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Growth and Yield Performance of Transplanted Sweet Corn Applied With Organic–Based Foliar Fertilizer

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Abstract

A field study was carried out to determine the effect of inorganic fertilizer plus varying rates of organic-based foliar fertilizer on sweet corn from November 2018 to February 2019 at experimental area of the Isabela State University, Cauayan City, Isabela with 7 fertilizer treatments as follows: T1-Farmers Practice (8 bags ha -1), T2 - 120-7-0 kg NPK ha -1 (RR), T3 - 120-7-0 + 0.5 Liter Foliar Fertilizer ha-1, T4 - 120-7-0 + 1 Liter Foliar Fertilizer ha-1, T5 - 120-7-0 + 1.5 Liter Foliar Fertilizer ha-1, T6 - 120-7-0 + 2 Liter Foliar Fertilizer ha-1, and T7 – 3 Liter Foliar Fertilizer ha-1 arranged in a Randomized Complete Block Design replicated three times.

Plant height at 30 and 60 days after transplanting, Ear height, ear length and diameter. Were significantly higher among fertilized with the combination of the recommended rate of inorganic fertilizer and organic-based foliar fertilizer. On the same manner, the weight of ear with and without husk per plant as well as six square meters sampling area out yielded the plants fertilized with foliar fertilizer alone. This is a strong manifestation that foliar fertilization of crops can complement soil fertilization.

Soil application method and foliar fertilization favorably produced the highest projected yield per hectare while farmer's practice of fertilization (8 bags per hectare) attained the highest return on investment.

INTRODUCTION

Due to the extensive and improper use of chemical fertilizers and pesticides in the soil, the soil is degrading to an alarming level, causing an imbalance in the ecosystem and environmental pollution as well. The impact of increased fertilizer use on crop production has been large and important. It has been estimated that fertilizer use contributed to about 25% of the total increase in corn production in Asia. However, in recent years there has been serious concern about long-term adverse effect of continuous and indiscriminate use of inorganic fertilizers on deterioration of soil structure, soil health and environmental pollution. The declining yield for major food crops coupled with the declining soil fertility have raised much concerns about agriculture's ability to feed a world population that is expected to exceed 7.5 billion by the year 2020 (Scott et aI., 2000). In the Philippines, about 70% of the crop lands are degrading its quality and fertility for crop cultivation which cannot produce good and high quality crops and yield anymore. The crops lands in the Philippines are getting more and more acidic because of continuous cultivation and application of inorganic fertilizers and pesticides. The acidic and degrading states of the soil dramatically reduce the soil productivity and the yield. In order to obtain higher yields in corn, innovations that will warrant and assure higher yields and economic returns should be developed to ensure the sustainability of corn production and to encourage more farmers and entrepreneurs to venture into corn production. Thus, it is important that fertilizer management strategies should include those that will not only increase nutrient use efficiency but likewise improve soil health to sustain productivity.

Application of foliar fertilizer is an effective way of correcting soil nutrient deficiencies when plants are unable to absorb them directly from the soil (Liang and Silberbush, 2002). Foliar applied fertilizers provide a quicker response and are more effective for some nutrients than soil applied fertilizers (Jamal *et al*., 2006). Considering the benefits of foliar fertilization cited in the literature, there was the need to evaluate in field trials organic based foliar fertilizers in transplanted sweet corn.
The objective of the study is to determine the growth and yield performance of transplanted sweet corn with the application of organic-based foliar fertilizer.

REVIEW OF RELATED LITERATURE

The nature of the soil plays a very vital role in the availability of some micronutrients like Mn, Cu, Zn and Fe which are precipitated in insoluble forms in alkaline soils. However, farmers must be sure that their crops will not be damaged by the foliar fertilizers as some plants are intolerant to this treatment (Gooding and Davies, 1992). In young leaves the nutrient solution is absorbed through minute hairs (trichomes) on the leaf surface through the stomata, even though the latter is not the major pathway. Most of the absorption takes place by diffusion through the cuticle (Salisbury and Ross, 1992). This is in contrast to soil applied fertilizer which is usually in powder or granular form which has to be dissolved by moisture from rainfall or irrigation to be available to plants via the roots. In other words, soil applied fertilizer has to dissolve into the soil solution to be available. When soil applied fertilizers are not readily available or insufficient, foliar feeding is usually practiced or used as supplement (Abbas and Ali, 2011). Chemical residues in the soil and its subsequent ground water pollution as a result of excessive use of fertilizers can be resolved by the use of small amounts of foliar applications to increase growth and yield in wheat (Sabir *et al*., 2002b).

