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Influence of mulching and organic liquid nutrient on growth and yield of *zaid* sesame (*Sesamum indicum L.*)

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Abstract
A field experiment was conducted during *Zaid* season 2024 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experimental plot was sandy loam soil in texture, low in organic carbon (0.458), nearly neutral soil pH (7.3), Nitrogen (186.50), Phosphorous (27.4), Potassium (243.8). The treatments consisted of 3 levels of Mulching (*No mulch, paddy straw mulch and dry neem leaves mulch*) and levels of Organic liquid nutrients (*Vermiwash, Panchgavya and cow urine 4% of each*) and a control. The experiment was laid out in Random Block Design with 10 treatments replicated thrice. The result revealed that application of mulching and organic liquid nutrient *i.e.* T_8 recorded maximum plant height (113.87cm), dry weight (8.33g), CGR (6.94g/m^2/day), RGR (0.025g/g/day), number of capsules per plant (31.51), number of seeds per capsule (68), test weight (3.13), seed yield (796.33kg), Stover yield (1057.47kg) and harvest index (43.00). It also recorded maximum gross returns (80,553.77 INR/ha), net returns (54,228.77 INR/ha), and B:C ratio (2.06) in sesame.

Keywords: Cow urine, Mulching, Panchgavya, Sesame and Vermiwash

1. Introduction
Sesame (*Sesamum indicum L.*) is a plant in the genus Sesamum, also called *simsim*, benne or gingelly. Numerous wild relatives occur in Africa and a smaller number in India. It belongs to the family Pedaliaceae. The sesame seed has been considered as “Queen of Oilseed” for its high oilseed content and quality and traditionally categorized as a health food in China, Japan and Asian countries. The oil seed crop plays the second important role in the Indian agricultural economy next of the food grain in term of area and production. As Indian climate is suitable for the cultivation of oilseed crops; large variety of oil seed crops are cultivated here. It is considered to have both nutritional and medicinal value. Moreover, seed is a rich source of edible oil (48-55%) and protein (20-28%) with anti-oxidants lignans such as sesame oil and sesame in which prevents rancidity and gives sesame oil a shelf life. Sesame oil is called 'poor man's ghee'. The lignin content has useful physiological effect in human and animal health. The seeds are very rich in iron, magnesium, manganese, copper and calcium and contain vitamin E, A, B and B1. India is the major producer of sesame (*Sesamum indicum L.*) and ranks first in both area (1.78 M ha) and production (0.81 Mt) with average productivity of 455 kg/ha. While in Uttar Pradesh, it grown under 3.0 lakh ha area with a production of lakh ton and productivity only 168 kg/ha (Directorate of Oilseeds Development 2022).

Abiotic and biotic factor can overcome by application of mulches and organic manure. Mulches are effective in controlling weed and conserving in-situ moisture (Uwah and Iwo, 2011) [11]. Mulching is the process or practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop production. Mulch technical term means "covering of soil. While natural mulches such as leaf, straw, dead leaves and compost have been used for centuries, during the last 60 years the advent of synthetic materials has altered the methods and benefits of mulching. Soil organic matter and moisture was found to improve under mulching. Thus, mulching serves as one of the best alternatives to manage both abiotic and biotic factors like rainfall, soil temperature (20 °C to 30 °C), weed, etc. which result in good crop establishment and increase the water use efficiency.

Thus, it facilitates more retention of soil moisture and helps in control of temperature fluctuation, improve physical, chemical and biological properties of soil. As it adds nutrients to the soil and ultimately enhances the growth and yield of crops (Komal *et al.*, 2018) [4].

