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THE USE OF ORGANIC AND INORGANIC FERTILIZERS AND ITS EFFECT ON THE QUALITY OF CORN PRODUCTS IN THE PHILIPPINES: A REVIEW

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ABSTRACT

The Philippines is an agricultural country with a land area of 30 million hectares, 47% of which is agricultural land. The prime agricultural lands are located around the main urban and high population density areas. Philippine agriculture remains concentrated on a few traditional commodities. Corn is second to rice as the most important crop in the Philippines, with one-third of Filipino farmers, depending on maize as their major source of livelihood. Most Filipino corn farmers prefer to use inorganic fertilizer in increasing the yield of their crops due to readily available nutrients in the materials and ease in application. However, due to the high cost of inorganic fertilizer and at time scarce supply caused by both energy crisis and socio-economic constraints, farmers are hesitant to use it alone. It is therefore necessary to integrate with organic fertilizer to augment the poor fertility of the soil. There is a need to integrate with organic fertilizer to attain better yield and compensate the slow release organic nutrient. Nutrient uptake values were higher in the combined application than the sole application. Besides, it is impossible for Filipino farmers to apply organic inputs alone especially in a large-scale farms.

The application of combined organic and inorganic fertilizers is advisable for corn production especially for those new hybrid varieties. New hybrid varieties of corn require a high amount of nutrients. The addition of organic materials in the soil could improve its fertility status and productivity, thus it could improve the yield and quality of the products. This could contribute to the high return on investment of the farmers.

Fertilization influence not only the growth and yield but also the physicochemical properties and sensory qualities of corn products. The pH value, total soluble solid, and titratable acidity of corn ears could be increased when it is applied with the organic fertilizers. The same also with the sensory qualities that the taste, aroma, texture, and color of cooked corn ears are found to be more likely acceptable to the consumers. Organically-grown products is the most preferred by the consumers nowadays since most of them are health conscious. It is also observed that organic fertilizers prolong the shelf life of the products when it is stored for 5 days, thus maintain the appearance quality of the corn ears.

INTRODUCTION

The Philippines is a tropical country. This country has a total land mass of 300,439 km^2 with 11 main islands representing more than 95% of the total area. The islands are geographically divided into three main areas, namely Luzon, Visayas and Mindanao (Fig. 1) (fao.org).

Figure 1. Map of the Philippines

The Philippines is an agricultural country with a land area of 30 million hectares, 47% of which is agricultural land. The prime agricultural lands are located around the main urban and high population density areas (Government > Agriculture (dlsu.edu.ph). Philippine agriculture remains concentrated on a few traditional commodities. The top agricultural crops in terms of area planted, volume produced, and value, are rice, corn, coconut, sugarcane, and banana (fao.org).

Corn is second to rice as the most important crop in the Philippines, with one-third of Filipino farmers, depending on maize as their major source of livelihood. White corn is the most important substitute staple in periods of rice shortage, especially in rural areas. Yellow corn is the primary source of raw materials for making feeds in the Philippines' animal industry, and is being increasingly used by the manufacturing sector. Maize production in the Philippines increased at an annual rate of 1.7% over a 20-year period (1980-2000). After production peaked in 1990 at 4.9 million metric tons, a sharp decline was posted in 1998 when the El Niño phenomenon affected the region (Gonzales & Lapiña, 2003).

Total area planted to maize was also highest in 1990, at 3.8 million hectares, but declined at 1.9% per year from 1985 to 2001 (Gonzales & Lapiña, 2003). These long-term figures reflect a sharper decline in white maize area in contrast to that planted to yellow corn. While average yields for white corn are consistently low, yellow corn yields increased by an annual rate of 4.9% over a 17-year period beginning in 1985 (Gonzales & Lapiña, 2003). The adoption of improved technology for yellow corn production has resulted in significant yield increases.

Philippine Statistics Authority reported that corn production increased from 2011 to 2015 in terms of volume, area planted, and its value (Philippine Statistic Authority, 2016). However, the April-June 2016 production fell to 0.91 million MT from the 2015 output of 1.01 million MT by 10.00 %. Harvest area dropped to 271 thousand hectares from last year's record of 330 thousand hectares. Nevertheless, yield per hectare increased by 9.38 % from 3.07 MT in 2015 to 3.36 MT in 2016 (Ocampo, 2016).

