

# Response of 25 Hybrid Maize Against Salinity Stress and Their Performance in Coastal Area

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**ABSTRACT :** Plant stress due to NaCl compound will have an impact on the reduction of plant growth and yield. Tolerant varieties are required to increase plant production in coastal areas since these areas are closely related to salinity. This study aimed to (1) determine the appropriate NaCl concentration for saline tolerance in maize stress selection, (2) determine the response of maize plant to salinity stress in nutrient culture, and (3) determine the response of new hybrid maize having adaptability in coastal area. Two experiments were run from November 2017 until May 2018. The first experiment was conducted in greenhouse at Laboratory of Agronomy, Faculty of Agriculture University of Bengkulu to determine the tolerance response of 25 new hybrid maize to salinity in nutrient culture. The second experiment was conducted on coastal area in Beringin Raya Village, Muarabangkahulu District, Bengkulu City to determine the response of new hybrid maize having adaptability in coastal area. The concentration of NaCl at which level the  $LC_{50}$  was determined was found to be in 150 mM. This concentration was then used to test the tolerance of 25 new hybrid maize to NaCl stress. The hybrids of CT18, CT19, CT22, CT25, CT31, CT33, CT34, CT40, CT47, and CT50 showed good responses to the concentration treatment of 150 mM NaCl based on plant fresh weight and shoot dry weight. The hybrids of CT17, CT19, and CT20 showed good adaptability on coastal area based on the length of cob, diameter of cob, seed weight per cob, and cob weight per plant. Among those three hybrids, CT17 and CT20 resulted low fresh weight and low shoot dry weight. The factors other than NaCl in coastal area maybe affect better response. However, CT19 proved as a hybrid which was consistently in a good response to salinity stress both in nutrient culture and in coastal growing area.

**Keywords:** coastal, hybrid maize, NaCl stress, nutrient culture

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## INTRODUCTION

Maize (*Zea mays* L.) is a very important food crop because until now corn is a food substitute for rice for some Indonesian residents. Maize is classified as a plant species that has a very large genetic diversity and is able to produce new genotypes that can adapt to varied environments. Besides being used as food in line with the increase in science and technological advancements that corn plants are currently also being developed as energy producers, corn is one of the plants that produce bioethanol in quite large amounts (Dachlan *et al.*, 2013). The area of maize plantations

ranks second after rice when compared to other commodities. Based on data from the Central Statistics Agency (2019) corn imports in 2018 amounted to 73,722,813 tons while corn imports in 2017 amounted to 51,749,614 tons. It is estimated that corn imports will always increase with the addition of the population if not balanced with a real increase in national production.

The expansion of the planting area is an effort to increase national corn production. The land available for agriculture is mostly tidal areas (Sholihah and Saputro, 2016). Tidal land which is a land located in a coastal area. Coastal areas are areas that are very

vulnerable to various conditions that can cause plant poisoning (Suwignyo *et al.*, 2010). Coastal areas generally have sand textured so that the ability to retain water and nutrient absorption is very low and is influenced by salinity caused by sea water which can inhibit plant growth.

Salinity is a limitation of the increase in crop production because it can cause a decrease in crop yield caused by inhibition of absorption of nutrients and water by plants (Rosmayati *et al.*, 2015). This situation causes the plant to become abnormal and a decrease in yield. Salinity is defined as the presence of dissolved salts in excessive concentrations in soil solutions. According to Follett *et al.*, (1981) states that the effect of salinity on plants with 1:1 extraction levels of 0-0.45 dSm<sup>-1</sup> (non-saline) can be neglected, 0.45-1.5 dSm<sup>-1</sup> (low salinity) sensitive plants disturbed, 1.51-2.9 dSm<sup>-1</sup> (moderate salinity) most plants are disturbed, 2.91-8.5 dSm<sup>-1</sup> (high salinity) only undisturbed tolerant plants and <8.5 dSm<sup>-1</sup> (very high salinity) only a few types of tolerant plants can grow.

Coastal land (coastal sand) is a marginal land with low water and nutrient storage capacity and sufficiently acidic pH, causing poor plant growth due to disruption of N and Ca nutrient uptake and high Al, Fe, and Mn dissolution so as to poison plants and reduced availability of Mo, P and K. High salt solubility can inhibit water and nutrient uptake by plants as osmotic pressure increases (Tatipata and Jacob, 2013).

Corn is a plant that is sensitive to salinity, the salinity tolerant genotype is not currently available on the market. New salt-tolerant cultivars can be obtained through assembly of varieties.

