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Remediation of Salt – Affected Soil by Addition of Different Growing Medias for Improving Yield of Chili (Capsicum frutescens L.)

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ABSTRACT

To mitigate the effect of salt stress and consequently improve crop yield. The objective of this study was to evaluate the effects of different growing media types application on growth and yield of chili grown under salt-affected soil. Application treatments consist of: (1) coarse sand, (2) coarse sand + M. *calabura* leaves, (3) coarse sand + polymer, (4) coarse sand + coconut shell hair and (5) no – application (control). The results revealed that chili plant death before produce an economic fruit yield in the coarse sand application alone and no – application (control) treatments. Application of coarse sand + M. *calabura* leaves gave the highest fruit yield in the present study.

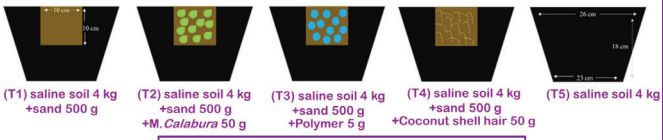
Key words: Saline soils, Organic matter, Polymer, Chili, Yield

INTRODUCTION

Saline soil is a important problem in the northeastern region of Thailand. Especially in this region, there is an area of saline soil spread around 17.8 million rai or 16.9 percent of the northeast region. In addition, there are 19.4 million rai of saline soil that has the potential to spread. In total, approximately 37 million rai of saline soil problems (Somsri, 1993). Saline soil affects to the growth and production of most plants, the salinity concentration in the soil affecting the stress of plant cells. The negative effects of salinity levels in the soil become more severe when the amount of organic matter in the soil is low (Muhammad et al., 2005). soil management and cultivation areas, modification of suitable planting methods such as reducing evaporation of water in the area without leaving it empty, the use of material to improve soil physical properties and increase soil fertility is another way to solve and alleviate saline soil problems. For this experimental study, choose chili, because chili can be grown in all areas of Thailand and important to generate income for farmers almost all over the country. Therefore, this research focuses on the management of extreme saline soil by growing media application on growth and yield of chili.

MATERIALS AND METHODS

- Greenhouse experiment was conducted in the period in May to October 2019 at the Faculty of Agriculture Khon Kaen University.
- Experimental design: Completely Randomized Design (CRD)
- Chemical fertilizer grade 15-15-15 (N, P_2O_5, K_2O) was applied to the soil at rate of 1.66 g pot^{-1} for all treatments
- Crops received water by drip irrigation 200 ml pot^{-1} a day.



(T1) saline soil 4 kg +sand 500 g | (T2) saline soil 4 kg +sand 500 g +M. *Calabura* 50 g | (T3) saline soil 4 kg +sand 500 g +Polymer 5 g | (T4) saline soil 4 kg +sand 500 g +Coconut shell hair 50 g | (T5) saline soil 4 kg

Treatment: 5 treatments with 3 replications

Soil physical property

- **Soil physical property** were determined; Field capacity, Permanent wilting point, Soil moisture content, Bulk density, Saturation percentage
- **Soil chemical property** were determined; pH, EC, Total Nitrogen, Available Phosphorus, Exchangeable Potassium, Exchangeable Sodium

Plant data

- **Growth and yield** such as height, leaf chlorophyll content index, leaf area, fresh - dry weight of root, stem and leaves, fruit number and fresh fruit yield
- **Chemical property** were determined; Total Potassium, Total Sodium

RESULTS

The T2 and T3 were significant higher Na+ ion accumulation in soil at harvest than that of T4 both IAZ and OAZ (Table1). The maximum Na+ was illustrated in the T2 treatment. This was associated with application of M.calabura increased the sorption capacity of the growth medium. This finding is in agreement with those reported by Esteban et al. (2016). Irrespective of EC, T2 and T3 were significant higher EC values than that of T4.

Table 1: Exchangeable sodium (Na+), electrical conductivity (EC) and exchangeable potassium (K+) of soil as affected by different growing media application at the last day of harvesting

Parameter	Treatments			
	T2	T3	T4	F-test
Na^+ (%)				
-Inside growing media application zone	0.473a	0.475a	0.399b	*
-Outside growing media application zone	0.38a	0.45a	0.20b	**
EC (dS/m)				
-Inside growing media application zone	11.94a	12.77a	9.19b	**
-Outside growing media application zone	8.32b	12.41a	5.53c	**
K^+ (%)				
-Inside growing media application zone	1.07a	0.75b	0.91ab	*
-Outside growing media application zone	1.14a	0.71b	0.80ab	*

Table 2: Potassium and sodium content in leaves, stems and roots of chili as affected by different media application at harvest

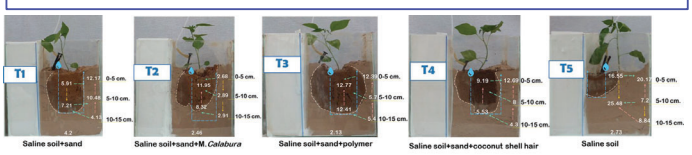
Parameter	Treatments			F-test
	T2	T3	T4	
Leaf:				
K^+	5.03a	5.00a	4.56b	**
Na^+	0.38c	3.18a	1.87b	**
K^+/Na^+	13.13a	1.57c	2.43b	**
Stem:				
K^+	4.34a	3.48b	3.21c	**
Na^+	0.40c	4.68a	3.49b	**
K^+/Na^+	10.73a	0.74c	0.92b	**
Root:				
K^+	1.60a	0.86b	0.64c	**
Na^+	2.56b	3.20a	1.66c	**
K^+/Na^+	0.62a	0.26c	0.38b	**

This indicates that manipulation of salt-affected soil by application of sand+M.*calabura* improved fruit yield of chili better than that of application sand+coconut shell hair and sand +polymer in this study.

Table 3: SPAD chlorophyll meter reading values in leaves of chili as affected by different media application at 98, 105, 112 and 119 days after transplanting (DAT)

SPAD chlorophyll meter reading values found that, application of sand with M. *calabura* tended to give the highest chlorophyll content index, followed by usage with sand with coconut shell hair in comparison with the other treatments (Table 3).

DAT	Treatments			F-test
	T2	T3	T4	
98	41.60a	25.36b	39.63a	**
105	41.88a	24.15b	40.48a	**
112	37.11a	17.88b	32.61a	**
119	37.86a	20.46b	32.65a	**



The water movement after drip irrigation in each treatment

Table 4: Growth and yield of chili as affected by different media application at harvest

Parameter	Treatments			F-test
	T2	T3	T4	
Plant height (cm)	68.5	54.5	60.5	ns
Leaf area ($cm^2 plant^{-1}$)	957.4a	264.8c	563.5b	**
Leaf dry weight (g $plant^{-1}$)	3.45a	0.52c	1.75b	**
Stem dry weight (g $plant^{-1}$)	3.74	3.53	3.52	ns
Root dry weight (g $plant^{-1}$)	0.97	0.73	0.95	ns
Fruit number (no.$plant^{-1}$)	7.33a	2.33b	4.33b	**
Fresh fruit yield (g $plant^{-1}$)	2.61a	0.34b	0.93b	*

Application of sand with M. *calabura* tended to increase plant height, leaf area, fresh plant weight, fruit number and fresh fruit yield per plant over control at harvesting. This was due to organic residues application provided available plant nutrients for crop growth (Table 4).

CONCLUSIONS

Application of different growing media namely M. *calabura* leaves or polymer and or coconut shell hair combined with sand allowed the chili plant survive and produced fruit yield under salt-stress conditions. However, M. *calabura* application attained the maximum fruit yield of chili by improvement of soil properties mitigating salinity.

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