17TH National Organic Agriculture Congress

Conference Proceedings

"Maunlad na Pagsasaka, Garantisado sa Organikong Agrikulturang Sinaliksik"

March 21-24, 2023
UNIVERSITY OF SOUTHERN MINDANAO
KABACAN, COTABATO

17th National Organic Agriculture Congress

Conference Proceedings

"Maunlad na Pagsasaka, Garantisado sa Organikong Agrikulturang Sinaliksik"

Preface

The National Organic Agriculture Congress (NOAC)—an annual gathering of government agencies, private sector, the academe, and various organic agriculture (OA) stakeholders is finally back this year devised as a Research Symposium. Purposely, this 17th NOAC Conference Proceedings will feature and highlight completed researches on OA focused on fertilizers, crops, rice, livestock and poultry primarily funded by the National Organic Agriculture Program (NOAP). The event is designed to draw a bead on disseminating research findings and innovations on OA to elevate the awareness level among OA practitioners and enthusiasts including the policymakers. Fervently, the NOAC is a methodical avenue to promote, propagate, and further develop the practices of OA in the country paving a way for its adoption and commercialization to achieve a globally competitive and sustainable OA industry.

Acknowledgment

In an unswerving effort and collaboration of various government agencies, private sector, and the academe, the 17th National Organic Agriculture Congress will convene to recognize the importance and development of Organic Agriculture in the country. Thus, the National Organic Agriculture Program - National Program Coordinating Office (NOAP-NPCO) would like to extend its utmost gratitude to the following:

To ***His Excellency and Agriculture Secretary Ferdinand R. Marcos, Jr.*** for his invaluable support and tutelage for the Philippine Organic Agriculture industry;

To ***Senator Cynthia A. Villar*** for being an Organic Agriculture advocate propelling for its proliferation and further development;

To ***Congressman Wilfrido Mark M. Enverga*** for being consistent with his advocacies of supporting the NOAP and upholding several initiatives toward the development of organic agriculture;

To ***Dr. Francisco Gil N. Garcia***, President of the University of Southern Mindanao (USM) and to other USM Officials and staff for accommodating the 17th NOAC and for offering its solid collaboration;

To the ***National Organic Agriculture Board (NOAB)*** for providing the necessary guidance and direction towards the success of the 17th NOAC;

To the ***Researchers and Organic Agriculture Industry Players*** for fostering and imparting their expertise, findings, and recommendations to uplift the Philippine Organic Agriculture industry; and lastly,

To ***other partners*** from the public and private institutions for their assistance in smoothing the sail of this year's congress.


GISAG NG PANGULO NG PILIPINAS

President and Agriculture Secretary
H.E. Ferdinand R. Marcos, Jr.

MALACAÑAN PALACE
MANILA

MESSAGE

My warmest greetings to the **National Organic Agriculture Program-National Program Coordinating Office (NOAP-NPCO)** of the **Department of Agriculture** as you conduct the **17th National Organic Agriculture Congress**.

Our nation is immensely grateful to our organic agriculture practitioners for their dedication in addressing various agricultural and environmental challenges pertaining to farming methods and food security. I thus commend the NOAP-NPCO for their steadfast commitment in developing and implementing programs that are consistent with our overall objective of ensuring access to nutritious, sufficient, and safe food for every Filipino.

This year's theme, which recognizes the importance of intensified research and the exchange of learning experiences of the NOAP, aptly captures our resolve to build a more feasible and healthier organic industry. May this gathering therefore emphasize our roles as forerunners in protecting both our farmers and consumers against the threats of food scarcity and environmental degradation. Let this also be a venue to discuss how we can encourage more Filipinos to promote and switch into organic farming.

Rest assured that the Department, under my direction, will be relentless in institutionalizing best practices that will enable us to achieve a bountiful, sustainable, and environmental-friendly future for the agricultural sector.

I wish everyone a productive and fruitful event.

FERDINAND R. MARCOS JR.

MANILA
21 March 2023

THE PRESIDENT OF THE PHILIPPINES

Chairperson, Committee on Agriculture and Food
Senate of the Philippines
Cynthia A. Villar

Organic agriculture is an advocacy close to my heart. I support and promote it and have practiced it myself. Since 2022, I have been producing organic fertilizers out of kitchen and garden waste.

Today, I have set up 89 composting facilities in Las Piñas and 50 facilities in Vista Land Communities. One composting machine in our City can produce 1,000 kilos or 67 tons of compost per month and provide livelihood to 140 families. Composting can divert up to 150 kilograms of food waste per household and savings of Local Government from hauling per year is P300 million that goes to health, education, and social services for our fellow Las Piñeros.

I hope that this event will encourage other farmers to follow organic practices as well to help minimize cost and increase yield in their farm.

I wish you all a successful and meaningful 17th National Organic Agriculture Congress.

Mabuhay ang organic farming sa Pilipinas!

Chairperson, Committee on Agriculture and Food
House of Representatives
Wilfrido Mark M. Enverga

I wish the National Organic Agriculture Program (NOAP) of the Department of Agriculture a successful conduct of the 17th National Organic Agriculture Congress this coming March 21-24, 2023.

Your efforts in pushing the organic agriculture programs in the Philippines to its greater heights is worthy of recognition and appreciation.

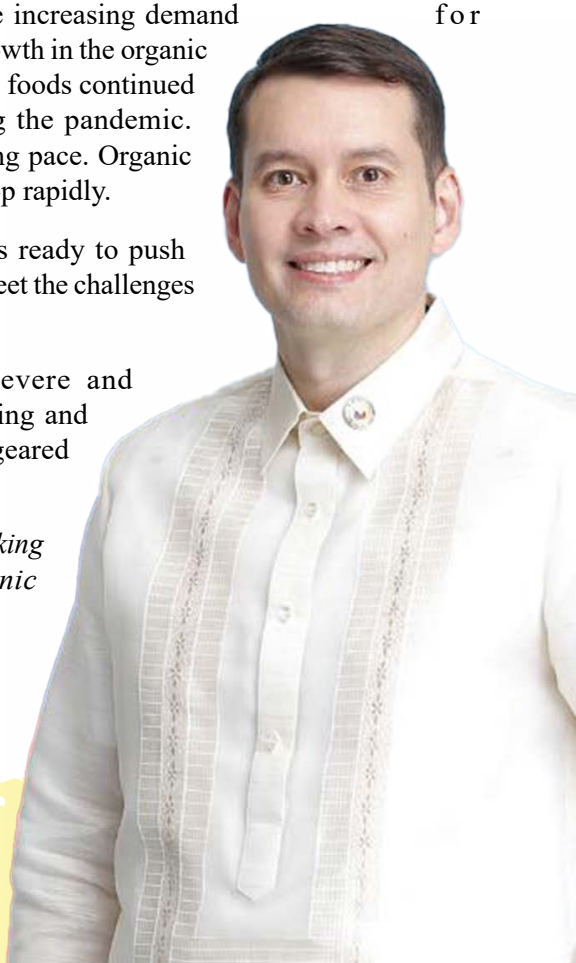
Hence, salute to the DA NOAP for being in the forefront on organic agriculture practices to assure the promotion of ecologically sound, socially acceptable, economically viable and technically feasible food production towards food security and sustainability.

Since 2020 data speaks of the increasing demand for organic products that stimulated the growth in the organic sector as consumer demand for organic foods continued to increase substantially even during the pandemic. Production side likewise is also keeping pace. Organic farmland grew and continues to develop rapidly.

I believe the NOAP is always ready to push forward, ready and flexible enough to meet the challenges of time.

May you continue to persevere and move forward in promoting, developing and implementing organic agri-practices geared towards sustainable organic industry.

Again, congratulations and looking forward to the 18th National Organic Agriculture Congress.



President, University of Southern Mindanao
Francisco Gil N. Garcia, ABE, PhD

Mabuhay from the University of Southern Mindanao!

My warmest welcome to the President, policymakers, directors, officers, members, and stakeholders of the National Organic Agriculture Program of the Department of Agriculture and to the participants and guests of the 17th National Organic Agriculture Congress.

The pandemic crisis hits us hard and the sudden changes in our daily living helped us appreciate the importance of agriculture, especially organically grown food crops and livestock. When the world stopped, most of us found comfort in growing plants and raising livestock. Hence, we need to collaborate to better understand and maximize the wonders and benefits of organic agriculture.

The USM community is glad that the University was chosen as the venue for this year's congress. May we all contribute to our country's quest to bring organic farming to every Filipino home.

Mabuhay po ang organic agriculture!

Program Director, NOAP
Bernadette F. San Juan, CESO II

The 17th National Organic Agriculture Congress is tailored for the future of the Philippine Organic Agriculture (OA) Industry.

This Congress is the result of painstaking effort and preparation involving the academe, OA researchers, policymakers, OA practitioners, and enthusiasts nationwide to encourage OA best practices and spur knowledge-investments to ensure sustained growth of the industry. As we continue to face the challenges of times, the 17th NOAC calls for a transformative shift towards healthier and safer food on our table and protection of our environment by dwelling on the completed researches centered on organic agriculture.

Let us continue to collaborate in our future endeavors to strengthen the implementation of R.A. 10068, known as the Organic Agriculture Act of 2010, as amended by R.A. 11511. Rest assured that our efforts will be brought to fruition as we see more OA practitioners benefiting under these undertakings.

Lubos po akong nagpapasalamat sa lahat ng aming naging katuwang upang maging matagumpay ang pagtitipon na ito! More power and Mabuhay!

Regional Executive Director
Department of Agriculture, RFO XII
Sailila E. Abdula, PhD

Masaganang Agrikultura, Maunlad na Ekonomiya!

It is of great honor that the 17th National Organic Agriculture Congress is staged here in the region.

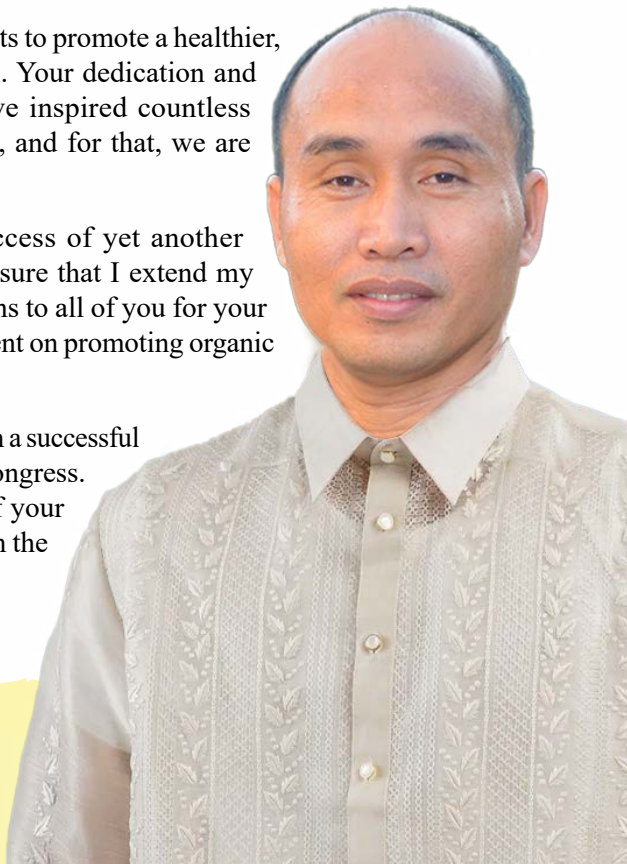
To the organizers and participants of the 17th National Organic Agriculture Congress, your tireless efforts in promoting the benefits of organic agriculture have not gone unnoticed. By organizing this event, you have provided a platform for like-minded individuals to come together and share their knowledge, experiences, and ideas.

You have also raised awareness on the importance of sustainable farming practices and the positive impact they can have on our health, environment, and economy.

I commend you on your efforts to promote a healthier, more sustainable future for all of us. Your dedication and passion for organic agriculture have inspired countless individuals to follow your footsteps, and for that, we are truly grateful.

Congratulations on the success of yet another inspiring event! It is with great pleasure that I extend my warmest welcome and congratulations to all of you for your hard work, dedication, and commitment on promoting organic agriculture.

Once again, congratulations on a successful 17th National Organic Agriculture Congress. I look forward to seeing the fruits of your labor continue to grow and flourish in the years to come.



Representative, Third District of Cotabato
Ma. Alana Samantha Taliño-Santos

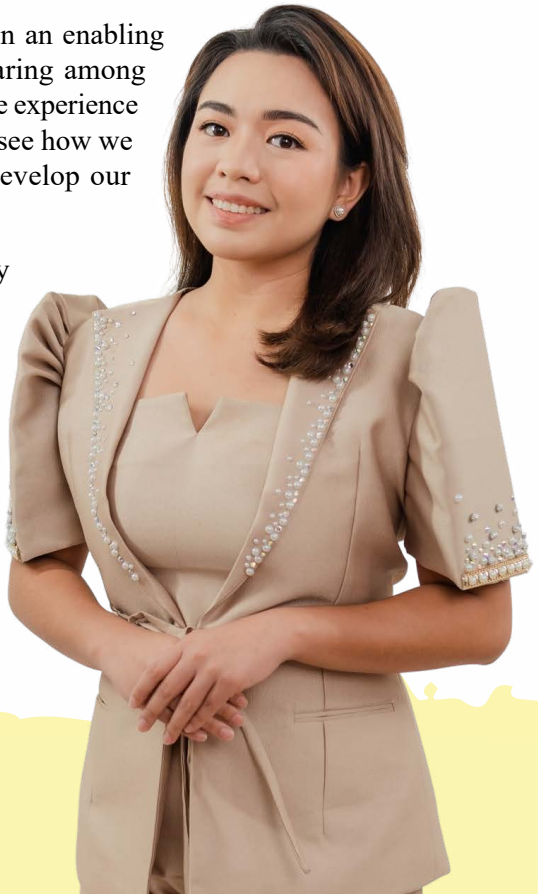
I would like to convey my congratulations to the Department of Agriculture and the University of Southern Mindanao for hosting the 17th National Organic Agriculture Congress (NOAC). The agriculture sector indeed plays a vital role in a country's economic development as it does not only provide food and raw materials, it also paves the way for employment opportunities for our people.

However, it is important for us to put balance among conventional farming, the environment, and the health of the people. By practicing organic agriculture production, we are able to strike this balance by putting high regard to the environmental and social impacts of farming to the farmers, consumers, and environment, and see where we can re-calibrate our practices to benefit the aforementioned.

Through the NOAC, we are given an enabling venue for discussion and knowledge-sharing among various experts and people whom have wide experience when it comes to organic agriculture, and see how we can further innovate our practices and develop our technology.

I am with you in this journey towards promoting and developing organic agriculture in the Philippines as a competitive and sustainable organic industry.

Padayon!



Governor, Province of Cotabato
Emmylou "Lala" Taliño-Mendoza, MNSA

We are pleased that you have chosen our beautiful province of Cotabato as your venue for the National Congress this year. I am sure that your three-day activity will provide an opportunity for our organic practitioners to showcase their products. It is also expected that they be provided with market opportunities and updates on the latest technologies of sustainable agricultural practices.

In 2013, the Provincial Government has adopted the Provincial Organic Agriculture code as our strong support and commitment for environmentally sound farming systems envisioned by Republic Act No. 10068, known as Organic Agriculture Act of 2010. As of today, there are 5,513 farmers involved with a total of 4,717 hectares devoted to organic farming engaged in different commodities.

This year's theme of "*Maunlad na Pagsasaka, Garantisado sa Organikong Agrikulturang Sinaliksik*" is timely as the need for organic farming support is highly in demand.

This leadership will ensure our constituents the availability of safe and healthy food in the market as we continue to promote market potentials of our organic products here and abroad.

I am looking forward for a more collaborative partnership with you in the promotion of organic agriculture in the province.

Mabuhay!

Local Chief Executive, Municipality of Kabacan

Evangeline Pascua-Guzman

My warmest greetings to every participant joining the National Organic Agriculture Congress.

It is my honor and privilege that our Municipality will be your home for the said activity.

I believe that with the growing challenges our agriculture sector faces today, organic agriculture will be of great help in organic farming sustainability and food security.

Organic agriculture will continuously be a holistic approach in promoting, enhancing agro-ecosystems health, including biodiversity, biological cycles, and soil biological activity.

My prayers that this congress will continue their mission in helping our farmers to boost their yield and will help our nation in producing safe and healthier farm-to-table food for the Filipinos and around the world.

Executive Director, IFOAM-Organics Asia

Jennifer Chang

Dear Friends in the Philippines, I would like to express my sincere congratulations to the organizers for hosting the 17th National Organic Agriculture Congress (NOAC). The hosting of the Congress is very opportune as we are still recovering from the impacts of Covid-19 and we need to emerge stronger from this crisis.

Food has never been more important. The pandemic has clearly brought to light the importance of local resilient food systems which have successfully provided food to their local communities and maintained the health and well-being of the people. Never has the organic movements been so important at this juncture when the importance of human health and personal immunity still need attention and nurturing.

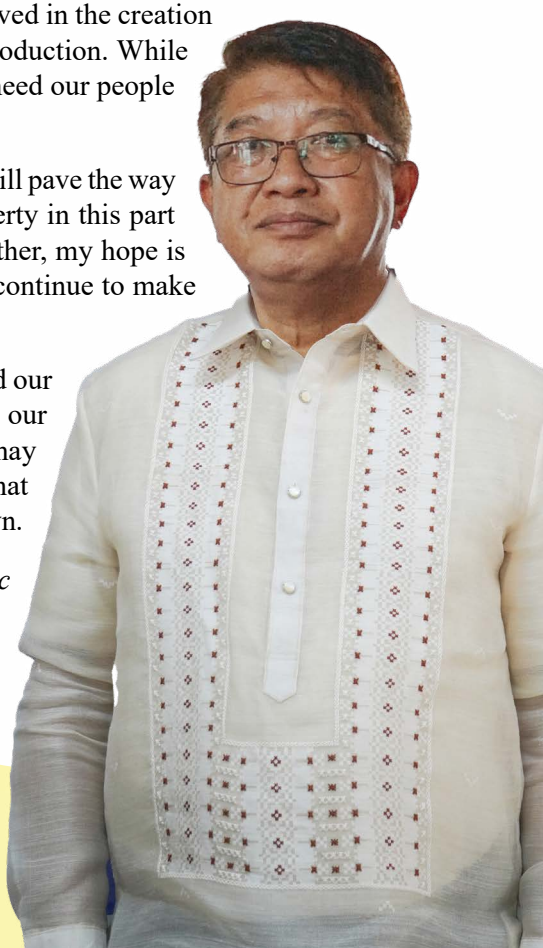
Sustainable food production and consumption are key to increasing both human and ecological capacities to cope with the major global challenges such as health, food and nutrition security, climate change and loss of biodiversity. We have to build back better for a more sustainable and inclusive world, a world with good health, in balance with nature and a safe climate.

I wish you success in your conference and good health and happiness to all the participants!

President, LOAMCP-PH
Municipal Mayor, Kauswagan, Lanao del Norte
Rommel C. Arnado

Our priorities should be centered toward sustaining life under extreme circumstances and conditions that we may have to face in the future. This is the reason why we should come together. This is the reason why we should initiate more conversations. This is the reason why we should act.

I commend the National Organic Agriculture Board (NOAB) and the National Organic Agriculture Program – National Program Coordinating Office (NOAP-NPCO) of the Department of Agriculture for creating platforms, priorities, strategies, and policies that would strengthen governance leaderships and communities in putting together ways to build new paths for sustainability. Our population need not only to be educated on the great benefits of organic agriculture, they also need to be engaged and be involved in the creation of local and national strategies in food production. While we need our communities to sustain, we need our people to get invested into these efforts.



I have no doubt that 17th NOAC will pave the way for bringing solutions to hunger and poverty in this part of the world. While learning from each other, my hope is that the government and our people will continue to make that commitment to work together.

By putting organic agriculture and our sustainability efforts to the front, we help our people find solutions to problems they may have today and in the future – solutions that are within their reach; solutions that they own.

Mabuhay ang 17th National Organic Agriculture Congress!

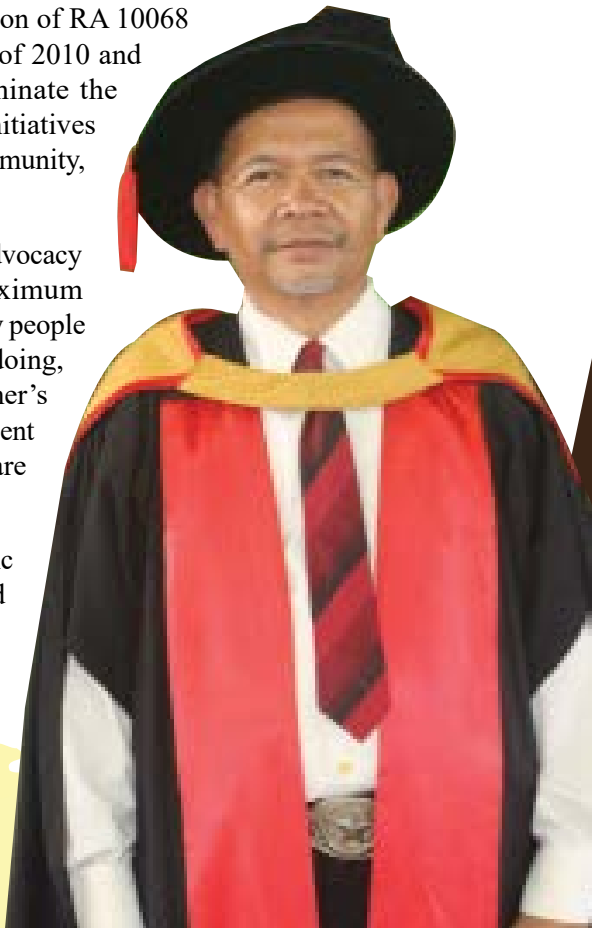
President, Organic Agriculture Society of the Philippines

Cayetano C. Pomares, PhD

Warmest greetings to the participants, guests, and organizers of the 17th National Organic Agriculture Congress with the theme "*Maunlad na Pagsasaka, Garantisado sa Organikong Agrikulturang Sinasaliksik*".

On behalf of the Organic Agriculture Society of the Philippines (OASP), I wish to thank and commend the National Organic Agriculture Board (NOAB) and the University of Southern Mindanao (USM) for hosting this event as the avenue for imploring research and development initiatives on organic agriculture of which OASP is supportive of.

The Congress will be conducted with parallel activities of the Organic Agriculture Society of the Philippines. This orchestrated event is designed to support the implementation of RA 10068 known as the Organic Agriculture Act of 2010 and aims to serve as an avenue to disseminate the results of research and development initiatives on organic agriculture to the science community, OA practitioners, and the public.



The challenge of sustaining its advocacy is dependent on us believing the maximum benefits of organic agriculture for healthy people and for a healthy environment. In so doing, harmonization of best practices, consumer's paradigm shift towards healthy food, efficient policies, and effective implementation are important to achieve a common goal.

More Power to the National Organic Agriculture Board. Congratulations and *Mabuhay!*

National Organic Agriculture Board

PRESIDENT FERDINAND R. MARCOS, JR.
Secretary
DEPARTMENT OF AGRICULTURE

HON. BENJAMIN DE CASTRO ABALOS, JR.
Secretary
DEPARTMENT OF THE INTERIOR AND LOCAL GOVERNMENT

DR. RENATO U. SOLIDUM, JR.
Secretary
DEPARTMENT OF SCIENCE AND TECHNOLOGY

HON. ALLEN A. CAPUYAN
Chairperson
NATIONAL COMMISSION ON INDIGENOUS PEOPLES

DR. ADEFLOR G. GARCIA
(SUCs/Academe Representative)
Professor VI
UNIVERSITY OF SOUTHERN MINDANAO

DR. VICTORIO FERNANDO D. NACPIL
(Luzon-Small Farmer Representative)
Vice President for Internal Affairs
NATIONAL EMPOWERMENT DEVELOPMENT EXCHANGES (NEDEX)

RENATO D. DELA CRUZ
(Mindanao-Small Farmer Representative)
President
INTEGRATED FARMING SYSTEM FOR SUSTAINABLE AGRICULTURE

(Non-Government Organization Representative)
GRATIA PLENA SOCIAL ACTION CENTER, INC. SOCIAL ACTION COMMISSION

HON. CONRADO M. ESTRELLA III
Secretary
DEPARTMENT OF AGRARIAN REFORM

DR. MARIA ROSARIO S. VERGEIRE, MPH, CESO II
Officer-in-Charge
DEPARTMENT OF HEALTH

HON. ALFREDO E. PASCUAL
Secretary
DEPARTMENT OF TRADE AND INDUSTRY

HON. DANILO P. CRUZ
Secretary
TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY

HENRY JAMES M. SISON
(Private Sector/Agri-Business Representative)
Managing Director
VERDANT SEASONS FARM MANAGEMENT TECHNOLOGIES CORPORATION

ANTONIO JESUS C. ORBIDA
(Visayas-Small Farmer Representative)
President
PEACEPOND FARMERS ASSOCIATION

HON. ROMMEL C. ARNADO
(Local Government Unit Representative)
Mayor of Municipality of Kauswagan
National President, League of Organic Agriculture Municipalities, Cities and Provinces of PH

MR. JOFFREY FRINAL
(Participatory Guarantee System Representative)
Member
PARTICIPATORY GUARANTEE SYSTEM (PGS) STO. NIÑO, SOUTH COTABATO

TABLE OF CONTENTS

Fertilizer

Crops

TABLE OF CONTENTS

Rice

TABLE OF CONTENTS

Poultry and Livestock

FERTILIZER
(RM 1, 2ND FLOOR, USM COMMERCIAL CENTER)

TRACK SCHEDULE	RESEARCH TOPIC	SPEAKER
9:00 - 11:30 AM	Technology Promotion of Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI) in Region IV A and IV B in Different Cropping and Plantation Systems	Dr. Marilyn Brown
	Value-Adding of Animal Wastes and Understanding the Fertilizer Value of Organic Fertilizer/Compost for Sustainable Farming Systems	Dr. Gina Pangga
	Micro/Nano-structures Properties of Different Biochars Derived from Biomass Wastes for the Improvement of Soil Quality: Shifting Paradigms on Soil Amendments	
2:00 - 4:00 PM	Protocol Improvement and Development of Microbial Inoculants for the Production of Improved Fermented Biological Extracts	Dr. Mannix S. Pedro
	Isolation and Utilization of Antibiotic Degrading Microorganism in the Production of Organic Fertilizer	Engr. Roy Searca Jose P. Dela Cruz

CROPS
(RM 2, 2ND FLOOR, USM COMMERCIAL CENTER)

TRACK SCHEDULE	RESEARCH TOPIC	SPEAKER
9:00 - 11:30 AM	Documentation and Field Efficacy Trial of Botanicals Against Fruitworm (*Helicoverpa armigera* Hübner) and Black Leaf Mold Disease Caused by *Psuedocercospora fuligena* (Roldan) Deighton in Tomato (*Lycopersicon esculentum* Miller)	Dr. Herminigilda Gabertan
	Postharvest Quality and Safety Management of Organically-Grown Fruits and Vegetables	Ms. Helen A. Barrios
	Assuring Quality, Safety and Nutritional Benefits from Organically-Grown Fruits and Vegetables through Postharvest Systems Improvement	
2:00 - 4:00 PM	Organic Vegetable Varieties for Higher Yields, Quality and Sustainability	Dr. Rodel Maghirang
	Participatory Breeding and Seed Production on Organic Vegetables	
	Establishment of Organic Seed Production System	
	Technology Promotion and Utilization of Selected Biofertilizer, Biostimulants and Microbial Biopesticides (BBM) for Sustainable Corn and Legume Production on Selected Regions	Dr. Marilyn Brown

RICE
(USM College of Arts and Social Sciences - AVR)

TRACK SCHEDULE	RESEARCH TOPIC	SPEAKER
9:00 - 11:30 AM	Efficacy Evaluation of IMO Applied with *Metarhizium anisopliae* against *Scotinophara coarctata* Fabricus (Rice Black Bug)	Dr. Joseph O. Castillo
	Efficacy of Aktrine 4.6 SL (Matrine) for the Control of Major Insect Pests of Rice	

POULTRY AND LIVESTOCK
(USM Skyroom)

TRACK SCHEDULE	RESEARCH TOPIC	SPEAKER
9:00- 11:30 AM	Mangosteen Rind Powder: A Natural Feed Additive for Chickens	Dr. Julius Jerome Ele
	Evaluation of Vermi Meal as Potential Organic Feed for Nile Tilapia Fingerlings	Mr. Zaldy Hechanova
	Growth of Nile Tilapia (*Oreochromis niloticus*) Using Varying Levels of Vermicast with Partial Supplementation of Feeds	
	Organic Complete Ration Mix (OCRM) Potential Feeds and Feeding System for Dairy Goats Production of Improved Fermented Biological Extracts	Dr. Cayetano Pomares
2:00 - 4:00 PM	Phenotypic Characteristics and Egg Quality of Improved Philippine Mallard Duck (*Anas platyrhynchos domesticus* L.) under Intensive Management System	Dr. Mary Joy Cañolas
	Growth and Carcass Performance of Male White Leghorn Fed with Organic and Commercial Free-range Diets Raised under Extensive Rearing System	Dr. Noel Lumbo

Fertilizer

Technology Promotion of Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI) in Regions IV A and IV B in Different Cropping and Plantation Systems[1]

M.B. Brown, M.L.Q. Sison, L.B. Opena, L.B. Willauer, R.P. Violanta, and M.S. Pedro[2,3]

ABSTRACT. *Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI) composed of finely chopped corn roots infected with either Glomus mosseae or Glomus fasiculatum that serves as BBMs, biostimulants and microbial pesticides (BBM). The aim of the project was to promote the utilization of VAMRI technology as substitute of chemical inputs for sustainable food production in Regions IV-A and IV-B in different cropping and plantation systems.*

Information was gathered to serve as basis for the introduction of improved and appropriate VAMRI technology, and the companion cultivation technologies.

Demonstration set ups were established and the need to include other BBM products during the early stage of the project was identified to achieve 100 percent substitution of chemical inputs. The demo trials were either shown to participants during PRA activity or during farmers' field day cum training.

Institutional linkages and partnership, to ensure sustainability of this intervention, the project emphasized collaboration with the provincial, municipal and Department of Agriculture in Regions IV A (CALABARZON) and IV B (MIMAROPA except Romblon), local government units, non-government organization and other offices to facilitate the effective extension of the technologies.

Trainors' training and distribution of IEC materials were likewise conducted to familiarize the users on handling, methods of application and maintenance of high-quality inoculants. Training of professionals on the basic aspects and research on mycorrhizae and composting were also conducted in cooperation with AFACI project through Rural Development Administration of Korea (RDA-Korea), Department of Agriculture, Bureau of Agricultural Research (DA-BAR) and Mycological Society of the Philippines Inc. (MSP).

Audio Visual Presentation (AVP) was also produced by DA-BAR for the promotion of VAMRI technology.

---

1 Project title funded by DA-Bureau of Agricultural Research (DA-BAR), (additional budget was sourced from RDA-KOREA AFACI Project for Participatory Rural Appraisal and Establishment of Demonstration set ups for Corn and Soybean in Batangas)

2 Project leader, study leaders and project staff involved in the project

3 Authors' Affiliations: National Institute of Molecular Biology and Biotechnology (BIOTECH), University of the Philippines Los Baños, College, Laguna 4031

RATIONALE

Technology promotion on the use of BBMs in line with various initiative and efforts in promoting remain an enormous challenge in Philippine agriculture. Despite the numerous discoveries and technologies on BBM, bringing it to the end-users particularly farmers is a very difficult task. Convincing them is costly as it entails unlearning and getting rid of their habits and beliefs that only chemical fertilizers can boost their yield.

The use of BBMs has been determined as one of the main options to address the rising concern on agricultural and environmental sustainability, and a key tool in helping provide answers to the gargantuan problem of high poverty incidence and food shortages in developing countries.

At the National institute of Molecular Biology and Biotechnology, the first wave of products paid off in the form of environmental friendly, yet very affordable microbial based fertilizers and inoculants that can enhance the yield of rice, corn, sugarcane and other important crops.

Vesicular Arbuscular Mycorrhiza Root Inoculant or VAMRI consists of chopped dried corn roots infected with arbuscular mycorrhizal fungus, either *Glomus mosseae* or *Glomus fasciculatum*.

OBJECTIVES

General: To promote Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI) technologies in region IV A and IV B in different cropping and plantation systems.

Specifically, this project aims:

1. To conduct participatory rural appraisal and to demonstrate the effectiveness of VAMRI in field conditions on different cropping and plantation crops systems;

2. To develop effective strategy/mechanism for promoting the VAMRI technologies;

3. To conduct trainers' training on VAM root inoculant quality control, handling and application of the technologies;

4. To prepare cost and return analysis and later a feasibility study/business plan for the commercialization of VAMRI.

METHODOLOGY

Study 1. Participatory Rural Appraisal and Field Demonstration of VAMRI in Different Cropping and Plantation Systems

Information was gathered to serve as basis for the introduction of improved and appropriate VAMRI technologies, and the companion cultivation technologies.

