Enhancing Corn Productivity through Application of Vermi Tea as Foliar Spray

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Abstract - *One of the major commodities in the Province of Apayao is corn. In the municipality of Conner, a previous study conducted showed that corn farmers heavily rely on the use of inorganic fertilizers and still produce low yield. This study was then conducted to compare traditional farming against the use of an intervention using Vermi Tea as supplemental spray. Results of this endeavor showed that the farms applied with supplemental organic spray performed better that that of the usual farmer's practice in various aspects of corn growth and yield. Findings show that vermi tea, when used as a foliar spray can significantly improve the growth and yield of corn . Due to the presence of plant growth regulators, and its ability to improve the condition of the soil, the corn farm sprayed with vermi tea produced taller corn crops with longer and thicker ears. As reflected in this study, corn when applied with the vermi tea can have an increased yield which can go as high as two tons/ha. More importantly, vermi tea promotes the use of organic fertilizer which does not entail high cost and can be prepared using agricultural wastes and other locally available materials. This will not only contribute to the reduction of the amount of total waste but will also help minimize the use of chemical fertilizers. The technology intervention promoted in this project complements and supports various government agency thrusts and priorities which are geared towards improving the agriculture industry, maintaining environmental quality and sustainable use of resources, climate change adaptation and mitigation; and production of excellent researches that will promote quality education and contribute to the upliftment of the country and encourage multisectoral/ multidisciplinary research along the priority areas like food safety and security among others.*

Keywords: Vermi tea, supplemental spray, organic fertilizer, corn production

INTRODUCTION

Corn (*Zea mays* L.) is one of the most important crops in the Philippines. Aside from being one of the country's staple foods, it is also being largely utilized by the livestock and poultry industries as well as being processed into other products.

Corn production can be done through a variety of method like strip cropping, intercropping, continuous corn system, and corn-soybean rotation.

To improve corn production, farmers must try to observe the ideal seeding rate, date of planting, spacing of rows, and others. However, these factors are continually changing. For instance, seedling rates sometimes need to be increased and planting needs to be done earlier than usual.

In addition, in its early stage, the crop is vulnerable to numerous environmental conditions such as frost, flooding, and drought. Products, such as herbicides or fungicides, applied to the crop early in the season may also impact overall growth. Articles provide information when corn is between emergence (VE) and approximately the tenth leaf stage (V10) [1].

Compared to other countries producing corn, the Philippines, with its average corn productivity of 3.21 metric tons/hectare (mt/ha) as recorded by DA is lagging behind. Despite the increasing demand for corn, (white consumed as staple by around 12 million Filipinos and yellow wherein approximately 70 percent is used as feeds for livestock), overall production is low and inefficient.

One of the causes seen for low production is climate change which causes the non- stop incidences of calamities like severe drought and typhoon. Another cause for this problem is the dependency of farmers on chemicals and inorganic fertilizers. The excessive use of pesticides and synthetic fertilizers is

usually observed in traditional farming of any crop. Although this practice provides instant relief and improves production and yield, it can bring hazardous effects in the long run. Among the negative impacts of regular chemical use include infertility of the soil, resistance of insects to pesticide, and hazards to human health. This means that this practice do not only pose threats to production stability but also to the environment and human health.

In the Philippines, some of the issues that limit the corn sector to flourish and attain self-reliance include low adoption of modern corn production technologies, high post-harvest losses, and high transport and marketing costs due to inadequate infrastructure.

However, previous reports from the National Corn Program of the Department of Agriculture (DA) reveal that on the national average, there is inefficiency of corn production.