New hybrids that have been assembled by Bengkulu University breeders from local elders have the potential to be adaptive to salinity because they are assembled from elders resulting from local mutations and Bengkulu strains. The new hybrid selection for salinity can be carried out by nutrient culture methods and in the field. This study aims to (1) determine the appropriate NaCl concentration for maize selection against salinity tolerance, (2) determine the response of new hybrid maize to salinity stress through haradan culture (3) determine the response of new hybrid maize that is adaptive to coastal land.

## MATERIALS AND METHODS

This research was conducted in November 2017 to May 2018 in the Greenhouse of Laboratory of Agronomy, Faculty of Agriculture, University of Bengkulu and on the coastal land in Beringin Raya Village, Muarabangkahulu District, Bengkulu City.

### Research design

#### 1. The response of new hybrid maize to salinity through nutrient culture

- a. Determination of the level of NaCl concentration

Selection is set at a 50% endurance level (LC50). This experiment was carried out using a Completely Randomized Design (CRD) with one factor namely NaCl concentration consisting of 9 levels namely, 0 (without NaCl), 60 mM, 120 mM, 180 mM, 240 mM, 300 mM, 360 mM, 420 mM and 480 mM. The plant used was BISI 18 which was a drought tolerant criterion and one of the maize hybrids

selected from several hybrids to be tested was CT 39. This experiment used the AB mix hydroponic nutrient solution.

b. Response of 25 new hybrid corns through nutrient culture

This experiment uses a completely randomized design with one factor consisting of 25 new hybrid corns namely CT16, CT17, CT18, CT19, CT20, CT21, CT22, CT23, CT24, CT25, CT29, CT31, CT32, CT33, CT34, CT39, CT40, CT41, CT42, CT46, CT47, CT48, CT49, CT50 and CT51. Each experimental unit consisted of 3 plants. The concentration of NaCl solution used is LC50 based on the results of the experiment.

**2. Response of 25 new hybrid corns to coastal land**

The experiment was arranged with a Complete Randomized Block Design (RCBD). The treatment consisted of 25 new hybrid maize as mentioned in 3.2.1.b and a commercial hybrid, Bisi 18. Corn was planted in rows along 5 m with 80 cm spacing between rows and 20 cm spacing in rows. So we get 25 plants per unit experiment. Each treatment was repeated 3 times. Observations were made on 5 sample

plants that were randomly selected.

**Research Stages**

**1. The response of new hybrid maize to salinity through nutrient culture**

a. Determination of the level of NaCl concentration

The stages of this research began with the preparation of a plastic tub that will be used as a planting medium. Plastic baskets measuring 20cm x 30cm x 10cm are given a hole in the bottom that will be given an axis as a link between the tub containing nutrient solution and the tub containing sand as a planting medium. Sand that will be used as a planting medium is washed first and then put into a tub. Seed is germinated in a plastic tub that has been filled with sand media. For the preparation of the concentration series NaCl preparations were made in advance of 2000 mM NaCl stock. From this stock the series of treatment concentrations is made as shown in Table 1.

The hybrid test determining LC50 concentration used is Bisi 18 and CT 39. The test is carried out for 4 weeks or until the most sensitive plants have died.

Table 1. Concentrations of NaCl treatment

Treatment Concentration (mM)	Stock of AB Mix Solution (ml)		Stock NaCl 2000 mM (ml)	Water (ml)
	A	B		
0	5	5	0	990
60	5	5	30	960
120	5	5	60	930
180	5	5	90	900
240	5	5	120	870
300	5	5	150	840
360	5	5	210	810
420	5	5	210	780
480	5	5	240	750

The observation variable in the experiment was the determination of

the level of NaCl concentration for the response of the new hybrid maize

namely the plant fresh weight and canopy dry weight.

Data obtained from observations made graphs then determined the concentration of 50% pressure. Based on the graph obtained from these data, LC50 is determined. Based on Hoque *et al.*, (2015) the main reference is on the canopy dry weight variable.

#### b. Response of 25 new hybrid corns through nutrient culture

The response of 25 new hybrid maize was carried out at the NaCl concentration results of experiment a with the same nutrient culture method. Observation variables for the response of 25 new hybrid corns were: plant height, number of leaves, root length, crown fresh weight, root fresh weight, crown dry weight and root dry weight. The observations of each variable were analyzed using analysis of variance with a F test of 5% level, if it was significantly different it would be continued by Scott and Knott's further tests. Based on Hoque *et al.*, (2015) the main reference is on the dry weight variable.

