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EFFECTS OF AQUEOUS EXTRACT OF MORINGA (*Moringa oleifera* LAM.) AND NITROGEN RATES ON THE CONTRIBUTION OF SOME PHYSIOLOGICAL AND YIELD ATTRIBUTES TO GRAIN YIELD OF SESAME (*Sesamum indicum* L.) II

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Abstract

Sesame is considered second best to cocoa in terms of export volume and value in Nigeria. However, there is a drawback in the land area under its cultivation recently due to the low yield per unit area. Yield is a quantitative character that is dependent on many related characters. For effective improvement in yield a simultaneous improvement of physiological and yield attributes alongside agronomic practices is pertinent. Moringa were reported to improve crops' yield because of its ability to improve soil fertility as well as play key roles as a plant growth hormone. Thus, field experiments were conducted in 2009 and 2010 rainy seasons at the Teaching and Research Farm, Faculty of Agriculture, Bayero University, Kano, Nigeria to study the roles of Aqueous Extract of Moringa and Nitrogen rates as they affect some Physiological and yield attributes in Sesame. Treatments consisted of four concentrations of moringa shoots extract (0%, 3%, 4% and 5%) and three Nitrogen rates (0, 45, 90 kg N ha^{-1}). These treatments were factorially combined and laid out in a Randomized Complete Block Design with three replications. Foliar spray of moringa extracts on sesame started at 2 weeks after sowing and continued fortnightly until 8 weeks after sowing. Nitrogen rates were applied in two doses at land preparation and at 5 weeks after sowing. Data were collected on Plant height, Leaf area index, Crop growth rate, Leaf area ratio, Number of capsules per plant and Grain yield ha^{-1}. Data obtained were subjected to correlation analysis between the measured characters and yield, thereafter, path analysis was carried out. Results showed significant association between the characters and grain yield. Plant height had the highest percentage direct contribution while Number of capsules per plant had the lowest contribution. Indirect/combined contribution of Crop growth rate with leaf area ratio was highest while leaf area ratio with number of capsules per plant was lowest and negative. Based on the results, it was concluded that moringa can compliment Nitrogen fertilizer in improving sesame growth and yield. Therefore, 90 kg N ha^{-1} with 3 % moringa extract are recommended for improved grain yield of sesame per unit area.

***Key words**: sesame, aqueous extract of moringa, nitrogen rates, physiological and yield attributes, grain yield.*

INTRODUCTION

The drawback in the land area under sesame (*Sesamum indicum* L.) cultivation in Nigeria had been attributed to low yield per hectare. This has become a major concern to the government, farmers and researchers. Sesame is considered second best to cocoa in terms of export volume and value in Nigeria (Anon., 2004). This concern made researchers to explore all possibilities to improve its production and productivity.

Yield is a quantitative character that is dependent on many related characters (Muhamman et al., 2012). For effective improvement in yield a simultaneous improvement of physiological and yield attributes alongside agronomic practices is important. Number of leaves per plant and plant height were earlier reported to significantly affect sesame grain yield (Muhamman et al., 2010).

Moringa (*Moringa oleifera* Lam.) a common plant in households in Nigeria were reported to enhance seed germination, growth and yield of crops (Foidl et al., 2001; Muhamman et al., 2009; Phiri and Mbewe, 2010).

On the other hand, fertilizer more especially nitrogenous types; the major input in crop production is very scarce and where available is beyond the reach of small holder farm families who constitute the major producers in Nigeria. The need to find synergy to nitrogen fertilizer becomes vital.

This research therefore, was conducted to determine the complimentary effect of aqueous extract of moringa with nitrogen rates and their effect on the contribution of some physiological and yield attributes to grain yield of sesame.

MATERIALS AND METHODS

Two years (2009 and 2010 rainy seasons) field studies were conducted at the Teaching and Research Farm, Faculty of Agriculture, Bayero University, Kano, Nigeria (Latitude 11^o 58' N and Longitude 8^o 25' E at an altitude of 458 m). Moringa shoots (about 40 days) were crushed with water (10 kg of fresh material in 1 litre of water) and filtered out.

