GROWTH AND DEVELOPMENT OF *Trigonella foenum-graecum L.* UNDER THE EFFECT OF MLE, GA_3 & NAA

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ABSTRACT

This study explored the effects of foliar spray of selected plant growth regulators (PGRs) on *Trigonella foenum-graecum L.* plant. Selected PGRs are Moringa Leaf Extract (MLE), Gibbrellic Acid (GA_3), Naphthalene Acetic Acid (NAA) at three concentrations (10ppm,20ppm and 30ppm). The analysis of foliar-treated plants revealed the content of total sugar (TS), reducing sugar (RS), total starch (Tstr), total protein (TPr), total phenol (TPh), and total chlorophyll (TC). The physiological parameters were measured (shoot length, root length, number of leaves; shoot weight, root weight and leaf weight). The best root weight was seen in 20ppm MLE and 10ppm NAA treated plants and highest root length was seen in 20ppm GA_3 & 30ppm NAA. All other growth parameters were observed highest in MLE in all concentration followed by GA_3 and NAA treated compared to control. Concentration of TS was highest in 10ppm MLE. 30ppm moringa shows highest concentration in RS, TP, TPH, TC followed by 30ppm GA_3 & 30ppm NAA. 10ppm MLE showed near to same results like 30ppm MLE. From the result it can be concluded that Moringa leaves yield better plant growth than NAA and GA_3 as plant hormones.

Key words: Moringa Leaf Extract, Gibbrellic Acid, Naphthalene Acetic Acid**,** Parts Per Million

INTRODUCTION

Today the world is suffering from pollution and its side effects. Fertilizers are having major impact on soil and its pollution. Fertilizers are mainly of two types; chemical fertilizer and organic c fertilizer. Chemical fertilizers are causing most dangerous effect on soil as well as on humans who are consuming the food products made from chemical fertilizer treated plants or crops. Synthetic Plant Growth Regulators (PGRs) are almost having same impact as chemical fertilizers. Organic fertilizers are very less harmful because they are made-up of natural and biodegradable waste.

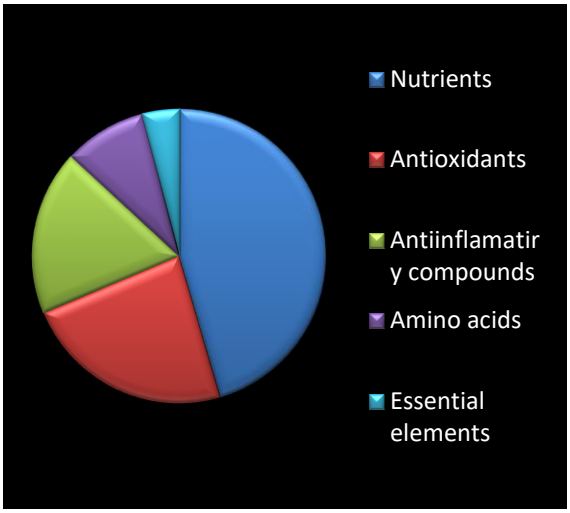
Plant hormones:

1) Auxin: Auxin helps in promoting rooting of plants. The concentration of auxin may differ from organ to organs. Auxins are one of the most important types of hormones because of their many-sided roles in plants. One such among them is Naphthalene acetic acid (NAA). It is widely used to promote rooting of cutting for faster results. Different types of concentrations are made for getting different result. It increases the fruit size and also affects flowering. It shows positive results for plant like increasing plant height, leaf size, number of leaf, root length.

2) Gibberellin: It promotes plant growth. Gibberellin or Gibberellic Acid is present in seeds in a large amount rather than other plant parts. There are various types of gibberellin used commercially which are; GA_1, GA_2, GA_3, GA_4. Among these GA_3 is the most active compound and most widely used. GA_3 is naturally produced plant hormone but very few amount of it is produced. GA_3 powder is available in market as an alternative source so it can be used as exogenous application for better and faster plant growth as well as for better plant production.

3) *Moringa oleifera*: *Moringa oleifera* Lam (syn. M. ptreygosperma Gaertn.) is one of the best known and most widely distributed and naturalized species of a monogeneric family Moringaceae (Nadkarni, 1976; Ramachandran et al., 1980). Moringa belongs to family Moringaceae. There are about 13 species of moringa of which M. oleifera is most widely grown. Since leaves of moringa are rich in zeatin, it can be used as natural source of cytokinin (Fuglie, 1999). In addition, moringa leaves is also rich in ascorbates, carotenoids, phenols, potassium and calcium, which have plant growth. Promoting capabilities and often applied as exogenous plant growth enhancers (Foidl et al., 2001).

Antioxidants such as ascorbic acid and glutathione, which are found at high concentrations in moringa chloroplasts and other cellular compartments, are crucial for plant defense against oxidative stress (Noctor & Foyer, 1998). In view of all these reports, it can be hypothesized that using leaf extract of moringa, which have mineral nutrients and vitamins in a naturally balanced composition, may promote the plant growth. *Moringa oleifera* is an important vegetable in many tropical and sub-tropical countries including Bangladesh. Its annual production is comparatively higher than many other secondary vegetables. Most of the parts of *M. oleifera* have medicinal value. Leaves, flowers and unripe fruits are used as vegetables, and roots and barks are used for medicinal purpose (Anwar *et al*, 2007). The flowers, leaves and roots are used for the treatment of as cites, rheumatism and venomous bites and as a cardiac and circulatory stimulant in some folk cures. The root bark and the roots of young tree are rubefacient and vesicant (Hartwell, 1995). More than 300 diseases including cancer, diabetes and high blood pressure can be controlled or cured by *M. oleifera* (Anon. 2009).



This chart shows important nutrients present in moringa plant.

Therefore, the objective of this work was to investigate the effect of GA_3, NAA and moringa leaves extract application on growth parameters both physiological and biochemical of fenugreek plant.