## 2. Response of 25 new hybrid corns to coastal land

The study began with preparing the land by removing weeds and plant residues manually. Conducting soil treatment by hoeing and making 3 plots of experimental plots with a distance between 1 m repetitions.

Planting is done by inserting 1 corn seed into each planting hole with a distance between planting holes 80 cm x 20 cm. Each planting hole is given 5-10 grains of Carbofuran 3% to prevent interference from insects. Maintenance in this study includes watering, replanting, fertilizing, growing, controlling weeds and pest. Watering is

done every morning and evening if the soil is dry or not rainy. Replanting is done at the age of the plant 1 week after planting (MST) which is done on plants that do not grow or die. Fertilizer was barried in a hole about 10 cm apart from the plant with a dose of Urea fertilizer 150 kg/ha, SP36 200 kg/ha, and KCl 100 kg/ha. The second fertilization is done after the plants are 4 weeks after planting by giving 150 kg/ha of urea fertilizer.

Soil planting is done when the plant is 4 MST at the same time as the second fertilization. Weed control is done if weeds start to grow at intervals of once a week starting from 1 MST by pulling or mechanically. Control of pests and diseases is done manually, mechanically and with pesticides when symptoms of an attack appear and in accordance with the symptoms of an attack that occurs.

Harvesting is done when the corn seeds are physiologically ripe. Harvest criteria such as corncoobs are dry and there is a black layer at the end of the seeds. Corn kernels are pithy, shiny and if pressed with hand nails do not show pressure marks or not break. Observation variables at the selection stage of new hybrid corn fields that were tolerant of salinity, namely: plant height, stem diameter, ear length, ear diameter, seed weight per ear and ear weight per ear per plant. The data obtained were analyzed statistically using analysis of variance with a F test of 5% level, if there were significant differences in the treatments tested then the data was carried out further tests Scott and Knott using InfoStat software.

## RESULTS AND DISCUSSION

### 1. The response of new hybrid maize to salinity through nutrient culture

#### a). Determination of NaCl

##### Concentration

Determination of 50% stress concentration of NaCl was carried out by nutrient culture experiments at several concentrations. Trial determination of NaCl concentration was carried out for 4 weeks. The results of tests carried out showed the plant was unable to grow at the age of 3 weeks after planting at a NaCl concentration starting at 300 mM (Table 2). This shows that the higher the concentration of NaCl, the more it will

suppress the rate of plant growth. Saline stress affects plant growth because it can reduce the potential of groundwater which can cause plants poisoning  $\text{Na}^+$  and  $\text{Cl}^-$  (Tavakkoli *et al.*, 2011).

The concentration of 480 mM NaCl hybrid CT 39 no growth due to very high concentrations, while the Bisi 18 hybrid the higher the concentration of NaCl given, the lower the fresh weight value of plants (Table 3). Plant growth is inhibited due to the difficulty of the roots absorb water and nutrients that are influenced by Na and Cl ions so that it inhibits cell division and plant growth becomes stunted.

Table 2. The average plant growth of 3 replications at each NaCl concentration

Genotype	Concentration NaCl (mM)	Number of plants growing				Percent of plants grow			
		M1	M2	M3	M4	M1	M2	M3	M4
Bisi 18	0	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
Bisi 18	60	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
Bisi 18	120	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
Bisi 18	180	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
Bisi 18	240	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
Bisi 18	300	3.0	3.0	0.0	0.0	100.0	100.0	0.0	0.0
Bisi 18	360	3.0	3.0	0.0	0.0	100.0	100.0	0.0	0.0
Bisi 18	420	3.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Bisi 18	480	2.0	0.0	0.0	0.0	66.7	0.0	0.0	0.0
CT 39	0	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
CT 39	60	3.0	3.0	2.0	3.0	100.0	100.0	66.7	100.0
CT 39	120	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
CT 39	180	3.0	3.0	2.0	2.0	100.0	100.0	66.7	66.7
CT 39	240	3.0	3.0	3.0	3.0	100.0	100.0	100.0	100.0
CT 39	300	2.0	3.0	0.0	0.0	66.7	100.0	0.0	0.0
CT 39	360	2.0	3.0	0.0	0.0	66.7	100.0	0.0	0.0
CT 39	420	1.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0
CT 39	480	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3. Fresh plant weights and shoot dry weight in two four-week-old hybrids

Concentration NaCl (mM)	Bisi 18		CT 39	
	Fresh plant weights (g)	shoot dry weight (g)	Fresh plant weights (g)	shoot dry weight (g)
0	40.09	3.18	42.57	3.52
60	35.87	3.13	22.93	2.48
120	25.19	2.28	26.21	2.86
180	19.62	1.40	9.96	1.00
240	9.18	0.86	11.42	1.30
300	0.54	0.11	0.26	0.07
360	0.40	0.09	0.15	0.00
420	0.19	0.04	0.04	0.01
480	0.11	0.03	0.00	0.00

