

# Salinity Resistance of Seven Varieties of Madura Corns on Early Stage of Growth

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**Abstract**—Seven of sixteen varieties of Madura Corns (Guluk-Guluk, Manding, Talango, Duko, Elos, Deber and Tambin), were planted on beach area. This research objectives was to study character the germination of maize in saline media. The corns were planted on saline media (0, 100, and 200 mM NaCl), conducted by using randomized block design with 4 replications. Significant differences between treatments were determined Duncan's Multiple Range Test at 5% level. The germination parameters were measured until seven days after treatment such as Full Germination Percent (FGP), Mean Germination Time (MGT), Germination Index (GI), and Salt Tolerance Index (STI). Seedling growth on saline media by wick system hydroponic was measured at 21 days after planting. The parameter measured were seedling height, growth ratio and proline content. The result was salinity decreased germination ability and seedling growth. Duko and Tambin had the highest salinity tolerance on germination, but Manding had the highest on seedling growth.

**Keyword**—corn, germination, saline, seedling growth

## I. INTRODUCTION

Corn (*Zea mays* L.) is used as food and feed ingredients. The corns is distinguished by seeds and endosperm character, the environment, harvest time, and their usefulness. Based on harvest time, the corn can be divided into short (75-90 days), medium (90-120 days) and long maturity (more than 120 days). Corn growing environment consists of tropical lowlands (<1,000 masl), subtropical lowlands, mid-altitude subtropics (1,000-1,600 masl), and tropical highlands (> 1,600 masl) [1].

There are many varieties of maize in Madura Islands, Indonesia. [2] mentioned 16 varieties, such as ; Tambin-1, Tambin-2, Delima, Cetek, Dheber, Parsong, Krajekan, Elos, Talango, Kangean, Guluk-guluk, Dlubeng, Raddin, Manding, Geltik and Duko. Four cultivars that have higher production potential than other Madura maize, namely Tambin-1, Delima, Tambin-2 and Raddin. Krajekan have shortest harvest time. Var. Manding have the potential as salinity resistant corn [3]

There are 7 varieties include Manding, were planted on beach area, such as Guluk-Guluk, Manding, Talango, Duko, Elos, Deber and Tambin. This research objectives

was to study character of maize in saline media on early stage of growth (germination and seedling growth).

## II. METHODS

### A. Plant material and Research Design

Maize from the research of [2], were var. Elos (El.), Manding (Md.), Guluk-Guluk (Gl.), Duko (Du.), Dheber (Dh.), Talango (Tl.) and Tambin (Tb.). Seeds with similiar size and weight were selected to obtain homogenous germination rate. Seeds were surface sterilized in 2% (v/v) sodium hypochloride for 10 min and washed with distilled water. Thirty seeds were placed on filter papers which contained different salt concentrations and located in 15 cm diameter steril petridishes.

The experiment was conducted by using randomized block design with 4 replications. Significant differences between treatments were determined by Duncan's Multiple Range Test at 5% level.

### B. Germination Assays

Salt stress was realised by germinated on NaCl solution 0.100mM and 200mM. All treatments were replicated four times each cultivars and NaCl content. Germination were compared at room temperature ( $\pm 27^{\circ}\text{C}$ ) in the dark. The germination seeds were counted everyday for seven days. Seeds were considered to have germinated when the emergence of radicles  $\geq 2$  mm [3], [4].

Full Germination Percent (FGP) was calculated by equation

$$\text{FGP} = \frac{\text{number of germinated seeds}}{\text{total seeds number}} \times 100\%$$

The Mean Germination Time (MGT) was calculated everyday for each replication used the equation [4], [5], and [6]

$$\text{MGT} = \frac{\text{number of seeds newly germinated at day D}}{\text{number of all germinated seeds}}$$

Germination Index (GI) was calculated by equation [4], [7], [8], [9].

$$\text{GI} = \sum \left( \frac{\text{the number of seeds germinated on D day}}{\text{number of days up to D day}} \right)$$

Salt Tolerance Index (STI) on germination was calculated by equation [7].

$$STI = \frac{\text{germination/growth in a particular treatment}}{\text{germination/growth in the control}}$$

**C. Seedling Assays**

The seedlings were cultivated by wick system hydroponic. The media used [10] added by NaCl 0.100 mM and 200 mM. It had same replication with germination treatment. Plants height measured at 21 days after cultivated. Plants leaves at 21 days after cultivated were cut and measured Proline content, quantified according to the method of nynhidrin [11].

