

Application Four Type of Ameliorant to Increase Cucumber (*Cucumis sativus* L.) Early Growth on Saline Land

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ABSTRACT

Saline land is one of the marginal land that have a potential to be planted. Saline soil condition has a high concentration of NaCl that need to be fixed because it less conductive to the plant growth. Application of ameliorant is one of solution to improve saline soil. The purpose of this research were to get the most effective land ameliorant for growth and yield of Cucumber (*Cucumis sativus* L.) varieties Metavy and Monza in saline land. This research was conducted from May to October 2016. It located at Sidomukti village, Brondong district, Lamongan that has saline lands with EC value $\pm 4.8 \text{ dS m}^{-1}$. This research using randomized block design with 10 treatments and 3 times replication. This research showed that ameliorant treatment can increase cucumber growth and yield of varieties Mevaty and Monza compared without ameliorant treatment. Cow manure that used for ameliorant was better to increase growth of varieties Metavy and Monza compared to gypsum, rice straw and *C. juncea*.

Keywords: *Cucumis sativus* L, Ameliorant, Salinity.

INTRODUCTION

Saline land is marginal land that potentially could be used as cropland. Improvement opportunities of cucumber yield on marginal lands including resistant crops in sub-optimum conditions, which is moderate tolerance to saline soil with EC 4.4 deci siemens per meter (dS m^{-1}) (Amacher *et al.*, 2000). The main problem in saline soil is high NaCl content in the soil. NaCl when dissolved in water dissociate into their constituent ions, there are Na⁺ and Cl⁻. The abundance of Na⁺ and Cl⁻ content can lead to inequality ion which cause metabolic activity in plants being distracted (Djukri, 2009). Saline soil are less conductive to plant growth, therefore it needs necessary improvement of soil fertility by giving ameliorant treatment. The purpose of ameliorant is to reduce levels of Electrical Conductivity (EC) in saline soil, therefore it will not inhibit the growth of plants. EC levels could decrease by adding water flood to the soil. Gypsum as inorganic ameliorant can provide substitution of Na⁺ in soil with Ca²⁺, thereby it could increasing the percolation of soil (FAO, 2005). Ameliorant organic materials contribute to the most physical

properties of soil cover structure, consistency, porosity and water binding potency (Atmojo, 2003). Cow manure also could significantly increase on the length of plant and number of leaves on cucumber (Fefiani and Barus, 2014).

MATERIAL AND METHODS

This study was conducted in May-October 2016 on saline land with EC value $\pm 4.8 \text{ dS m}^{-1}$. This research was located in the Sidomukti village, District Brondong, Lamongan. The tools used in this study is a shovel, water can, stakes, rope, calipers, ruler, and analytical balance, Leaf Area meter (LAM), Electrical Conductivity (EC) meter, Chlorophyllmeter SPAD-502, scissors, oven, stationery, knives and digital camera. Materials used in this research were Plant Growth Promoting Rhizobakteri (PGPR), cucumber seeds varieties Metavy and Monza, cow manure, green manure comes from *Crotalaria juncea* and rice straw.

This research methods were using randomized block design which consisting of 10 combination treatments and 3 replications, consist of: A0 (Variety Metavy without Ameliorant Land), A1 (Variety

Metavy with Cow Manure), A2 (Variety Metavy with Gypsum), A3 (Variety Metavy with green manure *Crotalaria juncea*), A4 (Variety Metavy with Rice Straw), A5 (Variety Monza without ameliorant), A6 (Variety Monza with cow manure), A7 (Variety Monza with Gypsum), A8 (Variety Monza with green manure *Crotalaria juncea*), A9 (Variety Monza with Rice Straw).

Parameter observations were including growth observations that consist of length of the plant, number of leaves, leaf area, shoot and root dry weight. Analysis of the plant growth were using rate plant growth. Data were analyzed using analysis of variance (ANOVA) and F test at 5% level. If the test results was significantly different then continued with HSD test at 5% level.