Fresh weights of plants in Bisi 18 hybrids from the test results of some NaCl concentrations formed a quadratic graph with the equation  $y = 0,0002x^2 - 0,1866x + 43,488$  so that LC50 was obtained at 150 mM NaCl concentration. The fresh weight graph of plants on CT 39 hybrids was more decreased compared to BISI 18 hybrids (Figure 1). CT 39 hybrid on the observed variables of plant fresh weight for LC50 determination was calculated from the equation  $y = 0,0002x^2 - 0,1903x + 40,14$  so that the LC50 was at 112 mMNaCl concentration.

BISI 18 hybrid canopy dry weight four weeks after treatment with a concentration of 0 mM NaCl of 3.18 grams and the highest concentration of 480 mM NaCl of 0.03 grams, then the LC50 value is calculated from the graph with the equation  $y = 2E-05x^2 - 0,0149x + 3,5758$  so that the LC50 value is at 149 mM NaCl concentration. While the canopy dry weight on CT 39 was formed quadratic graph with the equation  $y = 1E-05x^2 - 0,0149x + 3,6223$  so that LC50 was obtained at a concentration of 138 mM NaCl (Figure 2).

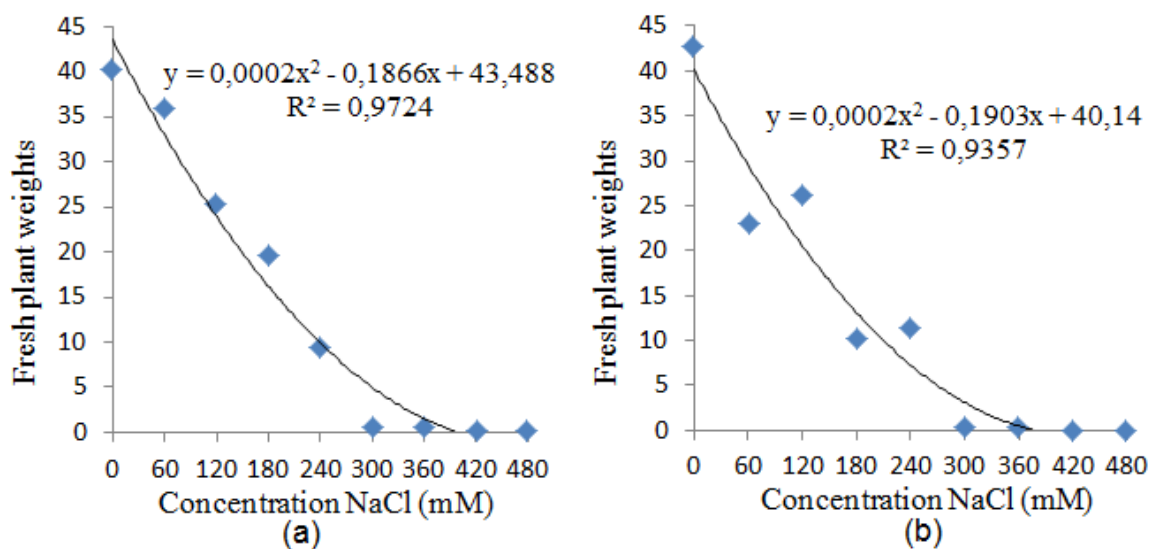


Figure 1. Graph of the relationship between plant fresh weight and NaCl concentration at (a) Bisi 18 and (b) CT 39.