Application of organic manure builds up soil health and sustains crop production for longer time. However, single organic source of nutrient supplementation may not crop up with the nutrient demand of crops. Integration of different organic nutrient sources and/or liquid organic manures help to solve dual problem of supplementation of sufficient nutrients besides synchronized nutrient availability as per crop demand associated with variable nutrient release pattern among different organic manures. In Sanskrit, panchgavya means blend of five substances obtained from desi cow is called 'Gavya', each individual of these five products is called 'panch' and together termed as 'Panchagavya' which is mixture of five products of cow such as cow dung, cow urine, milk, ghee and curd in a proper ratio (5:3:2:2:1) to this banana, jaggary and coconut water is added that allows it to ferment and the end product is known as panchgavya. It posess the properties of fertilizers and bio pesticides (Sireesha, 2017) [10].

2. Materials and Methods

A field experiment was conducted at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) during *Zaid* season 2024. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.3), organic carbon (0.458%), available N (186.50 kg/ha), available P (27.4 kg/ha), available K (243.8kg/ha) and Electrical Conductivity (0.375 dsm^{-1}). The experiment was laid out in Randomized Block Design with 10 treatments and replicated thrice. The treatments are T_1-No mulch + Vermicompost 4%,T_2-No mulch + Panchgavya 4%, T_3-No mulch + Cow urine 4%,T_4-Paddy straw mulch + Vermicompost 4%,T_5-Paddy straw mulch + Panchgavya 4%,T_6-Paddy straw mulch + Cow urine 4%,T_7-Dry neem leaves mulch + Vermicompost 4%,T_8-Dry neem leaves mulch + Panchgavya 4%,T_9-Dry neem leaves mulch + Cow urine 4% and T_{10}-Control (No mulch + Water spray). The observations were recorded on different growth parameters at harvest *viz*. plant height. Dry weight, number of capsules/plants, number of seeds/capsules, seed yield and Stover yield, were analyzed statistically to test their significance and the experiment findings have been summarized in the light of scientific reasoning and have been discussed below under the following heading:-

3. Results and Discussion

3.1 Growth Attributes

The data on growth-attributing traits are summarized in Table 1. During the course of the study, it was observed that plant height increased progressively following germination, reaching its peak around 80 days after sowing (DAS). Significantly highest values for plant height (113.87 cm) and dry weight (7.59 g) were recorded with the application of dry neem leaves mulch combined with a foliar spray of Panchgavya 4% *i.e.* T_8. However, foliar application of organic nutrients did not influence plant population and plant height of sesame at all stages of crop growth except plant height. Similar findings were reported by MD Salman (2022) [7], where foliar application of Panchgavya 3% achieved higher plant height.

3.2 Yield Attributes

3.2.1 Number of capsules per plant

The data on yield-attributing traits are summarized in Table 2. The highest number of capsules per plant (31.51) was observed with the application of dry neem leaves mulch combined with a foliar spray of panchgavya 4% *i.e.* Treatment 8. This result was statistically at par with Treatment 3 (30.66), Treatment 4 (30.33), Treatment 5 (30.33), Treatment 7 (30.53) and Treatment 9 (29.60).

The findings demonstrated that two panchgavya foliar sprays at 30 DAS and 60 DAS recorded the higher number of capsules per plant, seeds per capsule and test weight. However, vermiwash application was shown to be significantly similar with panchgavya (Watsh *et al*., 2023) [13].

3.2.2 Number of seeds per capsule

Maximum number of seeds per capsule (68) was recorded in the Dry neem leaves mulch combined with foliar spray of Panchgavya 4% *i.e.* Treatment 8 which was at par with rest of all treatment except Treatment 10 *i.e.* Control (No mulch + Water spray (63.83).

The maximum improvement in pod and biological yield with bio-nutrient sources might be associated with increased yield attributes due to concomitant increase in dry matter accumulation and supply of all the plant nutrients (Kumawat *et al*., 2009) [5].

3.2.3 Test weight

The highest test weight (3.13 g) was noted under Treatment 8 however, this result was found to be not statistically significant. The combined application of dry neem leaves mulch with foliar sprays of panchgavya 4% significantly influenced key growth and yield parameters of sesame, particularly the number of capsules per plant and seeds per capsule. Treatment 8 showed the best performance in terms of yield-contributing factors.

