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Effect of Nano-fertilizer and Conventional Fertilizer on the Growth, Yield and Yield Attributes of Sesame (*Sesamum indicum* L.)

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Abstract

An experiment was carried out during the kharif season of 2021 at CRC Farm, School of Agriculture, ITM University, Gwalior (M.P.). The goal of the study was to see how conventional and Nano- fertilizers affected sesame productivity and quality, as well as how they affected plant growth parameters, yield attributes, and yield, as well as sesame economics and quality. The soil in the experimental field had a sandy clay loam texture, was neutral in reactivity to normal EC, and had a medium OC, N, P, and K content. The total and average rainfall throughout the experimental year was 110.08 mm and 12.23 mm, respectively, while other climatic conditions were normal for better crop growth and development. In a randomized block design (RBD), ten treatments were tried with three replications. The crop was sown on August 5th, 2021,and harvested on November 11th, 2021. Soil samples from each plot were gathered before and after crop harvest and subjected to chemical analysis to determine changes in soil attributes over their baseline soil status. Finally, the treatments' economic viability was assessed in terms of cost of cultivation, gross returns, net returns, and the B: C ratio on a per-hectare basis. Based upon this experiment it is concluded that application ofNano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer produced significantly higher seed yield (9.19 q/ha), maximum gross returns (76098 Rs/ ha), maximum net returns (52345 Rs/ ha), and the highest B: C ratio of 2.31:1.

Keywords-*Nano-Fertilizer,Nitrogen, Phosphorus, potassium, Harvest Index, Biological yield.*

Introduction

Sesame (Sesamum indicum L.), also known as til and dubbed the "queen of oilseeds," is one of the earliest domesticated edible oilseeds utilized by humans. It is a member of the Pedaliaceae family. It may be grown in a wide range of climates, from the semi-arid tropics and subtropics to temperate zones. Its oil content ranges from 46 to 52 percent, with protein content ranging from 20 to 26 percent. Approximately 70 percent of sesame produced in the country is used for oil extraction, while the remaining 20 percent is used for domestic purposes such as the preparation of sweet candies as condiments, culinary and confectionary purposes, and the manufacturing of paint, perfumed oils, pharmaceuticals, and insecticides. Linoleic, oleic, palmitic, and stearic acids are the primary elements of sesame, according to its fatty acid content. The oil is known for its stability and purity, as well as its resistance to oxidative rancidity. Sesame oil is often referred to as a "poor man's ghee alternative." Sesame cake is a protein, carbohydrate, vitamin (niacin), and mineral-rich byproduct of the oil milling industry (Ca & P). The cake has

a nitrogen content of 6.0-6.2 percent, a phosphorus content of 2.0-2.2 percent, and potassium content of 1.0-1.2 percent, making it suitable for use as manure.

Sesame is grown over 20.0 million hectares in India, with an annual yield of 8.66 million tons. 405 kg/ha is the crop's average productivity. Sesame production (26%) and export (40%) are all dominated by India (Manivannan et al., 2020). Despite being such a significant oilseed crop, average productivity is low both globally and nationally. In dry farming regions under rainfed conditions, the only activity that can add to output and productivity through improved and effective use of existing resources and can assure maximum conservation of arid soil and water is irrigation, which has limited scope in the state.

Plant nutrition is an important factor in increasing productivity. Conventional fertilizers, such as N, P_2O_5, K_2O, and S, are an important choice to consider if crop yields are to be improved. An adequate supply of nitrogen is advantageous for both carbohydrate and protein metabolism because it promotes cell division and enlargement, resulting in more leaf area and better plant growth and development, which in turn results in a higher seed and dry matter yield. Nitrogen is a structural component of chlorophyll and protein. Similar to nitrogen, phosphorus is an essential plant nutrient that promotes plant development and growth, increasing agricultural production. It is an essential part of the skeleton of the plasma membrane, along with nucleic acid, a number of co-enzymes, and phosphorylated substances. It also aids in the flow of energy within the plant's body and the creation of the reproductive organ. As a result, a good phosphorus supply is usually connected with enhanced root density and proliferation, which aid in broad exploration and delivery of nutrition and water to growing plant parts, resulting in increased growth and yield qualities, ensuring more seed and dry matter output[1,2,3].

