ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

RELATION BETWEEN LEAF AREA AND LEAF RELATIVE WATER CONTENT UNDER THE EFFECT OF DIFFERENT BORON CONCENTRATIONS.

JADHAV SUJEET S. AND BHAMBURDEKAR S. B.

P.G. Department of Botany, Plant Physiology Section, Krishna Mahavidyalaya Rethare (Bk), Dist, Satara (M.S.) India, 415110.

Manuscript Info

Manuscript History:

Received: 14 November 2015
Final Accepted: 26 December 2015
Published Online: January 2016

Key words:
Leaf area, Relative water content, boron, sweet Sorghum.

Corresponding Author

JADHAV SUJEET S.

Abstract

The relative water content in leaf tissues is generally measured to assess the water status of plants while measurement of leaf area is most important for physiological and agronomical studies of crop growth. In the present investigation the effect of different boron concentrations on measurement of leaf area, leaf area ratio and relative water content of leaf tissues of sweet Sorghum c. v. Madhura was studied. The different concentrations of boron used as 10 ppm, 50 ppm and 100 ppm along with control i.e. 0 ppm as distilled water. The leaf area and leaf area ratio are showing increase due to 50 ppm boron concentration which ultimately increases relative water content. However further increase in boron concentration reduces both leaf area and relative water content in c. v. Madhura.

Introduction:-

The leaf area index has been defined as the total one sided area leaf tissues per unit ground surface area (Watson, 1947). The number of leaves, size expansion and senescence of a particular leaf determines the leaf area. At the initial stage of growth higher leaf area increases the photosynthesis in plants which develops root and shoot system. However higher leaf area at later stage of growth affects negatively on plant yield was observed by Vidhiyaverman *et al*. (1993).

RWC is the amount of water in leaf relative to its dry weight. RWC also expresses the effect of osmotic adjustments. It is an indicator of deficit water (Ehrler and Nakayama, 1994). Thus turgidity of a cell is counted as leaf relative water content. This was firstly known as 'Relative turgidity' but later corrected and termed as 'Relative Water Content'. The turgor and volume of a plant is maintained by water. The loss of turgor pressure is observed when RWC reduces, which leads to limited availability of water for cell expansion (Karimi *et al*., 2005).

Boron is a micronutrient essential for plant growth which plays important role in the most physiological processes within plant (Warrington, 1923). According to Bell (1997), the requirement of boron for plant growth varies from species to species. Boron is irregularly spread over the soil surface which leads to insufficient crop growth as it is either low or high, may cause some toxic effects on plants (Rerkasem *et al*., 2003).

Material and Method:-

The Sorghum c. v. Madhura is grown in individual pots which were treated with 10 ppm, 50 ppm and 100 ppm boron along with one pot untreated i.e. 0 ppm named as control. These treatments were given at 15 days old seedlings and the treatment was repeated at 40 days and 70 days old plant after sowing. The fresh leaf samples were collected on the 5^{th} day of last boron treatment and washed thoroughly with distilled water for further analysis.

The leaf area per plant was calculated by linear regression method using following formula,

Leaf Area (A) = Length x Breadth x Factor

Total leaf area was calculated by simply multiplying average number of leaves per plant and average leaf area. From this data, average leaf area per plant was calculated. For calculating leaf area ratio (cm^2 g^{-1}) the formula given by Radford (1969) was used which is as follows,

$$LAR = \frac{\text{Leaf area } (cm^2 \text{ plant}^{-1})}{\text{Total dry weight (g)}}$$

The LRWC was calculated by following the procedure as the two fully expanded leaves were selected from every treated pot along with control and weighted to determine fresh weight (FW). To obtain the turgid weight (TW), these leaves were kept floating in distilled water in a closed petridishes. These leaves were weighted periodically until a steady weight was achieved. Every time the tissue paper was used to wipe out water from leaf surface. Then the leaf samples were kept in pre-heated oven at 70^0 c for 48 hrs. in order to determine constant dry weight (DW). The values of FW, TW and DW were used to calculate LRWC using the equation given by Kaya *et al*. (2003) as given below:

$$LRWC\ (\%) = [(FW-DW)/ (TW-DW)] \times 100.$$

Result and Discussion:-

Table I. The effect of boron on the leaf area and Leaf area Ratio of sweet Sorghum c. v. Madhura.

Boron Treatments	Leaf Area (cm^2 pl^{-1})	Leaf Area Ratio (cm^2gm^{-1})
0 ppm (Control)	126.6 ± 0.80	1.4026
10 ppm	179.5 ± 2.10	1.4806
50 ppm	165 ± 2.60	1.7454
100 ppm	95.5 ± 0.48	1.0329

Table II. The effect of boron on the leaf relative water content of sweet Sorghum c. v. Madhura.

Boron Treatments	LRWC (%)
0 ppm (Control)	82.4
10 ppm	80.38
50 ppm	85.85
100 ppm	79.41

The table I shows that leaf area and leaf area ratio both are increased due to 50 ppm boron treatment. However higher dose of boron has reduced the leaf area and leaf area ratio. The table II shows the application of boron has increased the relative water content due to 50 ppm boron concentration. However the low concentration of boron i. e. 10 ppm and higher dose i. e. 100 ppm of boron has reduced LRWC in c. v. Madhura.