Researcher-managed field demonstration set ups were conducted in different areas identified during PRAs activities.

Study 2. Trainors' Training and Lecture Series Among Farmers on VAMRI Technologies (Quality Control and Handling of Inoculants).

Trainors' training of were conducted to familiarize the users on handling, application and maintaining high quality of inoculants effectively.

Study 3. Development of an Effective Mechanism for Promoting VAM Root Inoculant

FINDINGS AND CONCLUSIONS

Study 1. Participatory Rural Appraisal and Field Demonstration of VAMRI in Different Cropping and Plantation Systems.

The PRA activities were conducted, wherein primary data gathering was done. Secondary data were sourced from other means such

as key informant interviews, analyzing barangay and municipal development plans. Likewise, data from provincial and regional field units of the Department of Agriculture were obtained.

During the PRAs, simultaneous seminar-workshops related to biotechnology and BBMs were introduced. Discussion was however, focused on Vesicular-Arbuscular Mycorrhiza and composting. BBM products were also distributed to participants and training on the application techniques and quality control were done.

Majority of the respondents do not know or are not familiar on how to apply mycorrhiza (84.5%), BioGroe (90%), bioorganic fertilizer (63%), Bio-N (62%), and NitroPlus (87%). The core problems of farmers are high cost of production thus decreasing farm incomes.

Study 2. Establishment of field demonstration set ups in different places

Several set-ups were shown to farmers during Participatory Rural Appraisal (PRA) and Farmer's Field Day cum training. The noticeable growth increment and larger fruits due to VAMRI and BIOGREEN treatment relative to control were shown to the visitors or to the participants during the farmers' field day. Generally, growth performance of plants treated with BBM in combination with ½ RRC were comparable to those applied with full RRC. Likewise, the yield increments due to combination of VAMRI and BIOGREEN for non-leguminous crops and the addition of NITROPLUS for leguminous plants (stringbeans, soybean and peanut) were noted.

Generally, bitter gourd treated with (BBMs) either VAMRI or BIOGREEN alone or in combination with ½ RRC and RRC were more robust and greener in appearance and had bigger and longer fruits yield at first picking from 9 plants) compared to their uninoculated or untreated counterparts. Plants applied with full RRC were comparable to those treated with VAMRI with ½ RRC or full RRC. Highest yield was obtained when plants was mycorrhizal and fertilized with RRC and ½ RRC.

Yield of plants grown during wet season was significantly higher in plants treated with VAMRI and BIOGREEN compared to their untreated counterpart. Yield during dry season is yet to be analyzed.

Researcher-managed-demonstration set up in experimental site at BIOTECH (Eggplant, wet season). The total yield of 10 sample plants for four pickings as affected by the different treatments were analyzed. The yield obtained from plants treated with VAMRI plus BIOGREEN (T10) were comparable to the yield of plants fertilized with RRC (T3). This result indicate that chemical fertilization can be replaced by BIOGREEN when combined with VAMRI. It should be noted that VAMRI without BIOGREEN resulted to a low plant yield which was comparable to that of control plants.

Farmer-managed-demonstration set up in experimental site at BIOTECH (Dry Season). Fruit yield of BBM- treated (VAMRI and BIOGREEN) plants in combination with ½ Farmer's Practice (FP) was found to be comparable with the yield of plants applied with full FP which could imply reduction of chemical fertilizer usage by about ½ rate. High yield was also obtained from plants treated with VAMRI plus BIOGREEN, but this was significantly lower than the yield obtained from those fertilized by the RRC based on the recommendation of the seed producer.

Farmer-managed demonstration set up in San Pablo city (minimum tillage in support to conservation agriculture). The result showed that the plants with mycorrhizal inoculants, VAMRI and BIOGREEN without any chemical fertilizer were more

robust, healthier, and greener compared to plants fertilized with full the recommended rate of chemical fertilizer (farmers practice, FP). Likewise, the plants with BBM were taller compared to those plants treated with chemical fertilizer at full recommended rate (FP). Interestingly plants without the application of chemical fertilizer but with VAMRI and BIOGREEN was the best treatment as shown by the greener, more robust, and healthier plants compared to those applied only with chemical fertilizer. The result implied that VAMRI and BIOGREEN were both compatible with the conservation agriculture (minimum tillage) being promoted in the Philippines in some plantation system.

Residual effects of applied BBMs. Generally, germination and growth performance of corn seedlings grown in areas previously planted with soybean was higher and better compared to those grown in areas previously planted (PP) with corn. Moreover, growth performance of seedlings was noticeably better in all areas previously treated with BBMs (BIOGREEN and VAMRI for corn; and NITROPLUS, BIOGREEN and VAMRI for soybean) in combination with chemical fertilizer. However, when corn plants were blanket-fertilized with ½ RRC at 45 days after sowing a uniform growth was observed among plants grown in areas PP with corn treated with or without BBMs. Corn grown in areas PP with soybean and fertilized with the same ½ RRC remained to be remarkably healthier and greener than those grown in areas previously planted with corn.

Intercropping corn and peanut treated with BBMs and chemical fertilizer. Peanut inoculated with Rhizobium (NitroPlus) were healthier in appearance, greener and more robust compared to their uninoculated counterpart. Corn plants without fertilizer nor BBM intercrop with peanut without Rhizobium inoculation were likewise grew poorly, stunted, and appeared yellow. Both peanut and corn plants inoculated with Rhizobium and VAMRI respectively, appeared healthy and robust. Corn plants with ½ RRC intercrop to peanut with or without Rhizobium were comparable in appearance and it was noticeable that only peanut was affected with Rhizobium inoculation at this stage of plant growth.

Farmer-Managed Demonstration Set up in Lipa City, (Corn, Sweet grande). Only three treatments were used namely, Farmers practice (FP) and 1/2 FP + VAMRI and ½ FP only. Farmers practice was based on the recommended rates of chemical fertilizers by seed producers of corn (Sugar sweet). At sixty days after planting the height were not significantly different but it was noticeable that plants treated with full FP and ½ FP + VAMRI had bigger ears compared to those treated with ½ FP only. Yield obtained from VAM-treated plants +½ FP and those fertilized with full farmer's practice was comparable and almost all the ears were filled with kernels. Ears of plants fertilized with ½ FP alone were noticeably had a higher incidence of ears with incomplete kernels.

Farmer-Managed-Demonstration Set up in Batangas City (Corn, Pioneer, Mr. Ed Onte)

Yield obtained from VAM-treated plants applied with either ½ FP or full FP was comparable to those applied with full FP. But remarkably higher than the yield obtained from those applied with ½ FP without VAMRI. Yield differences among treatments were statistically insignificant. This indicate that VAMRI reduced fertilizer needs by as much as 50 percent of the RRC.

Study 3. Trainors' training and lecture series among farmers on VAMRI technologies (quality control and handling of inoculants).

Some of the activities were conducted simultaneously during participatory rural

appraisal and during farmer's field day. Brochure and training manuals were distributed to the participants. These activities were conducted in MIMAROPA except in Romblon and in CALABARZON except in Cavite. During the trainings, VAMRI and BIOGREEN were distributed to participants who signified interests to conduct demonstration set up. The participants were taught the right techniques of handling the inoculant. Brochures and flyers were given to

RECOMMENDATIONS

Expanding Project Reach/Geographical Coverage. Many farmers in and outside the areas covered so far are requesting to expand crop coverage and other plantation systems. This is an enormous challenge given the limited project of fund.

Sustainability of Project Intervention. While linkage with the LGUs and SCUs have been established and while some of them have expressed interest to continue what the project has started, several of them have yet to be convinced to conduct follow-through activities to ensure sustainability in the use of BBM in their areas. In addition, while trainer's trainings have been conducted, there is a need to further expand this activity to fully strengthen the technical support needed for a nationwide adoption of BBM technology.

Advocacy for Increased Government Support to the BBM Program. There is a clear need to strengthen the advocacy effort for increased government support to the BBM program. These present undertakings have substantially improved the awareness not only of the farmers, but also of government officials of the need to intensify the use of BBM in the country. However, much remains to be done in terms of specific projects to capitalize on this awareness and finally achieve a truly nationwide utilization of BBM technology for sustainable agriculture.

Dr. Marilyn Borja-Brown is the current Director of the National Institute of Molecular Biology and Biotechnology (BIOTECH) at the University of the Philippines Los Baños (UPLB).

A prolific researcher and esteemed expert in her field which is Plant Pathology, Dr. Brown has received several national and international awards in recognition of her inventions in agriculture, and scientific outputs. A well-published researcher, Dr. Brown has spearheaded several major research projects at BIOTECH that resulted to important products and technologies that improved the quality and safety of agricultural crops, food, and feed.

Dr. Brown developed a total of nine technologies, including a food safety detection kit with a granted patent; and biofertilizers and inoculants for control of soil-borne pathogens, and growth enhancement of crops, leading to increased yield and income for Filipino farmers. This include the Vesicular arbuscular mycorrhizal root inoculant or VAMRI that is already being used by numerous farmers and agriculture businesses all over the country due to its efficacy.

Dr. Brown is also affiliated with 10 international and national scientific and professional organizations, including ASEAN networks. She is active in capacity building activities and has organized and hosted a number of international and national symposia.

As the Director, Dr. Brown tirelessly steers BIOTECH towards modernization. She has persistently and proactively pushed for funding of the enhancement of its research, development, extension, and operations. Dr. Brown also maintained quality management at BIOTECH through the continued accreditation of the institute with ISO 9001:2015 which recognizes its management system that follows the international quality management standards in biotechnological research, development, and extension related to agriculture, food, forestry, industry, environment, and energy; and its technical and laboratory services.

Under her leadership, BIOTECH thrives with budget allocation from the General Appropriations Act as enhancement for its research, development, and extension activities.

Value-Adding of Animal Wastes and Understanding the Fertilizer Value of Organic Fertilizer/Compost for Sustainable Farming Systems

Gina Villegas-Pangga, PhD[1]

ABSTRACT. *A series of pot experiments was conducted in the Agricultural Systems Institute Composting and Demonstration Area, Pili Drive, U.P. Los Baños. This paper attempts to present the major issues associated in the utilization of animal wastes as soil amendment and the role of densification technology in improving the fertilizer value of the composting products. The powder and densified forms of composting products were tested on different crops grown under different soil properties (Lipa Clay Loam (Typic Eutrudepts), Sariaya Sandy Loam (Cumulic Hapludolls) and Alipit Clay (Typic Tropudalfs). Results suggest that manure-based fertilizers may be used as alternative to mineral commercial fertilizers when the latter are not available. Efficient utilization of the by-products of animal production as organic fertilizer, compost/soil conditioners and energy source will improve input use efficiency and environmental performance of the animal farms, reduce the environmental liability, and improve the quality of soil for a better and sustainable crop yields. The study confirms that the quality of the composting products and quality control (absence of pathogenic microorganisms) would make them more competitive with chemical fertilizers. The fertilizer value of compost and organic fertilizers (powder or densified forms) must be based on high quality standards consistently produced to offset the production costs while balancing the risks associated in handling bulk animal manures and the damages to humans and environment.*

Keywords: farm wastes, composting, problem soils, organic soil amendment, fertilizers

INTRODUCTION

The sustainability of agricultural production systems depends on the ability of the environment or natural resources to continuously render its ecological services. These services provided to the agricultural sector include the use of land and water resources, both as inputs to production and as receiver of wastes. The use of its assimilative capacity as waste receptor is not paid for, hence, the tendency is to use it excessively beyond the threshold level that creates on-site and off-site damages. Efficient utilization of the by-products of animal production as organic fertilizer, compost/soil conditioners and energy source will improve input use efficiency and environmental performance of the animal farms, reduce environmental liability, and improve the quality of soil for a better and sustainable crop yields.

This paper attempts to present the fertilizer value of the composting products (compost and organic fertilizers) through densification technology. It also demonstrated the production and use of densified organic fertilizers that conformed to the Philippine National Standards for Organic Soil Amendments (PNS-OSA) for a sustainable organic farming system.

1 Division of Soil Science, Agricultural Systems Institute, College of Agriculture and Food Science, University of the Philippines Los Baños, College, Laguna 4031
gvpangga@up.edu.ph

MATERIALS AND METHODS

Swine and poultry manures from the selected farms in Quezon, Laguna and Batangas were randomly collected and analyzed for nutrient composition at the Agricultural Systems Institute-Analytical Service Laboratory (ASI-ASL). Likewise, other raw materials that were utilized as additives to adjust the nutrient concentration of the compost products were submitted to the laboratory for analysis. The swine and poultry manures, with their respective additives, were composted in separate bins up to the time the level of completeness of the composting process were attained. The final compost products were fed to the molding machine and shaped into pellets. With its condensed property, these pellets were referred as densified organic fertilizers or compost. The samples of these products were submitted to the ASI-ASL for nutrient chemical analysis and National Institute of Molecular Biology and Biotechnology (BIOTECH) laboratory for microbial analysis.

To test the efficacy of the densified fertilizer products from animal wastes, a series of pot experiments was conducted in the ASI Composting and Demonstration Area, U.P. Los Baños, Philippines. The soil used in this study was classified as very fine clayey, mixed, isohyperthermic Typic Tropudalfs. The first crop was corn (*Zea mays* L.) followed by bush sitao (*Vigna unguiculata*) then pechay (*Brassica rapa chinensis* L). The treatments were as follows: T1- Control (no fertilizer); T2- Dried Swine Manure; T3- Dried Poultry Manure; T4- Densified Swine Manure-based organic fertilizer; T5- Densified Poultry Manure- based organic fertilizer; T6- Densified Vermicompost; T7- Gliricidia sepium; T8- Chemical Fertilizer (recommended rate). The experiments were laid out using Completely Randomized Design (CRD) with 3 replications. The data were analyzed using analysis of variance (ANOVA) and treatment means were compared using Least Significant Differences (LSD) at 5% level of significance.

RESULTS AND DISCUSSIONS

The conformity of the fertilizer final products made from swine and poultry manures to the requirements set by the PNS-OSA was assessed. The sum of the N, P and K concentration were 6.86 and 7.62%, respectively, with their organic matter > 20%. Hence, both final products are classified as organic fertilizers. Vermicompost, on the other hand, was classified as compost because of its low nutrient composition (2.82%). The Alipit clay soil used in the experiment is strongly acidic (pH 5.5) with high amount of Fe, Cu, Mn and Zn with moderate amount of organic matter (3.2%). However, the amount of Ca and Mg are in critical level including the cation exchange capacity (27.3 cmol(+)/kg soil).

All corn plants fertilized with organic materials were statistically different with plants applied with chemical fertilizer. The latter showed the highest mean of 106.4 g/pot which is twice that of the control treatment (57.5 g/pot). Results such as these are expected because of the readily available nutrients from the chemical fertilizer. It can be noted that between animal manure treatments, dried manures displayed the higher herbage dry weight than the densified fertilizers. The poor performance of the latter can be attributed to their slow-release characteristics. Such results are supported by the reports of Alemi et al. (2010) as they observed the effects of slow release of nutrients from mixed pellets in the test crop they used. According to Hara (2001) the shape of the pellet persists in upland soils for a relatively long time, and its breakdown is slower than that of ordinary compost. On the other hand, G. sepium is assumed to undergo decomposition first before it releases nutrients.

The densified fertilizers were not statistically

different with the chemical fertilizer on the number and weight of pods/pot. Similar trend was obtained with swine manure. Results such as these suggest that manure-based fertilizers may be used as alternative to chemical commercial fertilizers when the latter is not available. According to Colacicco (1982), the cumulative agronomic value of organic manure applied to agricultural soils could be more than 5x greater in the post-application period than the value realized during the year of application. On the other hand, Hepperly et al. (2009) stated that although synthetic chemical fertilization can stimulate high short-term yields, it will not be able to support sustainable crop productivity, crop health, or soil health over longer time periods.

The level of soil pH increased after 2 croppings. This observation agrees with the results obtained by Magdoff (1998) and Havlin et al. (2005). They attributed the increase in pH to the addition of organic matter in the form of organic fertilizers. Moreover, all treatments increased the CEC of the soil. It was observed to be highest in G. sepium treatment when compared to other soil amendments in both 1st and 2nd cropping. The direct influence of G. sepium green manure to soil organic carbon pool, CEC, soil physical properties and microbial community were reported by many workers. In the current experiment, Treatment RR displayed the lowest CEC distinctively at the 2nd cropping. This result is supported by Jakobsen (1996) who reported a reduction of CEC by mineral fertilizers in a pot experiment over a 7-year period. Considering that Alipit Clay soil has a moderate amount of organic matter, it was observed that its level declined after each cropping period. According to Srinivasa Rao et al. (2011), continuous application of organic matter as farm compost, farmyard manure, and plant residues is needed to maintain or increase soil organic matter content. Results of current experiment suggests that fertilization using organic sources did not show distinct improvement in soil properties within the period of this study because of the initial poor fertility status of Alipit clay. According to Schoenau (2006), it would be anticipated that effects of organic amendments on increasing soil organic matter content would be more pronounced on soils of lower organic matter content and low fertility, and it may take several years of application before significant differences can be detected.

CONCLUSIONS

The study showed the role of densification technology in producing a good quality organic fertilizer from animal wastes. At the same time, it highlighted the application of these fertilizers to different crops and considers the used of soil as receiver of wastes. Efficient utilization of the by-products of animal production as organic fertilizer, compost/soil conditioners will improve the environmental performance of the animal farms, reduce environmental liability, and improve quality of soil for a better and sustainable crop yields. Results such as these suggest that densified organic fertilizers may be used as alternative to chemical fertilizers in an organic farming system. The effects of slow release of nutrients from the densified fertilizers on both plant health and soil nutrient levels would be of great advantage on crops that need longer supply of nutrients.

REFERENCES

Alemi et. al. (2010) Alemi, H. Kianmehr, M. H. and Borghaee, A.M. 2010. Effect of pellet processing of fertilizer on slow-release nitrogen in soil. http://docsdrivecom/pdfs/ansinet/ajps/0000/17581-17581.pdf. Asian J. Plant Sci. July. 2013.

Colacicco, D. (1982). Economic aspects of composting. Biocycle 23: 26-30.

Hara, M. (2001). Fertilizer pellets made from composted livestock manure.

www.fftc.imita.org/htmlarea_file/library/20110801154610/eb506.pdf.

Havlin, J.L., Beaton, J.D., Tisdale, S.L. and Nelson, W.L. (2005). Soil fertility and fertilizers: an introduction to nutrient management. Pearson Prentice Hall. New Jersey. 515 p.

Hepperly, P. Lotter, D., Ulsh, C.Z., Seidel, R. and Reider, C. (2009). Compost, Manure and Synthetic Fertilizer Influences Crop Yields, Soil Properties, Nitrate Leaching and Crop Nutrient Content. Compost Science and Utilization. 17: 117-126.

Jakobsen, S.T. (1996). Leaching of nutrients from pots with and without applied compost. Resources, Conservation and Recycling 17: 1-11.

Magdoff, F. (1998). Nutrient management: sustainable agriculture research and education program. Bulletin 672, Michigan State University/Extension.

Schoenau. J.J. (2006). Benefits of Long-Term Application of Manure. Advances in Pork Production. 17: 155-156.

Srinivasa Rao C.H., Venkateswarlu, B. Sreenath, D., Sumanta, K. and Gayatri D.K. (2011). Livelihood Impacts of Soil Health Improvement in backward and Tribal Districts of Andhra Pradesh. Hyderabad, Andhra Pradesh, India: Central Research Institute for Dryland Agriculture. 119 p.

ACKNOWLEDGEMENT

This work was funded by Bureau of Agricultural Research-Department of Agriculture No. N815221 and University of the Philippines Los Baños.

Dr. Gina Villegas-Pangga, a U.P. Scientist and soil specialist, is currently working as a professor at the Agricultural Systems Institute, U.P. Los Baños. She obtained her bachelor's and master's degrees from the University of the Philippines, and PhD in Soil Science and Plant Nutrition from the University of New England, New South Wales, Australia.

Dr. Pangga is a recipient of many awards, with the UP Scientist (2021-2023) under the University of the Philippines Scientific Productivity System and the One U.P. Professorial Chair Award in Soil Fertility and Plant Nutrition for Outstanding Teaching and Research at UP Los Baños (2015- 2021). She also serves as the first-level core staff of the Soil Science team and serves as a technical advisor to different government agencies and private companies. She pioneered the production and use of biochar as soil amendment; and the value-adding of agricultural wastes into high quality organic fertilizers that help reduce environmental liabilities and improve problem soils.

Micro/Nano-structures Properties of Different Biochars Derived From Biomass Wastes for the Improvement of Soil Quality: Shifting Paradigms on Soil Amendments

Gina Villegas-Pangga, PhD[1]

ABSTRACT. *Soil degradation is a widespread phenomenon that troubles food production and depresses agricultural incomes and rural livelihoods. In recent years, biochar has been identified as a potential tool to increase agricultural productivity, boost carbon sequestration, enhance agriculture's resilience to the impacts of climate change and reduce greenhouse gas emissions. The source of biomass used for biochar production is a key aspect in the overall sustainability of the system.*

A study was conducted to investigate the potential of biochar systems from the low-value biomass resources that are pyrolyzed, enriched with fertilizers (mineral and organic) and applied as soil amendments for the enhancement of soil quality and soil productivity. Production of biochars from different biomass materials (rice straw, rice hull, water hyacinth, mahogany flower receptacle, coconut husk, cattle dung and swine manure) was done separately using the slow pyrolytic biochar-producing stove at different residence time and temperatures between 300 to 650 °C. The morphological characteristics and physicochemical properties of biochars were studied using the Brunauer-Emmett-Teller (BET) Automated Nitrogen Multilayer Physisorption system, Field Emission-Transmission Electron Microscopy (FE-TEM), Scanning Electron Microscopy (SEM) and X-ray Energy Dispersive Spectrometry. The efficacy of the developed biochar-fertilizer blends/mixes were examined on different agricultural crops grown under various soil conditions (acidic, red-clayey, heavy metals/contaminated soils).

Results of the study showed that biochar bulk physical and chemical properties vary as a function of the pyrolysis process conditions (e.g., temperature and time), the type and concentration of mineral matter in the feedstock, and the ratios of lignin, cellulose, and hemicellulose in the biomass. Micro and nanostructures of biochars are also affected by many of the same parameters, such that structures of biochars can be highly heterogeneous and complex. The compositional and crystallographic images substantiated that biochar mass has its elevated nutrients. Such findings confirmed that the use of biochar as a soil amendment have positive effects on soil porosity, soil acidity, cation exchange capacity, water holding capacity and nutrient retention all of which improve soil fertility and thereby plant growth.

Keywords: farm wastes, slow pyrolysis, biochar production, biomass, nano structures

1 Division of Soil Science, Agricultural Systems Institute, College of Agriculture and Food Science, University of the Philippines Los Baños, College, Laguna 4031 gvpangga@up.edu.ph

INTRODUCTION

Biochar is a carbon-rich solid material produced by heating biomass in an oxygen-limited environment and is intended to be added to soils to sequester carbon (C) and maintain or improve soil functions. Interactions between biochar, soil, microbes, and plant roots are known to occur within a short period of time after application to the soil (Lehmann et al., 2009). Biochar can be used as a product itself or as an ingredient within a blended product, with a range of applications as an agent for soil improvement, improved resource use efficiency, remediation and/or protection against environmental pollution, and as an avenue for greenhouse gas (GHG) mitigation."

With the increasing attention in using biochar for improving soil health, much research has been conducted to better understand the mechanism by which it affects the physical and chemical properties of soil and its suitability as a microbial habitat. Subsequently, soil organisms have many uses in the ecosystem, thus it is critical to understand how biochar amendment in the soil may affect soil ecology for the assurance of maintaining soil quality, enhancing soil resiliency and the integrity of the soil ecosystem (Thies & Rillig, 2009). Continuous efforts are needed to support the use of biochar with substantial scientific bases to ensure that the end outcome of using biochar produced positive and beneficial effects in both agricultural production and the biochar-environment, hence, this research project is being conducted. This study aims to characterize the biochars derived from different plant and animal biomasses and evaluate their properties for their use as soil conditioners for the enhancement of soil quality and soil productivity.

METHODOLOGY

Biochars used in this study were from mahogany tree (*Swietenia macrophylla*) flower receptacles, rice straws, rice hull and water hyacinth (*Eichhornia crassipes*), coconut husks, cattle manure, and swine manure. All materials were first cleaned from foreign objects, air-dried, cut into small pieces (4-6 cm), and oven-dried at 60°C and 10-15% moisture (w/w) before pyrolysis. The chemical composition of biochars were analyzed at the Agricultural Systems Institute- Analytical Service Laboratory (ASI-ASL), U.P. Los Baños. The specific surface area and pore size of biochar samples were analyzed using Brunauer-Emmett Automated Nitrogen Multilayer Physisorption system at Nanotechnology Laboratory, U.P. Los Baños. The surface morphological changes of the biochar samples were taken at different magnifications by using the Field Emission-Transmission Electron Microscope (FE-TEM). Scanning Tunneling Electron Microscope analysis was performed in obtaining High Angle Annular Bright Field (HAABF) images. Energy Dispersive X-ray analysis was made on the areas of interest of each biochar samples. The FE-SEM Imaging with EDX mapping was made possible using Dual Beam Helios Nanolab 600i. All surface morphology analysis were analyzed at Materials Science Division, Industrial Technology Development Institute-Department of Science and Technology, Philippines.

RESULTS AND DISCUSSIONS

The porosity and surface area represent physical properties of biochar, and may connect strongly with adsorption, and water retention abilities. These properties have potential to improve soil property (Fuertes et al., 2010). Woody feedstock like mahogany flower receptacle has 17.1Å. Comparison

among the variety of origins, apparent differences were observed between biochar properties. The High Angle Annular Bright Field images, spectrum and elemental X-ray maps of all biochars revealed areas high in C and other minerals rich in K, Cl, Ca, Mg, Si, and Al. As previously known, C concentration is an important criterion for characterizing biochar and it also reflects the biochar's stability in the soil. The utility of biochar for a specific application depends on its inherent properties. The organo-mineral particles previously defined (Xingzhu et al., 2016) as organic material with a high mineral contribution. Organo-minerals usually have a positive effect on soil nutrient transformation and adsorption.

The images through SEM morphological analysis that display the changing trends in biochar structures indicate that the properties of raw feedstocks and pyrolysis process strongly influenced substantial changes in their surface morphology. Studies of Al-Wabel et al., 2013 and Kim et al., 2012 mentioned that SEM can produce different pictures of biochars with different feedstocks. Biochars originating from plant wastes showed completely different appearance and disordered structures. It may be assumed that these biochar samples retained the original macrocellular morphology of the original materials. The SEM images of biochars derived from animal manures exhibited many pores and cracks on the surface and profile. The micropores, which have large surface area, are a preferred habitat for microbial communities in utilizing the soil. The macropores present on biochar may provide suitable dimensions for cluster of micro-organisms to grow and reproduce and the micro and meso porosity of biochars may also allow it to retain more moisture in soil and increase the water holding capacity (Theis & Rillig, 2009). As is known, porosity creates during the pyrolysis process is an important physical feature of biochar in soil processes and its behavior. The BET surface area and total pore volume for all biochar samples showed that the properties of raw organic biomass wastes influenced the surface area, pore volume and radius of biochars. The higher surface area is preferable because it helps to improve the soil structure and increase total water retention in soil. Average pore diameter denoted the pores are mostly mesopores and macropores. Mesopores and macropores are useful for liquid-solid adsorption (Downie et al., 2009).

CONCLUSIONS

The data presented in this work showed that the type of feedstock and pyrolysis conditions strongly affect the physical and chemical properties of the biochars produced from slow pyrolysis of plant and animal wastes. The surface morphology properties of the biochars were also remarkably influenced by the same factors. In conclusion, biochar is a highly potential material that can be used as soil conditioner in many types of soil to improve crop production. The abundant pores and minerals in the biochars are helpful for ameliorating soil through the supplies of micro spaces and mineral nutrition. The ability of biochar to improve crop performance and yield is related to the complex soil environment that develops in response to the varied chemical and microbial reactions happening in the soil due to the presence of these various nano-mineral and organic phases.

REFERENCES

Al-Wabel, M. I., A. Al-Omran, A. H. El-Naggar, M. Nadeem, and A. R. A. Usman. (2013). Pyrolysis temperature induced changes in characteristics and chemical composition of biochar produced from conocarpus wastes.Bioresource Technology 131:374–79. doi:10.1016/j.biortech.2012.12.165.

Downie, A., Crosky, A., Munroe, P., (2009).

Physical properties of biochar, Biochar for environment managemen science and technology, Earthscan, London UK, p.13.

Fuertes, A. B., M. C. Arbestain, M. Sevilla, J. A. Maciá-Agulló, S. Fiol, R. López, J. Smernikr, W. P. Aitkenhead, F. Arce and F. Macias. (2010). Chemical and structural properties of carbonaceous products obtained by pyrolysis and hydrothermal carbonisation of corn stover. Australian Journal of Soil Research 48:618–26. doi:10.1071/SR10010.

Kim, K. H., J. Kim, T. Cho, and J. W. Choi. (2012). Influence of pyrolysis temperature on physicochemical properties of biochar obtained from the fast pyrolysis of pitch pine (Pinusrigida). Bioresource Technology 118:158–62. doi:10.1016/j.biortech.2012.04.094.

Lehmann, J., and S. Joseph. (2009). Biochar for Environmental Management: An Introduction. In o. Lehmann, & S. Joseph, Biochar for Environmental Management (pp. 1-12). London: EarthScan.

Thies, J.E. and Rillig, M.C. (2009) Characteristics of Biochar: Biochar Properties. In: Lehmann, J. and Joseph, S., Eds., Biochar for Environmental Management Science and Technology, Earthscan, London, 85-105.

Xingzhu Ma, Baoku Zhou, Alice Budai, Alhaji Jeng, Xiaoyu Hao, Dan Wei, Yulan Zhang & Daniel Rasse (2016) Study of Biochar Properties by Scanning Electron Microscope– Energy Dispersive X-Ray Spectroscopy (SEM-EDX), Communications in Soil Science and Plant Analysis, 47:5, 593-601, DOI: 10.1080/00103624.2016.1146742

ACKNOWLEDGEMENT

This work was funded by National Research Council of the Philippines-Department of Science and Technology Project No F153; and Bureau of Agricultural Research-Department of Agriculture No. N815221

Dr. Gina Villegas-Pangga, a U.P. Scientist and soil specialist, is currently working as a professor at the Agricultural Systems Institute, U.P. Los Baños. She obtained her bachelor's and master's degrees from the University of the Philippines, and PhD in Soil Science and Plant Nutrition from the University of New England, New South Wales, Australia.

Dr. Pangga is a recipient of many awards, with the UP Scientist (2021-2023) under the University of the Philippines Scientific Productivity System and the One U.P. Professorial Chair Award in Soil Fertility and Plant Nutrition for Outstanding Teaching and Research at UP Los Baños (2015- 2021). She also serves as the first-level core staff of the Soil Science team and serves as a technical advisor to different government agencies and private companies. She pioneered the production and use of biochar as soil amendment; and the value-adding of agricultural wastes into high quality organic fertilizers that help reduce environmental liabilities and improve problem soils.

Protocol Improvement and Development of Microbial Inoculants for the Production of Improved Fermented Biological Extracts

Mannix S. Pedro[1], Marilyn B. Brown[1], Blesilda M. Calub[2], Rose G. Monsalud[1], Lovely B. Willauer[1], and Carmena Nimfa G. Cayabyab[1]

ABSTRACT. *Local farmers have been accustomed of making fermented preparations from various bioresources as alternative input for chemical fertilizers and pesticides. A lot of our farmers have been using these biological preparations for years and claimed positive benefits and yield responses on crops. However, each farmer has each own way of producing plant extracts preparations resulting to high variability of the product. These products are commonly known as fermented plant extract/juices (FPE/J), indigenous microorganisms (IMO) and fermented fruit extract (FFE) which are microbial based wherein farmers bait their microbes by chances from the environment.*

The objective of the research project was to evaluate the microbial and chemical properties of different biological concoctions to help improve the protocol of the development of liquid organic fertilizers from fermented biological resources. Also, this would help our farmers standardized their own biological extracts and make a better product.

The microbial community structures during the fermentation process of some biological extracts (FPE/J, IMO, and FFE) were determined using both molecular and conventional techniques. Results showed that majority of the microbial functional groups were nitrogen-fixers and plant growth promoters (or indole acetic acid producers, IAA) and some potassium solubilizers were detected in all biological extracts tested. Few phosphate solubilizers were found and detected only in FFE. In addition, modifications on the production protocols and use of inoculation techniques had significant improvement in the micronutrients of the biological extracts.

With the rich microflorae of the biological extracts, a microbial inoculant was then successfully developed and used in the production of biological extracts like FPE/J, IMO and FFE. The inoculant was consisted of the following; Bacillus amyloquefaciens, Chryseobacterium sp., Orchrobactrum sp., Pseudomonas aeruginosa, Bacillus velezensis, Alcaligenes faecalis, Serratia marcescens, Bacillus subtilis, Brevibacterium sp., Paenibacillus sp., Penicillium sp., Talaromyces purpurogenus, Aspergillus niger and Aspergillus tamarii. The efficacy of these improved biological extracts was evaluated and proven to be effective in increasing the yield on some high value crops.

