

A person wearing a white hairnet and a black face mask is pouring purple rice from a clear plastic bag into a metal tray. The rice is a vibrant purple color. The person is wearing a yellow shirt and a white apron. The background is a blurred industrial or laboratory setting.

# RESEARCH FOR DEVELOPMENT BARDIGEST

The official magazine of the Department of Agriculture-Bureau of Agricultural Research

*No more  
waiting  
in vain:*  
Farmers,  
processors  
find ubi's  
real worth

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## EDITOR

Mara Shyn M. Valdeabella-Pacunana

## CONSULTING EDITOR

Salvacion M. Ritual

## WRITERS

Kathleen Mae B. Bulquerin  
Lea B. Calmada  
Alexis B. del Mar  
Maria Elena M. Garces  
Rena S. Hermoso  
Angelo N. Padura  
Salvacion M. Ritual

## CONTRIBUTORS

Vanessa F. Calderon  
Camille O. Francisco  
Nordalyn B. Pedroche, PhD

## INFOGRAPHICS

Alexis B. del Mar  
Lino Norman D. Reyes

## LAYOUT

Rena S. Hermoso

## CIRCULATION MANAGER

Lyn D. Pardilla

## ADVISERS

Junel B. Soriano, PhD  
Joell H. Lales

---

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We welcome and appreciate your comments and suggestions. Reach us via email [ikm@bar.gov.ph](mailto:ikm@bar.gov.ph).

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# ABOUT THE COVER



Through the refurbished and upgraded crop processing facility of Quirino State University, Quirino Young Entrepreneurs Association discovered the full glory of kinampay ubi produced by farmers in Baguio Village, Quirino.

Known as the queen of the Philippine yams, the high value crop currently sustains the livelihood of ubi farmers and food processors in Quirino. Boasting its vibrant color and premium grade food qualities, the processed ubi food product now reaches both the local and international markets.



**Agricultural Magazine of the Year**  
2007 Binhi Awards

**Best News Magazine**  
2003 Gawad Oscar Florendo

# Bringing high value gains through R4D

JUNEL B. SORIANO, PhD

In a bid to sustain and improve the production and competitiveness of high value crops such as fruits and vegetables, the Department of Agriculture (DA) through its High Value Crops Development Program (HVCDP) pursues strategies aligned to the DA's goal of "Masaganang Agrikultura, Maunlad na Ekonomiya".

Created to help address food security, poverty alleviation and sustainable growth, the HVCDP is a significant partner of DA-Bureau of Agricultural Research (BAR) in ensuring that technologies and information are available for adoption by our clientele.

High value crops create income and livelihood opportunities across the value chain, benefiting small farmers to market sellers and food vendors. To which, several priority high value crops have already contributed significantly to the local and export markets.

Moreover, "the cultivation of high value crops plays a significant role in enhancing farm income, consumption expenditure and reducing poverty. Hence, growers should allocate areas for high value crops to have significant income enhancement and poverty reduction," noted the International Food Policy Research Institute.

At DA-BAR, we have long recognized the importance of high value crops in supporting the livelihoods of our small farmers and their role in improving food and nutritional security. Our R4D initiatives in this area have yielded outcomes that bring about significant developments in the countryside.

In this issue of the BAR R4D Digest, we are bringing to you some of the outputs of our recent R4D initiatives in the field of high value crops. It features specific R4D interventions that can help lead our farmers toward the DA's vision for Philippine agriculture.

The narratives on each of the projects featured discuss their potentials in great detail. For instance, onion is once again given attention particularly its associated pest, the onion armyworm that continues to cause significant damage to onion farming. The development of Electronic Management of Insecticide Resistance, a mobile application for IRM of fall armyworm and onion armyworm which aims to generate insecticide rotation calendar, digital library and maps on relevant information, is discussed here.

For vegetables, aside from being a staple food and its significant contribution to our dietary requirements, the story unfolded by studying the potentials for market expansion through vacuum fried chips including market assessment and refinement of other vegetable products.

For champion commodities such as pineapple, coffee, rubber and durian, DA-BAR has collaborated with R4D partners from DA-Regional Field Offices and research agency, as well as state universities and colleges. These projects are supported by DA-BAR to boost production and recommend strategies/mechanisms to address problems from production to marketing of products.

Featured also is DA-BAR's pro-active support to establish sustainable seed system/network for developed lowland vegetable varieties and registered native fruits and nuts of the UPLB-Institute of Plant Breeding. Learn how these interventions can provide easy access for stakeholders to available supply of seeds and other planting materials. This and more are discussed in the succeeding pages.

As you peruse this report, we hope you will gain knowledge, information, and best practices from the stories shared. We are grateful to the support of our partner institutions and stakeholders, and we look forward to more collaborations toward a brighter future for high value crops. •

# High Value Crops Development Program (HVCDP)

## R4D projects per commodity, 2019-2023

### Fruits



#### Mango

2 completed

3 ongoing



#### Banana

1 completed

3 ongoing



#### Various fruits

2 completed

2 ongoing

### Vegetables



#### Various vegetables

2 completed

10 ongoing



#### Onion

1 completed

4 ongoing



#### Tomato

1 completed

1 ongoing

The HVCDP is one of the banner programs of DA created through the High Value Crops Development Act of 1995. It aims to deliver appropriate services, promote access to local and international markets, and ensure proactive management actions on the demand and supply situation. The program is mandated to contribute to the attainment of food self-sufficiency, economic growth, and enhancement of consumer's health and welfare. The priority commodities include mango, banana, coffee, cacao, and onion.

The program supports DA-Bureau of Agricultural Research in the strategic management, coordination, and development of breakthroughs in high value crops research for development (R4D) programs and activities. The bureau coordinates with DA regional

offices, state universities and colleges, and other research institutions in developing and promoting packages of technologies for various priority high value commodities.

From 2008 to 2023, the bureau has funded various projects mainly on various high value crop commodities such as banana, mango, garlic, onion, yam, cacao, coffee, and other indigenous and local vegetables and fruits. These R4D projects have propagated and conserved indigenous crops to promote and increase its consumption; produced clean and quality planting materials; developed production management, pests and diseases control, and postharvest strategies; and developed value-added products from underutilized crops and crop wastes and by-products. •

## Plantation crops



### Coffee

4 ongoing



### Cacao

1 completed

1 ongoing



### Rubber

1 completed

1 ongoing

## Rootcrops



### Yam

1 completed

1 ongoing



### Various rootcrops

2 completed

1 ongoing

## Others



### Multi-crop

1 completed

1 ongoing

## Adlay



### Adlay

1 completed


1 ongoing



### Quinoa

2 completed

1 ongoing



*“Ang ubi raw ay tanim ng tamad,”* Brenda I. Diola, a farmer for nearly two decades, citing a popular saying in their community relating to ube farming.

Farmers in Baguio Village, Diffun, Quirino grow ube effortlessly. Planting the crop, according to them, is easy since it does not require fertilizer application as well as regular watering.

Yet easy does not mean profitable. After waiting for at least ten months, farmers take no delight in their unsold produce. This story reverberates to many ube plantations in Baguio Village not until the upgraded crop processing facility of Quirino State University (QSU) unwrapped the potential of their locally grown ube.

*“Kung dati ay nabubulok lang, o di naman kaya ay pinapakain lang namin sa aming mga alagang hayop, ngayon ay nabebenta na namin ito [ubi] at napagkakakitaan,”* Diola, marketing head of Baguio Village Multi-Purpose Cooperative (BAVIMCO), shared. At, at least, PHP 28 for every kilo, fresh ube produced by members of BAVIMCO are sold to food processors in the refurbished facility of QSU.