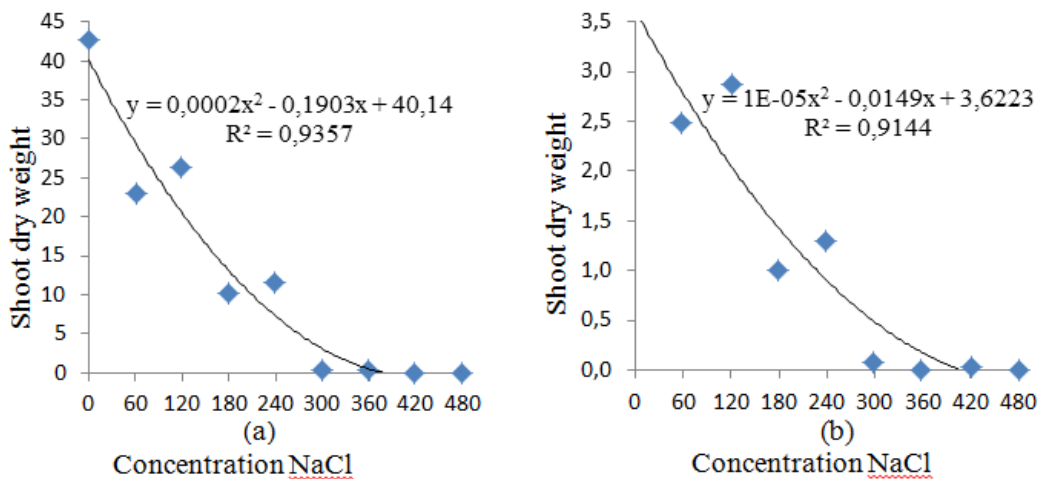


Figure 2. Graph of the relationship between shoot dry weight and NaCl concentration at (a) Bisi 18 and (b) CT 39

The response of plants to salinity can be seen decreasing in weight with the increase in concentration of NaCl (Dachlan *et al.*, 2013). High salinity can cause an unbalanced respiration process and if the respiration process is greater than photosynthesis, the plant dry weight decreases (Latuharhary and Saputro 2017).

The crop fresh weight and crown dry weight graphs for the two hybrids tested did not have significantly different decreases. The reduced fresh weight of plants caused by the stress of NaCl thus affecting the absorption of water and nutrients, the dry weight of the crown also decreases. According to Dachlan *et al.*, (2013) salt will affect the wet weight and dry weight of plants, Yustiningsih and Sila (2017) also stated that the plants given NaCl will experience a decrease in biomass. The test results of determining the concentration of NaCl stress pressure of 50% in two corn hybrids with LC50 is 150 mM nutrient culture experiments because on CT 39 hybrids have LC50 values that are not much different from BISI 18 hybrids which is 150 mM

b). Analysis of variance using nutrient culture

The results of the analysis of variance on 25 new hybrid corns on NaCl administration showed that the observed variables of plant height, canopy fresh weight and canopy dry weight significantly affected between hybrids tested and root fresh weight had a significant effect (Table 4). Plants treated with NaCl salinity stress for 30 HST with different concentrations give a response to plant growth. Variable plant height, number of leaves, canopy fresh weight, root fresh weight, canopy dry weight and root dry weight have low KK values. This shows that the maize hybrid tested had a low difference in the observed variables. The higher the value of KK, the wider the diversity of a plant's existing character. According to Effendy *et al.*, (2018) the value of the coefficient of diversity is determined in the range of 0-100%, a low (0% ≤ 25%), rather low (25% ≤ 50%), quite high (50% ≤ 75%), and high (75% ≤ 100%).

Table 4. Results of analysis of variance and KK of corn plants through nutrient culture

Variable	F Count	Coefficient of Diversity (%)
Plant length	6.08 **	20.76
Leaf number	1.39 ns	21.22
Root length <sup>T</sup>	1.51 ns	27.34
Shoot fresh weight <sup>T</sup>	2.69 **	22.25
Root fresh weight <sup>T</sup>	1.79 *	18.99
Shoot dry weight <sup>T</sup>	2.83 **	13.84
Root dry weight <sup>T</sup>	1.42 ns	9.93

Remarks: \* = Significantly influential on the test level 5%, \*\* Very significant effect on the test level 1%, ns = No significant effect on the test level 5%, T = Data is transformed with  $\sqrt{x+1}$

c). Response of 25 hybrid maize using nutrient culture.

The results of statistical analysis based on Scott and Knott's test of the resistance of corn plants to the administration of NaCl on plant height variables were tolerant plant groups namely CT 16, CT18, CT19, CT22, CT24, CT25, CT31, CT33, CT34, CT40, CT40, CT41, CT42, CT47 and CT50. CT 18 hybrid has the best response among several hybrids tested with a value of 34.53 cm, whereas CT 46 is a hybrid that is sensitive to the administration of NaCl with a value of 11.83 cm (Table 5). Decrease in plant height can be caused due to the limited availability of water and organic matter in the tissue due to the effect of salinity (Latuharhary and Saputro, 2017). Plant height is an indicator of plant growth and as a parameter used to see directly the influence of the environment or the treatment given to plants (Ekowati and Nasir, 2011). The effect of plant height is caused by the presence of osmotic stress which can make it difficult for plant roots to absorb water that is affected by the administration of NaCl (Dachlan *et al.*, 2013) and Pranasari *et al.*, (2012) stated that increasing the concentration of NaCl will cause plant

height growth to be increasingly depressed.