Liquid extract obtained were diluted with water in the following concentrations: 0%, 3%, 4% and 5% to give 4 treatments. These treatments with three N rates (0, 45, 90 kg N ha^{-1}) in a factorial combination were tested on sesame in an experiment laid out in a Randomized Complete Block Design with 3 replications. Foliar spray started at 2 WAS and continued fortnightly until 8 WAS. Land for the experiments were prepared by harrowing and ridging at a spacing of 0.75 m between rows, thereafter were marked into plots with gross plot size of 13.5 m^2 and net plot size of 3.15 m^2.

Table 1. Soil physico - chemical properties of soils of experimental sites in 2009 and 2010 rainy seasons

Soil properties	2009		2010	
	0 – 15 cm	15 – 30 cm	0 -15 cm	15 – 30 cm
Soil pH (H_2O)	6.70	5.90	5.60	5.51
Organic carbon (g kg^{-1})	3.90	1.00	9.70	8.90
Organic matter (g kg^{-1})	6.72	1.72	16.72	15.34
Total N (g kg^{-1})	0.98	1.26	1.90	1.40
Available P (mg kg^{-1})	5.13	5.02	6.01	6.05
C.E.C. (cmolkg^{-1})	9.67	5.94	6.92	4.30
Exchangeable K (cmol kg^{-1})	0.96	1.26	4.40	4.6
Exchangeable Na (cmol kg^{-1})	0.32	0.35	0.30	0.35
Exchangeable Ca (cmol kg^{-1})	0.04	0.05	0.28	0.73
Exchangeable Mg (cmol kg^{-1})	0.35	0.28	0.27	0. 27
Textural class	Silty clay	Silty clay	Silty clay	Silty clay

Soil samples were collected in the two seasons randomly at a depth of 0 - 15 cm and 15 – 30 cm using soil auger and the soil's physical and chemical properties determined in the laboratory (Table 1).

Few seeds of sesame were dibbled and later thinned to one plant per stand at 3WAS at a spacing of 0.75 m x 0.15 m. Half of N with 60 kg ha^{-1} P_2O_5 – 60 kg ha^{-1} K_2O were applied at sowing, and at 5 WAS the remaining half of N was applied as side dressing. Weeds were controlled manually using hand hoes at 3, 5 and 7 WAS.

Data were collected on: Plant height (PH) at 5 and 7 WAS, and at harvest: heights of five plants selected randomly and tagged were determined from each plot, mean calculated and recorded.

Leaf area index (LAI) at 5 and 7 WAS and at harvest: LAI were determined using the equation: LAI = LA/GA where LA = leaf area and GA = ground area covered by the plant. Crop growth rate (CGR) (g wk^{-1}): CGR was determined as follows: CGR = $(W_2 – W_1)/ (T_2 – T_1)$; where W_1 and W_2 are shoot dry weights taken at two consecutive harvests over time intervals T_1 and T_2. Leaf area ratio (LAR) (g cm^{-2}): this was determined as follows: LAR = $A_2 – A_1 (Log_e W_2 – Log_e W_1)/W_1 – W_2 (Log_e A_2 – Log_e A_1)$; where W_1 and W_2 are shoot dry weights taken at two consecutive harvests over time t_1 and t_2 and A_1 and A_2 were leaf area at these periods.

Number of capsules per plant (NCPP): capsules of the five tagged plants in each plot were counted and their mean recorded. Grain yield ha^{-1}: Net plots were harvested and grain weights were converted to yield in kg per hectare.

Data collected were subjected correlation analyses between the measured parameters and yield using SAS system for windows (SAS v 8, 2000). Thereafter, path analysis was carried out as described by Dewey and Lu (1959).

