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Full Length Research Paper

Influence of poultry manure application on growth and yield performance of accessions of sesame (*Sesamum indicum* L.) in a derived savanna transition zone of South eastern Nigeria

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A two-year study was carried out in the research farm of the Department of Crop Science, University of Nigeria, Nsukka, to test the effects of accessions and poultry manure rates on the growth and yield of sesame in the derived savannah zone of south eastern Nigeria. Three rates of poultry manure (0, 5 and 10 tons/ha) and four accessions of sesame (Zuru, NCRI-BEN O1M, 43 – 9 – 1 and NCRI-BEN O3L) were tested. The experiment was laid out in a 3 × 4 factorial experiment in randomized complete block design in three replications. The result showed that the application of poultry manure significantly promoted sesame growth and yield. Seed yield/ha was increased by 24 and 78% as manure rate was increased from 0 to 5 and 10 tons/ha, respectively, in 2009 season. In 2010, it was increased by 96 and 155% with the same increase in the rate of poultry manure. The accessions differed significantly in growth and yield parameters. Accession Zuru produced the highest seed yield/ha of 1146 and 543 kg in 2009 and 2010 seasons, respectively, among the accessions. There was also significant manure × accession interaction. Accession Zuru treated with 10 tons/ha poultry manure rate produced the highest seed yield/ha in both years.

Key words: Sesame, poultry manure, accessions, derived savanna.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oil seed crop grown in tropical and sub-tropical areas (Ashri, 1998). It is grown for the seed which is an excellent source of high quality oils, rich in carbohydrate, calcium, phosphorus and protein (NCRI, 2005). India, China, Sudan, Myanmar, Ethiopia, Uganda and Nigeria are the important world producers (Wikipedia, 2009). Sesame seed, apart from the oil, is traditionally used for direct consumption. It is also used in confectioneries, cookies, cake, margarine and bread making. The oil is used in the manufacture of soaps, cosmetics, perfumes, insecticides and pharmaceutical products. The cake is also used in compounding livestock feed. Sesame production in Nigeria started first in the middle-belt area by the West African Oilseed Mission which was mandated to investigate the possibility for its production in Nigeria (Idowu, 2002). The middle-belt zone also falls within the agro-ecozone for sesame cultivation, latitude 06° to 10° north (Agboola, 1979). Production is still concentrated in the north and middle belt areas and is carried out in small scale farms by peasant farmers. Production is characterized by poor production techniques and low input and yield is always low at 83 tons/annum compared with 800 and 750 tons/annum obtainable in China and India, respectively (FAO, 2005). El-Greedly et al. (2005) had reported increase in sesame production in recent years which they attributed to expansion of the growing area. This study is part of studies being carried out to find the possibility of growing this important oil seed crop outside the traditional growing area in Nigeria. This will increase the production of the crop in Nigeria to meet up with the demand for the seed. Also, in the present global search for alternative to fossil fuel, sesame seed oil could be converted to biodiesel for powering automobiles.

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Table 1. Physical and chemical properties of the experimental sites before land preparation in 2009 and 2010.

Soil properties	2009	2010
Clay (%)	21.00	24.00
Silt (%)	13.00	11.00
Fine sand (%)	24.00	28.00
Course sand (%)	42.00	37.00
pH (H_2O)	4.90	4.60
pH (KCl)	3.80	3.40
Carbon (%)	1.05	1.44
Organic matter (%)	1.08	2.48
Nitrogen (%)	0.07	0.09
Na^+ (me/100 g)	0.27	0.58
Ca^{2+} (me/100 g)	0.06	1.80
Mg^{2+} (me/100 g)	0.80	1.20
CEC (me/100 g)	9.20	20.60
Base saturation (%)	20.61	20.40
H^+ (me/100 g)	2.60	1.60
P (ppm)	15.02	28.91

Poultry manure application has been reported to improve crop performance in the study area (Ogbonna and Obi, 2007). Study conducted elsewhere has also shown that manure application promoted sesame yield (Suddhiyan et al., 2009). The enhancing effect of manure is attributed to the release of nutrient to the soil as well as improving the soil physical properties to the benefit of the crop (Mbagwu and Ekwealor, 1990). Manure also provides a gradual and more lasting release of a wide range of nutrient elements to the soil (Kroodsma, 1986). The present study was carried out to determine the effect of the application rates of poultry manure on growth and yield of accessions of sesame in the derived savannah zone of south eastern Nigeria.

MATERIALS AND METHODS

This study was carried out in the Teaching and Research farm of the Department of Crop Science, University of Nigeria, Nsukka, in 2009, and repeated in 2010. The site is located at latitude 06° 52' N and longitude 07° 24'E and altitude 447 m above sea level.

Four accessions of sesame obtained from the National Cereal Research Institute (NCRI), Badeggi, Nigeria, were used. Poultry manure was sourced from a deep litter poultry farm.

The experiment was laid out in a 3 × 4 factorial experiment in randomized complete block design (RCBD). The factors are poultry manure rates (0, 5 and 10 tons/ha) and accessions (43-9-1, NCRI-BEN 01M, Zuru, and NCRI-BEN 03L). These gave 12 treatment combinations and were replicated thrice. The site was ploughed, harrowed and marked out into blocks and plots. Distance between blocks and plots are 1.0 m. Soil samples were collected at random from the experimental plot at the depth of 0 to 15 cm prior to land preparation. These were bulked together to form a composite sample from which a sub-sample was taken to soil science laboratory for analysis for physiochemical properties of the soil. The poultry manure was measured out according to treatment and applied to the respective plots and worked into the soil. The sesame accessions were sown in their respective plots three days after manure application. Sowing was done by drilling the seeds in shallow furrows and then covered lightly with soil. This was done on July 22, 2009. Two weeks after germination, the plants were thinned down to two plants/stand at the spacing of 75 × 30 cm between and within rows. Weather records on rainfall, temperature and humidity were obtained from the meteorological station of the University of Nigeria, Nsukka, located 200 m away from the experimental site.

Data collection

Data collected include plant height (cm), stem girth (cm), number of branches/plant, and number of leaves/plant at maturity. Records were also taken on number of capsules/plant, number of seeds/capsule, 1000-seed weight, seed yield/plant and seed yield/ha.