MATERIALS AND METHODS

Pots were placed in a botanical cage under normal environmental conditions like light, temperature and humidity. Equal amount of water was poured daily in each set of pots

Experimental design:

Total 10 pots were taken for the experiment. One pot for control and three pot each for treatment of 10ppm, 20ppm and 30ppm. Soil was collected from Gujarat University near Physics Department. In each pot total 12 to 15 seeds are added for the experiment. Treatment was started when plants were in three leaf stage and approx one month old. Treatment was given in the form of foliar spray.

Treatment:

Total three types of treatments were given to the plants grown in pots.

Moringa Leaf Extract:

Moringa leaf extract (MLE) was made from *Moringa oliefera* tree leaves and young shoots by crushing it out and adding distilled water.

Gibberellic Acid:

GA_3 was taken in powder form and dissolved with the help of few drops of alcohol.

Napthalin Acetic Acid:

NAA was taken in powder form and it is dissolved with the help of NaOH.

Duration of treatment:

Plants were treated with Moringa leaf extract, NAA and GA_3 for 30 days duration in which these were applied at an interval of every 5 days till six readings were obtained

Date and season of grown plants:

The treatment was given from 26th January, 2017 to 2nd March, 2017 during winter season.

Collection of data:

Data was collected at an interval of every five days and readings were taken from 31st January, 2017.

Growth Parameters:

The collection of data was started on 31st January, 2017. After every five days growth parameters were measured of fresh plant material. The physical growth parameters were:

Root length, Shoot length, Leaf blade length, Weight of whole plant, Root weight, Shoot weight, Leaf weight (Blade+Petiole) and Number of leaves.

Estimation of Metabolites:

It includes the estimation of following metabolites:

Total sugar, Reducing sugar, Proteins, Phenols, Starch, Chlorophyll

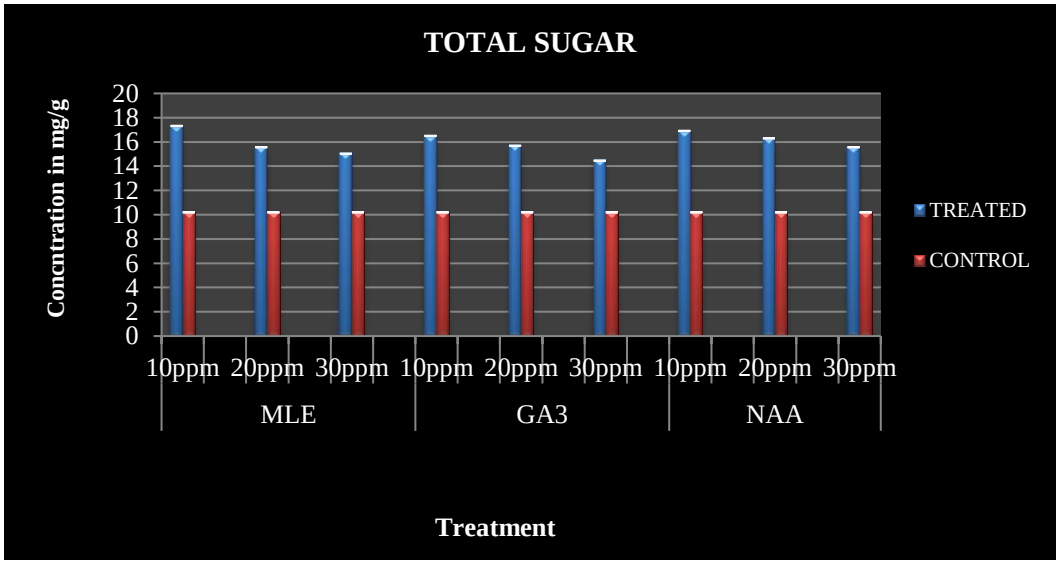
1) Total Sugars and reducing sugars concentrations using the method described by Nelson, (1944).
2) Starch concentrations using the method described by Chinoy, (1939).
3) Total proteins concentrations using the method described by Bradford, (1976).
4) Total phenols concentrations using the method described by Bray et al., (1954).
5) Total Chlorophyll concentrations using the method described by Arnon (1949).

RESULT AND DISCUSSION

Fertilizer and plants are scientifically related to each other. As when fertilizer is applied to the plants, they show some drastic responses and affects both physiologically and biochemically. When this experiment had been done with Fenugreek plants, then it shows that fertilizer actually influences the plants growth.

BIOCHEMICAL TESTS							
TREATMENT	**CONCEN-TRATION**	**TS**	**RS**	**TStr.**	**TPr.**	**TPh**	**TC**
CONTROL	-	0.221±0.031	0.52±0.15	0.108±0.004	0.402±0.006	0.305±0.11	0.502±0.23
MLE	10ppm	0.395±0.014	0.524±0.17	0.125±0.003	0.518±0.003	0.394±0.21	0.614±0.31
	20ppm	0.352±0.041	0.534±0.10	0.135±0.008	0.528±0.003	0.428±0.37	0.818±0.40
	30ppm	0.339±0.0051	0.574±0.056	0.175±0.006	0.531±0.012	0.715±0.02	0.954±0.29
NAA	10ppm	0.375±0.054	0.218±0.015	0.11±0.0012	0.5±0.011	0.481±0.19	0.525±0.33
	20ppm	0.355±0.016	0.221±0.08	0.118±0.013	0.505±0.011	0.441±0.09	0.548±0.07
	30ppm	0.325±0.028	0.239±0.045	0.123±0.0026	0.524±0.08	0.334±0.05	0.679±0.05
GA3	10ppm	0.385±0.066	0.559±0.065	0.115±0.0028	0.484±0.019	0.318±0.26	0.651±0.05
	20ppm	0.37±0.051	0.566±0.01	0.126±0.07	0.49±0.13	0.311±0.58	-
	30ppm	0.352±0.033	0.617±0.10	0.116±0.0012	0.498±	0.321±0.33	0.547±0.33

Table 1: Table showing comparative readings of metabolite concentrations of MLE, NAA and GA_3 treated plants.



Graph1: Concentration of total sugar was observed highest in 10ppm MLE and 10ppm NAA compared to control.