RESULTS AND DISCUSSIONS

The results of the composite soil samples for the two cropping seasons are presented in Table 1. Soils of the experimental sites were silty clay and slightly acidic; total N was moderately high. Organic carbon was also high. The variation in the physico – chemical properties in the seasons, with that of 2010 being slightly higher, likely be due to the residual soil nutrients and post harvest left over of the previous cropping season. Table 2 shows matrix of correlation describing the mean relationship between some physiological and yield attributes to grain yield of sesame in 2009 and 2010 rainy seasons. Leaf Area Ratio had a highly significant positive correlation (r=0.42) with grain yield, and plant height had a positive significant correlation with grain yield of 0.26. Leaf area index, CGR, NCPP had no significant correlation with grain yield.

Path diagram and coefficient of factors of some physiological and yield attributes affecting total grain yield of sesame (Figure 1) showed that PH, LAI, CGR, LAR and NCPP contributed directly to grain yield with magnitudes of 0.5907, -0.3808, 0.3898, 0.4562 and 0.1540, respectively. Indirect/combined contribution of CGR with LAR was highest (0.63) followed by LAI with CGR (0.62) and lowest in LAR with NCPP (-0.13), while 0.13 was residual. When the contribution was quantified into percentage (Table 3), PH contributed highest (34.89%) followed by LAR (20.82%) and least contribution (2.37%) was from NCPP.

The highest contribution of PH may be due to the fact that the higher the plant, the more branches may be formed, since dormant buds close to apical meristems becomes viable, as the shoot apex grows away from the auxiliary bud.

This may result to more leaves and leaf area thereby increasing the photosynthetic ability of the plant.

This will result into more dry matter accumulation, which may be partitioned to the sink (the grain). Plant height was earlier reported to significantly contribute to grain yield of sesame (Muhamman et al., 2010)

This may also explain the contribution of LAR. Since LAR is an important factor in estimating canopy photosynthesis (Amanullah et al., 2007). Also the percentage indirect/combined contribution of CGR with LAR was highest (22.41%), followed by PH with LAR (13.48%). This also followed the earlier explanation that as the plant increases in height more leaves may be formed.

This increases the photosynthetic ability of the plant and thus, the accumulation of more dry matter.

The least percentage of indirect/combined contribution was in LAR with NCPP and it was negative (- 1.83%).

Sesame capsules remain green until when the plant attained physiological maturity, and could take part in photosynthetic activities; hence it is regarded more of a source than a sink.

This may explain the reason why direct and indirect contribution of NCPP was the lowest.

About 13.15% is residual; unaccounted form of error, which cannot be explained in this study. The residual might form part of the attributes which are not part of this study. Attributes such as number of branches per plant where earlier reported to significantly affect grain yield of sesame (Muhamman et al., 2010)

Table 2. Matrix of correlation showing the relationship between some physiological and yield attributes to grain yield of sesame (*Sesamum indicum* L.) in the combined of 2009 and 2010 rainy seasons

		1 PH	2 LAI	3 CGR	4 LAR	5 NCPP	6 GY
1	PH	1.00					
2	LAI	0.40**	1.00				
3	CGR	0.11ns	0.62**	1.00			
4	LAR	0.25*	0.34**	0.63**	1.00		
5	NCPP	0.42**	0.18ns	0.22ns	-0.13ns	1.00	
6	GY	0.26*	0.19ns	-0.05ns	0.42**	0.08ns	1.00

PH = plant height, LAI = leaf area index, CGR = Crop growth rate LAR = Leaf area ratio, NCPP = Number of capsules per plant, GY = Grain yield per hectare, *= significant at 5 % level. ** = highly significant at 1 % level. ns = not significant.

