Growth and Yield Response of Arumba (Zea mays L. Ceratina) Glutinous Corn Varieties Toward Ameliorants and Growth Regulators on Peatland

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Abstract

Planting glutinous corn on peatland must be treated using ameliorant ingredients of manure fermented with EM4 and growth regulators. Ameliorated peatland can accelerate the supply of organic and mineral compounds which is easily absorbed by plants so that production can be optimized. This study aims to see the response of ameliorant ingredients and growth regulators on the growth and production of glutinous corn of Arumba (Zea mays L. Ceratina) variety on peatland. This study used a randomized block design (RAK) in factorial consisting of two factors, and three replications. The first factor was the ameliorant material (A), namely A0 = without ameliorant (control), A1 = cow manure fermented with EM4, A2 = chicken manure fermented with EM4, A3 = goat manure fermented with EM4 and he second factor is the type of Growth Regulatory Substance (ZPT), namely Z0 = without ZPT (control), Z1 = Superior Plant Hormone Growth Regulator (Ghost), Z2 = Harmonic Growth Regulatory Substance, Z3 = Atonic Growth Regulator Substance. The variables observed included plant height (cm), stem diameter (cm), weight of wet bean (g), weight of ear (g), length of ear (cm) diameter of ear (cm). The results showed that the ameliorant material from chicken manure fermented with EM4 and the use of superior plant hormone growth regulators (phantoms) provide optimal growth and production of glutinous corn because it corresponds to the description of glutinous corn of the Arumba variety, and is the best treatment.

Keywords : amelioration, glutinous corn, growth regulator, peatland

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1. Introduction

Glutinous corn (Zea mays L. Ceratina) is a local variety of corn with an attractive appearance because it is purple, white or a mixture of both, has almost 100% amylopectin starch content, sweet and fluffier taste. The purple color of the seeds is caused by the high content of anthocyanins which act as antioxidants [1]. Glutinous corn has an early maturity of about 59-60 days, has a small cob size so the yield potential is low [2], especially if it is planted on peatland without treatment.

Planting glutinous corn on peatland must be treated using ameliorant material because the main compounds in peat soil are usually hemicellulose, cellulose, and lignin which are still in the bound form not yet available for plants. The low productivity of peat soils is caused by the high content of organic acids and soil acidity. The application of ameliorant manure can increase the productivity of peat soil [3]. It is hoped that the ameliorated peatland is able to accelerate the supply of organic and mineral compounds that are easily absorbed by plants so that production can be optimal [4].

Peatland is ameliorated by loosening it and adding it evenly with manure fermented with Agricultural Effective Microorganisms (EM4), as a bioactivator. Manure will naturally decompose into manure which is ready to use [5]. Agricultural EM4 is a mixed culture of fermented and synthetic microorganisms consisting of lactic acid bacteria (Lactobacillus sp), photosynthetic bacteria Rhodopseudomonas sp, Actinomycetes sp, Streptomyces sp and Yeast (yeast) and cellulose decomposing fungi, to ferment soil organic matter into easy organic compounds. Absorbed by plant roots. The benefits of EM4 agriculture can improve soil physical, chemical and biological properties, increase
crop production and maintain stable production, ferment and decompose soil organic matter quickly, provide nutrients needed by plants, increase the diversity of beneficial microbes in the soil such as nitrogen fixing bacteria and phosphate solvent [6]. Soil microorganisms play a role in increasing chemical transformation during the decomposition process, breaking down polysaccharides into carbon and water and stimulating the weathering of plant remains into smaller particles [7].

Manure can improve soil structure and increase the number of soil organisms that are useful in the process of breaking down organic matter into material available to plants. Organic compounds are formed when soil organisms mineralize organic matter, so as to optimize the availability of nutrients [8]. The ameliorant material from manure can use cow manure, goat manure, and chicken manure. The nutrient content in chicken manure is higher, namely N 1.70%, P2O5 1.90%, K2O 1.50% when compared to cow manure and goat manure which have NPK content below 1% [9].