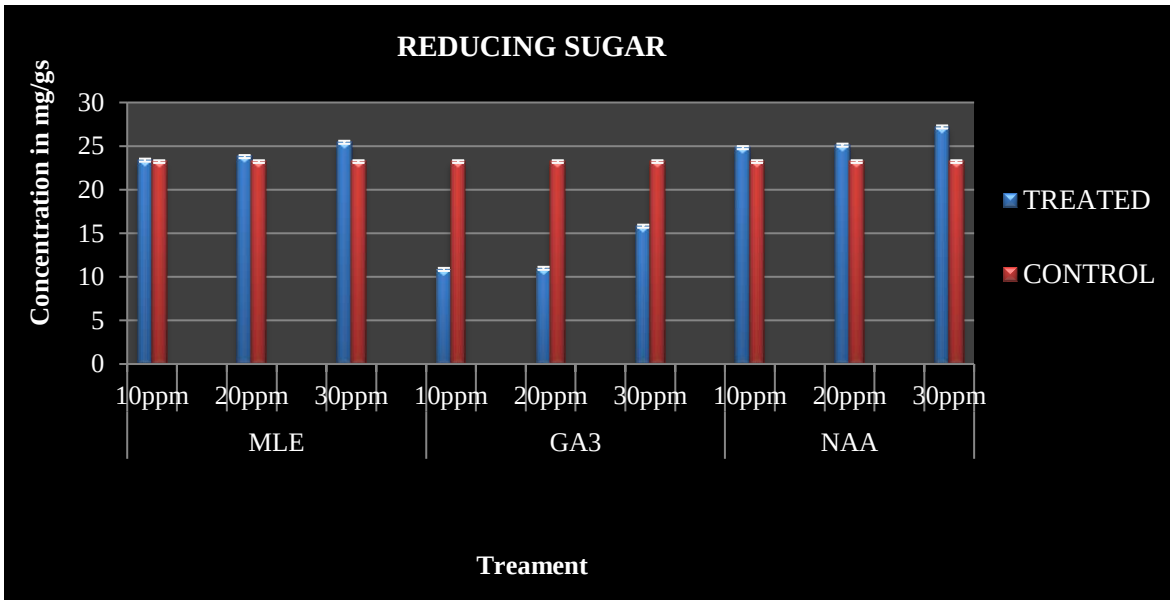


Figure2: The above graph shows highest concentration of reducing sugar was observed in 30ppm NAA and 30ppm MLE. Plants treated with GA_3 shows lowest concentration compared to control.

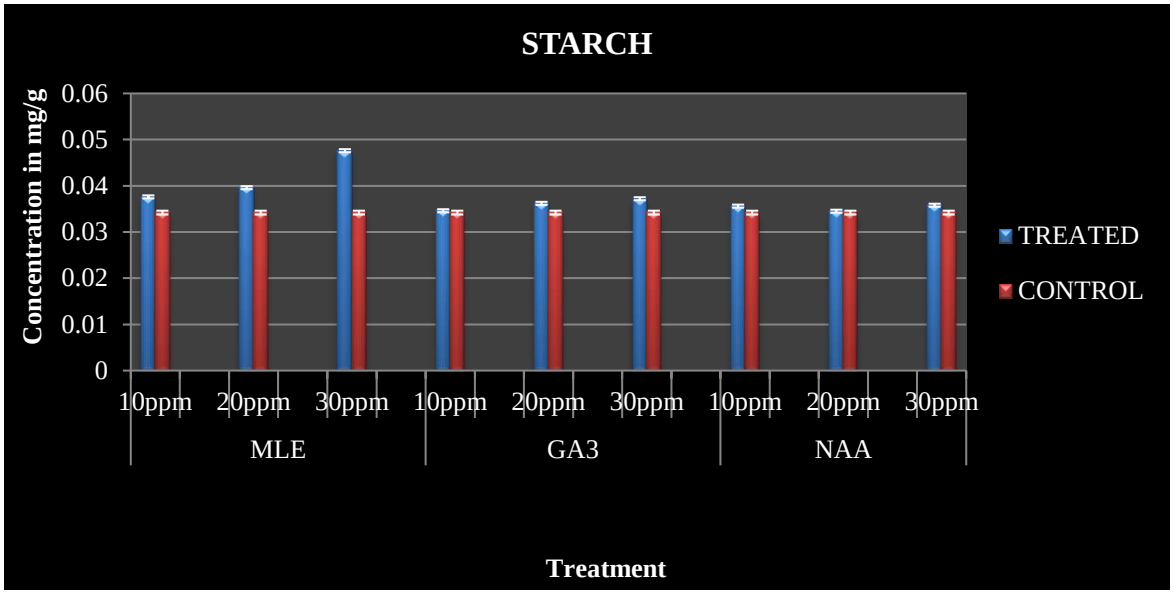


Figure 3: The above graph indicates that highest concentration was observed in 30ppm MLE. Other treatments shows average concentration related to control.

