Nutritional Efficacy of two Plant Extracts as Foliar Application on the Yield and Yield Components of Okra (*Abelmoschus esculentus* (l.) Moench), in Sub-humid Region of Nigeria

***Okonji C. J[1]., Ajayi E, O[2]., Adewale B, D[1]., Adara, T, M[1]., Oladigbolu, A.A[2] and Oyerinde J. B[1]**

[1]Department of Crop Science and Horticulture, Faculty of Agriculture. Federal University Oye-Ekiti, P.M.B. 373,Ekiti State, Nigeria.
[2]National Horticultural Research Institute Ibadan, Idi-Ishin, Jericho, Ibadan,Oyo State, Nigeria
**corresponding author: Christopher.okonji@fuoye.edu.ng*

Abstract
Field experiment was conducted at the Inland Valley (Fadama) Teaching and Research Farm of Faculty of Agriculture, Federal University Oye-Ekiti (Ikole Campus), Ekiti State from December 2016 to March 2017to evaluate the effect of foliar spraying of plant extracts as nutrient sources on the yield and yield component of okra. The experiment was arranged in a randomized complete block design (RCBD) with three replications. The trial consists of eight treatments of 10, 15 and 20 g of dry Neem leaf (powder); 10, 15 and 20g of dry Bitter leaf (powder), NPK 15:15:15 (treated check) and control(no fertilization).The results obtained showed that there were significant differences ($p<0.05$) in the plant height among all the treatments combinations. Okra that was sprayed with neem leaf extract with 20g concentration produced highest plant height (39.74 cm). Number of days to first flowering and 50% flowering were significantly ($p<0.05$) influenced by neem extract at 10 – 20g concentrations and the bitter leaf with 10g and 15g concentrations. Neem extract with 20g and bitter leaf with 10g and 15g concentrations had significant ($p<0.05$) effect on yield component of okra. The foliar application of Neem and bitter leave plant extract with 20g concentrations significantly produced the best yield (164.02g).
Keywords: Okra, sustainable, organic sources, application rate

INTRODUCTION

Okra (*Abelmoschus esculentus* L.Moench) has been reported as one of the most popularly home grown and consumed vegetables in the world both in tropical and subtropical regions(Senjobi et al 2013) it is also an important vegetable in Nigeria.Okra is cultivated for its fruits or pods, the tender fruits, leaves and succulent shoots are harvested when immature and consumed as a vegetable, either in fresh or dried forms for nutrient (Arapitsas, 2008). In Nigeria, okra is ranked third in relation to consumption and production area, following tomato and pepper (Ibeawuchi, 2007).According to Onunkun (2012) among the problems of okra production in Nigeria is the poor frequent use of inorganic fertilizer which has been found to increase the acidity of soil that adversely affect crop and microbiological properties of the soil. Also the high cost of importing inorganic fertilizers which have further aggravated the local currency devaluation, not only creates a serious drain on the economy of the countries like Nigeria but has made such fertilizers unaffordable to resource poor farmers (Alphonsus *et al.*,2005).

Considering the above mentioned fact, locally available and economically sustainable products and crop production strategies are now being explored to improve farmers yield and a productive environment. Nutrient supply as foliar through plant extracts which is a form of organic manure will not only reduce the dependence on chemical fertilizers but also encourage the growth, alleviate the deficiency of macro and micro nutrients and sustain higher productivity (Tiwari, 2002; Singh *et al.*, 2006).Further research efforts aimed at reducing the problems of using inorganic fertilizers led to the development and use of extracts from plants leaves. However, some of these

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plant extracts have been used for the management of insect pests control in vegetable production (Mallick 2005; Moyin-Jesu,2010). There is however, dearth of information on the use of neem leaves (*Azadiractha indica*) and bitter leaves (*Vernonia amygdalina*) extracts for use as nutrient supplement for the production of vegetables.This research work is therefore, aimed at identifying the best plant extracts and the appropriate concentration that can serve as foliar application for nutrient sources for increasing the yield and yield component of okra.

MATERIALS AND METHODS

Location and site characterization

The experiment was carried out from December 2016 to March 2017 at the Inland valley (Fadama) Teaching and Research Farm of Faculty of Agriculture, Federal University Oye-Ekiti (Ikole Campus), Ekiti State, Nigeria..Soil sample was taken at a depth of 0-15cm with a soil auger for routine analysis of the physical and chemical properties.

