ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 5, Issue 2 , February 2018

Impact of *Moringa oleifera* leaf extract on Biochemical Contents and yield of Soybean (*Glycine max* L.)

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ABSTRACT: This study was conducted during the planting season (May – August) of 2014 at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri to evaluate the impact of *Moringa oleifera* leaf extract in enhancing the biochemical content of soybean. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. *Moringa* leaf extract concentration (10%, 20% and 30%) formed the treatments while the untreated formed the control. Soybean seeds were sown and treatments applied the following parameters; yield and yield parameters. Other parameters included chlorophyll content, protein content and carbohydrate content. Results showed that moringa leaf extract at 20% and 30% concentration where able to improve the yield of soybean significantly ($P<0.05$). It was also revealed that MLE application boosted the protein, carbohydrate and chlorophyll content of soybean leaf. It was concluded that MLE is a potential crop enhancer for soybean. It was also recommended that MLE be used to boost the nutrient status of soybean and that further researchers should try higher concentrations of MLE on both soybean and other legumes.

1. INTRODUCTION

Moringa oleifera belongs to a *Monogeneric* family of shrubs and trees. It is originated from *Morinaceae* west region of India (Odee, 1998). This tree has many potential uses both in agriculture and industries, according to Foidl *et al.* (2001), the plant is a multipurpose tree that has made much impact in agriculture and human health.

The possession of many valuable properties has made it of great scientific interest. These include the high protein content of the leaves, twigs and stems, high protein and oil content of the seeds, the presence of growth factors in the leaves, the high sugar and starch content of the entire plant (Foidl *et al.*, 2001).

Moringa oleifera has been reported to provide human, livestock and crop nutritional benefits as reported by Fuglie (2001) where it has been used to promote growth and yield of crop plants in Zambia. *Moringa* accelerates growth of young plants, strengthens plants, improve resistance to pests and diseases, prolongs life span, increases number of roots, stem and leaves, produces more and larger fruits and generally increases yield by about 20-30% (Fugile, 2001).

These findings have earlier been reported by Price (1999) who observed increase in growth and yield of crops due to use of *moringa*. *Moringa* also has been reported to significantly improve soil fertility if used as a green manure when *moringa* seedlings are ploughed into the soil to a depth of 15cm at age of 25 days (Davis, 2000). It is considered one of the world's most useful trees, as almost every part of the *Moringa* tree can be used for food or has some other beneficial property. In the tropics, it is used as forage for livestock, and in many countries, *Moringa* micronutrient liquid, a natural anthelmintic (kills parasites) and adjuvant (to aid or enhance another drug) is used as a metabolic conditioner to aid against endemic diseases in developing countries (Foidle *et al.*, 2001).

The improvement in crop growth and yield resulted from the influence of Zeatin: a plant growth hormone from cytokinines group as reported by Price (1999). Foliar application of *Moringa* on wheat at tillering, jointing, booting and anthesis has been reported by Foidl *et al.* (2001) to increase wheat yield. Foidl *et al.* (2001) further reported 25-30 incresed yield for most of the horticultural and some field crops like onions, bell pepper, soya, maize, sorghum, coffee, tea, chill and melon.

Soybean is a legume, whose growth and yield are controlled by the natural environmental conditions, especially the climate and soil fertility status (Udoh *et al*, 2005).

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A fertile soil that contains adequate amounts of the essential nutrient in the right proportion, free from toxic substances and well drained to favour effective aeration and sufficient water supply, favours the growth and yield of plants (Brandy and Weit, 2002). In the wake of increasing global prices of in organic fertilizer, land and water pollution arising from use of inorganic fertilizer and the contribution of inorganic fertilizer to climate change and destruction of soil properties there is a need to find alternative soil and crop improvement materials. Study on the use of *Moringa* for agricultural purposes to enhance biochemical content of crops has not been widely evaluated in Nigeria hence the need to evaluate impact of Moringa leaf extract on Biochemical Contents and yield of Soybean (*Glycine max* L.)

11. MATERIALS AND METHODS

A. Location of Experiment

The study was conducted during the planting season (May – August) of 2014 at the Teaching and Research farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. Owerri is located within latitude $4^0$45' north and $7^0$15' north and longitude $6^0$5' east and $7^0$25' with the south eastern part of Nigeria (http://www.imostategov.org). Owerri has annual rainfall of 1900mm – 2,200mm temperature of above 20^0C and a relative humidity of 75% with a rainfall lasting from March to November every year.