Data analysis

These data were subjected to analysis of variance as described by Steel and Torrie (1980) for factorial experiments. The F-LSD method was used for separation of treatment means following the procedures described by Obi (2001). Test of significance was done at 0.05 probability level. The experiment was repeated in the following year (2010) at the same time of planting and at the same site.

RESULTS

The result of the soil analysis presented in Table 1 showed that the soil is low in fertility and is also slightly acidic. The soil of the site was however higher in some of

Table 2. Meteorological data for the years 2009 and 2010.

Months	2009						2010					
	Rain (days)	Rainfall (mm)	Temp (°C)		Relative humidity (%)		Rain (days)	Rainfall (mm)	Temp. (°C)		Relative humidity (%)	
			Max.	Min.	09:00 (h)	16:00 (h)			Max.	Min.	09:00 (h)	16:00 (h)
Jan	3	53.59	31.90	21.45	71.39	58.63	0	0.00	32.90	20.26	66.63	50.87
Feb	1	2.19	32.46	22.79	74.61	59.43	0	0.00	33.89	23.32	71.68	57.18
Mar	0	0.00	33.61	23.32	72.81	57.03	3	43.88	34.03	23.26	69.97	53.81
April	11	180.6	31.37	21.60	76.20	66.20	7	161.80	32.83	23.07	73.10	63.87
May	10	283.69	30.23	21.42	74.16	70.32	10	212.34	30.39	22.23	73.48	68.81
June	18	152.51	29.13	20.83	74.67	72.67	18	247.39	29.13	21.47	75.90	70.77
July	16	248.17	28.65	20.58	74.84	74.58	17	158.48	27.94	21.00	76.52	71.29
Aug	18	260.33	27.48	20.84	75.00	75.00	18	404.15	27.55	21.16	77.16	72.68
Sept	17	175.76	27.87	20.10	74.67	74.50	18	203.95	28.13	20.73	77.13	71.80
Oct	17	387.10	28.39	20.26	74.94	74.74	18	183.63	28.97	20.84	76.00	68.45
Nov	5	103.18	29.85	19.30	63.80	61.73	2	19.31	30.03	21.23	73.70	64.03
Dec	0	0.00	32.71	18.84	65.35	48.68	0	0.00	32.10	18.32	61.23	48.16

the nutrient elements in the second year than in the first year. The weather record shown in Table 2 indicated that more rainfall was recorded in the first year than in the second year. The rain also started earlier in the first year.

The result presented in Figures 1 to 4 shows that the application of poultry manure significantly increased growth parameters measured in sesame in both years. There was a trend of increase in plant height, number of leaves/plant, stem girth and number of branches/plant as poultry manure rate was increased from 0 to 5 and to 10 tons /ha. Most yield parameters were also significantly affected by poultry manure application. Results shown in Figures 5, 6, 8 and 9 indicated that number of capsules/plant, seeds/capsule, seed yield/plant and seed yield/ha were significantly increased by poultry manure application. One thousand seed weight increased with poultry manure application but not significantly (Figure 7).

There were observable differences in the growth parameters among the accessions, however, the accessions differed significantly only in plant height and stem girth while the differences in number of leaves/plant and number of branches/plant were non significant in both years (Figures 10 to 13). Accession Zuru had the highest values in plant height, stem girth and number of branches/plant while accession 43-9-1 showed the highest number of leaves/plant. Accession effect on yield parameters indicated differences among the accessions (Figures 14 to 18). Significant variation was observed in number of capsules/plant, seed yield/plant and seed yield/ha in both years. The accessions differed significantly in number of seeds/capsule only in 2010 experiment. Non significant accession effect was recorded in 1000-seed weight in both years. Accession Zuru was also the highest in number of capsules/plant, seed yield/plant and seed yield/ha among the accessions. Accession NCRI-BEN 03L had the highest 1000-seed weight and number of seeds/capsule. In 2010, accession Zuru recorded the highest value in all the growth attributes. The interaction effect of poultry manure and accession were significant in most of the growth and yield attributes recorded in 2009 (Table 3). The accessions maintained the same trend of improvement in performance as poultry manure rates was increased. Accession Zuru showed the best performance in all the yield parameters across the manure rates with the exception of number of seed/capsule at 0 and 10 tons/ha rates and 1000 seed weight at all the manure rates. In the second year experiment, significant accession × poultry manure rate interaction was also recorded in all parameters measured with the exception of 1000- seed weight (Table 4) Accession Zuru recorded the highest value in all

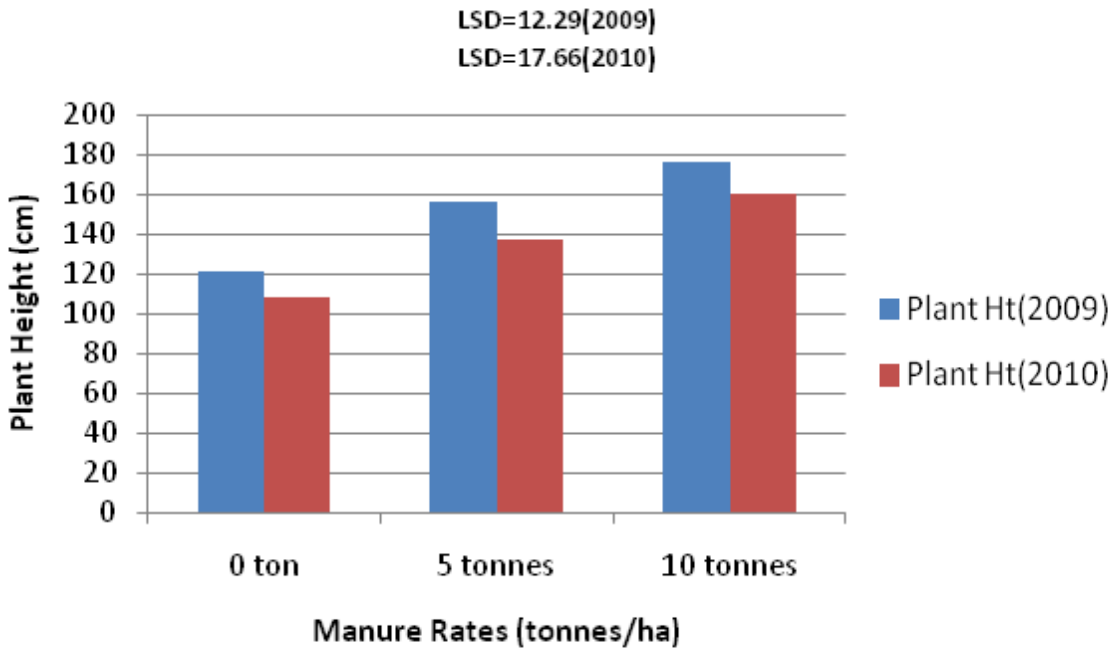

Figure 1. Effect of poultry manure rates on plant height in 2009 and 2010 experiments.

