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OPTIMISING GROWTH AND YIELD OF TWO SESAME (*Sesamum indicum* L.) VARIETIES USING COW DUNG AND NPK 15:15:15 FERTILIZER IN JALINGO, TARABA STATE, NIGERIA

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ABSTRACT

Soil fertility remains a major constraint in sesame *(Sesamum indicum L.)* production, necessitating the use of organic and inorganic fertilizers to optimize growth and yield of sesame crop. This study evaluated the effects of cow dung and NPK 15:15:15 fertilizer on the growth and yield of two sesame cultivars at the Taraba State University Research Farm. A field experiment was conducted using a 2 × 4 factorial arrangement involving two sesame cultivars (local and improved) and four fertilizer treatments with three replications: cow dung (CD), NPK 15:15:15, a mixed application (50% CD + 50% NPK 15:15:15), and a control. Growth and yield data were collected and analysed using R statistical software (Version 20.5). Results showed that cow dung significantly enhanced plant height, leaf development, and yield components compared to other treatments. The highest plant height (83.96 cm) was recorded in the local variety treated with cow dung, while the lowest (65.13 cm) was observed in the local variety treated with LSVNPK alone. Cow dung-treated plants also produced the highest number of leaves (41.83), longest leaves (11.03 cm), and widest leaves (6.70 cm). Additionally, cow dung resulted in the highest number of pods per plant (9.13) and highest seed weight (35.3 g), compared to the control LSVC (13.40 g). No significant differences were observed between the two cultivars. The study concludes that cow dung is a highly effective organic fertilizer for improving sesame growth and yield, and its combination with NPK 15:15:15 further enhanced yield components.

Keywords: Sesame, Cow dung, NPK 15:15:15 fertilizer, Growth, Yield, Taraba State

INTRODUCTION

Sesame (*Sesamum indicum L.*) is an important oilseed crop cultivated worldwide for its edible seeds, oil, and nutritional value. It is widely grown in tropical and subtropical regions, particularly in Africa and Asia, where it contributes significantly to food security and economic stability (Salam *et al.*, 2020; USAID 2002). Sesame seeds are rich in oil (45–50%), protein (20–25%), and essential minerals, making them a valuable source of edible oil and industrial products (Gamelin *et al.*, 2009). However, sesame production in Nigeria is often constrained by poor soil fertility, inadequate nutrient management, and suboptimal agronomic practices, leading to low yields (Adebayo *et al.*, 2020).

Soil fertility management is a critical factor influencing crop productivity, particularly in low-input farming systems. The use of organic and inorganic fertilizers has been widely recommended to improve soil nutrient status and enhance plant growth. Organic fertilizers, such as cow dung, improve soil structure, enhance microbial activity, and provide a slow-release source of essential nutrients (Gamelin *et al.*, 2009). Conversely, the importance of fertilizer as agricultural input cannot be over emphasised particularly in Nigeria where the nutrient levels of the soils are low (Agbede, 2009; Eifediyi, 2016). While both fertilizer types have benefits, their combined use (integrated nutrient management) may provide a synergistic effect, improving nutrient availability and soil health while sustaining productivity (Salam *et al.*, 2020; Ali *et al.*, 2006).

The response of sesame to different fertilizer regimes varies depending on soil conditions, environmental factors, and genetic differences among cultivars. Studies have shown that NPK 15:15:15 fertilizer application can significantly affect plant growth parameters such as leaf number, plant height, branching pattern, and pod formation, ultimately influencing yield (Adebayo *et al.*, 2020). However, there is limited empirical data on the combined effect of cow dung and NPK 15:15:15 fertilizer on the growth and yield of sesame varieties cultivated in Jalingo, Taraba State. This study aims to evaluate the effect of cow dung and NPK 15:15:15 fertilizer on the growth and yield of two sesame varieties under field conditions in Jalingo. Specifically, the study will assess key agronomic traits such as leaf number, branch formation, pod development, and seed yield to determine the most effective fertilizer regime for sesame production in the region. The findings will provide insights into optimizing nutrient management strategies for sustainable sesame cultivation in Nigeria.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Teaching and Research Farm of the Department of Agronomy, Taraba State University, Jalingo, Nigeria. The experimental site is geographically located between latitudes 6°30'–9°36'N and longitudes 9°10'–11°50'E, in the northeastern region of Nigeria. According to the National Population Commission (NPC, 2006), the area covers approximately 54,428 km² (Adebayo et al., 2020). The state is divided into southern, central, and northern agroecological zones, with a unimodal rainfall pattern extending from March to October. Agriculture is the primary occupation, engaging approximately 75% of the population.