The use of both foliar and soil application of NPK have been found to increase **grain yield** in maize (Ghaffari *et al*., 2011) and pods/plant, seeds/pod and seed weight in lentil (Hamayun *et al*., 2011). Silicon and boron foliar applications had also been used by Ahmed *et al*. (2008) on saline soils to hasten growth, yield and nutrient uptake in wheat. Sabir *et al*. (2002a) also used foliar application of nitrogen to increase vegetative and reproductive growth and development in barley. Afifi *et al*. (2011) used urea foliar application with the aim of minimizing soil applied fertilization of maize to reduce water pollution. Ben Dkhil *et al*. (2011) also found out that foliar potassium fertilization significantly increased vegetative growth of potato but not tuber numbers and yield.

Nitrogen is one of the macronutrients which is required in relatively high quantities for good vegetative and reproductive development in maize. It is a component of protein and **nucleic acids** and when it is inadequate, growth is reduced (Adediran and Banjoko, 1995). It forms part of many important compounds like chlorophyll and enzymes responsible for many physiological processes in the plant. Nitrogen serves as an intermediary in the utilization of phosphorus, potassium and other elements in plants (Brady and Weil, 2007). Phosphorus also has many vital functions in photosynthesis, utilization of both sugar and starches and in energy transfer processes. Young plants absorb phosphorus very rapidly, to provide rapid, extensive growth of roots. Onasanya *et al*. (2009) have stated that fruit ripening can be hastened by phosphorus when there is excessive application of nitrogen fertilizer in the soil. Potassium also acts as an activator of many enzymes in plant metabolism and provides the ionic background for the maintenance of the living entity of the plant cell (White and Collins, 1982).

METHODOLOGY

A field trial was conducted at the experimental area of the Institute of Agricultural Technology, Isabela State University, Cauayan City on November 2018 to January 2019. The **experimental design** was a randomized complete block with three replications. Pre-germinated seedlings of 5-7 day old were transplanted in a plot size of 7 rows, 5 m long with plant spacing of 75 x 50 cm. Different rates (0.5, 1.0, 1.5, 2.0 liters ha^{-1}) of organic foliar fertilizers (Vermitea and Masinag) were sprayed at 15 and 45 DAT alongside with the recommended inorganic fertilizer rate of 120-7-0 kg ha^{-1} were evaluated using transplanted sweet corn (Sweet Fortune F1).

Weeds on the plots were controlled when necessary throughout the experimental period. Soil samples were taken from each location at soil horizons of 0-30 cm depth for analysis. Soil chemical analyses indicated that soil is slightly acidic with pH of 6.10 and low in nitrogen (0.02-0.07%) and **organic matter** (2.48%). However, phosphorus level was high at (68.09 ppm) while potassium level was low (13.39 ppm).

Data on plant height, corn ear height, ear length, diameter and weight with and without husk were taken and **calculated**. All the data gathered were subjected to statistical analysis using the Statistical Tool for Agricultural Research (STAR) Package computer software. Where the ANOVA showed significant differences of variables between treatments, the Tukeys's Honest Significant Difference (HSD) was used to compare between treatment means.

RESULTS

1. Plant Height at 30 and 60 Days after Transplanting**.** The plants applied with the recommended rate of inorganic as well as the inorganic and foliar fertilizer (T_1, T_6) produced the tallest plants with a comparable mean heights ranged from 141.59 to 150.93 centimeters. The shortest plants were produced from the plants with sole foliar fertilizer with a mean of 95.91 centimeters.

At 60 days after transplanting same trend of results where variation existed. The application of inorganic fertilizer and foliar fertilizer rates from 0.5 liter to 2 liters per hectare produced taller plants with a comparable means ranged from 246.80 to 254.43 centimeters. The shortest were observed from the plants with sole foliar fertilizer at the rate of 3 liters per hectare with a mean value of 204.17 centimeters which shows that the combination of nitrogen and potassium and increasing rate of foliar fertilizer was better than the foliar fertilizer alone.