Procedure for forming plants extracts solution

a) Collection / Harvesting of plant leave samples (neem and bitter leaves).
b) Drying of leaves was done at room temperature (air drying) for 4 weeks.
c) Grinding of both leaves into powder was done using an electronic blender in the laboratory.
d) Filtering of the grounded samples was done using 425mic sieve.
e) Weighing of each sample at 10, 15 and 20g was done using a sensitive weighing balance.
f) Soaking of 10, 15, and 20g of each of the sample into 90, 85 and 80ml of water respectively for 24hrs.
g) Filtering each of the solution was done using 125mic sieve to obtain clean leaf extracts.
h) A hand sprayer was used in spraying the obtained clean leaf extract on the crop

The powdery form of both the neem and bitter leaf were taken to the lab for analysis as the results of the plant extracts analysis shows that the percentage compositions of both the macro and micro nutrients were higher except Calcium and Magnesium in bitter extract than neem extract. The percentage of nitrogen was 4.60% in bitter leaves extract and 2.79% in neem leaves extract, phosphorus was 0.37% in bitter leaves extract and 0.18% in neem while the Potassium was 0.93 in neem extract and 2.18% in bitter leaves (Table 2).

Experimental design and treatments

Okra(NHAe 47 – 4 variety) was obtained from NIHORT, Ibadan and was sown on a plot measuring 4 x 3 m (12 m^2). The okra seeds were planted at an inter/intra row spacing of 50x30cm with a total population of 66,666 plants/ha.The experiment was laid out in a randomized complete block design (RCBD) with three (3) replicates.The trial consists of applications 10, 15 and 20g of Neem and Bitter leavesaqueous extracts soaked in 100 ml of water with application of NPK 15:15:15 as a treated check control(no fertilizer application).The plant extracts were appliedat the different concentrations commencing from three weeks after sowing (WAS) and at two weeks interval till harvesting.

Plant sampling and data collection

Five plants were randomly selected and tagged from each plot for measuring the growth parameters at 3, 5, 7 and 9 weeks after sowing planting (WAS). Other parameters collected from the trial

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includedyield and yield components of the crops.

Data analysis

Data collected on growth and yield parameters were subjected to Analysis of Variance (ANOVA) using GENSTAT (General Statistics) (12th Edition input year). Significant means of the treatments were separated using Duncan Multiple Range Test (DMRT).

RESULTS

Effects of plants extract concentrations on growth of okra

Across all the sampling periods (3 – 9WAS) plant heights of okra (cm) significantly ($p<0.05$) differed among the two plant extracts used at their various concentrations. Neem leaf at 20 g concentration consistently had significantly ($p<0.05$) taller plant height (39.74 cm) while the control had the shortest plant (27.95 cm) (Table 3).There was no significant ($p<0.05$) different among the treatments at 3WAS. Neem leaf at 15 and 20 g produced the highest number of leaf at 7 – 9WAS. Amongst all, Neem leaf at 20 g produced the highest number of leaves across the sampling periods (16.86) (Table 3).

Table 4 shows that the leaf lengths of okra were significantly ($p<0.05$) influenced by plant extracts as they were observed to be different from each other throughout the sampling periods. Neem leaf at 20g concentration consistently influenced the increase in length of leaves across the observation periods and the smallest leaf length was recorded from the control plot (8.05 cm).Also from Table 4 significant differences were observed among the extracts at their various concentrations on leaf breath at 3WAS. The three levels of neem leaf (10, 15, and 20g concentrations) and bitter leaf at 10g showed significantly ($p<0.05$) different influence on the breath of leaves from other concentrations as neem leaf at 15g produces the widest leaves at 5WAS (13.9cm) while at 7WAS and 9WAS neem leaf led to the production of the widest leaves (21.3 and 26.5cm) at 20g of concentration.

