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Preliminary Investigation of Growth and Yield of Four Sesame Varieties (*sesamum indicum*) using Cured Poultry Manure in Owerri, Nigeria

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Abstract
To ascertain the response of Sesame to poultry manure (PM) in Owerri, rainforest agroecology of Nigeria, this research was carried out at the Teaching and Research Farm of the Federal University of Technology Owerri, Nigeria between March and July 2020. Poultry manure at 0, 5, 10 and 15 tons/ha were applied on four (NCRIBen04E, NCRIBen05E, NCRIBenE8 and Yandev-55) varieties of sesame. The treatment combinations were replicated three times and laid out as a 4 x 4 factorial in Randomized Complete Block Design (RCBD. Growth and yield data were collected. It was generally observed that growth parameters were favoured by amendment with PM. Variety when considered singly indicate that NCRIBen04E gave seed yield of 580.1 kg/ha which is significantly higher than 252.6 kg/ha and 365.5 kg/ha recorded for NCRIBenE8 and NCRIBen05E. 10 tons/ha poultry manure had significantly highest seed yield of 740.3 kg/ha and this is higher when compared with 401.50 and 448.10 tons/ha recorded for 5 tons/ha and 15 ton/ha by 45.76% and 39.47% respectively. For the interaction, NCRIBen04E variety amended with 10 tons/ha PM gave highest seed yield of 855.0 kg/ha and is hereby recommended for further trials in Owerri agro-ecology.

Keywords: Sesame, Performance, varieties, poultry manure

Introduction

Sesame (*Sesamum indicum*) had been classified as an oilseed crop. It belongs to the family of shrubs called *Pedaliaceae*. It is grown for its seed which is a good source of high-quality oil, carbohydrate, calcium, phosphorus and protein (NCRI, 2005). Sesame seed has both nutritional and medicinal values (Idowu *et al*., 2021). The residue after oil extraction is used in the manufacture of animal feeds and pharmaceutical products. The

seeds are used either decorticated or whole in sweets such as sesame bars and halva, in baked products, or milled to get high-grade edible oil or tahini, an oily paste (Bedigian, 2004). Sesame seed contains lignans such as sesamolin, sesaminol, sesamolinol, and sesamin which have anti-oxidative, anticancer and hypocholesterolemic properties (Elleuch et al., 2011). Studies conducted in Israel (Dalal et al., 2002) and Italy (Pastorello *et al.*, 2001) and Switzerland (Guenova et al., 2008) revealed that sesame seeds contain immunoglobulin E (IgE) which helps to defend the body against allergens. These attributes have continued to increase the demand for this crop in the world market. According to Food and Agriculture Organization (2006), global sesame seed production was estimated at 3.3 million tonnes in 2005. Twenty-five percent (25%) of the world hectarage is planted in Africa. The FAO (2013) asserted that Nigeria exported 59,600 metric tonnes of sesame seed worth $43 million in 2005. In value terms therefore, the crop is second to cocoa as an agricultural export. The sand dominated ultisols of southeastern Nigeria have constrained farmers to consider alternative sources of fertilizer. Long term usage of chemical fertilizers has however impacted the environment negatively. Consequently, focus has been shifted to organic agriculture towards achieving sustainable agriculture (Scotti et al., 2015). Large population of micro-organisms are introduced to the soil through organic manure which promotes nitrogen fixation and phosphorus solubilisation (Zhen et al., 2014).

Manure application has been reported to improve crop performance (Suddhiyan et al., 2009). Poultry manure in addition to providing nutrients for plant growth, improves soil quality when applied in compliance with standard recommendations and is also environmentally friendly. Poultry manure application has been reported to improve crop performance in the transition zone of southeastern Nigeria (Ogbonna and Obi, 2007). Nitrogen being a chief component of poultry manure has a direct positive relationship with grain yield (Abayomi et al., 2006). The enhancing effect of poultry manure is attributed to the slow release of wide range of nutrient elements to the soil (Amanullah et al., 2007). High yield of sorghum has been reported by Arunah and Ibrahim (2004) when poultry manure is applied in combination with nitrogen fertilizers. Nnebue et al. (2014 and 2020) had studied the performance of roselle and sesame varieties in relation to planting dates in the rainforest agro-ecology of Nigeria and recommended planting in early July and early April respectively, for optimum seed yield. However, there is paucity of information on the agronomic and yield responses of some varieties of sesame to soils amended with varying rates of poultry manure in Owerri. In view of these, the objective of this study was to determine the appropriate poultry manure rate for some varieties of sesame in Owerri within the rainforest agroecology of Nigeria.