Nanofertilizers are chemically synthesized or modified versions of traditional fertilizers, fertilizer bulk materials, or extracts from various vegetative or reproductive portions of the plant using nanotechnology to improve soil fertility, productivity, and quality of agricultural produce. Nano fertilizers can regulate the nutrient release and deliver the optimum amount of nutrients to crops in the right proportions, increasing output while protecting the environment[4,6,8].

Foliar feeding using nano fertilizers boosts chlorophyll production, and cellular activity, and regulates respiration. Foliar fertilization has been more popular in recent years due to the availability of soluble fertilizers, and it is especially important in the current climate change scenario. It also causes plants to respond to increased soil water and nutrient uptake.

The goal of foliar spraying fertilizers using nano fertilizers is to keep leaves alive longer by replenishing nutrients that are promptly translocated to growing seeds. Because data on critical issues such as the application of appropriate doses of conventional and nano fertilizers by foliar feeding to sesame is missing, a field experiment entitled “Effect of nano-fertilizer and conventional fertilizer on the growth, yield and yield attributes of sesame (Sesamum indicum L.)” was carried out at the student instructional field of the Department of Agronomy, School of Agriculture, ITM University, Gwalior (M.P.) during Kharif season of the year 2021.

Materials and Methods

A field experiment was conducted at the Crop Research Centre, School of Agriculture, ITM University, Gwalior, during the Kharif season of 2021- 22. (M.P.). Geographically experimental site is situated at the average elevation is 197 meters above the mean sea level, and the coordinates are 26.140° N, and 78.196° E. The site of the experiment is situated in the Grid Region of Madhya Pradesh. The soil in the experiment field was slightly alkaline in reaction (7.35), normal electrical conductivity (0.40 dsm-1), low in organic carbon (0.11), and low in available nitrogen (67 $kgha^{-1}$) and phosphorous (14.5 $kgha^{-1}$) and medium in available potassium (238 $kgha^{-1}$).

The experiment was set up in a Randomized block design (RBD)because of the nature of the issues under investigation and the convenience of agricultural operations. The experimental units were given ten treatments including various doses of conventional and nano fertilizer, as well as an integrated strategy. Thirty treatment combinations were created by replicating ten treatments of the recommended dose of inorganic fertilizers, organic manure (vermicompost), and nano fertilizer three times. In sesame, RDF, organic manures, and nano-fertilizer were treated according to the treatment plan. The following are the specifics of the treatment, T_1: Control, T_2: 100% RDF through chemical fertilizers (N-60, P_2O_5-60, K_2O-30 and S-25 kg/ha), T_3: 100% RDF through chemical fertilizers + nano fertilizer @250 g/ha, T_4: 100% RDF through chemical fertilizers +nano fertilizer @ 500 g/ha, T_5: 100% RDF through chemical fertilizers + nano fertilizer @ 750 g/ha, T_6: 75% RDF through chemical fertilizers + 25% RDF through vermicompost +nano fertilizer @ 250 g/ha, T_7: 75% RDF through chemical fertilizers + 25% RDF through vermicompost + nano fertilizer @ 500 g/ha, T_8: 75% RDF through chemical fertilizers + 25% RDF through vermicompost + nano fertilizer @ 750 g/ha, T_9: 100% RDF through chemical fertilizers + 25% RDF through vermicompost +nano fertilizer @ 750 g/ha, T_{10}: 100% RDF through nano fertilizers @ 500 g/ha.

Result and Discussion

The purpose of the current Research is to discuss the various causes of variation in statistically proven significant therapies. It has also been attempted to develop a "cause and effect" link based on the current inquiry, which has been backed up by relevant findings and evidence, to order to justify the influence of various quantities of conventional and nano-fertilizers on various parameters.

