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## RESEARCH ARTICLE

**EFFICIENCY OF BORON AND MAGNESIUM LEVELS ON PRODUCTIVITY OF CAULIFLOWER  
(BRASSICA OLERACEA L.)**

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**Abstract**

The aim of study was to evaluate the effect of dissimilar boron and magnesium levels on growth of cauliflower. Plants were checked for Plant height (cm), Number of leaves plant per plant day's number taken from transplanting to curd formation, day's number taken from curd initiation to maturity, fresh weight of foliage (gm), Foliage dry weight (gm), Curd weight (gm), Curd area (cm<sup>2</sup>), Chlorophyll contents (nm), Leaf area (cm<sup>2</sup>), Yield ha<sup>-1</sup>. The RCBD experiment was employed out in triplicate treatments. Experimental treatment included **T<sub>0</sub>** = Control, **T<sub>1</sub>** = Boron 10 kg ha<sup>-1</sup>, **T<sub>2</sub>** = Boron 15 kg ha<sup>-1</sup>, **T<sub>3</sub>** = Boron 25 kg ha<sup>-1</sup>, **T<sub>4</sub>** = Magnesium 10 kg ha<sup>-1</sup>, **T<sub>5</sub>** = Magnesium 15 kg ha<sup>-1</sup>, **T<sub>6</sub>** = Magnesium 25 kg ha<sup>-1</sup>, **T<sub>7</sub>** = Boron 10 kg ha<sup>-1</sup> + Magnesium 10 kg ha<sup>-1</sup>, **T<sub>8</sub>** = Boron 15 kg ha<sup>-1</sup> + Magnesium 15 kg ha<sup>-1</sup>, **T<sub>9</sub>** = Boron 25 kg ha<sup>-1</sup> + Magnesium 25 kg ha<sup>-1</sup>. Different treatments showed effect for different parameters on production of plants. Results showed that **T<sub>9</sub>, T<sub>8</sub> and T<sub>7</sub>** has enormous effect on plant height, number of leaves per plant, number of days to curd initiation to maturity Foliage fresh weight (FFW), Foliage dry weight (FDW), curd weight, curd area, chlorophyll contents, leaf area and yield and **T<sub>2</sub>, T<sub>4</sub> and T<sub>6</sub>** showed the minimum days for formation of curd as compared to control and other treatments. Thus outcome indicated that cauliflower needs nutrients combination for better growth and development in field.

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**Introduction:-**

Among the 16 essential nutrient elements Boron is a critical micronutrient for plants. Boron carries out a variety of functions for plant growth and enlargement. Application of boron significantly maximizes curd length and width, curd weight, production and superiority of cauliflower (Kumar et al., 2002). Boron absence can be the cause of hollow or unfilled stem, stem discolouration, curd cracking, rolling of leaf, malformed buds and additionally turning of curd colour into brown. Whenever the soil testing show little amount of boron the apply some boron to the soil or leaves. The potential function of B include sugar transportation, cell wall formation, lignifications, cell wall structure integrity, carbohydrate break down, RNA metabolism, uptake and intake of air, IAA metabolism and as part of the cell membranes (Ahmad et al., 2009). Total boron in soil is reported between the range of 20 to 200 mg B kg<sup>-1</sup> (Mengel & Kirkby, 1987) and its available concentrations also vary greatly from soil to soil. Application of micronutrient as calcium, magnesium and boron along with the recommended doses of macronutrient as N, P, K boost up yield component of cauliflower (Kirthisinghe and Dombagolla, 2011). Prevention and correction of Boron absence in crops on Boron lack soils can have a remarkable result on production quality of many crops including

fibre crops, cereals, pulses crops, oilseeds crops, vegetables, citrus and alfalfa crop (Ahmad et al., 2012). Magnesium deficit spots appear on the older leaves first and include interveinal chlorosis. As the chlorosis intensifies, purple colour spots might be seen close to the leaf borders. Lack is quite common particularly on soils having light acid. Longer shelf life in the curds obtained from NPK with Ca, Mg and B treatment irrespective of the storage conditions ( Kirthisinghe & Dombagolla, 2011). Magnesium and Nitrogen plays equal role in improving cauliflower yield. Curd mass can be increased and hollow stem can be decreased by applying B and M (Batal et al., 1997). Magnesium significantly improved fresh weight of foliage, height of plant, fresh weight of plant leaves and dry weight of plant leaves, whole profitable curds yield and chemical composition of leaves and curds (Ahmed et al., 2011). Keeping in mind the entire reasons, the research was done to investigate B and M efficacy on cauliflower by applying different combinations of treatment.

### **Materials and Methods:-**

Materials for this research consisted on plants of cauliflower (cv. Shumaila) and different boron and magnesium treatments. Cauliflower seeds were purchased from local seed. All treatments levels with its 3 replications were applied at time of sowing.

Row to row distance was 70 cm and plant to plant distance was 30 cm. The net plot size was (Net plot size =  $3.04 \times 18.29 = 55.60 \text{ m}^2$ ). Direct seed sowing method was taken place on ridges. Recommended fertilizer application of Nitrogen, Phosphorus and Potash were also applied in soil for stabilization. One third of NPK was given during land preparation while remaining NPK was applied throughout the season as needed by the crop. The first irrigation was applied immediately before transplantation while subsequent irrigations were applied as per crop requirement. Hoeing and weeding were culturally practiced according to requirement. Plant protection measures were applied and followed standard recommendations. Fungicides like Dithane M-45, Radomil and insecticides like Polo, tracer and Imidacloprid were applied to control insects and disease infestation. The trial was laid out according to Randomized complete block design and triplicate with ten (10) treatments.