Sources of Experimental Materials

Improved sesame (Sesamum indicum L.) varieties were obtained from the Taraba Agricultural Development Programme (TADP), Jalingo, while the local sesame cultivar and NPK 15:15:15 fertilizer were sourced from the Jalingo local market. The cow dung was fresh, collected within 24 hours of excretion to ensure minimal nutrient loss and microbial degradation. The dung was produced by healthy, mature cattle aged between 3 and 5 years maintained at the Teaching and Research Farm, Taraba State University, Jalingo. The cattle were primarily fed on a diet of natural pasture grasses such as *Andropogon gayanus*, *Panicum*

maximum, and supplemented with leguminous herbs like *Stylosanthes guianensis.*

Experimental Design

The experiment was designed as a 2 × 4 factorial experiment, incorporating two sesame varieties (V1: Local Sesame, V2: Improved Sesame) and four fertilizer treatments: Organic fertilizer (Cow Dung, CD), Inorganic fertilizer (NPK, NPK), Mixed fertilizer (50% CD + 50% NPK 15:15:15 was 75g and 50% cow dung was 5tons, MX) and Control (C) (No fertilizer application).

This factorial combination yielded eight (8) treatment groups, arranged in a Randomized Complete Block Design (RCBD) with three replications, resulting in a total of 24 experimental plots. Each plot measured 1 m × 1 m, with an inter-plot spacing of 0.5 m and inter-block spacing of 2.0 m to minimize inter-block variation. The treatment assignments were randomized using a random number generator to ensure unbiased allocation. The total experimental area covered 12 m × 7 m.

Cultural Practices

Land Preparation and Planting

The experimental site was manually ploughed and harrowed before seedbed preparation. Sesame seeds were sown by broadcasting at a seeding rate of 8 kg/ha and a planting depth of 1.5 cm. The planting date was August 15, 2024.

Weed Control

Weeding was carried out manually using a hand hoe at 2, 4, and 6 weeks after sowing (WAS) to reduced weed competition for nutrients, water, and sunlight.

Pest Control

To mitigate insect pest infestations, Cypermethrin 10 EC insecticide was applied at a rate of 8 g/ha at 2, 4, and 6 WAS.

Harvesting

Sesame plants typically reach maturity at approximately 90–120 days after sowing. The plants were harvested at physiological maturity when capsules began to dry and leaves started shedding, but before dehiscence to prevent seed loss. Harvesting involved cutting plants below the lowest fruiting point and bundling them for drying. The bundles were air-dried in the field using inclined drying racks (10 ft × 12 ft) to facilitate moisture reduction and prevent fungal contamination. Threshing was conducted by manually shaking the dry plants over a hessian sheet, followed by seed collection and weighing.

Data Collection

The following agronomic parameters were measured at 4, 6, and 8 WAS from four randomly selected and tagged plants per plot: Number of Leaves: Counted from four selected plants, and the mean recorded, Leaf Length (cm): Measured using a ruler from the leaf base to the tip, and the mean recorded, Leaf Breadth (cm): Measured at the widest portion of the leaf using a ruler, and the mean recorded, Number of Branches: Counted per selected plant, and the mean recorded, Number of Pods per Plant: Counted from selected plants, and the mean recorded, Grain Yield per Plot (g): Weighed using a digital electronic weighing balance, and data recorded.

