percent increase in yield of corn in crop rotation than in monoculture. The cost of production of the following crop decreases to an extent which mostly depends on the crop. This helps in increasing nutrient uptake of the plants from the soil as different crops require different nutrients in different quantities.

Compared to mono-cropping the yield performance in intercropping increased under corn-legume crop rotation. In Isabela, the corn-peanut gave the highest cumulative net income of PhP 292, 581.86 across the four cropping seasons while in Bukidnon and Cebu, the mungbean-corn crop rotation netted the highest income of PhP 275, 143.80 and PhP 225,040.86, respectively.
Net income of farmers per hectare for the four cropping seasons under corn-legume crop rotation creates a notable increase of 90 percent compared to continuous corn cropping in three locations across the Philippines.

Farmers in the provinces also saw a decrease in the incidence of insect pests, pathogens, and control soil-borne diseases. Dr. Salazar also found out that crop rotation does "work wonders" in improving soil structure and prevents the accumulation of toxic chemicals or substances secreted by crop plant.

"In all locations, income and soil fertility improved with crop rotation. It was shown that rotating corn with legumes is more advantageous than continuous corn cropping," Salazar expounded. Dr. Salazar touts the impact in reviewing how we treated our corn farms with opportunities in terms of higher overall farm productivity and better livelihood for farmers.

"Indeed, these grain legumes are an ideal crop to be utilized in a crop rotation system to enhance soil fertility and increase farmers' income. Rotating corn with grain legumes both provides agronomical and economic benefits which shows the general advantage of crop rotation over continuous corn cropping," Dr. Salazar said. **###**

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