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# Changes of Sorghum growth in response to drought and allelopathy stresses

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**ABSTRACT**

*In this research effect of Eucalyptus camaldulensis L. leaves compose as biotic stress in ratio 0,( control), 4 and 8% (w/w) with soil and drought as abiotic stress include 25% and 10% of soil saturation capacity on growth parameters of Sorghum were studied. Sorghum bicolor var. Speed feed seeds were planted under pots condition in photoperiods 21 ± 1 ºC and 14– h light /10 –h dark. 30 days after planting were separated root from shoot and growth parameters were determined. The results showed that length, fresh and dry weight of root and shoot, number and area of sorghum leaves to application of decompose of Eucalyptus leaf in ratio 4%and 8% with soil were significantly decreased. Also mild and sever stress of drought also reduced growth parameters in root and shoot of Sorghum in comparison to control . Our data showed the growth reduction in Sorghum is more severe by Eucalyptus leaf decompose as biotic stress in comparison to drought stress as abiotic stress.*

**Key words:** Allelopathy, Drought, Eucalyptus, Growth, Sorghum

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## INTRODUCTION

Drought stress is one of the major abiotic stresses, which adversely affects crop growth and yield[21,17] .Drought is a meteorological term and is commonly defined as a period without significant rainfall. Generally drought stress occurs when the available water in the soil is reduced and atmospheric conditions cause continuous loss of water by transpiration or evaporation[11]

Allelopathy also refers to the chemical inhibition of one species by another Allelopathy, the chemical mechanism of plant interference, is characterized by a reduction in plant emergence or growth..The multiple effects resulting from allelopathic allelochemicals include decreases in plant growth, absorption of water and mineral nutrients, ion uptake, leaf water potential, shoot turgor pressure, osmotic potential, dry matter production [23,6].

Sorghum is a drought-tolerant crop, it is often preferred by producers in cases of expected water stress. Grain sorghum is also more capable than corn of taking up nutrients from soil in drought conditions [14]. Nevertheless several factors limit sorghum yields including: drought, prolonged dry periods, or delayed rainfall; nutrient deficiencies; weeds, insects, and diseases; cool, wet weather at planting or harvest [2].

Eucalyptus is one of the most important tree species for wood production in the world. It is said that Eucalyptus is toxic, due to allelopathic properties, which serve to reduce germination of other plant [12, 22]. Researches showed

that Eucalyptus species released volatile compounds such as benzoic, cinnamic and phenolic acids, which inhibited growth of crops and weeds growing near it [20, 13].

Since the plants during their lives are affected by abiotic and biotic stress, the aim of this study was to investigate and compare changes in growth of sorghum in response to drought (abiotic stress) and Eucalyptus leaf compose (biotic stress).

## MATERIALS AND METHODS

In summer 2012, Eucalyptus leaves *(Eucalyptus camaldulensis* L.) were harvested from natural habitat located on Sari city in North Iran. Then leaves were dried in shade and grinded. Dried samples were mixed with soil (Si-Clay tissue) in ratio (0, control), 4 and 8% (w/w) and this mixture were placed in shade for 30 days.

For the drought stress treatments, the soil saturation capacity was determined. Then, 50%, 25% and 10% of soil saturation capacity respectively was considered as the control, mild and severe drought stress.

Seeds of forage sorghum (*Sorghum bicolor* var. Speed feed) were soaked for two days. Then 4-day seedlings were transferred to pots including 3 Kg of soil (Si-Clay tissue) in photoperiods 20 ± 2 ºC and 14– h light /10 –h dark. Then five treatments included 25% (as mild drought stress) and 10% (as severe drought stress ) of soil saturation capacity, decompose of Eucalyptus leaf in ratio 4% (as mild allelopathy stress ) and 8% (as mild allelopathy stress ) with soil 50% of soil saturation capacity without decompose of Eucalyptus leaf was considered as well as control. Each treatment was replicated four times and arranged in a randomized complete block design.

30 days after planting were separated root from shoot and growth parameters were determined.Root and shoot length was measured with a ruler (cm) and weight of them was measured on scales with an accuracy of 0.001g.

The statistical significance of the difference between parameters was evaluated by means of Duncan-test on SPSS 13 .The results were given in the text as p, the probability values, and $p \leq 0.05$ was adopted as criterion of significance.

## RESULTS

The results of this study showed that by increasing amount of decompose Eucalyptus leaf in soil (4 and 8%) shoot and root length of sorghum at $p \leq 0.05$ decrease compared with control significantly. Also mild and sever stress of drought reduced shoot and root length in sorghum in comparison to control (fig 1).

