Research Note
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EFFECT OF LAND CONFIGURATION AND COW DUNG MANURE ON MAIZE PERFORMANCE IN MINNA, SOUTHERN GUINEA SAVANNA ZONE OF NIGERIA

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Crop yield is adversely affected in the southern Guinea Savanna zone of Nigeria due to the low nutrient and organic matter status of the soils in this agro-ecological zone. The soils found in this zone are mostly coarse-textured (sandy in nature) and are prone to short periods of dryness that result from erratic rainfall pattern in this zone. The potential for crop and soil productivity is quite high considering the vast land area available for crop production in the southern Guinea Savanna zone. Nottidge *et al.* (2005) reported that low crop yields in the southern Guinea Savanna zone are due to low soil fertility, especially low nitrogen and organic matter content.

In an increasingly expanding population with a resultant scarcity of land for arable crop production, continuous cultivation of available land may be a key option for food security. However, continuous cultivation of already fragile agricultural lands gives rise to soil nutrient depletion. The challenge of continuous cropping is further aggravated by overgrazing and removal of crop residues after harvest with little or no application of chemical fertilizers which are often costly and inaccessible to most farming communities. These problems often reduce the productive capacity of both soil and crops (Uwah *et al.,* 2014). Thus, it may be necessary to take advantage of soil and crop management practices that would not only maintain favourable soil physical and chemical conditions, but would also replenish the depleted soil nutrients necessary for increased crop yield.

Application of organic manures is beneficial for improvement of soil physical condition as they work as amendments as well as a source of nutrients essential for enhancement of crop growth and increased yields. Amos *et al.* (2015) and Udom *et al.* (2007) noted that cow dung manure produced good crop growth and higher yield because of its ease of mineralization. Furthermore, organic manures reduce soil bulk density, improve moisture storage, increase organic matter content and enhance concentration of essential nutrients. Management strategies that would favour sustainable crop productivity which maintain soil fertility at reduced cost and increased crop yield are to be worked out.

Land configuration is the modification of the soil surface into various shapes or forms and sizes by employing tillage practices. The emphasis is usually on the configuration or shape of the soil surface irrespective of the type of tillage and tillage implement used. Hence, several researchers have referred to land

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configuration as planting or sowing methods, land configuration practices and land shaping methods (Chiroma *et al.,* 2006; Haque *et al.,* 2002; Deshmukh *et al.,* 2016). Major land configuration practices are ridges (open or tied), furrows, raised bed, broad bed furrows and mounds or heaps. Deshmukh *et al.* (2016) reported poor crop growth and lower yield resulted from sowing on flat bed without any appropriate land configuration. These planting methods are aimed at pulverizing and gathering the top soil to provide a favourable environment for crop growth and enhanced yields. This arises from the fact that most of the soil nutrients and organic matter are concentrated in the upper soil layer. According to Chiroma *et al.* (2008), water use efficiency and nutrient availability to crops are increased under land configuration practices. The effectiveness of any crop management practice (nutrient application, irrigation and crop variety) is determined mainly by land configuration. Therefore, identifying a suitable land configuration practice is essential for proper growth and development of particular crops. The objective of this study was to determine the influence of sowing methods and cow dung manure on the performance of maize.

Field trials were conducted during the growing seasons of 2014 and 2015 at the Teaching and Research Farm of Federal University of Technology, Minna (latitude 9^0 31' N and longitude 6^0 26' E, at 208 m above mean sea level). Minna is located in the southern Guinea savanna zone of Nigeria. Minna has a sub-humid climate with a mean annual rainfall of 1,300 mm and a mean temperature of about 30^0C (Ojanuga, 2006). Rainfall commences in April and ends in October every year. The soils are developed from basement complex rocks, and are mostly sandy in texture.

The treatments were land configuration (ridge, flat and mound) and cow dung manure application rate (0 tons ha^{-1}, 5 tons ha^{-1} and 10 tons ha^{-1}). There were nine treatment combinations altogether arranged in a randomized complete block design and replicated four times.

The experimental plots (4m x 4 m each) were marked out and levelled after ploughing. The net plot was 4 m^2. The various forms of land configuration were constructed followed by the application of cow dung manure. Three to four seeds of 'Oba super 1' maize variety were sown at a spacing of 0.75 m between rows and 0.50 m within rows. Thinning of maize seedlings to two plants per stand was carried out at two weeks after planting (WAP). NPK fertilizer was applied at the recommended rate (90:30:30 kg ha^{-1}). Due to the sandy nature of the soil, nitrogen was applied in split doses at two and six WAP. Weeds control was done manually at two and fiveWAP. Maize cobs were harvestedat physiological maturity (12 WAP), sun-dried for about two weeks and threshed. Plant height was recorded at seedling emergence, vegetative growth, tasseling and maturity stages. Grain yield, stover yield, cob length and cob weight were recorded after crop harvest.

Land configuration had significant ($P \leq 0.05$) influence on plant height at all the stages of crop growth except at vegetative growth stage. Planting on mounds or heaps produced significantly tallest (35.4 cm) maize plants at the seedling emergence stage, but this

Table 1. Effect of land configuration and cow dung manure on plant height (cm) of maize

	Crop growth stages											
	Seedling emergence			Vegetative growth			Tasseling			Maturity		
Treatment	2014	2015	Com-bined	2014	2015	Com-bined	2014	2015	Com-bined	2014	2015	Com-bined
Land configuration (A)												
Ridge	37.0b	28.5a	32.7a	82.1a	108.6a	95.4a	160.2a	210.6a	185.4	167.7a	228.4a	198.0a
Flat	40.0b	28.5a	34.2a	84.5a	107.7a	96.1a	160.8a	214.0a	187.4a	171.2a	230.1a	200.6a
Mound	46.1a	24.7b	35.4a	90.7a	95.2a	93.0a	172.6a	193.8b	183.2a	180.1a	211.8b	195.9a
SE±	2.6	1.7	1.7	6.0	6.1	4.4	8.9	8.1	5.9	8.1	6.9	5.2
Cow dung rate (B)												
0 t ha^{-1}	35.8b	24.1b	30.0b	75.8b	82.9c	79.3c	155.6a	192.0b	173.8b	163.4a	209.9b	186.6b
5 t ha^{-1}	42.3a	26.9b	34.6a	86.8b	103.5b	95.2b	167.9a	208.3ab	188.1a	176.8a	224.4a	200.6a
10 t ha^{-1}	45.0a	30.6a	37.8a	94.7a	125.1a	109.9a	170.1a	218.2a	194.1a	178.8a	235.9a	207.4a
SE±	2.6	1.7	1.7	6.0	6.1	4.4	8.9	8.1	5.9	8.1	6.9	5.2
Interaction A x B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means with different letter(s) on the same column are significantly different at 0.05 level of probability; NS: Not significant

Table 2. Effect of land configuration and cow dung manure on yield parameters and kernel yield of maize

	Grain yield (kg ha^{-1})			Stover yield (kgha^{-1})			Cob length (cm)			Cob weight (g/4 m^2)		
Treatment	2014	2015	Com-bined	2014	2015	Com-bined	2014	2015	Com-bined	2014	2015	Com-bined
Land configuration (A)												
Ridge	4,944a	3,019a	3,981a	9,833a	4,031a	6,932a	13.4a	13.6a	13.5ab	1,306a	684a	995a
Flat	5,083a	2,727a	3,905a	10,694a	4,031a	7,363a	12.9a	12.9a	12.9b	1,306a	592a	949a
Mound	6,278a	2,921a	4,600a	12,778a	3,990a	8,384a	13.5a	14.0a	13.7a	1,556a	632a	1,094a
SE±	617	270	335	1,203	192	627	0.4	0.5	0.3	171	52	88
Cow dung rate (B)												
0 t ha^{-1}	4,708b	2,396b	3,552b	10,472a	3,938a	7,205a	13.6a	12.4b	13.0b	1,306a	560b	933a
5 t ha^{-1}	5,236ab	2,926ab	4,081b	10,583a	3,938a	7,260a	12.6b	13.8a	13.2b	1,361a	629ab	995a
10 t ha^{-1}	6,361a	3,345a	4,853a	12,250a	4,177a	8,214a	13.6a	14.2a	13.9a	1,500a	721a	1,110a
SE±	617	270	335	1,203	192	627	0.4	0.5	0.3	171	52	88
Interaction A x B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means with different letter(s)on the same column are significantly different at 0.05 level of probability; NS: Not significant

trend was not sustained throughout the stages of crop growth(Table 1). Ridge planting method gave rise to significantly tallest plants, while the mound sowing method produced significantly shortest plants at both tasseling and maturity stages of crop growth. Rate of application of cow dung manure significantly affected the plant height throughout the cropping season (Table 1). Plant height increased with cow dung manure application throughout the crop growth periods. Irrespective of rate of cow dung manure applied, its applications produced the tallest plants, whereas, the shortest plants were produced when cow dung manure was not applied. In this study, the production of tallest plants resulting from the application of 10 tons ha^{-1} of cow dung compared to 0 and 5 tonsha^{-1} application rates attests to the fact that, increasing cow dung application rate will improve crop growth

Land configuration had significant influence on cob length only (Table 2). Mound planting method resulted in longer cobs than flatbed planting, whereas, both mound and ridge planting methods were on par with each other.Difference in cob length due to ridgeand flat planting method was also not significant. Cow dung manure application rate significantly influenced the grain yield, cob length and cob weight. These yield indices increased with cow dung manure application rate. Application of 10 tons ha^{-1} resulted in significantly highest grain yield, cob length and cob weight, while these yield parameters were significantly lowest with zero application of manure.

According to Deshmukh *et al.* (2016), poor crop growth and lower yield resulted from sowing on flat bed without any appropriate land configuration. Kiran *et al.* (2008) reported that plant height and total dry matter of sorghum increased with ridges and furrows than with the flat bed planting method. Ridges and furrows were observed to perform better due to higher soil moisture conservation. Management strategies that would favour sustainable crop productivity are those that maintain soil fertility and increase crop yield.

In conclusion, planting on the flat and on ridges, and application of 10 tons ha^{-1} of cow dung manure produced the tallest maize plants. Cow dung manure application rate @ 10 tons ha^{-1} resulted in the highest grain yield, cob length and cob weight. Therefore, application of cow dung as manure at 10 tons ha^{-1} has the potential for improving maize performance for sustainable food security.

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