At the maturity stage, observations were made on plant growth parameters (such as plant height, number of branches per plant, and number of leaves per plant), yield attributing characters (such as number of capsules per plant, number of seeds per capsule, and test weight), grain and stover yields, quality parameters (such as oil content), and economics. On November 11th, 2021, the crop was harvested. Soil samples from each plot were gathered before and after crop harvest and subjected to chemical analysis to determine changes in soil attributes over their baseline soil status. Finally, the treatments' economic viability was assessed in terms of cultivation costs, gross returns, net returns, and the B: C ratio on a per-hectare basis. The results

were interpreted using data from numerous parameters that were collated and statistically analyzed.

Effect on Growth parameters

The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer produced significantly higher plant heights of 104.73 cm at the harvest stage, compared to the other treatments.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer also influenced the number of branches per plant and produced the maximum leaves(4.60) at the harvest stage, proved significantly superior to the rest of the treatments.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer produced significantly more leaves per plant of sesame, with respective values of 9.67, 35.67, 85.47, and 79.20 at the growth stages of 30, 60, 90 DAS and at harvest, respectively, proving significantly superior to the rest of the treatments.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer, with a respective value of 41.53, were significantly superior to the rest of the treatments in terms of the number of capsules per plant of sesame.

The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer, with a respective value of 70.20, were significantly superior to the rest of the treatments in terms of the number of seeds per capsule of sesame.The nano- fertilizer and traditional fertilizer treatments of 100 percent RDF by chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer, with respective values of 3.63 g, was considerably superior to the rest of the treatments in terms of sesame test weight.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer with a respective value of 4.67 g were significantly superior to the rest of the treatments in terms of seed yield per plant of sesame.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer with a respective value of 1.10 kg were significantly superior to the rest of the treatments in terms of seed yield per plot of sesame.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer yielded the highest seed yield per hectare of sesame, with a value of 9.19 q/ha, significantly outperforming the other treatments. The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer produced the highest stover yield per hectare of sesame, with a value of 25.43 q/ha, significantly outperforming the other treatments[5, 10, 11].

The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost +

750 g/ ha nano fertilizer produced the highest biological yield per hectare of sesame, with a value of 34.62 q/ha, significantly outperforming the other treatments.The harvest index of sesame was significantly higher under the nano- fertilizer and traditional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer, with a value of 26.53 percent, compared to the other treatments.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer, with a respective value of 49.97 percent, were significantly superior to the rest of the treatments in terms of sesame oil content.The cost of sesame production was significantly higher under the nano- fertilizer and traditional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer, with a total cost of 23663.00 Rs/ha.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer yielded the highest gross monetary return of sesame, with a value of 76098.00 Rs/ha, significantly outperforming the other treatments.The nano- fertilizer and conventional fertilizer treatments of 100 percent RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ ha nano fertilizer yielded the highest net monetary return of sesame, with a value of 52435.00 Rs/ha, significantly outperforming the other treatments.The treatment combination consisting of the application of 100 percent RDF through nano fertilizers @ 500 g/ha with a respective value of 2.31:1 was considerably superior to the rest of the treatments in terms of the B: C ratio of sesame[12, 13, 14].

Conclusion

On the basis of the results of this experiment, it can be concluded that application of nano- fertilizer and conventional fertilizer treatments of 100 % RDF through chemical fertilizers + 25 percent RDF through vermicompost + 750 g/ha nano fertilizer produced significantly higher seed yield (9.19 q/ha), maximum gross returns (Rs 76098/ha), maximum net returns (Rs 52345/ ha), and the highest B:C ratio (2.31:1).

Table 1 Plant height, no of leaves, no of branches, no of capsules no of seeds per capsule and test weight as influenced by various treatments

Tr. No.	Treatment combination	Plant height At Harvest	No. of branches At harvest	No. of leaves At harvest	No. of capsules per plant	No. of seeds per capsules	Test weight (g)
T_1	Control	72.11	2.13	17.73	6.87	19.40	1.87
T_2	100% RDF through chemical fertilizers (N- 60, P2O5 - 60, K2O- 30 and S- 25 kg/ha)	92.93	2.93	67.00	37.60	65.00	2.92
T_3	100% RDF through chemical fertilizers + 250 g/ha nano fertilizer	95.80	3.00	67.93	38.47	67.47	3.00
T_4	100% RDF through chemical fertilizers + 500 g/ha nano	97.27	3.07	71.53	38.93	67.60	3.06

	fertilizer						
T_5	100% RDF through chemical fertilizers + 750 g/ha nano fertilizer	99.21	3.47	75.53	39.13	68.93	3.18
T_6	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 250 g/ha nano fertilizer	82.81	2.60	62.53	34.40	60.13	2.70
T_7	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 500 g /ha nano fertilizer	87.55	2.80	63.47	35.13	61.80	2.73
T_8	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 750 g / ha nano fertilizer	88.63	2.87	65.27	36.20	62.20	2.89
T_9	100% RDF through chemical fertilizers + 25% RDF through vermicompost + 750 g / ha nano fertilizer	104.73	4.60	79.20	41.53	70.20	3.63
T_{10}	100% RDF through nano fertilizers @ 500 g/ha	77.79	2.53	50.33	30.03	55.77	2.65
	S. Em ±	1.03	0.21	1.27	0.85	0.92	0.21
	C.D.(0.5)	2.99	0.61	3.71	2.48	2.68	0.60

Table 2 Seed yield, stover yield, biological yield, and harvest index as influenced by various treatments

Tr. No.	TREATMENT COMBINATIONS	Seed yield per hectare	Stover yield per hectare	Biological yield	Harvest Index (%)
T_1	Control	5.53	19.97	25.49	21.80
T_2	100% RDF through chemical fertilizers (N- 60, P2O5 - 60, K2O- 30 and S- 25 kg/ha)	8.00	23.78	31.78	25.21
T_3	100% RDF through chemical fertilizers + 250 g/ha nano fertilizer	8.17	24.39	32.56	25.08
T_4	100% RDF through chemical fertilizers + 500 g/ha nano fertilizer	8.19	24.49	32.69	25.07
T_5	100% RDF through chemical fertilizers + 750 g/ha nano fertilizer	8.39	24.50	32.89	25.52
T_6	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 250 g/ha nano fertilizer	7.25	23.35	30.60	23.82
T_7	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 500 g /ha nano fertilizer	7.39	23.46	30.85	23.96
T_8	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 750 g / ha nano fertilizer	7.61	23.65	31.26	24.36
T_9	100% RDF through chemical fertilizers + 25% RDF through vermicompost + 750 g / ha nano fertilizer	9.19	25.43	34.62	26.53
T_{10}	100% RDF through nano fertilizers @ 500 g/ha	7.24	21.42	27.76	22.84
S. Em±		0.68	0.82		
C.D. 5%		0.68	2.37		

Table 3 Economics of various treatments

Tr. No.	Treatment Combinations	Cost of Cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B-C Ratio
T_1	Control	15478	46219	3074	1.99
T_2	100% RDF through chemical fertilizers (N- 60, P_2O_5 - 60, K_2O- 30 and S- 25 kg/ha)	21413	66378	44965	2.10
T_3	100% RDF through chemical fertilizers + 250 g/ha nano fertilizer	21663	67773	46110	2.13
T_4	100% RDF through chemical fertilizers + 500 g/ha nano fertilizer	21913	68005	46092	2.10
T_5	100% RDF through chemical fertilizers + 750 g/ha nano fertilizer	22163	69561	47398	2.14
T_6	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 250 g/ha nano fertilizer	21679	60335	38656	1.78
T_7	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 500 g /ha nano fertilizer	21929	61457	39528	1.80
T_8	75% RDF through chemical fertilizers + 25% RDF through vermicompost + 750 g / ha nano fertilizer	22179	63254	41075	1.85
T_9	100% RDF through chemical fertilizers + 25% RDF through vermicompost + 750 g / ha nano fertilizer	23663	76098	52435	2.22
T_{10}	100% RDF through nano fertilizers @ 500 g/ha	15978	52809	36831	2.31

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