The growth of corn plants must be stimulated by giving growth regulators (ZPT), which is an organic compound that functions to influence physiological processes in plants, because it can encourage, or qualitatively change plant growth and development. The ZPT used was Superior Plant Hormone (SPH), harmonic and atomic. Superior Plant Hormones are useful for optimizing vegetative and reproductive growth of plants [10]. ZPT SPH is made from natural plant extracts whose main content is gibberellic acid 0.210 g/l, indole acetic acid 0.130 g/l, kinetin 0.105 g/l and zeatin 0.100 g/l, also contains 17 amino acids and vitamins A, D, E and Vitamin K. The benefits of SPH ZPT are plants have good growth power, accelerate root growth, accelerate growth so that leaves become thick and wide, accelerate the release of new shoots and tillers, repair damaged soil structure, increase soil fertility, accelerate the growth process and harvest period. [11].

Harmonic Growth Regulators play a role in cell enlargement and differentiation, accelerating the flow of amino acids and nutrients throughout the plant. ZPT Harmonic contains auxin, gibberellins and cytokinins which can promote growth and elongation of plant parts (roots and stems), stimulate flowering and normalize stunted plant growth. Another advantage of giving Harmonic ZPT is that it has a larger concentration range, so that if it is given in excess it does not harm plants, is easily decomposed by nature, is safe for humans and is environmentally friendly. The recommended concentration of ZPT Harmonic for vegetable crops is 1-2 cc/liter of water [12]; [13].

Atomic growth regulators are exogenous hormones that function to help plants accelerate physiological processes and also protect plants from disease. Atomic belongs to the auxin group which contains the active ingre-
the treatment of ameliorant material, growth regulators and their interactions had a significant and very significant effect on all observed variables, with a coefficient of variation of less than 10%.

Table 1. The results of the analysis of the diversity of responses of the growth and production of arumb glutinous corn toward ameliorants material and growth regulators on peatland

| Observed Changes | Ameliorant Material | ZPT | Interaction | KK |
|------------------|---------------------|-----|-------------|----|
| 1. Plant Height (cm) | ** | ** | ** | 6.9 |
| 2. Rod diameter (cm) | ** | ** | ** | 5.21 |
| 3. Wet weight (g) | ** | ** | ** | 5.58 |
| 4. Cop weight (g) | ** | ** | ** | 2.52 |
| 5. Cop diameter (cm) | ** | ** | ** | 5.33 |
| 6. Cop length (cm) | ** | ** | ** | 3.53 |
| 7. Weight of 100 grains (g) | ** | ** | * | 3.36 |

Note: * = significant ** = most significant CoD KK = coefficient of diversity

Table 2. Respond of observed changes toward ameliorant material

| Ameliorant Material | Control | Cow manure + EM4 | Chicken manure + EM4 | Goat manure + EM4 |
|---------------------|---------|-----------------|----------------------|------------------|
| Observed Changes    |         |                 |                      |                  |
| Plant height (cm)   | 173.92 a | 207.04 c | 210.56 d | 206.15 bc |
| Rod diameter (cm)   | 0.74 a  | 1.13 c  | 1.18 c  | 1.08 bc  |
| Wet weight (g)      | 429.67 a | 519.26 b | 545.72 d | 536.96 cd |
| Cop weight (g)      | 125.81 a | 193.26 b | 198.08 cd | 200.18 d |
| Cop diameter (cm)   | 3.12 a  | 4.34 c  | 4.35 c  | 4.22 b  |
| Cop length (cm)     | 11.54 a | 15.69 b | 16.67 c | 16.59 c |
| Eight of 100 grains (g) | 24.97 a | 31.15 bc | 31.81 c | 30.59 b |