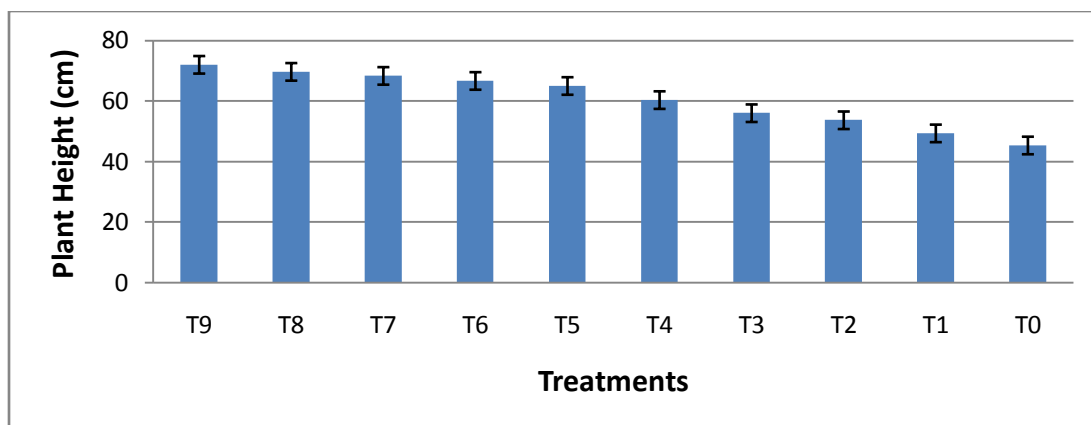
### **Statistical analysis:-**

The research was executed in open field conditions according to Randomized complete block design (RCBD) having ten treatments of different levels of boron and magnesium along with control. every treatment was replicated for three times. Mean values for various treatments indicating significant differences were compared using Duncan's Multiple Range Test (DMR) at 5% probability level (Steel and Torrie, 1997). In the end graphical representation was done from statistical means.

### **Results and Discussion:-**

#### **Plant Height (cm)**

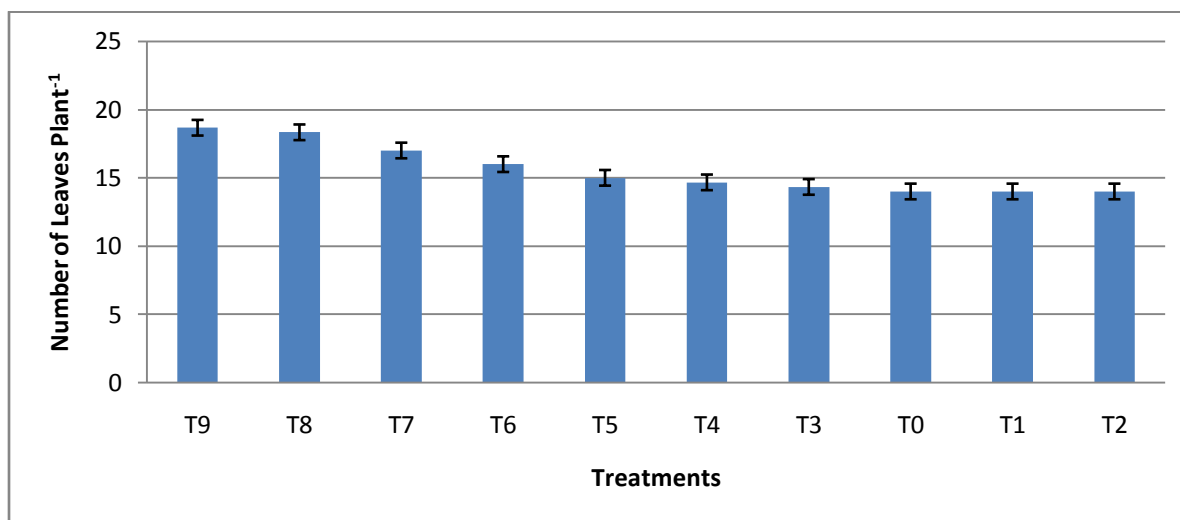
Cauliflower was put under experiment and height of plant was noted. Fig. 1 shows the comparison of average plant heights (cm) of shumaila cultivar obtained by the application of 10 different treatments. Highest plant height was observed in T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) and T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha), T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) showed average results. T<sub>6</sub> (Magnesium 25 kg/ha), T<sub>5</sub> (Magnesium 15 kg/ha) showed intermediate results. T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha), T<sub>1</sub> (Boron 10 kg/ha) and T<sub>0</sub> (control) showed no significant results. Results are related with the Adhikary et al. (2004), conducted experiment and found the similar results. They use 6 levels of boron (0 kg, 5 kg, 10 kg, 15 kg, 20 kg and 25 kg borax ha<sup>-1</sup>). The growth (plant height, leaf numbers, leaf length and fresh biomass production) was affected significantly by the boron levels. Ahmad et al. (2011) performed experiment and found that magnesium significantly effects the tender growth of plants.