### **Breathing life to a processing facility**

Since its establishment in 1994, QSU’s crop processing facility has been a shared-service facility for researchers, farmers and farmer cooperatives, and young entrepreneurs. Among those that benefit from the facility is the Quirino Young Entrepreneurs Association (QYEA), a QSU-based organization composed of agriculture students and alumni. QYEA produces food products

like *bignay* juice and wine, soya flour, and butterscotch utilizing locally grown crops from nearby communities. However, their production remained seasonal and curbed due to the limited capacity and degrading condition of the facility affecting the income of farmers from whom they source their raw materials.

In response, the research team spearheaded by Mila T. Benabise, in partnership with the DA-Bureau of Agricultural Research, implemented a project to upgrade the existing crop processing facility of QSU by retooling it with more advanced and efficient food processing equipment, and rehabilitating the facility itself.

Funded through the Agricultural Competitiveness Enhancement

# No more waiting in vain: Farmers, processors find ubi's real worth

ANGELO N. PADURA

Fund R4D grant of DA, the facility acquired a pulverizer, cabinet oven, hydraulic slicer, dehydrator, and vacuum fryer, among other processing equipment

used by processors in producing food products. The roofing system and processing stations were also improved resulting in a standards-compliant and a more systematic facility.

“With our upgraded facility, both the production capacity and quality of the food processors were improved. Notably, we are able to innovate a new and promising product—the ubi powder,” Benabise said.

## Rooting on ubi

By taking full advantage of the food processing equipment and expanded stations, QYEA processors developed a premium class ubi powder from the locally grown ubi of BAVIMCO farmers.

The product had a total sales amounting to PhP 65,870 and 41 inquiries from potential buyers during the International Food Exhibition Philippines held on 26-28 of May 2023 at the World Trade Center in Pasay City.

“Last May, we delivered 100 kg to Sasmuan Delicacies in Pampanga and another 500 kg to a food manufacturer in Japan,” Nur E. Agustin, acting QYEA chair, reported.

With the product appealing both to local and international markets, members of QYEA

boosted their production of ubi powder resulting in an increased demand for fresh ubi supplied by ubi growers from the Baguio Village. More importantly, both the ubi farmers and food processors now experience an increased and stable profit as the demand for fresh and processed ubi grows.

*“Kung dati ay kakaunti lamang ang mga produkto na aming nagagawa, ngayon ay mas malaki na ang aming produksyon at mas dumami na rin ang aming produkto. Dahil sa paggawa ng ubi powder, ‘yong dating dalawa hanggang tatlong beses namin na trabaho sa isang linggo ay naging lima hanggang anim na beses na,”* Joseph G. Gattoc, another QYEA member, shared.

With its current successes, ubi ensures a sustained and increased income to QYEA members and BAVIMCO ubi farmers.

“We have ongoing talks with potential partners in South Korea and government agencies in the country. We have come a long way but greater things are yet to come for the ubi powder and every hand that labors for it,” Benabise said. •

For more information:  
**Mila T. Benabise**  
Quirino State University  
(0916) 870 0012  
mtbenabise@yahoo.com

What happens when pests learn to evade their killers? Uncontrolled increase in population, a ticking time bomb to a costly pest outbreak...

Most farmers tend to misuse insecticides due to limited access to research-based mature technologies and management strategies. These actions converge with other actions and natural events. Time and again, evolution will take its course. These short-lived pests will eventually adapt to pesticides. And if left mismanaged, it will lead to insecticide resistance.

To help address this risk, the National Crop Protection Center under the University of the Philippines Los Baños (NCP-C-UPLB) through funding from DA-Bureau of Agricultural Research developed the Electronic Management of Insecticide Resistance (or simply, eMIR) mobile application. Soft launched in December 2022, eMIR is now available for free download at the Google Play Store and works with or without internet connection. Through this app, farmers can easily access essential technical information on the proper rotation of insecticides against fall and onion armyworms.

“This app [will boost] the global competitiveness of the farmers by strengthening their technical know-how on the application of the combination of strategies or [integrated pest management] (IPM) and considering the three keys of insecticide resistance management. [These are:] know the product mode of action (MoA), rotate the insecticide MoA, and follow the label. [Thereby], delaying insecticide resistance that will result in a bounty

harvest,” said Phase 1 project leader Karen P. Ardez.

The eMIR app has three key features: Calendar, Map, and Learn. The first one allows the user to input farm details and calendar activities. Based on the input data, farmers will be shown the ideal date to start the insecticide cycle, choices for effective and available insecticide options based on MoA, and guide on the spray interval on the frequency of application in varying effectiveness (excellent, good, and fair). The app removes the chosen insecticide from the list of recommendations on the next cycle, thereby preventing its consecutive use.

The second feature shows the map of the positive fall armyworm infestation in Luzon, Visayas, and Mindanao, as well as the area-specific availability of insecticide. It also contains the list of effective and ineffective insecticides per site.

The third feature, and the most important one according to Ardez, shows information on proper application, handling, and storage of insecticide groups; insect profile; profile and crop protection practices of local growers; and the basics of insecticide resistance management.

The main content was based on the outputs of the various laboratory and field trials, while information on effective macro- and micro-biological control agents to manage fall and onion armyworms based on grey literature will be added in future updates.

The Phase 1 of the project focused on fall armyworm, while

the ongoing Phase 2 is on onion armyworm, as well as further improvements of the app and its compatibility with iOS.

She also proudly shared that farmers can easily search for the DA-Fertilizer and Pesticide Authority-registered insecticides based on the following filters: MoA, active ingredient, company, and brand name. This was, as Ardez said, the initiative of retired scientist Mario V. Navasero who now serves as the consultant of the project.

“The efficacy data on fall armyworm and onion armyworm insecticides are being generated through rigorous protocols. We are confident that the recommendations we offer in the app are reliable,” assured Burgonio.

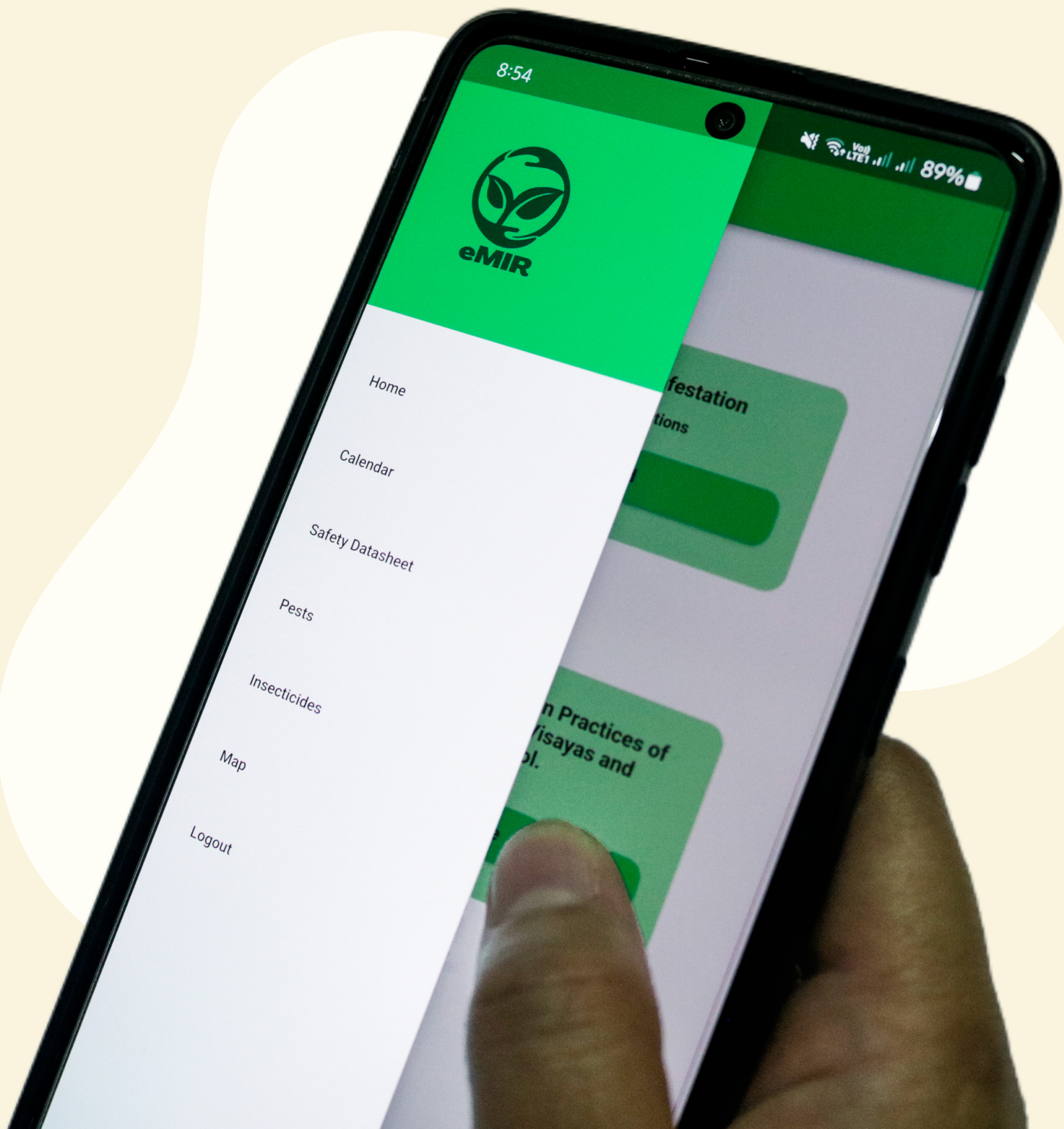
To test out the app and its recommendations, the project team will tap selected corn and onion farmers in Pangasinan, Pampanga, Nueva Ecija, and Occidental Mindoro. Beta users besides the stakeholders and project partners will also be trying out the app.

