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Profitability of hybrid sweet corn (*Zea mays* L. var Macho F1) production as applied with combined organic and inorganic fertilizers

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ABSTRACT

Organic manures can be used as an alternative for inorganic fertilizers. However, the application of organic inputs alone cannot meet the nutritional requirements of the crop. There is a need to combine them with inorganic fertilizers to attain better yield. This study was conducted to evaluate the effects of organic and inorganic fertilizers on the growth and yield performance of sweetcorn and assess the profitability of the combined application of organic and inorganic fertilizers on sweetcorn production. The experiment was laid out in RCBD with 3 replications. Treatments were as follows: T0 = Control (without fertilizer applied), T1 - Inorganic fertilizer at 90-60-60 kg ha-1 (N, P_2O_5, K_2O), T2 = 5 t ha-1 of vermicompost + 45-30-30 kg ha-1 N, P_2O_5, K_2O, T3 = 5 t ha-1 of poultry manure + 45-30-30 kg ha-1 N, P_2O_5, K_2O, T4 = 5 t ha-1 of cow manure + 45-30-30 kg ha-1 N, P_2O_5, K_2O, T5 = 5 t ha-1 of goat manure + 45-30-30 kg ha-1 N, P_2O_5, K_2O, T6 = 5 t ha-1 of mudpress + 45-30-30 kg ha-1 N, P_2O_5, K_2O, T7 = Foliar spray (Fermented Golden Snail) + 45-30-30 kg ha-1 N, P_2O_5, K_2O. Sweetcorn plants applied with organic + inorganic fertilizers regardless of sources gave a significant growth and yield compared to those plants without fertilizer applied. The highest net income and ROI were obtained from plants applied with combined goat manure and inorganic fertilizers at PhP 62,086.00 ha-1 and 72 %, respectively.

Keywords: Growth and yield performance, Inorganic and organic manures, profitability, hybrid sweetcorn

1. INTRODUCTION

Corn (*Zea mays* L.) is the second most important cereal crop next to rice, grown for human consumption and used as raw materials for different food products. Due to its versatility, it is consumed not only as food for humans and animals but also for industrial and agricultural purposes [1]

One of the management practices under intensive cultivation is through the application of fertilizers. Organic fertilizers, such as animal manure and crop residues can be used as an alternative for inorganic fertilizers [2]. However, recent studies revealed that the application of organic inputs alone cannot meet the nutritional requirements of the crop that there is a need to integrate with inorganic fertilizers to achieve better yields [3]. The supply of nutrients from organic materials can be complemented by enriching them with inorganic nutrients that will be readily released and utilized by the crop to compensate for the slow release of organic nutrients.

The application of inorganic fertilizer is needed for modern corn varieties to increase yield. However, fertilizers are so expensive nowadays and have a tendency to pollute the environment and decrease production efficiency as well [4]. Hence, a combination of organic and inorganic fertilizer is recommended to minimize the adverse impact on the environment, health, wildlife, and water source. Sound fertilizer management must attempt to ensure both an enhanced and safe environment; therefore, a balanced fertilization strategy that combines the use of chemical, organic, or biofertilizers must be developed and evaluated [5]. Judicious use of organic and inorganic nutrient sources is important to decrease dependence on chemical fertilizers. This will also lead to sustainably high crop production due to minimal nutrient losses to the environment and optimum nutrient use efficiency [6].

Several researches on fertilization have been studied on the yield performance and profitability of corn. However, most of the practices only used either organic or inorganic inputs alone. Hence, this study was conducted to evaluate the effects of combined organic and inorganic fertilizer application on the growth and yield performance of hybrid sweetcorn and to assess its profitability on hybrid sweetcorn production.

2. MATERIALS AND METHODS

2.1. Land Preparation

An experimental area of 857.5 m^2 at the Department of Agronomy, Visayas State University, Baybay City, Leyte was plowed and harrowed twice at the weekly intervals to pulverize the soil. This was done to incorporate the weeds in the soil and provide good soil conditions for seed germination. Furrows were made at a distance of 0.75 m between rows after the second harrowing. The site was plain and open area surrounded by a wide rice field and mini forest.