Soil Physicochemical Properties

Baseline soil physicochemical properties were analyzed to determine the influence of soil characteristics on sesame growth and yield. The results for soil analysis before the experiment in Jalingo experimental site were as follows: pH: 6.72, Electrical Conductivity (EC): 0.09 dS/m, Soil Texture: Loamy sand (86.00% sand, 4.80% clay, 9.20% silt), Bulk Density: 1.71 g/cm^3, Water Holding Capacity: 35.70%, Exchangeable Cations: Higher cation exchange capacity (CEC = 5.70 cmol/kg), Base Saturation: 70.18%, Sodium Adsorption Ratio (SAR) and Exchangeable Sodium Percentage (ESP): Elevated levels observed..

RESULTS AND DISCUSSION

Effect of NPK 15:15:15 and Cow-dung Fertilizers on Plant Height of Two Sesame Varieties

The results presented in Table 1 indicate significant variations in plant height across different fertilization treatments and sesame varieties. The treatment LSVCD (Local Sesame vs Cow-dung) exhibited the greatest plant height, with mean values of 45.90 cm at PH6 and 83.96 cm at PH8, significantly surpassing other treatments ($P < 0.05$). Similarly, ISVCD (Improved Sesame vs Cow-dung) achieved the highest mean height at PH8 (86.60 cm), reinforcing the efficacy of cow-dung as an organic fertilizer in promoting sesame growth.

Intermediate plant heights were observed in ISVNPK (Improved Sesame vs NPK 15:15:15) and LSVM (Local Sesame vs Mixed), with ISVNPK attaining 67.40 cm at PH8. Notably, treatments receiving minimal or no fertilizer input, such as LSVC (Local Sesame vs Control) and ISVC (Improved Sesame vs Control), resulted in significantly reduced plant height, highlighting the critical role of nutrient supplementation in sesame cultivation.

Table 1: Effect of NPK 15:15:15 and Cow-dung Fertilizer on Plant Height of Two Sesame Varieties

Treatment	PH4 (cm)	PH6 (cm)	PH8 (cm)
ISVNPK	17.90ab	31.33b	67.40bcd
LSVCD	21.36a	45.90a	83.96a
LSVM	19.30ab	34.73b	76.43ab
LSVNPK	18.36ab	34.23b	65.13ab
ISVC	15.33b	34.73b	56.70d
ISVM	17.73ab	35.75b	81.50ab
LSVC	15.96b	27.25b	63.23ab
ISVCD	18.60ab	49.10a	86.60a

LSVNPK = Local Sesame vs NPK 15:15:15, LSVCD = Local Sesame vs Cow-dung, LSVM = Local Sesame vs Mixed, LSVC = Local Sesame vs Control, ISVNPK = Improve Sesame vs NPK 15:15:15, ISVCD = Improve Sesame vs Cow-dung, ISVM = Improve Sesame vs Mixed, ISVC = Improve Sesame vs Control

Effect of NPK 15:15:15 and Cow-dung Fertilizers on the Number of Leaves in Two Sesame Varieties

The results presented in Table 2 demonstrate significant variations in leaf production across different fertilization treatments and sesame varieties. The LSVCD (Local Sesame vs Cow-dung) treatment exhibited the highest mean number of leaves, with 14.43 leaves at NL6 and 41.83 leaves at NL8, significantly surpassing other treatments ($P < 0.05$). Similarly, ISVCD (Improved Sesame vs Cow-dung) displayed strong leaf development, recording 14.43 leaves at NL6 and 31.23 leaves at NL8. These findings suggest that cow dung fertilization is highly effective in promoting vegetative growth in both local and improved sesame varieties.

ISVM (Improved Sesame vs Mixed) also showed considerable leaf development, producing 36.83 leaves at NL8. However, treatments receiving NPK fertilizer, including ISVNPK (Improved Sesame vs NPK 15:15:15) and LSVNPK (Local Sesame vs NPK 15:15:15), resulted in comparatively lower leaf numbers, particularly at NL8, with 26.66 and 25.06 leaves, respectively. Notably, the LSVC (Local Sesame vs Control) treatment recorded the lowest leaf count (5.90 leaves at NL4), emphasizing the detrimental impact of inadequate fertilization of NPK 15:15:15 on sesame plant growth.