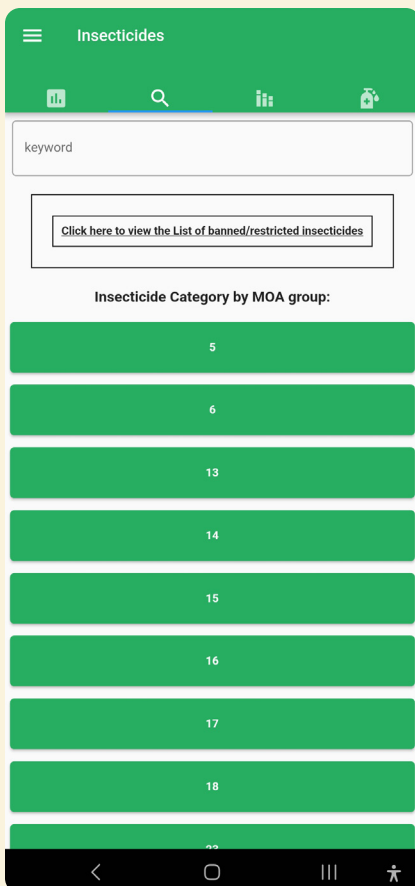
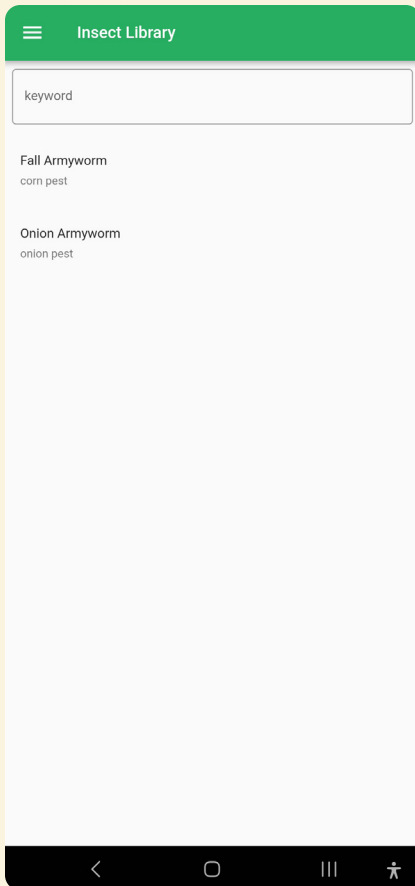
Rice and corn farmer Ener F. David of Mabalacat City, Pampanga shared his experience with the app and its recommendations in an interview with the project team. Before the project was implemented, he and his fellow farmers did not know that the pests infesting their corn was FAW. Through the photos found in the app, they were able to identify what insects were present on their farm. He also shared how they learned to manage the pest through the capacity building activity of the project team, as well as through the use of the eMIR app.



# eMIR app gives insecticide resistance management advice at the farmers' fingertips

RENA S. HERMOSO





The efficacy data on fall armyworm and onion armyworm insecticides are being generated through rigorous protocols. We are confident that the recommendations we offer in the app are reliable.

**Gideon Aries S. Burgonio, NCPC-UPLB**

*“Hindi ka dapat mag-spray kung kakaunti ang peste. Dapat ma-determine kung ilan sila. If you spray na hindi para sa fall armyworm (FAW), wala rin kwenta. Hindi related ‘yong gamot na binibigay mo sa FAW kaya sayang sa pera, sayang sa oras tapos masisiraan ka pa. Kung ‘yon ang palagi mong ginagamit, ‘yong mga peste immuned na sila,”* he said.

One of the future key features of the app is the text message alerts, akin to what the National Disaster Risk Management Council uses, to reach out farmers who do not have access to mobile phones with the internet.

“At present, a text message alert is not yet available because of the limited funds and timeline,” said Ardez.

But she is hopeful that collaboration with industry stakeholders can make this possible. She shared that CropLife Philippines, an association of companies that help improve the productivity of Filipino farmers and contribute to Philippine food security in a sustainable way, showed interest in the app when it was presented during the NCPC

anniversary webinar held in May 2023.

“They can help us with dissemination among farmers since they actively deploy technicians [in] remote locations. Also, the industry can help us by providing reviews to develop the design features of the app to convert it to a design specifically for target users. Telecommunication [services] providers [can also be tapped to] materialize the text message alerts,” said Ardez.

“The team [also] plans to include the eMIR app in one of the long-term core projects of NCPC, with collaborators from the computer science department. This prospective project would see through the maintenance and minor updating of the app system and contents,” shared Burgonio. •

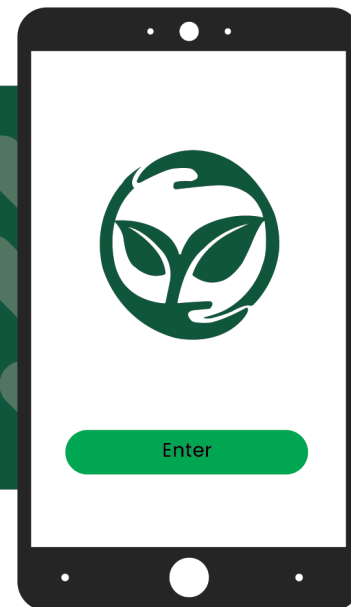
For more information:  
**Gideon Aries S. Burgonio**  
 National Crop Protection Center  
 -University of the Philippines Los Baños  
 gsburgonio@up.edu.ph  
 (0976) 302 8205

# eMIR app

## Electronic Management of Insecticide Resistance

developed by UPLB-National Crop Protection Center

A tool for a resilient crop protection, e-MIR seeks to increase the technical knowledge of farmers on preventing misuse of pesticides and to provide them with access to available safe pest control options.