In upland areas, maize production peaks from July to September; the lean months are from January to June. The upland regions of Mindanao have the most area planted to corn, and the highest production in the Philippines. Corn is also grown in the rainfed lowlands, where it is planted during the dry season after rice crop has been harvested (FSSRI, 2000; Eusebio & Labios, 2001). The top producing regions of corn production in the Philippines are (1) Autonomous Region in Muslim Mindanao, (2) Cagayan Valley, (3) Bicol Region, (4) Western Visayas, and (5) Central Visayas (fao. org).

The Philippines adopted a Good Agricultural Practices (GAP) to improve corn production (Banzon et. al., 2013) thus, most of the Filipino farmers apply GAP to their corn farm not only for them to be benefited but also to response the RA 10068 (Mojica et. al., 2013). The Code of Good Agricultural Practices for Corn (GAP Corn) is a set of consolidated safety and quality standards formulated by the Department of Agriculture (DA) for the production, harvesting and on-farm postharvest handling and storage of corn to avoid good marketing quality losses. Quality management of corn production using GAP includes organic inputs and practices (Philippine National Standard 2016). This is not a quit problem for the Philippines, because the country has a lot of resources for organic farming to positively response the implementation of GAP and also the RA 10068 (Rey, 2012). Hence, Many Filipino farmers apply organic inputs to their corn farms (Gerpacio et al., 2004; Guerrero, 2010; Maghirang et. al., 2011). However, several studies revealed that the application of organic fertilizer alone cannot meet the nutritional requirement of the crop. There is a need to integrate with inorganic fertilizer to attain better yield and compensate the slow release organic nutrient. In a large-scale farm, it is impossible for Filipino farmers to apply organic inputs alone because it is also a laborious.

Law for Organic Agriculture

The Implementing Rules and Regulations (IRR) are issued pursuant to the policies declared under RA 10068, to wit: “It is hereby declared the policy of the State to promote, propagate, develop further and implement the practice of organic agriculture in the Philippines that will cumulatively condition and enrich the fertility of the soil, increase farm productivity, reduce pollution and destruction of the environment, prevent the depletion of natural resources, further protect the health of farmers, consumers and the general public, and save on imported farm inputs. Toward this end, a comprehensive program for the promotion of community-based organic fertilizers such as compost, pesticides and other farm inputs, together with a nationwide educational and promotional campaign for the use and processing, as well as the adoption of organic agricultural system as a viable alternative shall be undertaken (Organic Act of 2010).

Organic Production

Environmental, social, and economic sustainability are the basic objectives of organic farming (Stockdale et al., 2001). Organic farming is growing rapidly since the last decade and has an annual increase of 20% (Avery 2007; Lotter, 2003). Statistics indicated over 31 million hectares is under organic farming with annual revenue of over 26 billion US $ worldwide (Yussefi & Willer, 2003).

Ensuring food security, alleviating poverty and conserving the vital natural resources is critically important (Rothschild, 1998). This can be addressed through organic farming and other means without spoiling natural resources. The major concern that compels scientists is that it is very difficult to feed the ever increasing population with organic food (Moghtader et al., 2011). However, safe production and secure food supply is one of the major needs of low income countries (Arshad & Shafqat, 2012) to restore their reservoirs. The concept of food security therefore surrounds the components of agriculture, environment, employment income, marketing, health and nutrition and public policy (Pottier, 1999).

Organic agriculture, as defined by the International Federation of Organic Agriculture Movement (IFOAM, 2010), includes all agricultural systems that promote environmentally, socially and economically sound production of food, fibers, and biofuels. These systems take local soil fertility as the key to successful production. Organic agriculture dramatically reduces external inputs by refraining from the use of chemo-synthetic fertilizers, pesticides and pharmaceuticals. Instead, it allows the powerful laws of nature to increase both crop yield and pest resistance (Carating et al., 2010). It is developed as holistic and ecosystem-based approach. This type of farming is visualized as a feasible alternative to ecologically sound conventional agriculture. In the Philippines, about 0.1M hectares of agricultural lands were managed organically (Willer & Lernoud, 2015) with rice and corn as the major organic products in the country. Philippine Partnership for the Development of Human Resource in Rural Areas (PhilDHRRA) (2004) revealed that the Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura (MASIPAG) showed that there were 1,897 farmers (with 1,754 hectares) who were fully adopting organic rice and corn farming, and 11,052 farmers (with 15,411 hectares) adopted the low chemical and pesticide practice.