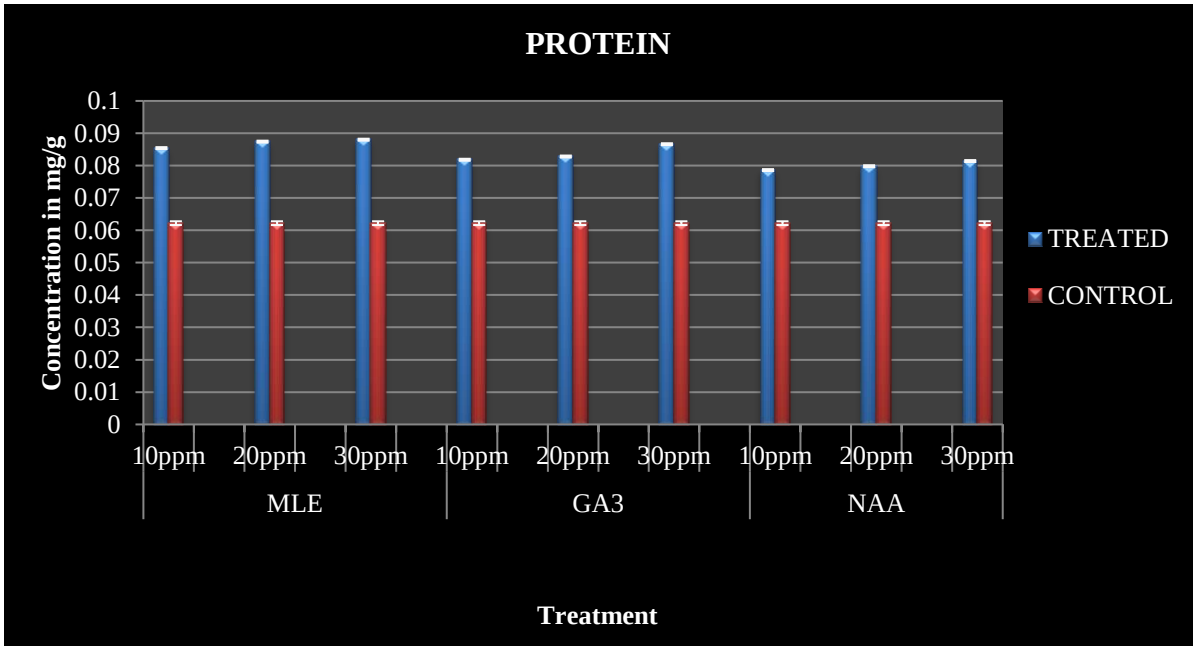


Figure 4: This graph indicates that highest concentration was observed in 30ppm MLE & 30ppm GA_3. Average result was seen in the plants treated with NAA compared to control.

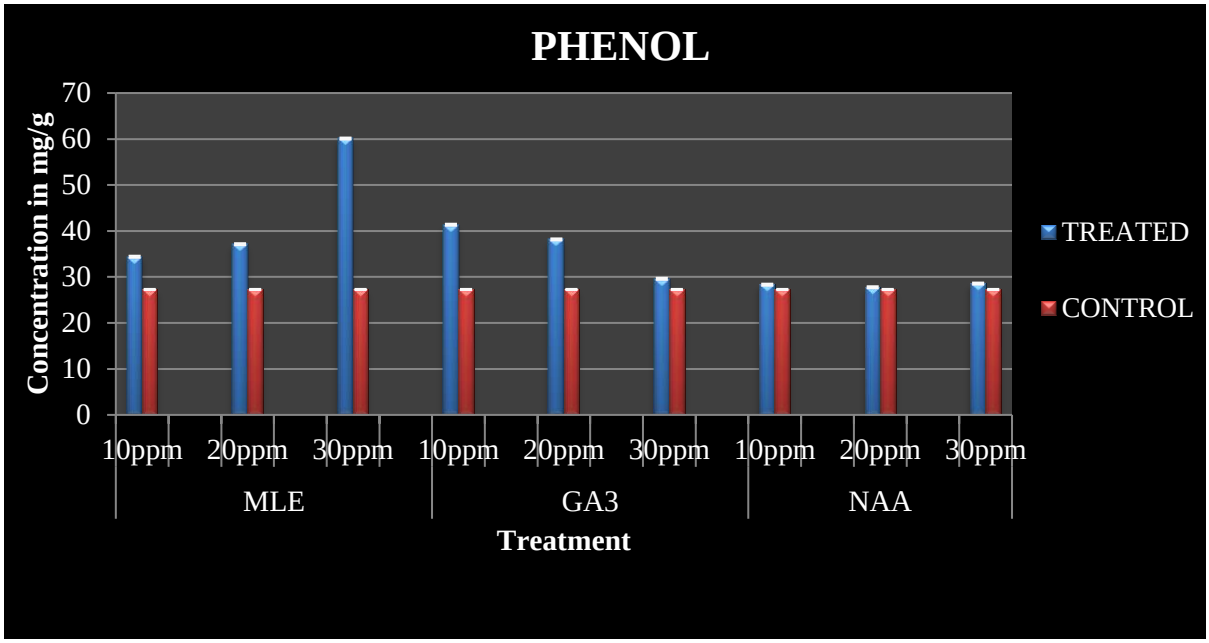


Figure 5: The above graph indicates that plants treated with 30ppm MLE shows highest concentration of phenol followed by 20ppm GA_3. Average result was observed in NAA treated plants which is nearly equal to control.

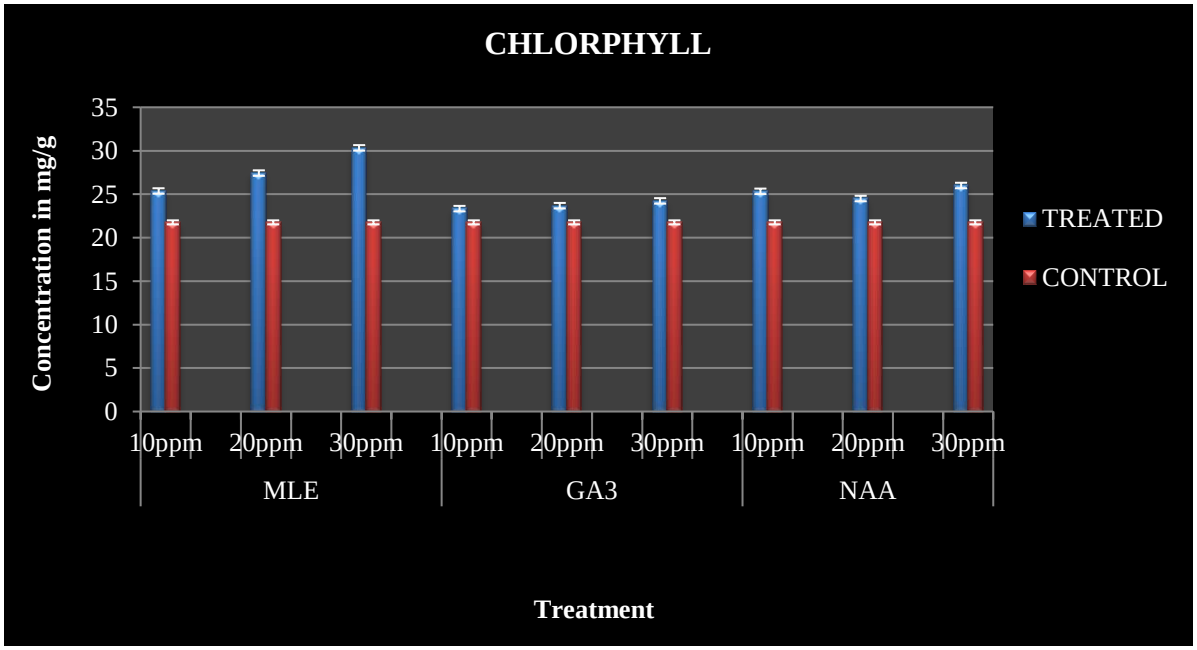


Figure 6: This graph shows highest concentration in 30ppm MLE and 30ppm NAA. Among three treatments plants treated with GA_3 do not shows more difference compared to control.

