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IMPACT OF ALPHA SPIN NANOPARTICLES ON GENETIC DIVERSITY OF NIGERIA SESAME (*Sesamum indicum* L.) GERMPLASM

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ABSTRACT
An experiment was carried out at the Botanical Garden, Department of Plant Science and Biotechnology of Federal University of Lafia, Nasarawa State- Nigeria to investigate the influence of Alpha spin nanoparticles on the Genetic diversity of sesame (*Sesamum indicum*). The sesame seeds were exposed to different levels of Alpha pin Nanoparticles at 20, 40 and 60 min alongside the untreated (control). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were collected on the basis of plant height, Number of pods per plant, Number of seeds per pod. The result from the study revealed that most of the parameters were significant at $P \leq 0.05$. Highest mean plant height was observed in variety $FUTM_9$ (98.03), while OMA 40 (41.83) has the least plant height. The result also showed that $FUTM_7$ (31.21) has the highest number of pods/plant while OMA 40, has the least number of pods/plant. $FUTM_9$ (70.22) was observed to have the highest number of seeds/pod while Ex sudan (44.66) has the least number of seeds/pod. NAK033 has the highest dry seed weight (22.60) while $FUTM_9$ has the least dry seed weight (3.89). Highest 1000 seed weight was observed in the variety Jig 86 (8.80) while the least was observed in Ex sudan (6.79). Most of the varieties recorded their highest mean performance at T_2 which is 40 minutes of exposure to alpha spin nanoparticles. It is therefore recommended that for most of the agronomic traits, T_2 (40 minutes exposure time) be applied.

Keywords: Alpha spin, nanoparticles, genetic diversity, sesame

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an annual plant that belongs to the family Pedaliaceae. It is an important annual oil seed crop in the tropics and warm subtropics where it is usually grown in small plots (Azeez & Morakinyo, 2011). The seeds are small, the size form and colours vary with the thousands of varieties now known (Banerjee & Kole, 2010). Typically, the sesame seeds are about 3 to 4 mm long by 2 mm wide and 1mm thick. The seeds are ovate, slightly flattened and somewhat thinner at the eye of the seed (hilum) than at the opposite end. It is however, given little attention and there are relatively few companies involved in the trade (Dixit, 2005). As a smallholder crop, often intercropped with other crops in Nigeria, the extent its cultivation is poorly known and there is little information on the morphological characterization, yields or productivity, genetic and environmental interaction. In Nigeria, sesame is widely grown in the northern and the central parts of the country as a minor crop. Since 1974, it has developed from being a crop of negligible importance to one of the major cash earner in its area of production (viz; Nasarawa, Borno, Gombe, Benue, Kogi, Kano, Jigawa, Plateau, Yobe, Katsina state as well as the FCT Abuja) (Abubakar *et al*., 1998). Nigeria was the world's sixth-largest exporter of sesame seeds in 2021, making sesame seeds the country's second most lucrative export after cocoa. An estimated 90% of the sesame seeds produced in the country are exported abroad (Abubakar, 1993). Nigeria exports an estimated 700 million dollars' worth of sesame seeds yearly, which equates to about $1400 per metric ton of exported seed. Exports of sesame seeds to Japan especially have had a positive impact on Nigeria's economy, as Japan imports about 40% of its sesame seeds from Nigeria, and the trade volume between the two countries reached $1 billion in 2022 (Arriel *et al*., 2023). Between 2020 and 2021, Nigeria's income from agricultural exports rose by an estimated 57.02%, a boost that sesame exports, which increased from 98.27 billion naira to 113.2 billion naira, played critical roles in propelling the Nigeria Economy (Arriel *et al*., 2023). Sesame is an important source of high quality edible oil and protein food for poor farmers of major sesame growing countries such as Sudan, Ethiopia, Nigeria, Uganda, Mexico, Venezuela, India, China, Pakistan, Turkey, and Myanmar who can hardly afford animal fat and protein. Sesame seed is the single readily available source of protein high in sulfur containing amino acids (Ashri, 1981). It is the major cash crop for smallholder farmers and valuable foreign exchange revenue for the economy of different countries. The remaining cakes of sesame are used as a source of crude protein for cattle feed. The study will provide valuable information for breeders, nutritionists, and industrialists who rely on sesame for various purposes. In Nigeria, sesame seeds are extensively cultivated, especially in Northern Nigeria, and are rich in fat, protein, carbohydrates, fiber, and minerals, with a high oil content that resists oxidative rancidity (Abubakar *et al*., 1998). Sesame seed is a good source of protein with an amino acid profile similar to soybean, and its chemical composition shows it is an important source of oil, protein, carbohydrate, and ash (Ashri, 1993). .