1 National Institute of Molecular Biology and Biotechnology (BIOTECH), University of the Philippines Los Baños, College, Laguna 4031

2 Agricultural Systems Institute College of Agriculture and Food Science, University of the Philippines Los Baños, College, Laguna 4031

RATIONALE

Local farmers have been accustomed in making fermented preparations from various plants or fish residues in an attempt to use them as alternatives to chemical fertilizers and pesticides. A lot of our farmers have been using these botanical or biological preparations for years and have claimed positive benefits and yield responses on their crops. However, each farmer has his own way of producing plant extract preparations, resulting in high variability of the expected quality product. Most of their products, commonly known as fermented plant extracts and juices (FPE/FPJ), indigenous microorganisms (IMO) and fermented fruit extracts (FFE), are seemingly microbial-based. Farmers simply bait their microbes from the environment.

Our initial research initiative (Protocol Improvement and Product Development of Liquid Organic Fertilizers from Fermented Plant Extracts (FPE's) and other Biological Concoctions, Phase I) had developed a science-based intervention that demonstrated and determined some critical aspects in the production of these biological extracts. In addition, our research demonstrated that a more precise production protocol could be used to improve the quality of these biological extracts like FPJ, FFE, and IMO. We have also determined the microbial community structure of the said biological extracts using both molecular and conventional techniques and evaluated several microbes that were involved during the process. Some microbial functional groups such as nitrogen fixers, phosphate solubilizers, and plant-growth promoting hormones/enzyme producers were also present in the concoctions and appeared to be important during the production process. *Lactobacillus* sp., *Bacillus* sp., *Pseudomonas* sp., *Pantoea* sp., and other fungi like *Aspergillus* sp., *Rhizopus* sp., and *Monascus* sp. are among these microbes. The chemical analysis of the micronutrient values improvement significantly when modified protocols and inoculation techniques were used.

We have collected potential microbes with some functional properties that can be used as starter microbial inocula in the production of a more standardized quality biological extract. It is important that the research findings and biological resources at our disposal be translated into a specific product or commodity that our farmers can use to increase crop productivity. As a result, the goal of this study was to develop a microbial-based inoculant for the standardized production of a high-quality biological extract.

OBJECTIVES

The general objective of the project is to develop a microbial inoculant for the production of improved biological extracts using improved protocols for use as fertilizers or soil conditioners. This was carried out based on the following specific objectives: a) to determine the microbial community of the biological extracts and screen potential microbial strains for the production of improved biological extracts; b) to determine the best strains compatibility as potential inoculants; c) to improve the production protocols of fermented biological extracts; d) to formulate starter inocula, establish biological extract fermentation and to characterize the physico-chemical properties of the improved biological extract; e) to determine the shelf-life of the starter microbial inoculant and activity of the improved biological extract; f) to evaluate biocontrol/pesticidal effects of the improved biological extract; and g) to determine the efficacy of the improved biological extracts on some high-value crops.

DESIGN AND METHODOLOGY

Different biological extracts (FPE/J, FFE, and IMO) were prepared using both the

traditional method and a modified method of production. FPE/J) was made using 50% ground Madre de cacao (*Gliricidia sepium*) leaves, 25% brown sugar, and 25% water in the traditional method. The modified method involves the use of 10% FPJ as seed culture.

Fermented fruit extract (FFE) was prepared traditionally using ground banana peelings at 50%, brown sugar at 25%, and water, 25%. For modified set-up, an inoculum at 1% rate was added using FPE/J or IMO.

Indigenous microorganisms (IMO) were prepared traditionally. This involved the use of 1 kg of cooked rice that was inoculated with white fungus, which was provided by the farmer collaborator. This was followed by the addition of molasses (100%) after 3 days of inoculation. Modification of production involves the use of diluted concentrations of molasses (20% and 10%).

The set-up for FPE/J and FFE was conducted using an 80-L plastic bucket (Orocan) and allowed to ferment for 30 days. A 16-L bucket was used as fermentation vessel for IMO and kept at room temperature for 21 days. Sampling was conducted every 3 days and parameters like pH, microbial count, and chemical analysis were noted. Chemical analysis of the biological concoctions was determined as follows: total nitrogen was measured using the Kjeldahl method while the other elements (P, K, Ca, Mg, Mn, Cu, Fe, and Zn) were determined using Atomic Absorption Spectroscopy (AAS). The pH value was measured using a pH meter (Orion model 290A).

The microbial population dynamics was analyzed using a culture-independent approach such as denaturing gradient gel electrophoresis (DGGE). In addition, culture-dependent technique was also employed like microbial isolation and purification. Identification of the isolates of interest was conducted using VITEK II and VITEK MS identification systems, which use analytical profiling indexes based on biochemical utilization and reaction. Finally, some of the isolates were also identified by 16S rDNA sequence analysis.

With the vast microbial resources obtained, the research project was then expanded to develop an inoculant to be used to standardize the production of fermented biological extracts. Plant tests were also conducted for the efficacy of the fermented biological preparations.

FINDINGS

The microbial community was determined during the fermentation of FPE/J. A DGGE profile of the microbial community structure in FPE/J was obtained at days 0, 15, and 30. The band patterns were not significantly different between the uninoculated and inoculated samples. The microbial community was composed of *Weisella* sp., *Chryseobacterium* sp., *Lactococcus* sp., *Lactobacillus*, *Pseudomonas* and an uncultured bacterium. At earlier stages, the non-lactic acid bacteria seemed to predominate while the lactic acid bacteria group predominated towards the end of the fermentation period. In general, such observations were the same in both inoculated and uninoculated set-ups. The succession of the bacterial populations was observed to show that the fermentation of Madre de cacao was mediated by complex microbial ecosystems, which includes both lactic acid and uncultured bacteria. The acidic conditions found during fermentation may be the most important factor influencing the prevalence of the different bacterial species.

In the fermentation of IMO, the microbial communities involved were of the bacillus group, *Sphingomonas* sp., and lactic acid bacteria group. The use of 100% molasses and 20% molasses seemed to affect the composition of the microbial community. Using 100% molasses, the most predominant microbe was of the bacillus group while

reducing the molasses concentration to 20% favoured the growth of the lactics.

Culture-dependent or culturable microbes were also evaluated during the trials. In general, the FPE microbial counts using some selective medium showed that the bacteria group predominated in all trials, followed by the yeast, lactic acid bacteria, and finally the mold group. Modifying the current mixing protocol by dissolving the sugar first in water before addition to Madre de cacao leaves relatively resulted in higher microbial counts in the inoculated set-up compared to the uninoculated set-up. Likewise, the chemical analysis also showed positive improvements for most of the microelements but did not much have significant effect on N-P-K content.

Further, the culturable microorganisms were isolated, characterized, and identified which include the following bacteria: *Bacillus megaterium*, *Bacillus circulans*, *Stenotrophomonas maltophilia*, *Pseudomonas geniculata*, *Bacillus tequilensis*, *Bacillus altitudinis*, *Sphingomonas* sp., *Staphylococcus* sp., and *Lysinibacillus* sp., which seemingly can be used as a potential component of the fermenting biological extracts. These bacterial isolates were screened to have high indole acetic acid (IAA) activity among the isolates obtained. Fungal isolates were identified as *Rhizopus oryzae*, *Monascus purpureus*, *Aspergillus oryzae*, *Aspergillus fumigatus*, and *Aspergillus niger*.

From the cultures above, only compatible isolates exhibiting and with stable plant growth promoting activity like IAA production, high nitrogen fixing activity, phosphate and potassium solubilizing activity were selected in the formulation of starter inoculum.

Some microbial functional groups such as nitrogen fixers, phosphate solubilizers, and plant-growth promoting hormone/enzyme producers were determined in the biological extracts FPE/Js, FFEs, and IMOs. A total of 210 microorganisms were isolated from Madre de cacao fermented plant juice, 120 of which were bacteria, 40 lactic acid bacteria, 40 fungi, and 10 yeasts. Out of 120 bacterial isolates screened, 82 (68%) were positive for IAA production, 5 (4.16%) had phosphate solubilizing activity, and 8 (6.67%) were positive for nitrogen-fixing activity. Of the 40 lactic acid bacteria, 6 (15.00%) were positive for nitrogen-fixing activity. Out of 40 fungi, 7 (17.5%) have potassium solubilizing activity, 3 (7.50%) have nitrogen-fixing activity, and only 1 (2.50%) has phosphate solubilizing activity. All the yeast isolates tested were negative on all the tests. The top isolates based on their functional characteristics were selected and screened for compatibility. The list includes 19 bacteria, 6 LAB, and 5 fungi. All bacterial strains evaluated were compatible with each other as well as among fungal strains. Among the microbial isolates tested, 12 bacteria and 4 fungi were selected and included in the concoction of the new microbial inoculant. This inoculant was used in the production of biological extracts like FPE/J, FFE, and IMO. Based on PCR-DGGE analyses, the inoculant was identified as *Bacillus amyloquefaciens*, *Chryseobacterium* sp., *Orchrobactrum* sp., *Pseudomonas aeruginosa*, *Bacillus velezensis*, *Alcaligenes faecalis*, *Serratia marcescens*, *Bacillus subtilis*, *Brevibacterium* sp., *Paenibacillus* sp., *Penicillium* sp., *Talaromyces purpurogenus*, *Aspergillus niger*, and *Aspergillus tamarii*.

Total microbial count, pH, and chemical composition were monitored from the time of harvest until 9 months of storage. Results showed a gradual decline in the microbial population of FPE/J inoculant stored at room temperature, having a final population level of 1.83×10^8 cfu/mL, while refrigerated samples had a higher final microbial count of 9.50×10^8 cfu/mL. The pH levels were

relatively stable after 9 months in both conditions. The nutrient composition of inoculated FPE/J has the highest values for all macro and micronutrients except for Zn. Values fluctuated in all samples but are relatively stable after 6 months of storage at room temperature.

Based on the preliminary field test, application of 0.5% FPE/J was found to be effective in increasing the yield of okra, soybean, hot chili pepper, eggplant, and bitter gourd.

CONCLUSION AND RECOMMENDATION

The fermentation of biological extracts is largely dependent on the natural microbial inhabitants of the biological resource used. Likewise, factors affecting the microbial load such as age of the plants and weather conditions would seemingly contribute to the characteristics of the final fermented product. In terms of microbial activity, keeping a good starter inoculum would be helpful to maintain a more uniform fermentation microflorae that will promote a more desirable and standardized product.

Application of the modified mixing protocols and the use of microbial inoculation proved to be effective in the above results. This could be useful in standardizing the fermentation of the botanical extracts to improve the quality of the fermented extract.

It is recommended that the findings in this project may serve as a guide in attaining a standardized product when dealing with fermented biological extracts and concoctions.

RELATED REFERENCES

Pedro, M. S., Monsalud, R. G., Brown, M. B, Calub, B.M., Willauer, L. B., Tan Gana, N, Creencia, A, and Cayabyab, C.M. Protocol Improvement and Product Development of Liquid Organic Fertilizers from Fermented Plant Extracts (FPEs) and other Biological Concoctions. Terminal Report. 2013.

Pedro, M. S., Brown, M. B., Calub, B.M., Willauer, and Cayabyab, C.M. Development of Microbial Inoculants for the Production of Improved Fermented Biological Extracts (Phase II). Terminal Report. 2019.

Mannix S. Pedro is a senior researcher at the National Institute of Molecular Biology and Biotechnology (BIOTECH), University of the Philippines Los Baños (UPLB). He earned his BS in Biology with a major in Microbiology from UPLB. He obtained a postgraduate course in Microbiology at the University of Tokyo and Osaka University and completed his Ph.D. in Biotechnology at the University of Tokyo. His research interests include the development of microbial inoculants and biofertilizers for sustainable agriculture and food security.

Isolation and Utilization of Antibiotic Degrading Microorganism in the Production of Organic Fertilizer

Roy Searca Jose P. Dela Cruz and Lani Lou Mar A. Lopez

ABSTRACT. *The extensive use of antibiotics for therapeutic and prophylactic use in livestock production has increased the possibility of antibiotic pollution of agro-ecosystem. Manure from livestock production usually serve as raw materials in the production of organic fertilizer and other soil amendments. It is an accepted recycling and reuse technique for agricultural waste such as manure turning the waste into a valuable resource but offers a number of risks to human health, economic productivity, ecosystem services and long- term sustainability of agricultural activities. The project aims to reduce the risk by removing antibiotics in manure thru bio-inoculant induced composting. Isolation and screening of microorganism from vermicompost, soil and manure were performed in order to identify possible antibiotic degrading microorganism. Two fungal species Aspergillus niger and Aspergillus flavus showed potential and were used as bio-inoculant during composting to remove tylosin and oxytetracycline in chicken manure. Results showed that both fungal species contributed to the removal of target antibiotics. Inoculant induced composting registered 83-92% and 20-68% removal of Tylosin and Oxytetracycline. The inoculants were among the primary fungal species during the time of significant antibiotic removal. They also showed potential for mass production by having luxuriant growth in various agricultural waste used as substrate. The compost produced from bio-inoculant induced composting have higher NPK values compared to commercial organic fertilizer and vermicast. Analysis of raw materials showed that chicken manure has high NPK content which contributed to better NPK values of the produced compost. Higher NPK content of produced compost results to better growth and yield of test crops during experimental studies.*

RATIONALE

Antibiotics belong to a group of emerging contaminants posing significant concern because of its bioactive nature that causes antibiotic resistance to pathogens. Antibiotic pollution of agro-ecosystems particularly those under protected and organic vegetable productions can be attributed to the heavy application of organic fertilizer from animal manure. When antibiotic laden manure is utilized as raw material in the production of organic fertilizer, antibiotics can be absorbed by crops and enter human food chain. Adding to this is the physiological effects of antibiotics which can inhibit crops growth and affect its quality. With the recent backlog in the development of new antibiotics, increased antibiotic resistance of pathogenic microorganism poses grave threat to public health, economic productivity, ecosystem services and long-term sustainability of agricultural activity.

Organic fertilizer is a suitable product in the utilization and recycling of animal waste such as manure. Removing antibiotics in animal manure is a necessary step in ensuring sustainability of crop production and prevent antibiotic contamination of vegetables. At present, very limited options are available for the treatment of antibiotics in animal manure. Subsequently, antibiotics will transport and accumulate to various soil crop systems, with vegetable systems posing the greatest risk. Composting is a sustainable technology that can be applied to remove antibiotics in manure. Microorganism such as bacteria and fungi can be inoculated during the process to target the removal

of specific antibiotics. Vermicompost may serve as the source of microorganisms which can be able to degrade emerging pollutants such as antibiotics. Microorganisms such as bacteria and fungi can be isolated from vermicompost and play a crucial role in various treatment facilities where antibiotics need to be eliminated.

OBJECTIVES

The project aimed to isolate, characterize and evaluate potential antibiotic degrading microorganism (ADM) from vermicompost to be used as inoculant in composting animal manure for organic fertilizer production. Specifically, the methodologies were designed to:

1. Isolate, screen and identify potential ADM from vermicompost.
2. Formulate substrate for the mass production of ADM.
3. Determine the efficiency of ADM in treating antibiotics present in chicken manure.
4. Determine the effect of ADM in the overall properties of organic fertilizer when utilized as treatment of antibiotic in the production of organic fertilizer.

METHODOLOGY

Objective 1: Isolate, screen and identify potential ADM from vermicompost

Mixture of various manures and rice straw were utilized as raw material for vermicomposting. Samples were collected; 100 grams from the composite sample was used for isolation of ADM following the standard microbiological protocol in serial dilutions (i.e. 10^{-1} to 10^{-7} dilution). The potential ADM that showed a visual formation of clear zone around the microbial colonies was purified, sub-cultured and maintained. The isolates were screened through morphologically method of characterizedsation. At least one best potential microorganism was selected for preliminary evaluation of its morphological characteristics and minimum inhibitory test. After purification, the extracted DNA, amplified ITS region and capillary DNA sequences of the isolates were sent to Philippine Genomics Center for molecular identification.

Potential antibiotic degrading isolates were screened for their ability to degrade tylosin and oxytetracycline. Different antibiotic concentration (200, 100, 50, and 25 mg/mL) were used for each of the microorganisms isolated. Disk diffusion method was used to observed the sensitivity of each potential antibiotic degrading microorganism to tylosin and oxytetracycline. Each isolate was observed within 4 to 6 days incubation period. The presence of halo zone formation (bacteria) or no growth of mycelia (fungi) during the incubation period was considered susceptibility to antibiotic while no formation of halo zone was considered resistance to antibiotic and considered as potential antibiotic degrading microorganism. Isolates were also inoculated in Potato Dextrose Agar (PDA) with different concentration of antibiotic (T1= Control, T2= 50mg/mL, T3= 100 mg/mL and T4= 200mg/mL). Mycelial growth of each isolate was observed and measured daily using Vernier caliper.

Objective 2: Formulate substrate for the mass production of ADM

Locally available substrates that were considered as farm waste but with high carbon content were evaluated. Rice bran, soy bean, corn cob, corn grits, saw dust and mungbean were evaluated as substrates for the mass production of inoculant. The substrates were ground into smaller part and moistened with water. Bottles of equal volume containing the substrates were placed in an autoclave for sterilization at 121°C for 45 minutes; cooled down then separately inoculated with 5 mm mycelia disk of different isolates. Isolates were grown in different substrates; incubated at

room temperature and observed for 14 days.

Objective 3: Determine the efficiency of ADM in treating antibiotics present in chicken manure.

Compost pile was prepared using a ratio of 3:2:0.5:0.5 (v/v) of rice straw, leaf litters chicken manure and carbonized rice hull. The materials were mixed then divided into different treatments. Antibiotics was spiked (630mg of tylosin and 1200 mg of oxytetracycline) by spraying into the composting mass. A total of 42 kg of composting mass per treatment was inoculated with 450 g of isolates. The materials were placed in a modified compost pile using a plastic box of 52cm x 39cm x 42cm dimension. Plastic cover was added to prevent the loss of moisture and exposure to sunlight as this may affect the microbial activity and could possibly interfere with degradation process of antibiotic through photodegradation.

Weekly turning and watering of the compost piles were done to regulate the moisture content, temperature and aeration for microbial activity. Samples were collected at day 1, 3, 9, 24, 40 and 60. A representative sample of 250g was collected and placed in zip lock plastic bag. The representative sample was placed in refrigerator prior to shipment to Lipa Quality Control Center (LQCC), Lipa City, Batangas for antibiotic analysis. At day 0 and day 60, 100g sample was also collected and brought to DA-RFU3 Bureau of Soil Water Management Soils Laboratory for analysis of NPK content, OC, OM and C: N ratio. Temperature monitoring of the compost piles were done weekly using soil thermometer. Harvesting of composts were done after 60 days. The harvested composts were ground and passed through a screen. The weight of the harvested composts were recorded.

Microbial count of fungi were monitored during sampling dates to assess the fungal community during the 60 days composting period. Two hundred fifty (250) grams of the composite samples from each treatment was collected and brought to the laboratory for microbial count following the standard microbiological protocol in serial dilution and plate counting. Twenty-five (25) g from the collected samples was diluted in 250 ml of double distilled water. Serial dilution was done up to 7 folds. Plate count of fungi were done according to the method described in the Federal Drug Authority – Bacteriological Analytical Manual (Maturin, 2001) with modification in the colony forming unit (CFU) of fungi. The fungal genomic DNA extraction, ITS region amplification and capillary sequencing of the isolated fungal species during composting were sent to Philippine Genomics Center for molecular identification to assess the dominant population during decomposition.

Objective 4: Determine the effect of ADM in the overall properties of organic fertilizer when utilized as treatment of antibiotic in the production of organic fertilizer

Raw materials used in composting and the final product of composting experiment were sent to the DA-RFU3 BSWM Soils Laboratory for analysis of NPK content OC, OM and C: N ratio. The properties of the compost produced from inoculant induced composting (final product) were compared with the Philippine National Standard for Organic Soil Amendments. The final product was tested to the agronomic parameters such as plant height, leaf diameter, number of leaves, fresh and dry weight of leaves then compared with other soil amendment products. Tomato (*Lycopersicum esculuntum*), hot pepper (*Capsicum annuum*) and pechay (*Brassica cinensis*) were used as test crop. Eleven (11) kg of garden soil were added with 400g of final product. Similarly the same mixture were done with commercially available

Table 1. Treatment designation in the composting experiment

Treatment	Material Composition
T1	Organic compost (OC) + tylosin
T2	OC + oxytetracycline
T3	OC + tylosin + (Isolate 1)
T4	OC + oxytetracycline + (Isolate 1);
T5	OC + tylosin + (Isolate 2)
T6	OC + oxytetracycline + (Isolate 2)
T7	OC + tylosin + (Isolate 3)
T8	OC + oxytetracycline + (Isolate 3)

organic fertilizer and vermicast. It was then placed separately in a polyethylene bag, labeled and planted with the test crop. Each treatment had 4 replicates and data were observed and recorded for 30 days after transplanting. The different treatment designations used in the experiment were as follows (Table 2):

Data relating to plant growth were analyzed using Complete Randomized Design and Comparison among means using Tuckey's Honest Significant Difference (HSD) Test. The data were statistically analyzed using the Statistical Tool for Agricultural Research (STAR).

FINDINGS

The study was able isolate a total of 30 microorganisms, 16 of which were fungal species and 14 were bacterial species. After screening, all bacterial species were found to be susceptible to tylosin and oxytetracycline. Initial screening showed that potential ADM isolates ADM3, ADM7, ADM8, ADM12 and ADM16 exposed to different concentration of tylosin grows very well in the media as it showed increase in its normal growth with the presence of antibiotic. Similarly, isolates ADM2, ADM3, ADMD4 and ADM13 expose to different concentration of oxytetracycline increases its mycelia growth when compared to its normal mycelia growth. Different isolates showed different reaction on the presence of antibiotic. However, ADM3 can be a potential ADM since it grow well in both antibiotics. Pure culture of the 14 fungal isolates were subjected to molecular identification and the results were tabulated in Table 3.

Genus *Aspergillus* is well suited for vermicomposting and composting process. Their requirement for growth (food, habitat, temperature, relative humidity and pH) all coincide with the general requirement for both processes. Based on the result of antibiotic screening and molecular identification *A. flavus* and *A. niger* were chosen as inoculant during composting. Both species were propagated on several substrate to evaluate its potential for mass production and results showed both have luxuriant growth in all substrates tested.

Composting of chicken manure using the

Table 2. Treatment designation for the evaluation of final product.

Treatment	Material Composition
PT1	garden soil + commercial organic fertilizer
PT2	garden soil + vermicast
PT3	garden soil + final product
PT4	garden soil only (Control)

isolates as inoculant registered percent removal for tylosin and oxytetracycline of 83-92% and 20-68% respectively across treatment. Peak tylosin removal was achieved within 24 days of composting. Antibiotic removal generally follows an increasing trend wherein the highest removal was recorded at the end of composting experiment. Oxytetracycline removal of 20-68% in the study was relatively low compared to other studies. The primary factor attributed to the removal of oxytetracycline is the thermophilic temperature during composting but was not observed during the experiment.

Colony forming units (CFU) of fungal community range from 1x103 cfu/g to 1x107 cfu/g across treatments. Eleven (11) to twenty one (21) fungal species were isolated on each treatment. A total of 36 fungal species were isolated throughout composting period. Twenty five (25) isolates were subjected to molecular identification. The isolates belong to 14 genera of fungi, (*Lichthemia*, *Aspergillus*, *Trichosporon*, *Talaromyces*, *Sarocladium*, *Rhizomucor*, *Phoma*, *Cladosporium*, *Diaporthe*, *Culvularia*, *Chaetomium*, *Lomentospora*, *Fusarium*, and *Myriococcum*,) under 3 divisions, (Basidiomycota, Ascomycota and Murocomycota). It was observed that generally the fungal community across treatments were similar, and the inoculant for each treatment was not necessarily the dominant fungal species in the treatment. For treatment involving tylosin, around 90% removal was achieved within the first 24 days of composting experiment. The fungal species present at this stage of composting experiment were *A. flavus*, *A. niger*, *A. fumigatus*, *A. terreus*, *T. asahii*, *L. romosa*, and *I4*. Maximum removal between 20 to 68% were observed in treatment involving oxytetracycline which was achieved only after 60 days of composting. The fungal community present at this stage of composting was also similar with the treatment involving tylosin. *A. flavus*, *A. niger*, *A. fumigatus*, *A. terreus*, *T. asahii*, *L. romosa*, *C. oxysporum*, and *I23* were the fungal species observed with *A. fumigatus* as dominant species. For the removal of tylosin, *A. niger*, *A. flavus*, *L. romosa* and *T. asahii* may play a significant role while *A. niger*, *A. flavus* and *C. oxysporum* may

Table 3. Identity of isolated fungal specie based on ITS region using ITS1 forward and ITS4 reverse primers and confirmed using BLAST analysis.

Isolate	Maximum identity (%)	GenBank Accession number	Species
1	98	MF374341.1	*Aspergillus flavus*
2	95	MH290451.1	*Fusarium solani*
3	99	MH237666.1	*Aspergillus flavus*
4	91	MH374606.1	*Aspergillus fumigatus*
5	99	MK139782.1	*Aspergillus fumigatus*
6			*unknown*
7	100	LC062385.1	*Aspergillus niger*
8	98	MK139781.1	*Aspergillus flavus*
9	98	MK346334.1	*Aspergillus cristatus*
10	99	MH664051.1	*Aspergillus flavus*
11			*unknown*
12	96	MK332591.1	*Aspergillus tamarii*
13	100	MH237666.1	*Aspergillus flavus*
14	99	MH613212.1	*Aspergillus tubingensis*

Table 4. Analysis of raw materials used in composting.

Treatment	Total Nitrogen (N) %	Total Phosphorus (P_2O_5) %	Total Potassium (K_2O) %	Total NPK	Organic Carbon (OC) %	Organic Matter (OM) %	C/N ratio
Chicken manure	2.49	3.42	1.11	7.02	12.58	21.63	5:1
Rice straw	0.96	0.19	2.39	3.54	35.04	60.27	37:1
Leaf litter	1.42	0.1	0.28	1.8	34.45	59.26	24:1
Carbonized rice hull	0.01	0.63	0.71	1.35	0.72	1.24	72:1

contribute in the removal of oxytetracycline during composting. Although *A. fumigatus* was present in all treatments and almost in the whole duration of the experiment, it may be contributing on decomposing the organic matter other than the target antibiotic.

Analysis of the different raw materials used in composting were presented in Table 4. Chicken manure has the highest nitrogen and phosphorus content while rice straw has the highest potassium content. Rice straw and leaf litter has the highest organic matter and organic carbon content. The highest contributor of NPK among the substrate used was chicken manure with total NPK of 7.02.

The properties of the different soil amendment used were analyzed and the result were presented in Table 5. Soil analysis of the different amendments shows that the final product of composting amended with the inoculant has the highest NPK content. This contributed to test results which is at par or even better when compared to the other soli amendments. The use of chicken manure as raw material in the production of organic fertilizer may improve the final NPK content of the compost.

CONCLUSION AND RECOMMENDATIONS

Two fungal species *Aspergillus flavus* and *Aspergillus niger* showed potential as ADM inoculant and can reduce tylosin and oxytetracycline in composting chicken manure. It also showed potential for mass production by having luxuriant growth in various agricultural by-products.

The study was able to record tylosin removal of 83-92% and oxytetracycline removal 20-68% during the 60 days composting period. Several studies attribute the removal of oxytetracycline to thermophilic temperature during composting, but since thermophilic temperature was not recorded in the study, it might be one of the reasons for low removal efficiency for oxytetracycline. The major degradation pathway of oxytetracycline observed in the study was metabolism by the inoculant and other fungal species present during composting. For tylosin, biodegradation was the major removal pathway observed. In the study, although thermophilic temperature was not observed and daylight was not present, tylosin removal efficiency recorded was comparable with other studies. For tylosin, inoculant *Aspergillus flavus* and *Aspergillus niger* may have contributed to the removal of tylosin thru biodegradation wherein tylosin might have been used as carbon source for metabolic process of the inoculant. The other observed fungal species present during composting which contributed in

Table 5. NPK analysis of the soil amendments used.

Treatment	Total Nitrogen (N) %	Total Phosphorus (P_2O_5) %	Total Potassium (K_2O) %	Total NPK	Organic Carbon (OC) %	Organic Matter (OM) %	C/N ratio
Commercial organic fertilizer	0.99	0.44	0.44	1.87	9.57	16.46	10:1
Vermicast	0.89	0.57	0.16	1.62	8.54	14.69	10:1
Organic fertilizer from ADM	1.18	2.35	0.91	4.44	2.07	3.56	2:1

the removal of tylosin were *L. ramosa* and *T. asahii*. As the factors were more suitable for the removal of tylosin compared to oxytetracycline, the removal efficiency for tylosin was higher than oxytetracycline.

Inoculant induced composting using the identified fungal species can significantly reduce if not eliminate tylosin and oxytetracycline in manure thus prevent antibiotic pollution of agroecosystems. The use of chicken manure as raw material in the production of organic fertilizer may improve the NPK content of compost and improve soil fertility for agriculture. The inoculant induced composting resulted to growth and yield of test crops at par or even better when compared to other soil amendments used in the experiment.

Composting parameters such as temperature, moisture content, duration, substrate ratio, inoculant to substrate ratio must be optimized in order to improve the quality of compost and removal of antibiotics during inoculant induced composting. The identified inoculant must also be tested against other antibiotics found in chicken manure.

Roy Searca Jose P. dela Cruz is a faculty member of Engineering Sciences Department, College of Engineering, Central Luzon State University. He teaches graduate and undergraduate courses for Civil, Agricultural and Biosystems Engineering, and Environmental Management students. He earned his BS Civil Engineering degree and MS Environmental Management Degree at Central Luzon State University. He finished his Ph.D. in Environmental Engineering at University of the Philippines – Diliman. His research interest is on sustainable development and emerging contaminants.

Crops

Documentation and Field Efficacy Trial of Botanicals Against Fruitworm (*Helicoverpa armigera* Hübner) and Black Leaf Mold Disease Caused by *Pseudocercospora fuligena* (Roldan) Deighton in Tomato (*Lycopersicon esculentum* Miller)

Herminigilda A. Gabertan, Ph.D., Niña R. Rosales, Michelle E. Javier, Brian Joseph S. Zulueta, Maria Narcisa V. Garcia, Hazel T. Calibo and Queenie S. Tabur

ABSTRACT. *Survey and documentation of organic farms were conducted on 343 farmers and agriculture practitioners in 13 provinces, 73 municipalities and cities in Regions IV-A, IV-B and V. A total of 74 plant species and 293 botanical concoctions were documented for organic pest control. A database of documented practices was organized in excel format. In addition, a catalog of documented botanicals and four brochures of selected individual botanicals were also developed. From the documented botanical concoctions, four were selected based on the criteria for selection of botanicals for efficacy trial, namely; matured mahogany leaves, oregano and lemongrass, Imelda grass and guava leaves. Evaluation of the four concoctions, and negative (non-chlorinated water) and positive (Bureau of Agriculture and Fisheries Standards registered neem-based organic pesticide) controls was done through field efficacy trial. Results showed that oregano and lemongrass concoction is promising against tomato fruitworm as least population was observed during the trial. It also exhibited lowest count of fruitworm damaged fruits at 96 pieces as compared to other treatments ranging from 111 to 163 pieces. Moreover, guava leaves treatment obtained the least disease severity index of tomato black leaf mold disease at 28.21%, but highest for oregano and lemongrass at 47.62%.*

Keywords: botanical pesticides, tomato fruitworm, tomato black leaf mold

RATIONALE

In the Philippines, tomato production reached 87.54 thousand metric tons (MT) on the first quarter of 2014, 3.5% higher than the recorded production of the previous year. Top producers include Ilocos Region, Central Luzon and CALABARZON. Increase in production was attributed to use of high yielding varieties, distribution of high-quality seeds from Department of Agriculture – Local Government Units (DA-LGUs), and additional tomato production areas (PSA, 2014). Just like any other crops, tomato is also at risk to insect pests and diseases that cause significant losses in the quality and quantity of fruits produced. One of the insect pests widely studied was tomato fruitworm (*Helicoverpa armigera* Hübner) (TFW) as it is considered as one of the most destructive pests of tomato (Brust, 2013). Another pest of increasing concern is tomato black leaf mold disease (TBLM) caused by the fungal pathogen *Pseudocercospora fuligena* (Roldan) Deighton. It was first reported in the Philippines in 1936 (Roldan, 1938). The disease was known to occur in tropical and sub-tropical regions with warm temperature and high humidity. In fact, these pests are currently prevailing and damaging

in the production and organic areas of BPI-Los Baños National Crop Research, Development and Production Support Center (BPI-LBNCRDPSC) and some of the tomato growing areas in CALABARZON, MIMAROPA and Bicol Region as seen during the survey and documentation done by the project staff. Synthetic pesticides have been proven to control the growth and population of insect pests and fungal pathogens. However, with the growing concern for global environmental risks and health hazards due to continuous use of synthetic pest control for agriculture, it has paved the resumption of organic pesticides in farmers' fields. In this regard, the need for organic plant protection strategies has increased substantially.