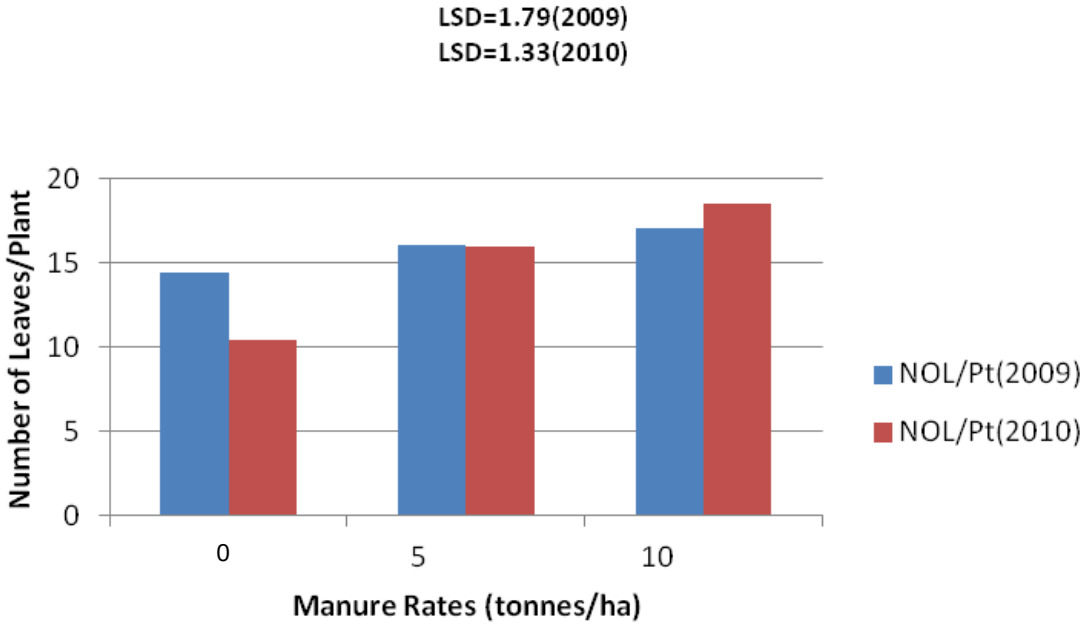

Figure 2. Effect of poultry manure rates on number of leaves/plant in 2009 and 2010 experiments.

these attributes.

DISCUSSION

The soil analysis indicated low soil fertility, however, the residual manure effect of the manure applied in the first year experiment caused the higher nutrient content in the soil prior to establishment of the second year experiment. The rainfall and temperature regimes recorded in both years fall within the range reported to be suitable for sesame production (Olowe, 2007). Application of poultry manure promoted vegetative growth in sesame in the study area. This consequently resulted to increase in

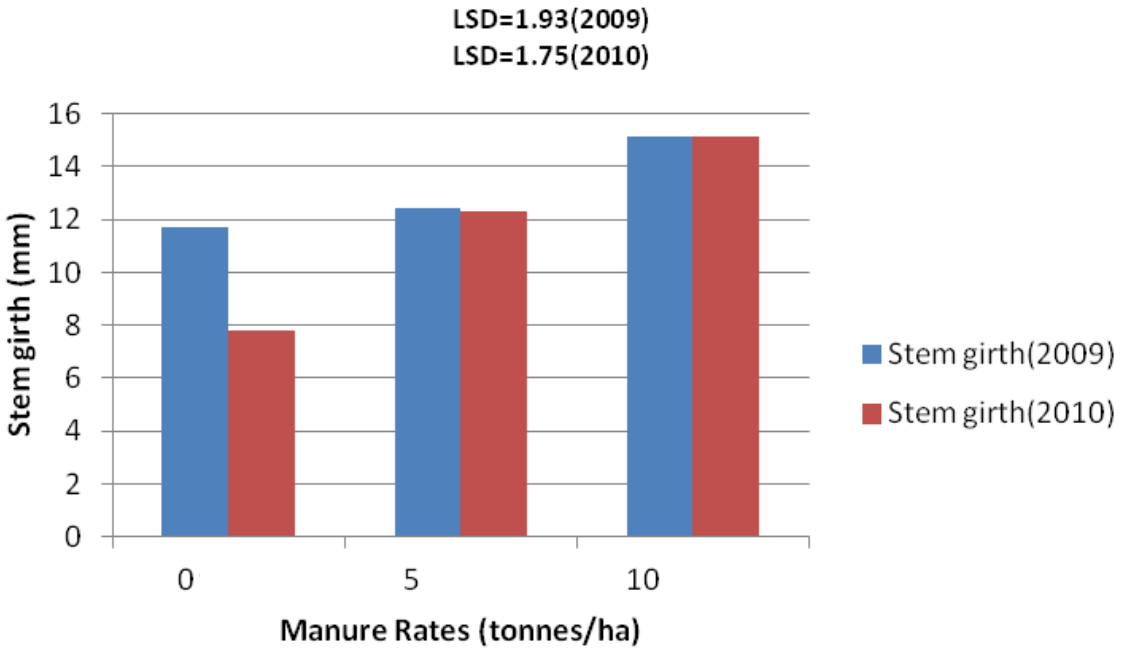

Figure 3. Effect of poultry manure rates on stem girth in 2009 and 2010 experiments.