Corn Nutritional Requirement and Fertilizer Management

The major contributor to enhance crop production and to maintain soil productivity as well as prevent soil degradation are the mineral nutrients. Improvement of the nutritional status of plants by applying fertilizers and maintaining soil fertility has been the critical step in food production since the beginning of 'Green Revolution' both in developed and developing countries (Loneragan, 1997).

According to the SMART: Corn Fertilizer Recommendations, corn requires adequate fertilizer management for profitable production. Applying the right fertilizers at the right amount and at the right time is crucial for a successful crop production. The nutrient requirements of corn depend on the yield goal and potential. New hybrids and high-yielding corn varieties will have a higher nutrient demand. For example, to produce 230 bushels per acre (approx. 14.5 ton/ha) of new hybrid corn, the crop requires the following nutrient rates in kg/ha (Table. 1), (Required Fertilizer for Corn Production n.d.):

Table 1. Required nutrient rates (kgha^{-1}) in corn

Nutrients	Required amount of nutrients needed (kgha^{-1}) of corn
N	276.74
P	215.11
K	217.36
Ca	89.64
Mg	84.03
S	25.76
Fe	2.91
Mn	0.49
Ni	0.57
Cu	0.15
B	0.37

Based on Field Crops: Fertilizer for Corn Journal, starter fertilizers should contain a small amount of nitrogen; most, if not all, of the recommended phosphorus; and possibly some potassium. Thus, a good starter fertilizer might range from a ratio of 1-4-0, 1-3-1, 1-3-3, to 1-1-1, depending on the rate of fertilizer required. It is not advisable to apply more than 89.67 kg to 112.08 kg per ha of N + K_2O in the starter band especially urea or diammonium phosphate.

Asio (1996) stated that the addition of organic materials in the soil could improve its fertility status and productivity. The increased microbial activity also enhanced release of immobilized nutrients present in the soil. These immobilized nutrients can be converted by microbial decomposers into available forms for plant use during mineralization process. Likewise, Pascual et al. (1997) reported that in the same way, the soil increases biomass, basal respiration and metabolic quotients due to the activity of soil microorganisms. Sarker et al. (2004) added that these microbial actions also improved physical condition of soil. Applications of livestock manure, poultry manure and crop residues have been found to bring about a gradual improvement in soil productivity and crop performance (Shafi et al., 2007). Studies of organic matter application in Japan showed that the root growth and nutrient uptake were increased with the application of organic matter resulting in higher yield (Food and Fertilizer Technology Center [FFTC], 1998). Ayoola and Makinde (2009) reported that the use of high amount of organic manures could likely enriched soil fertility and obtained high yield. Chau and Heong (2005) added that crops applied with organic fertilizers have been shown to be more tolerant as well as resistant to insect attacks.

Another benefit from the use of organic materials is that it can help solve pollution problems caused by agro-industrial wastes. However, the soil must not be seen as a dumping ground for organic wastes. If too much nitrogen is applied, be in the form of organic or chemical, excess nitrogen is converted to nitrate, which is harmful to human health (Preap et al., 2002). Excessive accumulation of nitrate in the corn plant may be also caused by prolonged drought and defoliation of leaves. The greatest risk of high nitrate levels had been noted in drought-stunted fields that have received excessive manure or nitrogen fertilizer. The risk is highest immediately following a drought-ending rain. Nitrates accumulate in the lower portion of the plant, so cutting higher under these conditions can help avoid high nitrate concentrations.

Normally, the ensiling process removes about one-half the nitrates present in the fresh corn silage (Curran & Lingenfelter, 2015).

Combined Application of Organic and Inorganic Fertilizers for Corn

The effects of combined organic and inorganic nutrients on soil fertility improves nutrient availability to crops and moisture retention in the soil. Nutrient uptake values were higher in the combined application than the sole application (Gabriel, 2010), yet there are no guidelines for their management. Organic materials are not magic; their roles with respect to soil fertility are known. Organic materials influence nutrient availability (i) by nutrients added, (ii) through mineralization-immobilization patterns, (iii) as an energy source for microbial activities, (iv) as precursors to soil organic matter (SOM), and (v) by reducing P sorption of the soil. The challenge is to combine organic with inorganic fertilizers to optimize nutrient availability to plants. Increased nutrient recovery and residual effects are associated with combined nutrient additions compared with inorganic fertilizers applied alone. Unfortunately, for many trials information on the nutrient content and quality of the organic inputs is lacking. Trials are needed that link the quality of the organic material to its nutrient content and its effect on the long term composition of SOM and crop yields. A systematic framework for investigating the combined use of organic and inorganic nutrient sources includes farm surveys, characterization of the quality of organic materials, nutrients analysis of organic fertilizer, and experimental designs for determining optimal combinations of nutrient sources. The desired outcome is tools that can be used by researchers, extensionists, and farmers for assessing options of using scarce resource for maintaining soil fertility and improving crop yields (Palm et al., 1997).