### KEY FEATURES



#### eMIR calendar

Input your farm details and plan different activities on a calendar.

Once you provide the necessary information, the application will show you the best starting date for your insecticide cycle and choices for effective and available insecticide options.



#### eMIR map

Identify the presence of fall armyworm infestation in Luzon, Visayas, and Mindanao, and find out the insecticide options available in each specific area.



#### LEARN ABOUT INSECTICIDES

Learn how to correctly apply, handle, and store, different groups of insecticides. Utilize e-MIR's digital insect library to assist in the identification of pests.

### OTHER FEATURES



Easy access to pest management information



User-friendly interface



No internet connection required



Future text message alerts

*"This app will boost the global competitiveness of the farmers by strengthening their technical know-how on the application of the combination of strategies or integrated pest management and considering the three keys of insecticide resistance management."*

*- Karen P. Ardez,  
Project Leader*



PHOTO: CLSU

# Bringing seeds of hope to onion farmers

ANGELO N. PADURA

Many of the farming communities in Nueva Ecija depend on onion farming as one of their main sources of livelihood. However, the scarce supply of good planting materials, viable seeds in particular, hinder the local production of onion farmers to propel. Among other factors hampering onion production, this problem contributes to the underlying challenges resulting in large importation, and rising prices of onion in the country.

“To reduce the importation of onions, we have to innovate ways to help our farmers boost their local production. One crucial step is to figure out ways on how to provide them with affordable and quality onion seeds,” Jeremias L. Ordonio, a researcher from the Central Luzon State University, said.

## **By far, we increased the flowering ability of selected onion varieties by 22%. Hopefully, we can increase it to 50% after the second phase of the project.**

### **On seed security**

Since onion requires cold conditions to produce flowers and seeds, farmers resort to buying imported seeds that are costly to start up each of their cropping season. Complicating the scenario even more, there are only limited varieties of onion, both single bulb and multiplier type, known to produce flowers and seeds adapting to the country’s climatic condition.

The Food and Agriculture Organization of the United Nations defines seed security as “ready access by rural households, particularly farmers and farming communities, to

adequate quantities of quality seed and planting materials of crop varieties, adapted to their agro-ecological conditions and socioeconomic needs, at planting time, under normal and abnormal weather conditions.”

In response, researchers from the Central Luzon State University, led by Ordonio, conducted a project, with funding support from the DA-Bureau of Agricultural Research, to improve the flowering and seed setting abilities of red creole and shallot, two of the commonly grown single bulb and multiplier type onions in the country.

### **On inducing flowering ability**

Five varieties of single bulb onion and four varieties of multiplier onion were evaluated in terms of their flowering and seed setting abilities during the first phase

of the study. Consequently, the varieties that showed potential flowering abilities were then used in improving the flowering-induction technology developed from a recent study.

The team also combined effective flower-inducing strategies with the proper application of foliar treatment to collected varieties of onion using the indoor vertical farming system with 16-hour daylight set up.

“By far, we increased the flowering ability of selected onion varieties by 22%. Hopefully, we can increase it to 50% after the second phase of the project,” Ordonio reported.

In its second phase, the study targets to annualize the flowering of onions, ensuring that viable seeds can be produced within a year as compared to 1.5 years without any intervention. With both phases of the study completed, the researchers aim to hybridize a single variety of onion highly capable of producing flower and seeds under the Philippine condition.

“Hopefully, we can transfer the flowering ability of the Batanes variety to the single bulb onion, Ordonio shared.

“To make onion production in the Philippines more productive and more competitive in the market, we have to develop new varieties of onion that are well adapted under Philippine conditions. The variety should have higher yield; with improved resistance to prevailing insect pests and diseases, with good weed competing ability or herbicide resistance, with efficient use of inputs, and is suitable for mechanization to reduce production costs; with good storability and superior quality,” he furthered.

With these efforts and successes underway, the project holds a better picture not only for the onion farmers, but for consumers as well. With the promise of a better flowering and seeding onion variety, farmers no longer need to depend on imported and expensive seeds resulting in an increased local production and more profitable industry of onion. •

For more information:

**Jeremias L. Ordonio**  
Central Luzon State University  
jlordono@clsu.edu.ph  
(0945) 796 7283

# Bringing back the glory days of Kapeng Barako in Batangas

LEA B. CALMADA

Coffee is life for most Filipinos. Their days are not complete without a cup or two and a half—which is true to 80% of Filipinos, according to Tacio (2018).

Kapeng Barako (Liberica) is one of Filipinos' favorite blends of coffee. According to the study by the Batangas State University (BatSU), the coffee bean was brought to the Philippines in 1740 by Spanish Franciscan monks in the town of Lipa, Batangas. The high altitude and fertile soil of the town made the Liberica variety of coffee grow well. In 1740, Lipa reigned as the center for coffee production in the country and kapeng barako was commanding five times the price of other Asian coffee varieties during the colonial era. However, the glory days of the Philippine coffee industry lasted only until 1889 when it was the Philippines'

turn to be afflicted by the coffee rust disease coupled by insect infestation, which destroyed virtually all the coffee trees in Batangas.

This prompted the BatSU to embark on the BARAKO: Batangas Actions towards Revitalization and Acceleration of Kapeng Barako Industry project which aims to bring back the glory of Kapeng Barako and promote the welfare of the farmers in the province of Batangas.

Completed in May 2023, the project developed a technology for an optimized method of sexual and asexual propagation of kapeng barako seedlings. In addition, a smart-demo farm was established to develop and test technologies such as remote sensing and environmental monitoring systems to improve

kapeng barako farming. Strain identification of different mother trees from different localities in the province was done with De La Salle University-Manila. Technology will later be extended to kapeng barako farmers through training and capability building.

In terms of results in numbers, more than 20,000 seedlings were dispersed to six coffee producing municipalities of Batangas. In terms of seedlings dispersed, this equates to an increase of at least 32 hectares of area devoted to coffee in the province. More than a hundred farmers have been directly engaged under the project. Of these, 92 have been trained on kapeng barako propagation and plantation management. Fifty-eight had farm suitability validation for kapeng barako plantation establishment.



Fifty-two farmers also received kapeng barako seedlings.

The BARAKO project was done in collaboration with the DA-CALABARZON Batangas Forum, Coalition for Agriculture Modernization of the Philippines, Pueblo Farms represented by Crisanto S. Gualberto II, Merlo Agricultural Corporation represented by Joe Mercado, Philippine Chamber of Commerce and Industries–Lipa represented by Faustino G. Caedo, and De La Salle University. Moreover, the Office of the Provincial Agriculture of Batangas City and Municipal Agriculture Offices of Lipa City, San Jose, Malvar, Cuenca, Padre Garcia, and Rosario have signified their commitment to revitalize and accelerate kapeng barako industry in the province of Batangas.

To ensure the sustainability of this project, the above-cited partners and stakeholders signed five memoranda of agreement and understanding. •

For more information:

**Dr. Romel U. Briones**

Batangas State University

[romel.briones@g.batstate-u.edu.ph](mailto:romel.briones@g.batstate-u.edu.ph)



# Increasing farmers' income through queen pineapple-based farming system

RENA S. HERMOSO

On a hot early afternoon of 5 June 2023, farmer-cooperators eagerly reaped the queen pineapples from one of the project sites in Labo, Camarines Norte during the Harvest Festival spearheaded by DA-Bicol Region.

The said event was part of the activities of the DA-Bureau of Agricultural Research-funded project, Technology Adaptation for Queen Pineapple-based Farming System in Camarines Norte, that aimed to increase the production of queen pineapple by introducing the double row planting technology and intercropping of taro, peanut, and corn.

The pineapple growers shared positive feedback on the project, while industry players committed support and assistance to the farmer-cooperators. They were keen to know whether the project will be outscaled to more areas in the province, and hopefully in the region.