RESULTS AND DISCUSSION

Analysis of Plant Growth

The observation of plant length at 2 WAP, 3 WAP, 4 WAP and 5 WAP showed the treatment cow manure as ameliorants on the variety Metavy and Monza has the highest value of plant length compared with gypsum, rice straw, *C. juncea* and treatment without ameliorant (Table 1). Fefiani and Barus (2014), stated cow manure significantly affected the length of cucumber plants. In accordance with the research Suharyani *et al* (2012), in saline soil organic material affects on water binding, so the plant roots can easily absorb nutrients that available for plant growth.

Data number of leaves at 2 WAP, 3 WAP, 4 WAP and 5 WAP showed that cucumber variety metavy and gypsum as ameliorant have more number of leaves at 2 WAP and 5 WAP than the other ameliorant treatments such as cow manure, rice straw, *C. juncea* and without ameliorant (Table 2). While on 3 WAP and 4 WAP, ameliorant cow manure had more number of leaves than gypsum, rice straw, *C. juncea* and treatment without ameliorant. Monza variety with ameliorants cow manure treatment had the number of leaves more than the treatment ameliorant gypsum, rice straw, *C. juncea* and treatment without ameliorant. Evanita *et al.*, (2014) stated that cow manure doses of 5 t ha⁻¹ can increase the number of leaves on the eggplant in the cropping pattern of intercropping.

The observation of leaf area at 2 WAP, 4 WAP, 6 WAP and 8 WAP showed the treatment ameliorants cow manure on the variety Metavy and Monza has the highest leaf area compared with gypsum, rice straw, *C. juncea* and treatment without ameliorant (Table 3). Cow manure serves as organic material in the soil and improve soil texture that can bind water in the soil so that the roots can easily absorb nutrients needed for plant growth. This is consistent with the statement of Ako (1997) that cow manure can increase leaf area index in the growth of sorghum plant

Shoot dry weight observations of cucumber plants at 2 WAP, 4 WAP, 6 WAP and 8 WAP in Table 4 showed the cucumber varieties Metavy and Monza with the treatment of cow manure as ameliorant had heaviest weight compared to gypsum, rice straw, *C. juncea* and treatment without ameliorant. Shoot dry weight were observed to know biomass production in plants. According to Arifin (2014), leaf area affects the production of plant biomass through the process of photosynthesis, the process of photosynthesis is also influenced by the availability of water, which is used to distribute the photosynthate to the plant organs. Wayah *et al* (2014) stated cow manure affect dry plant weight of corn, because of cow manure ameliorant can act as a binder of water in the soil.

The observation of cucumber root dry weight showed that cucumber varieties Metavy and Monza with ameliorant treatments showed no significant effect on the age of 2 WAP compared with treatments without ameliorant. At the age of 4 WAP and 6 WAP treatment ameliorants shows the significant effect compared to treatment without ameliorant. At the age of 8 WAP treatment ameliorants of cow manure showed the highest affect on the variety Metavy and Monza. According to Indrasari and Gratitude (2006), cow manure up to 30 t ha⁻¹ increases the organic matter content, Zn for plant tissue, fresh weight and root dry weight on corn plants.

Plant Growth Rate Observation

The observation of plant growth rate at 2-4 WAP, 4-6 WAP and 6-8 WAP showed treatment cow manure as ameliorant has the highest value of crop growth rate as

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compared to treatment ameliorant as gypsum, rice straw, *C. juncea* and treatment without ameliorant. The plant growth rate related with the production of plant biomass

through photosynthesis. This is supported by the number of leaves and leaf area that were high on cow manure as ameliorants treatment.