B. Experimental Materials and Methods

Soybean (*Glycine Max L.*) seeds was collected from the Imo State Agricultural Development Programme (ADP); simple farm tools was used. An experimental plot of 32mx30m dimension was used for the study. The experimental methods used in the study include four different concentrations of *Moringa oleifera* leaf extracts treatments. (0g, 100g/litre, 200g/litre and 300g/litre).

C. Experiment Design and Procedure

The experiment consisted of four treatments of *Moringa* leaf extract with four replications and fitted into a Randomized Complete Block Design (RCBD). The four treatments of *Moringa* leaf extract that was applied (T_1) control, 10% (T_2), 20% (T_3) and 30% (T_4) at the rate of 25ml per plant. Treatments were randomized.

D. Total Chlorophyll: This was analyzed from the leaf using spectrophotometer method described by Satory (1982)

E. Crude Protein: This was analyzed from the leaf using Kjeidahl method described by James, (1995)

F. Total Carbohydrate: This was analyzed from the leave using method as described Pearson *et al.* (1976).

G. Number of pods: This was obtained by visual counting of pods per plot.

H. Dry weight of pods: This was obtained after sun drying and then was measured with sensitive weighing balance.

I.100 seed weight: This was calculated using 100 dried seeds of soybean
J. Yield: This was calculated with the formulae

$$\frac{\text{Seed weight (Kg)}}{\text{Land area } (m^{2})} \times \frac{10,000}{1}$$

K. DATA ANALYSIS

Data collected was analyzed statistically using ANOVA in RCBD. Means were separated using least significantly difference (LSD) at 5%level of significance.

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III. RESULTS

A. Effects of MLE Application on Leaf Crude Protein Contents of Soybean

Leaf Crude Protein (LCP) content of soybean at 3WAP was highest (20.64%) from the 30% MLE treated plots which showed significant difference (P<0.05) from the mean in the other treated plots while the lowest (18.20%) mean LCP content was recorded from the control plots (Fig. 1).

At 6WAP, the 10% MLE treated plots recorded the highest (16.17%) mean LCP content which was not significantly different (P<0.05) from the lowest (15.09%) mean LCP content recorded from the 20% MLE treated plots (Fig. 1). At 9WAP, the 30% MLE treated plots recorded the highest (17.26%) mean LCP content which showed significant difference (P<0.05) from the lowest (15.51%) mean LCP content recorded from the control (Fig. 1). At 12WAP, 20% MLE treated plots recorded the highest (16.02%) mean LCP content which did not show significant difference (P<0.05) from the lowest (13.14% mean LCP content of soybean recorded from the 30% MLE treated plots (Fig. 1).