Note: notation at each the same line show the not significant different

Table 3. Respond of observed changes toward growth regulator material

| Growth regulator material (ZPT) | Control | Superior Hormonal Plant | Harmonics | Atonic |
|---------------------------------|---------|-------------------------|-----------|--------|
| Observed Changes                |         |                         |           |        |
| Plant height (cm)               | 188.08 a| 209.25 d                | 205.36 c  | 200.92 b|
| Rod diameter (cm)               | 0.79 a  | 1.21 b                  | 1.16 b    | 1.11 b |
| Wet weight (g)                  | 462.45 a| 549.25 d                | 537.42 c  | 512.01 b|
| Cop weight (g)                  | 168.95 a| 190.86 d                | 186.13 c  | 178.19 b|
| Cop diameter (cm)               | 3.78 a  | 4.34 d                  | 4.11 c    | 3.90 b |
| Cop length (cm)                 | 12.64 a | 17.36 d                 | 16.54 c   | 15.37  |
| Eight of 100 grains (g)         | 26.61 a | 32.64 c                 | 30.56 b   | 29.64 b|

Note: notation at each the same line show the not significant different
Interaction between ameliorant material in chicken manure fermented with EM4 and ghost ZPT resulted in the best growth and production, and was not significantly different from the ameliorant treatment for chicken manure fermented with EM4 with harmonic PGR.

Soil analysis in this study (based on the criteria of \[15\]: pH H2O=4.50 (very acidic), cation exchange capacity 25.67 cmol(+)/kg (height), C-organic 9.06% (very high), C/N ratio 24.66 (high), N-total 0.38% (medium), and P Bray 453.60 mg/kg (very high), Ca-dd exchanged base 6.52 cmol(+) kg(-1) (very high), Mg-dd 0.37 cmol(+) kg(-1) (very low), K-dd 0.57 cmol(+) kg(-1) (moderate), Nadd 0.84 cmol(+) kg(-1) (high), with 32.09% Base Saturation (low).

Table 4. Interaction between ameliorant material and Growth Plant Regulator on observed changes

| Observed Chnge | Plant height (cm) | Rob diameter (cm) | Cop weight (g) | Observed Chnge | Plant height (cm) | Rob diameter (cm) | Cop weight (g) |
|---------------|------------------|------------------|--------------|---------------|------------------|------------------|--------------|
| P0Z0          | 168.44 a         | 0.62 a           | 112.78 a     | 2.82 a        | 8.78 a           | 21.56 a          | 349.78 a     |
| P0Z1          | 186.89 b         | 0.85 b           | 141.44 c     | 3.47 b        | 14.10            | 27.78 bc         | 482.22 bc    |
| P0Z2          | 178.44 ab        | 0.82 b           | 136.21 c     | 3.27 b        | 13.23 b          | 25.67 bc         | 482.11 bc    |
| P0Z3          | 166.44 a         | 0.75 ab          | 123.21 b     | 3.07 ab       | 11.74 b          | 25.56 b          | 457.00 b     |
| P1Z0          | 194.44 b         | 0.83 b           | 182.78 d     | 4.05 b        | 12.11 b          | 29.33 cd         | 480.11 bc    |
| P1Z1          | 214.89 c         | 1.33cd           | 205.44 g     | 4.67 d        | 18.22 de         | 32.67 de         | 557.11 e     |
| P1Z2          | 213.56 c         | 1.27 cd          | 201.44 g     | 4.48 d        | 17.72 de         | 32.00 de         | 539.00 de    |
| P1Z3          | 211.78 c         | 1.23 cd          | 191.56 e     | 4.30 cd       | 16.73 d          | 31.44 d          | 520.56 d     |
| P2Z0          | 198.56 b         | 0.90 b           | 185.78 de    | 4.15 c        | 15.22 cd         | 29.00 cd         | 514.00 cd    |
| P2Z1          | 218.89 c         | 1.37 d           | 208.67 g     | 4.73 d        | 18.88 e          | 35.55 e          | 581.55 f     |
| P2Z2          | 216.78 c         | 1.33 cd          | 202.44 g     | 4.56 d        | 17.79 de         | 32.33 de         | 569.89 e     |
| P2Z3          | 214.22 c         | 1.27 cd          | 199.78 f     | 4.17 cf       | 15.90 cd         | 30.89 d          | 541.60 de    |
| P3Z0          | 190.89 b         | 0.80 b           | 194.44 ef    | 4.08 c        | 14.44 c          | 26.55 bc         | 505.89 cd    |
| P3Z1          | 216.33 c         | 1.27cd           | 207.89 g     | 4.50 d        | 18.22 de         | 34.55 e          | 576.11 e     |
| P3Z2          | 212.67 c         | 1.23 cd          | 204.44 g     | 4.13 c        | 17.40 de         | 32.22de          | 558.67 e     |
| P3Z3          | 211.22 c         | 1.17 c           | 198.22 ef    | 4.07 c        | 17.11 d          | 30.67 d          | 528.89 de    |

