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# Calcium carbonate forms applied to purple sweet corn in Capiz Philippines

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**Key words:** Calcium carbonate, Purple sweet corn, Lime, Oyster shell, Eggshell.

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## Abstract

Calcium carbonate is an active ingredient in agricultural lime. It is commonly found in rocks and the main component of pearls and shells of marine organisms, snails, and poultry eggs. Calcium carbonate forms such as lime, eggshells, and oyster shells were utilized to investigate its effect on the growth and yield characteristic of purple sweet corn planted in acidic upland soil in Quevedo Maayon Capiz Philippines. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four treatments replicated three times. The treatments used were the following: T1- soil (control), T2- soil + lime, T3- soil + eggshell, T4- soil + oyster shell. Results revealed no significant difference in the plant height at 15, 30, 45, and 60 days after planting (DAP), leaf area index (LAI), herbage weight, length, diameter, and weight of ears. Numerically, purple sweet corn applied with eggshells produced the tallest plant, longest and widest ears, while those applied with oyster shells got the highest leaf area index. Thus, the inclusion of eggshells and oyster shells has the potential in agricultural liming with appropriate rates of chemical fertilizer to obtained maximum yield in purple sweet corn production.

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## Introduction

Maize (*Zea mays* L.) is one of the most valuable cereal grains produced worldwide in the broad array of environments due to its greater adaptability (Kogbe and Adediran, 2003). The world production of maize is around 1,164 metric tons (FAOSTAT, 2018) and considered a staple food (Chulze, 2010) and valuable raw material for animal feed (Pimentel and Patzek, 2005).

The best suitable soils for maize production are those that are near neutral pH (The *et al.*, 2006). However, acid upland soils occupy approximately 32% of the total land area in the Philippines (IRRI, 1986) and mainly utilized for the production of corn, upland rice, sugarcane, coffee, and cacao (Duque, 1995) thus resulted to yield reduction and deleterious effect on soil fertility. In this matter, one of the mitigation strategies that are observed is the application of amendments rich in calcium carbonates to reduce soil acidity and induced yield.

Calcium carbonate is commonly found in rocks and the main component of pearls and shells of marine organisms, snails, and eggs. It is also an active ingredient in agricultural lime. Lime was firstly utilized by the Romans 2000 years ago to counterbalance 'sourness' (i.e., acidity) on agricultural land practiced on centuries (Goulding *et al.*, 1989; Connor *et al.*, 2011). On the other hand, the oyster shell contains hard tissue consisting of calcium carbonate and organic matrices (Lee *et al.*, 2010). In Capiz Philippines, the vast production from oyster shell farming resulted in severe problems in oyster shell waste disposal. In this work, calcium carbonate forms such as lime, eggshells, and oyster shells were utilized to investigate its effect on the growth and yield characteristic of purple sweet corn planted in acidic upland soil in Quevedo Maayon Capiz Philippines.

## Materials and methods

*Experimental field preparation, treatments, and corn cultivation*

A field study was conducted in Quevedo, Maayon, Capiz Philippines from October to December 2018. The experimental field consists of 12 plots, 20m² each, and arranged in a Randomized Complete Block Design (RCBD) with four treatments replicated three times.

The treatments of the study were the following: T1- soil (control), T2- soil + lime**,** T3- soil + eggshell, T4- soil + oyster shell. Eggshells, oyster shells, and commercial lime were collected locally. It was crushed manually and sieved before applied to the soil at the rate of 1.5 tons $ha^{-1}$.

The soils in the experimental area before planting has the following properties: pH (1:5 $H_2O$) 5.02, available phosphorus 20.79 ppm, organic matter 8.07 g kg-1, exchangeable K 0.09 cmol $kg^{-1}$ exchangeable Ca 1.07 cmol $kg^{-1}$ and exchangeable Mg 0.75 cmol $kg^{-1}$.

Carbonized Rice Hull was applied basally one-week before planting at a rate of 10 kg per plot and evenly applied to the furrows. Seeds of purple sweet corn were planted directly to the furrows at 20cm between hills.