Table 5 shows that there was no significant ($p<0.05$) effect among the extracts at their various concentrations and also the application of insecticide and control at 3WAS. Neem leaf at 20g was seen to significantly increase stem girth of okra at 5WAS while the bitter leaf extract was observed to produce the biggest plant diameter (stem girth) at 7 and 9 WAS (4.1 and 4.90cm).The level of significant effects of the plant extracts on the number of branches of okra across the observation periods are shown in Table 5 as bitter leaf plant extract at 10g concentration was observed to have had highly significant effect throughout the observation periods while the control gave the least. At 5WAS neem plant extract used at 15and 20g and the bitter leaf used at 10g concentrations were significantly ($p<0.05$) different from other concentrations. While at 7WAS the bitter leaf plant extract at 10g concentration increased the production of branches thereby producing the highest number of branches (3.60) and at 9WAS neem plant extract at 20g and the bitter leaf at 10g produced the highest number of branches (4.56 and 4.66).

Effects of plants extract concentrations on yield and yield parameters of okra

The plant extracts used at 10, 15, 20g concentrations of neem leaf and 10 and 15g concentrations of bitter leaf were significantly ($p<0.05$) different from each other on the number of days to first flowering. Also there was no significant difference between the bitter leaf plant extract at 20g and the NPK treated plant but the control which flowered late at 43days was significantly lower from all the treatment combinations (Table 6). The

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results in Table 6 shows the level of significant differences in the number of days to 50% of flowering in okra as influenced by the various concentrations of plant extracts. At 10g concentration of bitter leaf plant extract, 50% flowering occurred as early as 41days followed by neem plant extracts at 10 and 20g, respectively. Also, 20g concentration of bitter leaf extract and control were not significantly different from each other as they attained 50% flowering late at 44, 45, 45 days, respectively. The effect of the plant extracts was significant on the number of flowers formed per plant as neem extract at 20g and bitter leaf plant extract at 20g concentrations were seen to produce significantly higher number of flowers (12) and the control produces lower number of flowers (7) (Table 6).There were significant effect of plant extract on the yield and yield component of okra at various plant concentrations. The highest number of fruits per plant was recorded at 20g concentration of neem extract (11) and the lowest was from the control plot (8) (Table 6).Neem extract at 20 and bitter leaf at 10 and 15g of concentrations had significant effect on fresh weight of fruits per plant and were highly significantly different from all other treatment combinations. Also 10g of bitter leaf plant extract application produced the heaviest fruit weight at 20.00g per plant as the control plot produced the lowest fruit fresh weight at 17.46g per plant (Table 6).Plant extracts at different concentration levels had significant effect on fruit length as well (Table 6). Neem plant extract at 20g was shown to have had significant effect on length of fruits produced (5.03cm) compared to the control (3.5cm).Bitter leaf extracts at three concentration levels had significant effect on fruit girth of okra and were significantly different from all other treatment combinations. Also neem extract at 10, 15 and 20g and the check were not significantly different from each other but were significantly higher than the fruits girth obtained at the control plot (Table 6).Plant extracts at different concentration levels had significant effect on fresh weight of okra from net plot (Table 6). Neem and bitter leave plant extract at 20g of concentrations significantly increased the yield (164.02 g/plot and 163.65g/plot), as its yield was higher than the yields of other plant extract concentration. The lowest weight was obtained from the control plot (152.48g/plot).

DISCUSSION

The soil analysis showed that the soil is sandy loam, it is also an acidic soil whose pH level is 5.8. Udoh *et al.*(2005) refers to this type of soil as a low fertile soil as the organic matter content, available K, and P are low. Generally, growth characters such as plant height, number of leaves, length and breadth of leaves and stem diameter increased with time. This may be connected with the fact that photosynthesis and the ability of the photosynthesis path to accumulate photosynthate increased with time (Park 2009.). Yield characters such as number of flowers formed per plant, number of fruit per plant, fruit length, fruit weight and fruit diameter varies significantly with each treatment. From the observation, the treatment with neem aqueous extract at 20g of concentration produced the highest yield. The result agrees with the findings of Subbalakshmi (2012) that Neem application on crops helps to increase the yield. Neem extract has been noted to posses high insecticidal properties (Khan *et al* 1991), its use in the present study may have conferred some immunity on the crop thus preventing yield loss as this may have in turn supported the better productivity and yield of the crop. The

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application of various extracts produced significant effect on the performance of okra when compared with the Check and the control treatment. All the parameters taken were positively influenced by the application of the plant extracts at their various concentrations. The plant height treated neem extract at 20g of concentration was the tallest plant. This may be due to the presence of possible growth hormones in the appropriate amount in Neem (Kasarkar and Barge, 2016). Other growth parameters like the number of leaves, length and breadth of leaves and the number of branches appreciably increased with application of plant extracts than the inorganic fertilizer and the control plots. This finding is in agreement with (Akande *et al.,* 2010 and Ajari *et al.,* 2003) who reported that application of organic base fertilizers enhanced plant growth and development.