To improve the corn industry as a whole, the government through the National Corn Program has come out with strategies that aim to enhance average corn productivity from 3.21 mt/ha to 5.0 mt/ha; reduce the current average production costs by at least 20%; increase farmers' adoption of the yellow corn hybrid technology; produce quality corn and decrease post-harvest losses by 5% through timely and proper harvesting, shelling, drying and storage practices; increase the income of corn farmers by insuring at least 50% return on the investments, and by improving productivity of labor; stabilize prices at levels equitable to farmers, consumers and end users; ensure corn-based farming systems technology development and transfer system; and improve and institutionalize linkages between and among the DA, local government units (LGUs), non-government organizations (NGOs), peoples organizations (POs), state universities and colleges and (SUCs), and private sectors.

The efforts done to agriculture though research and development have been hailed for helping create and find new opportunities and develop on what have already been done. Particularly, the Bureau of Agricultural Research (BAR) as the R&D arm of DA, supports projects on corn that lead the farmer sector to new strategies and techniques not only to develop their skills as agriculturists and entrepreneurs but also help them obtain stable productivity and better [2].

In Conner, corn fields are suitable for corn production based on crop stand and yield. Despite this, data from the Municipal Planning and Development Office revealed that in 2010, the corn yield in Conner is much below the average yield of 5.05 tons per hectare as provided in the Corn Techno Guide of Region 2.

The use of earthworms have been found out to significantly improve the quality of the soil in terms of physical, chemical and biological properties as the worms thoroughly upturn and disperse the soil, ingest large volumes of soil and excrete nutritive materials (NKP and micronutrients) in the form of 'vermicasts' along with millions of beneficial soil microbes including nitrogen fixers [3].

The positive effects of vermin compost on the soil has been proven and discussed by a lot of researchers. In the Philippines, many technology adoptors confirm the benefits of using vermin compost to their plants and soil condition in general [4].

Vermi Tea has about one- third of the microbial activity and diversity of the solid vermin compost, volume to volume [5].

Magpantay [6] as cited by Chang [7] stated that the liquid mixture derived from vermicompost can be used as an additional fertilizer to enhance the growth of crops and increase nutrient availability.

Since it is in liquid form, vermi tea can be used as an organic foliar fertilizer. Spraying also allows plants to benefit from the pesticidal properties of vermitea.

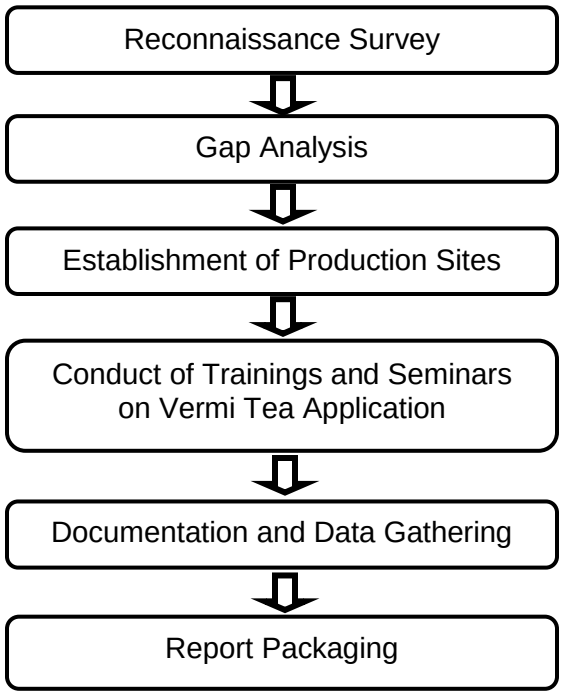
Vermi tea is also excellent plant growth promoter and soil amendment. According to soil scientist, using vermi tea produces major growth differences between plants grown on soil and water and those grown on soil and vermi tea. Guerrero III [8] in his study, stated that yields of corn fertilized with vermin compost at 5t/ha and rice at 2t/ha of vermin compost were comparable with those for corn fertilized with 100% chemical fertilizers and 40% increase over the control for rice. This study was then conducted to improve the production of corn by applying vermi tea as a foliar spray to increase the yield of corn.