Table 1. Data observations plant length of cucumber varieties monza and metavy by application four types of ameliorant

Treatment	Plant Length (cm)			
	2 WAP	3 WAP	4 WAP	5 WAP
Var. Metavy without Amelioran	23,72 a	49,28 a	74,39 a	112,67 ab
Var. Metavy + Cow manure	30,83 c	89,22 de	127,06 f	153,72 d
Var. Metavy + Gypsum	29,83 c	76,11 cde	113,94 def	140,06 c
Var. Metavy + Rice straw	28,94 bc	66,00 abc	99,56 bcd	119,89 ab
Var. Metavy + <i>C. juncea</i>	28,92 bc	65,83 abc	97,50 bc	119,33 ab
Var. Monza without Amelioran	24,61 ab	53,67 ab	85,10 ab	111,11 a
Var. Monza + Cow manure	33,11 c	90,89 e	129,89 f	152,39 cd
Var. Monza + Gypsum	30,67 c	79,72 cde	120,94 ef	142,83 cd
Var. Monza + Rice straw	29,97 c	71,56 bcd	104,22 cd	125,11 b
Var. Monza + <i>C. juncea</i>	29,39 c	71,11 bcd	106,39 cde	126,11 b
LSD 5%	4,57	18,81	16,3	13,62

Table 2. Data observations number of leaves of cucumber varieties monza and metavy by application four types of ameliorant

Treatment	Number of leaves (sheet)			
	2 WAP	3 WAP	4 WAP	5 WAP
Var. Metavy without Amelioran	3,11 ab	8,05 a	15,06 a	22,05 a
Var. Metavy + Cow manure	3,67 cde	13,94 de	22,56 e	29,55 ef
Var. Metavy + Gypsum	4,00 e	12,33 cde	21,72 cde	29,94 f
Var. Metavy + Rice straw	3,67 cde	10,78 bc	19,28 b	26,28 c
Var. Metavy + <i>C. juncea</i>	3,61 cde	11,11 c	19,00 b	26,17 bc
Var. Monza without Amelioran	3,06 a	8,61 ab	16,61 a	23,61 ab
Var. Monza + Cow manure	3,89 de	14,22 e	22,17 de	29,17 def
Var. Monza + Gypsum	3,89 de	12,22 cde	20,5 bcde	27,50 cdef
Var. Monza + Rice straw	3,50 bcd	11,39 c	19,72 bc	26,72 cd
Var. Monza + <i>C. juncea</i>	3,44 abc	11,56 cd	20,17 bcd	27,17 cde
LSD 5%	0,39	2,45	2,34	2,59

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on LSD at 5% level; WAP = week after planting.

Table 3. Data observations leaf area of cucumber varieties monza and metavy by application four types of ameliorant

Treatment	Leaf Area (cm ²)			
	2 WAP	4 WAP	6 WAP	8 WAP
Var. Metavy without Amelioran	61,32	188,43 a	467,88 a	696,04 a
Var. Metavy + Cow manure	86,71	612,25 c	891,21 f	1007,85 e
Var. Metavy + Gypsum	79,15	443,76 bc	761,45 def	868,98 d
Var. Metavy + Rice straw	80,24	372,47 ab	556,02 abc	799,92 bc
Var. Metavy + <i>C. juncea</i>	102,69	367,08 ab	574,64 abc	777,95 bc
Var. Monza without Amelioran	56,35	198,79 a	504,84 ab	684,44 a
Var. Monza + Cow manure	172,49	487,06 bc	768,74 ef	960,07 e
Var. Monza + Gypsum	80,71	419,21 bc	730,34 de	843,82 cd
Var. Monza + Rice straw	114,91	409,48 b	629,07 bcd	820,60 bcd
Var. Monza + <i>C. juncea</i>	90,64	362,05 ab	650,04 cde	765,83 b
LSD 5%	tn	202,63	136,75	66,37

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on LSD at 5% level; WAP = week after planting.