**Fig. 1:** Effectiveness of different levels of boron and magnesium on plant height (cm)

#### Number of leaves plant per plant:-

Data regarding number of leaves per plant of shumaila cultivar gained by the application of ten different treatments showed significant results (fig.2). Maximum number of leaves were recorded by applying T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 17.667 leaves per plant, followed by T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with 17.333 leaves per plant. Plants treated with T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha), T<sub>6</sub> (Magnesium 25 kg/ha), T<sub>5</sub> (Magnesium 25 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha) showed intermediate number of leaves per plant. Minimum number of leaves were recorded by applying T<sub>2</sub> (Boron 15 kg/ha), T<sub>1</sub> (Boron 10 kg/ha) and T<sub>0</sub> (control) which showed no significant results with T<sub>5</sub> (Magnesium 25 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha) and T<sub>3</sub> (Boron 25 kg/ha) by getting 11.58 leaves per plant. Adhikary et al. (2004) conducted experiment and found the similar results. They used six levels of boron (0 kg, 5 kg, 10 kg, 15 kg, 20 kg and 25 kg borax ha<sup>-1</sup>). The growth (plant height, leaf numbers, leaf length and fresh biomass production) was affected significantly by the boron levels. Ahmad et al. (2011) performed experiment and revealed results that magnesium has significant effects on vegetative growth of cauliflower plant.

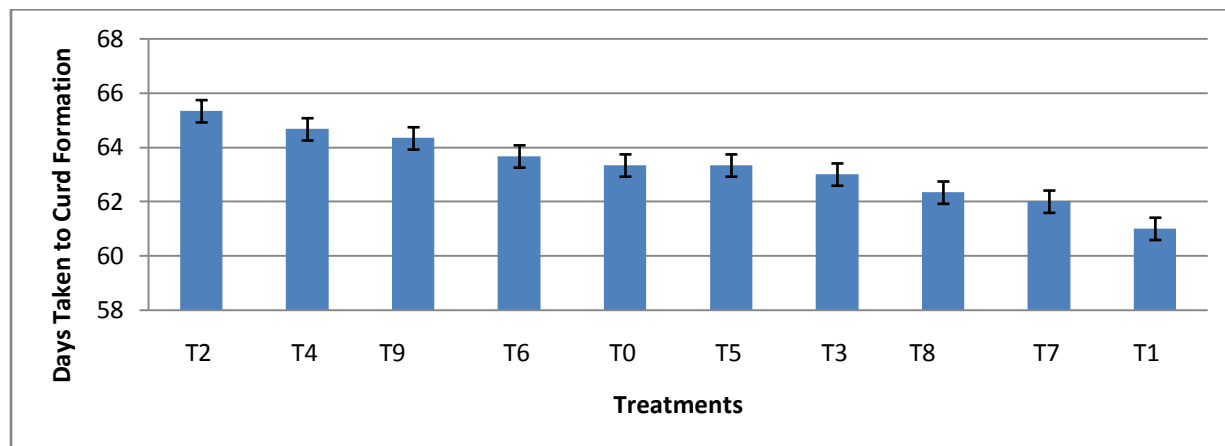


**Fig. 2:** Effectiveness of different levels of boron and magnesium on number of leaves plant<sup>-1</sup>

#### Number of Days Taken to Curd Formation:-

Number of days taken from sowing to curd formation was recorded by cauliflower variety Shumaila by the application of different treatments. Fig. 3 showed the assessment of average number of days taken from sowing to curd formation, gained by the application of ten different treatments. Minimum number of days were recorded in T<sub>2</sub> (Boron 15 kg/ha) with an average of 65.33 days, followed by T<sub>4</sub> (Magnesium 10 kg/ha) with 64.667 days T<sub>6</sub> (Magnesium 25 kg/ha) T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha). Plants treated with T<sub>3</sub> (Boron 25 kg/ha), T<sub>5</sub>

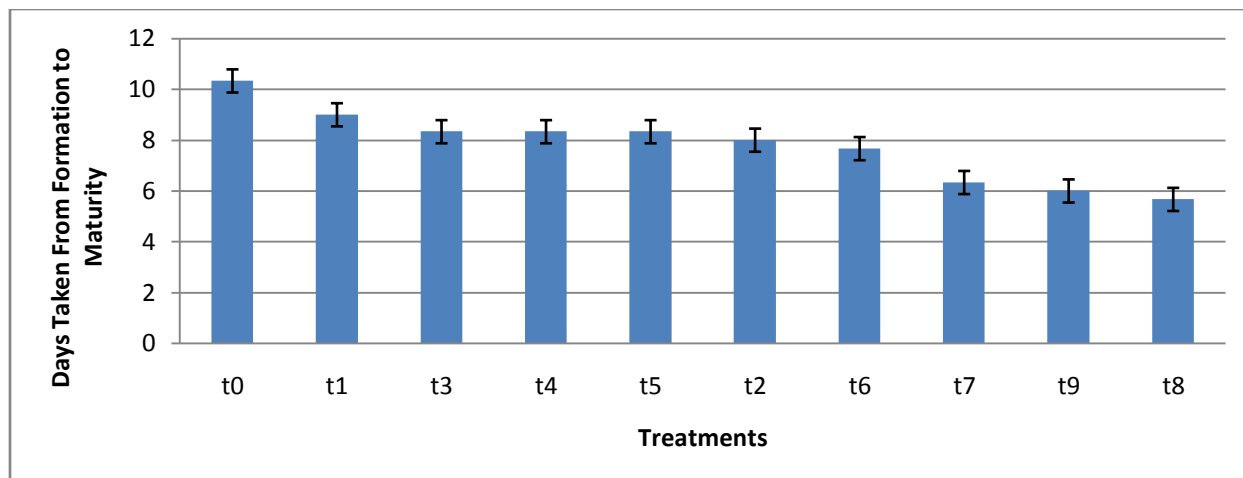
(Magnesium 15 kg/ha) and T<sub>0</sub> (control) showed intermediate number of days taken to reach curd formation stage. Maximum number of days were recorded by in T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha), T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) which showed significant results from all the rest of treatments by taking 67.35 days on average from sowing to curd formation. Rakhsh and Golchin, (2012) performed experiments and observed that boron has no significant results on number of days to curd formation. Kirthisinghe and Dombagolla, (2011) conducted experiment and revealed that magnesium and boron has no significant effect on number of days to curd formation.



