

**MAJOR PRACTICE AT THE PHILIPPINE CENTER FOR POSTHARVEST
DEVELOPMENT AND MECHANIZATION (PHilMech) WITH EMPHASIS
ON MORINGA PRODUCTION AND PROCESSING**

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An undergraduate major practice manuscript presented to the faculty of the Department
of Crop Science, College of Agriculture, Central Luzon State University,
Science City of Muñoz, Nueva Ecija in partial
fulfillment of the requirements
for the degree

**BACHELOR OF SCIENCE IN AGRICULTURE
(Crop Science - Horticulture)**

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ACCEPTANCE SHEET


This undergraduate major practice manuscript entitled "MAJOR PRACTICE IN PHILIPPINE CENTER FOR POSTHARVEST DEVELOPMENT AND MECHANIZATION (PHIMech) WITH EMPHASIS ON MORINGA PRODUCTION AND PROCESSING", prepared and submitted by MERRIAN ABES BOTE, in partial fulfillment of the requirements for the degree of BACHELOR OF SCIENCE IN AGRICULTURE, is hereby accepted:


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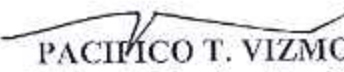

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BIOGRAPHICAL SKETCH

The author, MERRIAN ABES BOTE was born on FEBRUARY 9, 1997 at Community Medicare Hospital, General Tinio, Nueva Ecija. She is the second oldest out of all her siblings of Mr. Elmer Graneta Bote and Mrs. Anastacia Abes Bote. Her siblings are named Marjhor and Monica. They are residing in Brgy. Rio Chico, General Tinio, Nueva Ecija.

She finished her primary education at Rio Chico Elementary School and secondary education at General Tinio National High School. After she finished high school, she decided to pursue college in Central Luzon State University and took Bachelor of Science in Civil Engineering (BSCE). However, her plans did not go the way she wanted it to happen. Her self-worth and capability were challenged. She had to decide whether to continue or stop in pursuing BSCE. Everything about BSCE is challenge, it was fun until it becomes toxic environment that she cannot take it anymore and disappoint her parents. She decided to take another risk in Bachelor of Science in Agriculture major in Crop Science as her field of specialization, Horticulture. In this course, she learned and enjoyed while being oriented about the life of farming and the beauty behind it.

During her college days, she encountered a lot of difficulties and challenges that make her learned and improved through adapting the lessons behind those trials. She overcome it because of her trust in God and the never ending support of her family and friends.

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ABSTRACT

MERRIAN ABES BOTE, Department of Crop Science, College of Agriculture,
Central Luzon State University, Science City of Muñoz, Nueva Ecija, December 2019.

- Title:** Major Practice in Philippine Center for Postharvest Development and Mechanization (PHilMech) with emphasis on Moringa Production and Processing
- Venue:** Bio-Process Engineering Division (BPED)
Philippine Center for Postharvest Development and Mechanization (PHilMech)
CLSU Compound, Science City of Muñoz, Nueva Ecija
- Adviser:** Joan A. Bayla

The major practice was conducted at the Bio-Process Engineering Division, Philippine Center for Postharvest Development and Mechanization (PHilMech) from October 2019 to December 2019. The general objective was to enhance knowledge and acquire skills in different postharvest technologies in PHilMech by actively participating in existing activities and projects including the postharvest handling and processing of moringa, set acquainted in the processing of essential oil production of citronella and lemon grass and postharvest handling of cacao beans. The laboratory and field activity strengthened the ability and potential of student in postharvest management.

LITERATURE CITED

- AGBO, C.U. AND C.M. OMALIKO. (2006).** Initiation and Growth of shoots of *Gongronema latifolia* (Benth) stem cuttings in different rooting media. (Vol. 5(5)). *Afr. J. Biotechnol.*
- ALI M.A., Y.A. YUSOF, N.L. CHIN & M.N. IBRAHIM. (2017).** Processing of moringa leaves as natural source of nutrients. *Journal of Food Process Engineering.*
- ARAU I.K., G.K. AHORBO, E.K. ANKU, E.K. KUMAH & H. AMAGLO. (2016).** Postharvest handling practices and treatment methods for tomato handlers in developing countries: A mini review. *Advances in Agriculture*, 1-8.
- BECKER, K., N. FOILD & H.P.S. MAKKAR. (2001).** The Potential of Moringa oleifera for agricultural and industrial uses, In: *The miracle tree - the multiple attributes of moringa*. CTA. USA.
- DATTA, S., R. CHATTERJEE & J.C. JANA . (2015).** Value addition in vegetable crops. *Springer India*, 43-57.
- FAHEY, J. (2011).** A review of the medical evidence for its nutritional therapeutic and prophylactic properties. *Trees for Life Journal.*
- FOIDLE, N.,H.P.S. MAKKAR & K. BECKER. (2001).** The potential of moringa oleifera for agricultural and industrial uses. 45-76.
- KADER, A.A. (2013).** Postharvest technology of horticultural crops - an overview from farm to fork. *Ethiop .J. Appl. Sci. Technol.*, 1-8.
- KUMAR, D.S., L. GOPALAKRISHNAN & K. DORIYA. (2016).** Moringa oleifera: a review on nutritive importance and its medicinal application. *Food Science and Human Wellness*, 49-56.
- MAITI R., A.K. THAKUR, A. GUPTA & D. MANDAL. (2018).** Post harvest management of agricultural produce.
- MEDINA, M.G., G. GARCIA, T.Y. CLAVERO & J.M IGLESIA. (2007).** Estudio comparativo de Moringa oleifera y *Leucaenaleucoccephala* durante la germinacion y la etapa inicial de crecimiento. *Zootecnia Trop.*, 25(83).

- MOPERA, L.E. (2016).** Food loss in the food value chain: The Philippine agriculture scenario. *Journal of Developments in Sustainable Agriculture*, 11, 8-16.
- OSHUNSANYA, S.O., J.A. FAGBENRO, O. ALIKU & O.A. OKE. (2015, October).** Nursery establishment of *Moringa oleifera* as affected by pre-sowing seed treatments in a coarse textured soil.
- PAPILLO J. (2007).** *Moringa oleifera*: the multipurpose wonder-tree. Michigan Technological University, Michigan, USA.
- Philippine Center for Postharvest Development and Mechanization (PhilMech). (2015).**
- Philippine Center for Postharvest Development and Mechanization (PhilMech). (2018).** Science City of Munoz, Nueva Ecija: PhilMech Annual Report 2018.
- RAGHAVENDRA, M.P., D.C. MOHANA & R. K. ANANDARAO. (2006).** Antifungal activity of some plant extracts against important seed borne pathogens of *Aspergillus* sp. . *Journal of Agricultural Technology* , 109-119.
- SAKIN U.O., S. ERCISLI, O. ANAPALI. & A. ESITKEN. (2005).** Effect of Pumice amendment on physical soil properties and strawberry plant growth. (Vol. 6(3)). *J. Central Europe. Agric.*
- WILSON S.B., P.J. STOFFELLA & D.A. GRAETZ. (2001).** Use of Compost as a media amendment for containerized production of two subtropical perennials. (Vol. 19(1)). *J. Environ Hort.*
- YANG, R.Y., L.C. CHANG, J.C. HSU, B.B.C. WENG, M.C. PALADA, M.L. CHADHA & V. LEVASSEUR. (2006).** Nutritional and functional properties of moringa leaves - from germplasm, to plant, to food, to health.
- YASMEEN, AZRA. (2011).** Exploring the potential of moringa (*Moringa oleifera*) leaf extract as natural plant growth enhancer.