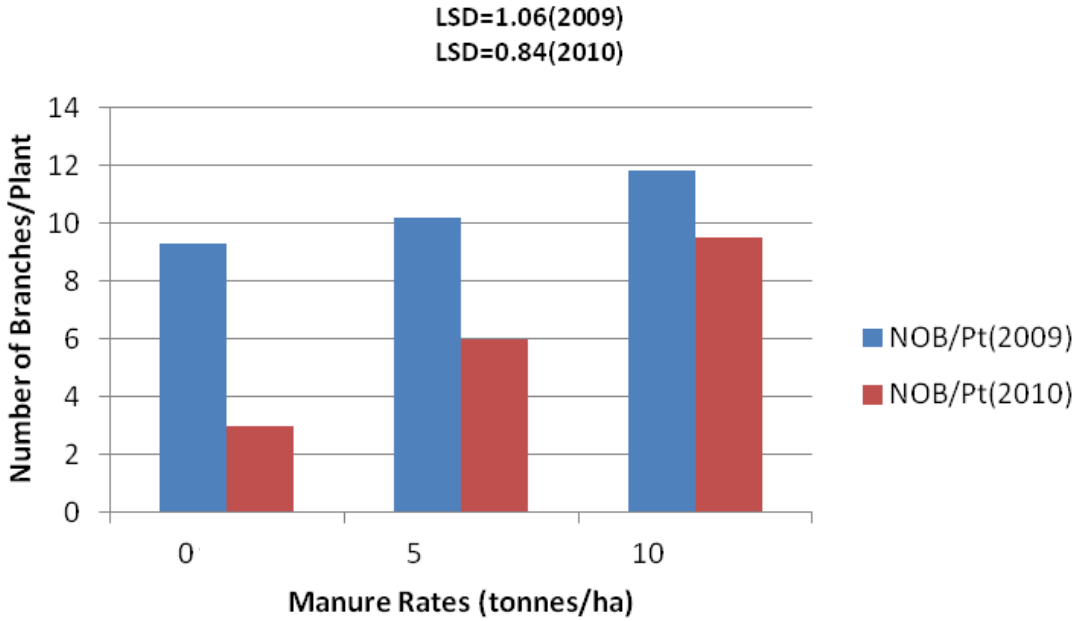

Figure 4. Effect of poultry manure rates on number of branches/plant in 2009 and 2010 experiments.

number of capsules produced, better seed formation and filling which led to the higher seed yield recorded in plots that received manure treatments. Increase in number of leaves/plant is expected to cause increase in photosynthetic efficiency of the plant which will translate to high yield. Similarly, high number of branches and plant height will cause increase in the number of capsules/plant since the capsules are produced on the stem and branches. Earlier study has shown that plant height and number of branches/plant have significant direct positive correlation with seed yield in sesame (Parameshwarappa et al., 2009). The same study also revealed that number of capsules/plant and number of seeds/capsule maintained positive linear relationship with seed yield in sesame. An experiment conducted in the northern guinea savanna area of Nigeria also showed

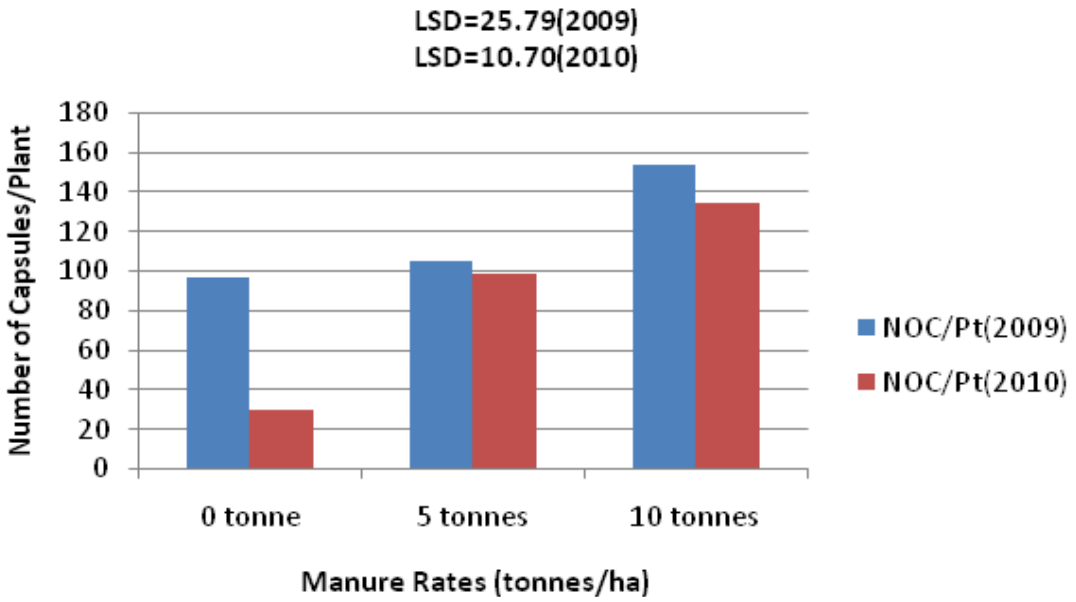

Figure 5. Effect of poultry manure rates on number of capsules/plant in 2009 and 2010 experiments.

that application of poultry manure in sesame production resulted to significant increase in sesame grain yield (Haruna, 2011). The study also indicated that plant growth attributes such as plant height, number of branches/plant, stem girth, number of leaves /plant as well as total dry matter yield were increased as a result of poultry manure application (Haruna et al., 2011). Akande et al. (2011) and Abdel-Sabour and El-Seoud (1996) also made similar observations on the effect of organic manure application in sesame production.

The seed yields of 1041 and 1495 kg/ha obtained in plots amended with 5 and 10 tons/ha of poultry manure in the present study compare well with yields obtained in major sesame producing areas (Abubakar et al., 1998) and higher than the Nigeria average which is as low as 300 kg/ha (Okpara et al., 2007).