**Fig.3:** Effectiveness of different levels of boron and magnesium on number of days taken to curd formation

#### Number of days Taken from curd initiation to maturity:-

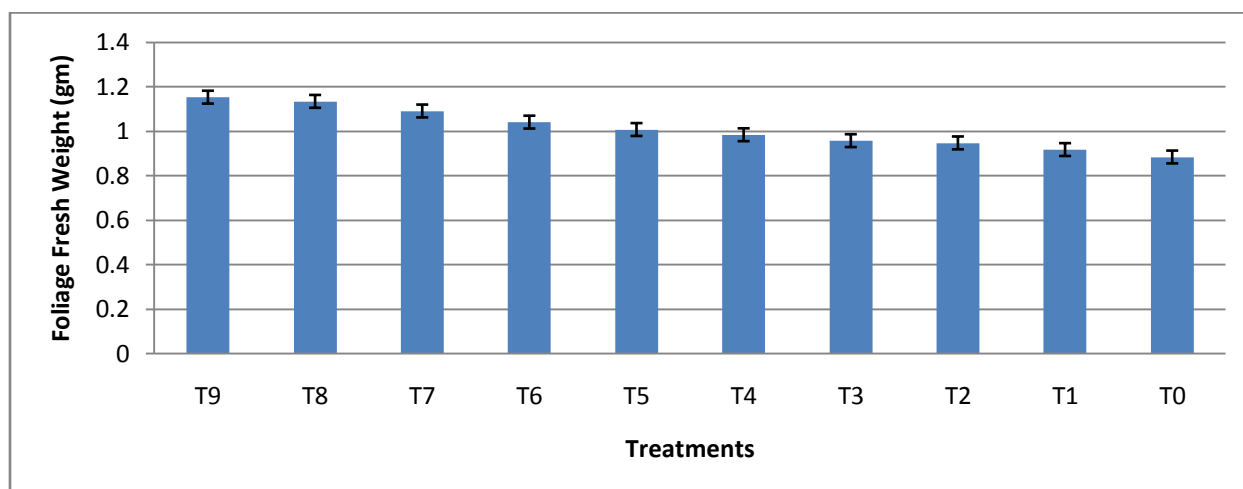
Significantly different number of days to reach curd maturity stage was recorded by cauliflower variety Shumaila the application of different treatments. Fig. 4 shows the comparison of average number of days taken from transplanting to curd formation, gained by the application of ten different treatments. Minimum number of days were recorded in T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with an average of 5.665 days, followed by T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with average of 6 days. Plants treated with T<sub>6</sub> (Magnesium 25 kg/ha) and T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) showed intermediate number of days taken to reach curd formation stage. Maximum number of days were recorded by in T<sub>5</sub> (Magnesium 15 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) which showed significant results from all the rest of treatments by taking 8.33 days an average from transplanting to curd formation. T<sub>1</sub> (control) showed significant result with rest of treatments by taking maximum numbers to maturity with an average of 10.33. Rakhsh and Golchin, (2012) performed experiments and observed that boron has no significant results on number of days to curd formation. Kirthisinghe and Dombagolla, (2011) conducted experiment and revealed observations that magnesium and boron has no significant effect on number of days to curd formation.



**Fig. 4:** Effectiveness of different levels of boron and magnesium on number of days Taken from curd initiation to maturity