The number of capsules per plant, number of seeds per capsule, test weight, seed yield, stalk yield and biological yield showed that foliar application of various liquid manures was significantly more effective than control in increasing sesame yield attributes. The findings demonstrated that two panchgavya foliar sprays recorded the higher number of capsules per plant, seeds per capsule and test weight, this finding is reported by Watsh *et al.*, 2023 [13].

3.3 Seed Yield (kg/ha)

The data on grain yield is summarized in Table 2 showed that significantly highest grain yield (796.33 kg/ha) was observed with Dry neem leaves mulch along with foliar spray of Panchgavya 4% *i.e.* (Treatment 8). However, treatment 5 (737.33 kg/ha), was found to be statistically at par with the treatment 8. The application of mulch types did not affect the dry seed yield, but neem mulch showed an increase in the yield. This may due to neem has slow decomposition of leaves biomass. Consequently, it has covered entire ground surface and has retained the soil moisture. Higher doses resulted in higher yield reported by (Hafsah *et al*. 2021) [3]. Foliar spray of panchagavya @ 4% + jeevamrut @ 500 liter/ha with irrigation registered significantly higher growth parameters like plant height, dry matter accumulation per plant at harvest, CGR, RGR and seed yield.

3.4 Stover Yield (kg/ha)

The data on stover yield is summarized in Table 2, showed that a significantly maximum stover yield (1169.50 kg/ha) was observed with Paddy straw mulch along with foliar spray of vermiwash 4% *i.e.* (Treatment 4). However, treatment 5 (1167.37 kg/ha) and treatment 6 (1103.57 kg/ha), it was found to be statistically at par with treatment 4. The comparative study was done on the effect of vermiwash on crop production capacities of soil by improve the physiochemical property of soil and reduced the insectpest infestation which would have facilitated increased uptake of the nutrients by the plants resulting in higher growth and yield (Verma *et al.*, 2018) [12]. Similarly, mulching improved nutrient availability and utilization, resulting in increased 1000 seed weight, increased seed yield through improved economic sink strength in mustard, increased stover yield due to increased leaf area and dry matter accumulation, and an improved harvest index, Mulching provided a continuous supply of nutrients and improved moisture conservation, creating ideal circumstances for photosynthate synthesis and translocation, ultimately resulting in greater crop performance across all evaluated parameters (Sharma *et al*., 2025) [8].

3.5 Harvest Index (%)

The data on harvest index is summarized in Table 2, showed that the highest harvest index (43.00 %) was observed with Dry neem leaves mulch along with foliar spray of panchgavya 4% *i.e.* (Treatment 8) and statistically found to be non-significant.

3.6 Economics

The data on the economics of different treatments summarized in Table 3. Showed that the significantly maximum net rectum (54,228.77 INR/ha) and benefit-cost ratio (2.06) were recorded with the application of Dry neem leaves mulch along with foliar spray of Panchgavya 4% *i.e.* (Treatment 8) and the minimum net return (37,520.23 INR/ha) were recorded in control (no mulch + water spray) *i.e*. (Treatment 10) and benefit-cost ratio (1.69) were recorded with the application of No mulch along with foliar spray of Panchgavya 4% *i.e.* (Treatment 2). Similar result showed that among the organic manures, application of vermiwash @ 2 t/ha secured higher net return as well as benefit cost ratio. While in case of bioenhancers, application of the Panchgavya @ 4 % spray gave higher net return and benefit cost ratio (Chaudhary *et al*., 2023) [1].

Table 1: Effect of mulching and organic liquid nutrients on growth attributes of sesame.