The response to manure application in the study area may be attributed to low fertility status of the soil. Tisdale and Nelson (1975) have shown that crops respond more to nutrient application in soils that are low in fertility. The applied poultry manure increased both major and minor essential nutrient elements as well as organic matter content in the soil which improves moisture and nutrient retention. Manure apart from releasing nutrient to the soil also improves the soil structure, pH, and cation exchange capacity of the soil (Mbagwu and Ekwealor, 1990), and provides better environment for root development and aeration. Akande et al. (2011) also noted that large population of micro organisms are introduced to the soil through organic manure which promoted N fixation and P solubilization. All these contributed to the enhancing effect on growth and yield attributes obtained from the poultry manure application. Pornparn et al. (2009) reported that yield obtained by the use of organic manures in sesame production compare favourable with that grown with inorganic fertilizer with the extra benefit of improving the soil pH, organic matter, phosphorus, potassium, minor elements and high microbial biomass carbon. It was also observed in the present study that the highest poultry manure rate of 10 tons/ha gave the highest performance among the rates suggesting that more nutrient is supplied to the soil at that rate. It will be necessary to test the effect of higher rates of poultry manure on sesame in this area to be able to determine the optimum rate. It has however been reported by Haruna (2011), that 10 tons/ha poultry manure application produced the highest grain yield as further increase to 15 tons/ha resulted to a decline in grain yield in sesame.

The accessions exhibited significant degrees of variation in growth, and yield attributes an indication that they have varying genotypic make-up as expressed in their different performances in similar environment. This was further confirmed by the significant accession × poultry manure rates interaction observed in most of the attributes measured in both years. The accessions performed very well in grain yield; however, accession Zuru produced the highest yield, though statistically same with that of accessions 43-9-1 and NCRI-BEN 01M. The emergence of a disease problem suspected to be *Fusarium* wilt in the second year experiment was indicted for the low performance recorded in that year.

Conclusion

The experiment has shown that poultry manure application promoted growth and seed yield in sesame in

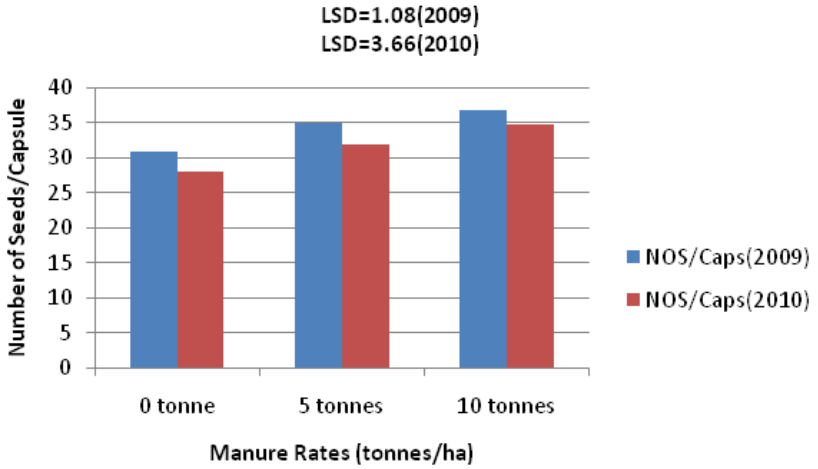

Figure 6. Effect of poultry manure rates on number of seeds/capsule in 2009 and 2010 experiments.

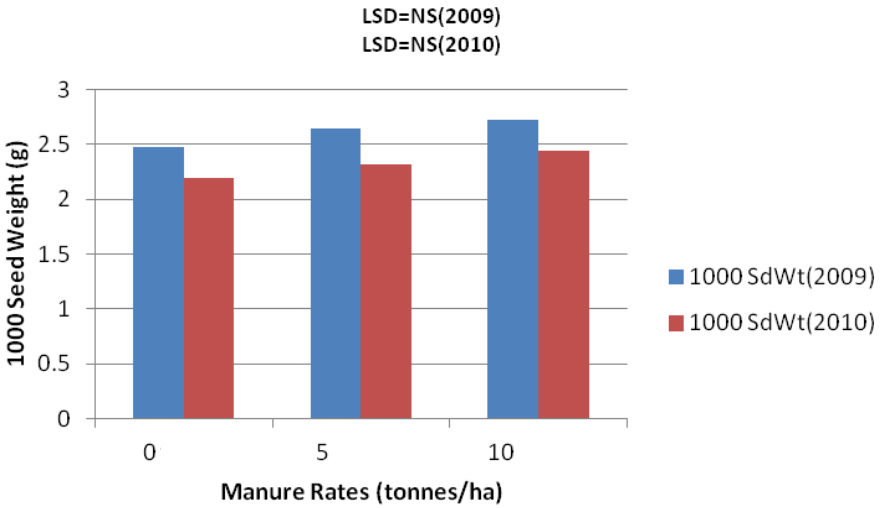

Figure 7. Effect of poultry manure rates on 1000-seed weight in 2009 and 2010 experiments.

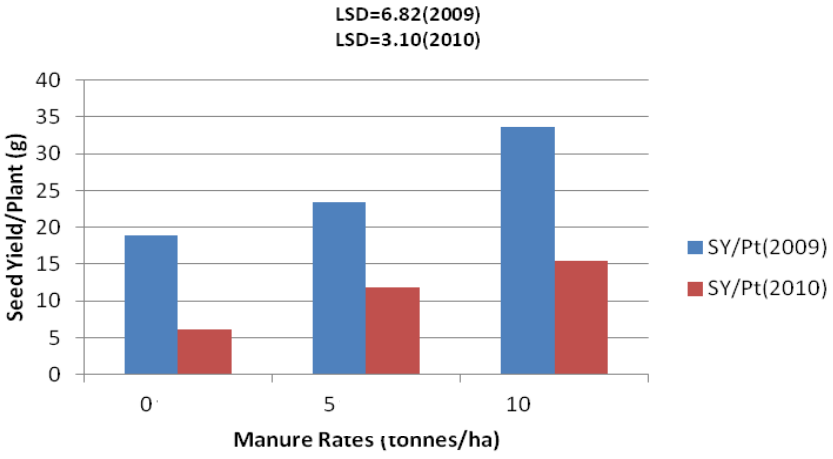

Figure 8. Effect of poultry manure rates on seed yield/plant in 2009 and 2010 experiments.

