The Effects of Humic Substances on Some Physiological Properties of *Citrus sinensis cv.Thomson navel* under Lime Condition

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***Abstract*—**The effects of soil application of humic acid and fulvic acid on some Physiological properties of *Citrus sinensis cv.Thomson plants* grown at various lime conditions were examined. Lime concentrations were 0, 15 and 30%. The liquid humic acid and fulvic acid were put into the soil pots three times on15,30 and 45th day after bud emerged. The application doses of humic acid and fulvic acid were 0, 50 and 100m g/l. Each application consists of four replications. The experiment was conducted in Pot experiment under controlled conditions in completely randomized factorial design in mazandaran. The interaction effect between lime & spray for N and RWC was not found statistically significant ($P < 0.05$) and the interaction effects between lime & spray for chlorophyll a, chlorophyll b was found statistically significant ($P < 0.01$) (table1). According to the analysis results, the most measurement of chlorophyll a, chlorophyll b and RWC in the level of lime (0%) and the least measurement of chlorophyll a, chlorophyll b and RWC by the level of lime (30%) obtained (table2).

***Keywords*—**Citrus, Humic Substances, Lime, Physiological properties.

I. Introduction

In many studies, humic acids were reported to increase the growth and developement of plants, therefore improving the nutritional status of the plant (Maggioni et al. 1987;Mackowiak et al. 2001, Rauthan and Schnitzer,1982). Humic acids may also reduce plant uptake of certain toxic metal ions, adsorbing them from the soil solution (Strickland et al., 1979). On the other hand, foliar and root application of commercial fulvic acids led to a severe plant growth depression (Cerdán et al., 2006). High amounts of lime in soils have negative effects on the plant growth. The plant growth and yield are reduced in lime-affected soils because of the excess uptake of potentially toxic ions (Grattan & Grieve 1999). A high lime content decreases the osmotic potential of the soil water and, consequently, this reduces the availability of the soil water for plants. One negative effect of increasing lime concentration is inhibited uptake of essential micronutrients such as N, P, and K (Ahmad, et al.,1981; Peacock et al., 1993). Briefly, high lime concentrations in the soil reduce the absorption of nutrients by plants which negatively affects the fertility of the soil (KHaled and Hassan, 2011). Many laboratory and glasshouse studies have shown that high amounts of lime can reduce total nitrogen accumulation (Alam 1994), P concentrations and the uptake of K in plants (Lopez & Satti 1996). In lime soil, the content of water is particularly low and the plants grown in these soils often show deficiencies of RWC (Relative Water Content) (Page et al. 1990). Humic substances may enhance uptake of chlorophyll a and chlorophyll b, one might reason that application of HS could improve plant response to lime. However, there is a lack of research regarding HS and application and its impacts on *Citrus sinensis* lime tolerance. Therefore, The aim of this study was to compare the effect of humic acid and fulvic acid on the physiological properties of *Citrus sinensis cv.Thomson* under lime condition.

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II. Material And Methods

The soil used in this study was collected from 0–30 cm depth of the field located in mazandaran. The planting dates were on 15th March, 2012. Some physical and chemical properties of the soil were determined and as a basal fertilization, the fertilizer crystalon comprised of nitrogen, phosphorus, potassium, Fe, Mn and Cu were applied to the pots before planting. The experiment was conducted in Pot experiment under controlled conditions in completely randomized factorial design with three soil application doses of humic Acid 0, 50, and 100mg/l, three soil application doses of fulvic Acid 0, 50, and 100mg/l, and three lime doses 0, 15, and 30%. Each application consists of four replications. All pots were irrigated with distilled water during the experiment. The soil applied humic acid and fulvic acid were prepared from humax company (United states). Air-dried soil samples were passed through 4 mm sieve. For soil applications, humic acid and fulvic acid were solved into distilled water according to the application doses. The plants into polyethylene covered plastic pots sprayed based on the application doses. Lime were added to the pots according to the application doses. Fulvic acid was sprayed three times (15 ,30 and 45 days) after bud emerged (Beginning in late

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march), with the soil application doses of humic acid treatment into the pots at the same times. After two months vegetation period, the plants were discarded and dried at 60°C and samples were wet digested by using HNO 3 + HCIO 4 (4:1) and RWC was determined by comparing wet and dry weight, N by kjeldahl and the manner of titration and chlorophyll a and b by spectrophotometre (Hanlon ,1998). The statistical analysis was performed using EXCEL, SAS, MSTATC statistical soft wares, and mean values were grouped with Duncan multiple range test ($P < 0.05$)..