OBJECTIVES OF THE STUDY

The study aimed to enhance the corn productivity in Conner, Apayao, specifically to improve the farming operations and productivity of the corn in Paddaoan and Sacpil, Conner, Apayao by applying vermi tea as supplemental spray; demonstrate and showcase improved production technology on corn to farmers/ entrepreneurs/ stakeholders to improve/ fast-track technology promotion and adoption of science-based technologies.

METHODS

Implementing Mechanism Implemented



Reconnaissance Survey

Based on the reconnaissance survey conducted, the farm of Ms. Florida Asistores was selected as the model farm for the use of biofertilizer as foliar spray. The selection was based on the following:

a) One of the main products product/commodity in the area is corn.
b) The farm is located within the community and is not very far away from the College thus monitoring is easy.
c) The availability of an expert of the college who prepares biofertilizers.
d) The willingness of the farmers and farmer-cooperator to implement innovative corn production practices.

Identification of Gaps

Based on interviews conducted to corn farmers in Conner, it was gathered that there has been a decline in corn yield. It was also learned that in the management of the growing corn plants, the farmers are only applying basal fertilizers like urea.

As mentioned earlier, the liquid mixture derived from vermicompost can be used as an additional fertilizer to enhance the growth of crops and increase nutrient availability. Since it is in liquid form, vermi tea can be used as an organic foliar fertilizer.

Other studies also discovered that Vermi tea is an excellent plant growth promoter and soil amendment. Soil scientists also found out that using vermi tea produces major growth differences between plants grown on soil and water and those grown on soil and vermi tea.

Establishment of the Production Sites and Application of Vermi Tea

For each of the farms, an area of 3 x 3 meters for every replication/ quadrant was prepared. For the production of corn, from land preparation to harvesting, the traditional practice was followed except in the aspect of managing the growing corn plants (early vegetative stage or 25 DAP) wherein vermi tea was used to spray in the demonstration farms. For every 10 liter of water, 1 liter of vermi tea was added. This ratio is based on BSWM. Likewise, various researches reviewed, like that of Magpantay also suggest the use of the same ratio of water and vermi tea.

Data Gathering Procedure

Plant height, number of leaves, ear height, ear diameter, number of rows per ear, and yield were measured and weighed. Other supplemental data were gathered from farmers who are engaged in corn farming in Paddaoan and Sacpil, Conner by means of interview and Focus Group Discussion.

RESULTS AND DISCUSSION

Corn Growth and Yield and Technical Feasibility

Using 10 sample plants per replication, from each of the farms, various parameters were measured including the final plant height, ear height, number of leaves, ear length, ear diameter, number of rows per ear, percentage shelling and drying recoveries, weight of 1,000 seeds, yield per quadrant, and computed ton per hectare yield.

a. Growth Performance of the Corn Plants

On the final plant height of the corn plants, not much difference was observed in Paddaoan with the farmers' practice having a mean height of 1.98 meters while the use of vermi tea had a mean height of 1.97 meters. However, in Sacpil, the corn plants sprayed with vermi tea were significantly taller with a mean of 2.37 compared to the farmer's practice with a mean of 2.27.

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Table 1. Final Plant Height

Farm Practices	Demo Farm Sites									
	Paddaoan Replications					Sacpil Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	1.91	1.93	2.11	5.95	**1.98**	2.28	2.33	2.20	6.81	**2.27**
Use of Vermi Tea as Foliar Spray	2.12	1.74	2.06	5.92	**1.97**	2.36	2.43	2.33	7.17	**2.37**

Table 2. Ear Height

Farm Practices	Demo Farm Sites									
	Paddaoan Replications					Sacpil Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	1.07	1.11	1.2	3.38	**1.13**	1.31	1.39	1.31	4.01	**1.34**
Use of Vermi Tea	1.18	1.0	1.23	3.41	**1.14**	1.25	1.42	1.44	4.11	**1.37**

Table 3. Number of Leaves

Farm Practices	Demo Farm Sites									
	Paddaoan Replications					Sacpil Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	1.5	14.8	15.0	44.3	**14.77**	16.6	16.9	16.7	50.20	**16.73**
Use of Vermi Tea	15.3	15.1	15.6	46.0	**15.33**	17.2	17.4	17.3	51.90	**17.30**

In terms of ear height, the traditional practice in Paddaoan had a mean ear height of 1.13 meters as compared to that of the corn sprayed with organic fertilizer having a mean ear height of 1.14 meters. An almost similar result was obtained in Sacpil wherein the former had a mean ear height of 1.34 while the latter had a mean of1.37 meters.