#### Foliage fresh weight (gm):-

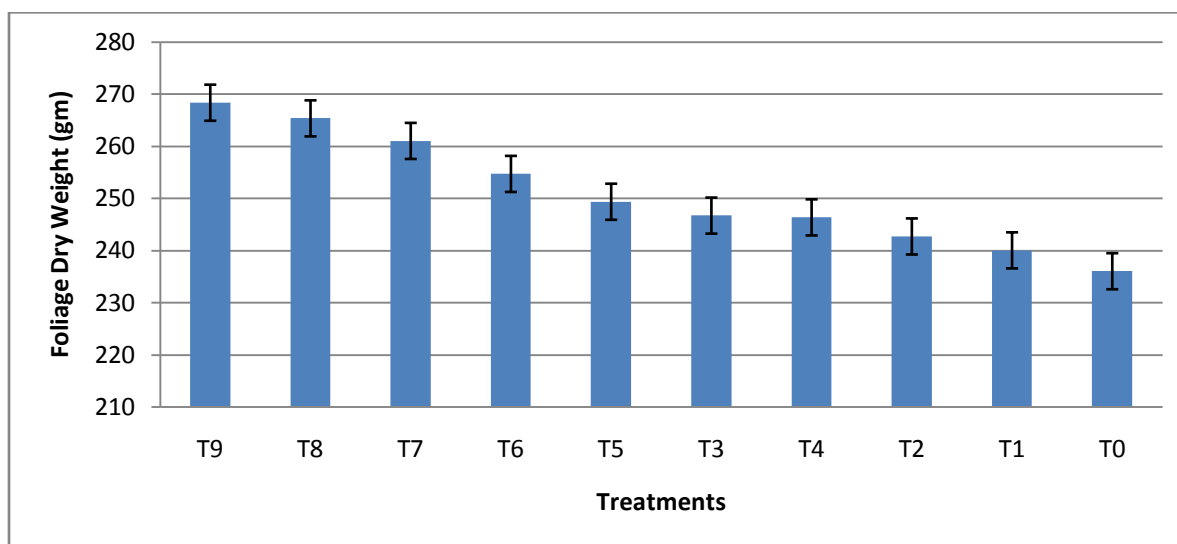
Fig.5 shows the comparison of average foliage fresh weights (gm) of Shumaila cultivar gained by the application of ten different treatments. Maximum foliage fresh weight was recorded in T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 1.152 g followed by T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with 1.133 g. Plants treated with T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha), T<sub>6</sub> (Magnesium 25 kg/ha) and T<sub>5</sub> (Magnesium 15 kg/ha) showed intermediate weights. Minimum foliage fresh weight was recorded in T<sub>0</sub> (control). While T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) also showed minimum non significant results. Bhat et al. (2010) performed experiments and observed that boron has significant effects on foliage fresh weight. Kirthisinghe and Dombagolla (2011) conducted experiment and revealed that magnesium and boron has significant effect on foliage fresh weight. Adhikary et al. (2004) conducted experiment and found similar results. They use six levels of boron (0 kg, 5 kg, 10 kg, 15 kg, 20 kg and 25 kg borax ha<sup>-1</sup>). The growth (plant height, leaf numbers, leaf length and fresh biomass production) was affected significantly by the boron levels. Ahmad et al. (2011) performed experiment and revealed results that magnesium has significant effects on vegetative growth of cauliflower plant.



**Fig. 5:** Effectiveness of different levels of boron and magnesium on foliage fresh weight (gm).

**Foliage Dry Weight (gm):-**

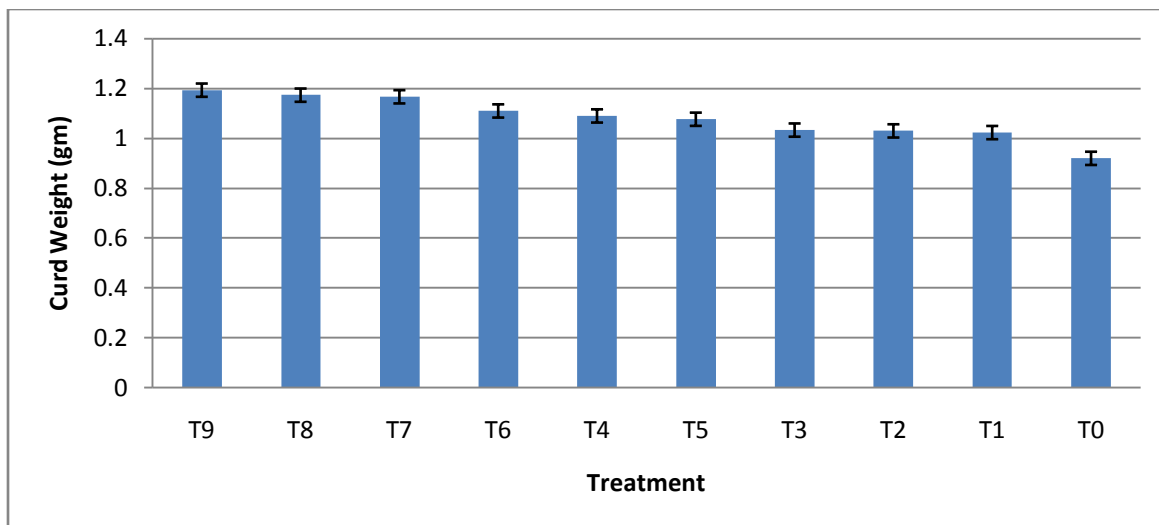
Fig. 6 shows the comparison of average foliage fresh weights (g) of Shumaila cultivar gained by the application of ten different treatments. Maximum foliage dry weight was recorded in T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 268.33 gm followed by T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with 265.33 gm and T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha). Plants treated with T<sub>6</sub> (Magnesium 25 kg/ha) and T<sub>5</sub> (Magnesium 15 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) showed intermediate weights. Minimum foliage dry weight was recorded in T<sub>0</sub> (control). Bhat et al. (2010) performed experiments and observed that boron has significant effects on foliage fresh weight. Kirthisinghe and Dombagolla, (2011) conducted experiment and revealed observations that magnesium and boron has significant effect on foliage fresh weight. Adhikary et al. (2004) conducted experiment and found the similar results. They use six levels of boron (0 kg, 5 kg, 10 kg, 15 kg, 20 kg and 25 kg borax ha<sup>-1</sup>). The growth (plant height, leaf numbers, leaf length and fresh biomass production) was affected significantly by the boron levels. Ahmad et al. (2011) performed experiment and revealed results that magnesium has significant effects on vegetative growth of cauliflower plant.