The general objective of this study is to evaluate the efficacy of selected botanicals against *Helicoverpa armigera* Hübner and black leaf mold disease of tomato caused by *Pseudocercospora fuligena* (Roldan) Deighton. Specifically, the study aims to: a.) Document botanicals being used for organic crop protection in Regions IV-A (CALABARZON), IV-B (MIMAROPA) and V (Bicol) and b.) Evaluate the effectiveness of selected botanical concoctions against *H. armigera* Hübner and *P. fuligena* (Roldan) Deighton through field efficacy trial.

METHODOLOGY

Survey and documentation of organic farms were conducted on 343 farmers and agriculture practitioners in 13 provinces, 73 municipalities and cities in Regions IV-A, IV-B and V. A total of 74 plant species and 293 botanical concoctions were documented for organic pest control. A database of documented practices was organized in excel format. In addition, a catalog of documented botanicals and four brochures of selected individual botanicals were also developed.

From the documented botanical concoctions, four were selected based on the criteria for selection of botanicals for efficacy trial, namely; matured mahogany leaves, oregano and lemongrass (OLG), Imelda grass and guava leaves (GL). Evaluation of the four concoctions, and negative (non-chlorinated water) and positive (Bureau of Agriculture and Fisheries Standards registered neem-based organic pesticide) controls was done through field efficacy trial.

FINDINGS

Results showed that OLG concoction is promising against tomato fruitworm as least population was observed during the trial. It also exhibited lowest count of fruitworm damaged fruits at 96 pieces as compared to other treatments ranging from 111 to 163 pieces. Moreover, guava leaves treatment obtained the least disease severity index of tomato black leaf mold disease at 28.21%, but highest for oregano and lemongrass at 47.62%.

CONCLUSION AND RECOMMENDATION

The identified concoctions namely; OLG against tomato fruitworm and GL against tomato black leaf mold should be further studied to validate the effectiveness of these botanicals. These can also be tested against other major insect pests and diseases of tomato, other solanaceous crops, as well as other vegetable crops.

Dr. Gabertan earned her MS in Agriculture at Pampanga Agricultural College in April 1933 and her PhD in Environmental Science at University of the Philippines-Los Baños in April 2008. She is currently the Assistant Director for Operations, and Technical and Production Services of the Department of Agriculture-Bureau of Plant Industry (from August 8, 2022 to present). She was the Agricultural Center Chief of BPI-Los Baños National Crop Research, Development and Production Support Center (LBNCRDPSC; from 2009 to August 5, 2022) where she led the in the planning and implementation of the various programs on Research and Development on Rice Program, High value Commercial Crops, National Organic Program, Cassava Program, Good Agricultural Practices.

She was the Chairman of the Sub-Committee on Culinary herbs and Spices: National Codex Organization Spices, wherein she was able to represent the Philippines during the 40th Session of the CODEX Alimentarius Commission (CAC 40) in 2018 in Geneva, Switzerland. She was also the Program and Project Investigator of foreign Technical Cooperation Projects of Korea Program on International Agriculture (KOPIA), and Asian Food and Agriculture Cooperation Initiative (AFACI), respectively.

Her notable projects were the following:

- Documentation and Evaluation of Botanicals and Microbials for Organic Agriculture in Support to Organic Stakeholders in CALABARZON, MIMAROPA and Bicol Region – the project from which the paper, "Documentation and Field Efficacy Trial of Botanicals against Fruitworm (*Helicoverpa armigera* Hübner) and Black Leaf Mold Diseases Caused by *Pseudocercospora fuligena* (Roldan) Deighton in Tomato (*Lycopersicon esculentum* Miller), was derived from;
- Development of Organic Seed Production System of Lowland Vegetables and Field Legumes at BPI-LBNCRDPSC and Strengthening Partnership in CALABARZON, MIMAROPA and Bicol Region;
- Cooperation for the Development of Organic Production between the Philippines and Argentina; and
- Strengthening Empowerment of Los Baños Communities Through Science-based Home and Community Gardening.

Organic Vegetable Varieties for Higher Yields, Quality and Sustainability

Rodel G. Maghirang[1], M. C. P. B. Rodriguez[1], J. C. Bengoa[1], C. D. Oraye[1] and G. S. Rodulfo[1]

ABSTRACT. *Crop yields and quality are dependent on the genotype, environment and their interaction (P= G + E + G×E). The attention on organic crop production both in practice and research has mostly been on environment or cultural management including organic inputs. Varieties used were generally developed under non-organic conditions which are highly dependent on chemical fertilizers and pesticides. This usually results in lower yields and quality of the produce when grown organically. Thus, we embarked on actively developing and selecting varieties that can perform well under organic conditions through the generous support of DA-BAR, DOST-PCAARRD and UPLB-IPB. So far, we have registered through the IPB-GTRRO a total of 23 varieties in 11 species of vegetables and legumes. These include three varieties in cucumber ('Milagrosa', 'Urduja' and 'Princesa'), two eggplant ('Dorikit' and 'Minyang'), mungbean ('Pagasa 23'), blackgram ('Napigket'), four pole sitao ('Maureen', 'Generosa', 'Tikagan' and 'Ilao'), three squash ('Amour', 'Sonrisa', and 'Luisa'), three cherry tomato ('Cherrys', 'Betty' and CTm 163436), okra ('Dilag'), and winged bean ('Gloria'). We have also released varieties of indigenous vegetables such as 'Reina' and 'Pasuquin' (roselle) and 'Sariaya' and 'Glan' (lagikway). In addition, 'Maureen' and 'Generosa' have already been approved by NSIC while tomatoes 'Agnes' and 'Lydia' and mungbean Pagasa 23 are undergoing NCT. These varieties have been distributed to several organic farmers/ practitioners and farmer groups, NGOs, and DA-RFOs in the form of seeds, seedlings, and propagated materials. Also in the pipeline are promising organic selections of 5-angled okra, slicing type cucumber, pole sitao, table tomato, hot pepper, cowpea and more IVs. Availability of these locally-bred organic varieties will help further boost organic vegetable production in the country. We have also trained researchers and farmers on organic vegetable breeding and seed production through our participatory varietal improvements projects and activities. In addition, we have developed organic production guides, related training materials and publications.*

1 Institute of Plant Breeding, College of Agriculture and Food Science, University of the Philippines Los Baños

Dr. Rodel G. Maghirang

Vegetable breeder at the Institute of Plant Breeding, College of Agriculture and Food Science, University of the Philippines Los Baños and has been doing vegetable breeding since 1979. Developed a good number of varieties of pole sitao, bush sitao, cowpea, snap beans, garden pea, winged bean, pigeon pea, hyacinth bean, eggplant, tomato, cucumber, squash, indigenous vegetables with several still in the pipeline. Author of numerous scientific papers, information bulletin, and technical notes on Crop Improvement, Vegetable Production and Organic Agriculture. Evaluator of programs and projects for DOST-PCAARRD, DA-BAR, CHED. TWG member/chair for various PNS and COHP on various fruits and vegetables including taro. Trainor on Organic Agriculture and Good Agricultural Practices (GAP). Consultant in various government and private sector programs on Vegetables and Organic Agriculture. Former Director of High Value Crops Program of the Department of Agriculture and former Director of the Institute of Plant Breeding, CAFS, UPLB.

Among the organic varieties developed and recommended are Cucumber ('Milagrosa' , 'Urduja', 'Princesa') ; Lagikway ('Glan' and Sariaya); Mungbean ('Iloilo Yellow' / 'Pagasa 23'); Pole Sitao ('Generosa' , 'Tikagan'); Roselle ('Reina' , 'Pasuquin'); Squash ('Amour' , Sonriza, 'Luisa'); Soybean (AGS 374, Tiwala 12 (IPB Sy96-27-23), Tiwala 22 (SP 963-9), Tiwala 24 (SP963-1), Tiwala 26 (SP 963-5)); Cherry Tomato ('Cherrys', 'Agnes', 'Betty'); Eggplant ('Dorikit' and 'Minyang') with many others in the pipeline.

Participatory Breeding and Seed Production on Organic Vegetables

Rodel G. Maghirang[1], E. Fery[1], C. de la Cruz[2], J. Misterio[3], J., and G.S. Rodulfo[1]

ABSTRACT. *In the production of organic vegetable, it would be best to use varieties developed and selected under organic conditions. It would be even better if the varieties were developed and selected in the organic farm itself. Farmers can be excellent breeders when given some basic technical knowledge. The objective in participatory breeding is to develop organic varieties in the farmer's fields by the farmers themselves. For this purpose we trained selected organic growers in regions 4A, 4B, 8 and 12 on organic variety development and seed production for them to develop organic varieties in selected vegetables then produce seeds of those varieties. Along with the training, farmers were provided with seeds of segregating lines of crops of their choice as starting materials. In region 4A trials the farmers, in OISCA were able to select CU 1162 in cucumber and two lines of squash, SQ 10127-1-2 and SQ 10128-1-1, chosen for their high yields and thick yellow orange flesh. They selfed and sibbed the selections for the next generation. Individual plant selections and seed production were made in leaf-type and romaine type lettuce varieties which they also shared with other members of the group. In pole sitao, lines 0801-5-1-1-0 and 10116-1-1-0 with dark green pods and lines 1096-1-1-0 and 10421-0-0 with light green pods were selected . Meanwhile in Aloague Farm, Alfonso, Cavite, individual plant selection, seed production and some crosses were made in cucumber (CU 11621), pepper (PE 10514-1, PE 10514-2, PE 10514-3, PE 10516-1 and PE 10516-2) and eggplant. Most notable in Aloage farm were the cherry tomato selections which farmers produced commercially as they performed better than the hybrids. In Tri-Star Farm, Brgy. Kaytitinga, Alfonso, Cavite, individual plant selections in five lines of pepper Pe 10449-1, 10507, 10514, Aruy-oy and Jalapeno were made. In Region 8 , organic farmers were trained in Abuyog (13,) Sta Fe (24), and Ormoc City (13). From trials in their farms, the farmers were able to select lines best suited for their areas. However, most of the farms were damaged by typhoon Yolanda. Despite this, there were still some successful farmers: Virginia Cerdena: for her sitao selections and crosses in squash; Manshuita Cutado for her selections and seed production of pole sitao, ampalaya and tomato; Mr. and Mrs. Amelito Aragon of Ormoc City for their ampalaya selection and seed production as well as selections in cucumber and pole sitao. In Region 12, 30 farmers were trained in addition to the staff of DA-CEMIARC Tupi, South Cotabato where selections were done on tomato, eggplant, cucumber, melon, watermelon and sitao. Selfing in tomato and eggplant and hybridization in sitao, tomato, eggplant and pepper were also demonstrated. Among the successful farmers were: 1) Edgar Ybañez - selected and seed produced pole sitao , cucumber, eggplant tomato and lettuce lines which he shared also with other farmers. He was also able to sell some of the organic seeds, 2) Teresita De Luna Zaldivia - selected and seed increased then planted in commercial scale her selections in tomato, cucumber and pepper, 3) Virgilio Almeyda - selected and seed increased lines of cucumber, pepper, lettuce and melon and watermelon, 4) Jess Esponilla - seed produced the selected plants from commercial varieties of lettuce and tomato , 5) Dennis Cocoba selected pole sitao (dark*

1 DA-PRES
2 DA-RFU 8-RIARC
3 DA-RFU XII-RIARC

green pods) and squash lines which were also seed produced and 6) Leonard de la Cruz - selected, seed produced and distributed lines of pole sitao, ampalaya, cucumber, squash and tomato lines along with the organic concoctions he produced. One of the challenges faced by the project was the land ownership issue adversely affecting sustainability. But with the knowledge and skills imparted on the farmers organic breeding and seed production can still take root somewhere else. Nevertheless, there should be more efforts to expand the bench of organic plant breeders through the organic growers themselves.

Dr. Rodel G. Maghirang
Vegetable breeder at the Institute of Plant Breeding, College of Agriculture and Food Science, University of the Philippines Los Baňos and has been doing vegetable breeding since 1979. Developed a good number of varieties of pole sitao, bush sitao, cowpea, snap beans, garden pea, winged bean, pigeon pea, hyacinth bean, eggplant, tomato, cucumber, squash, indigenous vegetables with several still in the pipeline. Author of numerous scientific papers, information bulletin, and technical notes on Crop Improvement, Vegetable Production and Organic Agriculture. Evaluator of programs and projects for DOST-PCAARRD, DA-BAR, CHED. TWG member/chair for various PNS and COHP on various fruits and vegetables including taro. Trainor on Organic Agriculture and Good Agricultural Practices (GAP). Consultant in various government and private sector programs on Vegetables and Organic Agriculture. Former Director of High Value Crops Program of the Department of Agriculture and former Director of the Institute of Plant Breeding, CAFS, UPLB.

Among the organic varieties developed and recommended are Cucumber ('Milagrosa' , 'Urduja', 'Princesa') ; Lagikway ('Glan' and Sariaya); Mungbean ('Iloilo Yellow' / 'Pagasa 23'); Pole Sitao ('Generosa' , 'Tikagan'); Roselle ('Reina' , 'Pasuquin'); Squash ('Amour' , Sonriza, 'Luisa'); Soybean (AGS 374, Tiwala 12 (IPB Sy96-27-23), Tiwala 22 (SP 963-9), Tiwala 24 (SP963-1), Tiwala 26 (SP 963-5)); Cherry Tomato ('Cherrys', 'Agnes', 'Betty'); Eggplant ('Dorikit' and 'Minyang') with many others in the pipeline.

Establishment of Organic Seed Production System

Rodel G. Maghirang[1], M. Cacal[2] , V. Ladia, Jr.[1], C.D. Oraye[1], J.C. Bengoa[1], M.C.P. Rodriguez[1], A.Q.C. Sabanal[1], G.S. Rodulfo[1], G. Onde[2] and M. Onde[2]

ABSTRACT. *Organic varieties are the missing link in the organic production chain. Organic agriculture is still reliant on conventionally bred varieties which usually do not perform well under organic condition. Organic vegetable varieties and lines were developed through the DOST-PCAARRD funded National RDE Program on Organic Vegetables with 'Variety Evaluation, On-Farm Trials and Seed Production of Organic Vegetables in the Philippines' as one of the sub-programs. The next step should be making those varieties available to the farmers for further seed production or direct use in organic vegetable production. The project aimed to produce seeds of those varieties, make them available to organic growers, develop new varieties as well as seed production method and seed treatments which were accomplished through four project components. In Component 1, 'Production of breeder and foundation seeds of the developed organic varieties of vegetables and legumes', seed production of organic vegetables and legumes of selected elite lines were done in Institute of Plant Breeding-PAMANA and DA-Palawan Agricultural Center (PAC) from August 2014 to 2018. Foundation seeds of eggplant (Round- 10441, 10435, (10413), Long Purple- 10138, 10437, 10154)), pepper (10449, 10514), tomato (10407, 10162), ampalaya (13000 series, 15000 series), cucumber (11621, 11622) , squash (10127, 10128) and pole sitao (10166, 10421) were produced. A total of 126.62 kg of organic vegetable seeds were distributed to 2,534 recipients. The foundation seeds were distributed to organic growers and government agencies mandated to do organic seed production. Distribution also expanded to teachers (Gulayan sa Paaralan), indigenous groups and local organizations that practiced organic farming. A total of seven (7) trainings with 190 participants in organic vegetable breeding and seed production, and organic farm inputs preparation were conducted. In Component 2,'Varietal improvement in selected vegetables', additional selections in Eggplant were made namely; Ep10152-7 and Ep 10154-1. In tomato, the selected lines were Tm10170-1-0 and Tm10410-1-0 as well as 8 other accessions with medium to large fruits. In cherry tomato, notable selections were Ctm11640, 12874 and 12876 which were later recommended for release through GTRRO. The selections in cucumber were Cu152358 and Cu152360. Meanwhile, in pole sitao, Ps152126, and PAC PS 5 , Ps 141750 and Ps 152352 were selected based on yield and quality. For Component 3, 'Improvement of the seed production protocols for the individual crops', it was found out that for pole sitao, 2.5 t/ha vermicompost gave the highest seed yield at 1kg seeds/5m^2 or about 2 t/ha. For cucumber the best treatment was 5 t/ha vermicompost at 227 kg seeds/ha at 29 gm/1000 seeds. In pole sitao the highest potential income was observed in harvesting for fresh pods up to the middle portion and for dry seeds the rest of the pods. In Component 4 on the 'Development of organic seed treatments and organic seed processing methods,' the results showed that the best seed treatments against bruchids in pole sitao were neem leaves, turmeric and incense in that order of efficacy. The project faced numerous challenges but with unwavering support of DA-BAR and assistance of IPB-UPLB progress were still made and sustained up to the present. For a sustainable organic seed system there should a separate NSIC for organic*

1 Institute of Plant Breeding-UPLB

2 DA-Palawan Research and Extension Station

varieties along with a good integration framework for formal and informal seed systems. DUS for organic varieties should also be different since the level of uniformity in organic is usually lower for better crop resilience.

Dr. Rodel G. Maghirang

Vegetable breeder at the Institute of Plant Breeding, College of Agriculture and Food Science, University of the Philippines Los Baños and has been doing vegetable breeding since 1979. Developed a good number of varieties of pole sitao, bush sitao, cowpea, snap beans, garden pea, winged bean, pigeon pea, hyacinth bean, eggplant, tomato, cucumber, squash, indigenous vegetables with several still in the pipeline. Author of numerous scientific papers, information bulletin, and technical notes on Crop Improvement, Vegetable Production and Organic Agriculture. Evaluator of programs and projects for DOST-PCAARRD, DA-BAR, CHED. TWG member/chair for various PNS and COHP on various fruits and vegetables including taro. Trainor on Organic Agriculture and Good Agricultural Practices (GAP). Consultant in various government and private sector programs on Vegetables and Organic Agriculture. Former Director of High Value Crops Program of the Department of Agriculture and former Director of the Institute of Plant Breeding, CAFS, UPLB.

Among the organic varieties developed and recommended are Cucumber ('Milagrosa' , 'Urduja', 'Princesa') ; Lagikway ('Glan' and Sariaya); Mungbean ('Iloilo Yellow' / 'Pagasa 23'); Pole Sitao ('Generosa' , 'Tikagan'); Roselle ('Reina' , 'Pasuquin'); Squash ('Amour' , Sonriza, 'Luisa'); Soybean (AGS 374, Tiwala 12 (IPB Sy96-27-23), Tiwala 22 (SP 963-9), Tiwala 24 (SP963-1), Tiwala 26 (SP 963-5)); Cherry Tomato ('Cherrys', 'Agnes', 'Betty'); Eggplant ('Dorikit' and 'Minyang') with many others in the pipeline.

Technology Promotion and Utilization of Selected Biofertilizer, Biostimulants and Microbial Biopesticides (BBM) for Sustainable Corn and Legume Production in Selected Regions[1]

M.B. Brown[2], R.A. Nepomuceno[2], C.M.B. Brown[2], L.B. Opena[2], L.B. Willauer[2], R.P. Violanta[2] and M.S. Pedro[2]

ABSTRACT. *Biofertilizers have been continuously promoted as a better alternative to traditional and inorganic fertilizers but its promotion and use is an enormous and daunting challenge. The massive application of chemical fertilizers and pesticides by farmers rooted on the first green revolution where high yielding varieties are used. We all know too well the unsustainability of these practices and if these remain unabated and improperly conducted, it may lead to a wide degradation of agricultural soil fertility.*

Organic agriculture excludes the use of chemical inputs to improve farming practices. The utilization of biofertilizers, biostimulants and microbial pesticides (BBM) products is becoming a crucial component of organic farming because this is the only alternative to chemical inputs for successful plant growth and development. BBM provides a healthy growing environment for a positive plant, microbial and soil interactions that is sustainable for future growing seasons.

The strategy for the utilization of BBM for organic agriculture as an alternative to chemical inputs is presented in the paper. This strategy was based on findings of various projects funded by the Department of Agriculture and other international organizations that aimed to promote, the utilization of Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI) technology in different cropping and plantation systems. The results suggested that in many cases only 50 to 85 percent of chemical inputs can be replaced by VAMRI alone. Thus, succeeding projects were conducted to establish the right combinations of VAMRI with other BBM, target host plants and various soil conditions to achieve a 100 percent replacement of chemical inputs.

The project also conducted: a) participatory rapid appraisal, b) demonstration of the effectiveness of BBM in field conditions on different cropping and plantation crops systems, c) effective strategy/mechanism for promoting technologies, and d) trainers' training on BBM inoculant quality control, handling, mass production and application of the technology.

RATIONALE

With the establishment of the National Institute of Molecular Biology and Biotechnology - University of the Philippines Los Baños (BIOTECH-UPLB) in 1979, R&D on BBMs and biopesticides (BB) grew rapidly. As one of the premier R&D institutions in the country, it has progressively developed innovations and technologies that greatly impacted the agricultural biotechnology landscape of the country. Since the 1990's, BIOTECH-UPLB has been promoting the use of microbial

1 Consolidated results of projects funded by the Department of Agriculture. The project was funded by DA-BAR.

2 Project and Study Leaders involved in the project.

inoculants or BBM for crop production. The Institute has contributed substantially to the acceptance by many farmers of low-input techniques and biotechnological innovations towards improved farm production. It has also made contributions in the dissemination of information and products for environment-friendly agriculture. Of the multitude of BBMs developed, only a few have gained private investment for manufacturing and commercialization and this lies in part with the absence of well-defined linkages between the local government units. industries and farmers. Investments should be made by the government and partnerships with the private sector must be promoted.

Further commercialization and outreach programs still have to be done. Training and extensions must be conducted in various parts of the country so that chemical fertilizer users are well- informed of the advantage of using BBMs.

This project is just an offshoot and continuation of a previous program funded by Asian Food and Agriculture Cooperation Initiative (AFACI) titled "BBM Technologies forSustainable Agriculture" which was officially implemented from May 2010 to December 2013 with an extension up to May 2014. As a result of the AFACI initiative plans for succeeding years include: a. Expanding Project Reach/ Geographical Coverage. Sustainability of Project Intervention, Trainers' training and Advocacy for Increased Government Support to the BBM Program.

METHODOLOGY

To ensure sustainability of this intervention, the project shall strengthen participatory rapid appraisal, collaborative efforts and institutional partnership with concerned agencies, provincial, cities and municipal agricultural offices, selected farmers' group and business sectors for a demand-oriented production initiative.

Lectures on the concepts, principles, and application of selected BBM on priority crops such as corn and legume were made. The promotion was supported by an aggressive information dissemination campaign through a multimedia approach, training credit/market, and linkage.

Field Demonstration trials of the efficacy of VAMRI and selected BBM were initially conducted in the selected areas nearby towns or provinces of Laguna due to Covid restrictions. Meeting with Provincial/ Municipal Agricultural Officers (PAO/ MAO) was initiated to identify the exact locations where demonstration areas can be established.

Table 1 shows the treatments for each demonstration set-up.

Extension effort was also intensified by the project staff in order to promote and increase VAMRI and other BBMs utilization and widen the target market.

HIGHLIGHTS OF ACCOMPLISHMENTS

Establishment of linkage between BIOTECH and selected municipal agriculture offices in the production and training of farmers in the use of technology

Information and needs assessment were gathered to serve as the basis for the introduction of improved and appropriate BBM technologies for corn and legumes farming. A suitable package of technology and other practices compatible with BBM technologies, was identified. BBM technologies include the time, rate, timing, and technique of application of the inoculants such as **Nitrolink, VAMRI PhosphoLink K-Sol B, Oryzinc. BIOPLASMA** and other new BBMs.

Table 1. Treatments for each demonstration set-up.

	LEGUMES	CORN
Full application of chemical fertilizer (Full Farmer's Practice[FFP])	FFP	FFP
½ FFP + VAMRI	Nitrolink / Oryzinc / K-Solb	Phospholink / Oryzinc/K-Solb
VAMRI	Nitrolink / Oryzinc /K-Solb	Phospholink / Oryzinc/K-Solb
Control (uninoculated)	Nitrolink / Oryzinc /K-Solb	Phospholink / Oryzinc/K-Solb

Technology Promotion, Development of Brochures and Strengthening Collaborative Efforts

Due to restrictions on traveling across provinces, the first few months of the project were spent in developing promotional materials such as brochures and lecture PowerPoint/ video that was used in future visits in the selected areas where BBM was promoted. Once the community quarantine protocols were eased in the nearby municipalities, capacity building was done through the conduct of brief training regarding the use and benefits of the selected BBM, dissemination of otional materials, and visitation of field trials or on-farm demonstrations.

Field Demonstration Trials of the Efficacy of VAMRI and Selected BBM

Field Demonstration trials of the efficacy of VAMRI and selected BBM on soybean, corn, and peanut and intercrops were initially conducted in the selected areas in nearby towns or provinces of Laguna due to Covid restrictions. These sites were in Magdalena, Victoria, Bay, Los Baños (BIOTECH-UPLB), Cabuyao, Laguna and Sariaya, Quezon.

Newly–developed BBMs such as Zinc solubilizing inoculant, phosphate solubilizing inoculant and nitrogen-fixing inoculant were found to have a positive interaction with VAMRI in increasing growth and yield of various crops tested.

Likewise, yield of cassava (Lakan 2) intercropped with corn was significantly increased by the combination of three BBMs PhosphoLink + VAMRI + BioPlasma.

The three different field demo trials of effectiveness of BBM on pole sitao (Negrostar) in Victoria, Laguna. with or without intercrops revealed that plants inoculated with VAMRI and Oryzinc performed best among other treatments.

Another field demonstration trial was established in Talavera, Nueva Ecija with the farmer cooperator Mr. Jay Maniquis, using Sweet Pearl F1 corn as the test crop.

The area was identified to be K and Zinc-deficient one.The parameters gathered were the number of ears, weight of fresh ears with and without husk, dry weight of kernel, and biomass weight at harvest. Aside from the experimental data, Mr. Jay Maniquis, the farmer-cooperator at Talavera, Nueva Ecija was grateful of this collaboration with BIOTECH. He said that the BBMs used greatly helped him and his co-farmers address their problems on the increasing cost of chemical fertilizers.

Field demonstration set ups and training workshop in Alicia, Isabela

Researchers of UPLB-BIOTECH visited Oshwind Multipurpose Cooperative in Alicia, Isabela last March 21, 2022. Isabela is known for its mungbean plantations and is the biggest producer of mungbean in the Philippines. Mr. Ricky Mabunga, a businessman and our cooperator in the province, introduced us to the mungbean farmers in the area. A field trial was established at the municipality and the mungbean seeds "Labo" variety were seed coated with nitrogen-enhancing/ fixing microbial inoculants NitroPlus and NitroLink, together with the Vesicular Arbuscular Mycorrhizal Root Inoculant (VAMRI). The farmer's practice in the area is to sow mungbean seeds after rice planting. Thus, planting mungbean with the dried rice straws in the field. The farmers do not apply any chemical fertilizer in the mungbean plants. This farmer's practice was adapted by the researchers for the field setup. After 60 days, the team together with the farmers of Alicia harvested the mungbean crop. A training seminar regarding the utilization of BBMs was conducted by the researchers as well as a Farmer's Field Day. Positive responses were received from the farmers of Isabela as there is an increased yield in their produce. The farmers and the cooperative were also grateful of the information and knowledge imparted by the research team.

SUMMARY AND RECOMMENDATIONS

Enough has been done with the following goal

Expanding project Reach/Geographical Coverage.

Sustainability of Project Intervention. Strong linkages with the LGUs and SCUs have been established

Trainers' training. Several trainer's trainings have been conducted, to expand and strengthen the technical support needed for a nationwide adoption of BBM technology.

Advocacy for Increased Government Support to the BBM Program. However there is still a clear need to strengthen the advocacy effort for increased government support to the BBM program. The present project intends to package and publish its results as an advocacy material to further convince agricultural policy makers, LGU officials and other key players in the government. Nevertheless, more important achievements along this end can be realized if the present project can be continued and expanded.

There is an urgent need for the upscaling of the production of the BBM for nationwide utilization for organic agriculture, food security and sustainable agriculture.

Dr. Marilyn Borja-Brown is the current Director of the National Institute of Molecular Biology and Biotechnology (BIOTECH) at the University of the Philippines Los Baños (UPLB).

A prolific researcher and esteemed expert in her field which is Plant Pathology, Dr. Brown has received several national and international awards in recognition of her inventions in agriculture, and scientific outputs. A well-published researcher, Dr. Brown has spearheaded several major research projects at BIOTECH that resulted to important products and technologies that improved the quality and safety of agricultural crops, food, and feed.

Dr. Brown developed a total of nine technologies, including a food safety detection kit with a granted patent; and biofertilizers and inoculants for control of soil-borne pathogens, and growth enhancement of crops, leading to increased yield and income for Filipino farmers. This include the Vesicular arbuscular mycorrhizal root inoculant or VAMRI that is already being used by numerous farmers and agriculture businesses all over the country due to its efficacy.

Dr. Brown is also affiliated with 10 international and national scientific and professional organizations, including ASEAN networks. She is active in capacity building activities and has organized and hosted a number of international and national symposia.

As the Director, Dr. Brown tirelessly steers BIOTECH towards modernization. She has persistently and proactively pushed for funding of the enhancement of its research, development, extension, and operations. Dr. Brown also maintained quality management at BIOTECH through the continued accreditation of the institute with ISO 9001:2015 which recognizes its management system that follows the international quality management standards in biotechnological research, development, and extension related to agriculture, food, forestry, industry, environment, and energy; and its technical and laboratory services.

Under her leadership, BIOTECH thrives with budget allocation from the General Appropriations Act as enhancement for its research, development, and extension activities.

Postharvest Quality and Safety Management of Organically-Grown Fruits and Vegetables

Dormita R. Del Carmen, Elda B. Esguerra, Helen A. Barrios, Ryan Anthony O. Lualhati, Ana Mithuzela D. Espigol, and Grace Anne Alcantara

ABSTRACT. *The developing organic industry of the country is faced with the challenge of delivering organically-grown fruits and vegetables that have same safety, quality and shelf-life as their conventionally-grown counterparts. The project is thus implemented to develop technologies for maintaining the quality and insuring safety of organically-grown fruits and vegetables during harvesting, postharvest handling, storage and marketing. Postharvest technology research focused on: 1. determining safety of the produce from microbial contaminants along the various points in the supply chain; 2. characterizing and determining the physico-chemical properties and quality changes; 3. maintaining the freshness of the produce and extending shelf-life; and 4. minimizing postharvest disease.*

Baseline information on the state of organic produce system (e.g., types of fruits and vegetables cultivated, the scale of operation and the cultural management, harvesting, postharvest operations and the marketing practices) were obtained through the conduct of primary interviews with the stakeholders of the industry and field visits to pre-identified growing areas of organic fruits and vegetables and markets. A survey of consumer preferences was also conducted to ensure that the improvements made would address consumer or market needs and wants. Postharvest interventions/treatments to enhance quality/marketability and extend shelf-life or organic fruits and vegetables were identified. These are on non-refrigerated storage technique using the principle of evaporative cooling, the use of organic-based sanitizer in minimizing disease problem, the use of bio-ethylene in ripening fruits and fruit vegetables, the use of different types of retail packaging or plastic films, modified atmosphere packaging, and refrigerated storage. Information, Education, and Communication (IEC) materials in the form of technical bulletin and flyers were produced for printing/reproduction and dissemination to the stakeholders of organic fruit and vegetable value chain.

INTRODUCTION

Organic farming emphasizes the use of renewable resources, land management that maintains natural soil fertility, water conservation and rich biodiversity, and long-term sustainability (7CGR205.2 as cited by Plotto & Narciso, 2006). The rapid growth in organic food over the years has been attributed to increased consumer confidence and enhanced awareness about the possible health risks and environmental impacts of conventional food production system. The demand for organic products increases as people opt for healthier lifestyle, including food options such as fruits and vegetables that are chemical/pesticide-free. The shift from conventional to organic production entails different production system inputs creating a challenge to postharvest research.

As stated by Perkins-Veazie and Lester (2008), the greatest unknown and potentially the most challenging topic to research is to determine whether organically produced fruits and vegetables will inherently have reduced postharvest

shelf life compared with conventional produce. In organic produce, synthetic chemicals are not allowed, and this may result in postharvest shelf life problems that are of minor importance in conventional produce which allows the use of synthetic chemicals. The need for disease-free organic produce is as important as for non-organic produce. However, the methods for controlling postharvest diseases which do not affect the organic integrity of the produce are limited (Narciso & Plotto, 2006). There is a need therefore to develop novel approaches to solving possible postharvest diseases and shelf life issues in an organic system. Moreover, certain postharvest practices approved for organic produce may affect appearance or cause changes in the phytochemical and nutrient content and even change in the ripening pattern or storage potential which in turn can affect harvest operations, marketing qualities and consumer acceptance. These aspects are potential areas of scientific study. The challenge therefore in organic system is to deliver organically-grown fruits and vegetables that have the same safety, quality and shelf life as conventional produce that could benefit growers, traders and distributors given the fact that tools or techniques for sanitation and postharvest treatments are not as widely available for organic as for conventional system.