Table 2: Effect of NPK 15:15:15 and Cow-dung Fertilizer on Number Leaves of Two Sesame Varieties

Treatment	NL4 (cm)	NL6 (cm)	NL8 (cm)
ISVNPK	6.90ab	11.70b	26.66bc
LSVCD	7.83a	14.43a	41.83a
LSVM	7.36ab	13.03ab	28.80bc
LSVNPK	7.33ab	11.90b	25.06bcd
ISVC	6.70ab	12.23b	14.23d
ISVM	7.03ab	12.80ab	36.83ab
LSVC	5.90b	11.13b	19.60cd
ISVCD	7.23ab	14.43a	31.23abc

NL = Number of Leave, LSVNPK = Local Sesame vs NPK 15:15:15, LSVCD = Local Sesame vs Cow-dung, LSVM = Local Sesame vs Mixed, LSVC = Local Sesame vs Control, ISVNPK = Improve Sesame vs NPK 15:15:15, ISVCD = Improve Sesame vs Cow-dung, ISVM = Improve Sesame vs Mixed, ISVC = Improve Sesame vs Control

Effect of NPK 15:15:15 and Cow-dung Fertilizer on Leaf Length in Two Sesame Varieties

The results presented in Table 3 demonstrate significant differences in leaf length among the various fertilization treatments and sesame varieties. The LSVCD (Local Sesame vs Cow-dung) treatment recorded the greatest mean leaf length, reaching 10.60 cm at LL6 and 11.03 cm at LL8, significantly surpassing all other treatments ($P < 0.05$). These findings highlight the superior efficacy of cow dung fertilization in enhancing leaf elongation, particularly in local sesame varieties.

ISVNPK (Improved Sesame vs NPK 15:15:15) exhibited notable leaf growth, with lengths of 8.53 cm at LL6 and 8.96 cm at LL8. While these values were lower than those of LSVCD, they indicate that NPK 15:15:15 fertilization also promotes leaf development, albeit to a lesser extent. Similarly, ISVM (Improved Sesame vs Mixed) and LSVM (Local Sesame vs Mixed) displayed moderate leaf length, particularly at LL8, with measurements of 9.76 cm and 9.56 cm, respectively. These results suggest that mixed fertilization strategies provide a beneficial but slightly less pronounced effect compared to cow dung application alone.

Conversely, control treatments (ISVC and LSVC) exhibited the shortest leaf lengths, with ISVC recording 3.20 cm and LSVC 3.60 cm at LL4. These findings underscore the adverse impact of nutrient deficiency on leaf development, further emphasizing the importance of adequate fertilization of NPK 15:15:15 in optimizing sesame growth.

Table 3: Effect of NPK 15:15:15 and Cow-dung Fertilizers on Leaf Length of Two Sesame Varieties

Treatment	LL4cm	LL6cm	LL8cm
ISVNPK	4.03ab	8.53abc	8.96abc
LSVCD	4.46a	10.60a	11.03a
LSVM	4.10ab	8.93abc	9.56ab
LSVNPK	3.70ab	7.10c	7.40bc
ISVC	3.20b	6.70c	7.00c
ISVM	3.36b	9.66ab	9.76ab
LSVC	3.60Ab	7.56bc	8.13bc
ISVCD	3.56ab	8.73abc	9.46abc

LL = Leaf Length, LSVNPK = Local Sesame vs NPK 15:15:15, LSVCD = Local Sesame vs Cow dung, LSVM = Local Sesame vs Mixed, LSVC = Local Sesame vs Control, ISVNPK = Improve Sesame vs NPK 15:15:15, ISVCD = Improve Sesame vs Cow-dung, ISVM = Improve Sesame vs Mixed, ISVC = Improve Sesame vs Control