**Fig. 6:** Effectiveness of different levels of boron and magnesium on foliage dry weight (gm)

**Curd weight (gm):-**

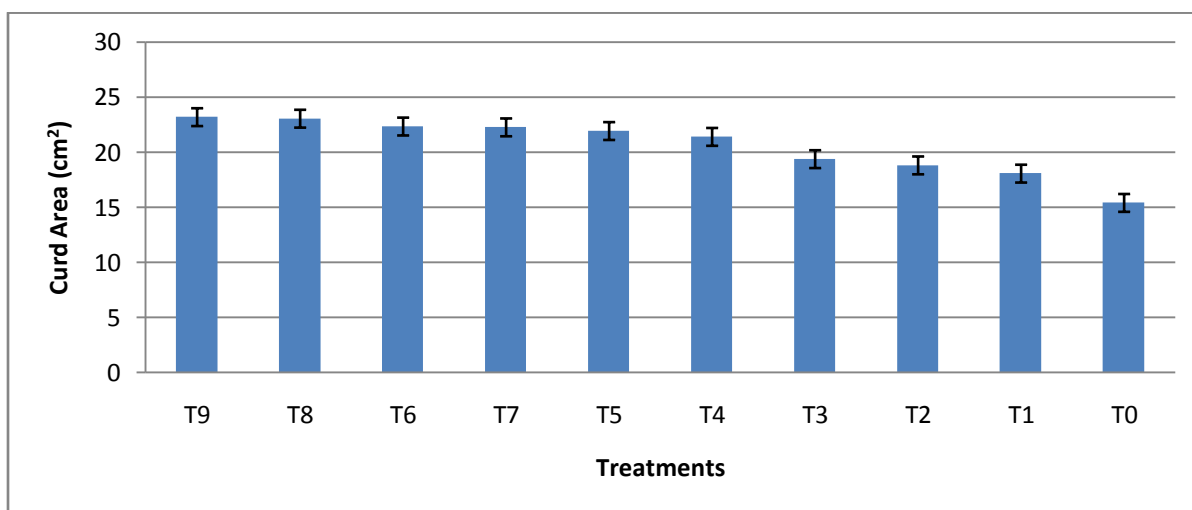
Fig. 7 shows the comparison of average curd weights (g) of Shumaila cultivar gained by the application of ten different treatments. Maximum curd weight was recorded in case of T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 1.19 gm, followed by T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with 1.17 gm, T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) and T<sub>6</sub> (Magnesium 25 kg/ha). Plants treated with T<sub>5</sub> (Magnesium 15 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) showed intermediate curd weights. Minimum curd weight was recorded by applying T<sub>0</sub> (control). Kirthisinghe and Dombagolla, (2011) conducted experiment and revealed observations that magnesium and boron has significant effect on foliage fresh weight. Bhat et al. (2010) performed experiments and observed that boron has significant effects on vegetative growth and yield of cauliflower.



**Fig. 7:** Effectiveness of different levels of boron and magnesium on curd weight

#### **Curd area (cm<sup>2</sup>):-**

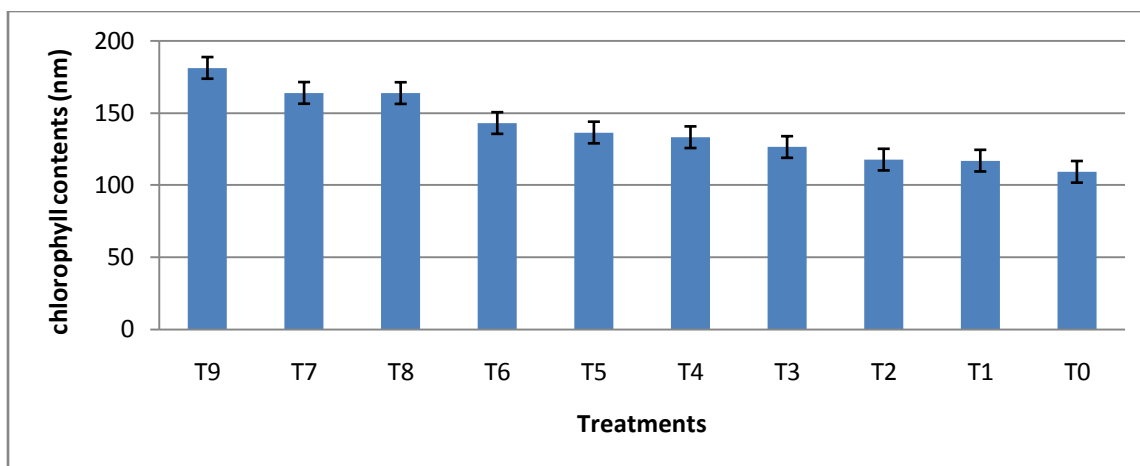
Curd area of cauliflower Shumaila cultivar was recorded and results revealed that significantly different curd areas were obtained by applying different treatments. Fig. 8 shows the comparison of average curd area (cm) of Shumaila cultivar gained by the application of ten treatments. Maximum curd area was recorded in T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 23.19 cm, followed by T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with 23.05 cm, T<sub>6</sub> (Magnesium 25 kg/ha), T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) and T<sub>5</sub> (Magnesium 15 kg/ha). Plants treated with T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) showed intermediate curd areas. Minimum curd area was recorded by applying T<sub>0</sub> (control). Batal et al. (1997) in Tifton conducted experiment to evaluate the effects of magnesium and boron on the curd yield and quality. They found the similar results that magnesium and boron significantly affects the curd yield in cauliflower by increasing curd area. Kirthisinghe and Dombagolla, (2011) conducted experiment and revealed observations that magnesium and boron has significant effect on curd area of cauliflower. Bhat et al. (2010) performed experiments and observed that boron has significant effects on vegetative growth and yield of cauliflower.