**III. RESULTS AND DISCUSSION**

**A. Germination Character**

Based on the results, salinity treatment decreased the value of FGP, GI and STI of all local Madura maize varieties (Table 1). Var. Duko and Elos could germinated in 200mM NaCl, which were not significantly different with the control (0mM NaCl). Manding and Dheber could germinated, but significantly different with the control. Corn var. Guluk-Guluk, Talango, and Tambin could not germinated in 200mM NaCl. The STI of each cultivars at the germination stage showed genotypic variation. At 0mM and 100mM, all varieties showed not significantly differences. it were significantly different on 200mM. Duko had the highest salt tolerance index but it was not significantly different with Elos. Guluk-Guluk, Talangoh and Tambin had the lowest STI.

Those results similar with previous research that salt stress can reduce germination ability [7], [12], [13], [14], [15], [16], [17], [18].

In 0mM NaCl medium, seeds germinated normally cause water and another nutrient normally absorbed. Increasing NaCl concentration in medium can decrease the osmotic potential that make prevent the uptake of water (necessary for mobilization of nutrient required for germination). Increasing NaCl, also make the ions (Na<sup>+</sup> or Cl<sup>-</sup>) may be toxic to the embryo [7]. Finally, its inhibits or slows the rate of germination and thus decreased germination percentage [17], [19].

**B. Seedling Character**

On seedling growth, Tabel 2 show that salt stress reduced corns height. Manding was the tallest on 200 mM NaCl and Duko was the shortest. Manding also had highest plant height ratio (in 200mM/0mM NaCl) and the lowest was Duko (Figure 1). The reducing of seedling growth also reported by another research [20], [21], [22], [23]. According to previous research [24], salt stress reduced plant growth by induced osmotic stress, ion toxicity, and nutritional imbalance. Osmotic stress means high concentration of salt in the root zone limits water potential of solution and reduces plant root water conductivity, make reducing of cell membrane permeability and influx of water to the plant. ions toxicity made by sodium, chloride,

sulphate and bicarbonates. Nutritional imbalance, occur in the cells was caused by excessive accumulation of Na<sup>+</sup> and Cl<sup>-</sup>, reduces the uptake of other mineral nutrients, such as K<sup>+</sup>, Ca<sup>2+</sup> and Mn<sup>2+</sup>. Those factors caused metabolism disruption, then inhibit seedling growth.

Table 1. Germination Character of Seven Corn Varieties on Difference Salinity Level

Parameter	Var.	Salt Treatment		
		0 mM	100 mM	200 mM
FGP (%)	El.	100 d	92.5 cd	80 bcd
	Md.	100 d	100 d	10 a
	Gu.	100 d	95 cd	0 a
	Du.	100 d	100 d	90 cd
	Dh.	95 cd	90 cd	7.5 a
	Tl.	100 d	75 bc	0 a
	Tb.	82.5 bcd	67.5 b	0 a
MGT (d)	El.	2.65 bc	4.67 def	5.00 ef
	Md.	2.40 b	4.05 bcdef	4.00 bcdef
	Gu.	3.18 bcde	4.60 def	0.00 a
	Du.	3.65 bcdef	4.68 def	5.45 f
	Dh.	4.00 bcdef	4.38 cdef	3.00 bcd
	Tl.	3.95 bcdef	5.02 cdef	0.00 bcd
	Tb.	3.81 bcdef	3.56 bdef	0.00 a
GI	El.	9.63 h	4.31 d	3.02 bc
	Md.	7.79 g	4.95 de	0.21 a
	Gu.	5.85 ef	4.18 cd	0.00 a
	Du.	5.79 ef	4.58 de	2.50 b
	Dh.	5.86 ef	4.74 de	0.13 a
	Tl.	6.71 fg	2.84 b	0.00 a
	Tb.	5.93 ef	2.95 bc	0.00 a
STI	El.	1.00 c	0.93 c	0.80 c
	Md.	1.00 c	1.00 c	0.10 ab
	Gu.	1.00 c	0.95 c	0.00 a
	Du.	1.00 c	1.00 c	0.90 c
	Dh.	1.00 b	0.96 c	0.33 b
	Tl.	1.00 c	0.75 c	0.00 a
	Tb.	1.00 c	0.81 c	0.00 a