Experimental Treatments

T_0 – Control (without fertilizer applied)
T_1 – Inorganic fertilizer at 90-60-60 kg ha-1 (N, P_2O_5, K_2O)
T_2 – 5 t ha-1 of vermicompost + 45-30-30 kg ha-1 N, P_2O_5, K_2O
T_3 – 5 t ha-1 of poultry manure + 45-30-30 kg ha-1 N, P_2O_5, K_2O
T_4 – 5 t ha-1 of cow manure + 45-30-30 kg ha-1 N, P_2O_5, K_2O
T_5 – 5 t ha-1 of goat manure + 45-30-30 kg ha-1 N, P_2O_5, K_2O
T_6 – 5 t ha-1 of mudpress + 45-30-30 kg ha-1 N, P_2O_5, K_2O
T_7 – Foliar spray (Fermented Golden Snail) + 45-30-30 kg ha-1 N, P_2O_5, K_2O

2.2. Soil Sampling and Analysis

Ten (10) soil samples were randomly collected from the experimental area at 20 cm depth before the conduct of the experiment. These were composited, air-dried, and sieved using 2.0 mm wire mesh. These were submitted to the Central Analytical Service Laboratory (CASL), Philippine Root Crops Research Center (PhilRootcrops), VSU, Visca, Baybay City, Leyte for the determination of soil pH, organic matter (%), total N (%), available phosphorous and exchangeable potassium content [7].

After harvest, soil samples were gathered for final analysis. Samples were collected per treatment plot at 20 cm depth and composited for the determination of the same soil parameters mentioned above.

2.3. Organic Manures Collection and Nutrient Analysis

Vermicompost was collected from the Farm Resource and Management Institute (Eco-FARMI), VSU, Visca, Baybay City, Leyte. Poultry manure was collected from Ciabo Poultry Farm, Ciabo, Baybay City, Leyte. Cow and goat manures were collected from the Department of Animal Science (DAS), VSU, Visca, Baybay City, Leyte. Mud press was secured from Juanito Farm, Montebello, Kanangga, Leyte. The raw organic materials secured were on their composted form.

One fourth (0.25) kilogram sample of each organic manures was collected and analyzed for pH, total N, available P, exchangeable K and moisture content (%) at the CASL, PhilRootCrops, VSU, Visca, Baybay City, Leyte. The actual amount of manure applied was based on MC (%) using the formula:

Actual amount of Organic Fertilizer = (5000 kgha-1) / (1 – % MC/100)

2.4. Fermented Golden Snail Preparation

The golden snails were collected from the rice field. These were crushed and mixed with muscovado sugar with a ratio of 2:1 kilos with a little amount of water. The mixture was placed in an empty clean container and the top was covered with manila paper and covered with its lid. It had been set aside for 2 weeks in a cool shaded place to allow fermentation process. After fermentation, straining was done to separate solid material from liquid. The liquid solution was placed in a clean container with lightly closed lid to prevent contamination and gas build up. A 250 ml sample of fermented golden snail was analyzed for pH, total N, available P, and exchangeable K at the CASL, PhilRootCrops, VSU, Visca, Baybay City, Leyte.

2.5. Application of Fertilizers

The organic fertilizers were applied uniformly in the furrows and were incorporated into the soil in each treatment plot two weeks before planting (WBP) at the rate of 5 t ha-1 for treatments 2, 3, 4, 5 and 6. The inorganic fertilizers were applied in the furrows. Complete fertilizer (14-14-14) was drilled 10 days after planting (DAP) at the rate of 90-60-60 for treatment 1 and 45-30-30 for treatments 2, 3, 4, 5, 6, 7. Urea (46-0-0) was side dressed 30 DAP. The actual amount of organic manures and inorganic fertilizer applied per plot are indicated in Table 1.

The fermented golden snail was applied as foliar spray in treatment 7, diluted at a ratio of 3 tablespoons to 1 liter of water and sprayed to plants at weekly interval. This was done at 7, 14, 21, 28, and 35 days after planting (DAP). The dilution rate of fermented golden snail vary in each application schedule by increasing the amount as the plant grew. The older the plants, the higher is the dilution rate of fermented golden snail (Table 1).

2.6. Sweetcorn Variety and its Characteristics

Macho F1 hybrid sweetcorn variety was used in the study. This variety produces long cylindrical ears with 16-18 kernel rows and with good tip-filled kernels. Its green husk makes it look fresh and more attractive to buyers. This variety is adaptable to wet and dry season. It is a high yielding hybrid with wide market potential which can be used for fresh and processed products. It is resistant against stalk rot and rust [8].

2.7. Planting

Seeds were directly planted at the rate of 1 seed hill-1 to have a desired plant population of 53,333 plants ha-1 at a distance of 0.75 m between rows and 0.25 m between hills 2 weeks after basal application of organic fertilizer. Seeds were also sown on seed trays for replanting of missing hills. Replanting was done 7 DAP.

2.8. Cultivation and Maintenance

Off-baring was done using a carabao drawn implement to turn the soil away from the base of the plants for better soil aeration and control of weeds 15 DAP. Hilling up was employed 30 DAP to cover the side dressed fertilizer on the second application for better anchorage, stability and also minimize the occurrence of weeds.

Hand weeding was done to control regrowth of weeds within the experimental area after hilling up but the weeds in surrounding area was maintained to conserve the population of the natural enemies. Weeds at the base of the plants was removed by hand weeding.

2.9. Control of Insect Pests and Diseases

Insect pests and diseases infestation were controlled by application of botanical pesticide derived from tobacco and mild liquid soap at weekly interval from V3 (third leaf) until VT (tasseling). Daily monitoring of insect pest infestations and diseases infections was done to assess damage. Marigold flower (*Calendula officinalis*) was also planted along the sides of the experimental area at a distance of 0.5 meter from the border plants at the sides and alleyways to serve as insect repellant.

2.10. Botanical Pesticide Preparation

Table 1. Amount of organic and inorganic fertilizers applied.

Types of fertilizer	Amount of fertilizers applied
Organic Manures (kg plot^{-1})	
Vermicompost	11.47
Poultry manure	11.47
Cow manure	11.71
Goat manure	12.23
Mudpress	11.60
Inorganic fertilizers (90-60-60) (kg plot^{-1})	
Complete (14-4-14)	0.96
Urea (46-0-0)	0.29
Inorganic fertilizers (45-30-30) (kg plot^{-1})	
Complete (14-4-14)	0.48
Urea (46-0-0)	0.07
Fermented golden snail as foliar spray (L plot^{-1})	
7 DAP	1.00
14 DAP	1.50
21 DAP	2.00
28 DAP	2.55
35 DAP	3.00

Tobacco (*Nicotiana tabacum* Linn.) was used as botanical pesticides. It contains varying amounts of nicotine, a powerful neurotoxin to pests. This was prepared following the procedure [9]:

- Mix 1 cup (250 ml) of tobacco extract in 1 gallon (4 liters) of water.
- Sit the mixture out in the sun or in another warm location. Allow it to stand for 24 hours.
- Check the color of the mixture. Ideally, the pesticides will look similar to the hue of a light tea. If it is too dark, dilute it with water. If it is too light, allow it to stand for another 1 to 2 hours.
- Add small amount of liquid mild soap.
- Pour the mixture into a large squirt bottle. Shake the solution inside the bottle once more to combine it further.
- Spray to sweetcorn plants at weekly interval from V3 (third leaf) until VT (tasseling) using knapsack sprayer (Table 2).

2.11. Harvesting

Sweetcorn was harvested at boiling stage or the green cob stage when it reached its R3 stage (Milking). All sample plants for gathering agronomic characteristics, yield and yield components and harvest index were taken within the harvestable area (13.5 m2). Ears from harvestable area were detached from its stover and dehusked.

The following are the indicators and/or steps for the determination of green cob ready to be harvested [10]:

- Inspect the appearance of the ears. Ripe sweet corn ears have dark green leaves covering them. The silk on the ears turns brown as the corn ripens.
- Squeeze the tip of the ears gently. Feel for a rounded end to the ear. If the end still feels pointed, the corn is likely still growing and not ready for harvesting.
- Peel back the husk slightly to inspect the corn kernels. Ears with plump, full kernels that are soft indicate ripeness.
- Puncture a kernel with your finger to evaluate the juice inside. Harvest the corn when the juice shall have a milky appearance. If the juice appears watery, it is still unfit to harvest.

2.12. Data Gathered

A. Agronomic Characteristics

- Number of days from planting to emergence - this was determined by counting the number of days from planting up to 50% of the crop population have emerged.
- Number of days from planting to tasseling - this was determined by counting the number of days from planting to Vt stage or 50% of the population reached tasseling [begins when hanging pollen (male flower) visible at the top of corn plant].
- Number of days from planting to silking - this was determined by counting the number of days from planting to R1 stage or 50% of the population reached silking or when the silks are visible at the tip of the husk.

Table 2. Amount of botanical pesticide applied (L plot-1)

Schedule of application (DAP)	Amount of botanical pesticide (L $plot^{-1}$)
7	1.0
14	1.5
21	2.0
28	2.5
35	3.0

- Number of days from planting to boiling stage - this was recorded by counting the number of days from planting up to the time when 80% of the population reach the R3 (boiling stage). Ears is ready to be harvested when the kernels contain milky juice and the silks are brown and dry. However, the husk are still green and supple. To test, kernels can be pierced and bitten to observe the milky juice.
- Plant height (cm) - this was determined by measuring 10 sample plants in each treatment plot from ground level up to the tip of the tallest plant part using a meter stick. This was done 14, 28, 42, 56 DAP and at harvest.
- Fresh stover yield (tha-1) - this was determined by weighing the fresh stalks including the husks of the sweetcorn ears within the harvestable area in each treatment plot after removing the ears using the formula:

Stover Yield (t ha -1) = (Stover Yield (kg) x 10,000 m^2 ha-1) / Harvestable Area (13.5 m2) x 1,000 kg t-1

Adjusted Stover Yield was calculated using the formula:

Adjusted Stover Yield (t ha -1) = (Weight of Stover Yield (t ha -1) / No. of hills harvested) x No. of possible hills

B. *Yield and Yield Components*

1. Number of ears plant-1- this was determined by counting the developed ears of ten (10) sample plants within the harvestable area of each treatment plot.
2. Ear length (cm) - this was determined by measuring the 10 sample dehusked ears in each treatment plot from the base to tip of the ear with kernels using a ruler at harvest.
3. Ear diameter (cm) - this was determined by measuring the diameter of 10 sample dehusked ears in each treatment plot using a vernier caliper.
4. Number of marketable ears plot-1 - this was obtained by counting the dehusked marketable ears within the harvestable area in each treatment plot. To consider the missing hills, this was calculated using the formula:

No. of marketable ears (plot-1) = (No. of marketable ears / No. of hills harvested) x No. of possible hills (72)

Ears were considered marketable when the following criteria were met [11]:

- The deshusked ear should be 15 cm and above in length.
- The dehusked ear should be 5 cm and above in diameter.
- The dehusked ear should be 0.25 kg and above in weight.
- The kernels of the dehusked ear should be large and filled out the ear.
- The dehusked ear should be free of damaged by insect pests, diseases, etc.
- The dehusked ear should bear complete kernels in each cob rows, firm and no soft spots and blemishes.

5. Number of non-marketable ears plot-1 - this was obtained by counting those dehusked ears within the harvestable area in each treatment plot not classified as marketable. To consider the missing hills, this was calculated using the formula:

No. of non-marketable ears = (No. of non-marketable ears / No. of hills harvested) x No. of possible hills (72)

6. Weight of marketable ears (t ha-1) - this was obtained by weighing the dehusked marketable ears within the harvestable area in each treatment plot. Weight of marketable ears in kilogram ha-1 was computed using the formula:

   Wt. of marketable ears (t ha-1) = (Wt. (kgplot-1 x 10,000 m2 ha-1) / (Harvestable area (13.5 m2) x 1,000 kg t-1)

7. Weight of non-marketable ears (t ha-1) – this was the weight obtained from those ears not classified as marketable ears from each treatment plot at harvest. This was calculated using the same formula used in the calculation of the weight of marketable ears.
8. Total ear yield (t ha-1) – The weights of marketable and non-marketable ears (t ha-1) were summed up to obtain the total yield.

C. Harvest Index – this was to ratio of the economic yield and biological yield of a crop. The dehusked ears and herbage of three (3) sample plants from each treat ment plot were weighed separately to obtain the harvest index using the formula:

Harvest Index = Economic Yield x Fresh green cob yield (dehusked) / Biological Yield x Fresh herbage plus green cob yield (dehusked)

D. Meteorological Data

Total weekly rainfall (mm), average daily minimum and maximum temperatures (0C) and relative humidity (%) throughout the conduct of the study were taken from the records of Philippine Atmospheric Geophysical and Astronomical Services (PAGASA) Station, Visayas State University, Visca, Baybay City, Leyte.

E. Statistical Tool Used

Analysis of variance (ANOVA) was done using the Statistical Tool for Agricultural Research (STAR). Treatment mean comparison was done using the Tukey's or Honestly Significant Difference (HSD) test.

F. Production Cost and Return Analysis

The production cost was determined by recording all the expenses incurred throughout the conduct of the study from land preparation up to harvesting. These include fertilizers, materials and labor that were used in the conduct of the experiment. Total cost (material, labor, etc.) incurred was subtracted to the gross income to obtain the net income. The gross income was determined by multiplying the marketable ear yield of each treatment plot by the current market price of sweet corn per kilogram. The gross income, net income and return on investment were determined using the following formula:

Gross Income = Total marketable ear yield (t ha-1) x current market price per kilogram

Net Income = Gross Income – Total Expenses

ROI = (Net Income / Cost of Investment) X 100

3. RESULTS AND DISCUSSION

3.1. Weather Observations

The total weekly rainfall (mm), average daily minimum, and maximum temperatures (°C), and relative humidity (%) throughout the study for almost 3 months are presented in Figure 1. Data showed that the rainfall fall on an average of 116.9 mm. This result substantially sufficient for the growth and development of sweetcorn because it conformed to the optimum requirement of the crop at more or less 60 mm per week from planting to harvesting [13]. The rainfall was increased in week 6 at 441.0 mm due to typhoon Paolo that brought heavy rainfall. The minimum and maximum temperature range from 22.3 to 30.1 0C respectively which gave favor to sweetcorn for normal growth and development. The Department of Agriculture and Fisheries [14] reported that the optimum temperature required for normal growth and development of corn stands is 24 to 28 0C. Likewise, Jacobson [15] also reported that sweetcorn needs a temperature of 20 to 30 0C for germination. The relative humidity of 81-89 % was also favorable for the growth and development of sweetcorn.

Soil Chemical Properties

Soil test results are presented in Table 3. Initial results revealed that the experimental area had a slightly acidic soil (6.51) with adequate organic matter content (5.478 %) and potassium (330.000 mg kg-1) content, low total nitrogen (0.206 %) and phosphorous (6.955 mg kg-1) based on the indices on soil nutrient availability by Landon [16].

After harvesting the crop, results of the soil analyses indicated that soil nutrients were not affected by the treatments except pH and available P (mg kg-1). The highest pH value (6.27) was recorded in plots applied with combined poultry manure and inorganic fertilizers (T3) comparable to plots not applied with any fertilizers (T0), combined cow dung and inorganic fertilizers (T4), combined goat manure and inorganic fertilizers (T5), combined with fermented golden snail and inorganic fertilizers (T7). This result could be contributed to the higher pH value of these organic manures applied (Table 4). On the other hand, the lowest pH value (5.56) was recorded from plots applied with pure inorganic fertilizers (T1). This could be attributed to the high pH from urea hydrolysis and ammonium content of inorganic

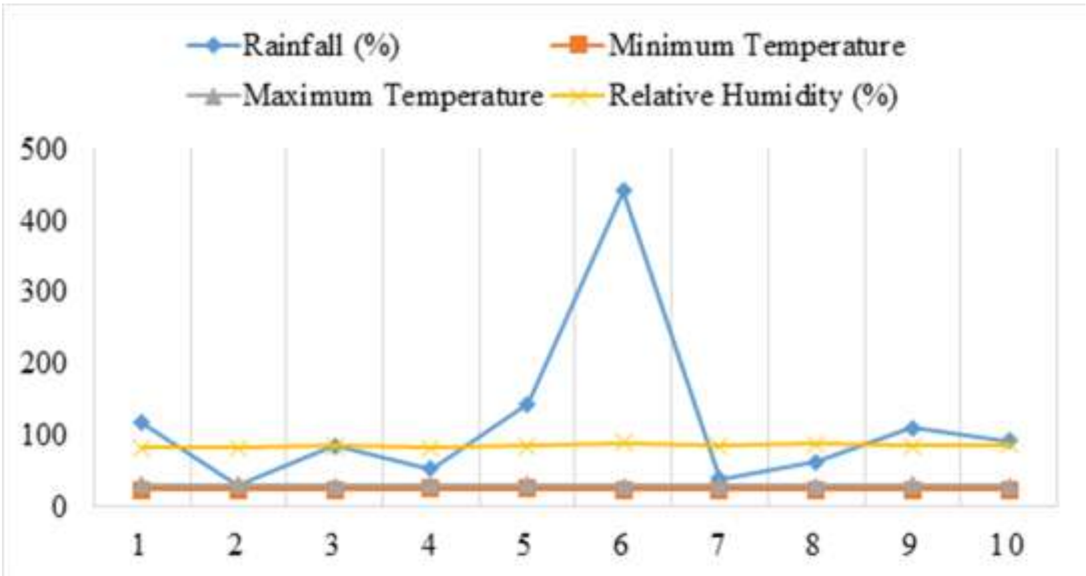

Fig 1. Total weekly rainfall (mm), average daily minimum and maximum temperatures (°C) and relative humidity (%) from planting to harvesting of sweetcorn

fertilizer. Jenkins [17] mentioned that fertilizer containing ammonium acidifies the soil. He added that inorganic fertilizer can be easy to be leached its nitrate and sulfate which loss some base cations causing acidification.

The relative increase in P after harvest could be attributed to the mineralization of organic fertilizers. Nutrient analyses of different manures (Table 4) revealed that poultry manure had the highest P content (2.226 %), thus plots applied with poultry manure and inorganic fertilizers (T3) obtained the highest P content after harvest relative to the plots applied with pure inorganic fertilizers (T1) comparable to those with vermicompost (T2), cow dung (T4) and mudpress (T6) combined with inorganic fertilizers.

3.2. Organic Fertilizers Chemical Properties

The chemical properties of organic fertilizers are presented in Table 2. Different organic fertilizers contained an adequate amount of nutrients. These contributed to the significant number, bigger, longer and marketable ears of sweetcorn than those not applied with any of these organic fertilizers. Thus, resulted in the crop obtained significant growth and yield.

3.3. Agronomic Characteristics of Sweetcorn

The number of days from planting to emergence, tasseling, silking and boiling stages, stover yield (t ha-1) and plant height (cm) of sweetcorn applied with different organic materials combined with inorganic fertilizers are presented in Tables 5, 6. Statistical

Table 3. Soil analysis before planting and after harvesting 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	6.08^{ab}	1.510	0.111	8.113^{b}	338.333
T_1	5.57^{c}	1.364	0.119	33.565^{a}	292.917
T_2	5.80^{bc}	1.233	0.119	15.817^{ab}	230.000
T_3	6.27^{a}	1.273	0.128	31.057^{a}	376.250
T_4	5.98^{ab}	1.346	0.115	13.587^{ab}	271.250
T_5	6.01^{ab}	1.551	0.129	9.304^{b}	382.708
T_6	5.84^{bc}	1.278	0.105	16.637^{ab}	237.500
T_7	6.01^{ab}	1.482	0.104	7.254^{b}	266.667
Mean	5.94	1.380	0.116	16.920	299.450
CV (%)	2.04	18.69	15.78	43.30	22.49

Treatments with the same and without letter designations are not significantly different at 0.05 (HSD) and ANOVA, respectively.

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

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C. Initial (before planting)					
	6.51	5.478	0.206	6.955	330.000
D. Final (after harvest)					
T_0	6.08^{ab}	1.510	0.111	8.113^{b}	338.333
T_1	5.57^{c}	1.364	0.119	33.565^{a}	292.917
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CV (%)	2.04	18.69	15.78	43.30	22.49

analyses revealed that all agronomic characteristics of sweetcorn except the stover yield were significantly affected by the treatments.

All plants applied with organic and inorganic fertilizers regardless of nutrient sources (T1, T2, T3, T4, T5, T6 and T7) reached the boiling stage earlier compared to those plants not applied with any fertilizers (T0). This could be attributed to the early tasseling and silking of fertilized plants. Joyo [18] found that unfertilized corn developed slower compared to fertilized plants. This result confirmed the findings of Catingan [19] that corn in less fertile soil delays boiling stage and maturity. Chen [20] also reported that the application of combined organic manure and inorganic fertilizers enhances the growth and development of corn, thus the crop matured earlier.

Plants applied with combined poultry manure and inorganic fertilizers (T3) and combined goat manure and inorganic fertilizers (T5) were similarly taller than other treatments (T0, T1, T2, T4, T6 and T7) at 14 DAP. This might be due to the high nutrient content of these organic fertilizers (Table 4). However, at 28 DAP up to harvest, plants applied with combined organic and inorganic fertilizers regardless of nutrient sources (T2, T3, T4, T5, T6 and T7) were statistically similar to plants applied with pure inorganic fertilizers (T1) and were taller than plants not applied with any fertilizers (T0). This result suggests that nutrients were already released and absorbed by the plants, thus, increasing plant height. This conforms to the findings of Elisan [21] that the application of combined organic and inorganic fertilizers

Table 4. Chemical properties of different organic fertilizers

	pH (1:2.5)	OM (%)	Total (%) N	P	K	Moisture Content (%)
Vermicompost	6.20	4.691	1.890	0.546	0.175	2.041
Poultry dung	8.73	4.342	3.049	2.226	3.513	2.041
Cow dung	8.49	5.090	2.018	0.446	1.363	4.167
Goat manure	8.61	5.586	2.448	0.304	2.200	7.527
Mudpress	6.66	5.844	2.276	0.967	0.225	3.093
FGS	6.50	nd	0.258	trace	0.130	nd

Table 5. Number of days from planting to emergence, tasseling, silking and boiling stages of hybrid sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	Number of days from planting to			
	Emergence	Tasseling	Silking	Boiling stage
T_0	5.00	50.67^{a}	57.66^{a}	69.00^{a}
T_1	5.00	48.67^{abc}	55.00^{ab}	67.00^{ab}
T_2	3.00	48.00^{abc}	53.66^{bcd}	67.00^{ab}
T_3	3.00	46.00^{c}	51.33^{d}	66.00^{b}
T_4	3.00	48.00^{abc}	53.33^{bcd}	66.67^{b}
T_5	4.00	47.33^{bc}	52.66^{cd}	66.67^{b}
T_6	4.00	49.00^{ab}	54.66^{abc}	67.33^{ab}
T_7	5.00	49.33^{ab}	54.66^{abc}	67.67^{ab}
C.V. (%)	0.00*	2.13	1.67	1.20

Table 6. Plant height (cm) and stover yield (t ha-1) of hybrid sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	Plant Height (cm) DAP					Stover Yield (t ha-1)
	14	28	42	56	At harvest	
T_0	30.72^{b}	79.72^{b}	124.85^{b}	184.20^{b}	189.03^{b}	12.42
T_1	31.00^{b}	100.25^{ab}	187.57^{a}	245.35^{a}	248.37^{a}	19.81
T_2	31.57^{b}	100.40^{ab}	182.28^{a}	245.47^{a}	250.12^{a}	21.95
T_3	36.61^{a}	113.18^{a}	193.93^{a}	246.02^{a}	248.30^{a}	20.69
T_4	30.27^{b}	100.72^{a}	185.35^{a}	245.15^{a}	247.43^{a}	19.93
T_5	33.53^{ab}	102.10^{a}	184.31^{a}	242.63^{a}	251.30^{a}	21.76
T_6	31.65^{b}	99.22^{ab}	177.42^{a}	245.88^{a}	247.90^{a}	20.27
T_7	30.07^{b}	93.43^{ab}	175.07^{a}	237.45^{a}	240.27^{a}	22.51
C.V. (%)	5.34	7.29	6.31	4.4	4.52	17.36

Treatment means with the same and without letter designations are not significantly different at 0.05 HSD and ANOVA, respectively.

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

significantly increased the height of glutinous corn during the early vegetative up to the reproductive stage. This result can be attributed to the adequate amount of nutrients from the fertilizers applied, thus elongates the internode of sweetcorn. As the internodes elongate, the stalks increased their length

3.4. Yield and Yield Components of Sweetcorn

The yield and yield characteristics of sweetcorn applied with different organic materials combined with inorganic fertilizers are presented in Tables 5, 6. Results indicated that plants applied with combined poultry manure and inorganic fertilizers (T3) had significantly more number of ears comparable to those with combined cow dung and inorganic fertilizers (T4). As expected, unfertilized plants obtained the least ear due to insufficient nutrients for

Table 7. Number of ears, ear length and diameter and number of marketable and non-marketable ears of hybrid sweetcorn applied with different organic materials combined with inorganic fertilizers

Treatment	No. of Ears plant-1	Ear (cm)		No. of Ears (plot-1)	
		Length	Diameter	Marketable	Non-Marketable
T_0	1.00^{c}	7.88^{b}	4.06^{b}	0.57^{b}	42.28
T_1	1.20^{b}	16.82^{a}	4.98^{a}	24.99^{ab}	28.61
T_2	1.27^{b}	16.80^{a}	4.79^{a}	24.40^{ab}	32.42
T_3	1.47^{a}	17.78^{a}	4.86^{a}	18.48^{ab}	42.72
T_4	1.33^{ab}	16.76^{a}	4.78^{a}	25.82^{ab}	32.74
T_5	1.27^{b}	16.07^{a}	4.85^{a}	30.00^{a}	28.37
T_6	1.23^{b}	16.60^{a}	4.79^{a}	24.24^{ab}	30.36
T_7	1.27^{b}	17.07^{a}	4.80^{a}	31.35^{a}	32.78
C.V. (%)	4.48	7.15	4.14	42.97	25.35

Table 8. Ear yield and harvest index of hybrid sweetcorn

Treatment	Ear Yield (t ha-1)			
	Marketable	Non- Marketable	Total	Harvest Index (HI)
T_0	0.05^{b}	2.35	2.40^{b}	0.2
T_1	5.07^{a}	3.87	8.94^{a}	0.32
T_2	3.33^{a}	4.97	8.30^{a}	0.2
T_3	4.03^{a}	4.9	8.93^{a}	0.27
T_4	5.55^{a}	3.09	8.64^{a}	0.32
T_5	5.93^{a}	3.33	9.26^{a}	0.27
T_6	3.38^{a}	3.71	7.09^{a}	0.23
T_7	4.95^{a}	3.63	8.58^{a}	0.26
CV (%)	26.89	27.16	25.04	31.76

Treatment means with the same and without letter designations are not significantly different at 0.05 HSD and ANOVA, respectively.