**Fig. 8:** Effectiveness of different levels of boron and magnesium on curd area (cm<sup>2</sup>).

### Chlorophyll contents (nm):-

Fig. 9 shows the comparison of average chlorophyll contents of Shumaila cultivar gained by the application of ten different treatments. Maximum chlorophyll contents were recorded in T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 188.08 nm, followed by T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) with 124.33 nm and T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha). Plants treated with T<sub>6</sub> (Magnesium 25 kg/ha), T<sub>5</sub> (Magnesium 15 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) showed intermediate chlorophyll contents. Minimum chlorophyll contents were recorded in T<sub>0</sub> (control) which showed no significant results with rest of treatment. Rakhsh and Golchin, (2012) worked on nitrogen and boron deficiency in calcareous soils and great impact of these elements on growth, yield and nutrient concentration of broccoli. they found the significant effects on quality of cauliflower. Hussain et al. (2012) conducted the experiment and revealed the similar results that boron has significant results on chlorophyll contents in cauliflower. Kirthisinghe and Dombagolla, (2011) conducted experiment and revealed observations that magnesium and boron has significant effect on yield quality of curd and on chlorophyll contents. Bhat et al. (2010) performed experiments and observed that boron has significant effects on chlorophyll contents and yield of cauliflower.

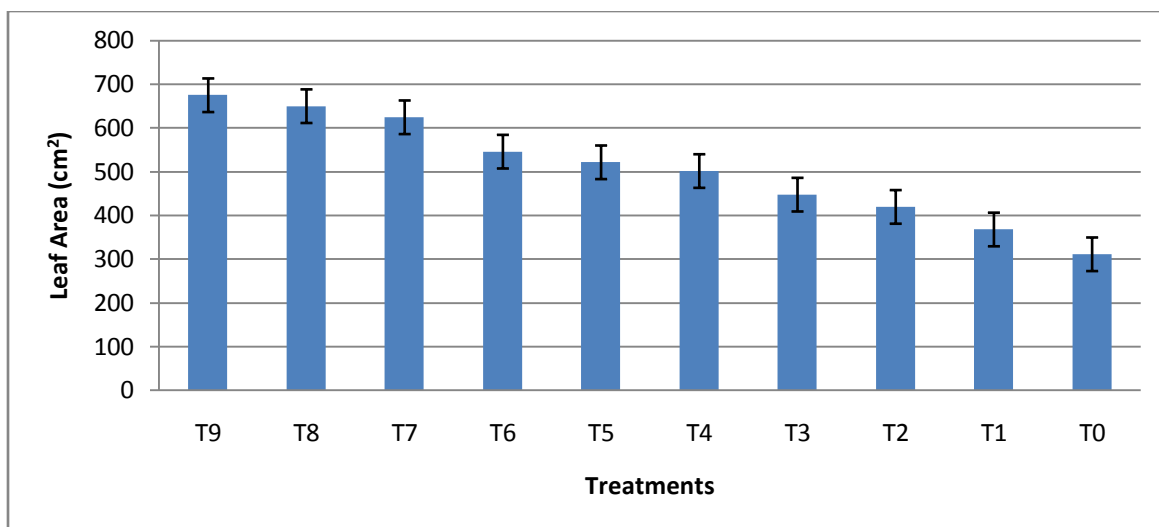


**Fig. 9:** Effectiveness of different levels of boron and magnesium on chlorophyll contents (nm).

### Leaf Area (cm<sup>2</sup>):-

Fig. 10 shows the comparison of average leaf area (cm<sup>2</sup>) of shumaila cultivar gained by the application of ten treatments. Maximum leaf area was recorded in T<sub>9</sub> (Boron 25 kg/ha + Magnesium 25 kg/ha) with an average of 675 cm<sup>2</sup>, followed by T<sub>8</sub> (Boron 15 kg/ha + Magnesium 15 kg/ha) with 650 cm<sup>2</sup> and T<sub>7</sub> (Boron 10 kg/ha + Magnesium 10 kg/ha) with an average of 624 cm<sup>2</sup>. Plants treated with T<sub>5</sub> (Magnesium 15 kg/ha), T<sub>4</sub> (Magnesium 10 kg/ha), T<sub>3</sub> (Boron 25 kg/ha), T<sub>2</sub> (Boron 15 kg/ha) and T<sub>1</sub> (Boron 10 kg/ha) showed intermediate leaf areas. Minimum leaf area was recorded by applying T<sub>0</sub> (control). Adhikary et al. (2004) conducted experiment and found the similar results. They use six levels of boron (0 kg, 5 kg, 10 kg, 15 kg, 20 kg and 25 kg borax ha<sup>-1</sup>). The growth (plant height, leaf numbers, leaf length and fresh biomass production) was affected significantly by the different boron levels. Ahmad et al. (2011) performed experiment and revealed results that magnesium has significant effects on vegetative growth of cauliflower plant. Hussain et al. (2012) conducted the experiment and revealed the similar results that boron has significant role in leaf area production in cauliflower.