The use of both foliar and soil application of NPK have been found to increase heights of the plants, which justified the claim of Abbas and Ali (2011) that when soil applied fertilizers are not readily available or insufficient, foliar feeding is usually practiced or used as supplement. Likewise, the significant increase in the plant heights of the plants applied with the recommended rate of inorganic and foliar fertilizer over the plants applied with sole foliar fertilizer, the result conformed the findings of Liang and Silberbush (2002) that foliar fertilizer may partially compensate for insufficient uptake by the roots of corn because the leaf area at the time of spraying might not be large enough to hold the liquid fertilizer in place to make it effective, hence smaller over the other treatments.

2. Ear Height**.** The ear height of the plants fertilized with the recommended rate at 120-70-0 /ha as well as the plants with the same rate of inorganic fertilizer supplemented at 0.5 (T_3); 1.0 (T_4); 1.5 (T_5); and 2.0 liters (T_6) foliar fertilizer per hectare produced the tallest ear with comparable mean values of 99.60, 98.93, 101.23, 102.67, 96.43 and 103.27 centimeters, respectively. The plants without inorganic fertilizer but applied with 3 liters foliar fertilizer produced the shortest ear height with a mean of 79.43 centimeters.

The positive effect of inorganic, organic fertilizer and foliar as exhibited on the ear height of the plants showed that the nutrients derived from inorganic (vermicompost), foliar (Masinag) can be used as an additional fertilizer to enhance the growth of crops and increase nutrient availability. The beneficial response may be due to plant growth regulators or hormones produced by the high microbial activity in vermicompost (Chang, 2013).

3. Ear Length. The plants applied with inorganic fertilizer at the application rate of 8 bag per ha-1 (T_1) as well as the application of inorganic fertilizer at the recommended rate (T_2) and the plant applied the same rate supplemented with foliar fertilizer at 0.5 liter (T_3), 1.0 liters (T_4), 1.5 liters (T_5) and 2.0 liters (T_6) produced a comparable mean values of 21.53, 21.70, 22.16, 21.46, 21.76 and 21.95centimeters, respectively. On the other hand, plants applied with 3 liters foliar fertilizer alone produced the shortest ear with a mean value of 15.45 centimeters.

The increases in ear length as a result of increasing foliar fertilizer levels may be ascribed to the role of nitrogen from inorganic in improving growth and development of longer ears leading to increase synthesis of amino acids and their assimilation into grain protein (Okumura *et al*., 2011).

4. Ear Diameter. All the plants applied with sole inorganic fertilizer as well as the application of the same rate supplemented with foliar fertilizer produced significantly bigger ears with mean values of 4.90, 4.98, 4.92, 4.96 from treatment 1, 2, 3, 4, 5, and 6 respectively. The smallest ear was produced from the plants applied with pure foliar fertilizer at 3 liter per ha-1 (T_6) with a mean value of 3.99 centimeters.

Such difference is attributed to the fertilizers used in this study that when such are blended, these were dominated by potassium from foliar and nitrogen from inorganic tend to promote vegetative growth and fruit size and to encourage seed development. In the case of ear quality. It is the key to a better yield as influenced by good pollination that is essential for full kernel development (Williams and Williams, 2006). Moreover, this maybe also attributed from the organic fertilizer which plays a vital role to plant growth. It is involved in several key plant functions, including energy transfer, photosynthesis, and nutrient movement within the plants (Brady and Well, 2002).

5. Weight of Corn Ears with Husk. The plants applied with 8 bags of inorganic fertilizer (T_1) as well as the plants applied with the recommended rate of inorganic fertilizer (T_2) and the plants applied the same rate supplemented with foliar fertilizer at the rate of 0.5 litters (T_3), 1.0 litters (T_4) 1.5 litters (T_5) and 2.0 litters of foliar fertilizer (T_6) produced the heaviest ear which comparable mean values of 366.73, 411.87, 407.97, 395.57, 404.30 and 432.37grams, respectively. The lightest ear was produced from the plants applied with pure foliar fertilizer at 3 litters per hectare with a mean value of 155.10 grams.