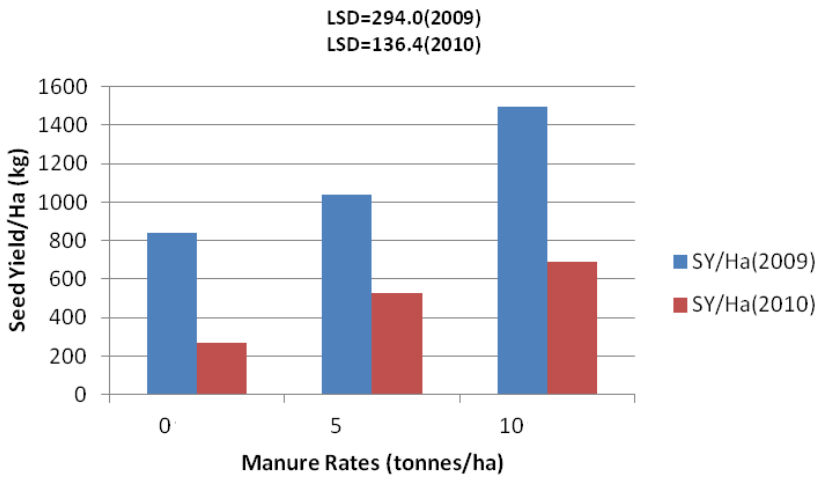

Figure 9. Effect of poultry manure rates on seed yield/ha in 2009 and 2010 experiments.

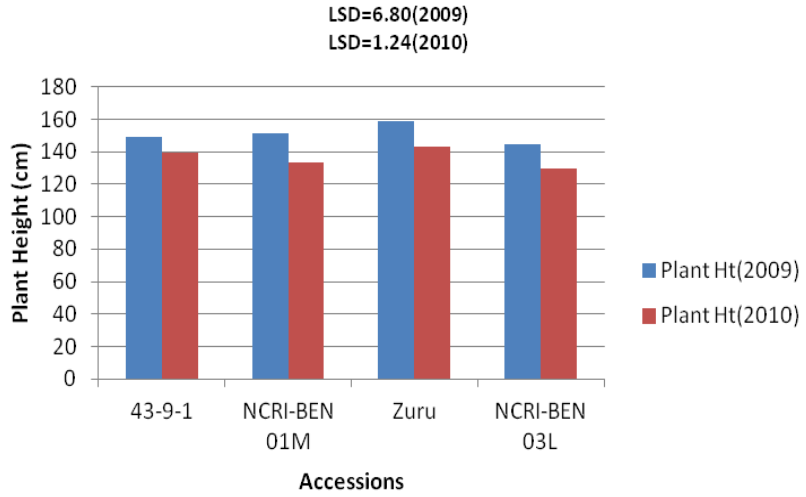

Figure 10. Effect of accession on plant height in 2009 and 2010 experiments.

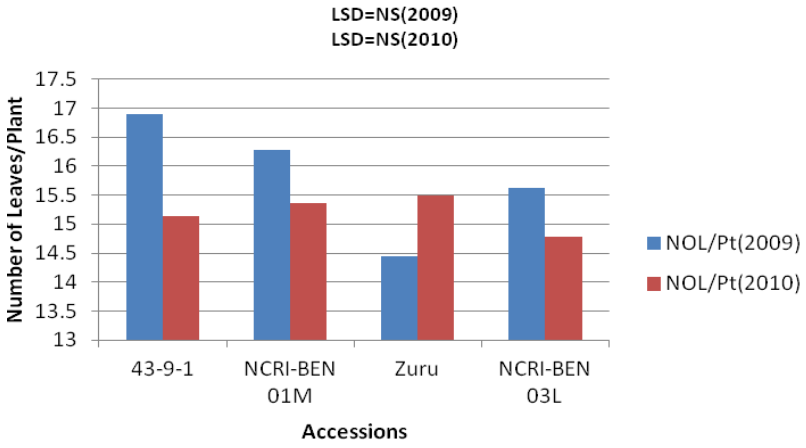

Figure 11. Effect of accession on number of leaves/plant in 2009 and 2010 experiments.

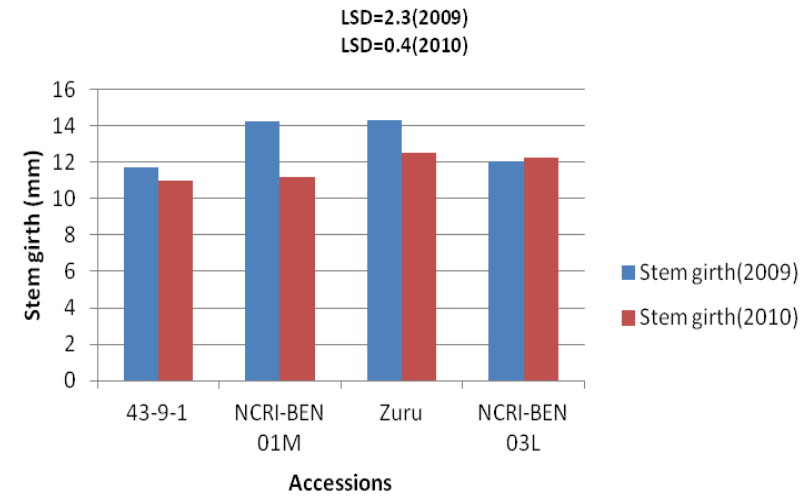

Figure 12. Effect of accession on stem girth in 2009 and 2010 experiments.

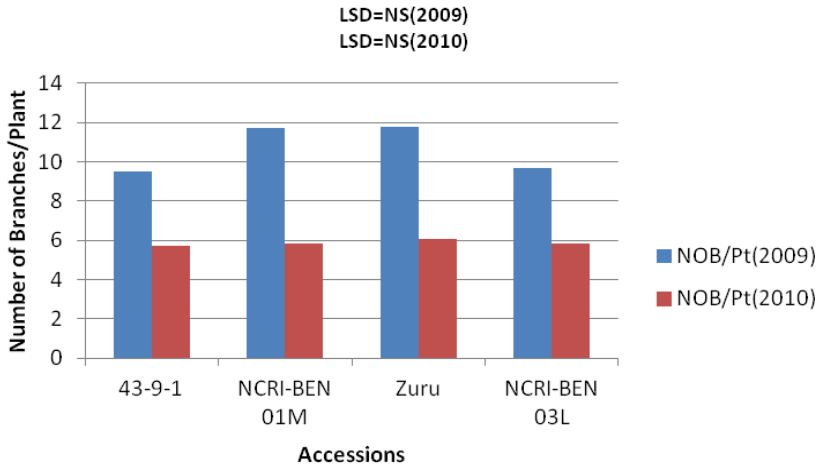

Figure 13. Effect of accession on number of branches/plant in 2009 and 2010 experiments.