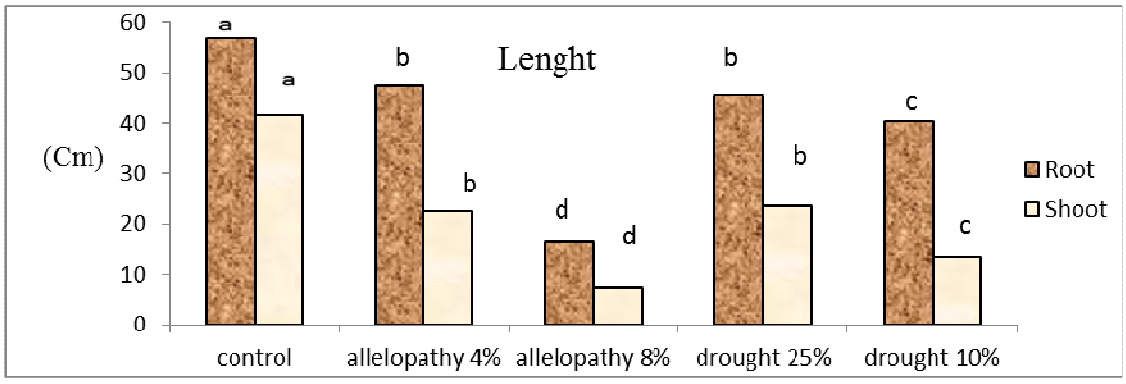


**Fig 1: Effect of allelopathy stress (decompose of Eucalyptus leaf in ratio 4%and 8% with soil ) and drought stress (25% and 10% of soil saturation capacity and control(50% soil saturation capacity and without decompose of Eucalyptus leaf ) on root and shoot length of Sorghum. Similar letters indicate no significant difference in Duncan's test (P≤0.05)**

Application 4 and 8% of Eucalyptus leaf decompose decreased fresh and dry weight of sorghum shoot and root in comparison to control that this reduction in shoot fresh and dry weight was higher (fig2,3).Present results also

indicated that mild and severe drought stress decreased fresh and dry weight of sorghum shoot and root compared with control (fig2,3)

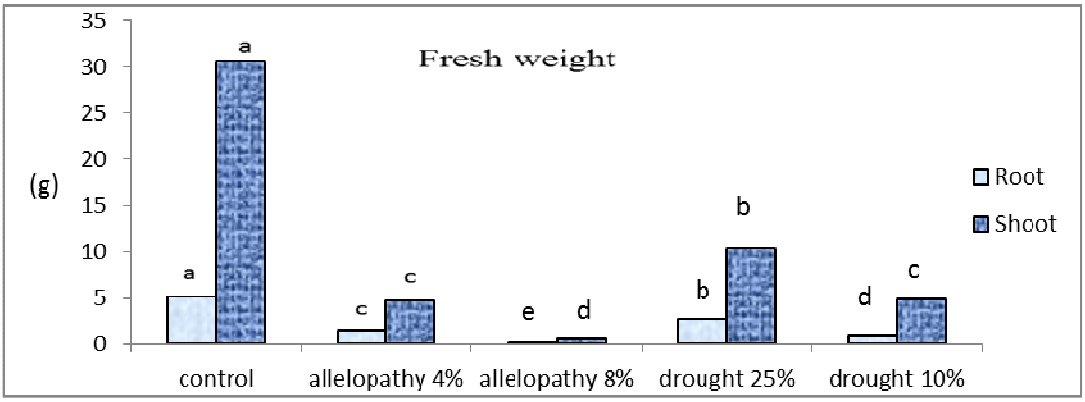


**Fig 2: Effect of allelopathy stress (decompose of Eucalyptus leaf in ratio 4%and 8% with soil ) and drought stress (25% and 10% of soil saturation capacity and control(50% soil saturation capacity and without decompose of Eucalyptus leaf ) on root and shoot fresh weight of Sorghum. Similar letters indicate no significant difference in Duncan's test (P≤0.05)**