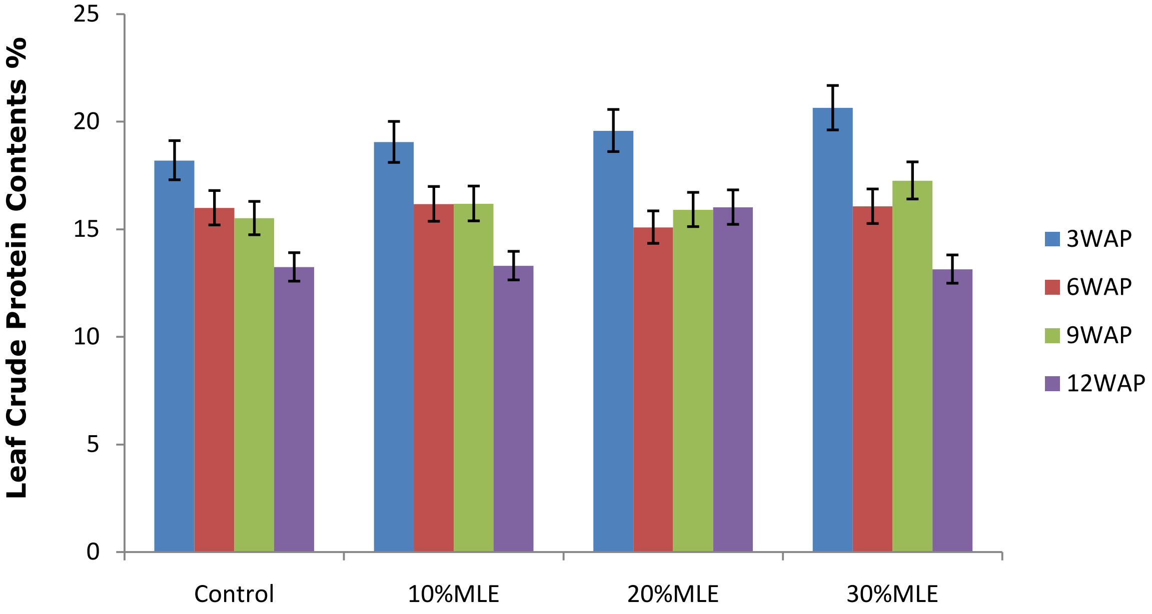

Fig. 1: Leaf Crude Protein Contents of Soybean

B.Effects of MLE Application of Leaf Carbohydrate Content of Soybean

Leaf carbohydrate (LC) content of soybean at 3WAP, was highest (43.62%) from the 30% MLE treated plots which showed significant difference from the lowest (31.93%) mean LC content which was recorded from the control (Fig. 2). At 6WAP, the 20% MLE treated plots recorded the highest (50.64%) mean LC content which was significant different (P<0.05) from the lowest (47.26%) mean LC content recorded from the control (Fig. 2). In the 9WAP, the 20% MLE treated plots recorded the highest (53.35%) mean LC content which was significantly different from the lowest (49.96%). At 12WAP, the 20% MLE treated plots recorded the highest (48.55%) mean LC content which was significantly different (P<0.05) from the lowest (45.77%) mean LC content recorded from both the control and 10% MLE treated plots (Fig. 2).

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International Journal of Advanced Research in Science, Engineering and Technology
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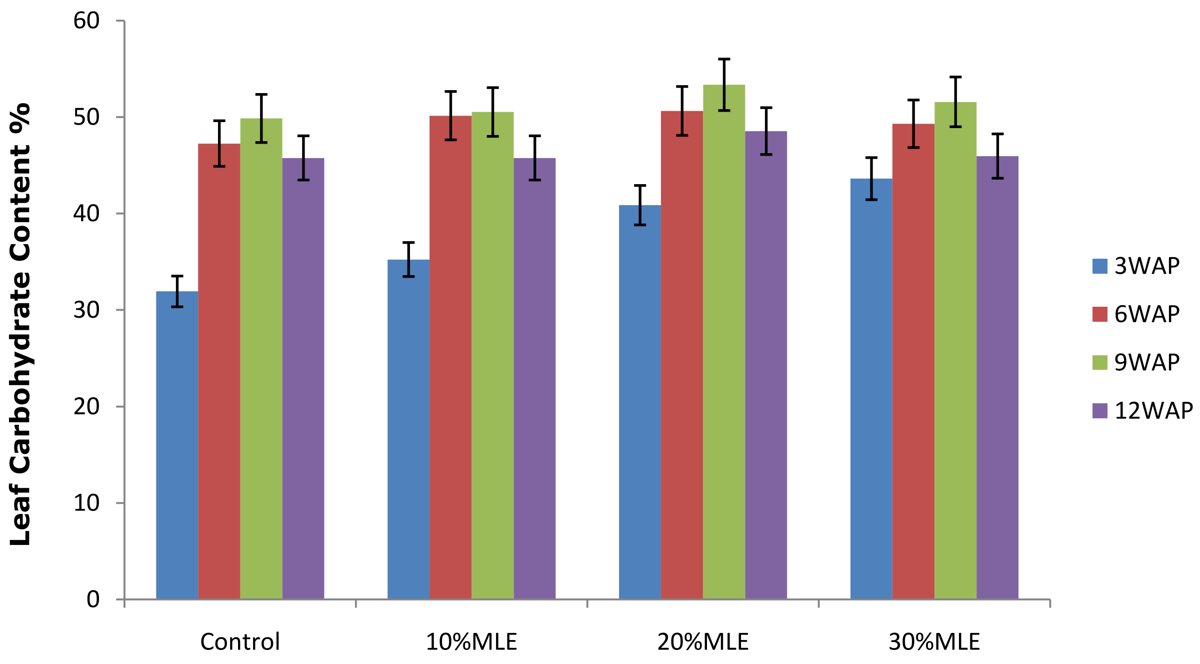