Most corn farmers prefer to use inorganic fertilizer in increasing the yield of their crops due to readily available nutrients in the materials and ease in application. However, due to the high cost of inorganic fertilizer and at time scarce supply caused by both energy crisis and socio-economic constraints, farmers are hesitant to use it alone. It is therefore necessary to integrate with organic fertilizer to augment the poor fertility of the soil (Sofia et al., 2006). Integrated use of organic amendments and chemical fertilizers may be a way to ensure sustainable agriculture and sustainable environment (Ashraf et al., 2016). Low organic matter content is one of the contributing factors for poor fertility status of soil. Application of bioslurry, a by-product from the biogas plant, successfully improve crop productivity and soil health (Muhmood et al., 2014).

Several studies have shown that corn plants respond well to the application of combined organic and inorganic fertilizers or those nitrogenous fertilizers. Boone et al. (1975), stated that corn adequately supplied with nitrogen from combined organic and inorganic fertilizers are usually dark green in color with vigorous growth. Catingan (1982) found that application of nitrogen from combined organic and inorganic fertilizers at the rate appropriate for the crops stimulate roots, stem, and leaf growth making the plants to photosynthesize effectively. In corn, either low or excess nitrogen applied delays silking and maturity. Application of nitrogen from combined organic and inorganic fertilizers at proper amount and time will promote the vigorous growth and yield performance of corn crop, hence obtaining a high yield. Ponsica (1982) found that poultry and cow manures combined with inorganic fertilizer enhanced early tasseling, silking and maturity which led to production of large ears of corn.

The integrated nutrient management is an alternative system which reduced the input of chemical fertilizers. The combined use of chemical fertilizers with animal manures, crop residues, green manure, fermented foliar spray and composts have shown to be highly beneficial. Combined use of chemical and organic fertilizers mitigated the deficiency of micronutrients in fields that continuously received only N, P and K fertilizers.

One of the examples of the results of the application of combined organic and inorganic fertilizers is found from the study of Biñas and Cagasan (2021). See the Table 2 and 3. Table 2 shows that most of the chemical and nutrient content of the soil had increased in the final soil analysis when they conducted a study on the growth and yield performance of hybrid sweetcorn that applied with different combination of organic and inorganic fertilizers. This can be a proof that through this method, the soil will be enhanced its fertility. Table 3 revealed also that most of the corn plants applied with the combination of different organic and inorganic fertilizers gained a high return on investment due to the high weight of the marketable ears.

Table 2. Soil analysis before planting and after harvesting of hybrid sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	pH (1:2.5)	OM (%)	Total N (%)	Available P (mg kg^{-1})	Exchangeable K (mg kg^{-1})
A. Initial (before planting)					
	6.51	5.478	0.206	6.955	330.000
B. Final (after harvest)					
T_0	6.08ab	1.510	0.111	8.113b	338.333
T_1	5.57c	1.364	0.119	33.565a	292.917
T_2	5.80bc	1.233	0.119	15.817ab	230.000
T_3	6.27a	1.273	0.128	31.057a	376.250
T_4	5.98ab	1.346	0.115	13.587ab	271.250
T_5	6.01ab	1.551	0.129	9.304b	382.708
T_6	5.84bc	1.278	0.105	16.637ab	237.500
T_7	6.01ab	1.482	0.104	7.254b	266.667
Mean	5.94	1.380	0.116	16.920	299.450

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Table 3. Cost and return analysis of hybrid sweetcorn production applied with different organic materials combined with inorganic fertilizers

Treatment	Marketable Ear Yield (t ha^{-1})	Gross Income* (PhP ha^{-1})	Production Cost (PhP ha^{-1})	Net Income (PhP ha^{-1})	ROI (%)
T_0	0.05b	1,250.00	51,620.00	-50,370.00	-97.56
T_1	5.07a				
T_2	3.33a	126,750.00	79,156.00	47, 594.00	60.13
T_3	4.03a				
T_4	5.55a	83,250.00	117,304.00	-34,054.00	-25.03
T_5	5.93a				
T_6	3.38ab	100,750.00	87,484.00	13,266.00	15.16
T_7	4.95a	138,750.50	85,964.00	52,786.00	61.40
		148,250.00	86,164.00	62,086.00	72.06
		84,500.00	84,724.00	-224.00	-0.26
		123,750.00	86,134.00	37,616.00	43.67

Gross income was computed based on the current wholesale/farmgate price of sweetcorn at PhP 25.00 kl^{-1} in the locality.