Effect of NPK 15:15:15 and Cow Dung Fertilizers on Leaf Breadth in Two Sesame Varieties

The results presented in Table 4 reveal significant variations in leaf breadth among the different fertilization treatments and sesame varieties. The LSVCD (Local Sesame vs Cow Dung) treatment exhibited the highest mean leaf breadth, reaching 6.53 cm at LB6 and 6.70 cm at LB8, significantly exceeding all other treatments ($P < 0.05$). These findings underscore the effectiveness of cow dung in promoting leaf expansion, particularly in local sesame varieties.

ISVNPK (Improved Sesame vs NPK 15:15:15) and ISVCD (Improved Sesame vs Cow Dung) also demonstrated substantial leaf breadth, recording 5.40 cm and 6.03 cm at LB6, respectively. This suggests that both NPK 15:15:15 and cow dung applications contribute positively to leaf development, with cow dung exhibiting a superior effect. ISVM (Improved Sesame vs Mixed) and LSVM (Local

Sesame vs Mixed) recorded moderate leaf breadth, particularly at LB6, indicating that mixed fertilization strategies provide a beneficial, albeit slightly less pronounced, impact compared to cow dung alone.

Conversely, LSVNPK (Local Sesame vs NPK 15:15:15), ISVC (Improved Sesame vs Control), and LSVC (Local Sesame vs Control) exhibited the lowest leaf breadth measurements, particularly at LB8, with values of 4.66 cm, 4.23 cm, and 4.33 cm, respectively. These results suggest that the nutrient supply provided may not have fully met the optimal requirements for maximum leaf expansion, reinforcing the general necessity of adequate fertilization for optimal sesame growth.

Table 4: Effect of NPK 15:15:15 and Cow-dung Fertilizers on Leave Breath of Two Sesame Varieties

Treatment	LB4	LB6	LB8
ISVNPK	2.46a	5.40abc	5.63abc
LSVCD	2.86a	6.53a	6.70a
LSVM	2.90a	5.86abc	5.46abc
LSVNPK	2.53a	4.53bc	4.66bc
ISVC	2.46a	4.33c	4.23c
ISVM	2.56a	6.10a	4.86bc
LSVC	2.56a	4.56bc	4.33c
ISVCD	2.70a	6.03bc	6.30ab

LB-Leave Breadth LSVNPK = Local Sesame vs NPK 15:15:15, LSVCD = Local Sesame vs Cow-dung, LSVM = Local Sesame vs Mixed, LSVC = Local Sesame vs Control, ISVNPK = Improve Sesame vs NPK 15:15:15, ISVCD = Improve Sesame vs Cow-dung, ISVM = Improve Sesame vs Mixed, ISVC = Improve Sesame vs Control

Effect of NPK 15:15:15 and Cow-dung Fertilizers on Number of Pods Per Plant of Two Sesame Varieties

The results (Table 5) indicate that the treatment LSVCD (Local Sesame vs Cow-dung) achieved the highest average number of pods per plant, with 9.13 pods, followed closely by LSVM (Local Sesame vs Mixed) at 9.50 pods, both significantly higher than other treatments ($P < 0.05$). This suggests that cow-dung and mixed fertilizer are particularly effective in promoting the establishment of more pods in local sesame varieties. In contrast, ISVC (Improved Sesame vs Control) exhibited the lowest number of pots per plot at just 1.70. Other treatments, such as ISVNPK (Improved Sesame vs NPK 15:15:15), LSVNPK (Local Sesame vs NPK 15:15:15), ISVM (Improved Sesame vs Mixed), and LSVC (Local Sesame vs Control), showed moderate numbers of pods, ranging from 4.30 to 7.63, suggesting that while they perform better than ISVC, they do not achieve the high productivity seen with LSVCD and LSVM. Overall, these findings highlight the significance of fertilizer methods, particularly cow dung and mixed treatments, in enhancing the number of pods per plant in sesame cultivation.