Fig. 2: Leaf Carbohydrate Content of Soybean

C. Effect of MLE Application on Chlorophyll Content of Soybean

The highest (41.6048) mean chlorophyll content of soybean at 3WAP, was recorded from the 30% MLE – treated plots which was significantly different ($P<0.05$) from the lowest (21.2765mg/cm^2) mean chlorophyll content (Fig. 3). At 6WAP, the 30% MLE treated plots also recorded the highest (42.1475mg/cm^2) mean chlorophyll content which showed significant difference ($P<0.05$) from the lowest (38.9000mg/cm^2) mean chlorophyll content (Fig. 3). At 9WAP also, the 30% MLE treated plots recorded the highest (46.623mg/cm^2) mean chlorophyll content when compared to the control but this showed significant difference ($P<0.05$) from the other treated plots while the 10% MLE treated plots recorded the lowest (39.110mg/cm^2) mean chlorophyll content in leaf. At 12WAP, the 20% MLE treated plots showed the lowest (42.405mg/cm^2) mean chlorophyll content which was not significantly different ($P<0.05$) from the highest (46.468mg/cm^2) mean chlorophyll content (Fig. 3).

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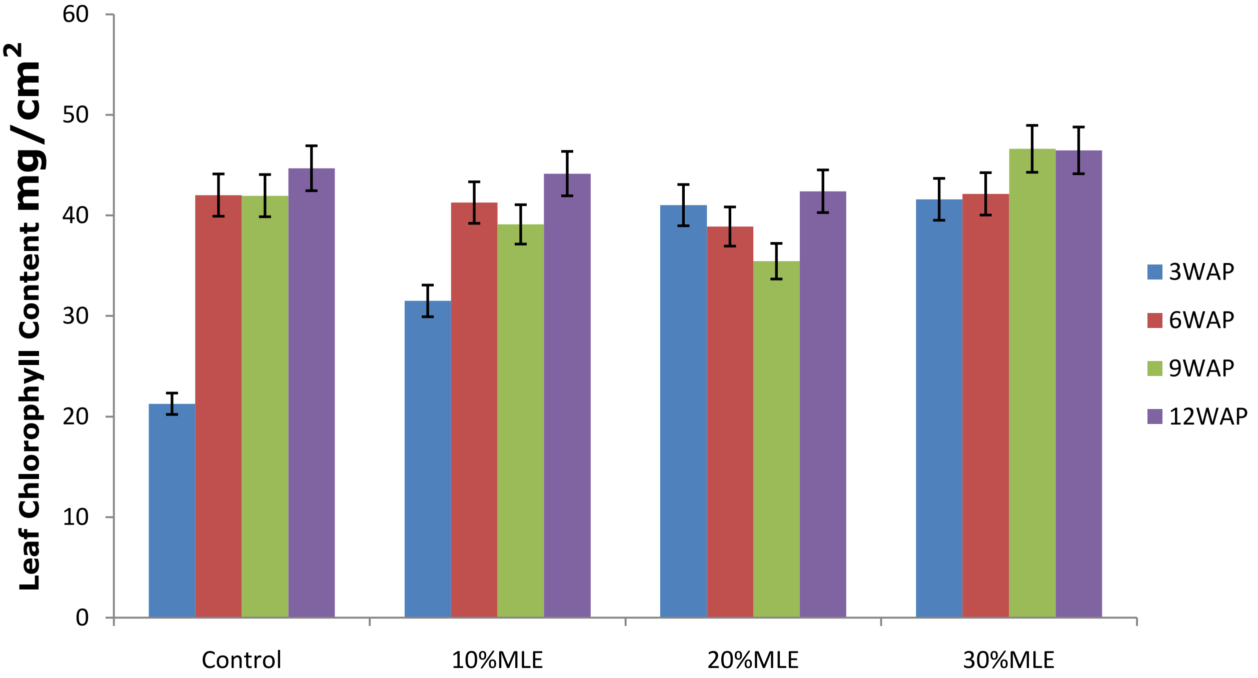

