



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 the 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 applica-

tion 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 *Rhodospseudomonas* 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 inorganic 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 atonic. 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].

Atonic growth regulators are exogenous hormones that function to help plants accelerate physiological processes and also protect plants from disease. Atonic belongs to the auxin group which contains the active ingre-

dients sodium othronitrophenol, sodium para-nitrophenol, sodium 2-4 dinitrophenol, and sodium 5 nitroguaiacol. These compounds are very effective in regulating root growth. Atonic growth regulators with a concentration of 0.50 cc/l can increase productivity [14]. The purpose of this study was to examine the response of ameliorant and growth regulators to the growth and production of Varietas Arumba (*Zea mays* L. Ceratina) glutinous corn on peatland.

2. Materials and Methods

The research was carried out in Pangkalan Balai Village, Banyuasin III District, Banyuasin Regency at an altitude of ±49-60 meters above sea level, on peatland with sapric maturity level with a depth of 30 cm. This study used a factorial randomized block design with three replications. The first factor was 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 the type of substance Growth Regulators (ZPT), namely: Z0 = without ZPT (control), Z1 = Superior Plant Hormone Growth Regulators (Ghosts), Z2 = Harmonic Growth Regulators, Z3 = Atonic Growth Regulators.

The technical work is as follows: The research area is cleaned of weeds and dirt, then hoed with a depth of approximately 30 cm mixed evenly with manure (~ 30 tons/ha), then watered evenly with a fermentation solution (1 EM4 : 1 molasses : 100 water), then the land is covered with plastic mulch, and left to ferment for 7 days. Then the land is leveled and made mounds measuring 780 x 50 x 30 cm, as many as 12 mounds. An experimental plot measuring 4 X 4 cm was made with a distance between groups of 100 cm and a distance between treatments of 60 cm

Corn seeds were soaked in each solution of Harmonic and Atonic growth regulators at a dose of 1cc/liter for 10 minutes, then planted in a vertical manner with a depth of 3 cm, 3 seeds were planted in each hole with a spacing of 50 X 50 cm. Each treatment planted 3 corn trees. The next ZPT spraying was carried out three times, namely in the second week, the fourth week after planting, and at the time of fruiting, for plants without treatment, they were only watered with water. Thinning is done 2 weeks after planting by leaving one plant that is growing well. Hoarding is done when the plant is 2 weeks after planting and the next is done when the plant is 5 weeks after planting. The variables observed were plant height (cm), stem diameter (cm), weight of wet pods (g), cob weight (g) ear diameter (cm), ear length (cm), and weight of 100 grains (g).

3. Results and Discussion

The results of the analysis of diversity showed that

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 arumba glutinous corn toward ameliorants material and growth regulators on peatland

Observed Chabges	AmelioranMaterial	ZPT	Interaction	KK
1. Plant Height (cm)	**	**	**	6.9
2. Rod diamteter (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 100grains (g)	**	**	*	3.36

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

Table 2.Respond of observed changes toward ameliorant material

Amelioran Material	Control	Cow manure +EM4	Chicken manure + EM4	Goat manure + EM4
Observed Chnges				
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 Chnges				
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⁻¹ (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⁻¹ (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), Na-dd 0.84 cmol(+) kg⁻¹ (high), with 32.09% Base Saturation (low).

and atonic 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

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

Observed Chnge	Plant height (cm)	Rob diame-ter (cm)	Cop weight (g)	Observed Chnge	Plant height (cm)	Rob diame-ter (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 b	482.11 bc
P0Z3	166.44 a	0.75 ab	123.21 b	3.07ab	11.74 b	25.56 b	457.00 b
P1Z0	194.44 b	0.83 b	182.78 d	4.05 c	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 abnormal 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 achidophilus*, *Lactobacillus reuteri*, *Leuconostoc mensesenteroides* 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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