Effect of Salinity Stress on Brix %, Growth, and Yield in Chili Pepper

R.M.S.M.B. Rathnayaka[1*], S. P. Sudasinghe[2], Kazuhiro Nemoto[3], Kenichi Matsushima[3]

School of Agricultural Technology, Sri Lanka Technological Campus (SLTC Research University), Padukka 10500, Sri Lanka[1] Department of Science and Technology, Graduate School of Medicine, Science and Technology Shinshu University[2]

Institute of Agriculture, Academic Assembly Faculty, Shinshu University[3]

[*]sangeethr@sltc.ac.lk

Abstract: Chili peppers (*Capsicum* spp.) are the most widely used spices for any cuisines and are getting popular not only as spices but also as a kind of vegetable. Taste components are very important factors when chili pepper using as a vegetable. Therefore, present experiment was conducted to find out the effect of salinity stress on the Brix, pod parameters, yield, and plant growth in chili pepper. The experiment was conducted in a greenhouse condition with three salinity levels using NaCl. The results and outcomes show that salinity stress conditions positively affect the Brix percentage of the harvest. However, salinity stress conditions negatively affected the plant growth and yield parameters.

Keywords: Brix, Chili pepper, Salinity stress, Taste components

I. INTRODUCTION

Chili pepper (*Capsicum annuum)* is the fruit of plants from the genus *Capsicum*, a member of the nightshade family, Solanaceae, are widely grown for their fruits, which may be eaten fresh or cooked (e.g., in salads, baked dishes, salsa, pizzas, etc.), used as a dried powder, or processed into oleoresins. It has been domesticated for more than 6000 years [3]. Peppers are commonly broken down into three groups: bell peppers, sweet peppers, and hot peppers. Most popular pepper varieties fall into one of these categories or as a cross between them [1]. Variations of the yield and the taste components in the chili pepper can be attributed to cultivar differences; additionally, as hereditary and environmental factors [6]. High concentrations of salts in soil and drought stress conditions are often responsible for large decreases in the yield of a variety of crops worldwide. It was estimated that about 20% (45 million ha) of irrigated land, producing 1/3 of the world's food, is salt-affected [5]. However, to the best of our knowledge, few investigations regarding the influence of environmental factors, especially salinity stress, on the Brix %, yield parameters, and growth parameters have been found. Accordingly, this study was composed to determine the effect of salinity stress on Brix %, yield, and growth in chili pepper.

II. MATERIALS AND METHOD

The Experiment was conducted as a pot experiment in a greenhouse at the Research field of Shinshu University, Minamiminowa, Nagano, in Japan in 2020, using the *C. annuum* cultivars; 'Sapporo Oonaga Nanban' and 'Sisito'. Our previous studies recorded that 'Sapporo Oonaga Nanban' had the highest Brix percentage among 39 tested chili strains cultivable in Japan [2] and we selected 'Sisito' as a non-pungent cultivar. In addition, we selected 'Sisito' due to its very low pungency and it was a common cultivar used in Japan for eating and also experiments.

Seedlings of similar height were transplanted in plastic pots filled with 1 kg of the same commercial potting medium. Six individuals of each cultivar were used for each treatment. After calculating the bulk density, the plastic pots filled with the medium occupied 130 mL of water. So, water supply with considering the daily temperature. As the treatments applied three salinity levels applied using sodium chloride (NaCl); the levels were excessive salinity [E; 10 dS/m (6.4 g/L)], additional salinity [A; 5 dS/m (3.2 g/L)], and the normal salinity as control [C; 0.9 dS/m (0.57 g/L)]. In both years, treatment application started after the seedlings were transplanted and harvest was collected at 40 dates after planting (DAF). Harvested fruits were used for analyzing the Brix value. The number of fruits, fruit weight, total yield, number of leaves, number of branches, and plant height was recorded on a per plant basis. A Randomized Complete Block Design was used to analyze the experimental data.

Solution preparation and analysis of Brix

Brix is primarily a measure of the sugar concentration in a solution. Extracts were prepared from fruit tissue ground using a grinder (YMB-400, Yamazen) and filtered through a 125-mm filter paper (ADVANTEC). Extracts were used directly to measure the Brix value with a digital portable refractometer (Pen-J, Atago Co., Ltd., Tokyo, Japan).

III. RESULTS AND DISCUSSION

The fruit Brix percentage of all cultivars in the salinity stress-treated plants tended to increase in both cultivars with increasing salinity in the soil. These results agreed with previous studies of water-stressed (drought) chili pepper [4]. Wu and Kubota (2008) also reported that the Brix of tomato fruits increased when the EC of the nutrient solution was increased.

However, the number of fruits, number of leaves, plant height, number of branches, total yield, and fruit weight were significantly lower in all cultivars with increasing salinity in the soil than the low salinity level.

When plants were grown under the salinity stress conditions, the size and weight of the fruits decreased compared to those grown under the control. According to [7], salinity stress significantly impacted the plant height and fresh and dry biomas of the chili pepper plants.

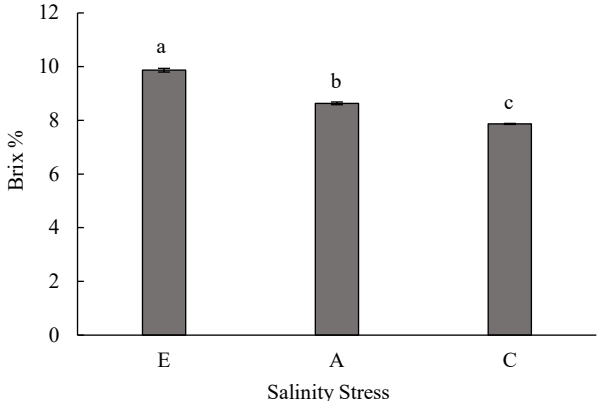

Fig. 1. The Brix at different levels of salinity stress condition in 'Sisito'. Different lowercase letters, a, b, and c, above the bars indicate significant differences among treatments, (Tukey's pairwise test, $P < 0.05$). Error bars indicate the standard error.

IV. Conclusion

The quality of the fruit getting increased with decreasing the stress conditioned. Therefore, it is important to find out the equilibrium point at which a profitable harvest with the highest quality can obtained through further experiments.

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Table 1. Effect of salinity stress for plant growth parameters, pod parameters, and yield of chili pepper.

Variety	Salinity Stress	No. of Fruits	No. of Leaves	Plant Height (cm)	No. of Branches	Total Yield (g/plant)	Fruit Weight (g)
Sapporo	E	24.3 a	88.8 a	34.3 a	7.3 a	150.0 a	6.20 a
	A	51.5 b	127.0 a	43.5 a	8.0 a	370.8 b	7.20 b
	C	69.8 c	183.8 b	62.3 b	11.0 b	637.7 c	9.15 c
Sisito	E	42.5 a	69.5 a	55.3 a	5.5 a	212.5 a	5.18 a
	A	52.8 b	131.3 b	66.5 b	9.0 b	369.3 b	7.25 b
	C	73.0 c	209.3 c	81.0 c	10.5 b	657.0 c	9.03 c

Different letters a, b and c for the treatments (control, C; additional salinity stress, A; and excessive salinity stress, E) indicate significant differences using Tukey Pairwise test at the 5% level.