Table 3. Direct and combined contribution (%) of some physiological and yield attributes to grain yield of sesame (*Sesamum indicum* L.) and their residual effect in the combined of 2009 and 2010 rainy seasons

Characters	**% Contribution**
Individual/direct contribution	
Plant height (PH)	34.8931
Leaf Area Index (LAI)	14.5013
Crop Growth Rate (CGR)	15.1955
Leaf Area Ratio (LAR)	20.8151
Number of pods per plant (NPP)	2.3716
Indirect/combined contribution	
PH – LAI	-17.9955
PH – CGR	5.0658
PH – LAR	13.4750
PH – NPP	7.6414
LAI – CGR	-18.4070
LAI – LAR	-11.8141
LAI – NPP	-2.1112
CGR – LAR	22.4087
CGR – NPP	2.6414
LAR – NPP	-1.8268
Residual	13.1457
Total	100.0000

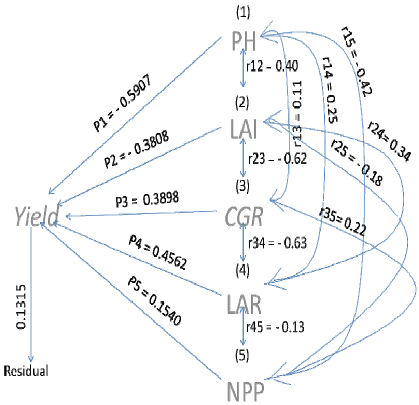

Figure 1. Path diagram and coefficient of factors of some physiological and yield attributes affecting total grain yield of sesame

CONCLUSIONS

From the results of this study, aqueous extract of moringa and nitrogen rates had significantly effects the physiological and yield attributes that contribute meaningfully to grain yield of sesame.

While it was obvious that the two factors complement each other, 90 kg N ha^{-1} with 3% aqueous extract of moringa should be adopted for improved grain yield.

REFERENCES

Anonymous., 2004. Nigeria targets ₦ 1.8 bn annually from sesame export. Daily Independent Newsletter Limited, Lagos, Nigeria.

Amanullah, Muhammad J.H., Khalid N., Asad A., 2007. Response of specific leaf area (SLA), leaf area index (LAI) and leaf area ratio (LAR) of maize (*Zea mays* L.) to plant density, rate and timing of nitrogen application. World Applied Journal 2, 3:235-243.

Dewey D.K., Lu K.M., 1959. A correlation and coefficient analysis of component of crested wheat grass seed production. Agronomy Journal, 51:515-518.

Foidl N., Makkar H.P.S., Becker K., 2001. The potential of *Moringa oleifera* for Agricultural and Industrial uses. In Fuglie, L. J. (editor) The Miracle Tree: The multiples attributes of Moringa. CTA and CWS, Dakar, Senegal, p. 168.

Muhamman M.A., Auwalu B.M., Manga A.A., Jibrin J.M., 2009. Effect of Moringa (*Moringa oleifera* Lam.) extract on the growth of Tomato (*Lycopersicon lycopersicum* (L.) Kert) in Kano, Sudan Savanna Ecological zone of Nigeria. Proceedings for the 27th Annual Conference of Horticultural Society of Nigeria. Kano State, Nigeria, p. 71-75.

Muhamman M.A., Mohammed S.G., Lado A., Belel M.D., 2010. Interrelationship and Path coefficient Analysis of some growth and yield characterestics in sesame (*Sesamum indicum* L.). Journal of agricultural sciences. Canadian Center of Science and Education. Volume 2, No. 4, p. 100-105.

Muhamman M.A., Auwalu B.M., Manga A.A., Jibrin J.M., 2012. The Contribution of Some Physiological attributes to Grain yield of Maize as affected by Aqueous Extract of Moringa (*Moringa oleifera* Lam.) and Nitrogen rates. Proceedings of 46th Annual Conference of Agricultural Society of Nigeria, Kano, p. 619-623.

Phiri C., Mbewe D.N., 2010. Influence of *Moringa oleifera* leaf extracts on germination and seedling survival of three common legumes. International Journal of Agriculture and Biology, 12:315-317.

SAS system for windows v.8, 2000. SAS Institute Inc. Cary. NC 27613 USA.