This study therefore, was undertaken to develop technologies for maintaining the quality and insuring safety of organically-grown fruits and vegetables during harvesting, postharvest handling, storage and marketing. Specifically, this aimed to document the current production, post-production, and marketing practices of organic farmers and to understand consumer preferences and buying habits for organically-grown fruits and vegetables. Critical points in the harvesting and postharvest handling chain where quality is lost were identified in order to develop appropriate technologies.

METHODOLOGY

Documentation/ Gathering baseline information on organic production and postproduction systems

Baseline information on the state of organic produce system (e.g., types of fruits and vegetables cultivated, the scale of operation and the cultural management, harvesting, postharvest operations and the marketing practices) were obtained through the conduct of primary interviews with the key people or stakeholders of the industry and field visits to pre-identified growing areas of organic fruits and vegetables and markets.

Consumer research on the quality of organic produce

A consumers' preference survey was conducted in existing production or market centers in Quezon, Laguna, Batangas, Metro Manila, and La Trinidad, Benguet using a structured questionnaire. Information on what quality attributes are desired by the consumers, or their expectations and how much are they willing to pay for organic produce were among the output of this activity.

Assessment of produce quality changes and microbiological safety along the chain

Physico-chemical characteristics of selected organically-grown fresh produce like total soluble solids, acidity, and vitamin C content were determined to establish baseline data on quality. To determine microbial safety of organically-grown vegetable produce, a series of sampling were conducted at the farm and market levels for analysis for microbial contaminants specifically the presence of *E.coli* and *Salmonella*.

Development of suitable postharvest treatments to extend shelf life and

maintain microbiological safety of organic produce

Based on the documentation activities, the postharvest interventions/treatments to enhance quality/marketability and extend shelf-life or organic fruits and vegetables were identified. These are on non-refrigerated storage technique using the principle of evaporative cooling, the use of organic-based sanitizer in minimizing disease problem, the use of bio-ethylene in ripening fruits and fruit vegetables, the use of different types of retail packaging or plastic films, modified atmosphere packaging, and refrigerated storage.

Packaging and promotion of appropriate technologies to maintain the quality and safety of organic produce

During the first year of project implementation, where postharvest technologies on organic fruits and vegetables are still to be optimized, technology dissemination or awareness training on the basic/general concepts and principles of postharvest handling were conducted upon request of, and in cooperation with the organic industry stakeholders, and the sponsoring LGU's and private agri-business. For the rest of the project years, trainings were continuously undertaken and results of research studies were included in the program. Information, Education, and Communication (IEC) materials in the form of technical bulletin and flyers were produced for printing/reproduction and dissemination to the stakeholders of organic fruit and vegetable value chain.

RESULTS

Documentation/Gathering baseline information on organic value chain: production and postproduction systems

A. Characteristics of the fresh organic fruit and vegetable supply/value chain

Organic cultivation of fruits and vegetables is done either in open field, semi-enclosed (with net or plastic roofing) or greenhouse systems (sophisticated or improvised), and their combinations. The specific types of vegetables grown include highland (leafy lettuce, pechay, arugula, broccoli, cauliflower, cabbage, carrots, cucumber, strawberry, herbs and spices, etc.) and lowland types of vegetables (pechay, tomato, eggplant, bitter gourd, bottlegourd, beans, winged bean, string beans, etc). Most farms regardless of location grow lettuce and other leafy vegetables. Other highland vegetables were also introduced in the lowland areas such as cabbage, broccoli, cauliflower, etc.

The supply chain of organic fruits and vegetables is generally short and simple where the growers themselves individually or through the association or farmers group are directly engaged in marketing of their produce to the consumers through the specialty organic or weekend markets. Although the large-scale growers also practice direct marketing where consumers or visitors buy vegetables directly from their farms, they market the bulk of their produce to institutional buyer-retailers like supermarkets, groceries and specialty stores.

B. Production, postharvest handling and marketing practices

Production, handling and marketing practices of small organic vegetable growers are more or less similar in all production areas in Luzon particularly in the use of inputs, fertilizer and pesticide management, harvesting and manner of marketing. Postharvest handling practices are also simple. After harvesting the produce, a little sorting is done, then these are placed in available packaging materials such as plastic crates, plastic bags or bundled in banana leaves. The produce are then transported to weekend organic markets and displayed in retail shelves or in the packaging containers with minimal handling. For the export of organic Balangon banana, the handling practices are more or less similar to

the conventionally-grown export Cavendish bananas by the multinational companies in the country, except that the former adheres to organic standard of non-use of any chemicals.

C. Challenges and opportunities in the organic fruit and vegetable supply chain

According to reports of DA, areas for organic production of fruits and vegetables are still growing and so with the demand for these produce. However, as observed, uncertainty of the supply and demand is still a problem. Certification of organic farms and inputs by a third party certifier is also seen as one area of concern as smallholder farmers are financially incapable of meeting the requirements for certification. Very few big farms reported to obtain a third party certification. Because of certification standards, the big supermarkets and other institutional markets could not just accept organic products which are not labelled accordingly. Thus, only the commercial-level organic farms could access the big market. Competition is also a challenge, because most consumers still preferred lower-priced conventionally-grown vegetables with good visual quality while organically-grown produce are usually priced higher and at times, quality could not be at par with the conventionally-grown counterpart.

Survey of consumer preference

The consumers have two major reasons for buying organic produce: 1) free from pesticide contaminants and are safe to eat, 2). are perceived to have better taste and be more nutritious than the conventionally-grown counterpart. Among the quality attributes looked for in buying organic vegetables, freshness was ranked first by majority of respondents, followed by cleanliness, size, absence of decay and absence of damage due to handling and insect pest.

Assessment of produce quality changes and microbiological safety along the chain

Presence of microbial contaminants on organically grown lettuce varieties were detected on samples from the different points in the handling chain. Coliform counts increased from the initial level at harvest throughout all points in the supply chain. The rate of increase varied among the three varieties which might be attributed to the physical characteristics of the leaf surface. Results from the handling trial to identify the critical points of microbial contamination showed that almost all surfaces that came in contact with the lettuce had a significantly high microbial count. Possible contamination may be through the use of unclean trimming scissors and plastic crates, and of unclean farmer's hands. Washing with chlorinated water reduced microbial count in all points in the supply chain.

Development of suitable postharvest treatments to extend shelf life, enhance marketability and maintain microbiological safety of organic produce

1. Use of evaporative cooling as an alternative to refrigeration

The major advantage of using evaporative cooling is on shelf- life extension of about 1- 4 days for selected fruits and vegetables such as leafy vegetables, carrots, radish, eggplant, cucumber, bitter gourd (ampalaya) and rambutan. This technique also minimized weight loss in fresh produce, hence less shrivelling, wilting, yellowing or browning. The produce visual quality is maintained and marketable life extended.

2. Hot water treatment for disease control

of organic Balangon banana

In the first trial, HWT at 53°C for 5-10 minutes indicated its potential for crown rot and anthracnose control even when fruits have high natural infection. Bananas subjected to the treatment also ripened normally. However, in the two succeeding trials, different results were obtained, because the untreated had lower incidence of crown rot and anthracnose than the HWT. Overall, the results of the three experiments on HWT as an alternative physical method of disease control cannot be recommended yet due to variability in the response of bananas from different growing areas.

3. MAP/Vacuum packaging of Balangon banana

Overall, the results of the three trials have proven that the use of MAP with or without ethylene absorbent (EA) was effective in maintaining green life of the fruit and in controlling crown rot development even up to the ripe stage.

4. MAP of other vegetables for shelf life extension: Broccoli, cabbage, lettuce, snap beans, strawberry and cherry tomatoes

a. Use of LDPE cling film as overwrap for broccoli

b. Use of LDPE cling film as retail packaging for cabbage

c. Romaine lettuce packed in polypropylene plastic bag had 1-2 days longer shelf life than the unpacked ones.

d. Organic snap beans packed in polypropylene plastic bag kept in good marketable condition (VQR 5) for 5 days, while those packed in LDPE cling film was kept longer for 8 days.

e. Organic strawberry kept in good quality for two days in polypropylene plastic tray with LDPE cling film and in polyethylene plastic assembly box, both with minimal rotting.

f. Cherry tomato kept marketable for 10 days in polypropylene plastic tray with LDPE cling film and for 11 days in polyethylene plastic assembly box, both without disease.

5. Ripening Using Bioethylene

Rain tree leaves proved to be a high ethylene producer and are suitable bioethylene sources for induction of ripening of Latundan and Saba bananas. The proportion of 10% by weight can be used for an exposure period of 48 hours in sealed condition.

SUMMARY AND CONCLUSION

Development of postharvest technologies for maintaining the quality and safety of organically-grown fruits and vegetables is a continuing challenge to cope with the developing organic agriculture industry in the country. The use of the evaporative cooler, bioethylene as ripening agents, hot water treatment and organic acids for disease control, and modified atmosphere packaging for shelf life extension are some of the interventions/treatments / protocols identified in this study. Optimization of these protocols appropriate for a specific commodity still remains to be established. Once technologies are mature, awareness training and capability building program on postharvest handling of organically-grown fruits and vegetables could be provided to the organic practitioners in response to the need of the industry.

REFERENCES

Perkins-Veazie, P. and Lester, G. 2008. Postharvest challenges for organically-grown orchard fruit. Hort Science 43:35-37.

Plotto, A. and Narciso, J.A. 2006. Guidelines and Acceptable Postharvest Practices for Organically Grown Produce. Hort Science 41: 287-291.

Helen A. Barrios is a University Researcher II at the Postharvest Horticulture Training and Research Center (PHTRC) of the College of Agriculture and Food Science, University of the Philippines Los Baños (UPLB). She earned her BS Agricultural Chemistry degree at UPLB and is currently pursuing her MS degree in Plant Pathology minor in Horticulture also at UPLB. Her research interest is on the development of sustainable and environment-friendly postharvest disease control technologies for fruits and vegetables.

Assuring Quality, Safety and Nutritional Benefits from Organically-Grown Fruits and Vegetables through Postharvest Systems Improvement

Dormita R. Del Carmen, Elda B. Esguerra, Helen A. Barrios Ryan Anthony O. Lualhati, Mary Shaddeline Zafra, and Regina Monic M. Bacalla

ABSTRACT. *As a continuation of the previous project funded by DA-BAR in 2018, this project was implemented to further develop, improve and optimize postharvest handling protocols that are commodity, location-and situation specific to maintain quality and nutritional value, extend shelf life, reduce losses, and insure safety of fruits and vegetables grown under different organic production systems. Major types of production and postharvest handling systems of selected organic produce were documented and several handling experiments for technology development, adoption and optimization were conducted. Basic data on postharvest characteristics (physical, chemical and mechanical properties), behavior, nutritional value and quality changes of selected organically-grown fresh fruits and vegetables were gathered as basis for technology intervention. Information on microbial and chemical contamination and on the critical control points in the value chain were also determined to enhance stakeholders' awareness on the importance of Good Agricultural Practices (GAP).*

General findings include that physical dimensions of organic produce were smaller than conventional produce. The ascorbic acid content of organically-grown produce was superior to its conventional counterpart. The results from this experiment can be used to further strengthen methodologies and evidences in comparing organic and conventional produce. The use of Oxo-biodegradable and polypropylene plastic bags was in general the most effective retail packaging in maintaining marketability, minimizing yellowing, wilting and disease. Disease control treatments such as using alum, lime powder, and citric acid could be possible alternatives to the use of chlorine. Microbial analysis experiments showed that multiplication of microbial contaminants were continuous during retail display and can reach a harmful level that may cause disease. Washing the produce using chlorinated water at 100 ppm concentration may reduce and minimize the risk of E. coli and Salmonella contamination. Finally, the CoolBot® Technology developed and tested is an effective temporary holding facility to maintain quality of freshly harvested produce.

Through these gathered evidences, PHTRC was able to conduct trainings, and generate poster papers, scientific papers for publication, and brochure to effectively disseminate information on postharvest technologies and handling of organic fruits and vegetables.

INTRODUCTION

The previous research project done by Del Carmen et al. (2016) provided benchmark data and information on the various types of organic production and postharvest handling systems in selected areas of Luzon, Philippines. Quality characterization had been undertaken and simple postharvest handling technologies were also adapted and optimized for selected produce. Moreover, capability building of stakeholders in selected fresh produce organic value chain, mostly

vegetable value chain, had been done. However, the scope and duration of the study is still limited with few areas covered in Luzon and only one in the Visayas. Few postharvest technologies were optimized due to seasonality, non-availability and low quantity of produce for the experiment, and except for vitamin C content, the other nutritional values such as anti- oxidant properties like beta carotene and phenolic compounds (flavonoids, phenolic acids) have not yet been determined.

To better promote organic produce and justify its relatively higher price, there must be added quality attributes and better product packaging/presentation through improved handling technologies so as to encourage greater purchase. It is also important to communicate key quality attributes of organic food so that producers and traders can market organic food more effectively and sustain the growth of organic agriculture. Information from scientific researches on quality characteristics, postharvest behavior, including the nutritional properties of organically- grown fruits and vegetables, and their comparison with the conventionally-grown produce should be made available to all stakeholders.

METHODOLOGY

Study 1. Documentation and determination of major types (Modalities) of production and postharvest handling systems of selected organic fruits and vegetables

An in-depth documentation of production and postharvest handling practices and challenges on selected organic fruits and vegetables (specifically leafy vegetables mostly lettuce, tomato, eggplant, qnd broccoli) in Benguet, Nueva Vizcaya, Negros Occidental, Laguna, Rizal, and Batangas was conducted to identify the major modalities and variables that may affect postharvest quality and losses.

Study 2. Postharvest quality evaluation of organically-grown produce under selected production and postharvest handling systems, and identification of postharvest technology interventions/ protocols for quality improvement

Simultaneous with the process of documentation was the conduct of quality profiling including nutritional value and postharvest characterization (physico-chemical and morphological characteristics) of selected fruits and vegetables in major types of production and postharvest handling systems to have baseline information for comparison. Postharvest behavior such as changes in visual quality, weight loss, firmness, total soluble solids, titratable acidity, and disease incidence and severity of the commodities were determined under ambient and low temperature conditions, simulating retail in supermarkets. Microbial (*E. coli, Salmonella*) and pesticide residue were also tested.

Study 3. Handling trials and technology development, adaptation and optimization

To obtain a more accurate data on quality and postharvest characteristics of organic produce, sampling was done for several time periods or seasons. Using the baseline information, possible improvements in postharvest handling were identified. The effects of variables like type of production system and harvesting practices, packaging, postharvest treatments (e.g. washing and disease control) and storage methods (e.g. use of CoolBot® technology) were assessed and optimized for quality and safety improvements recommendations.

Study 4. Quality comparison between organically and conventionally grown produce

Quality comparison of selected organically-grown and conventionally-grown vegetables

was conducted. The parameters for comparison were physical and physico-chemical qualities, nutritional value, and microbiological safety and pesticide residue levels.

FINDINGS

There were different types of organic production system observed but there were also commonalities in the practices, be its certified, under guarantee system or just practicing organic production. Some grow vegetables in net houses, and others in improvised plastic films cover. Vermicompost, chicken dung, and carbonized rice hull are generally used as soil amendments. The use of fermented or concocted juices from plant and other left-over materials is also common. Planting of Marigold as insect repellent and insect trap (yellow trap) is used for pest control.

Lettuce. Results from a comparative analysis of organically- and conventionally-grown 'Romaine' lettuce and its response to different packaging material show that the physico-nutritional quality did not significantly differ among the production systems apart from vitamin C being higher in organic-certified lettuce as compared to conventional. Postharvest qualities of lettuce were also not influenced by production system, but was slightly influenced by packaging through minimizing weight loss and wilting when polypropylene and Oxo-biodegradable plastic films were used.

Pechay. Pechay grown in conventional production system was slightly heavier and had longer stalks than those grown in the organic production system. However, pechay grown in the latter system had bigger leaves both in length and circumference. Vitamin C content of organically-grown pechay was higher than conventionally-grown counterpart and so with the dry matter content. But overall, there appeared to be no significant differences in physical characteristics and postharvest behaviour of pechay grown in the two production systems (organic and conventional).

Eggplant. Organically- and conventionally-grown eggplants were similar in length, diameter and average weight. However, the peel color was slightly different with the eggplants from the organic production having a generally brighter color. The ascorbic acid content of organically-grown eggplant was greater than the conventional counterpart, while the total soluble solids was similar in both systems. Packaging fruits in oxo-biodegradable and cling film provided longer shelf life than those fruits that were unpacked. Organically- grown eggplant packed in Oxo-biodegradable plastic had relatively higher browning than the conventionally-grown. Hence, cling wrap might be more suitable for the organic eggplant while the two packaging materials can both be used for the conventional counterpart. Fruits remained in good quality for 19 days when stored at 13^{o}C.

Broccoli. Broccoli heads from a certified organic farm were smaller and more uniform in size whereas those from the internal guarantee system were bigger and less uniform in size. In terms of color, those from the former were lighter and greener. These differences in size and color could possibly be attributed to the harvest maturity index used by the farmers in these sites considering that they are of the same variety and similarly grown organically. Vitamin C content of broccoli from a certified organic farm was slightly lower compared to those from the internal guarantee farm. The Vitamin C content in fruits and vegetables can be influenced by various factors such as genotypic differences, preharvest climatic conditions and cultural practices, maturity and harvesting methods, and postharvest

handling procedures. Broccoli heads packed in Oxo-biodegradable plastic were better protected from water loss than those packed in cling wrap. Yellowing of florets was also more rapid in broccoli heads wrapped in cling wrap than those packed in Oxo-biodegradable plastic. Overall visual quality declined with storage time in both plastic packaging films. Decline in VQR was more rapid in heads packed in cling wrap than those packed in Oxo-biodegradable plastic. This decline in VQR was primarily due to yellowing and to the presence of disease.

Tomato. Quality characteristics of 'Apollo' tomato fruits were similar at harvest for both organic and conventional production systems. These included properties such as color index, firmness, weight, titratable acidity, and vitamin C content. Total soluble solids however was higher in fruits harvested from plots with fermented fruit juice treatment. Results suggest that the production system affected the postharvest behavior or shelf life of tomato fruits. Quality of tomatoes harvested from plots applied with fermented plant juice deteriorated faster compared with those from plots not applied with fermented plant juice. This rapid deterioration was primarily due to shriveling and presence of disease. For better quality maintenance, fruits should be packed in polypropylene bags.

Onion. The diameter and height (size) of 'Red Dragon' onions sourced from the organic and conventional production system were similar. Total soluble solids content of organic Red Dragon' was higher than conventionally-produced. Values of TSS content of organically-grown ranged from 11.4 to 13.2°Brix and the conventionally-grown ones had TSS ranging from 9.9 to 10.6°Brix during the 8-week storage at ambient. Organically-grown onions had significantly higher dry matter content. Higher dry matter content generally increases the capacity of materials to bear external load before deformation. These results translate to better storability and handling quality of organically-grown onions compared to conventionally-grown.

Disease Control. Several organic compounds tested and optimized for disease control in organically- grown vegetables, and those that showed potential are: sodium bicarbonate minimized disease incidence in eggplant up to 4-6 days at 20°C; chlorine dioxide showed the best control of disease in tomatoes, followed by sodium hypochlorite up to 8 days at 20°C storage; and for pechay, lime (10%) showed to have the potential in minimizing disease incidence after 3 days at 20°C. Treatment with lime solution appeared to be the most promising both in reducing disease incidence and severity in lettuce. A 5% lime solution was effective in lowering the disease, indicating the potential of lime for disease control. Treatments with alum, lime powder, and citric acid have comparable effects with chlorine treatment and could be possible alternatives to the use of chlorine.

Microbial Safety. Low level of *E. coli* detected in freshly harvested lettuce reached a high level of contamination after 3 days at the retail display. This indicates that growth and multiplication of microbial contaminants continue during display and may reach a harmful level and cause disease if not totally removed by careful washing before consumption. In Romaine lettuce however, washing the produce in chlorinated water eliminated *Salmonella* contamination. Risk of *Salmonella* contamination regardless of production system was observed in tomatoes.

Pesticide Residue. Pesticide residue was not detected in onions for both organically- and conventionally grown, conventionally-

grown tomatoes, and in organically-grown Romaine lettuce and eggplant.

CoolBot® Technology. CoolBot® can be used to convert an ordinary window-type ACU as a refrigeration system for walk-in chiller. Proper room insulation and compatible ACU are the critical consideration when fabricating CoolBot® walk-in chiller. It is recommended to store fresh produce not more than six days inside the chiller at 7-10°C. In addition, the chiller is best for highly perishable high value crops like lettuce to have high rate of return of investment. Further studies using CoolBot® and different cold facility setup is recommended to establish the best setup and use for the device.

SUMMARY AND CONCLUSION

The physico-chemical characteristics of organically and conventionally-grown fruits and vegetables varies with commodity. Harvest from both production systems are mostly similar physically but nutritional value like Vitamin C, TSS, and total phenolics may differ significantly. Quality and safety maintenance is attained by appropriate packaging and careful handling along the supply chain. Postharvest treatments like washing maybe employed to minimize the risk of microbial contamination. Application of disease control agents and the use of CoolBot® technology help to ensure quality and safety of produce reaching the consumer.

Helen A. Barrios is a University Researcher II at the Postharvest Horticulture Training and Research Center (PHTRC) of the College of Agriculture and Food Science, University of the Philippines Los Baños (UPLB). She earned her BS Agricultural Chemistry degree at UPLB and is currently pursuing her MS degree in Plant Pathology minor in Horticulture also at UPLB. Her research interest is on the development of sustainable and environment-friendly postharvest disease control technologies for fruits and vegetables.

Rice

Efficacy Evaluation of IMO Applied with *Metarhizium anisopliae* against *Scotinophara coarctata* Fabricus (Rice Black Bug)

Joseph O. Castillo[1]

ABSTRACT. *A study was conducted to optimize indigenous entomopathogenic microorganisms against rice black bugs from July 2020 to June 2021. The experimental design was arranged in the randomized complete block design with ten treatments replicated three times. The application of IMO + M. anisopliae at six days intervals can effectively control the population of Scotinophara coartata in causing economic damage to rice plants. Moreover, the application of IMO + M. anisopliae at any interval cannot affect the population of the beneficial arthropod populations.*

Keywords: Organic rice production, Indigenous Microorganism, M. anisopliae, Scotinophara coartata, Scirpophaga innotata

RATIONALE

In the Philippines, rice is the primary staple food for most Filipinos. Rice can be considered a political food because any increase or decrease in production has a direct effect on the economy of the country. There are different factors affecting rice productivity, and one of these is insect pest infestation. Moreover, rice farmers solely rely on synthetic insecticides in controlling the insect pest population.

With the passage of the Organic Agriculture Act (RA 10068), rice production is expected to shift to organic production to comply with the provisions of the law. However, the transition to organic production is slow if not lagging. Almost all farmers are still using the conventional way of farming despite their knowledge of the detrimental effect of the persistent and systemic pesticides in our environment. Conversations with farmers reveal that even the regulated or commonly known banned pesticides are secretly sold and used in the locality.

To lessen the detrimental effect of pesticides, scientists and some researchers have come up with the technology in combating insect pests using the indigenous micro and macroorganisms, commonoly known as biocontrol agents. A common biocontrol agent mass-produced by the government and non-government organizations is *Metarhizium anisopliae*.

There are overwhelming success stories of the use of indigenous microorganisms (IMOs) and *M. anisopliae* as a control agent against several insect pests in other countries (Iwanicki et al., 2019; Peng et al., 2021). However, in the Philippines usage of M. anisopliae remains uncommon. This study is important in the generation of information from the field by assessing the state of the *M. anisopliae* population in the farmer's field and conducting a thorough investigation of *M. anisopliae* and IMOs as a biological control agent.

The study was conducted to optimize the indigenous entomopathogenic microorganisms against *Scotinophara coarctata* Fabricus (rice black bug or

1 Department Chair, Department of Crop Protection, College of Agriculture, University of Southern Mindanao, Kabacan, Cotabato, Philippines

RBB). Specifically, this study aimed to optimize the frequency of application and evaluate the effectiveness of the IMO applied together with *M. anisopliae* against RBB; and to evaluate the interaction of IMO applied together with *M. anisopliae* against RBB and consequent grain yield see table 1.

The study was conducted in Kabacan, Cotabato. The experiment was laid out in a randomized complete block design (RCBD) and replicated three times with 10 treatments (Table 1). Each plot size measured 4 m × 5 m. There was 1 m between the blocks and 0.5 m between plots. The total plot measured approximately 652 m^2. The study was conducted in two cropping seasons, wet and dry.

METHODOLOGY

Preparation of the Cultured *Metarhizium anisopliae*

Pure culture of *M. anisopliae* was sourced from the Provincial Agriculture Office (PAO), Amas, Kidapawan, Cotabato. Proper handling was strictly exercised and observed as prescribed by the agency. The acquired cultured *Metarhizium* was stored in cool dry room temperature.

Application of the *M. anisopliae* and IMO

The first application of IMO and M. anisopliae was applied 6 days after transplanting (DAT). For the first factor of frequency of application, the interval was 6 days until 96 DAT. For the second factor, the interval was nine days until 90 DAT. Lastly, for the third factor, the application was 12 days until 96 DAT. The pure culture was diluted in chlorine-free water following the recommended rate of approximately $1x10^{12}$ spores/mt.

Data Gathered and Statistical Analysis

Rice black bug (RBB)

Population count. The assessment was done 28 (DAT) at seven days intervals until one week before harvest. This was done by visually counting the nymphs and adults of RBB from 20 hill samples randomly selected per plot.

Number of deadhearts. This was assessed

Table 1. Treatments used in the efficacy evaluation of IMO Applied with Metarhizium anisopliae against *Scotinophara coarctata* Fabricus (Rice Black Bug) in Kabacan, Cotabato condition.

Treatments	Description
T1	IMO applied in an interval of 6 days
T2	*M. anisopliae* in an interval of 6 days
T3	IMO + *M. anisopliae* in an interval of 6 days
T4	IMO applied in an interval of 9 days
T5	*M. anisopliae* in an interval of 9 days
T6	IMO + *M. anisopliae* in an interval of 9 days
T7	IMO applied in an interval of 12 days
T8	*M. anisopliae* in an interval of 12 days
T9	IMO + *M. anisopliae* in an interval of 12 days
T10	No application.

at 28 and 56 DAT on 20 hill samples randomly selected per plot. Deadhearts caused by RBB were are differentiated when you will pull the central shoot (onion-like) it will not be pulled, and this is due to the presence of RBB sucking the sap at the base of the plant.

Number of whiteheads. This was assessed 10 days before harvest (DBH) on 20 hill samples randomly selected per plot. Whiteheads caused by RBB are when the empty panicle will not be pulled, and this is due to the presence of RBB sucking the sap at the base of the plant.

Rice black bug population infected with M. anisopliae. The population count of the infected Rice black bug was done five, eight, and 11 days after application. The infected insect pest was collected, counted, and recorded accordingly per plot.

FINDINGS

Insect Pest Population

The population of the RBB either nymph or adult as affected by the application of *M. anisopliae* and IMO in different frequencies during the wet and dry seasons shows significant differences among the treatment means. Results imply that the combination of IMO and M. anisopliae at an interval of six days can protect rice plants against the infestation of the adult RBB during the wet and dry seasons. With the consistent result, where there was a lower population of adult RBB compared with other treatments. The longer the interval of the application of IMO and *M. anisopliae*, their capacity to protect the rice plant was reduced, compared to the shorter interval of application. The shorter the intervals have more spores of *M. anisopliae* present in the field and give more protection against insect pest infestation.

RBB Population Infected with *M. anisopliae*

Assessment of the adult RBB population infected with *M. anisopliae* during the wet and dry cropping seasons revealed a meaningful comparison of significance among treatment means. The result implies that a shorter application interval translates to a higher presence of the *M. anisopliae* on the rice field, thereby increasing the number of RBB adults infected with *M. anisopliae.*

Grain Yield

Yield assessment of the rice plant during wet and dry cropping seasons as affected by IMO and *M. anisopliae* in different frequencies of the application reveals six days application interval of IMO+M. anisopliae gave a higher yield. A shorter application interval had a higher impact on augmenting IMO population and *M. anisopliae* spores, ensuring better protection of the rice plant and higher grain yield of rice.

CONCLUSION AND RECOMMENDATION

Based on the result of the study it can be concluded that the application of IMO+*M. anisopliae* at the interval of six days can effectively control the population of RBB and reduce their damage to the rice leading to higher yield.

Considering the results of the study, it is recommended to conduct more studies about organic rice production to improve the current practices of organic rice production and innovate novel technologies in the organic production practices to alleviate the status of organic products where only a handful of practitioners engage this type of production management.

REFERENCES

Iwanicki, N. S., Pereira, A. A., Botelho, A. B. R. Z., Rezende, J. M., Moral, R. D., Zucchi, M. I., & Júnior, I. D. (2019). Monitoring of the field application of *Metarhizium anisopliae* in Brazil revealed high molecular diversity of *Metarhizium* spp in insects, soil and sugarcane roots. *Scientific Reports*, *9*, 4443.

Peng, G. Xie, J. Guo, R., Keyhani, N. O., Zeng, D., Yang, P. & Xia, Y. (2021). Long-term field evaluation and large-scale application of a *Metarhizium anisopliae* strain for controlling major rice pests. *Journal of Pest Science*, *94*, 969–980.

Joseph O. Castillo is a faculty member of the Crop Protection Department, College of Agriculture, University of Southern Mindanao. He teaches graduate and undergraduate courses with a concentration in Integrated Pest Management and Biological Control. He is an accredited BAFS researcher for Organic Bio-control Agents, as a third-party researcher. He earned his BS in Agriculture major in Entomology and MS in Crop Protection with a specialization in Entomology at the University of Southern Mindanao. He is interested in organic farming and the production of effective entomopathogens.

Efficacy of Aktrine 4.6 SL (Matrine) for the Control of Major Insect Pests of Rice

Joseph O. Castillo[1] and Rex John R. Celiz[2]

ABSTRACT. *Aktrine 4.6 SL is a matrine, which is a natural derivative extracted from the leaves and roots of shrubby sophora (Sophora flavescens). This study was conducted to determine the efficiency of Aktrine 4.6 SL as a biological control agent against rice black bugs (RBB) (Scotinophara coarctata Fabricus), rice bugs (Leptocorisa acuta Thunberg), and white stem borers (Scirpophaga innotata Walker). Three Aktrine 4.6 SL concentrations were used in this study: 0.5 mL·L^{-1}, 1.0 mL·L^{-1}, and 2.0 mL·L^{-1} of water. Pure water treatment served as the control. The experiment was set in Randomized Complete Block Design (RCBD) with four treatments, replicated four times on the populations of the three species. Results demonstrate that Aktrine 4.6 SL applied at 1.0 and 2.0 ml·L^{-1} can control pest infestation and damage. At these concentrations, rice black bug and rice bug populations as well as damage from stem borer were significantly lower compared to plants with no treatment or those applied with 0.5 ml·L^{-1} Aktrine 4.6 SL. Further, plots treated with 1.0 and 2.0 ml·L^{-1} concentrations of Aktrine 4.6 SL produced significantly higher grain yield. To minimize costs, a concentration of 1.0 ml·L^{-1} is recommended.*

Keywords: Aktrine 4.6 SL, Leptocorisa acuta Thunberg, Matrine, Scirpophaga innotata Walker, Scotinophara coarctata Fabricus

RATIONALE

Pest management is one of the primary considerations in rice production. If not correctly managed, pests can significantly reduce the yield and quality of harvests and income. The International Rice Research Institute (IRRI) report an estimated 37% of rice crops are lost due to different pest species (IRRI, n.d.-a). In the Philippines, pesticides remain the top option to combat different kinds of rice pests for many farmers (Donayre et al., 2014). Usage of toxic and persistent pesticides in agriculture is the primary control measure, where it can affect the biodiversity of the environment and ecology. The continuous use of inorganic pesticides lead to insect pest infestation, causing insect pest resistance and contamination of toxic compound in the environment (Fahad et al., 2015). In order to mitigate the detrimental effect of the toxic and persistent pesticides, it is important to look for alternative pesticides that are not highly toxic to the environment.

This study investigates the pesticide Aktrine 4.6 SL. It is a matrine, which is a natural derivative extracted from the leaves and roots of shrubby sophora (*Sophora flavescens*). Aktrine 4.6 SL is a broad-spectrum biological insecticide advertised as being efficient in the management of a wide range of pests (Korea Bio Co., 2014). It is a registered organic biological control agent listed in the product catalogue of the Bureau of Agriculture and Fisheries

1 Division of Entomology, Department of Crop Protection, College of Agriculture, University of Southern Mindanao, Kabacan, Cotabato, Philippines.

2 Research and Registration Division, Aktiv Multi Trading Co. Phils., Inc., Door no. 205, GRDC Building, Km7, Lanang, Davao City

Standards (Limsan et al., 2020). The catalogue prescribes Aktrine 4.6 SL for the management of flower thrips, scale insects, and mealybug in banana plants, and of whorl maggot, brown planthopper, rice black bag, and leaf folder in rice plants. Aktrine 4.6SL does not contain synthetic ingredients, is of low toxicity to humans and livestock, and is environmentally friendly (Korea Bio Co., 2014).