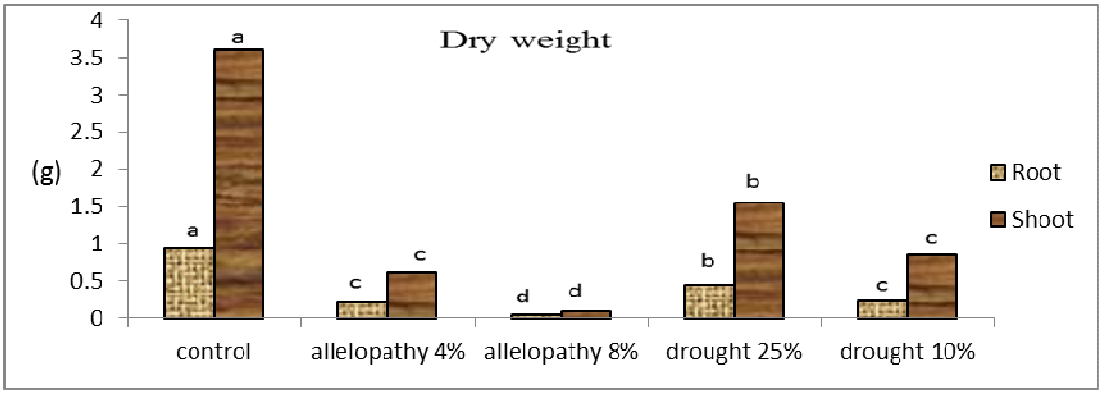


**Fig 3: Effect of allelopathy stress (decompose of Eucalyptus leaf in ratio 4%and 8% with soil ) and drought stress (25% and 10% of soil saturation capacity and control(50% soil saturation capacity and without decompose of Eucalyptus leaf ) on root and shoot dry weight of Sorghum. Similar letters indicate no significant difference in Duncan's test (P≤0.05)**

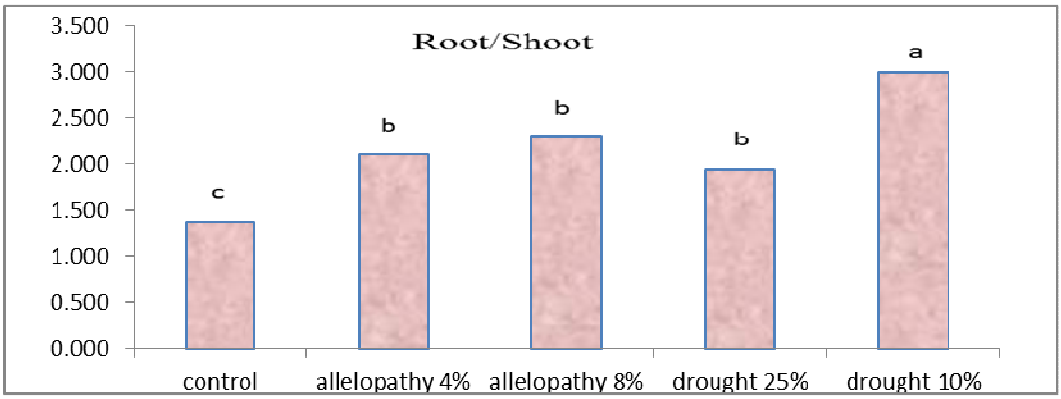


**Fig 4: Effect of allelopathy stress (decompose of Eucalyptus leaf in ratio 4%and 8% with soil ) and drought stress (25% and 10% of soil saturation capacity and control(50% soil saturation capacity and without decompose of Eucalyptus leaf ) on root / shoot length of Sorghum. Similar letters indicate no significant difference in Duncan's test (P≤0.05)**

Also, the analysis of data revealed that decompose of Eucalyptus leaf and drought stress increased root to shoot ratio in sorghum and was significant compared with the control(fig 4)

The results also showed that leaf number and area sorghum leaves were reduced in the treated decompose of Eucalyptus leaves and drought stress and this reduction in decompose of Eucalyptus leaf was more (fig 5,6).

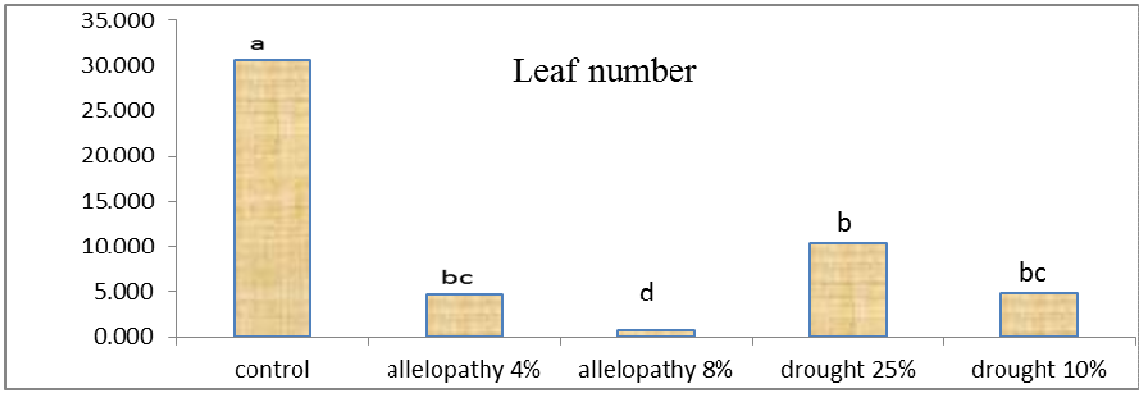


**Fig 5: Effect of allelopathy stress (decompose of Eucalyptus leaf in ratio 4%and 8% with soil ) and drought stress (25% and 10% of soil saturation capacity and control(50% soil saturation capacity and without decompose of Eucalyptus leaf ) on leaf number of Sorghum. Similar letters indicate no significant difference in Duncan's test (P≤0.05)**