Fig. 3: Leaf Chlorophyll Content of Soybean

D. Yield and Yield Components of Soybean

Effects of MLE Application on Number of Pods Per Plant

Table 1, shows that there was no significant difference in the mean number of pods recorded from the various treated plots. However, the 10%MLE treated plots recorded the highest (13.000) mean number of pods per soybean plant while the control plots recorded the lowest (8.750) mean number of pods per plant (Table. 1). The 10% MLE treated plots also recorded the highest (42.750) mean number of pods per plot which showed significant difference ($P<0.05$) from the lowest (22.500) mean number of pods per plot recorded from the control plots (Table. 1).

Effects of MLE Application on Seed Weight of soybean

The 30% MLE treated plots recorded the highest (15.1583g) mean seed weight of soybean which was significantly different ($P<0.05$) from the lowest (8.7507g) mean seed weight recorded from the control plots (Table. 1).

Effects of MLE Application in Seed Yield

The highest (1512.78kgha^{-1}) mean seed yield was recorded from the plots that received, 30% MLE treatments. This was significantly different from the means recorded from the other treated plots. The lowest (861.58kgha^{-1}) mean seed yield was recorded from the control plots (Table. 1).

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Table 1: Yield and Yield Components of Soybean

Treatments	Mean Number of Pods Per Plant	Mean Number of Pods Per Plot	Seed Weight(g)	Seed Yield ($kgha^{-1}$)
Control (T_1)	8.750^a	22.500^b	8.7807^d	861.58^d
10% MLE (T_2)	13.000^a	42.750^a	10.8457^b	1082.20^b
20% MLE (T_3)	12.000^a	34.500^{ab}	10.3465^c	1033.68^c
30% MLE (T_4)	11.000^a	31.250^{ab}	15.1583^a	1512.28^a

Means in the same column, having the same letter(s) superscript are not significantly different at $P<0.05$ according to LSD.

IV DISCUSSION

The yield of plants treated with MLE was significantly higher than the untreated. This could be attributed to higher number of leaves and leaf area (not shown) recorded from the MLE treated plots which made for greater area for trapping of more sun rays for greater conversion of chlorophyll to carbohydrate. As it was observed from analysis of results that the quantity of chlorophyll in the soybean plant commensurate with the analyzed carbohydrate. The enhanced accumulations of both total protein and chlorophyll in response to treatments with *Moringa* leaf were due to the high protein, sugar and starch content of the entire *moringa oleifera* plant (Foidl *et al*., 2001;Yameogo *et al*., 2011 Mona M. Abdalla, 2013,). Furthermore, this observation is a confirmation to the earlier claim of Foidle (1999), that *moringa* is best used as plant growth and yield enhancer. Foidl *et al.* (2001) further reported 25-30 increased yield for most of the horticultural and some field crops like onions, bell pepper, soya, maize, sorghum, coffee, tea, chill and melon. Again, the protein and carbohydrate content of the soybean plant recorded from the MLE treated plots revealed that application of *moringa* extract is a sure way to boost the nutrient content of soybean plant to meet with the increasing requirement of the teaming population. Also this is same with the chlorophyll content which will make for great yield performance.

The results and discussion presented above show that *moringa* leaf extract application was able to improve the growth and yield performance of soybean. And that the level of improvement increases with increase in the concentration of the MLE applied. It was also observed that protein, carbohydrate and chlorophyll level were influenced by the application of MLE leading to increase in yield of soybean in this study.

This could be as a result of effect of *Moringa* leaves is rich in Zeatin and can be used as a natural source of cytokinin. The leaves also contain ascorbates carotenoids, phenol, potassium and calcium, which will help enhance the synthesis of biochemicals in the soybean plants which have plant growth promoting capability and are being applied as exogenous plant growth enhancers (Foidl *et al.,* 2001).

V CONCLUSION

From the forgoing therefore, it suffices to say that within the limits of this study, moringa leaf extract is a growth and yield enhancer for soybean. And so it is recommended that moringa leaf extract be applied to soybean plants to boost the nutritional quality and also increase yield.It is also recommended that upcoming researchers should try higher concentrations of the MLE on soybean and other legumes.

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