Table 5: Effect of NPK 15:15:15 and Cow-dung Fertilizers on grain yield of Two Sesame Varieties

Treatment	NP/P	SWPP (g)
ISVNPK	7.63ab	32.40ab
LSVCD	9.13a	35.3a
LSVM	9.50a	23.43abc
LSVNPK	4.30ab	18.66abc
ISVC	1.70b	12.56c
ISVM	4.66ab	29.63abc
LSVC	4.33ab	13.40bc
ISVCD	6.96ab	21.60abc

NP/P = Number pod per plant, SWPP = Seed weigh per plot, LSVNPK = Local Sesame vs NPK 15:15:15, LSVCD = Local Sesame vs Cow-dung, LSVM = Local Sesame vs Mixed, LSVC = Local Sesame vs Control, ISVNPK = Improve Sesame vs NPK 15:15:15, ISVCD = Improve Sesame vs Cow-dung, ISVM = Improve Sesame vs Mixed, ISVC = Improve Sesame vs Control

Discussion

The findings of this study demonstrate that cow dung fertilization significantly enhances plant height in sesame varieties. The treatment LSVCD (Local Sesame vs. Cow-dung) exhibited the highest plant height, with an average of 45.90 cm at PH6 and 83.96 cm at PH8, which was significantly greater ($P < 0.05$) than other treatments. Similarly, ISVCD (Improved Sesame vs. Cow-dung) recorded an impressive plant height of 86.60 cm at PH8, confirming that cow dung positively impacts both local and improved sesame varieties (Langham et al., 2008). These findings are consistent with those of Jones et al. (2018), who demonstrated that organic fertilizers, particularly cow dung, significantly improve plant growth parameters across multiple crops.

The application of cow dung significantly increased the number of leaves in sesame plants. These results align with the findings of Kumar et al. (2017), who reported that organic fertilizers enhance leaf growth across different crop species.

The study revealed that cow dung application significantly improved leaf length and breadth in sesame plants. These findings are in agreement with Ahmed et al. (2022) and Singh et al. (2023), who documented the superior effects of organic fertilizers on leaf expansion and overall crop performance.

The number of pods per plant was highest in LSVCD (9.13 pods) and LSVM (9.50 pods), both significantly outperforming other treatments ($P < 0.05$). These findings align with Zhao et al. (2021), who reported that organic fertilization significantly boosts crop yield parameters.

Seed weight varied significantly across treatments, with LSVCD producing the highest seed weight (35.3 g),

demonstrating the effectiveness of cow dung in enhancing sesame seed production ($P < 0.05$). ISVNPK also showed favorable results, with an average seed weight of 32.40 g, suggesting that NPK 15:15:15 fertilization provides substantial benefits. Conversely, ISVC recorded the lowest seed weight (12.56 g), highlighting the adverse impact of inadequate nutrient application. Intermediate seed weights were observed in LSVM, ISVM, and ISVCD, ranging from 21.60 g to 29.63 g. These results corroborate the findings of Liu et al. (2024), who documented the positive impact of organic fertilizers on seed weight and quality in various crops.

CONCLUSION

This study investigated the effects of cow dung and NPK 15:15:15 fertilizers on sesame plant growth and yield, focusing on parameters such as plant height, number of leaves, leaf dimensions, number of pods per plant, and seed weight. The results revealed that cow dung fertilization consistently outperformed other treatments, significantly enhancing sesame growth and productivity.

In conclusion, cow dung fertilization (LSVCD) demonstrated the highest improvements across all measured growth and yield parameters, reinforcing its efficacy as an organic fertilizer. The study underscores the importance of nutrient management, with cow dung proving superior to NPK and mixed fertilization in enhancing sesame cultivation. The findings advocate for integrating cow dung into sesame farming practices, aligning with sustainable agriculture by improving soil health and productivity while reducing reliance on chemical fertilizers. Future research should explore the long-term effects of cow dung application on soil fertility and yield sustainability in sesame cultivation.

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