Growth, carbohydrate accumulation, and productivity of local glutinous corn Bimapulut (Zea mays var. ceratina Kuleshov) after seed priming and coconut coir ash fertilizer application

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Abstract. Seed priming and applying organic K fertilizer can involve efforts to increase local glutinous corn Bimapulut productivity. This study aims to determine the effect of gibberellin (GA3) as seed priming and coconut coir ash fertilizer on the growth, carbohydrate accumulation, and productivity of Bimapulut corn. The research was conducted using a randomized block design. The main plot was seed priming treatment with gibberellin concentrations of 0, 150, and 300 ppm. As a subplot was the treatment of coconut coir ash fertilizer with fertilizer/soil concentration of 0.00; 0.75; 1.50; 3.00 g/kg; thus, there are 12 treatment combinations. Each treatment was done in three replications. Data were analyzed using separate plot ANOVA with treatment arranged in a factorial. If the treatment is significant, Tukey’s honestly significant difference test will be carried out. The results an interaction between GA3 and coconut coir ash fertilizer on plant height, productivity without corn husks kg/ha, and amylose content but had no significant effect on leaf number, number of cobs per plant, cob length, number of row of seeds per cob, the weight of cob with and without corn husks.

1. Introduction
Pulut corn has been widely developed in Central Asia and East Asia for fresh consumption and commercial crops. The local pulut corn cultivar has several advantages: drought tolerance, parallelogram age, thick husk to protect corn grains from pests, and very specific flavors that need to be continuously developed. Pulut corn is a particular type of corn that has a delicious taste, is more savory, fluffier, and softer. The savory flavor is related to the high amylopectin content in 99% of pulut corn, ranging from 90% to 99% [1]. Pulut corn endosperm consists of a mixture of 72% amylpectin and 28% amylose [2].

Seed priming is a seed conditioning treatment at the planting stage. Seed priming is an alternative technology to overcome seed quality by seed treatment to induce physiological changes in seeds before planting. Priming can improve germination and performance/vigor in a broad spectrum which is also effective for stressful conditions, such as water stress and salt content [3]. Priming can increase germination rate and uniformity in seeds due to improved metabolic processes during the imbibition.
process [4,5]. Growth regulatory substances (PGR) are synthetic compounds with the same work activities as plant hormones [6,7]. One of the PGR that can be used is gibberellins (GA3). Gibberellins are hormones that accelerate seed germination, help shoot/embryo formation, stem elongation, leaf growth, stimulate flowering, fruit development, stem elongation, leaf growth, fruit development, influence root growth, and differentiation.

Efforts to increase crop productivity by fertilizing are often hampered by the high price of synthetic chemical fertilizers or their availability, which is often scarce. One solution to find alternative fertilizers that can substitute synthetic chemical fertilizers at low prices and are easy to obtain is to utilize plant residues or waste. Coconut coir is an example of plant waste that can be used as organic fertilizer [8]. The research objective was to determine the effect of seed priming combined with coconut husk ash on growth, carbohydrate accumulation, and local pulut maize productivity.

2. Research method
This research was conducted at the Integrated FMIPA Laboratory, Green House Central Laboratory, and the UNS food and nutrition laboratory. The research period is about 4 months, from December to March 2021

2.1. Coconut coir ash preparation and chemical analysis of organic fertilizer
Coconut husks are split into small pieces for easy burning. After splitting, the coconut husks are put into the drum in a way arranged one by one. Firewood is given at the bottom of the drum, while the drum's mouth is closed to slow the burning of coconut fiber, so that good quality ash is obtained. The ash formed from the combustion is then cooled. The coconut coir is divided into small pieces. The coconut coir organic fertilizer analysis measured pH, total potassium (K), organic C, cation exchange capacity (CEC), water content, and C/N ratio. Soil media is put in polybags and coconut coir ash mixed with soil according to a predetermined dose for each polybag. Then left for 3 days before planting.

2.2. Application of seed priming on corn kernels
Pulut corn kernels were separated from the cobs, divided into 3 groups and soaked in a gibberellin solution. The concentration of gibberellins consisted of 3 levels, namely 0 ppm (G1), 150 ppm (G2), 300 ppm (G3), with soaking time for 12 hours. The corn kernels were drained and dried/aired for 24 hours after soaking to be ready for planting.

2.3. Planting corn seeds
Make holes in each polybag to a depth of 2-3 cm, put corn seeds in each polybag, cover the pestle with soil until evenly covered, and water after the seeds are planted until they are wet.