The highest canopy fresh weight variable of the tested hybrids was 6.02 grams, namely CT 34 hybrid. NaCl stress gave effect to the canopy fresh weight because sensitive plants had difficulty in water absorption so that plant growth was inhibited. Asih *et al.*, (2015) states that high salinity stress will reduce the division of cells in the roots. Whereas the highest fresh root weight variable was CT 50 grams but it was not significantly different from some of the hybrids tested and the lowest fresh root weight was CT 48 hybrid of 0.19 grams (Table 6). Measurement of plant biomass can be done by measuring fresh weight and dry weight, but biomass measurements more often use dry weight because the fresh weight of plants is strongly influenced by water content (Ekowati and Nasir 2011). Based on the canopy dry weight showed that there were several hybrid groups tested which were tolerant to the administration of NaCl at 150 mM concentration, namely CT16, CT17, CT18, CT19, CT22, CT25, CT31, CT33, CT34, CT40, CT40, CT47 and CT50, but the highest value the hybrids tested were 0.99 grams, namely CT 34 (Table 6).



Table 5. Average growth of maize in some of the hybrids tested

Genotype	Plant length (cm)	Leaf number	Root length (cm)
CT 16	26.43 a	2.87 a	15.1 a
CT 17	22.07 b	3.03 a	11.17 a
CT 18	34.53 a	2.93 a	16.1 a
CT 19	25.83 a	3.1 a	11.23 a
CT 20	20.53 b	2.7 a	10.1 a
CT 21	17.07 b	2.97 a	12.9 a
CT 22	29 a	3.3 a	14.23 a
CT 23	15.83 b	3.03 a	8.7 a
CT 24	31.3 a	3.27 a	10.87 a
CT 25	26.73 a	3.33 a	13.93 a
CT 29	17.73 b	3.33 a	10.43 a
CT 31	33.4 a	3.33 a	16.03 a
CT 32	14.1 b	2.37 a	7.73 a
CT 33	30.3 a	3.7 a	13.2 a
CT 34	32.3 a	3.2 a	16.87 a
CT 39	17.03 b	3.2 a	6.2 a
CT 40	33.03 a	3.13 a	13.93 a
CT 41	23.77 a	2.9 a	8.17 a
CT 42	30.17 a	3.07 a	8.63 a
CT 46	11.83 b	2.13 a	5.77 a
CT 47	29.23 a	3.53 a	15.53 a
CT 48	12.9 b	1.67 a	3.2 a
CT 49	20.37 b	3.03 a	11.03 a
CT 50	31 a	3.33 a	16.4 a
CT 51	18.47 b	3.27 a	13.1 a

Remarks: the number of each column followed by the same letter shows no significant difference in the Scott and Knott test of 5%

The results of Scott and Knott's analysis of several hybrids tested were found in hybrid groups that were tolerant of giving NaCl with a concentration of 150 mM. Based on canopy fresh weight and crown dry weight variables, namely CT18, CT19, CT22, CT25, CT31, CT33, CT34, CT40,

CT47, and CT50. However, the tolerant hybrid group showed that CT 34 was the best hybrid for NaCl salinity stress in nutrient culture based on observed variables such as root length, canopy fresh weight, canopy dry weight and root dry weight.

Table 6. Average growth biomass of maize in some hybrids

Genotype	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)
CT 16	1.98 b	1.24 a	0.41 a	0.11 a
CT 17	2.04 b	0.80 a	0.41 a	0.17 a
CT 18	3.23 a	1.25 a	0.71 a	0.12 a
CT 19	3.34 a	1.34 a	0.50 a	0.13 a
CT 20	2.35 b	0.80 a	0.36 b	0.06 a
CT 21	1.41 b	0.73 a	0.22 b	0.06 a
CT 22	2.96 a	1.93 a	0.73 a	0.14 a
CT 23	0.89 b	0.65 a	0.18 b	0.05 a
CT 24	2.77 b	1.23 a	0.48 b	0.10 a
CT 25	3.14 a	1.48 a	0.56 a	0.11 a
CT 29	1.00 b	0.96 a	0.22 b	0.10 a
CT 31	3.13 a	0.99 a	0.59 a	0.10 a
CT 32	1.67 b	0.64 a	0.31 b	0.07 a
CT 33	2.35 a	1.14 a	0.50 a	0.09 a
CT 34	6.02 a	1.94 a	0.99 a	0.19 a
CT 39	0.80 b	0.41 a	0.17 b	0.04 a
CT 40	3.44 a	1.44 a	0.70 a	0.16 a
CT 41	1.95 b	0.81 a	0.31 b	0.08 a
CT 42	1.24 b	0.64 a	0.25 b	0.05 a
CT 46	0.72 b	0.53 a	0.14 b	0.15 a
CT 47	3.87 a	1.19 a	0.68 a	0.09 a
CT 48	0.31 b	0.19 a	0.05 b	0.01 a
CT 49	1.81 b	0.80 a	0.37 b	0.09 a
CT 50	5.46 a	2.17 a	0.94 a	0.21 a
CT 51	1.58 b	1.02 a	0.29 b	0.07 a

Remarks: the number of each column followed by the same letter shows no significant difference in the Scott and Knott test of 5%

## 2. Response of 25 new hybrid corns to coastal land

Based on the results of the analysis of variance shows that hybrid maize on coastal land has a very significant effect on variable plant height, cob length, ear diameter, seed weight per cob, and weight of cob per plot (Table 7). The variables of observation both vegetative and generative growth of all KK values are included in the low category because they have a coefficient value of 0-25%. The low coefficient of diversity indicates that the variation within the genotype it self is small and it can be assumed that the genotype diversity among lines is low (Draseffi *et al.*, 2015).

Table 7. Analysis of variance and coefficient of diversity of maize on coastal land

Variable	F Count	Coefficient of Diversity (%)
Plant height	6.22 **	6.67
Stem diameter	1.56 ns	7.71
Length of cob	7.00 **	7.36
Diameter of cob	4,31 **	4.26
Seed weight per cob	4.16 **	14.07
Cob weight per plant	4.86 **	13.64

Remarks: \* = Significantly influential on the test level 5%, \*\* Very significant effect on the test level 1%, ns = No significant effect on the test level 5%.

The results of the Scott and Knott test analysis showed that the highest plant height variable was 211.0 cm, namely CT 46 and significantly different from the comparative hybrid, BISI 18 (Table 8). Plant height is a variable that is often used to see the good and bad growth of plants that are influenced by environmental factors (Ekowati and Nasir 2011).

Table 8. Average vegetative growth of new hybrid maize on coastal land

Genotype	Plant height	Stem diameter
BISI 18	168,6 c	16,7 a
CT 16	190,3 b	17,5 a
CT 17	182,9 b	15,6 a
CT 18	168,9 c	15,3 a
CT 19	183,6 b	17,2 a
CT 20	181,3 b	16,0 a
CT 21	175,9 b	18,4 a
CT 22	146,6 c	14,7 a
CT 23	151,5 c	17,0 a
CT 24	146,5 c	15,8 a
CT 25	159,7 c	15,9 a
CT 29	179,6 b	15,9 a
CT 31	176,4 b	17,3 a
CT 32	175,4 b	15,7 a
CT 33	186,4 b	16,1 a
CT 34	160,4 c	16,3 a
CT 39	161,0 c	16,2 a
CT 40	168,9 c	15,8 a
CT 41	147,9 c	16,3 a
CT 42	162,0 c	16,3 a
CT 46	211,0 a	17,5 a
CT 47	203,8 a	18,3 a
CT 48	178,2 b	17,5 a
CT 49	162,A c	16,4 a
CT 50	193,2 a	15,8 a
CT 51	180,8 b	15,8 a

Remarks: the number of each column followed by the same letter shows no significant difference in the Scott and Knott test of 5%.

High corn plants also do not determine that the plants are the best, even low plants do not indicate that the plants are not good. Low plants have the advantage of being resistant to lodging. A good plant height must also be supported by a large stem diameter in order to streng then the upright of the plant so that it is resistant to lodging.

The largest stem diameter of the hybrid tested was 18.4 mm, namely CT 21 hybrid but was not significantly different from the other hybrids and comparison hybrids. In the stress condition of NaCl, plants will divide the energy that should be used for stem diameter growth to overcome the salinity stress conditions (Kurniasari *et al.*, 2010).