Sophora flavescens is a medicinal plant widely used in various pharmaceutical formulations for traditional medicinal remedies (Li et al., 2021) as well as in treatments against pests and natural enemies (Cheng et al., 2020; Hwang et al., 2009). Matrine and its derivatives possess anticancer, anti-inflammatory, antiviral, analgesic, anti- fibrotic, insecticidal and antimicrobial properties (Huang & Xu, 2016). Matrine may alsobe used for the prophylaxis and treatment of pathological conditions caused by estrogen deficiency or dysregulations sex-hormone-related metabolism (You et al., 2020). Against pests, matrine has been shown to be an effective eco-friendly bio control material in Chinese cabbage (Kim et al., 2013), 'Valencia' sweet orange (Zanardi et al., 2015), and 'Cavendish' banana (Celis & Ubaub, 2018). Kim et al. (2013) found that the combinations of *Bacillus thurengiensis* (BT) + Matrine and Matrine + Neem can give effective control and generate very high insecticidal activity against the 2 diamondback moth at 35 days after treatment. Zanardi et al. (2015) observed that a high concentration (150 ppm) of a matrine-based biopesticide caused a significant reduction of *Eutetranychus banksi* and *Panonychus citri* after 72 hours of application in a commercial sweet orange farm. Celiz and Ubaub (2018) showed that matrine- based pesticide was comparable with commercial insecticides in managing banana thrips. This study investigated the efficiency of Aktrine 4.6 SL as a biocontrol agent in rice. It aims to generate bioefficacy data needed to support the label expansion of Aktrine 4.6 SL with the Bureau of Agriculture and Fisheries Standard.

Three rice pests were investigated in this study: rice black bugs (RBB) (*Scotinophara coarctata* Fabricus), rice bugs (*Leptocorisa acuta* Thunberg), and white stem borers (*Scirpophaga innotata* Walker). RBBs are insects that attack rice plants in irrigated areas in almost all stages of growth (Catindig & Heong, n.d.; PhilRice, 2010). RBBs feed on the sap of the rice plant and can cause total damage and even death (PhilRice, 2010). According to Philrice (2010), female RBBs usually deposit their eggs on decaying outer leaf sheaths or on the basal part of the plant. Their eggs measure 1 mm long, and are laid in a mass of 40-60 eggs. Each female RBB can lay about 200 eggs during its lifetime. Eggs hatch after 5-7 days and become full-grown adults after six weeks.

Rice bugs are typically found during the flowering stage of the rice crop. Both immature and adult rice bugs suck out the contents of grains at the milking stage (Catindig, n.d.). They may cause small, shriveled, deformed, spotty, or empty grains, discoloration, or erect panicles (Catindig, n.d.). Female rice bugs lay eggs in rows of 10 to 20 on the upper surface of the leaf blade (Serrano et al., 2014). Eggs are oval and slightly flattened; their color turns from cream-yellow to reddish brown in one week (Serrano et al., 2014).

Stem borers feed upon tillers and can destroy rice from seedlint to maturity, causing deadheart and later, whiteheads (IRRI, n.d.-b). Stem borers are most destructive during the reproductive phase. The female rice stem borer is capable of producing up to 150 eggs; incubation occurs within 5-10 days (Samiksha, 2021). Young tillering rice plants can compensate

for stem borer damage by producing more tillers and are often undetected by farmers (Horgan et al., 2021).

In this study, various concentrations of Aktrine 4.6 SL were compared in terms of its effect on RBB and rice bug population, stem borer damage, and rice yield.

METHODOLOGY

The experiment was conducted in a private rice field in Maligaya, Lower Malamote, Matalam, Cotabato, Philippines. The field was planted with rice variety RC 158. The site lies in Liguasan marsh plains and is safe from flooding during the wet season.

The recommended cultural management practices of the farmer/ landowner for irrigated lowland rice were employed throughout the trial. Control of weeds and diseases were done as deemed necessary.

The experiment was set in Randomized Complete Block Design (RCBD) with four treatments, replicated four times. Each experimental plot measured 4 m × 5 m (20 m^2). Plots were separated by alleys measuring 1.5 m to avoid spray drifts to the minimum.

Three Aktrine 4.6 SL concentrations were used in this study: 0.5 $mL \cdot L^{-1}$, 1.0$mL \cdot L^{-1}$, and 2.0 $mL \cdot L^{-1}$ of water. Pure water treatment served as the control. The 3 required rates of treatments were quantified using a graduated cylinder, mixed in a small amount of water, and stirred well. The mixing container was filled with half of the required amount of water then the pre-mixed solution was added with continuous mixing. The remaining half amount of water was added to the mixing container and continuously stirred.

Assessment of insect population in rice was done a day before application of treatment to determine the pest pressure in the area. Areas with rice black bug, rice bug, and stem borer were chosen for the study. For each pest, ten plants per plot were randomly tagged in the inner rows of the plot (within a 9 m^2 sample area). The spray interval of the treatment solution was done in six cycles every 10 days from the first application (at 30, 40, 50, 60, 70, and 80 days after sowing). Application time was doneearly in the morning. Uniform spray deposits on the leaf surface were ensured by conducting spray calibration before applying the treatments.

Population (for rice black bug and rice bug) and damage (for stem borer) were assessed. Population of adult and immature stem borer was not assessed because the adult is highly mobile, and the larvae are hard to monitor until the nature of damage is visible once the egg hatched the larvae will immediately bore holes in the stem and stays inside the stem until it emerged into adult moth. Insect population was monitored early in the morning or not earlier than 4:00 in the afternoon. For rice black bug, population was assessed every after application of Aktrine 4.6 SL by counting nymph and adult bugs from the ten tagged plants per plot For rice bug, population was assessed by counting the number of nymphs and adults from the stem and base of the ten tagged plants per plot. Population counts were performed one day before the application of Aktrine 4.6 SL (starting at 29 DAS at ten day intervals until 79 DAS) and two days after application of Aktrine 4.6 SL (starting at 32 DAS at ten day intervals until 82 DAS).

For stem borers, the percentage of deadhearts (damaged tillers) and whiteheads were determined from the ten tagged plants.

Same with the procedure for rice black bug and rice bug, the number of deadhearts and whiteheads were performed one day before and two days after the application of Aktrine 4.6 SL.

Grain yield was based on 10 m^2 crop cut areas taken at the middle of each plot. The grains were tied and labeled according to the treatment. Harvested samples were threshed manually and cleaned by removal of the rice straw by bare hands. Unfilled grains were removed with the aid of an electric fan, then weighed by using a standard weighing scale to get the fresh weight. These were later sun-dried up to 14% moisture content. The grain yield per crop cut was converted to tons per hectare.

The data were analyzed using the Statistical Tool for Agricultural Research (STAR), a computer-aided statistical software of IRRI. Mean comparisons were tested for differences using one-way ANOVA; post hoc analysis was carried out through Tukey's Test.

FINDINGS

RBB population at the six-time points where significant results were found. The significant differences occurred two days after treatment. The results show that Aktrine 4.6 SL significantly prevented and reduced the RBB population.

The result implies that if Aktrine 4.6 SL is applied at a higher dose, their capacity to control the rice black bug population is also increased. In support of the result, among plots that had rice black bugs, bug burn was observed in the untreated plots while the treated plots did not show any damage caused by the rice black bug. It is evident that the mode of action of the Matrine is effective in controlling the rice black bug population.

The rice bug population at the four time points where significant results were found. Three of these (62, 72, 82 DAS) occurred two days after the Aktrine 4.6 SL treatment, and one (79 DAS) occurred one day prior to treatment. Plots applied with Aktrine 4.6 SL at 2 $ml \cdot L^{-1}$ had the lowest average population count of 0.13 followed by plots applied with 1 $ml \cdot L^{-1}$ (0.20) and Aktrine 4.6 SL at 0.50 $ml \cdot L^{-1}$ (0.28). These were all significantly different than the rice bug population in untreated plots (0.58). Similar findings were observed at 72 and 82 DAS.

The rice stem borer damage assessment at the time points when significant differences in damage (deadhearts and whiteheads) were observed. Results exhibit significant effect applied at 1.0-2.0 $ml \cdot L^{-1}$ and lower deadheart incidence was observed in treated plots. The result implies that among the treatments investigated, Aktrine 4.6 SL applied at 1.0 and 2.0 $ml \cdot L^{-1}$ can best control the damage caused by the rice stem borer

Results indicate that Aktrine 4.6 SL applied at 1.0 and 2.0 $ml \cdot L^{-1}$ can control the insect pest population and translate it into a higher yield than untreated plants and Aktrine 4.6 SL applied at 0.5 $ml \cdot L^{-1}$. A higher concentration of the Aktrine 4.6 SL can protect the rice plant from the infestation of rice black bug, rice bug, and stem borer, leading to a higher yield compared to rice plants not applied with Aktrine 4.6 SL. Further, a higher concentration of Aktrine 4.6 SL can prevent the population of thethese pests from going beyond the economic injury level (EIL) and economic threshold level (ETL) of the insect pest population. Managing the population within the limit of EIL and ETL will increase the productivity and yield of the rice plant.

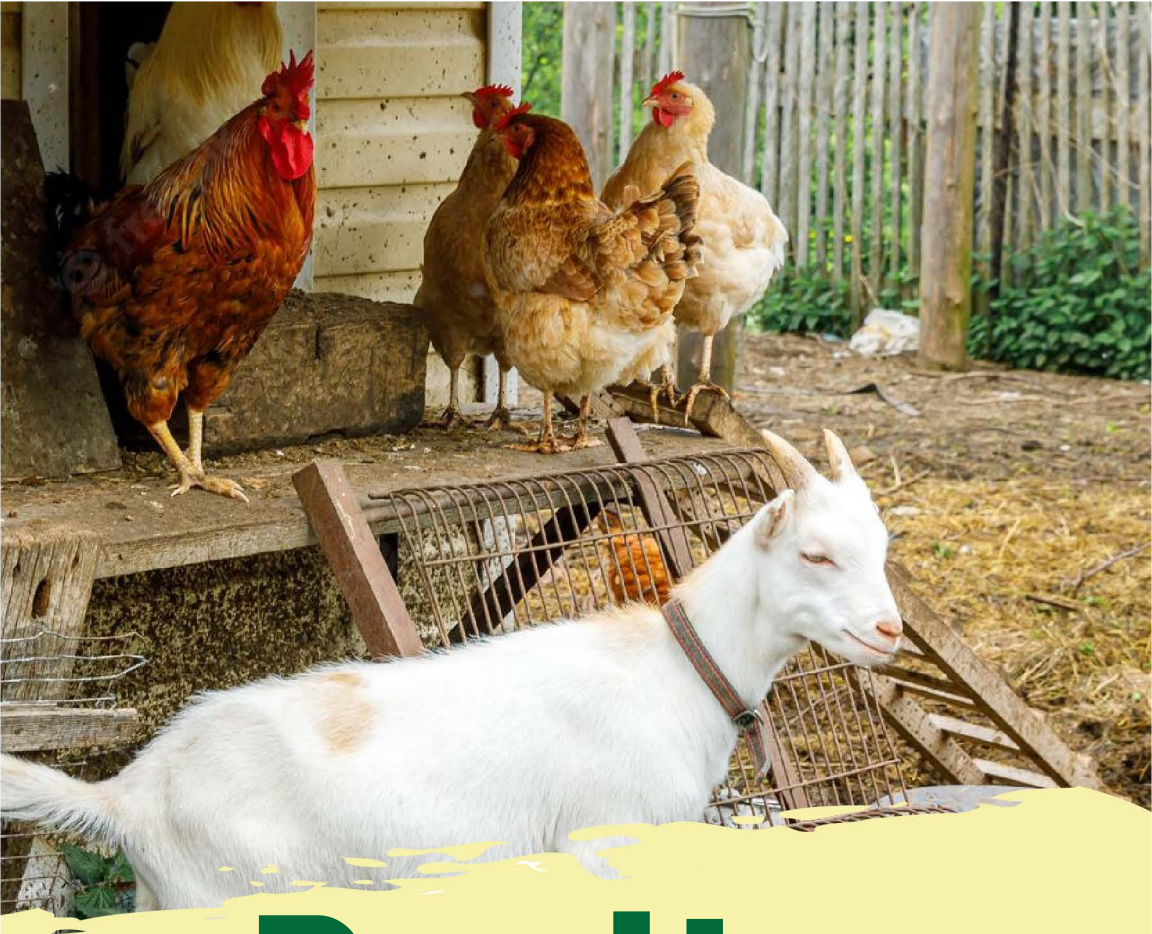
The data collectively demonstrate that Aktrine 4.6 SL applied at 1.0 and 2.0 $ml \cdot L^{-1}$ can control pest infestation and damage. At these concentrations, rice black bug and rice bug populations as well as damage from stem borer were significantly lower compared to plants with no treatment or

those applied with 0.5 ml·L^{-1} Aktrine 4.6 SL. Further, plots treated with 1.0 and 2.0 ml·L^{-1} concentrations of Aktrine 4.6 SL produced significantly higher grain yield. These results may be explained by the mechanism by which Matrine acts on insect pests. Matrine is an acetylcholinesterase (AchE) inhibitor whose main target of matrine is the nervous system. It affects the nerve impulses of the neuromuscular junction of the insect pest, which in turn hampers their locomotion and feeding habits (Ali et al., 2017; Zanardi et al., 2015; Zhou et al., 2008). Matrine may also act on insect pest brain cells, exhibit antifeedant effect, and inhibit breathing (Lewis, 2016), resulting in paralysis and eventual death (Zhou et al.,2008).

CONCLUSION AND RECOMMENDATION

Aktrine 4.6 SL applied at 1.0-2.0 ml·L^{-1} not only can effectively control rice black bug and rice bug population as well as white stem borer damage (deadhearts and whiteheads), but also reduce their plant economic damage. The result is increased yield when compared to rice plants not applied with Aktrine 4.6 SL. To minimize costs, a concentration of 1.0 ml·L^{-1} is recommended.

Joseph O. Castillo is a faculty member of the Crop Protection Department, College of Agriculture, University of Southern Mindanao. He teaches graduate and undergraduate courses with a concentration in Integrated Pest Management and Biological Control. He is an accredited BAFS researcher for Organic Bio-control Agents, as a third-party researcher. He earned his BS in Agriculture major in Entomology and MS in Crop Protection with a specialization in Entomology at the University of Southern Mindanao. He is interested in organic farming and the production of effective entomopathogens.



Poultry and Livestock

Phenotypic Characteristics and Egg Quality of Improved Philippine Mallard Duck (*Anas platyrhynchos domesticus* L.) under Intensive Management System

Mary Joy S. Cañolas[1], Angel L. Lambio[2], Agapita J. Salces, Rita P. Laude[3], and Rene C. Santiago[4]

ABSTRACT. *Organized selection and breeding program was implemented for the first time in the Philippines to address the lack of quality breeder stocks in the country. The developed select lines namely PMBr, PMBl, PMWh, and crosses were characterized based on their phenotypic traits. The PMBr and PMBl were mated employing 2x2 full diallel cross design and their growth, laying and egg quality traits were evaluated. The PMD select lines and crosses exhibited high uniformity, but sexual size dimorphism exists. A slight difference was observed in the growth performance of improved PMD in terms of body weight, feed consumption, and livability rate. The PMBl and PMBr exhibited early sexual maturity at 19 weeks, while the F1 reached more than 5% egg production at 22 weeks. The PMBl reached 50% egg production earlier at 27 weeks, while the peak of production ranged from 29 to 32 weeks. Hen-housed and hen-day egg production records showed similar trends. The F1 sustained an egg production of above 69% for 13 weeks with an average of 76%. The PMBr laid larger eggs ($p<0.05$) thus higher percent albumen, while slight variation on percent yolk weight, shell weight, shape index, shell thickness and yolk color were observed among PMD pure lines and crosses. The selection methods and purification process employed in PMD had shown positive results on high uniformity of their growth and laying performances.*

RATIONALE

The predominant egg-type duck raised by Filipino farmers primarily for balut (embryonated egg) production is the native Philippine Mallard duck (PMD) also known as Pateros but locally known as itik. The PMD is believed to have evolved from ducks that originated from the mainland China brought by Chinese traders in the early 19th century. The original plumage color was unknown but over the years, Filipino duck raisers selected ducks which are black in color with white bib. The importation of Khaki Campbell in the 1950s, Pekin ducks in the 1960s, Tsaiya and CV 2000 in the 1990s are believed to have influenced the overall characteristics of the present-day PMD due to indiscriminate crossing practiced by farmers as way of upgrading their stocks which resulted to ducks with variable plumage colors and unpredictable performances. The average annual egg production of PMD under the traditional system, which is the prevalent system of raising in the Philippines ranges from 40% to 60%.

1 Department of Animal Science, College of Agriculture, University of Southern Mindanao, Kabacan 9407, Cotabato

2 Breeding and Physiology Division, Institute of Animal Science, College of Agriculture and Food Sciences, University of the Philippines Los Banos, College, Laguna 4031 Philippines

3 Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Banos, College, Laguna 4031 Philippines

4 Bureau of Animal Industry - National Swine and Poultry Research and Development Center, Lagalag, Tiaong 4325, Quezon

The average performance of PMD continued to decline despite improved housing and feeding management. The major problems identified include lack of good quality breeder stocks, high cost of feeds, lack of credit, and inefficient marketing systems. The lack of quality ready-to-lay ducks as replacement stocks is the topmost concern of the industry because no one is engaged in the production of day-old ducks (DOD) and pullets that are of good quality. DODs are hatched from balutans when there is demand for it, a clear manifestation that replacement stocks are only a by-product of balut production.

Cognizant of the deteriorating condition of the local duck industry, organized selection and breeding program was implemented for the first time in the Philippines by the Bureau of Animal Industry - National Swine and Poultry Research and Development Center (BAI-NSPRDC) in Lagalag, Tiaong, Quezon together with the members of the Duck Industry Association of the Philippines, Incorporated (DIAPI) with support funding from DOST-PCAARRD to address the lack of quality breeder ducks using local genetics from the Provinces of Pampanga, Batangas and Quezon and to establish the Philippine signature Mallard duck breed.

The objectives of this study were to determine the phenotypic characteristics, growth and laying performances, and egg quality of the PMD pure lines and crosses.

METHODOLOGY

Animal care: The experimental procedure of this study was approved by the Institutional Animal Care and Use Committee (IACUC) of the University of the Philippines Los Baños.

Source of stocks: Two thousand hatching eggs collected from duck raisers who were members of the DIAPI were screened, hatched, and grown in confinement using the facilities of the BAI-NSPRDC, Lagalag, Tiaong, Quezon.

Methods of Selection: A combination of individual selection, independent culling level, and family selection were used. Individual selection was used on egg weight, egg weight at 40 weeks, and plumage colors such as brown, black, and white. Independent culling level was used in body weight at 18 weeks, while family selection was used on egg production. Phenotypic characterization was done starting at second generation to monitor the progress of the selection and purification process. In this study, the ducks belong to the third generation.

Phenotypic Characterization: A total 120 ducks (91 females and 29 males) from the three select lines namely PMBr, PMBl and PMWh were randomly selected for phenotypic characterization. The phenotypic traits such as plumage color and pattern, neck feather markings, bill color and shape, bean color, presence of crest, eye color, skin color, shank color, and body carriage were based on the description provided by the Philippine Native Animal Development (PNAD) Program with modification and pictorial guidance for phenotypic characterization of chickens and ducks. Tape measure was used to measure the morphometric traits such as the wingspan, bill length, chest circumference, body length, neck length and shank length. Digital weighing scale was used to get the body weight.

The qualitative traits were analyzed using descriptive statistics such as frequency counts and percentage while the quantitative traits were analyzed using sequential test in 2 x 2 factor factorial in CRD.

Mating design: The PMBr and PMBl were

assigned to a full diallel cross mating design wherein each mating combination was composed of one (1) drake and five (5) ducks given below:

Performance evaluation: In growth and laying performances evaluation of PMD select lines, PMWh was not included because they were not selected as one of the parents in the development of the improved PMD commercial line.

Progenies from each mating combination were randomly distributed into two replications with a male to female ratio of 1:5. The body weights of ducklings were periodically weighed (biweekly) using digital weighing scale. The weekly feed intake of all progenies was recorded during the brooding, growing, rearing, and laying periods until 40 weeks of age. The total number of live ducks in every stage of the growing period was recorded. Eggs were collected daily and labeled according to their respective mating group.

♂ \ ♀	PMBr	PMBl
PMBr	PMBr x PMBr	PMBr x PMBl
PMBl	PMBl x PMBr	PMBl x PMBl

PMBr – Philippine Mallard Brown, PMBl – Philippine Mallard Black
♂ - male, ♀ - female

Twenty per cent of the eggs produced per replication during the scheduled data collection except the soft and broken shell eggs were weighed individually using digital weighing scale. The egg components and egg quality traits were measured according to standard procedures. The 40 weeks partial egg production records were used as one of the selection criteria to improve annual egg production.

FINDINGS

Phenotypic characteristics: The select lines had uniform bill shape, no crest, white skin, and slightly upright body carriage. Sexual dimorphism in terms of plumage differences in colored PMD exist in which the males had iridescent green head while the females were drab. The male PMBr had well pronounced speculum and black tail feather while in PMBl and PMWh were obscured.

The PMBr select line has brown plumage, plain pattern, and neck feather marking, green (male) and slate-gray (female) bill , black bean, brown eyes, and orange shank.

The PMBl select line had black plumage, dusky with medium bib, green (male) and black (female) bill, brown eyes and either orange or brown shank.

The PMWh select line had white plumage, plain pattern and neck feather marking, yellow orange (male) and yellow with spots (female) bill, flesh bean, gray eyes, and orange shanks.

The F1 male cross had black plumage, dusky pattern, plain feather marking, green bill, black bean, brown eyes, and orange shank.

The F1 female cross had dark brown plumage, mallard pattern, plain or medium neck feather marking, slate-gray bill, black bean, brown eyes and brown shank.

The reciprocal F1 male cross had either

dark brown or black plumage, plain pattern with large bib, green bill, black bean, brown eyes, and orange shank.

The reciprocal F1 female cross had either dark brown or black plumage, dusky pattern with medium bib, either slate gray bill, brown eyes and orange shank.

Sexual dimorphism was evident among the PMD select lines with males having higher body weights, body lengths and chest circumferences than females.

The PMD select lines and crosses were comparable in terms of bi-weekly body weight, feed consumption during growing and laying periods.

No mortality occurred during the rearing period (100% livability). However lower livability rate was exhibited during the onset of laying.

Comparable egg production performance was exhibited by the select lines and crosses in terms of hen-housed and hen-day egg production.

Comparable egg number was exhibited by the select lines and crosses.

The PMBr line laid heavier eggs thus resulted to high percent albumen. In terms of yolk color and other egg quality traits, the select lines and crosses were comparable.

CONCLUSION

The selection efforts and purification process in PMD had shown positive results on high uniformity in qualitative and quantitative traits although there exists sexual dimorphism in favor of the male PMD. The growth, laying and egg quality traits were comparable except that the PMBr laid heavier eggs with high percent albumen.

RECOMMENDATION

Time will come that the select lines will be highly inbred as a result of the purification process and inbreeding depression will manifest in the performance, it is therefore recommended that other genetic groups of PMD located in other parts of the Philippines should be characterized phenotypically and genetically, and their performance be evaluated to identify genetic groups suitable for breeding thereby introducing new genes in order to maximize genetic variability within the improved PMD population.

Dr. Cañolas is the current Director of the Extension Services Office (ESO) of USM and Head of the Animal Research Division of the USM Agricultural Research and Development Center (USMARDC). She was the former Research Coordinator of the College of Agriculture and Cotabato Agriculture, Aquatic and Natural Resources Research and Development Consortium (CAARRDEC) now SOX-AARRDEC. She holds an Associate Professor position and teaches Animal Science subjects at the Department of Animal Science, College of Agriculture, USM, Kabacan, Cotabato.

In her capacity as ESO Director, she represents the USM President in various government organizations like the Cotabato Province-led Agri-Fishery Extension System (CPAFES), Task Force SOCCSKSARGEN Food Basket and Agri-Fishery Competitiveness, Regional Agriculture and Fisheries Extension Network (RAFEN), to name a few.

She finished her Doctor of Philosophy in Rural Development in 2013 at USM, and PhD in Animal Science in 2017, specializing in Animal Breeding, with a minor in Genetics at the University of the Philippines Los Baños. She studied the genetic and phenotypic characteristics, and combining abilities of growth, laying, and egg quality traits of Philippine Mallard Duck Select lines, now Itik Pinas.

She is a member of the Philippine Society of Animal Science (PSAS), and the World Poultry Science Association (WPSA), and an accredited consultant of OneExpert of the Department of Science and Technology (DOST).

Mangosteen Rind Powder: A Natural Feed Additive for Chickens

Study 1. Immune Response of Broiler Chickens Fed Diets with Different Levels of Mangosteen (*Garcinia mangostana* Linn.) Rind Powder[1]

Julius Jerome G. Ele[2] , Josephine R. Migalbin[3], Elma G. Sepelagio[4], Vingelle B. Jimenez[5] and Peter Greame F. Lacia[6]

ABSTRACT. *The general objective of the study is to determine the immune response of feeding diets with different levels of mangosteen rind powder to broiler chickens. Specifically, it aimed (1) to determine the immune responses of broiler chickens on the total white blood cell count, heterophil count and lymphocyte count, including the presence of basophils, eosinophils and monocytes and (2) to determine the immune effects of the different levels of mangosteen rind powder on the bursa of Fabricius and spleen through histological examination. The study was conducted in a Completely Randomzed Design. A total of eighty (80) day old chicks were randomly distributed into five (5) different treatments. The five (5) treatments used include the control wherein no mangosteen rind powder or no commercial antioxidant is incorporated in the diet, commercial antioxidant incorporated in the diet, 33 g of mangosteen rind powder/ kg of feed, 66 g of mangosteen rind powder/ kg of feed and 100 g of mangosteen rind powder/ kg of feed. For study 1 and 2, formulated diets of corn-soya based was used incorporated with different levels of mangosteen rind powder were used. The inclusion of 66 g and 100 g of mangosteen rind powder per kg of feed in the diet of broiler chickens increased the total white blood cell count, heterophil count, lymphocyte concentration in the bursa of Fabricius and the spleen lymphatic node formation. Results show that mangosteen rind powder at 66 g/kg of feed and 100 g/ kg of feed enhances the immune system of broiler chickens.*

Keywords: Mangosteen rind powder, Broiler Chickens, Immune Response

Study 2. Performance of Broiler Chickens Fed Diets with Different Levels of Mangosteen (*Garcinia mangostana* Linn.) Rind Powder[7]

Julius Jerome G. Ele[2], Josephine R. Migalbin[3], Elma G. Sepelagio[4] and Peter Greame F. Lacia[6]

ABSTRACT. *Mangosteen is a tropical fruit known to have therapeutic and medicinal properties. The beneficial effects of mangosteen include antioxidant, anti-inflammatory, antihistamine, antibacterial, antifungal, anticancer, antiviral, antidiabetic, nerve, blood,*

1 The full study can be accessed from Asia Pacific Journal of Multidisciplinary Research, 6(2), 35-44.

2 University of Southern Mindanao, Kabacan, Cotabato, Philippines 9407; jeromeele@yahoo.com

3 joshmig@yahoo.com

4 elmagsepelagio@gmail.com

5 vingelle.jimenez@fnu.ac.fj

6 petgreame@gmail.com

7 The full study can be accessed from NVSU Research Journal, 3(2), 5-10.

digestive and cardiovascular functions. The general objective of the study is to determine the performance of broiler chickens fed diets with different levels of mangosteen rind powder. The study was conducted in a Completely Randomized Design. A total of 100 birds for study 1 and 80 day old chicks for study 2 were randomly distributed into five different treatments namely, T1 – basal diet (corn-soya based) control, T2 – basal diet + commercial antioxidant, T3 – basal diet + 33g mangosteen rind powder/kg of feed, T4 – basal diet + 66g of mangosteen rind powder/kg of feed and T5 - 100g of mangosteen rind powder/kg of feed. There were no significant differences observed in the final weight, total feed intake, total weight gain, feed conversion efficiency, dressing percentage, livability, production number and index of broilers fed with five treatment diets.

No significant differences were noted in the broiler's cholesterol, High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) levels at day 14 fed diets with different levels of mangosteen rind powder. Meanwhile, triglycerides level at day 14 and day 28, cholesterol, HDL and LDL levels at day 28 showed significant differences among treatment means. Weight of internal organs (heart, liver, and gizzard) relative to body weight showed no significant differences among treatment means for day 14 and day 28. For the cost and return analysis, highest return of investment was obtained by the birds fed with commercial antioxidant at 49.89%. This was followed by the control group at 47.34%. Treatment with 66g of MRP followed with 45.82%, then by treatment with 100g of MRP at 43.90%. Lastly, the 33g of MRP group had 40.06%. Feeding broilers with diets with different levels of mangosteen rind powder have shown similar growth performance results of mangosteen rind powder and those fed with commercial antioxidants. Moreover, the results have shown that the 66g of mangosteen rind powder and 100g of mangosteen rind powder are capable of decreasing the amounts of triglycerides, increasing the amounts of HDL and reducing the levels of LDL.

Dr. Julius Jerome G. Ele (Professor VI) is the current Dean of the College of Agriculture. His main areas of specialization include animal nutrition and feeding, poultry nutrition, management and production, swine nutrition, alternative feed or feed substitutes, and vermicomposting. He completed his PhD in Agricultural Science Major in Animal Science from the University of Southern Mindanao, and his MS in Animal Science from the University of Georgia in the United States, the latter under the Philippine Department of Agriculture and Fulbright Scholarship. He is a licensed agriculturist, ranking Top 2 in the Agriculturist Licensure Examination in 2014. He also has TM I certificates–National Certificate II in Organic Agriculture Production and in Animal Production. In 2014, he was awarded the Professional Achievement Award by the Province of Cotabato during its 100th Centennial Celebration

Growth and Carcass Performance of Male White Leghorn Fed with Organic and Commercial Free-range Diets Raised under Extensive Rearing System

Noel B. Lumbo, Agapita J. Salces, Maria Cynthia R. Oliveros, Jose Alberto I. Nuez III, Blessy Hanna M. Albaladejo, and Jorge Michael D. Dominguez[1]

ABSTRACT. *The study examined a total of 400 hardened (45 d) male white leghorns for their performance in meat production and profitability to be raised under a free-range system fed with different diets. The two diets were organic and commercial free-range diets. Chickens were randomly distributed to eight houses with ranging areas. All management practices and feed composition strictly adhered to the guidelines set by PNS/BAFS 07:2016, PNS/BAFS 262:2018, and DA Circular No. 09 Series of 2020. Growth performance data were collected bimonthly. At 75 and 90 days, five chickens per houses were randomly sacrificed to assess the carcass traits. Overall, chickens that received commercial free-range diet had significantly better growth and carcass performance. On the other hand, chickens fed with organic diets had significantly yellower skin and leg color. Chickens that were slaughtered at a higher age significantly have higher carcass traits. Moreover, male White Leghorns fed with organic or commercial free-range diets had high positive margin over feed cost.*

RATIONALE

Demands on products derived from chickens that are raised under extensive production system, such as free-range and organic systems, are on the rise (Masilang, 2021; Yan, 2019). Meat products derived from alternative production systems have been associated with high meat quality, and have high positive impact on animal welfare by marketers and consumers (Castellini et al., 2016; Fanatico et al., 2005; Fanatico et al., 2008; Wang et al., 2009; Michalczuk et al., 2014). However, annual volume of chicken production in the Philippines is increasingly declining from 2019 to 2021 (PSA, 2022). Therefore, producers should maximize all the available resources, especially chicken genetic resources, not just to meet the quantity but also to supply high quality poultry meat.

Two standards were created to guide producers on choosing which chicken breeds or chicken genetic resources can be used for organic agriculture and free-range system. The PNS/BAFS 07:2016 (Organic Agriculture) states that in organic livestock production, the choice of breeds should consider the capacity to adapt to local conditions. Further, chickens should have reasonable productivity level even with low external input, and should maintain genetic diversity. On the other hand, the PNS/BAFS 262:2018 (Free range Chicken) states that producers should only use strains or breeds that are available and suited for free range production.

Under PNS/BAFS 07:2016, the use of native/local breeds should be promoted but are not compulsory, and the standard does not indicate which genotypes should be used in organic system. On the other hand, PNS/BAFS 262:2018 enumerated

1 Authors' Affiliation: Institute of Animal Science, College of Agriculture and Food Science, University of the Philippines Los Baños, College, Laguna, Philippines

several breeds and strains and classified them according to usage (e.g. for meat and egg). However, both standards failed to mention the usage of male layer chicken for meat production. In other countries, rearing male layer chicks for meat is currently being practiced (Choo et al., 2014; Gerken et al., 2003; Giersberg & Kemper, 2018; Lichovníková et al., 2009; Mueller et al., 2018, 2020; Murawska et al., 2019; Popova et al., 2022).