PHYSIOLOGICAL PARAMETERS							
TREATMENT	CONCENTRATION	SHOOT LENGTH	ROOT LENGTH	LEAF LENGTH	SHOOT WEIGHT	ROOOT WEIGHT	LEAF WEIGHT
CONTROL	-	19.9±0.2	5.56±0.23	1.5±0.04	112.5±0.32	9.96±0.23	60.4±0.32
MLE	10ppm	28.16±0.6	10.1±0.40	1.8±0.05	213.6±0.88	25.93±0.40	190.66±0.44
	20ppm	27.43±0.28	10.8±0.56	1.83±0.03	236.8±0.17	33.8±0.30	116.63±0.30
	30ppm	20.46±0.51	9.73±0.92	1.66±0.11	231.36±0.31	16.46±0.2	166.66±0.33
GA3	10ppm	21.6±0.6	8.53±0.55	1.43±0.08	114.6±0.25	15.1±0.2	97.66±0.33
	20ppm	24.06±0.57	9.8±0.36	1.5±0.08	185.83±0.72	13.4±0.55	85.56±0.23
	30ppm	26.13±0.46	9.9±0.49	1.7±0.11	226.3±0.20	17.76±0.14	185.13±0.69
NAA	10ppm	21.63±0.51	10.4±0.5	1.56±0.11	152.6±0.17	15.5±0.28	131.83±0.44
	20ppm	22.7±0.9	9.8±0.15	1.46±0.08	118.8±0.2	12.2±0.2	105.16±0.60
	30ppm	20.53±0.46	9.73±0.46	1.63±0.11	121.9±0.75	16.3±0.35	164.13±0.56

Table 2: Table showing comparative readings of physiological parameters of MLE, NAA and GA_3 treated plants.

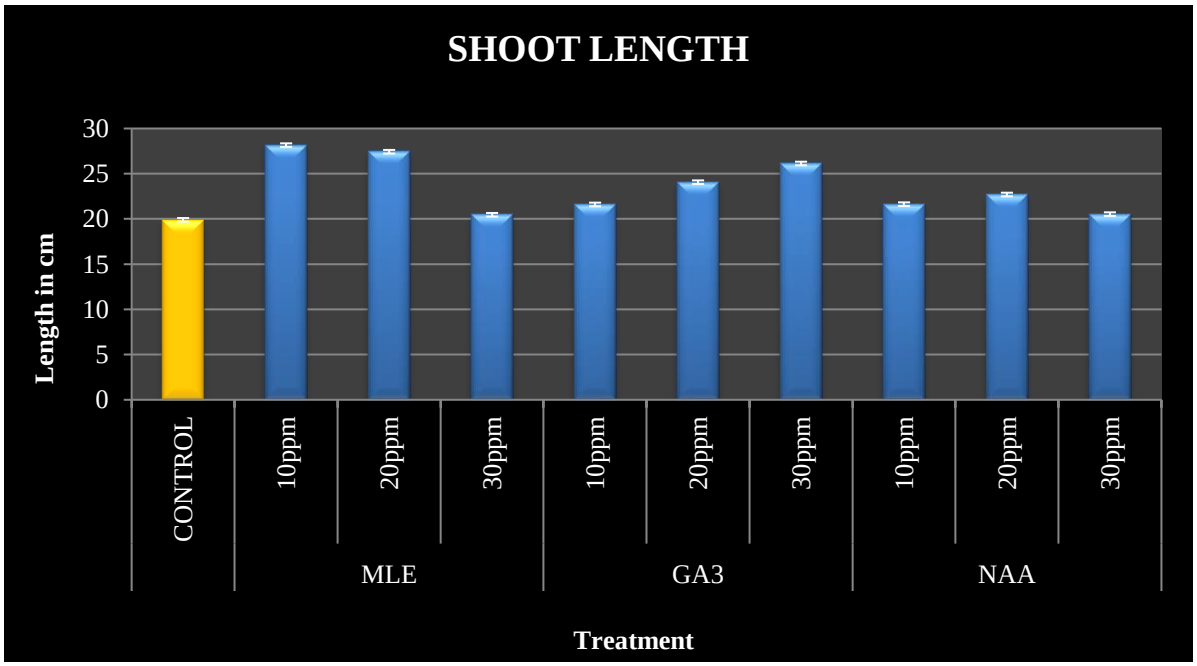


Figure 7: The weight of shoot was higher in 20ppm MLE and 30ppm GA_3. Much different was not seen in NAA. From all these three highest shoot weight was observed in MLE.