Sesame seeds are used whole in cooking, yield sesame oil, and have a rich nutty flavour, with various uses in different countries, including the US, Nigeria, and Asia. Sesame seeds are not only used for culinary purposes but also in traditional medicines for their nutritive, preventive, and curative properties, with phyto- nutrients like omega-6 fatty acids, flavonoid phenolic anti-oxidants, vitamins, and dietary fiber (Bahrenfus & Fehr, 1984). Sesame oil is an edible vegetable oil derived from sesame seeds, used in various countries, and is stable and free from undesirable nutrition or flavor components, with a natural oxidant that prevents aging and is vital for liver cell production (Balses, 2003). Sesame (*Sesamum indicum* L.), otherwise known as sesamum or benniseed, member of the family Pedaliaceae, is one of the most ancient oilseeds crops known to mankind. Sesame plays an important role in human nutrition. Most of the sesame seeds are used for oil extraction and the rest are used for edible purposes (Banerjee & Kole, 2010). The current challenges of sustainability, food security and climate change are engaging researchers in exploring the field of nanotechnology as new source of key improvement for the agricultural sector. Several technological innovation have been employed in agricultural improvement of plants which have resulted in, hybrid variety, synthetic chemicals. Therefore, it will be of immense importance for researchers to seek in nanotechnology a new source of agricultural improvement (Baydar *et al*., 1999).

Alpha spin optimizes the natural frequency as it can increase harmony in the body by stimulating vital life energy. Any contact with alpha-spin, the molecular structure will create smaller clusters that will make penetration and absorption easy by full optimizing the body's molecular and cellular functions via resonance and then forming a vortex that results in the expression of a quantum energy field which will exert its effect in the content of an organism's body. Its functions include improvement of absorption and increase in hydrations, improve micro circulations. It can also be used to facilitate the flow of energy through reflexology frequency, through which it can improve plant growth, seed germination and extend the shelf life of fruits and vegetables (Siddhartha, 2014).

Nanotechnology has the potential to advance agricultural productivity through genetic improvement of plants, delivery of genes and drug molecules to specific sites at cellular levels, and nano-array based gene-technologies for gene expressions in plants and animals under stress conditions. The potential is increasing with suitable techniques and sensors being identified for precision agriculture, natural resource management, and early detection of pathogens and contaminants. Nanomaterials in agriculture aims in particular to reduce the amount of sprayed chemical products by smart delivery of active ingredients, minimise nutrient losses in fertilisation and increase yields through optimised water and nutrient management (Jegan, 2025). The study will contribute to the body of knowledge on sesame research and provide a basis for further studies.

MATERIALS AND METHODS

This research was carried out in the Botany Garden of Federal University of Lafia, Nasarawa State, located on latitude 8^0 35'N, longitude $8^0$32'E altitude 181.53m above sea level with a mean temperature of 34^0C, relative humidity 0f 40-80 % and average day light of 9-12. It is located in the southern Guinea Savannah Region of North-central Nigeria. Sesame seeds were obtained from National Cereal Research Institute (NCRI). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Twenty sesame accessions were used for this research (Table 1). The sesame seeds were exposed to three levels of Alpha Spin nanoparticles at Control 0min (T_o), 20 min (T_1), 40 min (T_2) and 60 min (T_3) before planting while the untreated seeds were planted alongside the treated seeds and used as control (Kana *et al*., 2021). Data were collected on the following bases: Number of Days to Germination, Number of Germinated Seeds, and Seedling Height. The data were subjected to Two-Way analysis of variance (ANOVA) using GENSTAT version 17.0 software. Means were separated using least significant difference (LSD) at $p \leq 0.05$.

Table 1: Sesame evaluated during the 2025 rainy season in Lafia, Nasarawa State

S/N	Germplasm	Source
1.	NAK033	NCRI
2.	FUTM9	NCRI
3.	YANDEZ 55	NCRI
4.	OMA 40	NCRI
5.	Kach 02	NCRI
6.	Dan Taraba	NCRI
7.	Kan 079	NCRI
8.	Jig 86	NCRI
9.	Bas 042	NCRI
10.	FUTM7	NCRI
12.	MKW 064	NCRI
13.	GOLD 12	NCRI
14.	FUTM2	NCRI
15.	NCRIBEN 04E	NCRI
16.	NCRIBEN 05E	NCRI
17.	GUJ BLACK	NCRI
18.	CHI 001	NCRI
19.	E8	NCRI
20.	Ex sudan	NCRI
21.	Kan076	NCRI

Source: NCRI (2025)

RESULTS AND DISCUSSION

Plant height

The result for plant height showed that the sesame variety FUTM$_9$ with mean performance of (98.03 cm) had the highest plant height while variety OMA 40 has the least mean performance of (41.83 cm). The result for alpha spin nanoparticle revealed that (T_2) 40 minutes time of exposure (95.09) recorded the highest mean performance compared to other time of exposures with (74.33 cm) and (74.02 cm) for (T_3) 60 minutes and (T_1) 20 minutes respectively (Table 2).

Number of pods per plant

The result for number of pods per plant revealed that variety FUTM$_9$ with mean performance of (31.21) had the highest number of pods while OMA 40 had the least mean performance of (3.70). The result of alpha spin nanoparticles showed that (T_2) 40 minutes of exposure had the highest mean performance (19.77) while (T_3) 60 minutes had the least mean performance (7.05)

Number of seeds per pod

The result for number of seeds per pod showed that the variety FUTM$_9$ (70.22) the the highest mean performance for number of seeds per pod while Ex sudan (44.66) had the least mean performance for number of seeds per pod. (T_2) 40 minutes had the highest mean performance (71.23) while (T_1) 20 minutes had the least time of exposure (60.06).