The length to maturity can be deduced from the number of days to first flowering and days to 50% flowering, which can be indicated from the result that the treatment with neem extract at 10 – 20 g of concentrations and the bitter leaf at 10 and 15g of concentrations among others had the highest number of days to first and 50% flowering while the bitter leaf at 20g, the inorganic fertilizer and the control had the lowest number of days to first and 50% flowering. This observation was supported by Mallick (2005) who reported superior performance of plant extracts on flower formation. Nevertheless, the significant effect of extracts on the number of flowers, fruits and weight of fruits could be attributed to the macro and micro nutrients in the plant extract as Adeniyan and Oyeniyi (2005) reports the importance of these elements. This also corroborate with the findings of Akande *et al.*(2010) that plant extracts as organic manure helps to improve the quality of plant, thereby enhancing the growth of plants and fruits. Their findings were also in line with the work of Akande *et al*., 2010 who attributed higher growth and development in okra to application of organic manure, though this was not as foliar application.The poor growth and yield performance of okra in the control treatment was consistent with the fact that the soil was very low in nutrient contents. This observation was supported by Arapitsas (2008) who had reported poor growth and yield responses of crops in unfertilized soil.

CONCLUSION

The study revealed the potentials of the foliar application of aqueous plant extracts as nutrient source. The use of neem and bitter leaf aqueous extracts is a way to organic farming and an attempt to sustainable agriculture with less threat on the environment. The results obtained from this study showed that neem and bitter leaf aqueous extracts at 20gconcentrations both increase the yield of okra.

REFERENCES

Adeniyan, N. O. and Oyeniyi, S. O. (2005). Effect of poultry manure, NPK 15:15:15 and combination of the reduced levels on maize and chemical properties. Nigeria Journal of Science 2005; 15, 34-41.

Ajari, O.I., Tsado, E. K., Oladiran, J. A. and Salako, E. A. (2003). Plant height and fruit yield of okra as affected by field application of fertilizer and organic matter in Bida, Nigeria. *The Nigerian Agricultural Journal*, 34: 74 - 80.

Akande, M. O., Oluwatoyinbo, F. I., Makinde, E. A., Adejoju, A. S. and Adepoju, I. S. (2010). Response of okra to organic and inorganic

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fertilization. *Nature of Science*, 8: 261 - 266.

Alphonsus, M. O., Michael, C. D. and Christopher, I. A. (2005). Field Evaluation of Extracts of Five Nigerian Spices for Control of Post-Flowering Insect Pests of Cowpea, *Vigna unguiculata* (L.) Walp. *Plant Protect. Sci*., 41 (1): 14 - 20.

Arapitsas, P. (2008). Identification and quantification of polyphenolic compounds from okra seeds and skins. *Food Chemistry*, 110:1041 - 1045.

Fageria, N. K., Filho, B. M. P., Guimaraes, C. M. and Moreira, A. (2009). Foliar fertilization of crop plants. *Journal of Plant Nutrition*, 32: 1044 – 1064.

Ibeawuchi, I. K. (2007). Intercropping a food production strategy for resource poor farmers. *Nature and Science,* 5: 46-49.

Khan M, Schneider B, Wasilew SW, Splanemann V (1988). The effect ofPetrol ether leaf extract of neem on fungi pathogenic to humans in vitroand in vivo. Recent Advances in Medicinal, aromatic and spice crops ,1: 269-272.

Mallick, F. (2005) Neem; The wonder tree. Bulletin Re-search. *Foundation for Science Technology and Natural Resource*, 4: 1 - 3.

Moyin-Jesu, E. I. (2010) Comparative evaluation of modi-fied neem leaf, neem leaf and woodash extracts as pest control in maize (*Zea mays* L). *Emirate Journal of Food and Agricultural*, 22, 34-44.