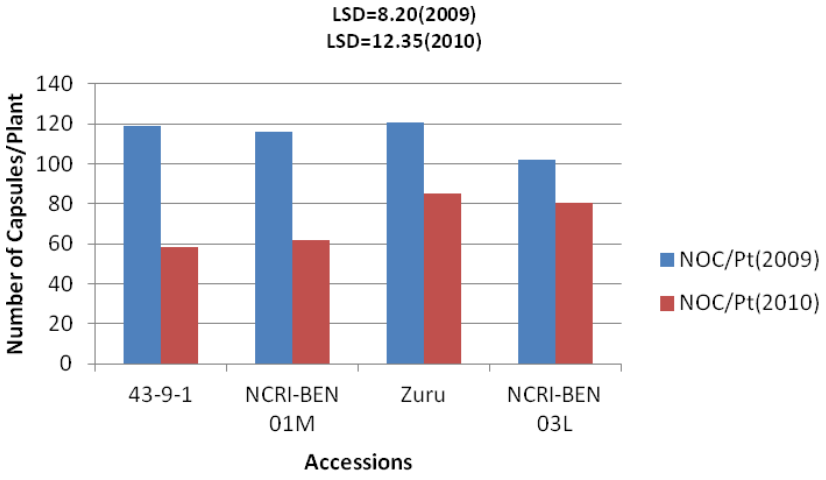

Figure 14. Effect of accession on number of capsules/plant in 2009 and 2010 experiments.

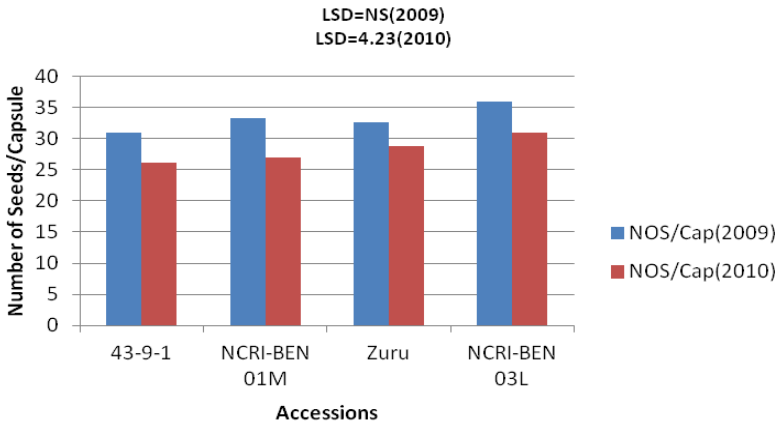

Figure 15. Effect of accession on number of seeds/capsule in 2009 and 2010 experiments.

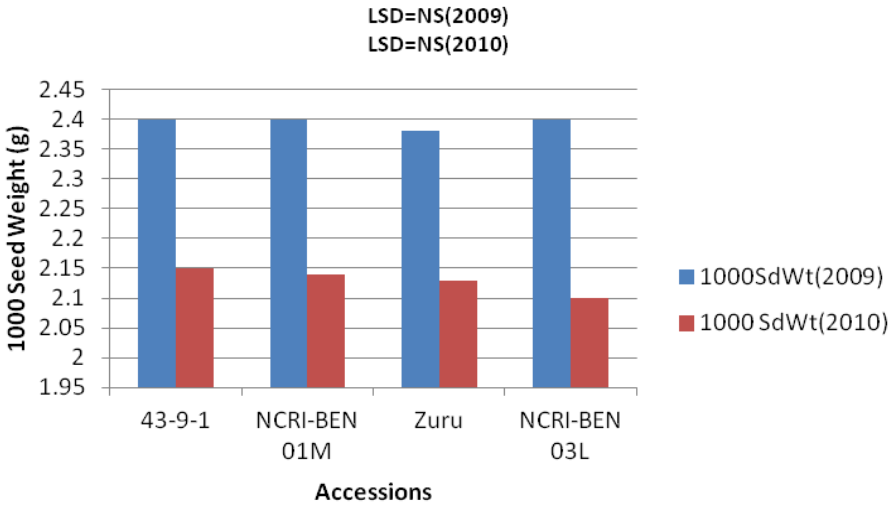

Figure 16. Effect of accession on 1000-seed weight in 2009 and 2010 experiments.

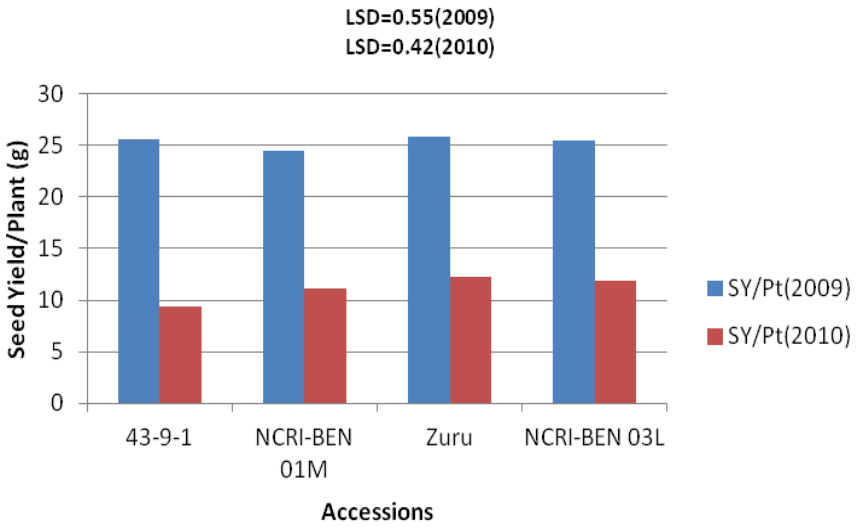

Figure 17. Effect of accession on seed yield/plant in 2009 and 2010 experiments.