Sr. No.	Treatments	At 80 DAS		At 60-80 DAS	
		Plant height (cm)	Dry weight (g)	Crop Growth rate (CGR) (g/m^2/day)	Relative growth rate (RGR) (g/g/day)
1.	No mulch + vermiwash 4%	99.80	5.76	2.11	0.016
2.	No mulch + Panchgavya 4%	106.04	6.93	1.77	0.009
3.	No mulch + Cow urine 4%	104.41	5.78	0.72	0.004
4.	Paddy straw mulch + vermiwash 4%	105.07	8.33	6.94	0.031
5.	Paddy straw mulch + Panchgavya 4%	102.57	6.63	4.33	0.025
6.	Paddy straw mulch + Cow urine 4%	110.37	8.37	4.12	0.018
7.	Dry neem leaves mulch + vermiwash 4%	109.61	6.40	2.41	0.011
8.	Dry neem leaves mulch + Panchgavya 4%	113.87	7.59	3.15	0.015
9.	Dry neem leaves mulch + Cow urine 4%	109.02	6.76	0.78	0.004
10.	Control (No mulch + Water spray)	105.75	6.77	5.46	0.033
	F-Test	S	S	S	S
	SEM±	2.43	0.34	0.20	0.00
	CD (P=0.05)	7.22	1.02	0.59	0.01

Table 2: Effect of mulching and organic liquid nutrients on yield attributes of sesame

	Treatment Combinations	Number of capsules/plant	Number of seeds/capsule	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
1.	No mulch + Vermicompost 4%	28.98	67.6	3.09	612	1023.13	37.46
2.	No mulch + Panchgavya 4%	26.6	67.33	2.69	686.67	1001.40	40.68
3.	No mulch + Cow urine 4%	30.667	67.33	2.94	643.33	1002.13	39.1
4.	Paddy straw mulch + Vermicompost 4%	30.333	66.97	3.05	659.33	1169.5	30.14
5.	Paddy straw mulch + Panchgavya 4%	30.333	66.7	3.10	737.33	1167.37	38.72
6.	Paddy straw mulch + Cow urine 4%	29.21	67.63	3.08	613.33	1103.57	35.99
7.	Dry neem leaves mulch + Vermicompost 4%	30.533	67.87	3.06	636.67	973.87	39.53
8.	Dry neem leaves mulch + Panchgavya 4%	31.51	68	3.13	789.33	1057.47	42.78
9.	Dry neem leaves mulch + Cow urine 4%	29.6	67.77	3.10	660	982.53	40.18
10.	Control (No mulch + Water spray)	28.4	63.83	2.77	573.67	969.53	37.17
	F test	S	S	NS	S	S	NS
	SEM(±)	0.76	0.58	0.12	28.63	34.34	2.33
	CD (P=0.05)	2.25	1.73	-	85.06	102.03	-

Table 3: Effect of mulching and organic liquid nutrients on economics of sesame

	Treatment Combinations	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
1.	No mulch + Vermicompost 4%	21725	61047.77	39322.77	1.81
2.	No mulch + Panchgavya 4%	25925	69639.47	43714.47	1.69
3.	No mulch + Cow urine 4%	20965	63602.60	42637.60	2.03
4.	Paddy straw mulch + Vermicompost 4%	22125	64328.33	42203.33	1.91
5.	Paddy straw mulch + Panchgavya 4%	26325	74962.07	48637.07	1.85
6.	Paddy straw mulch + Cow urine 4%	21365	62420.47	41055.47	1.92
7.	Dry neem leaves mulch + Vermicompost 4%	22125	63674.40	41549.40	1.88
8.	Dry neem leaves mulch + Panchgavya 4%	26325	80553.77	54228.77	2.06
9.	Dry neem leaves mulch + Cow urine 4%	21365	63035.07	41670.07	1.95
10.	Control (No mulch + Water spray)	20925	58445.23	37520.23	1.79

4. Conclusion

It is concluded that application of Dry neem leaves mulch along with foliar spray of Panchgavya 4% in treatment 8 recorded highest seed yield and benefit cost ratio in sesame.

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