III. Results And Discussion

According to the analysis results, the most measurement of RWC in T0h50 treatment, and the least measurment by the treatment of T30blank obtained (table2). These Results corroborate findings of Chen & Aviad (1990), Fagbenro & Agboda (1993) & David et al., (1994) regarding RWC of plants. According to the analysis results, the measurement of N in every treatment was the same statistically, and the differences between treatments were Nonsignificant (table2). These results corroborate findings of Chen & Aviad (1990), Fagbenro & Agboda (1993) & David et al.,(1994) Regarding N uptake of plants. According to the analysis results, the most measurement of chlorophyll a in T0f100 treatment, and the least measurment by the treatment of T30f100 obtained (table2). According to the analysis results, the most measurement of chlorophyll b in T0f100 and T30h100 treatment, and the least measurment by the treatment of T30f100 obtained (table2). These Results approve findings of Chen & Aviad (1990), Fagbenro & Agboda (1993) & David et al.,(1994) regarding chlorophyll content of plants. Also Khaled and Fawy (2011) reported that application in 0.1% humic acid treatment increased N amounts in plants which 30% lime treatment when compared with the control and 0.2% humic acid treatment. Liu and Cooper (2002) in creeping bentgrass reported that lime did not affect the content of N and other elements. Neeraja et al., (2005) found that foliar and root application of organic acids product from animal origin led to a severe plant growth depression. Anjum et al., (2008) in citrus reported that lime condition increased the accumulation of chlorophyll b, but decreased chlorophyll a and RWC. Abdalhamid et al., (2003) reported that the application of exogenous organic acid on desert plants stimulated the growth and water content by neutralizing destructive effects of lime.

IV. Conclusion

Humic substances can ameliorate negative soil properties and improve physiological properties.They may be used in the case of the negative effect of lime that would inhibit growth and development of plants. Regarding our finding, humic acids and fulvic acid are ineffective on N uptake. This study indicated that the application doses are important for deriving benefit from humic substances under lime conditions. However, there are not many researches into humic substances application and their effects on plant lime tolerance. Therefore, more research is necessary to explain the positive impacts of humic acid and fulvic acid on citrus plants under lime condition..

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TABLE I
THE ANALYSIS OF VARIANCE OF PHYSIOLOGICAL PROPERTIES

	N	CHLb	CHLa	RWC
Lime	2.83**	0.082**	0.00121**	371.33**
Spray	2.78**	0.003**	0.000017**	602.64**
Spray*Lime	0.108ns	0.004**	0.000011**	11.20ns
Error	0.166	0.00000067	0.00000001	16.66
CV	14.74	1.08	1.15	5.00

Ns,*,**Nonsignificant or significant at P = 0.05, 0.01 respectively.

TABLE II
THE MEAN VALUES OF EFFECTS OF HUMIC SUBSTANCES
ON PHYSIOLOGICAL PROPERTIES

Lime*Spray	**N**	**CHLb**	**CHLa**	**RWC**
T0blank	2.18a	0.112e	0.0112e	72.44ef
T0f100	3.60a	0.196a	0.0188a	85.66b
T0f50	3.00a	0.158b	0.0160c	91.80a
T0h100	3.84a	0.143c	0.0183b	86.16b
T0h50	3.16a	0.128d	0.0155d	92.24a
T15blank	2.02a	0.096f	0.0029g	72.66ef
T15f100	2.96a	0.048i	0.0049f	81.00d
T15f50	2.74a	0.064h	0.0036f	88.40ab
T15h100	3.06a	0.039j	0.0042f	80.28de
T15h50	2.96a	0.028k	0.0032g	88.00ab
T30blank	1.80a	0.088g	0.0013i	68.14f
T30f100	2.60a	0.009l	0.0009ij	74.60e
T30f50	2.30a	0.112e	0.0021h	84.00bc
T30h100	2.88a	0.196a	0.0009ij	72.44ef
T30h50	2.44a	0.158b	0.0018i	85.66b

H50 & H100 = humic acid 50 & 100 mg/l, F50 & F100 = fulvic acid 50 & 100 mg/l, T0, T15 & T30 = lime %,respectively, chlorophylls= (ppm),N&RWC=%.