The efficacy of inorganic fertilizer to increase crop growth and yield is well known since the nutrients are readily available for plant use. It shows that the combination of inorganic and foliar fertilizers significantly affected the weight compared to single application of inorganic fertilizer. It appears that the nutrients applied used in the corn is enough and appeared to be better when combined rather than foliar fertilizer alone. Moreover, the demand for some nutrients may be greater during the physiological growth and the combination of inorganic and foliar fertilizers have the capacity to supply the required nutrients and there was an available and abundant supply. This often occurs during the development of fruit or grain.

6. Weight of the ear without Husk (g). The integration of inorganic fertilizer to organic foliar fertilized differ significantly among treatments. Consistently, the plants applied with 8 bags inorganic fertilizer (T_1) the plants applied with the recommended rate at 120-7-0 kgs NPK per hectare (T2) as well as the plants applied the same rate of inorganic fertilizer supplemented with 0.5 liters (T_3), 10 liters (T_4), 1.5 liters (T_5) and 2 liters of foliar fertilizer (T_6) produced the heaviest ears inch a comparable mean values of 268.57, 293.40, 290.67, 285.37, 285.83, 302.90 grams, respectively. The plants applied 3 Liters Foliar Fertilizer ha^{-1} had

produced the lightest ear without husk with a mean value of 111.63 grams.

The results herein is in contrast with the findings of Reickenberg and Pritts, (1996); Jamal *et al*., (2006) that foliar applied fertilizers provide a quicker response and are more effective for some nutrients than soil applied fertilizers. It has to consider that the nature of the soil plays a very vital role in the availability of some micronutrients like Mn, Cu, Zn and Fe which are precipitated in insoluble forms in alkaline soils. Basically, corn plant requires an adequate supply of nutrients particularly nitrogen, phosphorus and potassium for optimum growth and yield (Agba and Long, 2005). If the amount of nitrogen is deficient, it could exert a particularly marked effect on corn crop yield as the plant would remain small and rapidly turn yellow if sufficient nitrogen is not available for the construction of protein and chlorophyll (Kogbe and Adediran, 2003). This is traced in the plants applied with sole fertilizer alone.

7. <u>Weight of ear per Sampling Area with Husk</u> (kg/6 m^2). Consistently, the application of inorganic fertilizer at 8 bags per hectare (T_1) application of some recommended rate of inorganic fertilizer (T_2) as well as the same rate supplemented with foliar fertilizer at the rates of 0.5 liters (T_3), 1.0 liters (T_4), 1.5 liters (T_5) and 2.0 liters per hectare (T_6) produced the heaviest ears per sampling area with a comparable mean values of12.30, 13.29, 13.41, 13.80 and 14.32 kilograms, respectively. The 3 liters foliar applied plants produced the lightest ears with a mean values of 5.96 kilograms.

Foliar fertilizer improves adhesion of the fertilizers to the leaf surface and release nutrients over a prolonged period of time. These can also improve the growth of plant foliage, roots, and yield. By increasing plant growth processes within the leaves, an increase in carbohydrates content of the leaves and stems occurs thus producing heavier seed weight (Chen, 2004).

8. <u>Weight of Ear (w/o Husk) per Sampling Area</u> (kg/6 m^2). In like manner, the effect of combining the recommended rate of inorganic fertilizer and foliar fertilizer tend to increase the weight of ears without husk per six square meters sampling area. The mean weights ranging between 8.62 kg to 9.96 kilograms (T_1 to T_6) showed the superiority of the plants applied with the complete nutrients. The plants applied with sole foliar fertilizer (T_7) had produced the lightest ear weight without husk with a mean value of 3.68 kilograms.

The results indicates that aside from the nitrogen and phosphorus from inorganic source, foliar nutrient applications quickly correct physiological disorders caused by nutrient deficiencies, as well as help to overcome various stress conditions (Kuepper, 2003). Proper nutrition is essential for satisfactory crop growth and production. Efficient application of the correct types and amounts of fertilizers for the supply of the nutrients is an important part of achieving profitable yields as in case of this study.