Materials and Methods

Site Description/Location

The site of experiment was the Teaching and Research Farm of the Federal University of Technology Owerri, (FUTO), Imo State which lies on Latitude 5^0 22´56´´N and Longitude 6^0 59´´26´´ E at 56m above sea level (www.findlatitudeandlongitude.com) in the tropical rainforest region of Nigeria. The maximum temperature of the area is 32°C while the minimum is 20°C and relative humidity is about 83%. The mean annual rainfall is 2500 mm with a bimodal rainfall pattern characterized by two rainfall peaks in June and September (Okorie, 2015).

Experimental Materials

The experimental materials included seeds of four varieties of Sesame (*Sesamum indicum* L.) obtained from the National Cereals Research Institute in Badeggi, Niger State and cured poultry manure obtained from the battery cage system of the poultry section of the Federal University of Technology Owerri (FUTO) Farms Limited. The sesame varieties were: NCRIBEN-05E, NCRIBEN-04E, YANDEV-55 and NCRIBenE8.

Field Layout and Sowing

The total area measuring 6.5m × 23.5m (152.75 m^2) was divided into 16 plots, replicated 3 times to give a total of 48 plots. Sowing was done by drilling, within the first week of April on plots that measured 1.5m by 1m and contained 50 plants sown in 5 rows with each row having 10 plants at a spacing of 30cm within rows and 10cm between rows. Planting depth is 5 cm.

Experimental Design and Treatment Allocation

The experiment assessed two factors; four rates of poultry manure (0, 5, 10 and 15 tons/ha) and four varieties (NCRIBEN-05E, NCRIBEN-04E, YANDEV-55 and NCRIBenE8) of sesame. The poultry manure was incorporated into the soil 1 week before planting to allow for proper incorporation. They were then set up as a 4×4 factorial in Randomized Complete Block Design in three replicates.

Data Collection and Statistical Analysis

Data were collected on Establishment percentage, Plant height (cm), Number of leaves, Leaf area (cm^2), Number of flowers per plant, Number of capsules per plant, Number of seeds per capsule, Seed yield per hectare and 1000 seed weight. Data collected were subjected to Analysis of Variance (ANOVA) as outlined by Wahua (1999). Significant means were separated using Least Significant Difference (LSD) tool at 5% level of probability.

Results

Effects of Poultry Manure and Variety on the Establishment Percentage (%) and Vegetative Parameters of Sesame

The differences in the establishment percentage of the sesame varieties with varying rates of poultry manure are displayed in Table 1. The variety, poultry manure and variety x poultry manure interaction did not significantly affect the establishment percentage of sesame. Application of poultry manure significantly increased the height and number of leaves of the sesame plants across all sampling times (Table 2). At 4 and 6 WAP, sesame plants that received 5, 10 and 15 ton/ha PM did not differ significantly in height. When compared to application of 0 tons/ha of PM, the height of sesame plants significantly (p = 0.05) increased by 5.4 cm, 3.87 cm and 3.88 cm in response to 5, 10 and 15 tons/ha of PM respectively. At 8 WAP sesame plants grew as tall as 155.0 cm in response to application of 15 tons/ha of PM. These plants were significantly (p = 0.05) taller than the plants that received 5 (149.7 cm) and 10 (148.5 cm) tons/ha of PM respectively. There were no significant effects of variety and variety x poultry manure interaction on the plant height.

At 4 and 6 WAP, plants that received 5, 10 and 15 tons/ha of PM did not differ significantly in the number of leaves produced, but they all had significantly greater number of leaves when compared to plants that received 0 tons/ha of PM (Table 3). Among the varieties, leaf area was smallest in NCRIBen04E at 4 and 6 WAP, and largest in NCRIBenE8 and Yandev55 at 4 and 6 WAP respectively. At 6 WAP, Yandev55 had significantly larger leaf area (7147.76 cm^2) than NCRIBen04E.