Table 9. Average generative growth of new hybrid maize on coastal land

Genotype	Length of cob	Diameter of cob	Seed weight per cob	Cob weight per plant
BISI 18	15,6 b	42,6 a	127,4 a	177,1 a
CT 16	19,3 a	39,6 b	76,0 b	112,7 b
CT 17	17,3 a	42,6 a	123,2 a	152,7 a
CT 18	16,0 b	41,1 b	90,0 b	112,3 b
CT 19	17,0 a	46,3 a	128,0 a	148,0 a
CT 20	17,4 a	41,9 a	105,8 a	140,9 a
CT 21	17,3 a	38,8 b	94,2 b	125,9 a
CT 22	16,2 b	39,9 b	92,1 b	106,8 b
CT 23	12,7 d	41,5 b	80,0 b	94,9 b
CT 24	15,2 b	41,1 b	81,8 b	101,7 b
CT 25	13,5 d	37,0 b	78,8 b	88,3 b
CT 29	16,8 a	40,6 b	128,5 a	133,1 a
CT 31	15,4 b	44,7 a	108,6 a	142,9 a
CT 32	14,9 c	44,7 a	104,6 a	132,5 a
CT 33	14,7 c	41,5 b	115,0 a	136,3 a
CT 34	15,5 b	45,0 a	109,1 a	141,9 a
CT 39	13,0 d	41,2 b	93,2 b	114,5 b
CT 40	12,5 d	40,3 b	79,9 b	94,7 b
CT 41	13,3 d	38,9 b	76,4 b	92,1 b
CT 42	12,7 d	43,2 a	97,3 b	122,5 a
CT 46	15,4 b	42,3 a	94,6 b	134,8 a
CT 47	14,0 c	41,3 b	104,5 a	126,7 a
CT 48	15,8 b	42,6 a	118,4 a	148,9 a
CT 49	14,7 c	40,1 b	104,6 a	129,6 a
CT 50	15,0 c	42,5 a	116,0 a	149,0 a
CT 51	14,0 b	44,1 a	114,3 a	144,0 a

Remarks: the number of each column followed by the same letter shows no significant difference in the Scott and Knott test of 5%

Coastal land with DHL 0.21 dSm<sup>-1</sup> showed generative growth on the variable length of cob significantly different from some of the hybrids

tested. Based on Scott and Knott's test, there is a good group of cob lengths in coastal areas, namely CT16, CT17, CT19, CT20, CT21, and CT29

The largest cob length of 19.3 cm on CT 16 is even better than the comparative hybrid of 15.6 cm on BISI 18 hybrids. Cob length is one of the variables used to increase corn crop production, but it must be accompanied by a good cob diameter. The diameter of the cob is affected by the nutrient content and the water available in the soil or the planting media used, the more nutrients the plants need, the greater the diameter of the cob. The largest ear diameter is a hybrid CT 19 of 46.3 mm. CT 19 hybrid has a larger cob diameter than BISI 18 which is used as a comparison with a cob diameter of 42.2 mm.

Based on the results of the skott and knott test analysis of 5% level of the hybrids tested on the coastal land there is the best hybrid group because it is equivalent to the hybrid comparison of BISI 18. Hybrids CT 17, CT 19, and CT 20. Which have generative growth equivalent to BISI 18 and have a better cob length.

Response of 25 new hybrid maize through nutrient culture there is a group of hybrid maize that has a good response to stress NaCl with a concentration of 150 mM namely CT18, CT19, CT22, CT25, CT31, CT33, CT34, CT40, CT47, and CT50. The hybrid maize group that had high yields in coastal areas were CT 17, CT 19, and CT 20. Both trials had different results, but there were hybrids that were consistent with a good response to NaCl stress through nutrient culture and coastal land namely CT 19 There are differences in yields through nutrient culture and coastal land because this is influenced by planting media factors. Corn stress in nutrient culture is caused only by NaCl factor and has AB Mix nutrition, whereas in

coastal areas many factors affect plant growth, namely low C-organic content (1.32%), P-Bray is very low (3.19 ppm), low K-dd (0.37 me/100g) and pH 6.8. Coastal land is influenced by environmental factors, namely pH <8.5, and is dominated by salts of Na, Ca and Mg in the form of chloride or sulfate which causes low availability of N, P, Mn, Cu, Zn, and Fe in the soil, high osmotic pressure, weak water movement, and low soil microbial activity (Tester and Davenport 2003).

## CONCLUSIONS AND SUGGESTIONS

### Conclusions

- a. LC50 NaCl concentration in this study was obtained at 150 mM.
- b. Based on nutrient cultures with 150 mM NaCl stress hybrid CT18, CT19, CT22, CT25, CT31, CT33, CT34, CT40, CT47, and CT50 have a good response to salinity
- c. Based on the results on the coastal land obtained by groups of plants that have good results, namely CT 17, CT 19 and CT 20

### Suggestions

Salinity-tolerant genotype selection is very important to increase maize production in the use of coastal land, so a very precise method is needed more quickly in the determination of tolerant genotypes. From the results of the above research it is necessary to do more research to determine a better method.

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