2.4. Data collection
Growth parameters: Plant height was measured using a ruler from the base of the plant to the highest leaf (monocots) and the growing point (dicots), and measurements were carried out every 2 weeks from the age of 14 to 56 days after planting. The number of leaves on each plant was determined every two weeks from 24 to 56 days after planting. Leaves that are counted include leaves that are complete. The productivity parameters variables include the number of cobs from the beginning of cobs emergence to harvesting. The length of the cob was measured from the base to the tip of the cob with a ruler, starting from brownish/yellowish age—number of seeds per cob by counting the number of seeds per row perpendicular to the cob. The weight of the cob with and without the cob was weighed using a digital/analytical scale in grams carried out at the time of harvest. Production = axbxcx1/3500, (a) the number of plants, (b) the number of cobs planted, (c) the number of seeds per cob; Productivity by calculating the number of plants, the number of cobs planted, the number of seeds per cob with the formula. Amylose content was determined based on the reaction between amylose and iodine, which
produces a blue color. The intensity of the blue color formed was measured with a spectrophotometer at a wavelength of 625 nm.

2.5. Statistical analysis
The data obtained were analyzed using separate plot ANOVA with treatment arranged in a factorial. If the treatment is significantly different, Tukey's honestly significant difference test will be carried out 5%.

3. Results and discussion

3.1. Chemical of organic fertilizers
The laboratory analysis of organic fertilizer for coconut husk ash is shown in Table 1. The minimum technical requirements for organic fertilizers in crumbs/bulk [9] are also presented in the same table.

Table 1. Analysis of coconut ash fertilizer in crumb/bulk form.

| Parameter         | Minimum Technical Requirements for Solid Organic Fertilizer in the Form of Crumbs/Bulk | Coconut husk fertilizer | Information          |
|-------------------|----------------------------------------------------------------------------------------|-------------------------|----------------------|
| pH                | 4-9                                                                                    | 9.69                    | Does not meet        |
| Total K           | Minimal 4                                                                              | 10.12%                  | fulfill              |
| C-organic         | Minimal 15                                                                             | 11.24%                  | fulfill              |
| KTK               | -                                                                                     | 20.27 cmol(+)kg\(^{-1}\) | -                    |
| Water content     | 15-25                                                                                 | 29.63%                  | Does not meet        |
| C/N ratio         | 15-25                                                                                 | 36.65                   | Does not meet        |

In general, it can be seen that coconut husk ash has alkaline properties with a pH of 9.69. Thus, coconut husk has the potential to increase the pH of soils that have high acidity. The cation exchange capacity of coconut coir is 20.72 cmol (+)kg\(^{-1}\) which is quite large when compared to other materials such as wood (3.47 cmol (+)kg\(^{-1}\)), rice husk (16.70 cmol (+)kg\(^{-1}\)), tau sawdust (18.36 cmol (+)kg\(^{-1}\)).

The water content of coconut coir is 29.63% higher than the standard quality of 15-25%, suspected to be related to coconut coir's high porosity, which can bind fluids in its pores. The C/N ratio in coconut husk is 36.65% which is also higher than the quality standard (15-25%), indicating a more optimal level of fertilizer maturity.

3.2. Local Pulutbima corn crops
Seed priming in the form of gibberellin solution (GA\(_3\)) treatment and application of coconut coir ash fertilizer can increase plant height and productivity of local bima corn without husks but cannot increase the number of leaves, number of cobs planted, length of cobs, number of seeds per cob, the weight of cobs with husk, without husk, and was able to reduce the amylose content in the local Bimapulut corn kernels (Table 2).

3.2.1. Vegetative growth of corn plants. The concentration of gibberellins can accelerate the growth rate and dosage of coconut coir ash, a slow-release organic fertilizer. Potassium is needed in photosynthesis, CO\(_2\) fixation, and photosynthetic transfer to various parts of the plant. Light intensity significantly affects stem growth, the stem of the plant in the shade, and it will increase the auxin level that works simultaneously [10]. The number of leaves could not increase because plant growth, such as the number of leaves, is also influenced by other factors such as environmental conditions, nutrient availability, and water. The number of leaves is influenced by genotype and environment [10].
3.2.2. Generative growth of corn plants. The seed priming with gibberellin and ash fertilizer did not significantly affect the number of cobs planted. These results showed that local bimapulut maize plants had the same ability to form cobs, even though the treatment of gibberellin and coconut husk ash was different. In addition, it is suspected that ear formation is more genetically controlled [11,12]. The treatment also could not increase the length of the local corn cobs. Due to the lack of K nutrients, the local pulut corn plants stunted so that the cobs produced were small. Even though the lack of potassium can still bear fruit bear the cob, the cob produced is small and has a tapered tip. It is also related to the number of leaves and leaf areas. We were not able to increase the number of seeds per cob of local bima corn cobs. The need for nutrients, especially potassium, is not met by plants. The dominant genetic trait controlled the number of leaves in maize in [13].