Dry seeds weight

The result for dry seeds weight showed that variety NAK033 had the highest dry seeds weight (22.60 g) while FUTM$_9$ had the least dry seeds weight (3.89 g). The result for alpha spin nanoparticles revealed that (T_2) 40 minutes time of exposure had the highest mean performance (13.13 g) while (T_1) 20 minutes time of exposure had the least time of exposure (6.04 g).

1000 seeds weight

The result for 1000 seeds weight showed that the variety Jig 86 had the highest mean performance of (8.80 g) while variety Ex sudan had the least mean performance (6.79 g). The result for alpha spin nanoparticle showed that (T_2) 40 minutes time of exposure had the highest mean performance (8.89 g) while (T_1) 20 minutes time of exposure had the least mean performance (7.05 g) (Table 2).

Table 2: Mean Performance for Agronomic traits of sesame germplasm treated with Alpha spin nano spin particles evaluated in Lafia

	Agronomic traits				
Varieties	**Plant height (cm)**	**Number of pods/plant**	**Number of seeds/pod**	**Dry seeds weight (g)**	**1000 seed weight (g)**
NAK033	49.34	5.44	58.56	22.60	6.97
FUTM9	98.03	24.11	70.22	3.89	7.87
YANDEZ 55	44.83	4.27	54.37	6.80	6.81
OMA 40	41.83	3.70	62.10	9.50	7.47
Kach 02	65.56	6.11	55.23	7.77	6.96
Dan Taraba	63.11	12.56	63.31	4.00	8.06
Kan 079	72.33	6.89	64.11	12.98	8.00
Jig 86	58.67	6.61	59.54	9.02	8.80
Bas 042	55.01	5.72	57.00	7.12	8.22
FUTM7	95.45	31.21	66.71	3.95	8.20
MKW 064	66.67	8.98	63.98	6.90	8.01
GOLD 12	60.21	7.77	64.04	5.90	7.89
FUTM2	78.21	22.45	65.11	4.00	8.01
NCRIBEN 04E	70.27	6.89	68.66	12.13	8.12
NCRIBEN 05E	70.70	9.50	51.70	4.54	7.88
GUJ BLACK	46.87	4.47	64.87	6.99	7.12
CHI 001	64.63	12.13	54.67	5.98	7.20
E8	71.02	11.98	62.54	6.77	7.30
Ex sudan	63.22	7.03	56.43	6.60	6.79
Kan076	50.57	5.87	44.66	8.87	7.98
Mean	59.33	10.14	60.33	7.37	7.88
Alpha Nano spin					
0	78.99	8.08	61.98	6.09	7.10
20	74.33	7.44	60.06	6.04	6.23
40	95.09	19.77	71.23	13.13	8.89
60	74.02	7.05	61, 17	6.12	7.05
LSD	NS	NS	NS	0.03	0.14

Sesame plant height responded positively to moderate concentration of alpha spin nanoparticles (Alexander and Kwon-Ndung, 2024) who observed that tomato responded positively toward nanoparticles encapsulating tomato seeds at 50 ppm (40 minutes time of exposure) concentration than the other levels of treatments.

Number of pods per plant also showed positively response at T_2 which is 40 minutes of exposure to alpha spin nanoparticles. The result also agrees with (Iliyas *et al*., 2023) who reported that moderate application of Selenium Nanoparticles in sesame increases yield performance.

Number of seeds per pod responded positively to moderate concentration of alpha spin nanoparticles at T_2 which is 40 minutes of exposure to alpha spin nanoparticles, these aligns with the findings of Kana *et al*. (2021) who reported the Pattern of Growth and dry matter accumulation in some improved cowpea varieties exposed to alpha spin nanoparticle.

Dry seeds weight performed well at T_2 which is 40 minutes of exposure to alpha spin nanoparticles. Moderate concentration of nanoparticles has been shown to increase growth in sesame. The observation disagrees with findings of (Siddhartha, 2014) who observed that the more the concentration the more the yield.

1000 seeds weight responded positively at T_2 which is 40 minutes of exposure to alpha spin nanoparticles. The result also aligned with the findings of (Janalizadeh *et al*., 2021) who reported that moderate application of Magnetic Field and Application of Silicon Dioxide Nano-Particles increase yield and other agronomic parameters in sesame.

CONCLUSION

In conclusion, this study revealed that sesame variety FUTM$_9$ performed well in most of the parameters measured, such as plant height, Number of pods per plant, Number of seeds per plant and dry seed weight. OMA 40 performed poorly compared to other sesame varieties. (T_2) 40 minutes time of exposure to alpha spin nanoparticles had the highest mean performance in all the parameter measured. The study offers valuable insights into Nigeria's germplasm collections, revealing substantial genetic variability that provides foundation for developing improved varieties.

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