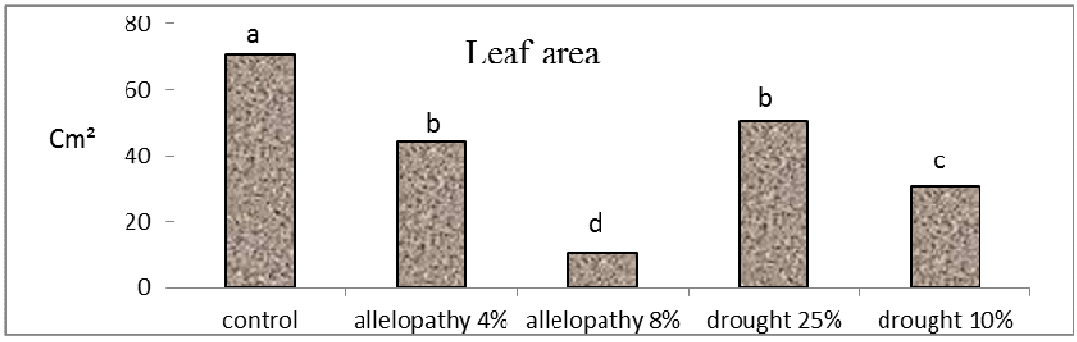


**Fig 6: Effect of allelopathy stress (decompose of Eucalyptus leaf in ratio 4%and 8% with soil ) and drought stress (25% and 10% of soil saturation capacity and control(50% soil saturation capacity and without decompose of Eucalyptus leaf ) on leaf area of Sorghum. Similar letters indicate no significant difference in Duncan's test (P≤0.05)**

## DISCUSSION

Present results also indicated that length, fresh and dry weight of root and shoot, number and area of sorghum leaves to application of decompose of Eucalyptus leaf in ratio 4%and 8% with soil were significantly decreased.(fig 1-6).

Researches showed that Eucalyptus species released volatile compounds such as benzoic, cinnamic and phenolic acids [20]. Daizy [7] reported that volatile oil from leaves of *Eucalyptus citriodora* significantly reduced germination seedling length in *Triticum aestivum*, *Zea mays* and *Raphanus sativus*. Batish [4] reported that water extracts of *E. citriodora* significantly reduced weed establishment.

Morphological effects in growth may be the secondary manifestation of primary events, caused by variety of more specific effects acting at the cellular or molecular level in the receiver plants. Moreover, the inhibitory compounds might have reduced the uptake of nutrients which ultimately reduced shoot growth [18]. It has been reported that most of the growth parameters of Phalaris were decreased when exposed to different amounts of decompose and water extracts of *Eucalyptus camaldulensis* leaf and the reduction is more severe by Eucalyptus leaves decompose [15].Recently, allelochemicals have been proposed to cause oxidative stress in target tissue and induce an

antioxidant mechanism. Increased levels of scavenging enzymes indicates their induction as a secondary defense mechanism in response allelopathic compounds [16, 1].

The results of this study showed that mild and sever stress of drought also reduced length, fresh and dry weight root and shoot , number and area of sorghum leaves in comparison to control (fig 1-6). It has been reported sorghum can tolerate short periods of less severe water deficit. However, long-term and severe stress can affect sorghum growth and the final yield [3]. Researches have shown that water stress at seeding will reduce endosperm weight as well as growth of the coleoptile, radicle, shoot, and root of sorghum [5,10]. Also drought stress decrease the rate of cell expansion and, ultimately, cell size and consequently, growth rate, stem elongation, and leaf expansion . Therefore, water stress reduce plant height and rate of leaf appearance [9] It has been indicated that growth of corn decreased at higher drought stress level [8].Our results indicated drought stress increased root to shoot ratio in sorghum and was significant compared with the control (fig4). In most cases, the sorghum root-to-shoot ratio has been reported to increase under water stress [19, 24]. The increased ratio is mainly due to a decrease in shoot growth rather than an absolute increase in root growth under stress[ 3].

## CONCLUSION

Present results indicated that all growth parameters in *Sorghum bicolor* var. Speed feed were reduced in response to drought (abiotic stress) and Eucalyptus leaf compose (biotic stress) and the reduction is more severe by Eucalyptus leaf decompose.

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