Tables 1 and 2 coincide with the statement of Aracon (2007) that the presence of plant growth regulators in the vermi tea can influence plant growth.

As to the number of leaves, table 3 shows that both in Paddaoan and Sacpil, a slightly higher difference was observed with the plants sprayed with vermi tea.

All the parameters measured under the growth performance of corn plants depict better performance of corn sprayed with vermi tea compared to the farmer's usual practice of not applying organic foliar spray. This signifies better photosynthetic activities of the corn plants which can lead to higher yield.

b. Yield Performance of the Corn Plants

The ear diameter also showed that the farms applied with intervention had thicker corn ears with an average diameter of 4.28 centimeters while the farmers' practice only had 4.14 ear thicknesses in Paddaoan. Similarly, in Sacpil, the use of veri tea produced thicker ears with 4.58 while for the traditional practice, only 4.01.

Table 4. Ear Diameter

Farm Practices	Demo Farm Sites									
	Paddaoan Replications					Sacpil Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	4.0	4.1	4.3	12.4	**4.14**	4.38	3.82	3.8	12.0	**4.01**
Use of Vermi Tea	4.3	4.17	4.37	12.8	**4.28**	4.64	4.46	4.64	13.74	**4.58**

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Table 5. Number of Rows per Ear

Farm Practices	**Demo Farm Sites**									
	Paddaoan Replications					**Sacpil** Replications				
	Q1	**Q2**	**Q3**	**Total**	**Mean**	**Q1**	**Q2**	**Q3**	**Total**	**Mean**
Farmer's Practice	13.6	12.8	13.6	40	**13.33**	13.2	13.2	12.8	39.2	**13.07**
Use of Vermi Tea	14.4	14	13.8	42.2	**14.07**	13.6	14.0	14.0	41.6	**13.87**

Higher number of rows per ear was also recorded for the corn plants sprayed with vermi tea having a mean of 14.07 compared to the plants under conventional method with an average of 13.33 rows in Paddaoan. Likewise in Sacpil, the number of rows of the corns applied with vermi tea gave a mean of 13.87 while for the corn with no foliar spray had 13.07 rows.

Table 6. Percentage Shelling Recovery

Farm Practices	**Demo Farm Sites**									
	Paddaoan Replications					**Sacpil** Replications				
	Q1	**Q2**	**Q3**	**Total**	**Mean**	**Q1**	**Q2**	**Q3**	**Total**	**Mean**
Farmer's Practice	88.3	73.3	79	235.6	**78.54**	82.21	85.7	80.6	248.5	**82.84**
Use of Vermi Tea	85.0	73.7	83.3	242.01	**80.67**	80.56	89.5	81.08	251.1	**83.72**

The shelling recovery of the corn plants were also recorded wherein the plants sprayed with the organic liquid fertilizer had higher percentages. This higher percentage of shelling recovery implies that bigger and better quality corn are produced when applied with vermi tea.

Table 7. Percentage Drying Recovery

Farm Practices	**Demo Farm Sites**									
	Paddaoan Replications					**Sacpil** Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	68.8	78	76.7	223.5	**74.89**	91.2	86.68	92.41	270.3	**90.10**
Use of Vermi Tea	77.9	82.9	84.3	245.1	**81.70**	97.24	91.03	92.00	280.3	**93.42**

On the percentage of drying recovery, it was observed that in Sacpil, both in the farmer's practice and the farm with intervention had higher percentage than the standard drying recovery for corn which is 80- 85%. This is because in Sacpil, the corn plants were not harvested at the scheduled time thus rendering them over matured, implying that the corns had lesser moisture content.