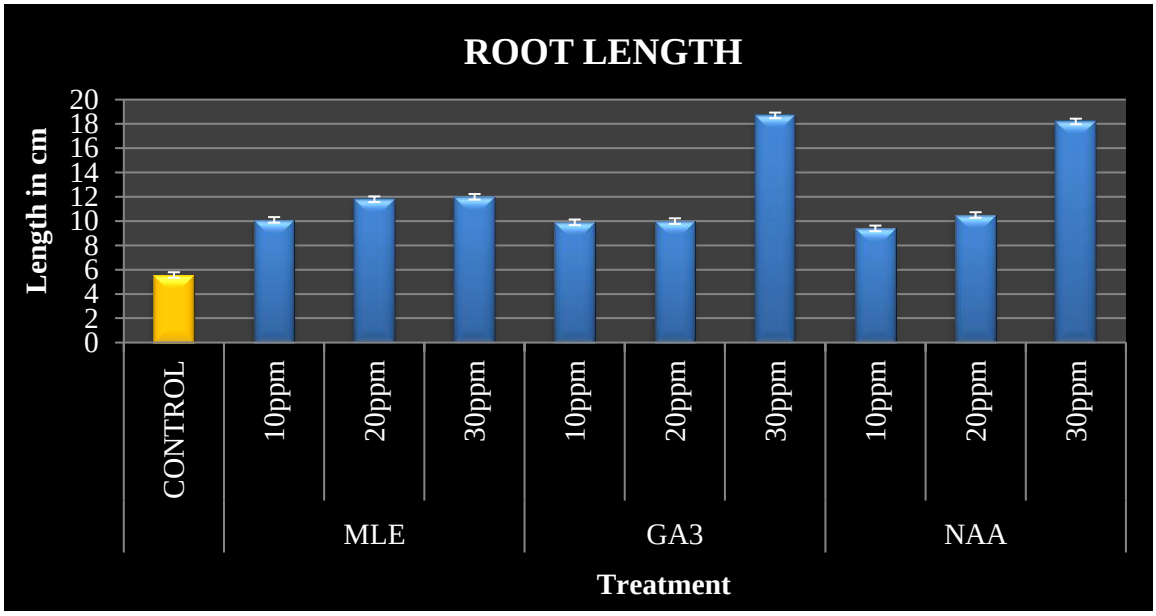


Figure 8: The length of root was higher in 20ppm GA_3 and 30ppm NAA. Much difference was not observed in MLE. From all these three highest root length was observed in GA_3.

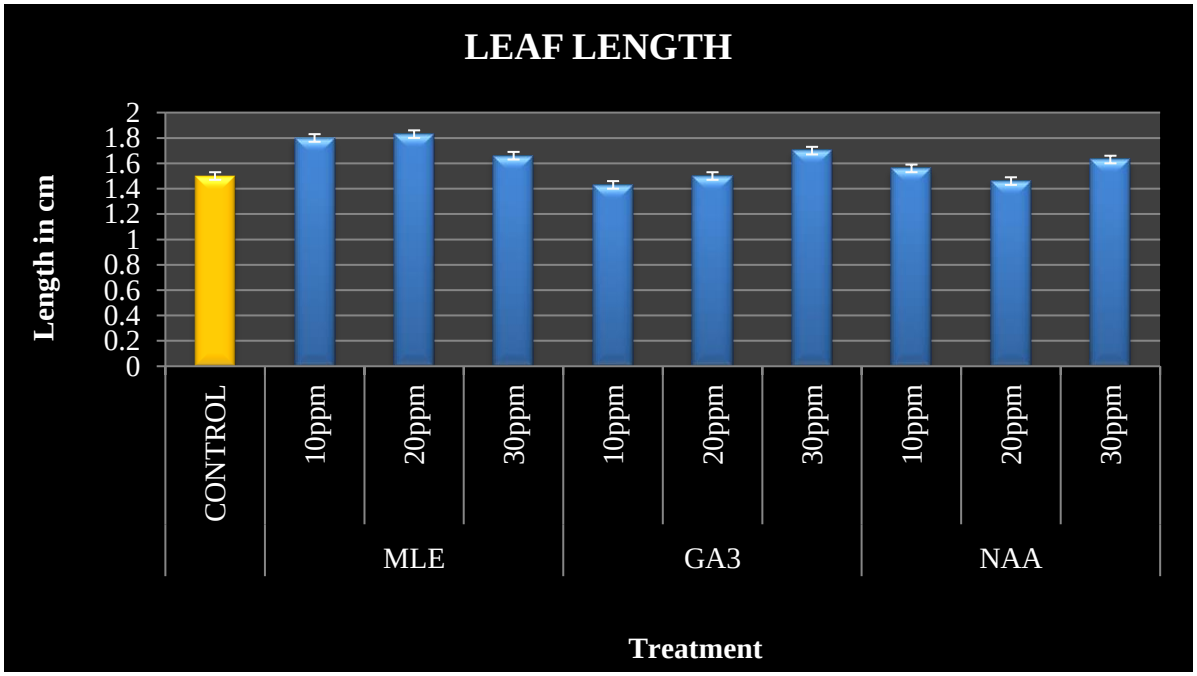


Figure 9: The length of leaf was higher in 20ppm MLE and 30ppm GA_3. Treatment of 30ppm NAA shows average compared to other treatments of MLE & GA_3. From all these three treatments highest leaf length was observed in MLE and lowest result was seen in 10ppm GA3 compared to control.

