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Influence of integrated nutrient management on growth and quality of sesame (*Sesamum indicum* L.) under irrigated conditions

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Abstract

An experiment was conducted during *kharif* season of 2021-22 on sesame (Punjab Til No.2). The experiment comprised was conducted in split plot design with 15 treatment combination and three replications viz Main Plots SF₁: 100% RDF, SF₂: 75% RDF, SF₃: 50% RDF Sub Plots LF₁: 5% Panchgavya solution, LF₂: 5% Vermi wash solution, LF₃: 2% Urea solution + 3% Vermi wash solution, LF₄: 2% DAP solution, LF₅: 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution. The results revealed that the significantly maximum plant height (cm), Number of leaves plant⁻¹, Number of branches plant⁻¹, Dry weight plant⁻¹, Crop growth rate (g m⁻² day⁻¹), Protein content (%), Oil content (%) were observed with the application of (3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution).

Keywords: Integrated nutrient management, sesame

Introduction

Sesame (*Sesamum indicum* L.) having chromosome number 2n=26 in an important oilseed crop belongs to the family Pedaliaceae. Oilseed crops are the 2nd important crops after cereals. Photosynthetically, Sesame is a C₃ plant. It is one of the oldest crops which are being cultivated in India. Sesame is commonly known as "Til, Gingelly, Sim Sim, Benne, etc." and it was originated from India. It is also known as "Queen of oilseeds" and often referred as poor man's substitute for ghee. It is a crop of arid regions where water is deficient or where no other crop can be cultivated, therefore, it is also said that it is a survivor crop. In India, it is mainly cultivated as *kharif* season crop. Being a short duration crop it is well adjusted in most of the cropping systems. Sesame is an erect annual herb, branching of the plant starts from the base and the plant height grows up to 90-95 cm. Capsules are 2-5 cm in length and seeds are small and flat. The crop requires warm climate, 25-27 °C for rapid germination and 32 °C temperature for its growth and development. It requires well drained sandy loam soils for its cultivation. The crop is sensitive to water logged conditions.

According to the All-India Co-ordinate Research Project on Sesame and Niger, India ranks 1st in the Sesame production with 16.73 Lakh hectare area and 6.5 Lakh tonnes production. The production has increased only up to 6.6 Lakh metric tonnes with area of 18-20 lakh hectares till 2018 (Lokhande *et al.* 2020) [5]. In India, it is being cultivated in states such as Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, West Bengal and in some parts of Punjab and Haryana. India is also the major exporter of Sesame to many of the countries. The Sesame is the 3rd important oilseed crop after Rapeseed, Mustard and Sunflower in Punjab (Grover *et al.* 2007) [3]. Its cultivation in Punjab is only done in the districts of Amritsar, Ferozepur, Gurdaspur, and Hoshiarpur with 75% of total production from Punjab. Sesame producing areas in Punjab are very less as compared to others states because of soil type of Punjab. Nutrient supply is important factor for each and every crop. Number of factors such as growth and development, quality parameters, disease and pest control etc. is affected by the nutrient supply to plant. In Sesame crop also, nutrition greatly affects the crop. Organic manures are the important components for crop production as they add organic matter to the soil and

supply plant nutrients as well. Organic manures improve soil health without causing any damage to the soil and improve the soil microbial activities. Panchgavya is liquid organic manure which is made from five elements which are cow dung, ghee, honey, curd and cow milk. It can be sprayed after germination of seed of Sesame at young seedling for plant and soil health. panchgavya is mixed with water of certain concentration and sprayed directly to the young seedlings and during the crop development phase (Jain *et al.* 2012) [4]. It is important to move towards the sustainable agriculture to protect our ecosystem and the available resources for agriculture mainly our soil (Nayak *et al.* 2019) [7].

Materials and Methods

The present of investigation was carried out during *kharif* season of the year 2021 at the Campus for Research and Advanced studies, Dhablan G.S.S.D.G.S. Khalsa College, Patiala. The experiment was conducted in split plot design that is replicated three times with integrated nutrient management practices. The treatment considered three main plots (SF₁: 100% RDF, SF₂: 75% RDF, SF₃: 50% RDF) and five sub plots (LF₁: 5% panchgavya solution, LF₂: 5% vermi wash solution, LF₃: 2% urea solution + 3% vermi wash solution, LF₄: 2% DAP solution, LF₅: 3% panchgavya solution +5% vermi wash solution +2% urea solution + 1% DAP solution). From five randomly selected plants the plant height was recorded from ground level to the tip of the main stem. The number of leaves five randomly plants were counted and average was computed. The five plants randomly selected from each plot and tagged permanently in each plot for height measurement were used to record the number of branches. The plants taken for fresh weight was put for drying for a week. And after a week dried weight was taken and computed. Crop growth rate is the gain in weight of a community of plants on a unit of land in a unit of time and is intensively used in growth analysis of field crop. The per cent crude protein content in seed was calculated by multiplying per cent nitrogen of seed with a factor 6.25. Oil content two gram sample of seeds was dried at 100 °C for 24 hours and then carefully transferred into extraction thimble.

Results and Discussion

The interaction of Solid and liquid fertilizer 100% RDF with 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP solution has higher plant height because sufficient amount of nutrients is applied to crop through soil and foliar way that participate in number of physiological processes of plant growth. Similar results were recorded by Swain *et al.*

(2020) [10].

Interaction of 100% RDF with 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP solution has higher results because balanced application from roots as well as vegetative parts of plant increases the growth of plant, wherever integration of liquid and solid is done in right manner. Similar results were reported by Sawant *et al.* (2013) [9].

In case of interaction of both solid and liquid has their effect on number of branches plant⁻¹ that higher number of branches plant⁻¹ with 100% RDF with 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP solution is recorded with the application because required amount of nutrients by the plant are quickly available to crop through soil and foliar way that participate in number of physiological processes of plant growth. Similar results are found by Swain *et al.* (2020) [10].

In case of interaction of both solid and liquid nutrient application has their effect on dry weight plant⁻¹ that higher dry weight plant⁻¹ 100% RDF with 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP solution is recorded with the application because balanced amount of nutrients is applied to crop through soil and foliar way that participate in number of physiological processes of plant growth. Similar results are found by Parmar *et al.* (2020) [8].

Interaction of solid and liquid fertilizers affects the crop growth rate as maximum crop growth rate was attained with the application of 100% RDF with 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP solution. Because sufficient amount of nutrients is applied to crop through soil and foliar way that participate in number of physiological processes of plant growth. Similar results are found by Deepthi *et al.* (2018) [2].

Interaction of solid and liquid fertilizer also affects protein content. Maximum protein content is attained with the application of 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP and lowest seed yield with 2% urea + 1% DAP solution application. