



RESPONSE OF RADISH (*Raphanus sativus* L.) VARIETIES TO MANURE SOURCES.

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ABSTRACT

The research was conducted during 2013 rainy season at Bayero University, Kano, Research Farm and Kwana area, Jahun Local Government Jigawa State. Both sites are located in the Sudan savanna agro-ecological zone of Nigeria. The experiment was to evaluate the effect of manure sources on growth and yield of radish (*Raphanus sativus* L.) varieties. The treatment consisted of factorial combinations of three manure sources (Cow dung, Layer manure, Pigeon manure and the Control) and three varieties of radish (Cherry, French Breakfast and Ural) which were arranged in a Randomized Complete Block Design (RCBD) with three replications. Application of the manure sources affected all the growth characters (plant height, number of leaves, leaf area index and root girth) and yield and yield components (root length), varieties also differed significantly in both locations. Ural variety was significantly superior in terms of all growth and yield component, and Cherry recorded the least. Application of pigeon manure and variety Ural produced the highest yield, in both locations. Thus farmers in Sudan savanna zone of Nigeria could be advised to use Ural at 10tha⁻¹ pigeon manure.

INTRODUCTION

Radish (*Raphanus sativus* L.) belongs to the family Brassicaceae. It is a popular root vegetable in both tropical and temperate region (Juan *et al.*, 2010), mostly grown for its edible roots. In addition to this, the tops can also be used as a leafy vegetable (Sadhu, 1993).

Radish has a very short vegetation cycle (35-60 days), which provides a rapid return of capital (Juan *et al.*, 2010). In Nigeria, there is no much information on radish especially on agronomic practices related to growth, development and yield. Some cultivars adapted to the tropics and used in Africa are the small radishes 'Cherry Belle' or 'Radis Cerise' (red and round), 'Sparkler' (round with a red top and white base), 'French Breakfast' or 'Radis 18 Jours' (similarly red/white but more cylindrical), 'White Icicle' (long and white, with a mild

taste), and the mooli types 'Red Bombay', 'White Bombay', 'Bombay Long White', 'Ural' and 'Himalaya' (Herklots, 1972)

The cultivars with relatively small roots (small radish) are most important in temperate climates of the world and only of limited importance in Africa. Larger-rooted cultivars (like Chinese radish) are most important in East and South-East Asia. In East Africa and elsewhere in the cooler parts of the African continent, large, white radishes are known under the Swahili/Arabic name 'fijili' and the Hindi name 'mooli' and these are becoming increasingly popular.

In Japan, Korea and Taiwan, but also in Yemen, radish ranks high in importance. No production data are known from tropical Africa but its significance is minor when compared with Asia or Europe, (Hadfield, 1960).

World production of radish was estimated at 7million tons per year, accounting for about 2% of the total world production of vegetables (Schipper, 2004).

Radish can be used as Salad, eaten raw, while serving as source of vitamin C and minerals such as phosphorus, potassium and calcium. Radish root is potent for treatment of headache, sleeplessness, cough, hepatic disorder and chronic diarrhea. (Sadhu, 1993), while the seeds contain up 48% non-drying fatty oil suitable for soap making. The oil is also a potential source of biofuel. (Dhananjaya, 2007). The leaves are used for extraction of protein on a commercial scale, and can also be used in the preparation of potato soup. It is also used as antiseptic and a powerful immune booster. Radish can be useful as companion plants for many other crops. This is probably because their pungent, odor deters such insect pests as aphids, cucumber beetles, tomato hornworms, among other insect pest. They can also function as a trap crop, luring insect pests away from the main crop.(Fahey *et al.*,2001)

Very few information are available on the suitable type of manure used for radish varieties. Therefore this study aimed at evaluating the appropriate type of manure for maximum growth and yield of radish (*Raphanus sativus* L.) varieties and asses the best adaptable variety in the Sudan Savannah agro-ecological zone.

MATERIALS AND METHODS

Experimental Sites

The study was conducted during 2013 rainy season at two locations: Bayero University Research Farm, Kano (11°59'N; 8°25'E; 466m above sea level) and Kwana area, Jahun, Local Government Area, Jigawa state (12°03'N and 9°35'E).Both sites are located in the Sudan savanna agro-ecological zone, characterized by brown and reddish brown loamy sands with loamy and clayey surface horizon.

Treatments and Experimental Design

The treatments consisted of three radish varieties (French breakfast, Cherry and Ural) and four sources of manure (Cowdung, Pigeon manure, Layers manure and the Control. These were arranged in a Randomized Complete Block Design (RCBD) with three replications.

The plot size was 4.5m² consisting of 4 ridges of 1.5m length. The net plot was 2.25m² made up of two innermost ridges which were used for yield assessment.

Fertilizer application

The Manures were pre -plant incorporated as per treatment at a uniform rate of 10 t ha⁻¹

Data collection

Growth, yield components and yield data were collected from 5 tagged plants in the net plot. (I.e. plant height, number ofleaves, leaf area index, root girth, root length and yield). The data collected were subjected to Analysis of Variance using Genstat discovery 16. Significantly different means were compared using Duncan's Multiple Range Test (DMRT)

RESULTS

Plant height (cm)

Plant height was significantly affected by manure and variety (Table 3). Application of manure had significant effect on plant height of radish at all the sampling periods at both locations. At BUK, the result indicated that, at 2, 4 and 6 WAS application of all the manure sources except Cow dung and the Control were statistically at par. At Jahun, application of Pigeon manure at 2, 4 and 6WAS produced the tallest plants which were statistically similar with layer manure at 2WAS. In this location, the control recorded the least height value at all sampling periods.

The result also showed that, the varieties tested recorded significant variation in plant height in the two locations, except at 2WAS in BUK. French Breakfast and Ural produced statistically similar and taller plants, while the least values were consistently produced by the variety Cherry at all the sampling periods. This least height value recorded by Cherry did not differ significantly from that of Ural at 2WAS at Jahun. Interaction between manure application and radish variety on plant height was not significant at both locations.

Number of leaves/plant

The effects of manures and varieties on number of leaves of radish at BUK and Jahun are shown in Table 4. At BUK applications of manures at 2WAS had significantly affected number of leaves of radish at all the sampling periods at both locations.

Layer and Pigeon manures were at par and gave plants with higher number of leaves than Cowdung which produced plants with significantly higher number of leaves than the Control. However at Jahun application of Layer and Pigeon manures were similar and produced plants with higher number of leaves followed by Cowdung. The least number of leaves was produced by the Control.

At both locations at 4WAS, Layer and Pigeon manures were statistically at par and higher than the Cow dung and the Control at Jahun. At 6WAS application of pigeon manure produced plant with the highest number of leaves followed by Layer manure and control. Cowdung recorded the least at BUK. However, at Jahun Pigeon manure produced plants with significantly higher number of leaves. Other sources and the Control were statistically similar and recorded the lower number of leaves.

Furthermore, the effect of varieties showed that, there were no significant differences at 2WAS among the varieties in both locations. At 4 and 6 WAS Ural variety produced significantly higher number of leaves than the Cherry and French breakfast varieties which were at par and recorded lower number of leaves in both locations. The highest number of leaves recorded by Ural at 4 and 6 WAS did not differ statistically with Cherry at 4WAS in Jahun. The interaction between manure sources and varieties was not significant at both locations.

Leaf area index

The effect of manure and variety on leaf area index (LAI) at BUK and Jahun are shown in Table (5). Application of manure significantly affected LAI of radish at all the sampling periods at both locations. At BUK application of Layer and Pigeon manures, at 2 and 4WAS were at par and produced higher LAI than Cow dung and the Control had the least LAI. At 6WAS application of Pigeon manure at BUK had the highest LAI while Cowdung and the Control produced the least LAI. However at Jahun, application of Pigeon manure produced plants with highest LAI, but they are not statistically different from Layer manure at 2WAS and the Control was found to produce

the least LAI although Cow dung application was not statistically different from the Control at 2WAS.

The effect of varieties on LAI indicated that, there were no significant difference between varieties in LAI at 2WAS at both locations and at 4WAS at Jahun. Ural produced significantly higher LAI followed by French Breakfast at 4WAS and 6WAS in BUK and Cherry had the least LAI. At Jahun, Ural variety produced significantly higher LAI than the other varieties which were at par and produced the lower LAI.

The interaction between manure and varieties was not significant.

Root girth (cm)

The effect of manure and variety on root girth at BUK and Jahun are shown in Table 6. Application of manure had significantly affected root girth of radish at all the sampling periods at both locations. At BUK, the result indicated that, at 2 WAS application of Layer manure produced plants with significantly highest root girth but did not statistically differ from pigeon manure except Cowdung which produced lower root girth and Control recorded the least. However, at 4 WAS, Layer manure and Pigeon manure were at par and produced the highest root girth. However, Cowdung gave higher root girth than the Control which recorded the least. At 6 WAS application of Pigeon manure gave significantly highest root girth but did not differ statistically from Layer manure. Similarly, Cowdung and the Control were statistically at par and recorded the least.

Similarly, at Jahun application of Pigeon manure at 2, 4 and 6 WAS gave the highest root girth but did not differ statistically from Layer manure at 2 WAS Cowdung produced plants with higher root girth than the Control in all sampling periods. The effect of variety indicated that, French Breakfast and Cherry gave significantly higher root girth at the sampling periods in both locations except French Breakfast at 4 WAS in BUK. Ural gave consistently lower root girth at both locations. The interaction between manure and variety was not significant.

Root length (cm)

Root length was significantly affected by manure and variety (Table 7). Application of manure had significant effect on root length of radish at both locations. Application of Pigeon manure at both locations gave highest root length. Layer manure also produced plants with higher root length than Cowdung and the control recorded lower values of root length.

The effect of variety showed that, Ural produced the highest root length at both locations followed by other varieties except the variety Cherry at BUK which had the lowest root length in both locations.

The interaction between manure and variety sources and variety on root length was not significant.

Yield (t ha⁻¹)

The effect of manure and variety on yield at BUK and Jahun are shown in Table 8. Application of manures had significant effect on yield of radish in both locations. At BUK, application Pigeon manure produced the highest yield. Other sources were statistically at par and had yield higher than the Control. However, at Jahun application of Pigeon manure gave the highest yield followed by Layer manure. However, Cowdung and the Control were statistically at par and produced the least yield.

Similarly, the effect of variety indicated that, variety Ural gave significantly higher yield, followed by French Breakfast variety and the variety Cherry recorded the least.

Discussion

There were significant effect of manure sources on all the growth characters and the yield. Data for plant height showed significant effect of the manure sources indicating superiority of Pigeon over other sources. The shorter plants were produced by Cow dung and the Control. This could be attributed to rapid mineralization and availability of organic N in Poultry manure sources (Pigeon, and Layer manures) than Cow dung, which is crucial for the crop being a short cycle. Similar observation was made by Costellanos and Pratt (1981) who estimated that 60 per cent of the organic N in poultry manure was available. Due to its rapid mineralization, Poultry manure

was recognized as a valuable source of nutrients for crop. Yanwang *et al* (2002) reported that, application of dairy cattle waste and poultry waste released approximately 31.5 and 51.3 per cent nitrogen, respectively and had decreased nitrate leaching to deeper soil layer in Kyushu area. Srivastava, (1998) also reported that, the performance of Poultry manure was better than FYM. One kg of nitrogen from FYM and Poultry manure was able to produce 15 and 28 kg of Potato tuber respectively.

The varieties differed significantly with regards to the growth and yield components. It was observed that Ural and French Breakfast varieties were statistically at par and taller plants than the variety Cherry. This could be attributed to the inherent characteristics of the varieties.

Similarly, on leaf area index (LAI) the variety Ural gave significantly higher LAI than the other varieties. This could be attributed to genetic characteristics of leaves of the variety (of broader and of greater length than other varieties.) coupled with favorable growing condition, through optimum uptake of the nutrients by the crop. The result for the root girth clearly indicated that, the variety Cherry produced the highest root girth. This could be due to inherent characteristics of the variety.

The root length of a variety is one of the factor which is of main concern to a researcher for the benefit of the farmers. The variety Ural gave the maximum root length. The minimum root length was produced by the variety Cherry. This could be attributed to the genetic characteristics of the variety. This result is in conformity with the findings of Mohammed *et al.* (1983) who observed that, the cultivar minno ochali attained the maximum root length of (34.07cm) followed by early long white (Ural) (33.7 cm), Desi (32.94cm) and Shaomai (24.19cm). The minimum root length was attained by Round red (Cherry) which was 4.48cm. Similar result has also been reported by Thamburaj (1974). Sendur *et al.* (1998) also indicated that the application of organic and inorganic fertilizers recorded higher growth, yield and quality of tomato.

Conclusion

The results of the experiment showed that application of Pigeon manure gave the highest yield of radish in both locations, and Ural variety was found to be superior to the other

varieties at both locations. Therefore, famers in the study area could be advice to adopt Ural variety, using 10t ha⁻¹ of pigeon manure in the production of radish.

Table 1: Physico-chemical properties of the soils (0-30cm depth) of the experimental sites at BUK and Jahun, 2013 raining season.

Physical properties	BUK	JAHUN
<u>Particles size distribution (g kg⁻¹)</u>		
Sand	72.96	85
Silt	16	5.5
Clay	11.04	9.5
Textured class	sandy loam	loamy sand
<u>Chemical properties</u>		
PH in H ₂ O	5.27	6.6
Organic carbon (g kg ⁻¹)	0.618	0.566
Total Nitrogen (g kg ⁻¹)	0.28	0.17
Available P (g kg ⁻¹)	15.90	8.92
Organic Matter	1.065	0.976
<u>Exchangeable bases (cmol kg⁻¹)</u>		
Ca	3.12	3.00
Mg	1.01	1.487
K	0.61	0.24
Na	0.32	0.247

Table 2: The chemical properties of the manures used in the experiments at BUK and Jahun, 2013 raining season.

Sample I.D	N(gkg ⁻¹)	P(mgkg ⁻¹)	K(cmol(+)kg ⁻¹)
Cow dung	0.12	9.00	0.14
Pigeon manure	0.08	24.21	0.38
Layer manure	0.13	19.31	0.26

Table 3: Effect of manure sources and varieties on plant height (cm) of radish at BUK and Jahun, 2013 raining Season.

	BUK			JAHUN		
	2 WAS	4 WAS	6 WAS	2 WAS	4 WAS	6WAS
Manure Sources						
Cowdung	7.83b	11.57b	12.68b	5.56b	7.23cd	10.66b
Layer manure	9.20a	15.05a	17.21a	7.08ab	9.38bc	12.74b
Pigeon Manure	9.26a	14.96a	17.17a	8.12a	13.27a	19.62a
Control	7.41b	11.39b	12.88b	3.53c	5.18d	6.78c
SE ±	0.52	0.68	0.99	0.68	1.11	1.33
Varieties						
French breakfast	9.12	15.16a	16.95a	7.42a	10.36a	13.96a
Cherry	8.36	11.94b	11.54b	5.47b	7.92b	11.39b
Ural	8.61	14.11a	17.27a	6.21b	8.81ab	13.97a
SE ±	0.52	0.68	0.99	0.68	1.11	1.33
Interaction						
Manure x Variety	NS	NS	NS	NS	NS	NS

Means in a Column followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT), NS=Significant

Table 4: Effect of manure sources and varieties on number of leaves of radish at BUK and Jahun, 2013 raining season.

Manure Sources	BUK			JAHUN		
	2 WAS	4 WAS	6 WAS	2 WAS	4 WAS	6 WAS
Cowdung	5.2bc	5.22b	4.98b	4.67ab	4.59b	4.10b
Layer manure	5.71a	5.94a	6.24ab	5.00a	5.09ab	5.03b
Pigeon manure	5.64ab	6.46a	6.96a	5.29a	5.96a	7.09a
Control	5.13c	5.76ab	5.79ab	4.20b	4.24b	4.83b
SE ±	0.18	0.27	0.64	0.29	0.43	0.50
Varieties						
French breakfast	5.31	5.11b	4.82b	4.86	4.52b	3.91c
Cherry	5.61	5.28b	4.45b	4.91	5.22ab	5.42b
Ural	5.48	7.10a	8.70a	4.77	5.57a	7.33a
SE ±	0.18	0.27	0.64	0.29	0.43	0.50
Interaction						
Manure x Variety	NS	NS	NS	NS	NS	NS

Means in a Column followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT), NS= Not Significant

Table 5: Effect of manure sources and varieties on leaf area index of radish at BUK and Jahun, 2013 raining Season.

Manure Sources	BUK			JAHUN		
	2 WAS	4 WAS	6 WAS	2 WAS	4 WAS	6 WAS
Cowdung	1.02bc	3.18bc	3.42c	0.52c	0.91cd	2.38bc
Layer manure	1.53a	4.55a	4.42bc	0.91ab	1.85bc	3.42b
Pigeon manure	1.54a	4.70a	6.59a	1.01a	3.54a	6.81a
Control	0.91c	2.75c	2.91c	0.22c	0.43d	1.53c
SE ±	0.14	0.34	0.61	0.15	0.53	0.74
Varieties						
French breakfast	1.25	3.69b	4.30b	0.76	1.69	3.40b
Cherry	1.25	2.88c	2.66c	0.54	1.45	3.03b
Ural	1.40	5.30a	6.28a	0.76	2.11	5.09a
SE ±	0.14	0.34	0.61	0.15	0.53	0.74
Interaction						
Manure x Variety	NS	NS	NS	NS	NS	NS

Means in a column followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT). * = Significant, NS = Not Significant.

Table 6: Effect of manure sources and varieties on root girth (cm) of radish at BUK and Jahun, 2013 raining season.

	BUK			JAHUN		
	2 WAS	4 WAS	6 WAS	2 WAS	4 WAS	6 WAS
Manure Sources						
Cowdung	0.95bc	2.99bc	4.48c	1.02cd	2.16cd	3.78bc
Layer manure	1.55a	4.39a	6.55ab	1.32abc	2.98bc	4.89b
Pigeon manure	1.32ab	4.44a	7.00a	1.53ab	4.49a	8.23a
Control	0.79c	2.74c	4.44c	0.82d	1.10d	2.91c
SE ±	0.17	0.38	0.62	0.16	0.59	0.73
Varieties						
French breakfast	1.25a	4.21b	6.04a	1.30	3.26a	5.81a
Cherry	1.43a	5.28a	6.34a	1.34	3.46a	5.61a
Ural	0.84b	1.86c	4.70b	1.13	2.00b	4.19b
SE ±	0.17	0.38	0.62	0.16	0.59	0.73
Interaction						
Manure x Variety	NS	NS	NS	NS	NS	NS

Means in a Column followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT) NS = Significant

Table 7: Effect of manure sources and varieties on root length (cm) of radish at BUK and Jahun, 2013 raining season.

	BUK	JAHUN
Manure Sources		
Cowdung	7.23c	4.95de
Layer manure	9.36b	8.24b
Pigeon manure	10.84a	13.75a
Control	8.05bc	4.32d
SE ±	0.56	1.03
Varieties		
French breakfast	9.09b	7.38b
Cherry	5.94c	6.04b
Ural	12.12a	12.01a
SE ±	0.56	1.03
Interaction		
Manure x Variety	NS	NS

Means in a Column followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT), NS=Not significant

Table 8: Effect of manure sources and variety on yield (t ha⁻¹) of radish at BUK and Jahun, 2013 raining season.

	BUK	JAHUN
Manure Sources		
Cowdung	2.25b	1.88c
Layer manure	2.67b	3.16b
Pigeon manure	3.40a	8.86a
Control	1.53c	1.32c
SE ±	2.53	3.74
Varieties		
French breakfast	2.73b	6.25ab
Cherry	1.78c	2.38b
Ural	3.47a	9.57a
SE ±	2.53	3.74
Interaction		
Manure x Variety	NS	NS

Means in a Column followed by the same letter(s) are not significantly different at 5% level of probability using Duncan's Multiple Range Test (DMRT), * = significant

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