What made the farmers so eager?

Project leader Jasmin M. Dacillo reported an initial 9-17% increase in the income of the farmer-cooperators, largely due to the additional profit from the intercrops. The return on investment for queen pineapple

was between 73% to 89%, while peanut was at 29% and corn was at 67%.

These numbers did not go unnoticed by the farmer-cooperators.

*“Malaki po ang pagkakaiba sapagkat lumaki ang kita namin ngayon. Dati po ang queen pineapple na tinatanim namin halos isa’t kalahating taon na wala kaming kinikitang pera. Samantalang sa ngayon, sa loob lang po ng tatlo hanggang apat na buwan kumikita na po kami sa pamamagitan ng [intercrops] na mais, peanut, at taro,”* shared farmer-cooperator Ruel A. Boribor from Basud.

*“Ang tinanim namin ay 5,000 suckers ng pinya. Halos 70% po ang naani namin kung saan nabenta po namin ito sa presyo na PhP 9 hanggang PhP 13 bawat piraso. Nakabayad ako ng utang at nakabili ng fertilizer para sa susunod na cropping,”* he added.

Boribor has been cultivating queen pineapple for 14 years. He is the president of Hunlunan Farmers Association, which actively looks for ways to minimize the members' production expenses and improve their production practice through the bayanihan approach. Their







active status as a group was what caught the attention of the research team, paving the way to their involvement in the project.

Meanwhile, Rosalie C. Umerex from Maisog shared the same sentiments on the increase in income. In her case, however, she sells the produce on her own. She opted to hire her sibling who could ferry her harvest to local markets in Naga, instead of selling to traders.

Umerex earned an approximately PHP 40,000 for 3,000 pieces of queen pineapple during her most recent harvest. She added this money to their revolving fund to be used on their other agriculture endeavors such as hog raising and copra production. Prior to the project implementation, Umerex stopped planting queen pineapples when the price for fertilizers spiked.

In addition to the double row planting technology and intercropping, she, along with the other farmer-cooperators, also learned the proper fertilizer application, as well as the package of technology on queen pineapple production. Farmer-cooperators were also grouped into clusters and followed a staggered planting schedule, to ensure that the year-round production would not be simultaneously done which could cause drop in prices.

Alicia B. Odiaman, farmer-cooperator from Basud, attested to these learnings. She shared how the technology interventions helped improve her current farming practices.

*“Ang natutunan ko dito ay ang tamang paglalagay ng fertilizer*

*sa pinya kasi dati hula-hulang, gaya-gaya sa kung anong sasabihin ng kapitbahay. Dito po, base sa soil sampling ang paglalagay ng fertilizer sa pinya,”* she said.

Odiaman was able to sell around 2,000 pieces of queen pineapple to traders, with good sized ones at PHP 10 per piece and the butterballs (or those approximately weighing 250 to 350 grams) at PHP 2 per piece.

As a barangay agricultural extension worker, she also maximized this opportunity by teaching what she has learned to other pineapple growers. But, as expected, most of them are apprehensive about it. Despite this, she still continues to share what she has learned, especially to those who are interested.

The DA-Bicol Region, once the project is completed, will transfer the project to the municipal local government units of Basud, Labo, and San Lorenzo Ruiz, as well as forge linkages with cooperatives and trading centers.

*“Plano rin naming makipag-ugnayan sa mga kooperatiba gaya ng Caayunan Multipurpose Cooperative, Labo Progressive Multipurpose Cooperative, at San Lorenzo Ruiz Farmer Agriculture Cooperative upang masiguro na ang mga produce ng ating mga pineapple growers ay may pupuntahang sure market,”* said Dacillo. •

For more information:  
**Jasmin M. Dacillo**  
DA-Bicol Region  
jasmindacilloda2017@gmail.com  
(0917) 555 7540

# Fighting coffee berry borer through biocontrol agents

NORDALYN B. PEDROCHE, PhD  
Benguet State University

The current challenges of the Arabica coffee industry are evident in the amount of coffee produced per tree—less than a kilogram of dried coffee. Increasing the yield and expanding production areas are the next best solutions to make the coffee industry more competitive and sustainable.

Among the many road bumps in attaining this is the poor management of its pests, specifically coffee berry borer (CBB)—identified as the most common and damaging insect in Arabica coffee farms.

CBB or *Hypothenemus hampei* attacks both immature and mature berries, usually from eight weeks after flowering up to harvesting. Females bore holes into the berries and then build galleries in the seeds for reproduction. Upon hatching, larvae feed on the coffee seed. This therefore causes premature fall as well as reduction of quality and yield of coffee berries. Severe infestation may lead to crop losses of up to 35% and, if left unattended, up to 100%.

The Benguet State University (BSU), through funding support from DA-Bureau of Agricultural Research, implemented a project to develop an eco-friendly

biopesticide to control CBB in Arabica coffee. On 9 December 2022, BSU in collaboration with the Municipal Agriculturist Office of Tublay, Benguet conducted a stakeholders' consultation and meeting to evaluate and develop the effective biological control agents (BCAs) against CBB. Sixty coffee aficionados and organic coffee producers from Tublay attended the said meeting.

The activity raised the awareness of growers on the presence of local BCAs for the management of important coffee pests, as well as provided a venue to propose designs to farmer-cooperators and technical partners in the local government unit for a pilot trial using locally isolated BCAs.

BCAs, such as predatory insects and entomopathogenic fungi, may be used as part of practical methods for CBB management. Accordingly, entomopathogenic fungi such as *Beauveria sp.* can aid in the management of not just coffee tree pests but also nearby plants. Actual specimens of pests and diseases were also displayed during the forum, with explanations of their structures under the microscope and their corresponding damage.



During the forum, the project team revealed that besides CBB, other pests typically experienced by producers included white and red stem borer, green and brown scale insects, coffee rust, blight, and sooty mold. They also discussed the life cycle and alternate hosts of pests discovered in survey areas, as well as practical management practices.

Good cultural and sanitary practices, manual removal of infected parts, and use of BCAs such as *Beauveria* and *Trichoderma* to control coffee rust, Fusarium wilt, and other pests are some of the few observed management practices in Benguet and Mountain Province.

Other biotic and abiotic stresses and their pattern of occurrences were also covered, as were the steps in disease diagnosis. Recommendations were made to prevent the disease from further spreading. It was also proposed that the causal organism of some diseases was systemic in nature and was not easily detectable, but once symptoms appear, it would account for a complex of many infections.

Entomopathogenic fungi (EPF) found locally that have shown potential for reducing coffee pests, notably the CBB and the green scale insect, were also highlighted and will be tested in farms in the present project. The benefits and need of testing for field variations in pathogenicity and environmental effects will also be explored.

To establish the most feasible technique for their preservation and maintenance, the EPF and entomopathogenic nematodes (EPN) isolates will be subjected to different physiological assessments under artificial and *in vivo* conditions. Then, early mass production protocols will be developed for the consequential periodic release of the EPF or EPN for use under farm conditions. To achieve this, farmers' adoption and support must be ensured by training and dissemination of potentially developed technologies. •

For more information:  
**Nordalyn B. Pedroche**  
Benguet State University  
n.pedroche@bsu.edu.ph  
(074) 665 7645

PHOTO: BSU

# From research to market expansion: MangBean food brand's recipe for success

CAMILLE O. FRANCISCO and VANESSA F. CALDERON  
DA-Cagayan Valley

In the Cagayan Valley region, technology and innovation is taking shape under the MangBean food product brand which is introducing a new era of convenience and health consciousness to Filipino consumers. At its core, the brainchild of DA-Cagayan Valley Research Center brings forth two food products — Instant Ginisang Munggo and Instant Mungbean Noodles.