Legend:

T_0 = Control (without fertilizer applied)
T_1 = 90-60-60 $kgha^{-1}$ N, P_2O_5, K_2O
T_2 = 5 t ha^{-1} vermicompost + 45-30-30 $kgha^{-1}$ N, P_2O_5, K_2O
T_3 = 5 t ha^{-1} poultry manure + 45-30-30 $kgha^{-1}$ N, P_2O_5, K_2O
T_4 = 5 t ha^{-1} cow dung + 45-30-30 $kgha^{-1}$ N, P_2O_5, K_2O
T_5 = 5 t ha^{-1} goat manure + 45-30-30 $kgha^{-1}$ N, P_2O_5, K_2O
T_6 = 5 t ha^{-1} mudpress + 45-30-30 $kgha^{-1}$ N, P_2O_5, K_2O
T_7 = Fermented golden snail (foliar spray) + 45-30-30 $kgha^{-1}$ N, P_2O_5, K_2O

Organic Foliar Fertilizer

One of the benefits of organic foliar fertilization (OFF) is the increased uptake of nutrients from the soil. This notion is based on the scientific knowledge that OFF causes the plant to exude more sugars and other exudates from its roots into the rhizosphere. Beneficial microbial populations in the root zone are stimulated by the increased availability of these exudates. In turn, this increased biological activity correspondingly increased the availability of nutrients, disease-suppressive biochemicals, vitamins, and other processes beneficial to the plant.

The golden apple snail (GAS) (Pomocea canaliculata) Lamarck or "Kohol" is an introduced pest in the Philippines that proliferates in rice paddies and consume young rice seedlings (Jensen et al., 2006). Due to its high protein content (12%) it can be used in the manufacture of Kohol Amino Acid (KAA) (Jensen et al., 2006) which can be used as liquid nutrient formulation for vegetable production (Salas & Salas, 2014; Salas et al., 2015). The chemical composition of combined flesh and shell of GAS (g/kg) is 181 dry matter, 621 crude protein and 149 ash (Kaensombath & Ogle 2015). In the case of Hamid et al. (2015), he showed the chemical composition of GAS flesh only (%) with 83.85 MC, 1.54 ash, 10.79 protein, 1.40 fat, and 2.42 carbohydrate.

These composition showed that GAS is rich in nutrients, thus it improves the growth and yield of lettuce (Salas & Salas, 2014; Casillano & Salas, 2013).

Fermented golden apple snail can be drenched on the soil surface or sprayed to the plant. This improved crop yield because it restore and improve soil fertility, increase population of beneficial microorganisms and quickly absorbed by plants (Alfajri, 2015).

Food Quality of Crops Applied with Organic Fertilizers

The principles and practices of organic food production are to encourage and enhance biological cycles within the farming system so as to maintain and increase long term fertility status of soils. Reducing the amount of commercial fertilizer and pesticides in farming will also minimize pollution, produce high quality food and safe to humans and environment (Bourn & Prescott, 2002).

The increasing demand for organic products is brought by the growing health consciousness, and awareness of consumers on the nutritional value of organically grown products (Woese et al., 1997). Consumers prefer organic products because it is healthy, safe, keep our water clean, protect humans and animals and offers outstanding flavor (Hugher et al. 2007; Chait, 2017). Most of the people now a days are conscious of the safety food they eat.

Consumers' concern regarding adverse health effects of foods produced through conventional farming methods has led to considerable interest in the shift to organically produced crop and animal products. Misner and Armstrong (2001) mentioned that there is a significant difference between organically and non-organically grown foods. These differences relate to food safety, primary and secondary nutrients and health outcomes. Organically-grown fruits and vegetables had been found to be highly nutritious and rich in 'antioxidants' (Sinha et al., 2011). Organic foods have high antioxidant levels 30% higher than chemically-grown foods (Benbrook, 2005). Smith (1993) found high mineral contents in organic foods. Vitamins, minerals, flavonoids and phytochemicals contents also contributed greatly to human health protection. Likewise, organic foods are high in 'organic acids' and poly-phenolic compounds'.