White leghorns are considered as egg-type chicken and are used to create commercial layer strains. Leghorns are also active and efficient foragers which is great for alternative production system (Senbeta, 2017). Since egg production and growth rate are negatively correlated (Buzala & Janicki, 2016), male leghorn chicks are culled immediately after hatching. Limited chick availability for chicken production is one of the current problems facing the poultry industry. Rather than culling male layer chicks, producers should invest in raising these birds for meat production. However, performance and profitability analysis of raising male layers under alternative production system in the Philippines is scarce; hence, this study.

OBJECTIVES

The study was conducted to determine the growth and carcass performance of male white leghorns raised under extensive rearing system fed with organic and commercial free-range diets. Moreover, the profitability of rearing male layer chickens under free-range production system was also accounted in the study through the income over feed cost analysis.

DESIGN AND METHODOLOGY

The study was in accordance with the Institutional Animal Care and Use Committee of UPLB (approval no. CAFS-2021-010). A total of 400 hardened birds (45 d) were raised in the University Animal Farm, Institute of Animal Science, College of Agriculture and Food Science, University of the Philippines Los Baños from 28 June 2021 to 07 October 2021. All management practices strictly adhered to the guidelines stated on PNS/BAFS 07:2016 and PNS/BAFS 262:2018. Chicken houses and range area were constructed with a stocking density of six birds/m^2 and one bird/m^2, respectively. Chickens were randomly distributed to eight houses with range area. Outdoor access to the range area was provided during daylight hours and birds were confined to indoor pens at night.

Birds had free access to ad libitum feed and water (both in the range area and indoor pens). Two treatment diets were tested: Organic feed diet and free-range commercial crumble feed (B-Meg Integra 2000). Organic feed diet was formulated based on the Department of Agriculture Circular No. 09 Series of 2020 (National list of permitted substances for organic agriculture). Body weights and feed intake of chickens were recorded bi-monthly. The average daily feed intake (ADFI) and average daily gain (ADG) was used to calculate the feed:gain ratio (F/G).

At 75 and 90 days of age, five birds per pen were sacrificed to evaluate the carcass performance. The birds were killed by manual exsanguinations. Furthermore, birds were scalded, defeathered, eviscerated, and chilled using an ice bath at 1^{2OC} for 15 min. After weighing the carcass, major cut-up parts were separated and yield of breast, wings, legs, and back were recorded. Yield was computed as a percentage of carcass weight. Legs and wings were further dissected, and yield of separable lean, fat-and-skin, and bone were determined. Skin and lean color were measured on breast and leg parts using the CIE L* (lightness), a* (redness), and

b* (yellowness) values of Konica Minolta CR-400 chroma meter.

Data were evaluated with a linear model and the significance of differences was evaluated by t-test. For the carcass data, the slaughter age effect and interaction were also included in the model. All statistical analyses were conducted using t-test in RStudio (RStudio Team, 2020). Significance was set at $p \leq 0.05$.

Furthermore, profitability of rearing male white leghorns under free-range system was determined using income-feed cost analysis. Feed cost per chicken was computed by multiplying the total feed consumed by price per kilogram of feed. Value of gain per chicken was calculated by multiplying the total weight gain by the live weight price per chicken. Feed cost per kilogram of gain was computed by dividing the feed cost per chicken by the total weight gain. And lastly, margin over feed cost (MOFC) was computed by subtracting the feed cost per chicken from the value of gain per bird.

FINDINGS

The growth performance of chickens fed with different diets significantly diverged from 87 d up to 101 d (Table 1). Chickens fed with commercial free-range diet had significantly higher ADG that resulted in significantly higher body weight and better F/G than the other group. Moreover, differences in diet significantly ($p<0.05$) affected the ADFI of white leghorns. The differences in foraging and activity level between the two groups likely contributed to the different degree of feed intake and feed conversion of the two groups (Fanatico et al., 2008). Although not quantitatively measured, birds fed with organic diet tend to grazed more than the other group.

Slaughter (SW) and carcass weight (CW), and carcass yield (CY) were significantly affected by the interactive effects of age at slaughter and diet (Table 2). Chickens fed with commercial layer diet have consistently higher SW, CW, and CY than the other group since they have higher growth performance. On the other hand, chickens slaughtered at 90 d had consistently higher SW, CW, and CY than chickens slaughtered at 75 d. The direct relationship of age at slaughter and carcass performance is also observed by Dal Bosco et al. (2014).

Although leg percentage was not significantly different between diets, the composition of legs were significantly different between treatments. Chickens fed with organic diet tended to have significantly higher bone percentage. Meanwhile, chickens fed with commercial free-range diet tended to have significantly higher lean percentage. Differences in the leg composition can be attributed to the foraging time of the chickens. As stated earlier, chickens fed with organic diet had higher foraging time in the range area. This activity can improve the development of the bone, and reduce leg weakness problems (Mikulski et al., 2011).

Skin and meat color are some of the first characteristics noticed by consumers when buying meat products. In markets, where carcasses are often marketed whole, the color of the skin plays a particularly important role (Fanatico et al., 2007). The color of the skin and meat of chicken can be affected by feeds. Naturally occurring or supplemented carotenoid pigments that can be found in the feed or roughages can be accumulated in the skin and meat (Baeza et al., 2022). In the current study, in general, increasing the age at slaughter significantly increases the skin, breast and leg color. Significant effects of diet were only observed in the yellowness of skin and leg part. The higher foraging time

Table 1. Growth performance of male White Leghorns fed with organic and commercial free-range diets raised under extensive rearing system.

Growth Performance	Free-range Diet	Organic Diet	SEM
Body weight (kg)			
45 dNS	0.52	0.52	0.01
59 dNS	0.72	0.75	0.02
73 dNS	0.88	0.92	0.04
87 d*	1.13	1.01	0.04
101 d*	1.30	1.21	0.03
Average daily gain (g/d)*			
45 to 87 d	14.7	11.7	1.48
45 to 101 d	14.1	12.3	0.68
Average daily feed intake (g/d)*			
45 to 87 d	61.4	65.4	1.67
45 to 101 d	68.0	70.7	1.17
Feed-to-Gain*			
45 to 87	4.25	5.64	0.482
45 to 101	4.83	5.73	0.403

^{NS} Not significant ($p>0.05$)

* Significant $p<0.05$)

Birds were raised in the University Animal Farm, Institute of Animal Science, College of Agriculture and Food Science, University of the Philippines Los Baños from 28 June 2021 to 07 October 2021

Table 2. Carcass performance of male White Leghorns fed with organic and commercial free-range diets raised under extensive rearing system.

Parameter	75 days		90 days		SEM	Significance		
	Free-range Diet	Organic Diet	Free-range Diet	Organic Diet		A	D	AxD
Slaughter Weight (kg)	0.96c	0.90d	1.30a	1.14b	0.02	**	**	*
Carcass Weight (kg)	0.62c	0.57d	0.89a	0.75b	0.02	**	**	*
Carcass Yield (%)	64.20c	62.80d	68.20a	65.30b	0.64	**	**	*
Breast (%)	-	-	23.40	22.90	0.26	-	NS	-
Lean	-	-	52.70	52.10	0.86	-	NS	-
Skin-and-Fat	-	-	12.40	13.0	0.54	-	NS	-
Bone	-	-	34.90	34.90	0.80	-	NS	-
Legs (%)	-	-	30.40	30.10	0.21	-	NS	-
Lean	-	-	62.10a	59.80b	0.58	-	*	-
Skin-and-Fat	-	-	10.51	9.94	0.31	-	NS	-
Bone	-	-	27.40b	30.30a	0.58	-	*	-
Wings (%)	-	-	14.20	14.70	0.27	-	NS	-
Back (%)	-	-	32.00	32.20	0.31	-	NS	-
Skin Color								
L*	78.70	78.60	78.50	79.50	1.10	NS	NS	NS
a*	6.83	6.02	37.68	35.37	1.44	**	NS	NS
b*	17.30y	18.00x	63.60b	68.30a	1.20	**	*	NS
Breast Color								
L*	63.30	64.70	93.40	94.50	0.96	**	NS	NS
a*	12.40	12.00	35.20	35.10	1.07	**	NS	NS
b*	14.20	14.80	46.50	49.30	2.20	**	NS	NS
Leg Color								
L*	55.70	55.80	56.0	56.80	1.20	NS	NS	NS
a*	14.40	14.60	60.60	60.0	0.78	**	NS	NS
b*	8.98y	10.45x	35.91b	41.05a	1.82	**	*	NS

** $p<0.001$
* $p<0.05$
NS not significant
a, b, c, d Means with different superscript are significantly different ($p<0.05$)
x, y Means with different superscript are significantly different ($p<0.05$)
Factors: Age at slaughter and Diet
Color: L* - lightness value, a* - redness value, b* - yellowness value
Birds were raised in the University Animal Farm, Institute of Animal Science, College of Agriculture and Food Science,

University of the Philippines Los Baños from 28 June 2021 to 07 October 2021

Table 3. Income over feed cost analysis of male White Leghorns fed with organic and commercial free-range diets raised under extensive rearing system

Parameters	Feed Cost per Bird	Value of Gain per Bird	Feed Cost/ kg Gain	Margin over feed cost
45 to 87 days				
Free-range Diet	92.84	134.20	152.19	41.36
Organic Diet	81.44	156.80	166.21	75.36
45 to 101 days				
Free-range Diet	137.09	171.60	175.75	34.51
Organic Diet	117.39	220.80	170.13	103.41

Assumed liveweight price of free-range chicken = Php. 220.00 /kg
Assumed liveweight price of organic chicken = Php. 320.00 /kg
Price of commercial free-range diet= Php. 36.00 / kg
Price of commercial organic diet= Php. 29.65 / kg

of chickens fed with organic diets led to an increase consumption of grasses. According to Dal Bosco et al. (2016), chickens with greater ability to forage can ingest higher amounts of grasses that can lead to higher consumption and storage of bioactive compounds, such as carotenoids.

Feed cost accounts for 70 to 80% of the total production cost in poultry production. Hence, the margin between the returns and the feed cost (Table 3) can be used to measure the profitability of raising male layer chickens under free-range system. A margin over feed cost (MOFC) greater than 1 means that the production is profitable. Across rearing period, chickens fed with free-range diet has higher MOFC than chickens fed with commercial free-range diet. This is because carcass from organic chickens commands higher price than the other group. To have higher profit, chickens fed with free-range diet should be sold at 87 d. On the other hand, higher profit can be attained in chickens fed with organic diet when sold at 101 d.

CONCLUSION

Overall, chickens fed with commercial free-range diet had significantly better growth and carcass performance. On the other hand, chickens fed with organic diets had significantly yellower skin and leg color. Older chickens slaughtered have significantly higher carcass traits. Moreover, both diet groups had high positive margin over feed cost.

Dr. Noel Lumbo is a graduate of Doctor of Veterinary Medicine and Doctor of Philosophy in Animal Science specializing in monogastric nutrition and gut health interactions in UP Los Baños. He is currently an Assistant Professor and Head of the Animal Nutrition Division of the Institute of Animal Science in UP Los Baños. His research interests are on gut health, feed ingredient evaluation, evaluation of non-conventional feedstuffs and designing diets for free-range and organic feeding systems.

He is the Secretary of the Philippine branch of the World Poultry Science Association, member of the Philippine Veterinary Medical Association and UPLB Interdisciplinary Center for Organic Agriculture. He is also the Division Leader for Food and Feed Safety of the UPLB Program for Zoonotic Diseases. He is a Life Member and Auditor of the Philippine Society of Animal Science. He is a Diplomate of the Philippine College of Poultry Practitioners (PCPP) and Philippine College of Veterinary Feed Practice (PCVFP).

He was the recipient of the Asian-Australasian Association of Animal Production Congress (AAAP Congress) Outstanding Young Scientist Award in 2016 and in 2021, the Philippine Society of Animal Science (PSAS) Outstanding Young Professional in Animal Science Teaching. This year, the Philippine Veterinary Medical Association (PVMA) awarded him the 2022 Outstanding Veterinarian in Education and the Asian-Australasian Association Animal Production Congress (AAAP Congress) Outstanding Young Scientist Award for 2022.

Evaluation of Vermi Meal as Potential Organic Feed for Nile Tilapia Fingerlings

Melchor M. Tayamen, Zaldy F. Hechanova and Sheila Marie D. Baluran[1]

ABSTRACT. *This study utilized earthworm meal or Vermi Meal (VM) as a replacement for Fish Meal (FM) in the diet of fingerlings of the Nile Tilapia fingerlings (Oreochromis niloticus). Six treatments with varying levels of vermimeal (25%, 40%, 60% and 100% ration) and Fish Meal (25% and 100% ration) on a triplicate set-up were provided as food for 180 days of culture.*

The feeding experiment used 1 x 1 m B-net hapa with a stocking rate of 2 fingerlings/m2. The initial feeding was computed based from the 15-10% Average Body Weight of the fingerlings (ABW = 3.41 and was given on a daily basis for four weeks. Feeding was adjusted to 7-2% feeding rate until harvest.

Results showed that Treatment 3 (25% Fish Meal + 75% Rice Bran) had the highest growth of 293.42 ± 25.46 g and was significantly different with Treatment 6 (100% Fish Meal) with final body weight of 148.87 ± 21.01 g. In terms of survival rate, the highest were obtained at Treatment 1 (100% Vermi Meal,), Treatment 4 (40% Vermi meal+60% Rice bran) and Treatment 6 (100% Fish Meal) with 100% survival. The best Feed Conversion Ratio (FCR) was achieved at Treatment 4 (40% Vermi Meal + 60% Rice Bran) with 1.65 kg consumed feeds but not significantly different with the other treatments ($\alpha = 0.05$). This study has proven that Vermi Meal is a suitable alternative as animal protein source in supplemental feeds for Nile Tilapia in terms of FCR under semi-intensive organic culture. It has the potential to replace expensive and major feed ingredients like Fish Meal provided there is an abundant supply of ANC and this could incur substantial savings in feed cost.

RESULT AND DISCUSSION

Experimental diets were formulated based on the protein content of feed ingredients namely fish meal, vermi meal and rice bran using Pearson's Square method to attain the acceptable crude protein requirement of 25% for organic farming. Table 1 shows the percentage composition of experimental diets. Appropriate quantities of ingredients in each diet: T1-100% vermi meal (51%CP); T2-25%vermi meal+75%rice bran(25% CP); T3-25% fish meal+75%rice bran(25%CP); T4-40%vermi meal+60% rice bran(27.4%CP); T5-60%vermi meal+40% rice bran (35.6%CP) and T6-100% fish meal(27%CP) were weighed and mixed thoroughly. Diets were extruded into spaghetti-like strands using a 2mm die and sun-dried. Once all diets had dried completely, portions of each diet were stored in plastic bags and stored in a plastic container.

Table 2 and 3 shows the monthly gain in weight and mortality rate of fish per treatment fed with various rations of vermi meal, fish meal and rice bran.

1 Bureau of Fisheries and Aquatic Resources-National Freshwater Fisheries Technology Center

Monthly growth of fish in all treatments showed no significant differences on its first 30 days. Results show that Treatment 3 (25%FM+75% RB) gained the highest weight gain at harvest followed by Treatment 2 (25% VM+75%RB). However, it should be taken into account that the said treatments with the highest average body weight also have the highest mortality rate of 50% at harvest. It has been noted that population density directly affects the growth performance of fish since the remaining fish have lesser competitors in terms of feeds, dissolved oxygen and space. Taking this into consideration, treatment with 0% mortality and with high weight gain like Treatment 4 (40%VM+60%RB) with average body weight of 220.06g at harvest maybe seen as the treatment with the most desirable result. Moreover, treatments with 100% animal protein T1 (100%VM) and T6 (100%FM), exhibited lower gain in weight compared to T2 (25% VM+75%RB) and T3 (25%FM+75%RB) with carbohydrates ration. The difference in weight gain between ration of 100% animal protein (T1 and T6) and combination of protein and carbohydrates (T2, T3, T4 and T5) was very evident and a clear indication that feed ration should contain both protein and carbohydrates. In terms of water quality parameters, readings are within the range of favorable level and are suitable for the normal growth of Nile Tilapia. (Figures 1-4).

Progressive weight gain of Nile Tilapia was recorded in the four vermi meal dietary treatments throughout the duration of the experiment. This was an indication that the fish responded positively to the diets in terms of growth and possibly, the protein content of the experimental diet was likely adequate for the growth of the fish. It also implies that none of the experimental diets contained anti-nutritional growth factors (Sogbesan et al., 2006).

Economic Analysis

Production of vermi meal which involved culturing, harvesting and processing was laborious. In addition, the processed earthworm biomass is only 16% dry matter based on the conduct of this study that required a total of 28.2kg (P500.00/ kg) of fresh ANC for 180 days culture of experimental fish. Moreover, propagation of earthworm takes a long period since earthworm has slow growth. These made the production difficult and expensive in terms of time and energy compared to fish meal which is readily available in the market. Considering the expensive cost of fresh ANC per kilogram compared to the cost of Fish Meal per kilogram (P70-P75.00/kg), the utilization of vermi meal as partial replacement for fish meal may not be considered feasible. However, less operating cost will be incurred if the operator uses his own farm-produced earthworm (African night crawler), where vermi meal is derived. High production rate of ANC will result to the availability of commercially-viable animal-based protein feed ingredient. This situation on ANC production will improve medium to

Table 1. Proximate analysis of ANC based from Guerrero, 2009b.

Composition	Percentage (%)
Crude Protein	68.00
Fat	9.57
Nitrogen-free extract	11.05
Ash	9.07

Table 2. Results on the Statistical analysis of Body Weight (g), Standard Length (cm), Survival Rate (%) and FCR (kg) of Nile Tilapia fingerlings fed with six different feed treatments

Treatment	Final Body Weight	Survival Rate	FCR
T1 – 100% Vermi Meal	194.24^{AB}	100.00^{A}	1.7367^{A}
T2 – 25% Vermi Meal + 75% Rice Bran	242.14^{AB}	50.00^{B}	2.2400^{A}
T3 – 25% Fish Meal + 75% Rice Bran	293.42^{A}	50.00^{B}	2.0033^{A}
T4 – 40% Vermi Meal + 60% Rice Bran	220.07^{AB}	100.00^{A}	1.6467^{A}
T5 – 60% Vermi Meal + 40% Rice Bran	233.84^{AB}	83.33^{AB}	1.9267^{A}
T6 – 100% Fish Meal	148.87^{B}	100.00^{A}	1.9033^{A}

Table 3. Monthly gain in weight (ABW) and Survival Rate (SR) of experimental fish per treatment

TREATMENT	Initial Body Wt	1st		2nd		3rd		4th		5th		6th	
		ABW (g)	SR (%)	ABW (g)	SR (%)	ABW (g)	SR (%)	ABW (g)	SR (%)	ABW (g)	SR (%)	ABW (g)	SR (%)
T1 - 100% Vermi meal	3.58	29.40	100	73.56	100	107.66	100	151.96	100	171.98	100	194.24	100
T2 - 25% Vermi meal + 75% Rice Bran	4.64	29.56	100	70.67	100	113.94	70	156.96	50	191.81	50	230.54	50
T3 - 25% Fish meal + 75% Rice Bran	3.74	32.38	100	72.60	100	91.28	83	135.17	83	228.46	83	293.42	50
T4 - 40% Vermi meal + 60% Rice Bran	3.60	28.71	100	76.02	100	112.93	100	152.51	100	189.50	100	220.06	100
T5 - 60% Vermi meal + 40% Rice Bran	3.56	30.40	100	78.98	100	125.76	83	193.43	83	210.29	83	228.90	83
T6 -100% Fish Meal	3.73	29.80	100	68.31	100	89.04	100	103.10	100	127.22	100	148.87	100

large scale farm operations not only for Nile Tilapia but also for other freshwater

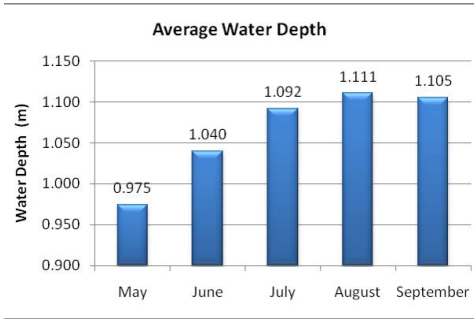


Figure 1. Monthly reading of average water depth

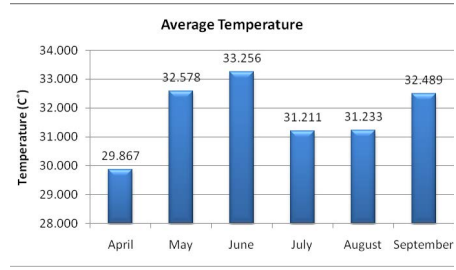


Figure 2. Monthly reading of average temperature

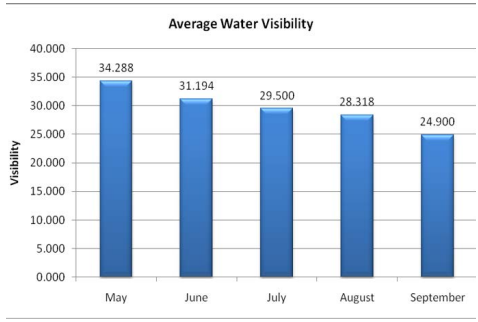


Figure 3. Monthly reading of average water visibility

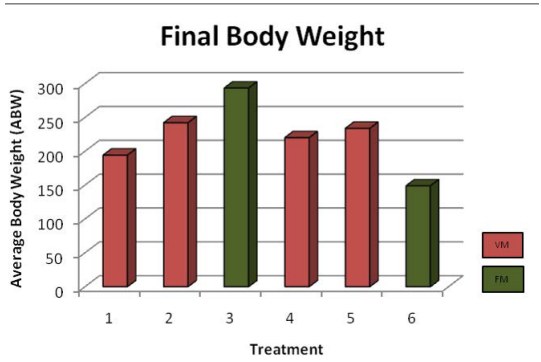


Figure 4. Final body weight of experimental fish per treatment

species with high commercial value. Since there were only few farmers who are venturing into ANC production, there is a limited supply in the market resulting to its high cost. This constraint should be addressed to ensure sustainability on vermiculture technology through intensive promotion and information drive.

SUMMARY, CONCLUSION AND RECOMMENDATION

The results indicate that the replacement of fish meal with vermi meal at various levels of inclusion was suitable for favorable growth of Nile Tilapia fingerlings since there was no significant difference in the growth rate and survival. All treatments are not significantly different with each other which indicate that the formulated diets with fish meal and vermi meal rations has no great effect on the growth performance of the fish. However, there is a low supply of African night crawler at present. This aspect greatly affects the demand for the production of vermi meal which resulted to the high price of fresh ANC and burdens the farmers in terms of production cost. Also, the laborious nature of its harvesting could be a major constraint to the potential of earthworm as a source of protein for fish and as fishmeal replacement. Our farmers may find it difficult to formulate vermi meal on their own due to the work involved. Through the support of the government, it is therefore recommended to create further awareness in vermiculture technology and its potential as diet source for aquaculture species. With this, there will be high production rate of ANC which will create the potential of vermi meal to replace expensive and major feed ingredient like Fish Meal and this could incur substantial savings in feed cost. This will help the agriculture sector to produce a cost-efficient organic feed ingredient for organic farming. Conduct of another trial is also recommended to verify its growth efficiency and economic viability as an alternative food replacement for Nile Tilapia.

Zaldy F. Hechanova is the Head of the Organic Aquaculture Production Section of the Bureau of Fisheries and Aquatic Resources - National Freshwater Fisheries Technology Center located in the Central Luzon State University compound, Science City of Munoz, Nueva Ecija. He is a member of the Technical Working Group for Organic Agriculture and has served the agency for 30 years. He has an MS in Aquaculture and is a registered Fisheries Technologist with Expertise in M. rosenbergii Production. His interests are organic aquaculture and other related topics.

Growth of Nile Tilapia (*Oreochromis niloticus*) Using Varying Levels of Vermicast With Partial Supplementation of Feeds

Melchor M. Tayamen, Zaldy F. Hechanova and Sheila Marie D. Baluran[1]

ABSTRACT. *The study was conducted to determine the varying levels of vermicast on the growth performance and the economic feasibility for nile tilapia. The experimental fish were monitored for a period of five months. Results showed that tilapia growth in Treatment 1 (2,000 kg/ha Chicken Manure as control) was significantly better than Treatment II (1,500 kg/ha) Vermicast), Treatment III (2,000 kg/ha Vermicast) and Treatment IV (2,500 kg/ha Vermicast). Final mean weight of tilapia in Treatment I was 202.42g and daily mean weight gain was 1.3g/day whereas in Treatment II, III, IV final mean weight were 138.04g, 169.16g and 159.10g respectively and daily mean weight gain were 0.92g/day, 1.1g/day and 1.0g/day respectively. Simple economic analysis is significantly not successful in all treatments due to low survival caused by extreme warm temperature (33-37°C). Throughout the investigation period, fertilization using chicken manure (T1=2,000kg/ha, control) showed the highest survivability and growth as compared to the varying levels of vermicast (1,500, 2,000 and 2,500 respectively). Percent mean survival of Treatment I, II, III and IV were 51.05%, 42.52%, 40.09% and 31.73% respectively.*

RESULTS AND DISCUSSION

Optimization of tilapia production in pond was done by using organic manure throughout the culture period all treatments have an increase in weight however, ANOVA shows that the growth performance of tilapia from the control group is significantly different from all the treatments. It was noted that a consistent and remarkable increase in growth increment, gains was observed in the fish using chicken manure followed by T3 and T4. Minimum growth performance was observed. Total yield was also highest in the chicken manure (T1) followed by T3 (2,000 vermicast). Low yield of T4 and T3 maybe due to the low survival obtained. However, trend of the growth could reveal that higher plankton count resulted to bigger size fish as compared to low rate of fertilizer.

Percent survival was highest in the treatment with chicken manure followed by increasing order of the different treatment. Mortalities from all treatments was already been observed from the first month onward up to the last month of culture however peak mortalities was recorded during the month of August that could somehow be attributed by the extreme rise in temperature from 35.16 to 37.85 °C. Highest mortality rate was observed in T4 with season abundance of phytoplankton is at its peak however, rains was experienced during the afternoon especially in the month of August and September resulting to thermal shock that eventually lead to mortalities of the experimental fish.

Feed conversion ratio in this study confirms that the fish growth benefited from the natural foods stimulated by fertilization. High feed conversion ratio in T4 was

1 Bureau of Fisheries and Aquatic Resources-National Freshwater Fisheries Technology Center

probably caused by very low survival compared to other three treatments.

The average water temperature was almost similar in all the experimental ponds (29.82 – 30.74 °C) in the morning and 33.11 – 35.09 °C in the afternoon which is sub-optimal for *O. niloticus*. Likewise, there was a marked rise in temperature (37.16 – 37.85 °C) during the month of August. Average dissolved oxygen obtained during the tenure of the study is within the optimum range (3.95 – 7.89 ppm) however, lowest average value of 0.65 ppm in the morning and 2.13 ppm in the afternoon was obtained. Secchi disc visibility showed that optimum range was obtained during the month of April to August in T1 and T4 however T2 and T3 revealed that plankton production was lesser.

In addition lesser was also observed in T2 in the month of August. Plankton analysis in each treatment showed that chicken manure produces abundant plankton as compared to vermicast that could somehow attributed to the growth performance of the fish. Chicken manure maintained a level of nutrients that produces dominance of green algae, diatoms, euglena, rotifers and later part blue-green algae. Moreover, phytoplankton was also identified in each treatment every two weeks. Phytoplankton identified in the control group was green algae, blue-green algae and zooplankton. Phytoplankton population identified in T4 has the most number of green algae, diatoms, blue green algae and zooplankton followed by T3 and T2 (green algae, zooplankton). An increasing trend in the abundance of plankton was observed with an increasing rate and days in all treatments. However, the control group dominates the most number of populations.

SUMMARY, CONCLUSION AND RECOMMENDATION

Protocol on Organic Tilapia Farming was developed through the conduct of on-farm trials and experiments that followed organic standards from the pioneering regulation programs of IFOAM and EU. It has been noted that in choosing fertilizers for organic farming aside from its algal nutrient provisions, economic viability must be considered. The rate of application has also been redefined for its utilization efficiency without any wastage that will incur additional operating cost and load of debris to pond as well (which will later on results to oxygen depletion). One of the contributing factors to proper fish health management is the population density. In organic farming, low stocking density results to reasonable growth rate with respect to suitable living conditions of fish.

In view of the BFAR-NFFTC in improving developed protocols in organic tilapia culture, organic fish nutrition must also be established. Developing organic feed ingredients which are locally available to fish farmers should be tested through the conduct of similar study and in order to determine the appropriate feeding rate for more feasible fish farming.

Zaldy F. Hechanova is the Head of the Organic Aquaculture Production Section of the Bureau of Fisheries and Aquatic Resources - National Freshwater Fisheries Technology Center located in the Central Luzon State University compound, Science City of Munoz, Nueva Ecija. He is a member of the Technical Working Group for Organic Agriculture and has served the agency for 30 years. He has an MS in Aquaculture and is a registered Fisheries Technologist with Expertise in M. rosenbergii Production. His interests are organic aquaculture and other related topics.

Organic Complete Ration Mix (OCRM): Potential Feeds and Feeding System for Dairy Goats

Cayetano C. Pomares

ABSTRACT. *Animal production is a key sector as it must meet consumers' demand and the need for higher sustainability. Development of Organic Complete Ration Mix (OCRM): Adoption, processing and commercialization for organic dairy goat production is economically beneficial because feed nutrient is enhanced and sustained. Results determined feeding systems on: (1) the procedure of feeding regimens; (2) the nutrient specifications of the diets; (3) the effects on milk production; (4) the health benefits; and (5) the sustainability of the ration and supply of organic ingredients. The organic dairy goat feeding systems as a technologies output of the study demonstrated feeding regimens for sustainable milk and meat production as soilage, silage, haylage, formulated concentrate mix and pelleted forage-mix complete ration derived from authentic organic resource and facility. The "in vivo" digestibility procedure using "in sacco" rumen degradation techniques screened legume species revealed the highest degradability percentages (from 85 to 95%) for indigofera, rensonii, and ipil-ipil under 48 hour-incubation period. Ensiled and pelleted rations enhanced palatability and degradability showing a highly significant difference both in average total feed intake with a mean of 132.64 kg and daily feed intake mean of 4.47 kg. Feed conversion efficiency revealed a highly significant difference with efficiency of 0.79; [Pelleted grass: legume: concentrate mix, TC] feed regimen showed the capacity to convert a kilogram of feeds to meat when offered [pelleted forage grass:legume:concentrate; corn silage mix at 50:20:30 by parts], enhancing production. Ensiled and pelleted organic feeds enhanced the milk production with [Pelleted grass: legume: concentrate mix, TC] producing an average milk produced of 4.66 liters while [Grass/legume soilage: corn silage: concentrate mix, TE] produced 4.62 liters of milk.*

Keywords: Organic complete ration mix (OCRM), hybrid dairy goats, forage, silage, soilage, pellets, organic milk and chevon, forage, fodder, pasture, "in sacco" degradability of feedstuff, organic forage gardens

Animal production is a key sector as it must meet consumers' demand and the need for higher sustainability. Different production systems have been proposed as potential solutions, among them organic feeding systems for goats. The benefits of using local resources and providing different strategies related to the technical management of organic animals that are of interest for organic farms in relation to animal nutrition such as feeding regimens, digestibility, degradability, nutrient analysis, milk production and the beneficial intake of plant components or concentrates for the heath of animals have been proposed and studied.

Development of Organic Complete Ration Mix (OCRM): Adoption, processing and commercialization for organic dairy goat production is economically beneficial because feed nutrient is enhanced and sustained, an improvement in productivity, or both. The results determined the feeding systems on: (1) the procedure of feeding regimens; (2) the nutrient specifications of the diets; (3) the effects on milk production; (4) the health benefits; (5) the sustainability of the ration and supply of organic ingredients.

Overall, aspects such as physiology, nutrition, eating behavior, diet selection, seasonal nutrient supply, and environmental interactions must be studied and implemented more accurately where there is a higher availability of feed resources (feed materials and feed additives) and a higher flexibility in terms of their use.

A good accomplishment in organic livestock farming system stands upon the nutritional management of the animals for better performance and animal health. Nutrition plays a key role to prevent nematode infections, to provide wellbeing to the animals through better immunity and to improve animal production.

A study on organic dairy goat feeding systems was demonstrated through feeding regimens for sustainable milk and meat production as soilage, silage, haylage, formulated concentrate mix and pelleted forage-mix complete ration.

The organic dairy goat feeding systems as a technologies output of the study demonstrated feeding regimens for sustainable milk and meat production as soilage, silage, haylage, formulated concentrate mix and pelleted forage-mix complete ration derived from authentic organic resource and facility.

The "in vivo" digestibility procedure using “in sacco” rumen degradation techniques screened legume species revealed degradability percentages from 85 to 95 under 48 hour-incubation period for indigofera, rensonii, and ipil-ipil, while degradability percentages of (67.5,%) for para grass, (62.5%) for setaria, royal guinea and napier grass, (35.0%). Fodder crops with degradability percentage are mulberry (86.6 %) and madre de agua (66.6%).