Onunkun, O. (2012). Evaluation of Aqueous Extracts of Five Plants in the Control of Flea beetles on Okra (Abelmoschus esculentus (L.) Moench). JBiopest, 5 (supplementary): 62-67 (2012).

Park S. Nobel (2009). Physicochemical and Environmental Plant Physiology (Fourth Edition).

Kasarkar AR and Barge AN (2016). Effect of aqueous extract of neem (Azadirachta indica A. Juss) leaves on germination and growth of some agricultural crops. Journal of medicinal plants studies 4(5): 11 – 13.

Singh, Y., Singh, C. S., Singh, T. K., Singh, J. P. (2006). Effect of Fortified and Unfortified Rice straw Compost with NPK Fertilizers on Productivity, Nutrient Uptake and Economics of Rice (*Oryza sativa*). *Indian Journal Agronomy*, 51: 297-300.

Subbalakshmi, L., Muthukrishnan, P and Jeyaraman S. (2012). Neem products in the agricultural applications. *J. Biopest*, 5: 72 – 76.

Sunanda Rani, N., Mallareddy, M. (2007). Effects of different organic manures and inorganic Fertilizers on growth yield and quality of carrot. *Karnataka Journal of Agricultural Science*, 20: 686 - 688.

Tiwari, K. N. (2002). Nutrient Management for Sustainable Agriculture. *J. Ind. Soc. Soil Sci*., 50: 374 - 377.

Udoh, D. J., Ndon, B. A., Asuquo. P. E. and Ndaeyo, N. U. (2005). Crop Production Techniques for the Tropics. Concept Publication, Lagos. Nigeria, 446 p

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Table 1: Physico-Chemical Properties of the soil of the experimental site

Parameters	Units	Soil
pH(in water, 1:2.5)	1:2.5	5.8
organic matter	%	2.20
Total nitrogen	%	0.25
Available phosphorus (Bray method)	*Ppm*	6.20
	Exchangeable	
- Potassium (K)	$Cmolkg^{-1}$	1.69
- Sodium (Na)	$Cmolkg^{-1}$	0.10
- Calcium (Ca)	$Cmolkg^{-1}$	8.56
- Magnesium (Mg)	$Cmolkg^{-1}$	0.94
ECEC		11.29
Zinc (Zn.)	*Ppm*	9.74
Copper (Cu.)	*Ppm*	4.66
Manganese (Mn.)	*ppm*	263.69
Iron (Fe.)	*ppm*	104.15
	Particle size	
- Sand	%	68
- Clay	%	19
- Silt	%	13
Textural class	-	Sandy loam

Table 2: Physico-Chemical Properties of plant extracts

Parameters	Units	Neem Leaves	Bitter leaves
Nitrogen (N)	%	2.79	4.60
Phosphorus (P)	%	0.18	0.37
Calcium (Ca)	%	2.73	1.71
Magnesium (Mg)	%	0.32	0.29
Potassium (K)	%	0.93	2.18
Sodium (Na)	*ppm*	51.85	68.51
Zinc (Zn)	*ppm*	19.44	56.97
Copper (Cu)	*ppm*	4.76	9.58
Manganese (Mn)	*ppm*	41.52	247.44
Iron (Fe)	*ppm*	20.52	27.20

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Table 3: Effects of plant extracts on plant height and number of leaves of okra

	Plant height (cm)				Number of leaves			
Treatment	3WAS	5WAS	7WAS	9WAS	3WAS	5WAS	7WAS	9WAS
NL10	7.4ab	16.12ab	27.13a	37.84ab	4.33a	7.64ab	14.91abc	15.72ab
NL15	8.45a	17.0ab	28.24a	38.61a	4.48a	7.63ab	15.84a	16.60a
NL20	8.81a	19.39a	28.77a	39.74a	4.66a	7.88a	16.05a	16.86a
BL10	8.97a	12ab	27.32a	36.72abc	4.67a	7.20bc	15.27ab	15.22bc
BL15	8.62a	18.10ab	27.68a	33.14cd	4.80a	7.56ab	15.14abc	14.74bc
BL20	7.17ab	16.74ab	24.98ab	33.76bcd	4.63a	6.73cd	14.07bc	14.31c
NPK	7.35ab	15.73bc	24.47ab	30.56de	4.60a	6.98c	13.82c	14.23c
Control	5.0b	12.85c	22.30b	27.95e	4.23a	6.26d	12.14d	12.38d