Table 4 Data observations shoot dry weight of cucumber varieties monza and metavy by application four types of ameliorant

Treatment	Shoot Dry Weight of Plant (g)			
	2 WAP	4 WAP	6 WAP	8 WAP
Var. Metavy without Amelioran	1,03	1,53 a	5,13 a	6,75 a
Var. Metavy + Cow manure	1,29	3,84 b	10,58 d	13,92 e
Var. Metavy + Gypsum	1,42	3,62 b	9,08 cd	12,12 d
Var. Metavy + Rice straw	1,22	3,15 b	7,51 bc	10,13 bc
Var. Metavy + <i>C. juncea</i>	1,20	2,77 b	6,73 ab	9,20 b
Var. Monza without Amelioran	1,07	1,54 a	5,49 a	6,90 a
Var. Monza + Cow manure	1,41	3,16 b	9,82 d	12,56 de
Var. Monza + Gypsum	1,25	3,23 b	9,22 cd	11,60 cd
Var. Monza + Rice straw	1,24	3,72 b	7,71 bc	9,93 b
Var. Monza + <i>C.juncea</i>	1,46	2,82 b	7,57 bc	9,58 b
LSD 5%	tn	1,08	1,81	1,55

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on LSD at 5% level; WAP = week after planting.

Table 5 Data Observations Root Dry Weight Cucumber varieties Monza and Metavy by Application Four Types of Ameliorant

Treatment	Root Dry Weight of Plant (g)			
	2 WAP	4 WAP	6 WAP	8 WAP
Var. Metavy without Amelioran	0,09	0,11 a	0,19 a	0,27 a
Var. Metavy + cow manure	0,13	0,29 b	0,4 c	0,48 d
Var. Metavy + Gypsum	0,12	0,26 b	0,42 c	0,47 d
Var. Metavy + Rice Straw	0,09	0,21 ab	0,32 b	0,41 bc
Var. Metavy + <i>C. juncea</i>	0,12	0,24 b	0,32 b	0,39 b
Var. Monza without Amelioran	0,12	0,12 a	0,21 a	0,31 a
Var. Monza + Cow manure	0,14	0,27 b	0,41 c	0,49 d
Var. Monza + Gypsum	0,11	0,21 ab	0,39 bc	0,48 d
Var. Monza + Rice straw	0,12	0,27 b	0,36 bc	0,41 bc
Var. Monza + <i>C.juncea</i>	0,09	0,21 ab	0,39 bc	0,41 bc
LSD 5%	tn	0,1	0,07	0,061

Remarks : Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on LSD at 5% level; WAP = week after planting.

Table 6 Analysis of Plant Growth Rate Observations Cucumber varieties Monza and Metavy by Application Four Types of Ameliorant

Treatment	Plant Growth Rate (g m ⁻² hari ⁻¹)		
	2 - 4 WAP	4 - 6 WAP	6 - 8 WAP
Var. Metavy without Amelioran	0,13 ab	0,94	0,43
Var. Metavy + Cow manure	0,69 d	1,75	0,87
Var. Metavy + Gypsum	0,60 cd	1,43	0,79
Var. Metavy + Rice straw	0,52 cd	1,14	0,69
Var. Metavy + <i>C. juncea</i>	0,43 bcd	1,03	0,65
Var. Monza without Amelioran	0,12 a	1,03	0,39
Var. Monza + Cow manure	0,47 cd	1,74	0,72
Var. Monza + Gypsum	0,53 cd	1,57	0,63
Var. Monza + Rice straw	0,67 cd	1,04	0,58
Var. Monza + <i>C.juncea</i>	0,38 abc	1,26	0,52
LSD 5%	0,31	tn	tn

Remarks: Numbers followed by the same letter in rows and columns in each age observation showed no significant differences based on LSD at 5% level; WAP = week after planting.

Therefore, the higher number of leaves and leaf area could help the photosynthesis process to produce higher photosynthate. Arifin (2014) stated leaf area interconnected with the production of plant biomass that is going through the process of photosynthesis. The research of Wulandari *et al* (2014) also stated that leaf area will affect the quantity of light absorption in plants that increase the production of plant biomass in photosynthesis process.

CONCLUSION

Treatment ameliorant on cucumber varieties Monza and Metavy could increase the plant growth better than treatment without ameliorant. Cow manure as ameliorant treatment on the varieties Monza and Metavy could increase the length of the plant, number of leaves, leaf area, shoot dry weight and root dry weight higher compared with ameliorant from gypsum, rice straw and *C. juncea*.

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