The Note: notation at each the same line show the not significant different

The land in this study has low soil fertility, because the pH value is classified as acidic, so that the availability of bound nutrients is not yet available for plants. This peaty soil must be improved using ameliorant material from manure fermented with EM4 as a bioactivator and growth regulator.

The growth of maize plants such as plant height, stem diameter, and wet-potato weight was very significantly different between maize plants grown on peatland treated with ameliorant manure fermented with EM4 and growth regulators, compared to control treatments without ameliorant and without ameliorant. Growth regulator. Ameliorant material from cow manure, chicken manure, and goat manure gave an insignificant difference in maize growth, but the best manure as an ameliorant on peatsoil was chicken manure. The treatment of growth regulators between superior plant hormones (phantom), harmonics and atomic gave no significant difference in maize plant growth results, but the best growth regulators were superior plant hormones (phantoms).

These data show the importance of providing ameliorant and PGR in peatland management. The application of ameliorant chicken manure can increase the productivity of peat soil, improve the root environment and stimulate plant growth [16];[17], and can increase the pH value of peat soil by 0.6 [3]. This makes the soil loose so that plant roots develop more and affect the absorption of nutrients, especially N which is good for increasing the height of glutinous corn plants [18]. The control plants showed stunted growth, namely symptoms of nitrogen and phosphorus deficiency which were marked by yellowish leaf color and purplish leaf veins.

Ameliorant from chicken manure can increase soil P availability through decomposition which produces organic acids in the soil. The acid produces ions that can break the bonds between P and the elements Al, Fe and Mn so that P becomes available. Weathering of organic matter will produce humic acid, vulvic acid, and other organic acids. The acid can bind to metals such as Al and Fe so that P binding is reduced, P is more available, and can reduce soil acidity [19].

The main function of phosphorus in corn plants is as an energy source for the process of photosynthesis, energy transfer in the form of ADP and ATP in the plant body associated with the metabolism of amino acids or proteins, sugars, fats, cellulose, flour and other organic acids. Corn plants absorb relatively little P than the absorption of N.
and K nutrients. Potassium plays a very important role in increasing plant diameter, especially in its role as a network that connects roots and leaves in the transpiration process [18].

The pattern of P accumulation in corn plants was almost the same as that of nutrient N accumulation. In the early phase of growth, P accumulation was relatively slow, but after 4 weeks of age it increased rapidly. P nutrient plays an important role in plant weight. The availability of sufficient P for plants will affect the dry weight of the plant. The higher the availability of P for plants, the better energy transfer and plant metabolism, the higher the dry weight of the plants produced [20].

Manure that has been completely decomposed, has the availability of nutrients that are more quickly absorbed by plant roots, producing humus that is able to form media aggregations that ensure good air and water management so that the activity of organisms in the media takes place properly. This is what can increase the availability of nutrients N and P for plants. The availability of nutrients in the media causes plant growth to run well [21].

The use of organic chicken manure has several advantages, including as a supply of soil nutrients and increasing water retention [22], so that it can increase the growth and fresh weight of plant stoves [23].

The use of the right planting media can provide optimal environmental conditions for plant growth. A good medium is well aerated and free of pests and diseases, contains sufficient organic matter and is able to hold high water, so that the water needed during initial growth is always met [10].