Table 8. Weight of 1,000 seeds (grams)

Farm Practices	**Demo Farm Sites**									
	Paddaoan Replications					**Sacpil** Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	240	275	285	800	**266.67**	260	250	255	765	**255**
Use of Vermi Tea as Foliar Spray	290	295	310	895	**298.33**	285	280	275	840	**280**

Table 8 shows that 1,000 seeds from corns sprayed with vermi tea weighed heavier than seeds from corns not applied with organic foliar spray. This indicates that corn, when sprayed with vermi tea has bigger seeds compared to the seeds produced through the usual farmer practice.

Table 9. Yield per quadrant

Farm Practices	Demo Farm Sites									
	Paddaoan Replications					Sacpil Replications				
	Q1	Q2	Q3	Total	Mean	Q1	Q2	Q3	Total	Mean
Farmer's Practice	1.81	3.58	3.69	9.08	**3.03 kg**	4.56	4.32	4.47	13.25	**4.45 kg**
Use of Vermi Tea	4.64	3.69	6.59	14.92	**4.97 kg**	5.29	6.4	4.7	16.39	**5.46 kg**

Perhaps a more telling and perhaps the best data to demonstrate the advantages of using vermi tea as foliar spray for corn is on the yield of the corn plants. After weighing the harvested corn from each quadrant, higher mean yields were much heavier both in Paddaoan and Sacpil wherein in Paddaoan, a mean yield of 4.97 kg compared to the 3.03 kg mean weight for the usual farmer practice. The mean weight was even higher in Sacpil wherein the yield of corn sprayed with vermi tea was 5.46 kg while the farmer's practice was 4.45 kg.

For Paddaoan, the yield of corn with vermi tea converts to 5.53 tons/ hectare while in Sacpil, 6.07 tons/ hectare. This is shown in table 10 below. Both the converted yields are higher than the average yield of corn of the same variety as reported in the Agri Pinoy Corn Technoguide of Region 2 which is 5.05.

The higher yield can be attributed to the better growth performance of the corn plants applied with vermi tea which had higher final plant height, ear height, and number of leaves which helped in the generation of more carbohydrates for the plants as a result of the better photosynthetic activities of the corn plants.

The study on the Effects of Vermicompost Teas on Plant Growth and Disease by Edwards, Arancon and Greytak[9] explain that the beneficial response may be due to plant growth regulators or hormones produced by the high microbial activity in vermicomposts.

Table 10. Computed yield per hectare (t/ha)

Farm Practices	Demo Farm Sites									
	Paddaoan Replications					Sacpil Replications				
	Q1	**Q2**	**Q3**	**Total**	**Mean**	**Q1**	**Q2**	**Q3**	**Total**	**Mean**
Farmer's Practice	2.01	3.98	4.1	10.09	**3.36**	5.07	4.8	4.97	14.84	**4.95**
Use of Vermi Tea as Foliar Spray	5.16	4.1	7.32	16.58	**5.53**	5.88	7.11	5.22	18.21	**6.07**

Corn Income and Economic Viability

Farmers' Practice

ITEMS	Paddaoan	Sacpil
	AMOUNT	
A. Labor Cost (from Land Preparation to Drying)	**14,850.00**	**14,850.00**
B. Farm Supplies and Materials (Seeds, Fertilizers, Herbicides, Twine)	**15,630.00**	**15,630.00**
Total Production Cost	**30,480.00**	**30,480.00**
Yield (t/ha)	3.36	4.95
Price per Kg	11.5	11.5
Gross Income	38,640	56,925.00
Net Income	**8,160.00**	**26,005.00**
ROCE	**26.77%**	**84.10%**

Table 10 (cont.) S&T Intervention

ITEMS	Paddaoan	Sacpil
	AMOUNT	
A. Labor Cost (from Land Preparation to Drying)	**14,850.00**	**14,850.00**
B. Farm Supplies and Materials (Seeds, Fertilizers, Herbicides, Twine, vermi tea)	**18,099.00**	**18,099.00**
Total Production Cost	**32,949.00**	**32,949.00**
Yield (t/ha)	5.53	6.07
Price per Kg	11.5	11.5
Gross Income	63,595.00	69,805.00
Net Income	**30,646.00**	**36,856.00**
ROCE	**93.01**	**111.86**

The return on cash expenses for the two farms shows that using vermi tea as supplemental foliar spray significantly increased farmers' income by 93.01% in Paddaoan or a net income of 30,646.00 and 111.86% or 36,856.00 net income in Sacpil. Both are higher than the returns derived from the corn produce without the vermi tea as S&T intervention.

Technology Transfer Vis-a Vis Farmers' Empowerment

Through the establishment of the demonstration farm using vermicompost as foliar spray for corn, the corn farmers in Paddaoan were motivated to become technology-transfer agents as manifested by the farmers' willingness to establish demonstration farms showcasing organic fertilizers. Further, during the course of the project implementation, the farmers were given the opportunity to gather and record data on the performance of the corn plants of the two subject farm sites.

Aside from aforesaid capacity enhancement activities, trainings on corn production were also conducted. These are presented in the table below.

Table 11. Training on Corn Production

Title of Training	Date conducted	Venue
Training on Soil Fertility and IPM	January 5-6, 2015	Paddaoan, Conner
Training on Soil Fertility and IPM	January 9 & 30, 2015	Sacpil, Conner
Training on Harvesting, Post Harvesting analysis	April 9, 2015	Sacpil, Conner
Training on Harvesting, Post Harvesting analysis	April 10, 2015	Paddaoan, Conner

Significant Impacts

The technology intervention promoted in this study advocates the utilization of an organic liquid fertilizer proven to be an effective means of enhancing the production of corn. It supports various thrust and priorities laid out by the line agencies and local government units particularly the Organic Agriculture Program of DA and the National Corn Program.

This study also complements the AGRI-PINOY CORN PROGRAM, a project on "Corn Agricultural Productivity Enhancement" (CAPE) which intends to increase corn productivity through biodynamic farming system in order to rehabilitate the soil and protect the environment.

Other thrust and priorities supported by this include one of the five KRAs under the President's Social Contract which is maintaining the integrity of the environment and climate change adaptation and mitigation; the Cordillera Regional Developmental Goal of Environmental Quality and Sustainable Use of Resources; and one of CHED's mandates which is for SUCs to produce high quality research that will advance learning and national development and encourage multisectoral/ multidisciplinary research along the priority areas like food safety and security, pollution control, and climate change specifically on the issue of global warming.

Also, the sustained promotion and utilization of the intervention used in this project, can play a role in contributing to the upliftment of the socio-economic conditions of Apayao.

CONCLUSION AND RECOMMENDATION

Vermi tea when used as a foliar spray can significantly improve the growth and yield of corn . Due to the presence of plant growth regulators, and its ability to improve the condition of the soil, the corn

farm sprayed with vermi tea produced taller corn crops with longer and thicker ears. As reflected in this study, corn when applied with the vermi tea can have an increased yield which can go as high as two tons/ha.

More importantly, vermi tea promotes the use of organic fertilizer which does not entail high cost and can be prepared using agricultural wastes and other locally available materials. This will not only contribute to the reduction of the amount of total waste but will also help minimize the use of chemical fertilizers.

It is recommended that training on vermi tea production should be conducted to capacitate the farmers in the locality to capacitate them on the preparation of vermi tea. Vermi culture facilities should be established and maintained within the barangays to ensure sustainability of materials for vermi composting by the farmers. Conduct researchers on the effects of vermi tea on the growth and yield performance and as insect and pest control method for other crops grown in the locality like rice, vegetables, and fruit trees.

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