The reports on effect of boron on leaf area development in Sorghum are very scanty. In barley plant, El-Feky *et al*. (2012) reported that when boron was given at limited dose of 0.5 to 1.5 mg per lit shows increased leaf area but gradual increase in boron up to 6.0 mg per lit. has adverse effects. The 50 ppm boron foliar application along with yeast in broad bean plant (*Vicia faba* L.) shows highest total leaf area was reported by El-Yazied and Mady (2012).

The Sorghum variety like *Sorghum bicolor*, sudan grass (*Sorghum sudanense*) and maize when subjected to water stress conditions, full turgor pressure was reported by Zhang and Kirkham (1995), Singh and Singh (1995) and Bibi *et al*. (2010) respectively. According to Xie *et al*. (2010) RWC is decreased due to draught and stressed conditions in sweet Sorghum.

Similarly there are various reports suggesting effects of boron on RWC in different plants. Supply of boron to maize in boron deficit soil has increased leaf relative water content was reported by Sayed (1998). According to Nasta *et al*. (2014) in *Salvia officinalis*, plant under saline water treatment shows increased RWC when boron was applied.

Higher doses of boron also responsible for decreasing RWC in sunflower plant as reported by Riaz *et al*. (2012). According to him minimum production of leaf area due to higher boron doses are responsible to reduce RWC.

In the present investigation the decrease in RWC also noticed due to 10 and 100 ppm boron treatment correlated with these findings.

Conclusion:-

The enhancement in leaf area, leaf area ratio and RWC due to application of 50 ppm boron in c. v. Madhura shows correlation which is an adaptive mechanism for stress conditions.

References:-

1. Bell, R. W. (1997). Diagnosis and prediction of boron deficiency for plant production. *Plant Soil*, **193**: 149-168.
2. Bibi, A., H. A. Sadaqat, H. M. Akram and M. I. Mohammed (2010). Physiological markers for screening Sorghum (*Sorghum bicolor*) germplasm under water stress condition. *Inter. J. Agri. and Bio.*, **12**: 451-455.
3. Ehrler, W.L. and Nakayama, F.S. (1984). Water stress status in guayule as measured by relative leaf water content *Crop Sci*., **24**: 61-66.
4. El-Feky, S.S., El-Shintinawy, F.A., Shaker, E.M. and El-Din, H.A.S. (2012). Effect of elevated boron concentrations on the growth and yield of barley (*Hordeum vulgare* L.) and alleviation of its toxicity using different plant growth modulators. *Aust. J. of Crop. Sci.*, **6**(12): 1687-1695.
5. EL-Yazied, A. A. and M.A. Mady (2012). Effect of boron and yeast extract foliar application on growth, pod setting and both green pod and seed yield of broad bean (*Vicia faba* L). *J. App. Sci. Res.*, **8**(2): 1240-1251.
6. Karimi, G., M. Ghorbanii, H. Heidari, R. A. Nejad and M. Assareh (2005). The effect of NaCl on growth, water relations, osmolytes and ion content in Kochia prostrate. *Biologia Plant*, **49**(2): 301-304.
7. Nasta, O., A-L. Anastasia, G. Liakopoulos and A-E. Nikolopoulou (2014). Effects of salinity in the form of simulated sea-spray (NaCl or NaCl + H_3BO_3 solution) on growth and photosynthetic performance of sage (*Salvia officinalis*). *AJCS*, **8** (8): 1186-1194.
8. Rerkasem, B., S. Nirantrayagul and S. Jamjod (2003). Increasing boron efficiency in international bread wheat, durum wheat, triticale and barley germplasm will boost production on soils low in boron. *Field Crops Res.*, **86**:175-184.
9. Riaz, M. A., M. Soqib, J. Akthar and R. Ahmad (2012). Interactive effect of salinity and boron application on growth and physiological traits of sunflower (*Helianthus anuus* L.) genotypes. *Soil Environ*. **31**(2): 119-124.
10. Sayed, S. A. (1998). Impacts of boron application on maize plants growing under flooded and unflooded conditions. *Biologia Plantarum*, **41** (1): 101-109.
11. Singh, B. R. and D.P. Singh (1995). Agronomic and physiological responses of Sorghum, maize and pearl millet to irrigation. *Field Crop Res*., **42**:57-67.
12. Vidhiyavarman, P., Geetha Lakshmi, V. and Raveendran, T. S. (1993). Partitioning of dry matter in foliar disease resistance genotypes of groundnut (*Arachis hypogaea* L.) *Journal of oilseed Research*, **10**: 187-190.
13. Warrington, K. (1923). The effect of boric acid and borax on the broad bean and certain other plants. *Ann. Bot.*, **37**: 629- 672.
14. Watson, D. J. (1947). Comparative physiological studies on growth of field crops. I. Variation in net assimilation rate and leaf area between species and varieties and within and between years. *Ann. Bot.* **41**: 41-76.
15. Xie Tingting, S. Peixi and S. Lishan (2010). Photosynthetic characteristics and water use efficiency of sweet Sorghum under different watering regimes. *Pak. J. Bot*., **42**(6): 3981-3994.
16. Zhang, J. and M. B. Kirkham (1995). Water relations of water-stressed, spilt-root (*Sorghum bicolor*, Poaceae) and *Helianthus annuus* Asteraceae plants. *Amer. J. Bot*., **82**(10): 1220-1229.