In view in the fact that organically-produced foods have great advantage and the demands are higher than conventionally-produced crops, organic food items are more expensive than those grown with commercial or chemically-formulated fertilizers. The only way to lower production costs is for farmers to learn to process their own organic fertilizers (Barcenas, 2015). Thus, the use of organic sources such as green manuring, fermented golden apple snail, animal manures, vermicompost and any formulation from natural sources reduced direct exposure to chemical fertilizers.

Effects of Fertilizer on Physicochemical Properties of Crops

Fertilization, either organic, inorganic or their combination affected the physicochemical properties of produce (Champagne et al., 2017). Champagne et al. (2007) reported that protein content in rice either increased or decreased with time and rate of nitrogen fertilizer applied. Keawpeng and Meenune (2012) also reported that rice applied with organic fertilizer alone had lower protein and anthocyanin content than with inorganic fertilizer. Owureku-Asare et al. (2015) found that organic fertilizers improves the sweetness and quality of pineapple. Its acidity decreases resulting low astringency and longer the storage shelf life. It was also reported that with higher potassium fertilizer resulted in the higher the acidity in fruit of any crops (Souza, 1991). Increasing application levels of nitrogen fertilizer, on the other hand, resulted in a reduction of the brix value (Py et al., 1987). .Abuh-Zahra (2016) also found that pineapple fruits fertilized with inorganic fertilizer had bigger size, higher in TA, moisture content, and ammonium and nitrate contents than fertilized by organic fertilizer. However, those applied with organic fertilizer had higher anthocyanin, TSS, dry matter content, ascorbic acid, total phenols, and crude fiber.

Based on the result of the study of Biñas and Cagasan (2021), the physicochemical properties of hybrid sweetcorn ears were affected by the different combinations of organic and inorganic fertilizers. The pH value, total soluble solid, and titratable acidity of sweetcorn ears has increased by the application of the combined organic and inorganic fertilizers (Table 4).

Table 4. Physicochemical properties of hybrid sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	TSS(^{0}Brix)	TA (%)	pH
T_0 – Control (without fertilizer applied)	1.90	0.0017	7.47ab
T_1 – 90-60-60 kgha^{-1} N, P_2O_5, K_2O	1.67	0.0013	7.67ab
T_2 – 5 t ha^{-1} vermicompost + 45-30-30 kgha^{-1} N, P_2O_5, K_2O	1.87	0.0013	7.57ab
T_3 – 5 t ha^{-1} poultry manure + 45-30-30 kgha^{-1} N, P_2O_5, K_2O	1.67	0.0010	7.37ab
T_4 – 5 t ha^{-1} cow dung + 45-30-30 kgha^{-1} N, P_2O_5, K_2O	1.87	0.0023	7.27ab
T_5 – 5 t ha^{-1} goat manure + 45-30-30 kgha^{-1} N, P_2O_5, K_2O	2.03	0.0010	7.77ab
T_6 – 5 t ha^{-1} mudpress + 45-30-30 kgha^{-1} N, P_2O_5, K_2O	2.10	0.0020	7.87a
T_7 – Fermented golden snail (foliar spray) + 45-30-30 kgha^{-1} N, P_2O_5, K_2O	2.10	0.0027	7.17b

Storability and Sensory Qualities of Organic Products

The State of the Science Review 2006 attempts to answer this question: “Do organic products taste better than conventional products?”.

First, 43% of consumers of organic food give "better taste" as a major reason for purchasing organic fruits and vegetables (MORI Poll, 2001 as cited by Heaton, 2001). However, consumer conviction of "better taste" is due solely to the "halo effect (cognitive bias that arises when information about one quality attribute of a product serves to influence and bias the judgment of its other qualities)" of the organic label and not real claim that organic produce tastes better. Second, the levels of phenolic compounds are higher in organic products (Benbrook, 2005). Plants produced phenolic compounds to make plant tissues less attractive to herbivores, insects, and other predators. Some of these phenolic compounds actually taste bad (Drewnowski & Gomez-Carneros, 2000; Lesschaeve & Noble, 2005).Third, many sellers, distributors, and promoters of organic foods claim that organic foods taste better (Theuer, 2006). Organic cultivation practices can influence storability and flavor of the products and thus alter the organoleptic qualities of produce at the point of sale and consumption (Theuer, 2006). Organoleptic is the sensory properties of a particular food which includes: its taste, appearance and color, aroma, size and firmness, and even sound (e.g., the "snap" or "crack" when biting). Organoleptic measures however include mouth feel and any other sensations in eating food. Organoleptic quality also include storability since many products are stored at various periods to enable "non-seasonal" availability (Theuter, 2006). Clearly, products that are stored for several days or long period will result to soft spots, blemishes and lack of flavor. If the products are stored well, it will be more appealing to consumers (Theuer, 2006).