Note : number followed by same letter on row and column, not significantly different on DMRT 5%.

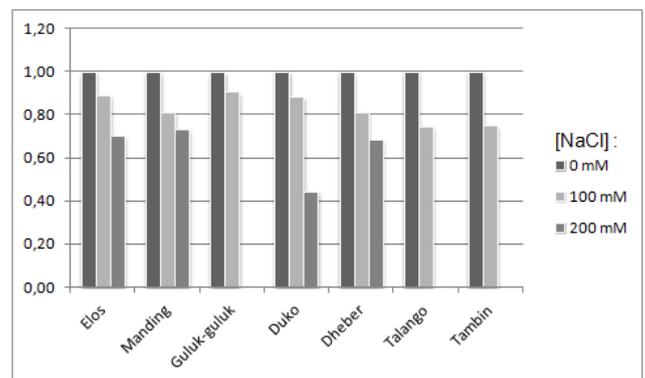


Figure 1. Shoot Height Ratio of Madura Corn on Salt Stress

Table 2 also showed that proline level of all varieties increased when NaCl concentration also increased. But Talangoh was decreased on 200mM NaCl. The highest NaCl concentration was Manding, could indicate more tolerance to salt stress than others. Increasing of prolin content on salt stress also reported by [25], [26], [27] and [28]. Plants produce proline to block reactive oxygen species (ROS). ROS was substance in plant (such as

hydrogen peroxide, superoxide, singlet oxygen, and hydroxyl radical) that produced while plants was under stress. Overproduction of ROS increased lipid peroxidation, protein degradation and DNA mutation [29]. In higher plants proline increased to stabilize cell membran [30].

**Table 2. Seedling Character of Seven Corn Varieties on Difference Salinity Level**

Para-meter	Var.	Salt Treatment		
		0 Mm	100 mM	200 mM
Height	El.	33.00 defghi	29.00 cdefgh	23.00 cdefg
	Md.	38.63 ghi	31.25 defghi	27.78 cdefgh
	Gu.	33.60 fghi	30.40 defgh	0.00 a
	Du.	32.25 defghi	27.25 bcdefg	14.10 b
	Dh.	31.83 defghi	24.83 bcdef	20.88 bcde
	Tl.	40.38 i	29.68 cdefgh	0.00 a
	Tb.	36.35 ghi	27.05 bcdefg	0.00 a
Growth ratio	El.	1.54	1.50	1.71
	Md.	1.49	1.15	1.58
	Gu.	1.87	1.78	1.70
	Du.	1.46	1.43	1.50
	Dh.	1.54	1.30	1.84
	Tl.	1.50	1.41	1.93
	Tb.	1.53	1.90	1.41
Proline	El.	2.31 b	138.92 l	180.68 n
	Md.	74.36 g	99.65 h	279.42 s
	Gu.	16.41 d	132.50 k	195.49 o
	Du.	1.45 a	119.79 i	253.13 r
	Dh.	6.14 c	131.58 j	210.65 p
	Tl.	6.35 c	55.92 f	22.92 e
	Tb.	2.98 b	179.36 m	237.92 q

Note : number followed by same letter on row and column, not significantly different on DMRT 5%.

#### IV. CONCLUSION

Salinity resistance of seven varieties of Madura corns were difference. Stress decrease germination ability and seedling growth of all varieties. Maize var. Duko and Elos had the highest salinity tolerance on germination but Var. Manding had the highest on seedling growth.

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