The Instant Ginisang Munggo is ready-to-cook viand that pays homage to the beloved Filipino cuisine. While preserving its rich tradition, this modern interpretation has a cooking time of merely 3-5 minutes. Elevating it further, this dish comes adorned with an array of nutrient-packed vegetables such as *malunggay*, squash blossoms, mushroom, and amaranth.

Meanwhile, the Instant Mungbean Noodles is devoid of additional preservatives, making it a guilt-free indulgence for those seeking a healthier alternative to the ubiquitous instant noodles in the market.

The DA-Cagayan Valley's Technology Transfer and Entrepreneurial Development Service seamlessly facilitated the successful transfer of the technology to partner farmer cooperative, FLOW of Pariir Agricultural Cooperative. Within a year of operation, they achieved a remarkable milestone, producing 65,893 packs of Mang Bean. This exceptional production translated into a substantial gross income of PhP 1,412,496. Such rapid and prosperous progress is a testament to the effectiveness of collaboration and the potential of innovative agricultural technologies to transform livelihood.

Despite the market potential of these products, its commercialization has been confined to the perimeters of the region focusing on catering to government institutional buyers for their feeding and relief programs.

Through yet another support from DA-BAR, the products are poised to transcend geographical





PHOTOS: DA-CAGAYAN VALLEY



boundaries. The DA-Cagayan Valley aims to captivate the taste buds and hearts of consumers in Central Luzon and the bustling hub of the National Capital Region.

Extensive efforts were made to gather valuable insights from the stakeholders in Central Luzon through focus group discussions, complemented by an extensive market survey involving over 400 participants. The goal was to evaluate the profile and discern the specific requirements of the prospective market.

Qualitative data extracted from this comprehensive study revealed that when it comes to the Instant Mungbean Noodles, majority of the respondents expressed their belief in its superiority, particularly when catering to children’s dietary needs. This preference stems from its wholesome vegetable-based formulation, making it a healthier alternative compared to its commercial counterparts.

Meanwhile, the participants hailed the Instant Ginisang Munggo as a novel, nutritious, and highly convenient option. They emphasized its time-saving aspect, from the average preparation and cooking time for the traditional dish of an hour and half to five minutes for this product. Quantitative results of the study showed a high acceptance rate for the pre-consumption (eg. label and packaging) and post-consumption (eg. aroma, texture, and flavor) attributes. These findings underscore the remarkable potential and appeal of both products within the discerning consumer landscape in Central Luzon.

Results of the study will be instrumental in guiding the further improvement of the product. Initial arrangements for the display of the products in various marketing establishments are also in progress. This proactive approach reflects DA-Cagayan Valley’s commitment to enhance the accessibility of the products.

MangBean, as a brand, not only represents a culinary venture, but also showcases joint dedication of research, innovation, and teamwork to provide wholesome, tasty, and nutritious food choices. The road ahead is promising, and the journey has just begun. •

For more information:  
**Vanessa Joy F. Calderon**  
DA-Cagayan Valley  
cvrc.rfo2@da.gov.ph

# Resisting new and emerging pests in the Philippines

ALEXIS B. DEL MAR

The presence and impact of crop pests pose a major agricultural problem as it continues to jeopardize the productivity and abundance of major crops in different Philippine regions.

Over the past years, the Philippines has witnessed a significant increase in requests coming from various stakeholders for technical assistance in combating pests and diseases that pose significant threat to crops. The battle still persists as new and emerging pests continue to inflict severe damage on major crops, aggravating the situation.

To address this issue, the National Crop Protection Center (NCPC) under the College of Agriculture and Food Science of the University of the Philippines Los Baños implemented a project, titled Quick Response, Surveillance, Monitoring and Management of New and Emerging Pests of Major Crops in the Philippines. The project,

funded by DA-BAR, aims to minimize potential crop losses caused by various crop pests and diseases.

During an interview, Gideon Aries S. Burgonio, one of the project leaders, stated that NCPC saw the need to streamline its service delivery practice, with Regional Crop Protection Centers (RCPCs) as its partners, to cater to the increasing demand in pest diagnostics and management consultations. The need became apparent following the outbreaks of coconisap and onion armyworm.

He said that both the farmers and the RCPCs are the recipients of the project's benefits.

“The project targeted farmers as the final and RCPCs as the direct beneficiaries. The RCPCs have always been the direct beneficiaries of most NCPC projects since it is the latter's mandate to provide the former

with new information on crop protection,” Burgonio said.

## Fall armyworm invasion

In 2019, the project encountered the fall armyworm (FAW), an invasive alien species, infesting a corn field in Piat, Cagayan. Swift action was taken to verify the pest's identity morphologically and through molecular analyses. The subsequent surveys revealed the rapid spread of FAW, emphasizing the importance of vigilance amidst climate change and farming practices.

“The project was instrumental in the verification of the species identity of FAW in the Philippines. It served as a requirement in finally declaring the presence of the pest in the country,” said Burgonio.

The project also published a scientific paper outlining the distinctive morphological features of FAW, enabling field identification without relying





on molecular tests. Improvised pheromone traps were also employed to monitor FAW populations in several areas.

### Series of pest infestation

The project's efforts were not limited to FAW. It also tackled various pest and disease issues affecting different crops and regions in the country.

In November 2019, the project assisted the Katipunan ng mga Samahang Magsisibuyas ng Nueva Ecija in diagnosing and managing postharvest rot in onions. They isolated and identified fungal pathogens responsible for the rot and established pheromone traps to monitor the presence of onion armyworm and cutworm.

In Bay, Laguna, guyabano farms faced infestations from several pests, such as the oriental fruit fly, ants, termites, and mealybugs. As part of the project's efforts, capacity building initiatives were

arranged for farmers, focusing on the adoption of appropriate sanitation and cultural practices to effectively manage and control pest infestations.

Furthermore, the project also collaborated with Cagayan State University to conduct a rapid survey of Arius plant pests and diseases in Basco, Batanes. They documented scale insects, leaf miners, and a phytoplasma-like pathogen affecting Arius plants. The project aimed to identify the specific pathogen causing the disease and develop appropriate mitigation measures.

### Continued support

To offer more assistance to stakeholders, the NCPC has established a system that enables them to submit reports and requests for diagnoses through an online form. Subsequently, a group of experts will be tasked with evaluating these submissions. Following the assessment, the client will receive

diagnoses and suggestions, while the respective RCPC will also be informed about the case. If there's a need for onsite evaluations, the NCPC will collaborate with the RCPC to make necessary arrangements.

The Plant Health Clinic and Quick Response Services of NCPC's Technical Support and Advisory Services (TechSASPro), an integral program of NCPC, have now incorporated the system. It offers services like pest diagnosis, field assessment, and specimen identification which are all accessible through TechSasPro's website. •

For more information:  
**Gideon Aries S. Burgonio**  
National Crop Protection Center  
gsburgonio@up.edu.ph  
(0976) 302 8205

The Philippines is among the top rubber producing countries in the world. Its total area planted to rubber or *Hevea brasiliensis* is 229,431 hectares, with the total number of bearing trees recorded to be 57,805,744 and total production of 431,674 tons (Philippine Statistics Authority [PSA], 2019).

“Smallhold rubber farmers are also beset with problems of low latex yield, exponential increase in production cost, and volatile rubber prices. This prompts the need for improvement in the current rubber situation by re-evaluating current farming strategies and rethinking ways to enhance rubber productivity,” shared Elline T. Macay, science research specialist, DA-Philippine Rubber Research Institute (PRRI).