In the case of organic sweetcorn when cooked a few days later, it was noticeably less sweet and even had a slightly chalky mouthfeel. Freshly picked sweetcorn had high sugar and low starch contents. However, the longer it is stored after harvesting, sugar is turned into starch. This decreases good flavor and affects its texture when cooked (Christensen, 2008). On the other hand, Hanson (2017) found that unhusked sweetcorn stays tasty even stored for a couple of days when it is loosely packed in plastic bags to allow the circulation of air.

Biñas and Cagasan (2021) found that the application of organic and inorganic fertilizers affected the sensory qualities of sweetcorn. Based on their study on the sensory attributes of hybrid sweetcorn to different combinations of organic and inorganic fertilizers, it is perceived that the taste, aroma, color, and texture of cooked sweetcorn ears are more likely acceptable to the consumers due to the good sensory qualities (Table 5 and 6; Figure 2).

Table 5. Sensory attributes of hybrid sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	Color^{ns}	Taste^{ns}	Aroma^{ns}	Texture^{ns}
Freshly cooked sweetcorn				
T_0	Golden yellow to yellow	Slightly sweet to sweet	With pleasant odor	Slightly hard
T_1	Golden yellow to yellow	Slightly sweet	With pleasant odor	Slightly hard
T_2	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard
T_3	Golden yellow	slightly sweet	With pleasant odor	Slightly hard
T_4	Golden yellow	Sweet to slightly sweet	With pleasant odor	Slightly hard

T_5	Golden yellow	Slightly sweet to sweet	With pleasant odor	Slightly hard
T_6	Golden yellow	Sweet	With pleasant odor	Slightly hard
T_7	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard
5-day stored cooked sweetcorn				
T_0	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard
T_1	Golden yellow	Bland to slightly sweet	With pleasant odor	Slightly hard
T_2	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard
T_3	Golden yellow	slightly sweet	With pleasant odor	Slightly hard
T_4	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard
T_5	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard
T_6	Golden yellow	Sweet to slightly sweet	With pleasant odor	Slightly hard
T_7	Golden yellow	Slightly sweet	With pleasant odor	Slightly hard

Sensory Description:

Color	Taste	Aroma	Texture
1 – slightly yellow	1 – bland	1 – with unpleasant odor	1 – hard
2 – yellow	2 – slightly sweet	2 – with pleasant odor	2 – slightly hard
3 – golden yellow	3 – sweet	3 – with strong pleasant odor	3 – sticky
			4 – slightly sticky
			5 – soft

Table 6. Acceptability ratings from sensory evaluation of sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	Color^{ns}		Taste^{ns}		Aroma^{ns}		Texture^{ns}		General Acceptability^{ns}	
	Freshly cooked	5-day stored cooked	Freshly cooked	5-day stored cooked	Freshly cooked	5-day stored cooked	Freshly cooked	5-day stored cooked	Freshly cooked	5-day stored cooked
T_0	7.77	7.70	7.67	6.60	7.37	7.20	7.50	7.13	7.47	7.20
T_1	7.73	7.47	7.60	6.43	7.47	6.80	7.40	6.93	7.30	6.83
T_2	8.07	7.90	7.60	7.07	7.60	7.50	7.37	7.37	7.53	7.70
T_3	8.00	7.77	7.73	6.70	7.53	6.97	7.50	7.03	7.63	7.33
T_4	8.03	7.70	7.60	6.80	7.50	6.97	7.40	6.87	7.63	7.20
T_5	7.77	7.77	7.60	7.03	7.60	6.97	7.50	6.80	7.50	7.17
T_6	7.97	7.67	7.61	7.17	7.39	7.03	7.29	6.90	7.52	7.17
T_7	7.90	7.43	7.72	6.97	7.55	6.93	7.34	7.33	7.41	7.13
Sig.	0.55	0.89	1.00	0.65	1.00	0.77	1.00	0.65	0.89	0.16

Acceptability ratings

1-dislike extremely	4-dislike slightly	7-like moderately
2-dislike very much	5-neither like nor dislike	8-like very much
3-dislike moderately	6-like slightly	9-like extremely