9. <u>Computed Ear Yield per Hectare</u>. In descending order, Treatment 6 (120-7-0 + 2 Liters Foliar Fert. ha^{-1}) produced the highest ear yield with 23.86 tons per hectare. This was followed by T_5 - (120-7-0 + 1.5 Liter Foliar Fert. ha^{-1}), T_4 - (120-7-0 + 1 Liter Foliar Fert. ha^{-1}), T_3 – (120-7-0 + 0.5 Liter Foliar Fert. ha^{-1}), T_2 – (120-7-0 kg NPK ha^{-1} (RR), and T_1 – (Farmers Practice (8 bags ha^{-1}) with corresponding grand means of 23.00 tons, 22.35, 22.08, 22.15 and 20.50 tons per hectare, respectively. On the other hand, the least was produced by Treatment 7 with 9.93 tons per hectare.

10. <u>Projected Cost and Return Analysis</u>. The plants fertilized using the farmer's practice attained the highest return with 996.25 percent. This was followed by the plants applied with 120-7-0 + 2 Liters Foliar (T_6) with 985.83 percent, Treatment 5 with 953.59 percent, Treatment 2 with 936.01 percent, T_4 with 930.90, and Treatment 7 with 527.10 percent, respectively.

CONCLUSION AND RECOMMENDATION

Field study was carried out to evaluate the effect of organic-based foliar fertilizers on the growth and yield performance of transplanted sweet corn at the experimental site of Isabela State University, Cauayan Campus, Cauayan City, Isabela laid out following the Randomized Complete Block Design with three replication. The results of the study were summarized as follows:

1. The heights of sweet corn at 30 and 60 days after transplanting applied with the recommended rate of inorganic with varying levels of organic-based foliar fertilizer were significantly different from those plants applied with sole foliar fertilizer.
2. Likewise, plants applied with such fertilizer combinations performed better in terms of ear heights, ear length and diameter over the plants applied with sole foliar fertilizer.
3. The ear yield of sweet corn with and without husk was increased by the application of the 120-7-0 kg NPK per hectare plus foliar fertilizer regardless of the levels similar to the farmers' practice.
4. The highest projected ear weight was obtained by Treatment 6 (120-7-0 + 2 Liters Foliar Fertilizer ha^{-1}) which was due to improvement in yield components.
5. Among the treatments, farmers 'practice recorded the highest return on investment with 996.25 percent**.**

The combination of the recommended rate of inorganic fertilizer and organic-based foliar fertilizer increased the growth and yield components of transplanted sweet corn. However, fertilization following the farmer's practice (4 bags urea and 4 bags 16-20-0 kg NPK per hectare out yielded all other treatments.

Based from the results of the study, the farmer's practice of applying 4 bags 16-20-0 kg NPK per hectare at basal and 4 bags urea at topdress is a good practice in transplanted sweet corn which attained higher yield and economical than the combination of inorganic and organic-based foliar fertilizers, hence it is recommended. Moreover, follow up study along this way is recommended for further verification

Table 1. Growth and yield of transplanted corn applied with different rates of organic-based foliar fertilizers

TREATMENTS	30 DAT	60 DAT	Ear Diameter (cm)	Ear Length (cm)	Ear Weight (g)	Weight per sampling Area (kg/6 m^2)	Yield Per Hectare (tons)	ROI (%)
T_1 Farmers Practice	142.73a	242.70a	4.90a	21.53a	268.57a	8.62a	20.50	996.25
T_2 120-7-0 kg NPK ha^{-1}	149.18a	250.33a	4.94a	21.70a	293.40a	9.34a	22.15	936.01
T_3 0.5 L ha^{-1} Foliar Fertilizer	150.93a	246.80a	4.89a	22.16a	290.67a	9.22a	22.08	925.70
T_4 10 L ha^{-1} Foliar Fertilizer	141.59a	253.07a	4.92a	21.46a	285.37a	9.32a	22.35	930.90
T_5 1.5 L ha^{-1} Foliar Fertilizer	144.22a	249.27a	4.96a	21.76a	285.83a	9.64a	23.00	953.59
T_6 2.0 L ha^{-1} Foliar Fertilizer	145.26a	254.43a	4.96a	21.95a	302.90a	9.96a	23.86	985.83
T_7 3.0 L ha^{-1} Foliar Fertilizer	95.91b	204.17b	3.99b	15.45b	111.63b	3.68b	9.93	527.10
ANOVA	9.27**	7.97**	46.74**	38.77**	50.42**	40.89**		
CV (%)	7.84	4.43	1.88	3.20	6.26	4.79		

Means with common letter are not significantly different with each other at 1% HSD

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