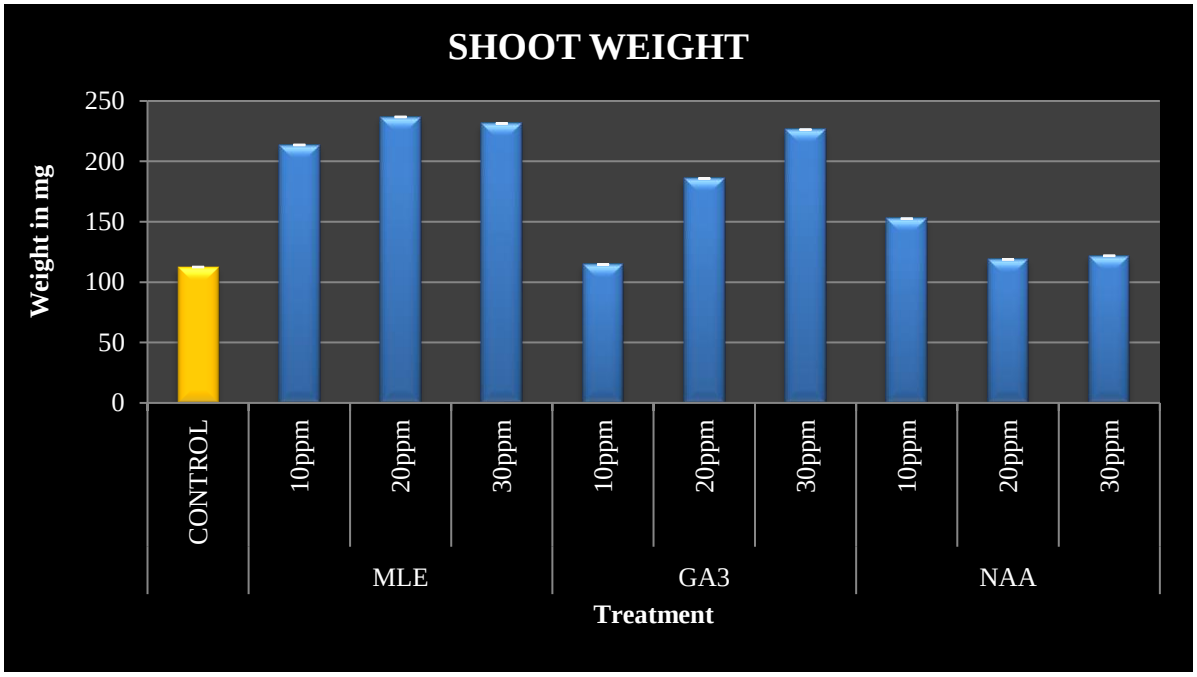


Figure 10: The weight of shoot was higher in 20ppm MLE and 30ppm GA_3. Much different was not seen in NAA. From all these three highest shoot weight was observed in MLE.

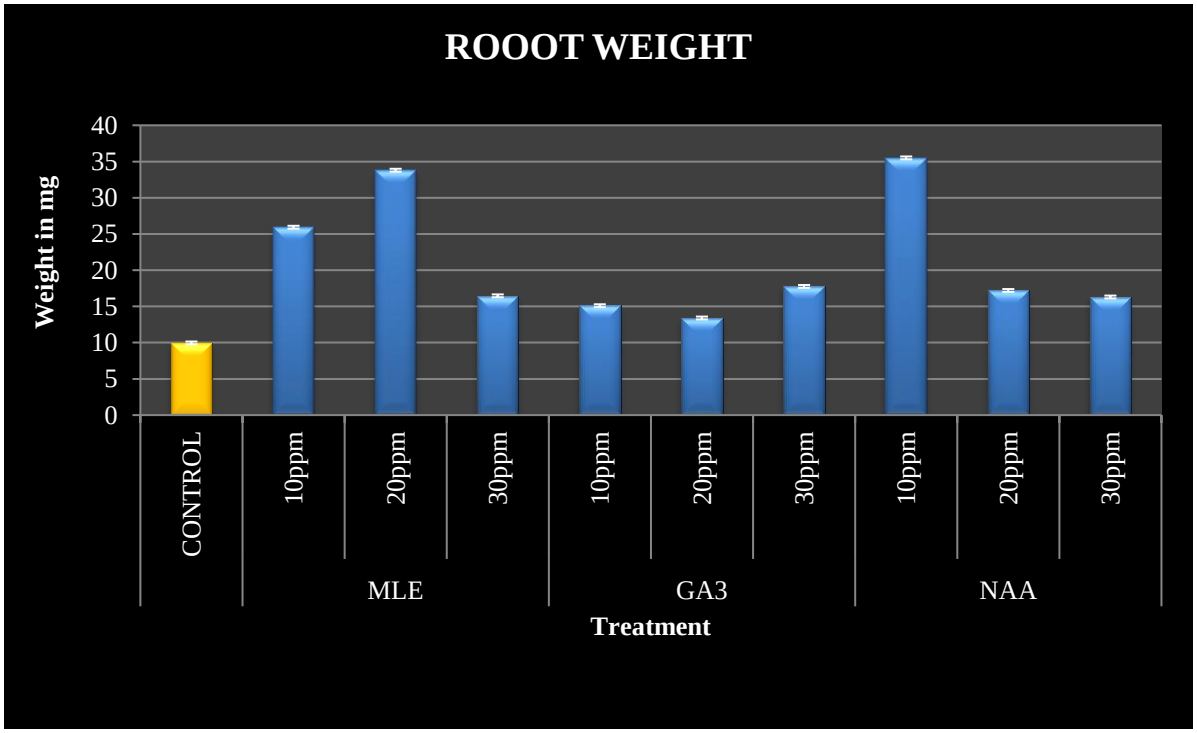


Figure 11: The weight of root was higher in 20ppm MLE and 10ppm NAA. Much different was not seen in GA_3. From all these three highest shoot length was observed in NAA.