A perennial agricultural crop, rubber trees can be productive for at least 30 years. Aging rubber trees and those grown from seedlings produce less latex than the budded trees. Through a research aimed to optimize the latex production of some recommended (budded) rubber clones, particularly the PB260, PB330, and RRIM 600, the DA-PRRI explored potential stimulants that could enhance the production of rubber latex yield within Zamboanga Peninsula, particularly in Molave, Zamboanga del Sur; Liloy and Sandingan, Zamboanga del Norte; and Naga, Zamboanga Sibugay.

Stimulants are mixtures containing vegetable oils and ethylene hormones or other active ingredients used to improve rubber productivity through increase in latex yield. These substances optimize latex production by extending the flow

of latex and temporarily removing some of the yield-limiting factors from the tree’s environment.

“This technology is actually being used in other Asian countries like Malaysia and Sri Lanka, which is now being commercialized in other rubber producing countries and we want to know if our small scale rubber farmers can also benefit with the use of this technology,” explained Macay.

The DA-PRRI introduced the use of stimulants (Ethylene and Paclobutrazol), which are plant growth hormones, reported to increase the latex production of rubber plants. Ethylene affects the permeability of membranes, prolonging latex flow, and regenerative metabolism in general. Paclobutrazol application causes a variety of physiological changes associated with increased yield in various crop plants.

The local government units of the three provinces recommended possible rubber partner cooperators. They also assisted in the conduct of site validation and mediated in the discussion on partnerships and privileges of farmer cooperators.

Experimental site was selected based on a number of criteria. The rubber farm should be a plantation type, accessible to both transportation and communication for easy and frequent monitoring and visitation, free of stray animals, and well secured. It should also have caretakers and tappers. Moreover, its rubber trees are planted as monocrop and are 10 to 20 years old or approaching its senile stage. The experimental trees are also budded, with

similar planting date, distance, girth size, and clones per site.

Prior to the application of stimulants and following the Code of Good Agricultural Practices for Rubber (published by Bureau of Agriculture and Fisheries Standards, 2019), the rubber plantation was cleaned, weeded, and applied with herbicide and fertilizer to exhaust the production of latex, especially to aging rubber trees. Rubber tappers assigned in the sites were also trained to handle and apply rubber latex stimulants properly, which is reapplied monthly, following the published recommended practices.

The project conducted trials on the different levels of stimulant concentrations (at 1.25%, 2.5%, 3.75%, and 5%), where rubber trees were categorized as experimental units as to the girth size of the trees, labeled, and tagged accordingly. The experimental layout was set up statistically in a randomized complete block design with three replicates for each concentration and then the trees were marked and tagged for easy recognition and identification.

“While trials are still ongoing, the initial results are quite promising with a 10%-20% weekly increase in the latex yield per tapping among the treatments applied. We will further monitor and continue gathering and analyzing data to verify and validate these results,” Macay reported. •

For more information:  
**Elline T. Macay**  
DA-Philippine Rubber Research  
Institute  
ellinetmacay@gmail.com



# Stimulating latex yield of aging rubber trees

MARIA ELENA M. GARCES



# Scaling out the seeds of evergreen abundance

KATHLEEN MAE B. BULQUERIN

In recent years a concept gaining much emphasis, in line with the goal of abundant harvests, improved food security, and a resilient agricultural future, is that of scaling-out.

Scaling out in agriculture involves expanding the adoption and implementation of successful agricultural practices, technologies, or innovations among a larger group of farmers or across a broader geographical area. Of these, scaling out the utilization of registered fruit and vegetable seeds—carefully selected and bred to bear the fruits of progress for farmers and consumers alike, has emerged as a key strategy.

Registered fruit and vegetable seeds are the products of painstaking research and breeding programs—designed to showcase favorable traits such as high yield, disease resistance, and improved quality. By scaling out the use of these specialized seeds, farmers gain access to improved crop varieties that pave the way for better performance and increased productivity.

One of the most significant benefits of scaling out registered seeds is its positive impact on food security. As farmers cultivate higher-yielding crops, there is a substantial increase in food production, leading to a more abundant supply of nutritious fruits and vegetables available for consumption.

## Scaling out sustainable seed network of fruits

The project, Scaling-Out the Utilization of Selected Registered Fruit Varieties and Other Native Fruit Species Toward Sustainable Seed Network, aims to protect and promote registered fruit varieties and native fruits in specific locations for use by current and future farmers. By establishing foundation scion groves in selected regions of the Philippines, the project, led by Lavernee S. Gueco at the University of the Philippines Los Banos, intends to ensure the conservation and accessibility of these fruits for the community, thus safeguarding the diversity of fruit species in the Philippines.

As for the authenticity of varieties, scions were collected from certified mother trees from institutions where the varieties were registered. Since this will be planted in different regions under different climatic/environmental conditions, the UPLB team will identify the best variety suited in their local condition.

After identifying the most suitable variety, this may be one of the basis for planting and expansion of areas planted to a particular crop. Since they will be planted in several regions in the country, these varieties will be more accessible to farmers as they do not have to travel far to avail of these varieties. If the farmer's will be planting these varieties, this will also ensure their availability

in the future, a strategy known as “conservation through use.”

## Scaling out sustainable seed system

Another remarkable endeavor, titled Scaling-Out the Utilization of Institute of Plant Breeding (IPB)-Developed Seeds for Selected Lowland Vegetables Toward Sustainable Seed System, strengthened public sector seed linkages, making seeds of IPB-developed varieties of lowland vegetables and legumes more widely available and accessible to local farmers.

Quality-assured basic seeds of assorted vegetable crops were produced by the IPB and distributed through DA-Regional Field Offices to government seed farms and farmer seed growers. The project team provided training covering seed production techniques, plant pest management, harvesting, postharvest handling, and seed storage to over a hundred agricultural officers and lead farmers from different regions of the country who are engaged in vegetable production.

The training participants will in turn transfer their knowledge to other seed growers to be able to produce their own quality seeds and, ultimately, enhance seed self-sufficiency at the local level. Follow-up technical assistance and regular monitoring will be necessary to ensure the successful transfer of

learned proper practices in seed management.

The project had four key objectives: increase regional multiplication of base planting materials; scale-out the adoption of seed production technologies; ensure a standby supply of pre-packed seeds for immediate rehabilitation after calamities; and improve information, education, and communication materials for seed production and dissemination.

The project team was successful in establishing seed production areas for 11 vegetable crops in various field sites. Capacity building programs effectively equipped stakeholders with the knowledge and skills needed for sustainable production and utilization of lowland vegetable and legume crops.

By empowering farmers with high-quality seed varieties and promoting sustainable farming methods, scaling out registered seeds holds the promise of a

perpetual, evergreen abundance in the fields of agriculture, ensuring a prosperous and resilient future for generations to come. •

For more information:

**Lavernee S. Gueco**  
University of the Philippines Los Baños  
laverngueco@yahoo.com

**Mary Ann D. Maquilan**  
University of the Philippines Los Baños  
mdmaquilan@up.edu.ph



**Registered fruit and vegetable seeds are the products of painstaking research and breeding programs — designed to showcase favorable traits such as high yield, disease resistance, and improved quality. By scaling out the use of these specialized seeds, farmers gain access to improved crop varieties that pave the way for better performance and increased productivity.**



Being the top producer of highland vegetables, the province of Benguet produces 64.9% of priority vegetables in the Cordillera region. In terms of vegetable production in general, the province contributed 83.6% or 308,218 metric tons of the total 368,608.2 MT of the region (Philippine Statistics Authority, 2020).

However, with farmers producing the same kind of highland vegetables all at the same time, resulting in surplus, the demand and price for these vegetables could drop significantly.

Aside from the absence of crop programming in the region, the unprecedented spike of COVID-19 cases led to limited movement or distribution of vegetables to markets in nearby provinces and in Metro Manila—causing price drop. Demand for fresh produce at the height of the pandemic was greatly reduced since large markets like restaurants, hotels, and resorts were closed or at limited operation. Additionally, inclement weather also limited the delivery of the vegetables to target markets.