Table 2. Growth, productivity, and amylose content of local Pulutbima treatment of gibberellin concentration (GA$_3$) and coconut coir ash fertilizer.

| Treatment | Plant Height | Leaf Number | Cob Length | Number of Row of Seeds Per Cob | Cob Weight with Husk | Cob Weight without Husk | Amylose Content |
|-----------|--------------|-------------|------------|--------------------------------|----------------------|------------------------|-----------------|
| G1A0      | 133.33a      | 12          | 4.3        | 31                             | 7                    | 5                      | 10.02ab         |
| G2A0      | 132.77ab     | 12          | 5.4        | 36                             | 10                   | 9                      | 12.26bc         |
| G3A0      | 136.93bc     | 13          | 4.3        | 30                             | 15                   | 8                      | 8.09bc          |
| G1A1      | 126.23a      | 11          | 5.0        | 27                             | 17                   | 12                     | 8.37ab          |
| G2A1      | 118.03ab     | 12          | 4.7        | 40                             | 17                   | 13                     | 9.79c           |
| G3A1      | 145.13bc     | 13          | 5.7        | 56                             | 21                   | 17                     | 8.58bc          |
| G1A2      | 116.67a      | 12          | 4.8        | 28                             | 10                   | 8                      | 10.09ab         |
| G2A2      | 103.13ab     | 11          | 5.2        | 33                             | 14                   | 5                      | 10.67bc         |
| G3A2      | 136.37bc     | 13          | 6.3        | 35                             | 22                   | 18                     | 9.55bc          |
| G1A3      | 111.70a      | 12          | 4.9        | 34                             | 16                   | 10                     | 8.11a           |
| G2A3      | 151.23bc     | 13          | 7.1        | 55                             | 25                   | 7                      | 8.52bc          |
| G3A3      | 128.43bc     | 12          | 4.9        | 40                             | 18                   | 10                     | 9.89bc          |

Information: The numbers that are followed by the same letter are not different at $\alpha = 0.05$. coconut husk ash fertilizer and GA3 G1A0: 0 ppm and 0.00 g/kg, G2A0: 150 ppm and 0.00 g/kg, G3A0: 300 ppm and 0.00 g/kg, G1A1: 0 ppm and 0.75 g/kg, G2A1: 150 ppm and 0.75 g/kg, G3A1: 300 ppm and 0.75 g/kg, G1A2: 0 ppm and 1.50 g/kg, G2A2: 150 ppm and 1.50 g/kg, G3A2: 300 ppm and 1.50 g/kg, G1A3: 0 ppm and 1.50 g/kg, G2A3: 150 ppm and 300 g/kg, G3A3: 300 ppm and 300 g/kg.

The contribution of K and GA3 elements in increasing the formation of carbohydrates through the process of photosynthesis. The reduced rate of photosynthesis causes CO2 to be released, more CO2 bound in respiration, and could not increase the weight of the cobs without cob [10]. The seed priming with gibberellin and ash fertilizer also could not increase the weight of the cob. Crop yields are strongly influenced by genetic traits and their ability to interact with different growing environments.

The treatment of gibberellins (GA$_3$) and coconut coir ash fertilizer could increase the productivity of local Bimapulut corn in the G3A1 treatment. (GA$_3$) is produced by the embryo, which stimulates cells in the aleurone layer to synthesize and produce the enzyme -amylase, which converts starch in the endosperm into sugar for the growth of young seeds[6]. Priming can increase photosynthetic activity per unit leaf area, facilitating dry weight production and yield in some plants [14].

3.2.3. Amylose content. The results of the f test showed that the treatment of coconut coir ash and gibberellins (GA$_3$) was able to reduce the amylose content of local rice maize seeds. The amylose content in the seeds of local maize pulutBima was 8.09-12.26%. The amylose composition of corn starch is genetically controlled [15].

4. Conclusions
The mix of the gibberelin seed priming and coconut coir ash fertilizer can increase the growth of local rice maize with variable plant height. Still, it cannot increase the number of leaves, the number of cobs
planted, the length of the cob, the number of seeds per cob, and the cob’s weight with and without cob. The mix of the gibberellin seed priming and coconut coir ash fertilizer can also increase the accumulation of carbohydrates with a variable amylose content and reduce amylose levels in the seeds with G1A3 treatment, which is 8.11%. The increase in coco ash fertilizer causes the amylose content in the sources to decrease. Moreover, it can increase Bima local pulut corn without cob with G3A1 treatment, 2485.36 kg/ha. The increase in gibberellins (GA3) led to the rise in quantity to the productivity of local Bima maize without cob.

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