*Investigation of corn growth and yield characteristics*

Ten (10) plant samples were randomly selected in each plot. Plant height was measured from the base to the longest leaf. Leaf area index was measured to investigate the potential photosynthetic activity efficiency, biomass, and net dry matter productivity. Corn ears were harvested upon reaching maturity at 75 days after planting (DAP). Herbage weight was also evaluated to determine the stability and production potential. The length, diameter, and weight of ears per sample of purple sweet corn were measured to determine the yield characteristics.

*Statistical analysis*

The data gathered were subjected to the Analysis of Variance using the Statistical Tools for Agricultural Research (STAR) with an alpha level of significance set at 0.05. Figures were presented using Sigma plot version 12.0 software.

**Results and discussion**

The climatic conditions (precipitation, temperature, and relative humidity) have been observed throughout the study (October 31- December 1, 2018) (Fig. 1). The total rainfall was 9.69mm, and the maximum temperature and relative humidity were 26.89℃ and 92%, respectively. There was no pest invasion observed from planting until the termination of the study. However, early maturity and stunted growth were observed in purple sweet corn.

**Table 1.** Plant height of purple sweet corn at 15, 30, 45, and 60 DAP applied with calcium carbonate forms.

| | Plant height | | | |
|---|---|---|---|---|
| Treatments | 15DAP | 30 DAP | 45 DAP | 60 DAP |
| T1- Soil (control) | 24.18 | 62.13 | 64.72 | 149.73 |
| T2- Soil + Lime | 24.00 | 62.00 | 139.00 | 158.2 |
| T3- Soil + Eggshell | 24.68 | 63.97 | 145.07 | 161.43 |
| T4- Soil + Oyster shell | 23.58 | 63.28 | 144.5 | 159.73 |
| *P-value* | $0.92^{ns}$ | $0.98^{ns}$ | $0.07^{ns}$ | $0.14^{ns}$ |
| CV (%) | 8.34 | 12.13 | 27.40 | 3.49 |

ns= not significant

CV= Coefficient of Variance.

*Plant height at 15, 30, 45 and 60 DAP*

The data on plant height at various stages of growth of purple sweet corn are presented in Table 1. Statistical analysis revealed no significant differences in the height of the test crop as affected by the application of different forms of calcium carbonate. Numerically, tallest corn plants were observed in treatments applied with eggshells with a mean of 161.43cm at 60 DAP followed by the oyster shell with a mean of 159.73cm. The result conforms to the findings of Holmes *et al.*, (2011) that the growth and yield parameters were higher in corn plants applied with eggshell compared to lime.

**Table 2.** Leaf area index and herbage weight of purple sweet corn applied with calcium carbonate forms.

| Treatments | Leaf area index (cm) | Herbage weight (kg) |
|---|---|---|
| T1- Soil (control) | 2.77 | 58.33 |
| T2- Soil + Lime | 3.09 | 81.67 |
| T3- Soil + Eggshell | 3.28 | 70.00 |
| T4- Soil + Oyster shell | 3.46 | 70.00 |
| *P-value* | $0.4148^{n.s}$ | $0.1231^{n.s}$ |
| CV(%) | 15.33 | 13.82 |

ns= not significant

CV= Coefficient of Variance.

*Leaf Area Index and Herbage Weight*

The mean leaf area index (LAI) and herbage weight of sweet corn were presented in Table 2. The data revealed no significant differences among treatment means when applied with calcium carbonate forms. But numerically corn plants treated with the oyster shell has the highest LAI of 3.46cm followed by eggshell and lime with LAI of 3.28 and 3.09, respectively. In terms of herbage weight, purple sweet corn applied with lime got the heaviest herbages with a mean of 81.67kg. The results conform to the findings of Opala (2017) that maize applied with the highest rate of lime (2 t $ha^{-1}$) got the highest herbage weight.

**Table 3.** Length, diameter, and weight of ears per sample of purple sweet corn applied with calcium carbonate forms.

| Treatments | Length of ears(cm) | Diameter of ears(cm) | Weight of ears per sample(g) |
|---|---|---|---|
| T1-Soil (control) | 23.80 | 14.73 | 180.83 |
| T2- Soil + Lime | 24.23 | 14.07 | 218.00 |
| T3- Soil + Eggshell | 27.07 | 16.47 | 200.50 |
| T4- Soil +Oyster shell | 25.97 | 15.80 | 219.00 |
| *P-value* | $0.58^{ns}$ | $0.28^{s}$ | $0.46^{ns}$ |
| CV(%) | 12.42 | 9.5 | 15.33 |

ns= not significant

CV= Coefficient of Variance.