Feeding regimens as [Grass: concentrate mix, TA] for Control; [Grass/ legume soilage: concentrate mix, TB]; [Pelleted grass: legume: concentrate mix, TC]; [Corn silage: concentrate mix, TD]; and [Grass/ legume soilage: corn silage: concentrate mix, TE] with ad libitum drinking water infused with fermented organic extracts as feed on-offer ration to hybrid dairy goats were established for the modular feeding system.

Ensiled and pelleted rations enhanced palatability and degradability showing a highly significant difference both in average total feed intake with a mean of 132.64 kg and daily feed intake mean of 4.47 kg. Feed conversion efficiency revealed a highly significant difference with efficiency of 0.79; [Pelleted grass: legume: concentrate mix, TC] feed regimen showed the capacity to convert a kilogram of feeds to meat when offered [pelleted forage grass:legume:concentrate; corn silage mix at 50:20:30 by parts], enhancing production.

Ensiled and pelleted organic feeds enhanced the milk production with [Pelleted grass: legume: concentrate mix, TC] producing an average milk produced of 4.66 liters while [Grass/legume soilage: corn silage: concentrate mix, TE] produced 4.62 liters of milk.

Dr. Cayetano C. Pomares is a retired University Professor who retired as the Vice President for Research, Development and Extension at the University of Southern Mindanao. Currently, he is a commissioned officer of the Reserve Force of the Armed Forces of the Philippines with the rank of Lieutenant Colonel. He remains to be a consultant on Organic Agriculture for the Department of Agriculture (DA) Region XII and a commodity consultant for the DA Bureau of Agricultural Research.

During his career, Dr. Pomares earned various national and regional awards, including the Award of Military Civic Action Medal. His research has won awards for Best Paper in various conferences. In 2014, he was awarded the Gawad Dangal ng Cotabato by the Provincial Government of North Cotabato; in 2013 he was awarded the Gawad Saka Agricultural Scientist by the President of the Republic of the Philippines; and in 2005, he was awarded the Gawad Pag-asa Award by the Civil Service Commission.

Dr. Pomares finished his PhD in Wool and Animal Science (Breeding, Genetics, and Reproductive Physiology) at the University of New South Wales in Australia. Prior to this, he earned his Masters of Science degree in Animal Science at the University of the Phiilppines Los Baños and a Diploma in Agricultural Science at the University of Melbourne in Australia.

Authors' Index

Farm Profile

Antipas Techno Demo Farm

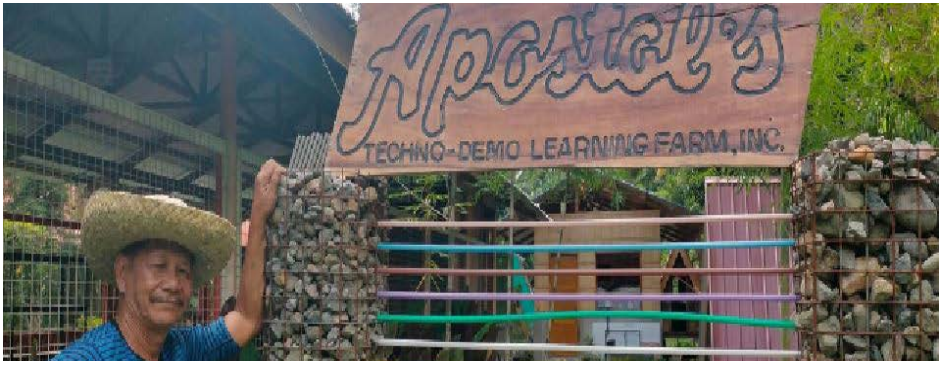
- Managed by the Office of Municipal Agriculture-Antipas
- The 11.2-hecatres demo farm is located at Malatab, Antipas, North Cotabato
- The techno-demo farm produces organic black rice. They also have fruit trees, vegetables, poultry (chickens and eggs), livestock (goat), fisheries (tilapia) which they also distribute to their farmers and fisherfolks.
- Since 2004, the farm showcases their technology, provide job immersions, and accommodates walk-in clients.

- Farm facilities:
  - Training hall
  - Administrative hall
  - Staff house
  - Staff and Visitors canteen
  - Material Recovery Facility
  - Storage Room/Warehouse
  - Vermicomposting
  - Parking area
  - Guard house
  - Washing area for farm tools and equipment

- Farm Machineries and Equipment:
  - Forage chopper
  - Incubator
  - Rice transplanter
  - Rice thresher
  - Rice reaper
  - Shredder Machine
  - Power Sprayer
  - Generator set
  - Electric Motor Water pump
  - Grass cutter
  - Solar Bubble Drier
  - Rotary Weeder
  - Knapsack Sprayer
  - Gardener Tools

Contact, Socials and other details:

- The farm is 150 km from DA-RFOXII with two hours and 52 minutes travel time, and from USM it will take one hour and 17 minutes.



Apostol's Techno-Demo Learning Farm, Inc.

- Owned by Mr. Daniel F. Apostol
- His five-hectares (5 ha) organic-based integrated farm is located at Roxas, Concepcion, Koronadal City, South Cotabato.
- They also have off-campus facilities, the three-hectares (3 ha) Eco-tourism park at Lampitak, Tampakan; and one-hectare (1 ha) demo farm at Katangwan, General Santos City both in South Cotabato province.
- The mission of the demo farm is to become a leading farm in carrying the best agricultural practices towards a healthy life and environment and increased farm productivity.
- Its vision is to develop a replicable farm and time-tested sustainable farm technologies and practices that produce clean and healthy food without prejudices to environment.

Achievement/s:

- In 2018, Apostol's techno-demo farm is a National Gawad Saka Awardee in Outstanding Organic Farm. It's a certified Good Agricultural Practicing (GAP) farm by Department of Agriculture (DA)-Bureau of Plant Industry (BPI) and a certified school for Practical Agriculture acknowledged by Agricultural Training Institute (ATI).
- The techno-demo farm is also a Tourism Farm.
- They are one of the major partners of DA, ATI, and Technical Education and Skills Development Authority (TESDA) in providing training in Rice Production, in which they already trained 1,200 rice farmers to become more productive and sustainable.

Contact, Socials and other details:

- The farm is four kilometers from Koronadal City Hall.
- Gmail: apostletechnodemofarm818@gmail.com
- Facebook: Apostol's Techno-Demo Learning Farm
- Number: 0920-200-5151

Deo's Farm and Organics

- Owned by Mr. Lorde A. Magoncia
- His 6.3-hectares organic and diversified farm is located at Kabulacan, Matalam, North Cotabato.
- The farm is filled with vegetables (lettuce), fruits (mango and banana), aqua-fishery (hito and tilapia), rice, and vermicomposts.
- Deo's farm started in 1984 and engaged in organic production in 2009. Now, the farm can produce 2,000 sacks of vermicompost per month.

Achievement/s:

- In 2010, the farm was awarded as a Top Organic Producer.
- From 2017 up to 2020, they were certified as an organic farm by a 3rd Organic Certifying Body (OCB) assisted by DA-RFO XII.
- Deo's farm is an acknowledged learning site for agriculture.

Contact, socials and other details:

- The farm is 108 km from DA-RFO XII with 2 hours travel time. From University of Southern Mindanao (USM) takes 15 to 20 minutes travel time.
- Gmail: magoncia.zahyen@gmail.com
- Facebook: https://www.facebook.com/DeosFarmAndOrganics/
- Number: 0917-633-6171

GBS III Agro Farm

- Owned by Mr. Gregorio Begasin Saljay, III an Animal Science graduate from Central Mindanao University
- The GBS III Agro farm is located at Pigcawayan, North Cotabato

Programs and courses:

- They are an ATI certified learning site for Organic Agriculture, a training center acknowledged by TESDA, an accredited Farmer Field School (FFS), and a beneficiary of Rice Competitiveness Enhancement Fund (RCEF)
- As a training center, they offer NCII course in Animal Production (swine, poultry, and ruminants) and Rice Machine Operation.
- They also offer programs on high quality inbred rice production, seed certification, and farm mechanization.
- Their farm projects include vermiculture production, goat and sheep management, poultry management, and edible greens.
- They also have programs and training for out-of-school youth and they are open for practical training and field trips.

Contact, Socials and other details:

- Can be reached through personal farm visit.

J & A Highlands

- It's a ten-hectares (10 ha) integrated diversified farm located at Campo 10, Rangayen, Alamada, North Cotabato.
- The farm produces organic-highland vegetable crops which are sold to various market venue depending on the scale of the produce.
- Open for visitors who want to relax, unwind and enjoy, as well as agriculture enthusiasts who want to explore and learn.
- The farm also accommodates exclusive events such as parties, gatherings, and/or group meetings.

Achievement/s:

- The farm was established on December 8, 2015. Since then the farm was developed into an Agri-Tourism site recognized by the Office of The Tourism Development and Promotion-Alamada.
- On November 25, 2020 the farm was accredited by ATI-RXII and was launched as a learning site for agriculture.

Farm products are all subject to availability:

- Fruits & Vegetables
  - Strawberry & Mullberry
  - Singkamas
  - Turmeric & Ginger
  - Sayote
  - Lettuce
  - Carrots
  - Sweet Pepper
- Value Added Products
  - Strawberry Jam
  - Mango-Habanero Hot Sauce
  - Kagikit Espeyal
  - Palapa Supreme
  - Atchara/Pickled Vegies
  - Spices
  - Dried Herbs

The farm also accommodates exclusive events such as parties, gatherings, and /or group meetings.

- Farm amenities
  - Secure parking space
  - Reception Counter
  - Holding Area
  - Multipurpose/Function Hall
  - Gazebo
  - Open Cottages
  - Clean Comfort Rooms
  - Washing Area
  - Flower Gardens
  - Vegetables Fields
  - Orchard
  - Park
  - Tree Deck
  - Play Ground
  - Outdoor Table and Chairs
  - Picnic Spaces
  - Camping Ground
  - Selfie Station
  - Panoramic view of mountain ranges

Contact, Socials and other details:

- Gmail: jp_b_cruz@yahoo.com
- Facebook: J&A Highlands

Oblate Galilee Farm

- Envisioned by Fr. Yves Caroff, OMI – a French oblate missionary priest.
- The nine-hectares model project for upland areas is located at Sitio Bugawak, Malangag, Antipas, North Cotabato
- The hilly terrain and rolling creeks of the farm was intended to:
  - Create an environment which is chemical and pollution free;
  - Repair the damage done by humans to the environment; and
  - Build bridges between people separated by race and religion.

Contact, Socials and other details:

Facebook: Oblate Galilee Farm
Contact number: 0955-133-9105

Organikian Urban Farm

- Organikian is located at Reyes Subd, 1st block, Koronadal City, South Cotabato
- It started in 2017 with the vision “Plant Seeds, Grow Blessings!”
- In January 2020, Organikian’s Café opened its door with a garden-to-table concept. They offer fresh vegetables such as lettuce, kale, arugula, holy basil, and other herbs. The café also offers salad and shakes.
- Three months later, pandemic came, Organikian created drinks for the community. They offer green, red, and yellow immune booster drinks.
- After two years of innovation, Organikian created healthy food as a brand for food security creating organic ingredients that are good for the body.
- The farm’s goal is to spread awareness on health by eating healthy. “We want to plant seeds and grow more blessings”

Achievement/s:

- Today, Organikian has been in partnership with the Department of Tourism, Department of Agriculture, Department of Science and Technology, ATI RXII, Overseas Workers Welfare Administration, and many more for promoting healthy food and organic products.

Contact, socials and other details:

- Gmail: organikianurbanfarm@gmail.com
- Facebook: Oblate Galilee Farm
- Website: organikianurbanfarm.business.site/?m=true
- Contact number: 0917-717-5268




Phoenix Larrrel Agriventure Inc.

- Owned by Mr. Renato Dela Cruz
- His 1.7-hectares diversified farm is located at Saravia, Koronadal City, South Cotabato
- The farm produce vegetables (patola, kalabasa, bottle gourd, eggplant, etc.), fruits (passion fruit, abuyog sweet, etc.), poultry (native chicken and duck), spices (ginger, onion chives, onion, chili, etc.)

Achievement/s:

- It started 12 years ago (2010), currently it's a certified learning site for agriculture. It's also a certified organic farm by a third-party organic certifying body.

Contact, socials and other details:

- The farm is only 2.7 km from DA-RFO XII office with 15 minutes travel time, from USM it will take two hours to reach the farm.
- Facebook: Phoenix Larrrel Agriventure
- Contact number: 0939-908-1845

Sebul Farm

- Owned by Mr. William Sy
- The four-hectares (4 ha) diversified farm is located at Katangwan, Conel Road, General Santos City, South Cotabato
- The Sebul farm is filled with fruits (cacao, mangosteen, avocado, durian, etc.), herbs, crops, poultry (native chicken and turkey), rabbit, aqua-fishery (hito and tilapia), and different variety of plants.
- The farm also produces chocolates, coffee, peanut butter, cacao wine, tablea, coco powder, etc.
- The farm has function hall that can accommodate 50 persons and an overview deck that can hold for 30 persons.

Achievement/s:

- The Sebul farm is also a certified learning site for agriculture.

Contact, Socials and other details:

- The farm is 51.4 km from DA-RXII office with one-hour travel time. From USM it will take three hours to reach the farm.
- Facebook: Sebul Farm & Organic Products
- Contact number: 0963-542-2490

University of Southern Mindanao Agricultural Research & Development Center

- Research arm of the university
- One of the few actively public breeding institutions of corn in the Philippines
- 300-hectares planted with a diversified farming system: cereals, vegetables, legumes, ornamentals, tropical fruits, and industrial crops (Cacao, rubber, oil palm & coconut).

- Located in the eastern part of the university, almost 1 km from the main campus Topographical Description:
  - Lowland
  - Irrigated
- Production Practices:
  - Conventional
  - Natural/Organic Farming
- Germplasm area:
  - Durian
  - Citrus
  - Rambutan
  - Mango
  - Banana
  - Cacao
- Other Farm Operations/ Laboratories/Activities/ Component
  - Corn Research
  - Corn Production
  - Legumes Research (peanut & mungbean)
  - Coconut production
  - Oil Palm Production
  - Fruit-bearing trees: Rambutan
  - Cacao Research & Production
  - Rubber Research & Production
- Organic Farming:
  - Banana
  - Corn, Vegetables & Spices
- List of Farm Facilities
  - Biotechnology
  - Central Analytical Laboratory
  - Rubber Testing Laboratory
  - Post-harvest
  - Seed Storage
- Farm Machineries
  - Tractors
  - Combine Harvesters
  - Corn Picker
  - Corn Planter

Farm Tour Information Sheet

	FARM NAME	FARM ADDRESS	CONTRACT PERSON	PHONE NUMBER AND EMAIL ADDRESS	FACEBOOK PAGE
1	Antipas TD Farm	Brgy. Malatab, Antipas, North Cotabato	April Joy Masculino	09128912954 omagantipas@gmail.com	fb.com/profile.php?id=100008542036323
2	Apostol's Techno Demon Farm	Brgy. Concepcion, Koronadal City, South Cotabato	Daniel F. Apostol	09202005151	fb.com/apostols.tecnodemo
3	Deo's Farm and Organics	Brgy. Kabulacan, Matalam, North Cotabato	Lorde M. Magoncia	09657511189 magoncialorde@gmail.com	fb.com/lorde.magoncia.9
4	GBS III Agro Farms	Brgy. Presbitero, Pigcawayan, North Cotabato	Gregorio N. Saljay III	09126928878 gbsiiiagrofarms@gmail.com	fb.com/profile.php?id=100088917760724
5	J & A Highlands	Brgy. Rangayen, Alamada, North Cotabato	Angelie Militar	angeliemilitar@yahoo.com	fb.com/profile.php?id=100063540655103
6	Oblates of Galilee	Bugwak, Brgy. Malangag, Antipas, North Cotabato	April Joy Masculino	09128912954 omagantipas@gmail.com	fb.com/profile.php?id=100008542036323
7	Organikian Urban Farm	Brgy. Morales, Koronadal City, South Cotabato	Christian Castaneda	09177062982 organikianurbanfarm@gmail.com	fb.com/organikianurbanfarm
8	Phoennix Larrrel Agriventures Inc.	Brgy. Saravia, Koronadal City, South Cotabato	Precy Dela Cruz	09088822040 frecydelacruz@ymail.com	fb.com/profile.php?id=100054246501697
9	Sebul Farm	Brgy. Tasiman, Lake Sebu, North Cotabato	William Sy	09089284380	fb.com/profile.php?id=100057386953872
10	University of Southern Mindanao Agricultural Research Center	USM-Kabacan, North Cotabato	Adeflor G. Garcia Dennis Sarmiento	099778355854 / 09124404306 dfsarmiento@usm.edu.ph	fb.com/chairman09

Our Sponsors

We genuinely

THANK YOU

for supporting the

17th National Organic Agriculture Congress!

Hon. Emmylou "Lala" Taliño-Mendoza, MNSA
Governor, Province of Cotabato

Hon. Joselito S. Sacdalan
Representative, 1st District of Cotabato

Hon. Rudy S. Caoagdan, DPA
Representative, 2nd District of Cotabato

Hon. Ma. Alana Samantha Taliño Santos
Representative, 3rd District of Cotabato

Hon. Cristobal D. Cadungon
Mayor, Municipality of Antipas

Hon. Jay Lawrence S. Gonzaga
Mayor, Municipality of Magpet

Hon. Jeam D. Villasor
Mayor, Municipality of Arakan

Hon. Jonathan O. Mahimpit
Mayor, Municipality of President Roxas

Hon. Armando M. Quibod
Mayor, Municipality of Makilala

Hon. Angel Rose L. Cuan
Mayor, Municipality of Libungan

Hon. Juanito C. Agustin
Mayor, Municipality of Pigcawayan

Hon. Jesus N. Sacdalan
Mayor, Municipality of Alamada

Hon. Jose Paolo M. Evangelista
Mayor, City of Kidapawan

Hon. Reuel P. Limbungan
Mayor, Municipality of Tulunan

Hon. Rolando C. Sacdalan
Mayor, Municipality of Midsayap

Hon. Sumulong K. Sultan
Mayor, Municipality of Pikit

Hon. Rogelio T. Taliño
Mayor, Municipality of Carmen

Hon. Eduardo C. Cabaya
Mayor, Municipality of Aleosan

Hon. Russel M. Abonado
Mayor, Municipality of Mlang

Hon. Oscar M. Valdevieso
Mayor, Municipality of Matalam

Hon. Jesus F. Alisasis
Mayor, Municipality of Banisilan

Hon. Evangeline Pascua-Guzman
Mayor, Municipality of Kabacan

17th National Organic Agriculture Congress

OFFICIAL MEDIA PARTNER

17th National Organic Agriculture Congress

Organizing Commitee

NATIONAL ORGANIC AGRICULTURE PROGRAM

Director Bernadette F. San Juan
Ms. Lea C. Deriquito
Ms. Maria Teresita S. Lesaca
Ms. Alexandrea D. Suñga
Ms. Dyesel G. Cezar
Mr. Dale Russeth Gabanes
Ms. Adeline P. Gomez
Mr. Mark Daniel U. Laygo
Mr. Glenn B. Umandap

17th National Organic Agriculture Congress

Organizing Committee

DA REGIONAL FIELD OFFICE XII

Sailila E Adbula, PhD. ----------OIC-Regional Executive Director
Lorna P Vilbar, PhD. ---------- OIC-RTD for Research and Regulation
Zaldy M Boloron, MPA---------- OIC RTD for Operation
Ismael M. Intao ----------OIC-Chief, Field Operation Division
Roel C De Ramos---------- OIC-Chief Research Division
Ma. Corazon E. Sorilla---------- Regional OAP Focal Person
Harold G. Ramos ---------- OAP Report Officer

Farm Tour Incharge

Grizel Ann A. Tulunan ---------- South Cotabato Farms
Debbie M. Cervantes---------- South Cotabato Farms
Archie Dela Cruz ---------- South Cotabato Farms
Cornelio I.A. Gatierra---------- North Cotabato Farms
Dawn Mark O. Cantil ---------- North Cotabato Farms

Break out Session Documentor

Fema M. Agustin---------- SRS II/RTD for Research & Regulation
Angelica L. Cabalfin ---------- SRS II/Research Division
Vincent M. Porras---------- SRS II/Research Division
Rodel A. Mohammad---------- RA/RTD for Research & Regulation
Paula Joy S. Candido---------- RA/ROS Tupi

Video, Photography and Lead Monitor Operator

Edgar Allan Pasaol---------- Overall In-Charger
Gallardo Zafico---------- Videographer
Justin Aquino ---------- Photographer
Danilo Jaruda, Jr ---------- Photographer
John Paul Daquido---------- Videographer
Carl Ulysses Aguillon ----------FB Live Arranger
Bobby Parbo---------- Lead Monitor Operator
Marlon Genove ---------- Lead Monitor Operator
Joel Cocjin---------- Lead Monitor Operator
Ronnie Flores---------- Lead Monitor Operator

Trade Fair and Exhibit

Abdulkadil I. Ango ----------OIC Chief-AMAD/Organizer
Josalyn M. Jomuad ----------Co-Organizer
Nurhira Camille S. Penduma---------- Sales Monitoring
Rosa P. Esclamada---------- Sales Monitoring

DA REGIONAL FIELD OFFICE XI

Mr. Abel James I. Monteagudo ----------Regional Executive Director
Ms. Marila L. Corpuz ---------- RTD for Operations
Mr. Andres L. Alemania ---------- RTD for Research & Regulations
Ms. Elizabeth C. Torio -- Chief, Regional Agriculture & Fishery Information Section
Mr. Rey R. Reintar---------- Regional OAP Focal Person
Ms. Pearl Catherine T. Pepito ---------- OAP Report Officer

Welcome and Working Group Committee for the Arriving Guests, VIPs, and Delegates

Oversight Committee

Dr. Marila L. Corpuz .---------- Chairperson
Ms. Marie Ann M. Constantino ----------Co-Chair
Mr. Ray R. Reintar ----------Member

Transportation & Welcome Committee

Ms. Marilyn Mamaril ---------- Chair
Mr. Samuel Dacera ----------Co-Chair
Ms. Janice May A. Seraspe ----------Member
Mr. Wilson Bolanio----------Member
Ms. Cherry Ann Piamonte----------Member
Mr. Jayson Panes----------Member
Ms. Aime Tumbaga----------Member
Mr. Jonathan Legaspi----------Member
Mr. Hermie Mayormita Jr.----------Member
Ms. Eloise Segui ----------Member
Mr. Leo Ingalla ---------- Member
Mr. Gilbert Javier ----------Member
Mr. Jomar Lamoste ----------Member

Food Committee

Ms. Pearl Catherine Pepito ---------- Chair
Ms. Aime Tumbaga ----------Member
Ms. Maria Catherine Ramada ----------Member

Finance Committee

Ms. Flordeliza Enriquez ---------- Chair
Ms. Janice May A. Seraspe ---------- Member

TASK FORCE 17th NOAC

Franciso Gil N. Garcia, PhD
Overall Coordinator

Mary Joy S. Cañolas, PhD
Co-Coordinator

Hospitality/Welcome

Ms. Meldred F. Samblaceño---------- Chair
NOAP, RFO 11 and RFO 12 ----------Co-Chair
Tourism students ----------Member
Mr. Rosyell Angelo N. Piosca----------Member
CHEFS Faculty ----------Member

Secretariat & Registration

Ms. Leanne Jay S. Manceras ---------- Chair
Ms. Alexandrea D. Suñga----------Co-Chair
Mr. Amancio Manceras, Jr----------Member
Mr. Bryan Lloyd P. Bretaña ----------Member
Mr. Leandreux D. Ocasion ----------Member

Conference Kits & Token

Mr. Joseph O. Castillo ---------- Chair
Engr. Benjamin Fortinez----------Co-Chair
Ms. Cyren Gay A. Fernandez ----------Member
Mr. Leandreux D. Ocasion ----------Member
Ms. Alexandrea D. Suñga----------Member

Venue Preparation & Restoration

Mr. Joseph O. Castillo ---------- Chair
Engr. Benjamin Fortinez----------Co-Chair
Dr. Jurhamid C. Imlan----------Member
Mr. Neil Pep Dave N. Sumaya----------Member
Soils Major Students ----------Member
Animal Science Major Students ----------Member
University Volunteers Club----------Member

Event Programs

Dr. Florence Roy P. Salvaña ---------- Chair
Dr. Leida Donque ----------Co-Chair
Dr. AP Warren P. Adamat ----------Member
Ms. Roselyn Clemen ----------Member
USG Officers ----------Member

Cultural Presentation/Live Band

Ms. Jessa S. Buisan ---------- Chair
Dr. Marlene Orfrecio ----------Co-Chair
RFO XII Band----------Co-Chair
Ms. Girlie D. Batapa ----------Member
Mr. Ildefonso Seguritan ----------Member
Mr. Muhammad Buisan ----------Member
Mr. Mark San Pedro ----------Member

Presentation of Organic Agriculture Research and Findings

NOAB, OASP ---------- Chair
Dr. Ardniel A. Baladjay ----------Session Chairs Chair
Dr. Mel Crisel A. Sales----------Fertilizers
Dr. Mark Al-jamie J. Muttulani ---------- Crops
Dr. Lorelyn Joy T. Milagrosa ---------- Rice
Dr. Vrenelie II D. Flores ---------- Livestock & Poultry
Ms. Aisa B. Guzman ----------Checker
Mr. Jayson J. Corda----------Checker
Ms. Kristil Mae M. Pagar----------Checker
Mr. Jorimel P. Quieta----------Checker
Ms. Cherry Mae C. Dizon ----------Checker
Mr. Remsha Peterjul D. Martin ----------Checker
Mr. Eugene M. Pagaduan----------Checker
Ms. Mae Ann N. Marcos ----------Checker
Ms. Ivy M. Pasquin----------Documentation Staff
Ms. Bernadith T. Borja----------Documentation Staff
Mr. Noe Mamon ----------Documentation Staff
Dr. Gelyn V. Amilbahar----------Documentation Staff
Dr. Gwen Iris D. Empleo ----------Documentation Staff
Mr. Neil Pep Dave Sumaya----------Documentation Staff
Dr. Mark Steven A. Estefania ----------Documentation Staff
Ms. Mary Ann B. Rama----------Documentation Staff
Fertilizer – Dr. Ellen N. Tanabe---------- Panelists (Academe)

Crops – Dr. Ardniel A. Baladjay ---------- Panelists (Academe)
Rice – Dr. Baser L. Mamalac ---------- Panelists (Academe)
Livestock & Poultry – Dr. Josephine R. Migalbin ---------- Panelists (Academe)

Sound System

Dr. Uldarico E. Lavalle, Jr. ---------- Chair
Dr. Joel V. Misanes ----------Co-Chair
RAFIS RFO XII----------Co-Chair
Mr. Rene Cabahug, Jr.----------Member
Selected CTI Students ----------Member
Mr. Ildefonso Seguritan ----------Member
Mr. Zherwin R. Descallar----------Member

Connectivity

Mr. Eugene G. Ranjo ---------- Chair
UICTO ----------Co-Chair

ICT Support

Mr. Melecio Cordero, Jr. ---------- Chair
CEIT Faculty ----------Co-Chair

Meals and Snacks (Organic)

Ms. Preciosa Valmores ---------- Chair
Ms. Shirl Mae M. Bebit ----------Co-Chair
Ms. Apple Ureta----------Member
Ms. Kathleen Esparagosa ----------Member
Ms. Avegale S. Roy----------Member
Ms. William Gonsaga ----------Member
Hostel and Café Martina Personnel ----------Member
HM Students----------Member

Conference Proceedings

Dr. Debbie Marie B. Verzosa ---------- Chair
Ms. Lea C. Deriquito ----------Co-Chair
Ms. Myrna Tan ----------Co-Chair
Ms. Janice Bangoy----------Member
Mr. Dennis Sarmiento ----------Member
Mr. Thea Hernandez----------Member

Mr. Reijie Madre----------Member
Dr. Glyn Magbanua----------Member
Dr. Krizler Tanalgo ----------Member
Mr. Nelson Balneg----------Member
Ms. Alexandrea D. Suñga----------Member
Mr. Dale Russeth Gabanes----------Member
Mr. Mark Daniel U. Laygo ----------Member

Farm Tour and Exposure

Ms. Ma. Corazon Sorilla ---------- Chair
RFO XII----------Co-Chair
Mr. Rezin G. Cabantug----------Member
Ms. Dyesel Cezar ----------Member

Security Services

PLTCOL Irish Hezron F. Parangan,
COP Kabacan MPS ---------- Overall Ground Commander
Mr. Orlando B. Forro----------Co-Chair
LT. COL. Rowel E. Gavilanes, Battalion Commander 90 IB ----------Member
LT. COL. Antonio P. Peralta, TMU Head, Kabacan ----------Member
Dr. May Eva Z. Garcia ----------Member
Mr. Vicente delos Reyes ----------Member
Ms. Winnie Reyno ----------Member
USM Security force ----------Member
USM Criminology students ----------Member

President's and Governor's Welcome Dinner Mayor's and Congressmen's Fellowship Night cum Closing Ceremony Food Service Committee

Mr. Jmjson C. Bautista ---------- Chair
BM Renato Dela Cruz ----------Co-Chair
Ms. Avegale S. Roy----------Co-Chair
HM Students----------Member
CEC Personnel ----------Member

CHEFS Faculty ----------Member

Newsletters

Mr. Lloyd Anton Von Colita---------- Chair
DELL Faculty ----------Co-Chair
AB English Students ----------Member
Mr. Gerwin Alcalde----------Member
Ms. Phoebe Baure ----------Member

Promotions, Streamers, & Press Conference

Antonio Jesus C. Orbida ---------- Chair
DA RFO 12 ---------- Chair
Ms. Vilma Santos ----------Co-Chair
Mr. Brex Brayan Nicolas ----------Member
DXVL Staff----------Member
PPDS Personnel ----------Member
Mr. Mark Daniel U. Laygo ----------Member

Invitations and Advisories

NOAP-NPCO ---------- Chair
Dr. Mary Joy S. Cañolas----------Co-Chair
Mr. Rezin Cabantug ----------Member
Mr. Dennis Sarmiento----------Member
AMAD AMAS RFO ----------Member

Plaques, Certificates, & Tokens

Mr. Rezin G. Cabantug---------- Chair
Ms. Jasmin A. Pecho ----------Co-Chair
Ms. Mary Grace Samulde----------Member
Ms. Marry Grace Balbuena----------Member
Ms. Nenita Olero----------Member

Documentation (Photos and Videos) & Livestreaming

Mr. Allan C. Facurib---------- Chair
Mr. Brex Brayan Nicolas ----------Co-Chair
Ms. Sarrah Guerrero ----------Member
DXVL Kool FM Staff ----------Member
DevCom Students----------Member
UMPC Staff----------Member

USM Media Team ----------Member

Conference Kit Preparation

Dr. Joan P. Sadoral---------- Chair
Dr. Mel Chrisel Sales----------Co-Chair
Soils Major ----------Member
Mr. Joeseph S. Quisado ----------Member
Mr. Neil Pep Dave N. Sumaya ----------Member

Exhibits & Trade Fairs of Organic Products

DA - AMAS and DA RFO 12 - AMAD ---------- Chair
Ms. Pia Amabelle M. Flores ----------Co-Chair
Mr. Jalaloden M. Marohom ----------Member

First Aid & Health Services

Dr. Liza D. Mariposque---------- Chair
Ms. Jza A. Taposok ----------Co-Chair
Ms. Marianne I. Meriales----------Member
Selected Nursing Students----------Member
USM Hospital Staff (Regular nurse) ----------Member
Mr. Peter Elarde----------Member

Sanitation and Cleanliness

Dr. Ivy Mar Cabornida---------- Chair
Dr. May Eva Z. Garcia ----------Co-Chair
Dr. Adeflor G. Garcia----------Member
Mr. Jeyson Donque ----------Member
USM Utility Workers ----------Member
USM ROTC ----------Member
USM Volunteers Club ----------Member

Electrical

Engr. Eugene Mars H. Abril ---------- Chair
PPDS ----------Co-Chair

Essential Contact Numbers

Geoffray R. Atok---------- 09075714606
Transportation & Accommodation

Meldred F. Samblaceño ---------- 09297853888
Hospitality/Welcome

Leanne Jay S. Manceras ---------- 09063402080
Secretariat & Registration

Ardniel A. Baladjay ---------- 09124457867
Scientific Programme & Farm Tour

Preciosa B. Valmores ---------- 09437004790
Meals and Snacks

Orlando B. Forro ---------- 09481265450
Security Services

Pia Amabelle M. Flores---------- 09307754975
Exhibits & Trade Fairs of Organic Products

FIRST AID

Liza D. Mariposque ---------- 09228565720
USM Hospital Ward ----------09319765038/09469199398(VIBER)
Ambulance Drive (Peter Elarde)---------- 09352746487

Trunkline: (02) 8928-8741 to 64
Local: 3322; 3321
noap@da.gov.ph
Department of Agriculture
Elliptical Road, Diliman, Quezon City