Superior plant hormone growth regulators (phantoms) gave the best growth results compared to harmonic and atonic PGR. This is because the ZPT of superior plant hormones is more complete, in addition to containing elements of organic growth regulators, it also contains fertilizers. The ghost ZPT elements consist of Auxin, Gibberellin, Kinetin, Zeatin and Cytokinin which are formulated from natural ingredients, with levels of GA3-98, 37 ppm, GA5-107, 13 ppm, GA7-131, 46 ppm, Auxin (IAA) -156, 135 ppm and Cytokinins, Kinetin 128, 04 ppm and Zeatin 106, 45 ppm. Fertilizer content levels: N-63, P-14, Na, Mg, Cu, Fe, Mn, Zn, Co, Cd, Pb [10], so as to reduce the use of inorganic fertilizers. The effectiveness of PGR will give good results if it is given at the right growth phase and at the right concentration. Giving ZPT causes plants to enter the generative phase more quickly and have a shorter harvest life [24].

Corn production, such as cob weight, cob diameter, cob length and weight of 100 grains of corn, were significantly different between maize grown on peatland treated with manure amelioration agent fermented with EM4 and growth regulators, compared to control treatment without ameliorant and without growth regulators. The best treatment was the use of ameliorant material in chicken manure which was fermented using EM4 and growth regulators for superior plant hormones (phantoms).

Provision of chicken manure as organic fertilizer plays an active role in increasing the N content in the soil so that the amount of N produced from the decomposition and mineralization of chicken manure is able to meet the N needs of plants. The better the vegetative growth of corn plants, the photosynthesis process will run well so that more photosynthate is produced. The results of photosynthesis from the vegetative phase to the generative phase will be stored as food reserves in the form of carbohydrates in the form of seeds [25].

Amelioration of chicken manure ingredients also plays a role in improving the physical, chemical and biological properties of the soil so that it makes the soil more friable, air can enter the soil, can hold water and nutrients from being washed away and increase the activity of microorganisms [26]. Chicken manure contains 1.70% N, 1.90% P2O5, 1.50% K2O and various micro nutrients. With such nutrient content, chicken manure is classified as having a high nutrient content of N, P and K so that it can be absorbed by plants in sufficient quantities. According to [27] that the element N contained in chicken manure after being absorbed by plants is a constituent of organic matter both in the leaves and in the seeds so that the application of fertilizer containing N to plants will increase the dry weight of the seeds. Apart from the N element, chicken manure also contains quite high P, where P is an important factor in flower growth, filling seeds and making seeds more pithy, so that with high P administration tends to increase corn yields [28].

Bacteria in chicken manure include Lactobacillus acidophilus, Lactobacillus reuteri, Leucomostoc mensen teroides and Streptococcus thermophilus, some actinomycetes and molds are present [29], and microbial culture derived from EM4 can decompose compounds on peatland into NP and K elements, which is more available to plants. The element of nitrogen resulted in an increase in the length of the cob and the diameter of the corn cob so that the weight of the cob increased. Organic acids produced by phosphate solubilizing microbes are able to increase the solubility of unavailable P into available P in the soil, so that the absorption of P by plants will also increase. The availability and absorption of P elements causes more photosynthate allocated to the cobs so that the fruit size becomes larger. Plant metabolism will also be more active so that the process of cell elongation, division and differentiation will be better so that an increase in fruit weight, length and diameter will occur. Element P plays a role in generative growth, especially the formation of cobs [30].

Availability of nutrients can not be separated from the process of filling the seeds. Nutrients that are absorbed will be accumulated in the leaves into proteins that form seeds. The accumulation of metabolic products in the formation of seeds will increase, so that the seeds formed...
have a maximum size and weight, this happens when the nutrient needs are met which causes metabolism to run optimally. The formation of cobs requires macro nutrients, namely P and K elements in optimum amounts.

4. Conclusion

Peaty soil can still provide optimal growth and production of glutinous corn plants, through the amelioration process with manure fermented with EM4 and the use of growth regulators. The best amelioration material uses chicken manure fermented with EM4 and the best growth regulators are superior plant hormones (ghost). The growth and production of glutinous corn on peat soil through the amelioration process and the use of growth regulators have met the description of glutinous corn of the Arumba variety.

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