Means with the same letters are not significantly different at 5% level of probability across the column.
Weeks After Sowing =WAS,
NL= Neem Leaf,
BL=Bitter Leaf

Table 4: Effects of plant extracts on the length and breadth of okra leaves

	Leaf Length (cm)				Leaf Breadth (cm)			
Treatment	3WAS	5WAS	7WAS	9WAS	3WAS	5WAS	7WAS	9WAS
NL10	4.97bc	12.35ab	19.02ab	22.92ab	8.46ab	13.61a	20.76a	24.40b
NL15	5.00bc	12.08ab	19.0ab	22.89ab	9.23ab	13.93a	20.99a	24.73ab
NL20	7.01a	13.01a	20.03a	23.92a	10.38a	13.91a	21.34a	26.58a
BL10	6.68ab	11.38bc	18.16bc	24.27ab	7.44bc	13.11a	19.36ab	23.90bc
BL15	6.47ab	10.33c	17.15c	21.89ab	8.17ab	11.33b	18.57b	22.13cd
BL20	6.32abc	9.85c	16.72c	21.50b	8.57ab	10.81b	18.25b	21.61de
NPK	5.89abc	10.12c	17.15c	21.63b	6.77bc	11.60b	18.50b	22.40cd
Control	4.63c	8.05d	14.66d	19.16c	5.02c	9.07c	15.82c	19.87e

Means with the same letter are not significantly different at 5% level of probability across the column.
Weeks After Sowing =WAS,
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Table 5: Effects of plant extracts on stem girth (diameter) and numbers of branches of okra plant.

	Stem Girth (cm)				Numbers of Branches		
Treatment	**3WAS**	**5WAS**	**7WAS**	**9WAS**	**5WAS**	**7WAS**	**9WAS**
NL10	1.11a	2.28ab	3.82abc	4.63abc	1.70ab	2.68bc	3.06c
NL15	1.17a	2.37ab	3.40bcd	4.20bcd	2.06a	2.26cd	3.86b
NL20	1.25a	2.84a	3.86ab	4.66ab	2.28a	3.14ab	4.56a
BL10	1.34a	2.44ab	4.1a	4.90a	2.04a	3.60a	4.66a
BL15	0.8a	2.16abc	3.60bcd	4.40bcd	1.68ab	2.67bc	4.19ab
BL20	1.11a	1.83bc	3.64abc	4.40bcd	1.70ab	2.71bc	4.34ab
NPK	1.13a	1.86bc	3.36cd	4.17cd	1.20bc	2.02cd	3.27c
Control	1.10a	1.55c	3.15d	4.01d	0.86c	1.78d	2.79c

Means with the same letter are not significantly different at 5% level of probability across the column.
Weeks After Sowing =WAS,
NL= Neem Leaf,
BL=BitterLeaf

Table 6: Effects of plant extracts on yield and yield parameters of okra plant.

Treatment	Days to first flower	Days to 50% flower	Number of flower /plant	Number of fruit/ plant	Fruit fresh weight/ plant (g)	Fruit length (cm)	Fruit Girth (cm)	Fresh fruit weight yield/plot (g)
NL10	38.00b	42.33ab	10.00ab	9.44ab	18.89c	4.63ab	2.03ab	156.27bc
NL15	37.33b	42.33ab	10.00ab	9.60ab	19.18b	4.90ab	2.03ab	157.26abc
NL20	39.00b	42.33ab	12.00a	10.64a	19.91a	5.03a	2.20ab	164.02a
BL10	36.66b	41.00b	9.00b	8.92abc	20.00a	4.80ab	2.30a	160.80ab
BL15	37.00b	42.66ab	10.00ab	8.64bc	19.90a	4.03bc	2.33a	159.44ab
BL20	39.33ab	44.00a	12.00a	9.60ab	19.13b	4.76ab	2.40a	163.65a
NPK	39.00ab	45.00a	10.00ab	8.00bc	18.20d	4.56ab	2.23ab	156.25bc
Control	43.00a	45.00a	7.00c	7.6c	17.46e	3.56c	1.83b	152.48c

Means with the same letter are not significantly different at 5% level of probability across the column.
NL= Neem Leaf,
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