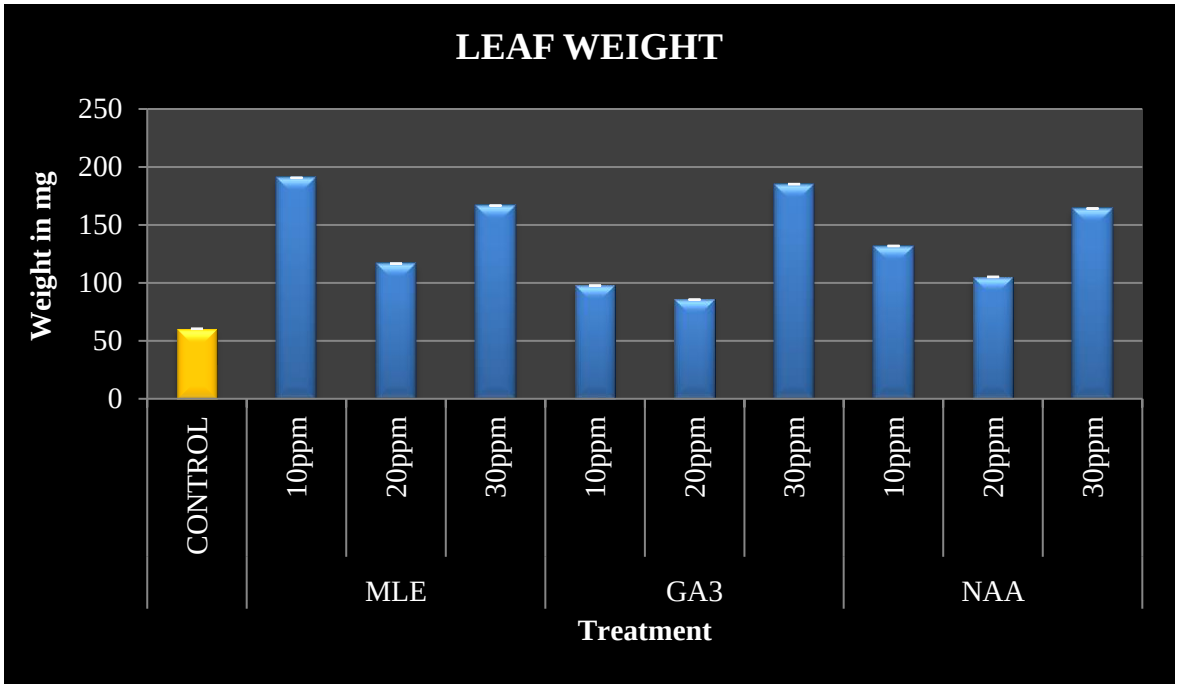


Figure 12: The weight of leaf was higher in 10ppm MLE and 30ppm GA_3. Much different was not seen in NAA. From all these three highest shoot weight was observed in MLE. Lowest leaf weight was seen in control.

DISCUSSION

When MLE, GA_3 & NAA were applied on plants, the best growth and concentration of biochemical parameters were observed highest in MLE treated plant and especially in 30ppm MLE except for root length and root weight. Because moringa leaves contains lots of vitamins and antioxidants compared to GA_3 and NAA, the results were obtained positive with MLE.NAA usually enhances root formation. So good results were obtained in 10 and 30 ppm NAA which showed the maximum root weight and root length. GA_3 is seen to enhance length elongation in plants. So positive result was obtained with 20ppm and 30 ppm that showed highest root length, weight of plant and leaf length, leaf weight, plant weight, shoot weight were highest respectively. Moringa leaves showed positive result with all the biochemical parameters yielding the highest concentration of total, reducing sugar, phenols, starch and chlorophyll. Whereas reducing and total sugar were more in NAA than in GA_3 and protein content was higher in GA_3 than in NAA. So from all the above result and observation it can be said that though NAA and GA_3 excelled in some part of the growth, but MLE excelled and showed highest result in almost all the parameters, morphological or biochemical.

CONCLUSION

In developing countries like India the researchers are always finding a way to reduce the cost of newly synthesized products. Since so many years farmers are using chemical fertilizer in a huge amount because of its fast result but overall it is having negative impact on our land which leads to pollution and also affect on human health. Some farmers uses organic

fertilizer which is beneficial but on other way it is not cost effective. Even growth hormones are sold in thousands of amount. The process of manufacturing of some synthetic hormones is so long that indirectly affect the final price of the product. In this study result shows that Fenugreek plants treated by Moringa Leaf Extract shows positive results by measuring the growth parameters like whole fresh weight, whole length and by performing biochemical test like Total Sugar, Reducing Sugar, Total Starch, Total Protein, Total Phenol and Total chlorophyll. So it is concluded that plant growth is better in Moringa treated plants than in other plant growth hormones.

To reduce the cost of fertilizers and side effects that they cause, Moringa leaves can work a wonder. The result obtained clearly indicates the positive effect of Moringa leaves as plant growth enhancer. This aspect of Moringa leaves can be very useful in plant physiology, Horticulture and Agriculture fields of study. Farmers can utilize Moringa leaves as natural growth enhancer as it would not cost much, has positive effects and is easily available.

REFRENCES

Jen-Hshuan Chen (2006): The combined use of chemical and organic fertilizers and/or biofertilizer for crop growth and soil fertility, International workshop on sustained management of the soil 1-7.

Davies, Peter J. (2010): The plant hormones: their nature, occurrence, and functions. Springer Netherlands

Johnson, M., & Koenig, R. (2011): Selecting and Using Organic Fertilizers

Anwar. F. Latif, S., Ashraf. M. & Gilani, A.H. (2007). *Moringa oleifera*: A food plant with multiple medicinal uses. Phytotherapy Research 21, 17-25.

Aregheore, E.M. (2002). Intake and digestibility of *Moringa oleifera*- batiki grass mixtures by growing goats. Small Ruminant Research 46, 23-28

Anonymous,(2009):http://www.mathaba.com/moringa-oleifera-the-miracle-tree.html
Anonymous, (2010). http://e-articles.info/e/a/title/Moringa-oleifera-::-The-Miracle-Tree

Bau, H.M., Villaume, C., Lin, C. F., Evrard, J., Quemener, B., Nicolas, J. P. & Mejean, L. (1994): Effect of a solid-state fermentation using *Rhizopus oligosporus* sp. T-3 on elimination of antinutritional substances and modification of biochemical constituents of defatted rapeseed meal. Journal of the Science of food and Agriculture 65, 315-322.

Fahey J.W. (2005): *Moringa oleifera*: A review of the Medical evidence for its nutritional, Therapeutic and prophylactic properties. Part1. http://www.TFLjournal.org/article.php /20051201124931586. accessed 15/03/2010

Hartwell, J.L. (1995): Plants used against Cancer. A Survey. Lloydia, 30-34

Suarez, M., J. M. Entenza, C. Doerries, E. Meyer, L. Bourquin, J. Sutherland, I. Marison, P. Moreillon & N. Mermod. 2003. Expression of a plant-derived peptide harboring water-cleaning and antimicrobial activities. Biotechnology and Bioengineering 81,13-20.

Thurber, M. D. and Fahey, J. W. (2009): Adoption of *Moringa oleifera* to combat under-nutrition viewed through the lens of the "Diffusion of Innovations" theory. Ecology of Food and Nutrition 48, 212-225

Fuglie LJ (2000): New Uses of Moringa Studied in Nicaragua: ECHO's Technical Network Site-networking global hunger solutions. ECHO, Nicaragua

Prosecus P (2006): Biosynthesis-Plant Hormones and Growth Regulators: Chemistry and Biology. Biosynth Ag. Co., Switzerland.