Effects of Poultry Manure and Variety on some Reproductive Parameters of Sesame

The number of flowers and capsules progressively increased as the rate of PM application increased from 5 to 15 tons/ha. In response to 10 and 15 tons/ha of PM, number of flowers significantly increased by 90.2% and 117.6% while number of capsules significantly increased by 97.6% and 127.1% respectively (Table 5). The number of seeds produced by NCRIBenE8 was significantly more than the number of seeds produced by all other varieties.

Effects of Poultry Manure and Variety on Seed yield and 1000 seed Weight

Seed yield and 1000 seed weight were significantly affected by differences in variety, PM and the interaction between variety and PM (Fig. 1 and 2). The weight of 1000 seeds for plots amended with 5 tons/ha PM is 3.722 g and this significantly higher than 3.311, 3.286 and 3.094 g recorded for plots amended with 0, 10 and 15 tons/ha PM, respectively. NCRIBenE8 variety recorded 1000 seed weight of 3.682 g and this is immediately followed by NCRIBenE8 whose 1000 seed weight is 3.377 g. NCRIBenE8 and NCRIBen04E amended with 5 tons/ha had the highest 1000 seed weight of 4.129 and 3,950 g respectively when compared with other interactions. Among all interactions, NCRIBen04E amended with 10 tons/ha produced the highest seed yield of 855 kg/ha. Seed yield from other interactions ranged from 144.3 to 628.9 kg/ha.

Discussion

Generally, application of poultry manure led to increased number of leaves, branches and taller plants. This increase may be attributed to improved soil fertility resulting from decomposition, mineralisation, and immobilization triggered by poultry manure application. This corroborates the work of Haruna et al. (2011) who reported that poultry manure application increases plant height of Sesame.

According to Parameshwarappa et al. (2009), seed yield of sesame has direct positive correlation with plant height and number of branches per plant. The study also revealed that the number of capsules per plant and number of seeds per capsule maintained positive linear relationship with seed yield in sesame.

Higher number of branches and consequently, leaves create more sources for carbohydrate production during photosynthesis. The implication of this is overall increase in crop yield. Haruna (2011) and Nanyi et al (2015) separately showed that application of poultry manure resulted to significant increases in sesame grain yield in the Northern guinea savanna area of Nigeria. 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. Asides releasing nutrient to the soil, manure also enhances the soil structure, pH and cation exchange capacity of the soil (Mbagwu & 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 relatively enhanced growth and yield characteristics obtained from the poultry manure application in this study.

Pornparn et al. (2009) reported that yield obtained by the use of organic manures in sesame production compared favourably 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. The varieties exhibited significant degrees of variation in growth and yield attributes, an indication that they have varying genotypic make-up as expressed in their differences in 1000 seed weight, number of seeds per capsule and seed yield per hectare.

Conclusion and Recommendations

In this present study, there was progressive increase in the yield components of sesame with increase rates of poultry manure application. Plants that received 10tons/ha yielded relatively better when compared with observations from other rates of PM application. However, plants that received 15 tons/ha had the highest number of capsules/plant and seed yield/ha but these were not significantly different from those recorded from plants that received 10 tons/ha and as such, did not justify the economic implications of increasing application from 10 to 15 tons/ha. The varieties performed very well in grain yield. However, variety NCRIBenE8 produced the highest yield when evaluated in different yield parameters. Furthermore, variety NCRIBen04E under 10 tons/ha PM yielded comparatively better.

Based on these findings, NCRIBen04E amended with poultry manure at 10 tons/ha is hereby recommended to researchers for further studies in Owerri.

Table 1. Effects of Poultry Manure and Variety on the Percentage Establishment (%) of Sesame

Variety	Percentage Establishment Poultry Manure (tons/ha)				
	0	5	10	15	Mean
NCRIBenE8	51.3	56.0	42.7	42.3	48.1
NCRIBen04E	57.3	48.7	38.0	36.7	45.2
NCRIBen05E	58.0	56.0	41.3	48.0	50.8
YANDEV55	78.0	46.7	60.0	52.7	59.3
Mean	61.2	51.8	45.5	44.9	
$LSD_{(0.05)}$ Variety					Ns
$LSD_{(0.05)}$ Poultry manure					Ns
$LSD_{(0.05)}$ Variety x poultry manure					Ns

Key:

LSD = Least Significant Difference
Ns = Not significant

Table 2. Effects of Poultry Manure and Variety on the Plant Height (cm) of Sesame

Variety	Weeks after planting														
	4					6					8				
	Poultry manure (tons/ha)					Poultry manure (tons/ha)					Poultry manure (tons/ha)				
	0	5	10	15	Mean	0	5	10	15	Mean	0	5	10	15	Mean
NCRIBenE8	15.33	23.80	20.20	18.27	19.40	63.50	87.70	80.30	83.90	78.85	126.50	156.00	151.10	146.80	145.10
NCRIBen04E	10.20	18.73	17.27	20.67	16.72	56.50	81.90	69.20	85.00	73.15	121.30	148.10	142.30	155.70	141.80
NCRIBen05E	17.20	18.07	16.33	15.07	16.67	70.70	70.70	75.50	84.40	75.32	140.30	145.40	145.00	152.80	145.90
YANDEV55	15.93	19.67	20.34	20.20	19.04	58.10	76.70	79.00	84.90	74.82	116.70	149.30	155.70	164.70	146.60
Mean	14.67	20.07	18.54	18.55		62.20	79.20	76.00	84.50		126.20	149.70	148.50	155.00	
$LSD_{(0.05)}$ Variety					Ns					Ns					Ns
$LSD_{(0.05)}$ Poultry manure					3.85					11.75					13.15
$LSD_{(0.05)}$ Variety x poultry manure					Ns					Ns					Ns

Key:

LSD = Least Significant Difference
Ns = Not significant

Table 3. Effects of Poultry Manure on Number of Leaves of Sesame

Variety	Weeks after planting														
	4					6					8				
	Poultry manure (tons/ha)					Poultry manure (tons/ha)					Poultry manure (tons/ha)				
	0	5	10	15	Mean	0	5	10	15	mean	0	5	10	15	Mean
NCRIBenE8	6.40	7.86	7.20	7.46	19.40	14.70	21.80	21.50	27.70	21.40	26.70	36.50	31.20	33.50	32.00
NCRIBen04E	6.07	7.60	7.33	7.13	16.72	15.50	43.80	23.70	20.60	25.90	31.60	34.10	43.10	41.10	37.50
NCRIBen05E	6.80	7.86	7.20	6.93	16.67	14.70	17.50	20.70	22.30	18.80	30.10	32.70	42.80	32.70	34.60
YANDEV55	6.80	8.13	7.77	8.00	19.04	17.70	19.30	21.00	27.30	21.30	23.10	32.40	27.60	33.70	29.40
Mean	6.51	7.86	7.38	7.38		15.60	25.60	21.70	24.50		28.10	33.90	36.20	35.20	
$LSD_{(0.05)}$ Variety					Ns					Ns					Ns
$LSD_{(0.05)}$ Poultry manure					0.53					10.24					Ns
$LSD_{(0.05)}$ Variety x poultry manure					Ns					Ns					Ns

Key:

LSD = Least Significant Difference
Ns = Not significant

Table 4. Effects of Poultry Manure on the Leaf Area (cm^2) of Sesame

	Poultry Manure (tons/ha)									
	4 WAP					6 WAP				
Variety	**0**	**5**	**10**	**15**	**Mean**	**0**	**5**	**10**	**15**	**Mean**
NCRIBenE8	676.32	2007.34	1106.22	1353.56	1285.57	3429.02	7607.58	8014.69	7460.40	6628.24
NCRIBen04E	525.00	1075.32	1276.33	1274.13	1038.62	3921.02	6563.87	5986.56	6538.44	5752.04
NCRIBen05E	928.00	1259.11	1263.21	1202.57	1163.65	4357.06	6945.42	7614.75	7234.62	6537.04
YANDEV55	1052.00	1217.01	1455.72	1086.37	1203.90	4904.75	9438.54	7032.54	7216.85	7147.76
Mean	795.00	1889.05	1275.86	1229.45		4153.83	7638.88	7162.26	7112.74	
$LSD_{(0.05)}$ Variety					422.80					975.90
$LSD_{(0.05)}$ Poultry manure					Ns					Ns
$LSD_{(0.05)}$ Variety x poultry manure					Ns					Ns

Key:

LSD = Least Significant Difference
Ns = Not significant

Table 5. Effects of Poultry Manure on some Reproductive Parameters of Sesame

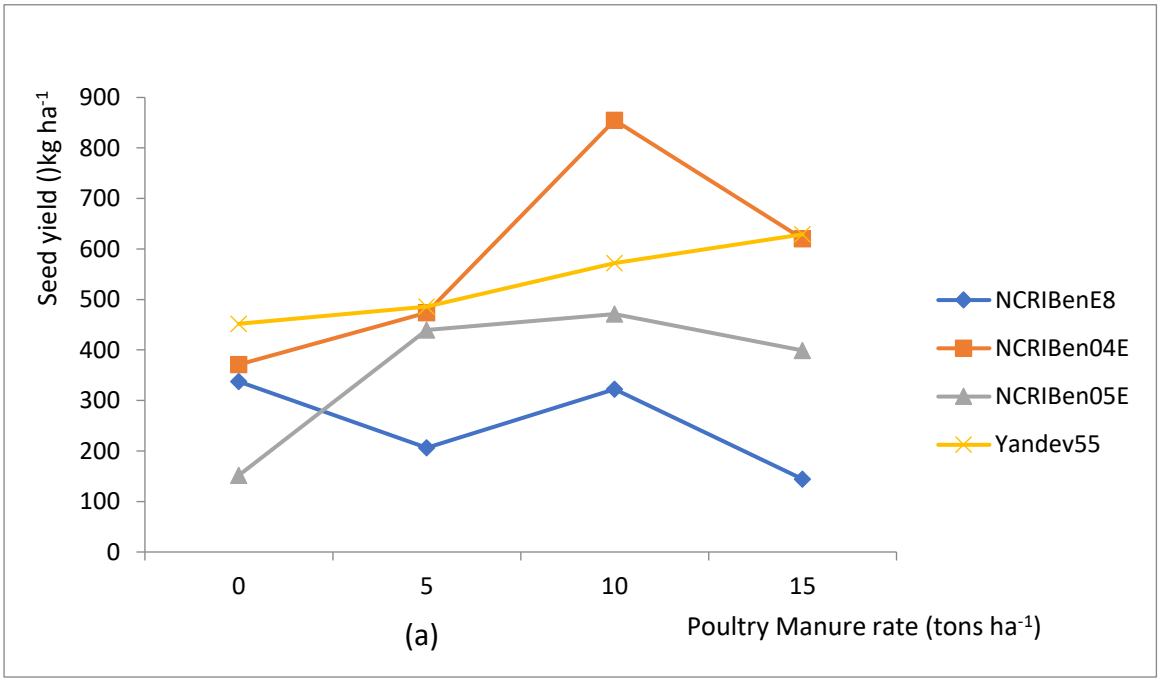
Variety	Weeks after planting NO OF FLOWERS Poultry manure (tons/ha)					NO OF CAPSULES Poultry manure (tons/ha)					NO OF SEEEDS Poultry manure (tons/ha)				
	0	**5**	**10**	**15**	**Mean**	**0**	**5**	**10**	**15**	**Mean**	**0**	**5**	**10**	**15**	**Mean**
NCRIBenE8	49.10	78.70	95.30	98.40	80.40	45.70	74.70	91.00	94.50	76.50	19.33	18.47	18.80	18.13	18.68
NCRIBen04E	60.70	110.20	124.30	140.90	109.00	55.70	105.90	120.10	135.60	104.30	17.30	18.30	18.20	17.53	17.83
NCRIBen05E	62.00	106.50	120.80	112.60	100.50	57.80	102.40	116.60	109.00	96.40	16.80	17.53	17.97	17.17	17.37
YANDEV55	43.60	65.20	69.60	117.10	73.90	39.90	61.40	65.70	113.10	70.00	17.80	17.53	17.13	16.93	17.35
Mean	53.90	90.50	102.50	117.30		49.80	86.10	98.40	113.10		17.81	17.96	18.02	17.44	
LSD Variety					Ns					Ns					0.74
LSD Poultry manure					37.46					37.28					Ns
LSD Variety x poultry manure					Ns					Ns					Ns

Key:

LSD = Least Significant Difference
Ns = Not significant

Table 6. Pre-planting Soil Physico-chemical Properties of the Study Area

pH (H_2O)	5.52
Organic matter (%)	1.68
Nitrogen (%)	0.04
Available Phosphorus (cmol/kg)	18.49
Calcium (cmol/kg)	0.98
Potassium (cmol/kg)	0.04
Sodium (cmol/kg)	0.04
TEA (cmol/kg)	1.07
ECEC (cmol/kg)	4.20
BS (%)	76.16
Sand (%)	86.30
Silt (%)	6.86
Clay (%)	6.84
Textural Class	Sandy Loam



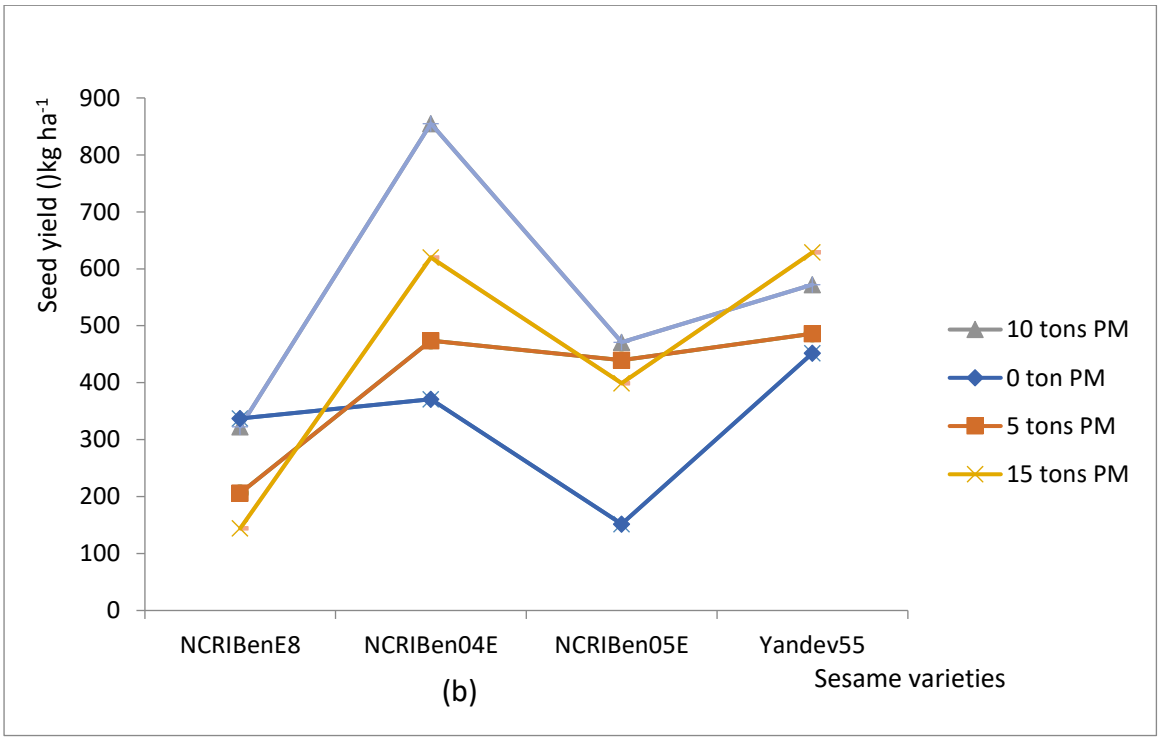


Fig. 1. Interaction effect of (a) rate of poultry manure, and (b) variety on the seed yield of sesame

Key: PM - Poultry Manure

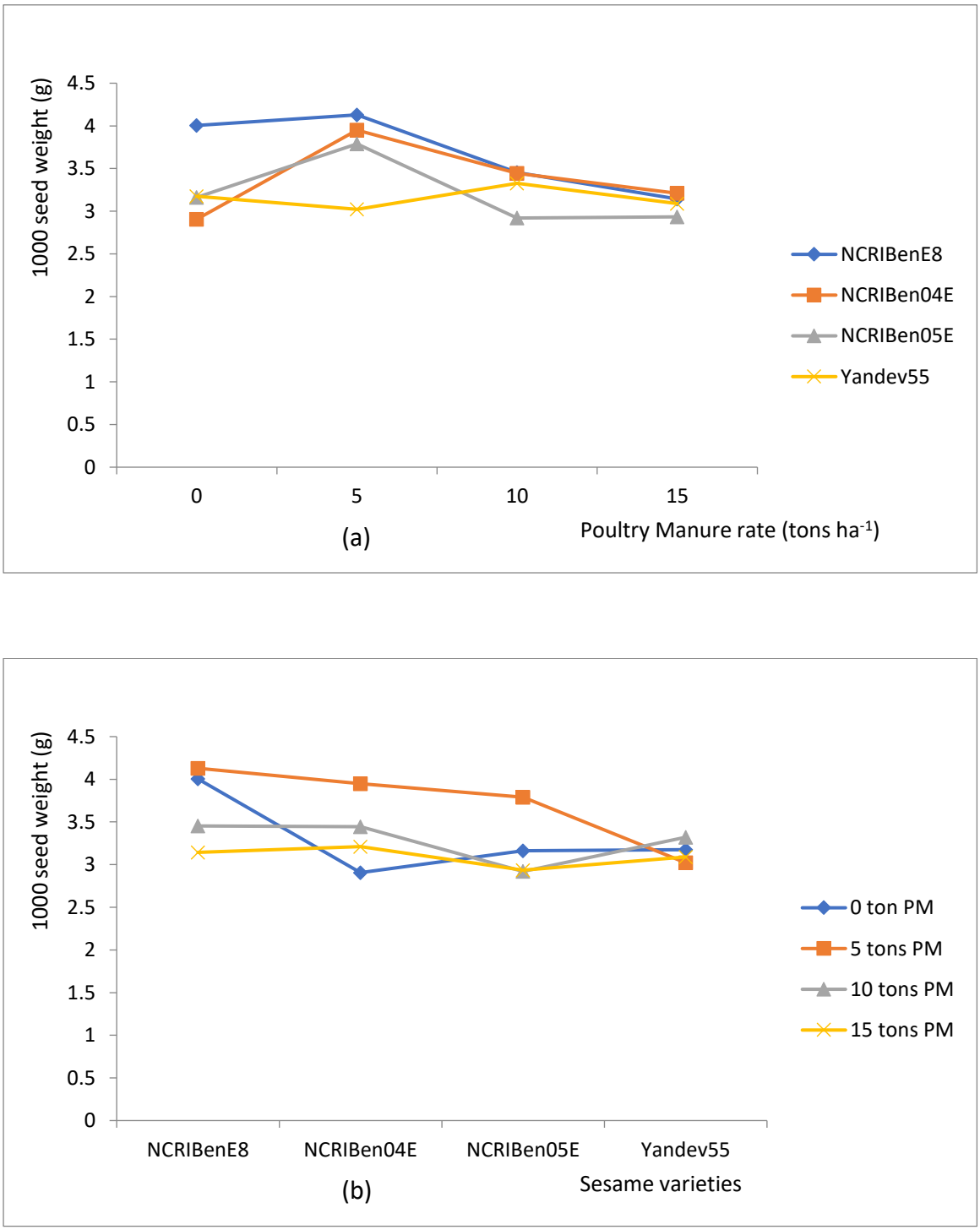


Fig. 2. Interaction effect of variety and rate of PM application on 1000 seed weight of sesame

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