The oversupply of vegetables in the region leads to heavy losses on agricultural inputs and on farmers' productivity. News of vegetables being sold at very low price, almost given free, or vegetables just rotting in the market or thrown in remote areas by farmers, leaving them no income, were seen in recent years.

To reduce spoilage and guarantee income to producers, there is a need to diversify and add value through processing technologies, such as vacuum frying of vegetables and producing (nutritious) chips, with the latter being an all-time favorite snack of people of all ages.

# Chopsuey chips:

## *Healthier snack from otherwise surplus produce*

MARIA ELENA M. GARCES

Conventionally, fried products may contain as high as 40% oil, which affects the product's characteristics and also its fat content. This leads to a number of health related diseases in human beings such as obesity, risks of diseases, cancer, and heart diseases, and even early deaths. Hence, the increased demand for healthy snack products that taste and look good.

This demand offers an opportunity to design a novel frying technology that can produce fried products with less fat, low calories, and less oil absorption, while at the same time, containing health promoting properties—making food safer and better for human consumption without compromising its taste.

One such processing method is vacuum frying which may be considered as an alternative to conventional atmospheric frying method. It was reported that vacuum frying improves the quality of fried food as it decreases overall oil absorption, inhibits lipid oxidation and enzymatic browning, and preserves the nutrients and organoleptic characteristics of the food.

“Vacuum frying of vegetables is new to the Cordillera Administrative Region, thus, there is a need to develop formulation and optimize vacuum frying processes on selected priority vegetables and be introduced in the community, and eventually

increase utilization of highland vegetables,” explained Dr. Jao-jao A. Somyden, lead of Benguet State University research for development (R4D) project on Market Assessment and Development of Vacuum Fried Chopsuey Chips.

Somyden also explained that in as much as raw materials are available in the locality, standard protocols in the development of vacuum fried highland vegetables may add value to the fresh produced vegetables especially during the season of surplus.

To increase the utilization of selected chopsuey (highland) vegetables, Somyden and her team collaborated with DA-Cordillera Administrative Region, to develop processing protocols to produce vacuum fried chips of chopsuey vegetables, namely, carrots, french beans, cabbage, and broccoli (including broccoli stalks). The vacuum fried vegetables come in the form of individual vegetables or combination of two to four vegetables. These form the variants of the chopsuey chips. They may also be flavored or unflavored.

The general flow of vacuum fried chopsuey vegetable chips production includes: a) washing of vegetable, b) slicing or cutting vegetable (according to the established protocol), c) blanching, d) cooling by plunging in cold water, e) draining of cooled vegetable, f) partial drying or centrifugation, g) freezing,

h) vacuum frying at 130°C, i) de-oiling by centrifugation, j) de-oiling at atmospheric pressure, k) cooling of vacuum fried vegetables to ambient temperature, and l) packing in 130 microns resealable foil pouch and sealed using multifunctional band sealer.

The developed products are still being subjected to accelerated shelf life which is targeted to be more than six months. Meanwhile, the standard nutrient facts which include calories, carbohydrates, fats, and protein contents of the product were already determined.

Study recommended mono-oriented polypropylene mat with aluminum foil lining metalex foil pouch as the appropriate packaging material, based on factors such as crispiness and rancidity of the chips.

“The established protocols on vacuum frying of chopsuey vegetables and projected Return of Investment at 30.37% and payback period of 3.29 years will serve as guide to budding agripreneurs and other interested individual or groups, to sustain the production of the new products and the utilization of glut upland vegetables,” said Somyden. •

For more information:  
**Dr. Jao-jao A. Somyden**  
Benguet State University  
j.somyden@bsu.edu.ph  
(0929) 577 2332

# Financial Viability of Vacuum Fried Chopsuey Chips

Vacuum fried chopsuey chips is very much acceptable to consumers, based on sensory evaluation. It has no known competitors in the local market apart from those from neighboring Asian countries that can be purchased online; thus, the product has a big market potential. With this, it is assumed that its sales is production-driven.

Table 1 shows production cost and selling price for the three variants. The first variant is a four vegetable chips mix composed of 30% carrots, 30% French beans, 20% broccoli, and 20% cabbage. The second is composed of three vegetables, 40% carrots, 30% French beans, and 30% cabbage. The last variant is plain carrot chips. The table further reveals that purchasing the production equipment in Table 2 leads to much lower Factory Overhead Cost compared to when it is rented in Table 1.

Assuming a 50% markup based on production cost, the projected sales, expenses, and net income is presented in Table 3 using Table 2 and assuming further that the three variants are sold equally. One batch of 50-kilogram raw vegetables produces an average of 4,750 grams of finished product which when packed in 50-gram pouch yields to about 94 units. From the projected annual net income of PhP 438,942.99, the Payback Period and Return on Investment is computed at 11.37 years and 8.8% respectively, from an investment cost of PhP 5,000,000 as shown in Table 3. This is computed based on government investment; it will differ for individual investors.

Table 1: Total Production Cost for Chopsuey Product Variants (50 g), if production is rented

Particular	4 Vegetable Chip Mix (30% Carrot, 30% French Beans, 20% Broccoli & 20% Cabbage)	3 Vegetable Chip Mix (40% Carrot, 30% French Bean & 30% Cabbage)	Plain Carrot Chip
Direct Materials	48.38	46.10	37.52
Direct Labor	15.79	16.60	18.72
Factory Overhead	77.62	85.30	91.34
<b>Total Production Cost</b>	<b>141.79</b>	<b>148.00</b>	<b>147.58</b>
Markup (50%)	70.89	74.00	73.79
<b>Selling Price</b>	<b>212.68</b>	<b>222.00</b>	<b>221.37</b>

# um Fried Chopsuey Chips

Table 2: Total Production Cost for Chopsuey Product Variants (50 g), if production is acquired

Particular	4 Vegetable Chip Mix (30% Carrot, 30% French Beans, 20% Broccoli & 20% Cabbage)	3 Vegetable Chip Mix (40% Carrot, 30% French Beans & 30% Cabbage)	Plain Carrot Chip	Average
Direct Materials	48.38	46.10	37.52	44.00
Direct Labor	15.79	16.60	18.72	17.04
Factory Overhead	5.09	5.27	5.57	5.31
<b>Total Production Cost</b>	<b>69.26</b>	<b>67.97</b>	<b>61.81</b>	<b>66.35</b>
Markup (50%)	34.63	33.99	30.91	33.17
<b>Selling Price</b>	<b>103.89</b>	<b>101.96</b>	<b>92.72</b>	<b>99.52</b>

Table 3: Projected Sales, Expenses and Income

Particular	Per Unit Figures	Output per Batch in Units (50 g)	Batch Production per Week	Annual Figures
Sales	99.52	94	9	4,389,870.98
Cost of Sale	66.35	94	9	2,926,727.69
Gross Profit	33.17	94	9	1,463,143.29
Administrative and Marketing Expenses (70%)	23.22	94	9	1,024,200.70
<b>Net Profit</b>	<b>10.00</b>			<b>438,942.99</b>

Table 4. Initial Investment Cost

Production Facility	3,000,000.00
Vacuum Fryer	1,500,000.00
Other Proudction Equipment	400,000.00
Working Capital	100,000.00
<b>TOTAL</b>	<b>5,000,000.00</b>



**Chopsuey chips:**  
Healthier snack from  
otherwise surplus produce  
READ THE STORY ON PAGE 28

RESEARCH FOR DEVELOPMENT  
**BARDIGEST**  
DA-BUREAU OF AGRICULTURAL RESEARCH  
RDMIC Bldg., Elliptical Road corner Visayas Avenue  
Diliman, Quezon City, Philippines 1104



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