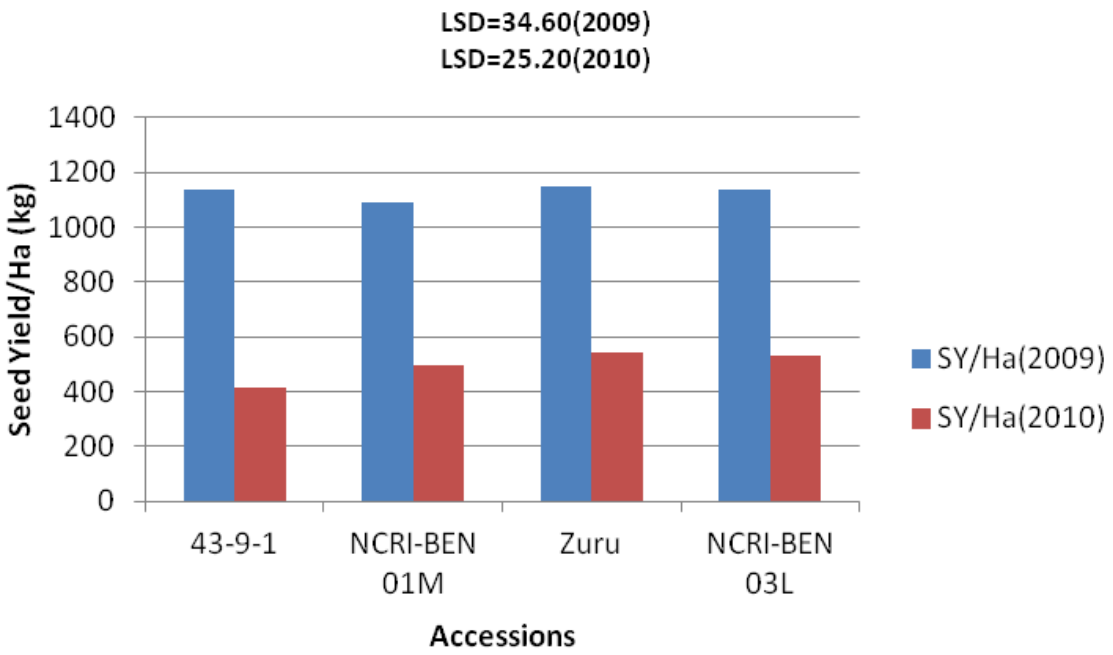

Figure 18. Effect of accession on seed yield/ha in 2009 and 2010 experiments.

Table 3. Effect of poultry manure x accession interaction on growth and yield of sesame in the 2009 experiment.

Plant attributes	0 tons/ha manure rate				5 tons/ha manure rate				10 tons/ha manure rate				LSD
	Accessions				Accessions				Accessions				
	1	2	3	4	1	2	3	4	1	2	3	4	
Plant height (cm)	123.7	116.4	121.3	115.1	155.1	152.1	157.4	160.4	160.4	174.5	182.6	179.5	10.5
No. of leaves/plant	14.83	16.17	11.99	14.50	17.17	16.00	15.33	15.22	18.67	16.17	16.00	17.17	1.08
Stem girth (mm)	10.25	11.95	10.44	10.23	12.09	13.46	13.39	10.76	12.75	17.39	15.19	15.25	1.38
No. of branches/plant	7.63	10.89	7.63	8.15	9.57	11.65	10.73	8.76	11.33	12.58	11.18	12.17	Ns
No. of capsules/plant	93.7	84.8	95.9	84.5	106.1	103.2	109.2	106.7	129.1	111.5	156.5	140.8	8.80
No. of seeds/capsule	32.8	28.7	36.0	36.5	33.3	31.6	37.7	34.2	38.7	39.5	42.5	44.4	0.22
1000 seed weight (g)	2.12	2.83	2.77	2.91	2.80	2.98	2.90	3.37	3.20	3.19	3.15	3.40	0.04
Seed yield/plant (g)	19.89	13.66	21.31	20.88	21.94	20.63	27.95	22.39	33.68	28.76	39.15	33.75	3.66
Seed yield/ha (kg)	884.0	607.0	947.0	928.0	975.0	917.0	1242.0	995.0	1497.0	1278.0	1740.0	1500.0	24.82

Accessions 1 = Zuru, 2 = NCRI-BEN 01M, 3 = 43-9-1 and 4 = NCRI-BEN 03L.

Table 4. Effect of poultry manure x accession interaction on growth and yield attributes of sesame in the 2010 experiment.

Plant attributes	0 ton/ha manure rate				5 tons/ha manure rate				10 tons/ha manure rate				LSD
	Accessions				Accessions				Accessions				
	1	2	3	4	1	2	3	4	1	2	3	4	
Plant height (cm)	114.4	115.6	118.0	98.1	142.3	137.8	135.5	133.5	160.3	163.5	162.1	156.4	12.4
No. of leaves/plant	10.50	10.00	11.17	9.92	14.75	16.83	15.50	9.92	20.17	19.25	16.83	17.67	1.08
Stem girth (mm)	7.98	7.67	8.28	7.15	11.36	12.03	12.27	13.46	13.54	13.91	17.09	16.05	4.02
No. of branches/plant	2.75	3.17	3.61	3.33	5.00	7.67	8.17	5.17	9.83	8.42	11.00	8.00	3.50
No. of capsules/plant	30.70	30.10	34.70	31.00	102.10	105.30	117.70	118.30	102.9	105.1	118.80	108.00	21.4
No. of seeds/capsule	26.80	25.75	30.06	28.28	34.36	31.42	39.64	36.00	35.49	35.04	35.92	35.06	3.50
1000 seed weight (g)	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.33	2.40	2.40	2.40	Ns
Seed yield/plant (g)	6.73	6.39	7.85	7.81	12.58	11.61	14.56	13.30	14.60	14.28	17.30	15.75	2.82
Seed yield/ha (kg)	299.00	284.00	349.00	347.0	559.00	502.00	647.00	605.00	649.00	635.00	769.00	700.00	42.60

Accessions 1 = Zuru, 2 = NCRI-BEN 01M, 3 = 43-9-1 and 4 = NCRI-BEN 03L.

of 10 tons/ha produced the highest seed yield and should be recommended for sesame production in this area. Accession Zuru also recorded the highest seed yield and the study area. Application of poultry manure at the rate was stable in performance in the two years among the accessions tested. It should therefore be recommended for production in the study area.

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