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

ear development. Different applications of various organic materials combined with inorganic fertilizers on hybrid sweetcorn had significantly longer and larger ears (cm), had more marketable ears, heavier marketable ears (kg ha-1) and total ear yield (t ha-1) than the untreated control. The significantly longer and bigger ears contributed to the significant weight of marketable ears of fertilized plants regardless of nutrient sources. Thus, the fertilized plants significantly obtained a higher total ear yield compared to the untreated control (T0). This could be attributed to the adequate amount of nutrients from different organic fertilizers (Table 4) + inorganic fertilizers applied. Burr [22] reported that sweetcorn required a minimum rate of 90-60-60 kg N, P2O5, K2O. Sweetcorn without fertilizer applied had the lowest yield. The result implies the benefits of the combination of organic and inorganic fertilizers plus the favorable atmospheric condition on the significant increase yield in green cob of

Table 9. 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	0.05[b]	1,250.00	51,620.00	-50,370.00	-97.56
T_1	5.07[a]	1,26,750.00	79,156.00	47, 594.00	60.13
T_2	3.33[a]	83,250.00	1,17,304.00	-34,054.00	-25.03
T_3	4.03[a]	1,00,750.00	87,484.00	13,266.00	15.16
T_4	5.55[a]	1,38,750.50	85,964.00	52,786.00	61.4
T_5	5.93[a]	1,48,250.00	86,164.00	62,086.00	72.06
T_6	3.38[ab]	84,500.00	84,724.00	-224	-0.26
T_7	4.95[a]	1,23,750.00	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.

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

sweetcorn. Ojeniyi (2002) also reported that the combination of organic and inorganic fertilizers can improve the yield of corn crops significantly. With inorganic fertilizer applied though half of the recommended rate could have provided readily available plant nutrients which improved corn yield and productivity. Likewise, Motavilli et al. (1994) found that the combination of organic fertilizers to soil improves corn yield and its quality

3.5. Production Cost and Return Analysis During the Conduct of the Research for almost Three Months

The profitability of sweetcorn production ha-1 applied with different organic materials combined with inorganic fertilizers is presented in Table 7. All fertilized plants obtained higher gross income, net income and return on investment (ROI) compared to plants without fertilizer applied. Results show that the higher marketable ear yield greatly contributed to the increase in gross income. It also depicts that the higher the production cost, the lower is the net income.

The highest net income of PhP 62,086.00 ha-1 was obtained from plants applied with combined goat manure and inorganic fertilizers (T5) followed by plants applied with combined cow dung and inorganic fertilizers (T4) (PHP 52,786.00 ha-1) and plants applied with pure inorganic fertilizer (T1) (PHP 47,594.00 ha-1) due to their high marketable ear yield obtained and slightly lower production cost.

ROI is a profitability ratio that calculates the profits of an investment as a percentage of the original cost. For example, the plants applied with combined goat manure and inorganic fertilizers (T5) got the highest ROI of 72 %; it means that in every 1 peso invested, there is a gain of PHP 0.7206. Sweetcorn plants applied with different organic materials in combination with inorganic fertilizers were profitable except T2 and T6. This might be due to the higher amount of nutrients of these organic fertilizers applied that contributed to the marketable ear yield but low production cost.

The cost of organic materials differs among treatments. The highest cost was incurred from the combination of vermicompost and inorganic fertilizers (T2) because of the high price of vermicompost (Appendix Table 31) but since it has a low amount of nutrients (Table 4) relative to mudpress (T6), thus the returns were negative. The combination of goat manure and inorganic fertilizers (T5) was more profitable and advantageous because of the low price of goat manure yet with a high amount of nutrients (Table 4) thus, high yield. The combination of poultry manure and inorganic fertilizers (T3) got the lowest net income because of its relatively higher price.

4. CONCLUSION

Sweetcorn applied with organic and inorganic fertilizers regardless of sources gave favorable growth and yield performance. Application of combined goat manure and inorganic fertilizers (T5) was greatly profitable for it gained higher net income and ROI of PhP 62,086.00 ha-1 and 72.06 %, respectively. While, application of combined inorganic fertilizers with either vermicompost (T2) or mudpress (T6) got a negative net income

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6. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

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