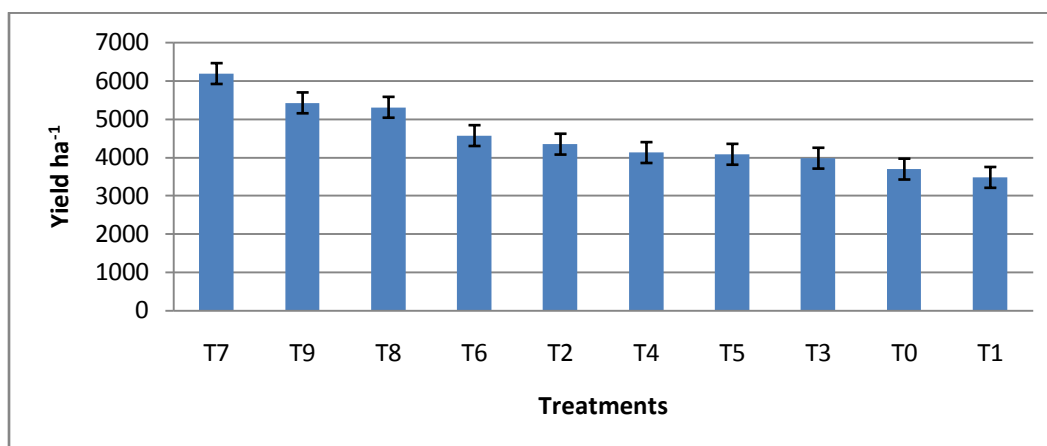




**Fig. 10:** Effectiveness of different levels of boron and magnesium on leaf area (cm<sup>2</sup>).

#### Yield ha<sup>-1</sup>:-

Fig. 11 shows the comparison of average yield of shumaila cultivar gained by the application of ten different treatments. Maximum yield was obtained in T<sub>7</sub> (Boron 10 kg ha<sup>-1</sup> + Magnesium 10 kg ha<sup>-1</sup>) followed by T<sub>9</sub> (Boron 25 kg ha<sup>-1</sup> + Magnesium 25 kg ha<sup>-1</sup>) and T<sub>8</sub> (Boron 15 kg ha<sup>-1</sup> + Magnesium 15 kg ha<sup>-1</sup>) which are statistically at par and are significantly different from other treatment. T<sub>6</sub> (Magnesium 25 kg ha<sup>-1</sup>) showed average results. Minimum yield was observed in T<sub>2</sub> (Boron 15 kg ha<sup>-1</sup>), T<sub>4</sub> (Magnesium 10 kg ha<sup>-1</sup>), T<sub>5</sub> (Magnesium 15 kg ha<sup>-1</sup>), T<sub>3</sub> (Boron 25 kg ha<sup>-1</sup>), T<sub>0</sub> (control) and T<sub>1</sub> (Boron 10 kg ha<sup>-1</sup>) these all are statistically at par. Bhat et al. (2010) performed the experiment and found the same results as our research findings. Hussain et al. (2012) conducted the experiment and also revealed the similar results that boron has significant role in leaf area production in cauliflower.



**Fig. 11:** Effectiveness of different levels of boron and magnesium on yield ha<sup>-1</sup>.

**References:-**

1. Adhikary, B.H., Ghale, M.S., Adhikary, C., Dahal, S.P. and Ranabhat, D.B. 2004. Effects of different levels of boron on cauliflower (*Brassica oleracea* var. botrytis) curd production on acid soil of malepatan, pokhara. Nepal Agric. Res. J. 5: 65-67.
2. Ahmad, W., Munir Zia, H., Sukhdev, S. Niaz Malhi, A. and Saifullah. (2012). Boron deficiency in Soils and Crops: A Review, Crop Plant, (Ed.), ISBN: 78-114.
3. Ahmad, W., Niaz, A., Kanwal, A., Rahmatullah, S. and Rasheed, M. K. (2009). Role of boron in plant growth: Rev. J. Agric. Res. 47: 329-338.
4. Ahmed, M.E.S., Elzaawely, A.A. and M.B. Elsayy, M.B. (2011). Effect of the foliar spraying with molybdenum and magnesium on vegetative growth and curd yields in cauliflower (*brassica oleraceae* var. bottytis L.). World J. Agric. Sci. 7: 149-156. attributes and yield of cauliflower. Crop. Res. Hisar., 24(3):494-496.
5. Batal, K.M., Granberry, D.M. and Mullinix, B.G. (1997). Nitrogen, Magnesium and Boron application affect cauliflower yield, curd mass and hollow stem disorder. Hort. Sci. 32: 75-78. Bern, Switzerland.
6. Bhat, B.A., Singh, H. and Rather, S.A. (2010). Effect of boron on yield and nutrient content in cole crops. Res. J. Agric. Sci. 1: 158-159.
7. Hussain M.J., Karim, A. J. M. S., Solaiman, A. R. M. and Haque, M. M. (2012). Effects of nitrogen and boron on the yield and hollow stem disorder of Broccoli (*Brassica oleracea* var. italica). The Agric. 10: 36-45.
8. Kirthisinghe, J.P and Dombagolla, S.G. (2011). Effect of Calcium, Magnesium and Boron on Yield and Quality of Cauliflower (*Brassica oleracea* L.). Proceedings of the Peradeniya Univ. Res. Sessions, Sri Lanka. 16: 167-170.
9. Kirthisinghe, J.P and Dombagolla. S.G. (2011). Effect of Calcium, Magnesium and Boron on Yield and Quality of Cauliflower (*Brassica oleracea* L.). Proceedings of the Peradeniya Univ. Res. Sessions, Sri Lanka. 16: 167-170.
10. Kumar, S., Chaudhury, D.S. and Kumar S. (2002). Effect of FYM, molybdenum and boron applications on yield
11. McGraw-Hill, New York, USA.
12. Mengel, K. and Kirkby, E.A. (1987). Principles of plant nutrition. 4th ed. International Potash Institute, Worblaufen
13. Rakhsh, F. and Golchin, A. (2012). Nitrogen and boron on growth, yield and nutrient concentration in broccoli. Int. J. Agric. 2: 646-651.
14. Steel, R. G. D. and Torrie, J. H. (1997). Principles and procedures of statistics: a biometrical approach. 2<sup>nd</sup> Ed.