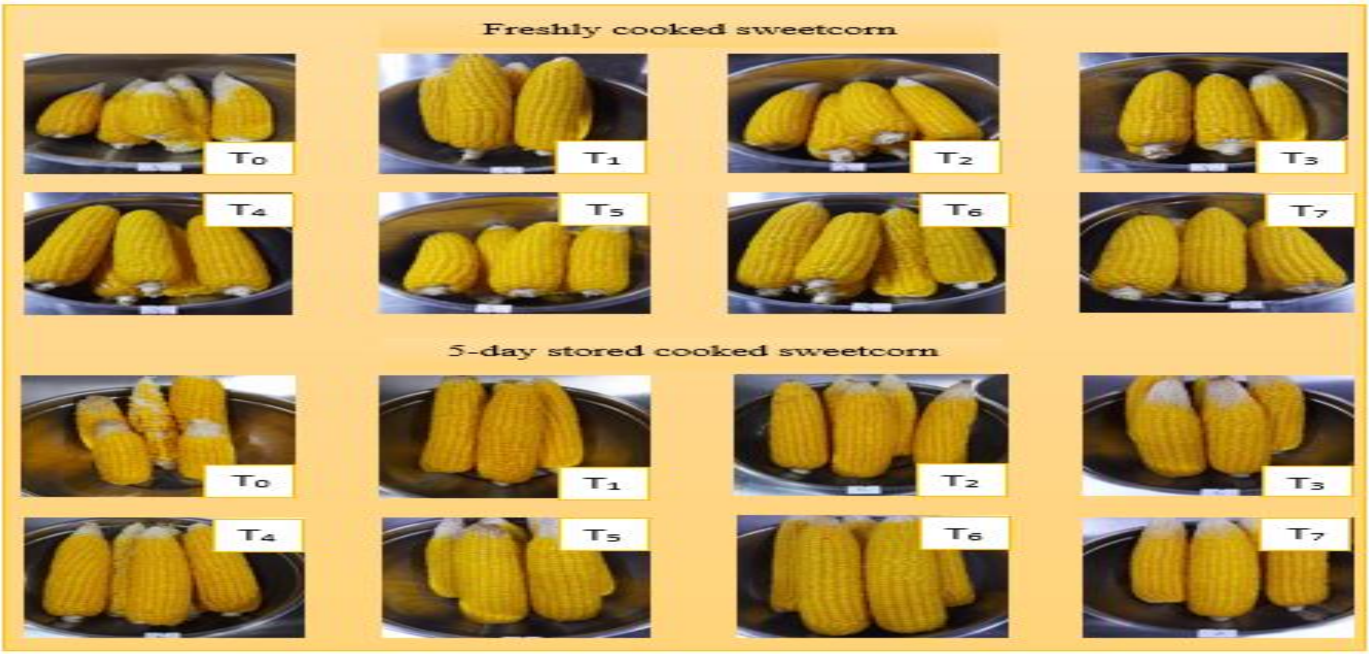

Figure 2. Appearance of freshly cooked and 5-day stored sweetcorn before i

Legend:

T_0 = Control (without fertilizer applied)
T_1 = 90-60-60 kgha^{-1} N, P_2O_5, K_2O
T_2 = 5 t ha^{-1} vermicompost + 45-30-30 kgha^{-1} N, P_2O_5, K_2O
T_3 = 5 t ha^{-1} poultry manure + 45-30-30 kgha^{-1} N, P_2O_5, K_2O
T_4 = 5 t ha^{-1} cow dung + 45-30-30 kgha^{-1} N, P_2O_5, K_2O
T_5 = 5 t ha^{-1} goat manure + 45-30-30 kgha^{-1} N, P_2O_5, K_2O
T_6 = 5 t ha^{-1} mudpress + 45-30-30 kgha^{-1} N, P_2O_5, K_2O
T_7 = Fermented golden snail (foliar spray) + 45-30-30 kgha^{-1} N, P_2O_5, K_2O

CONCLUSION

The use of organic fertilizer can compensate the inorganic fertilizer on corn production. Therefore, the combination of organic and inorganic fertilizers on corn production is found to be good and advisable to improve soil fertility and productivity and thus can attain better yield and income.

The application of organic fertilizer ca also improve the physicochemical properties and sensory qualities of corn products. Therefore, it is preferred by the consumers as it is more likely acceptable in their sense.

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