*Length, diameter, and weight of corn ear per sample*

The application of eggshell resulted in a longer and higher diameter of corn ears with a mean of 27.07cm and 16.47cm, respectively. In contrast, the application of oyster shells exhibits the highest weight of corn ears per sample (Table 3). Statistical analysis revealed that the application of different calcium carbonate forms has no significant effect on the length, diameter, and weight of corn ear per sample.

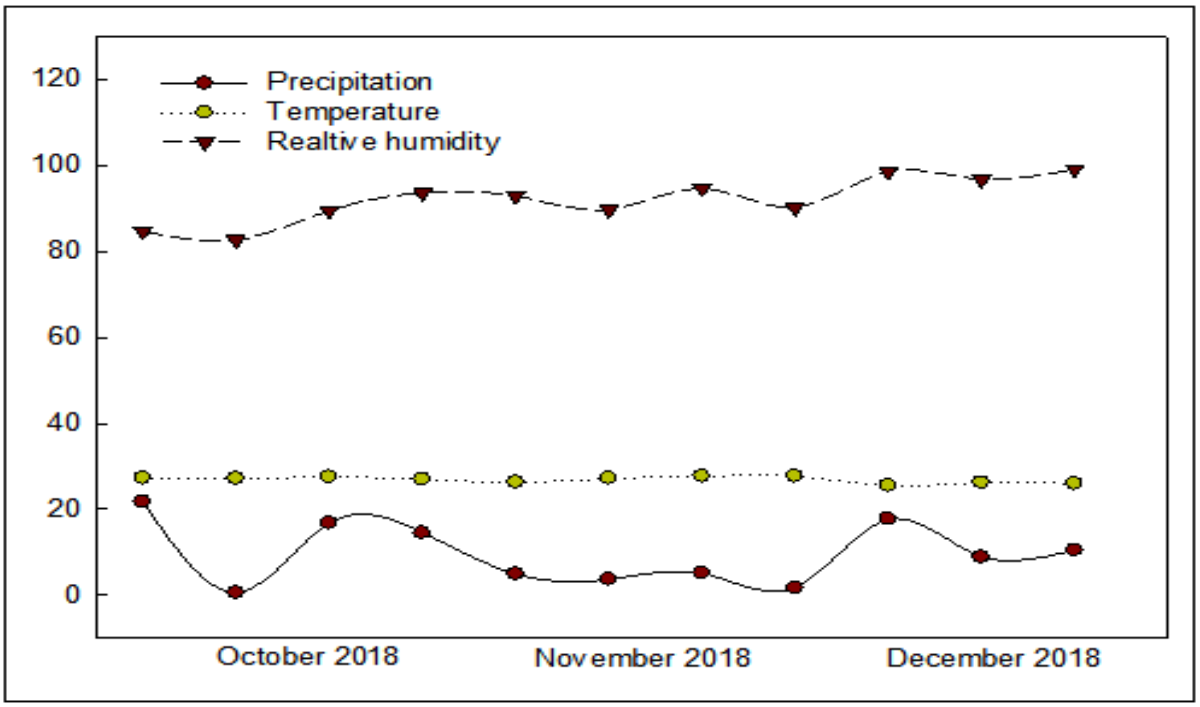


**Fig. 1.** Average precipitation, temperature, and relative humidity in the entire study.

**Conclusion**

In the light of the findings, application of calcium carbonate forms had no significant effect on plant height at 15, 30, 45, and 60 days after planting (DAP), leaf area index (LAI), herbage weight, length, diameter, and weight of ears. Numerically, purple sweet corn applied with eggshells produced the tallest plant, longest and widest ears, while those applied with oyster shells got the highest leaf area index. Therefore, the inclusion of eggshells and oyster shells has the potential in agricultural liming with appropriate rates of chemical fertilizer to obtained maximum yield in purple sweet corn production.

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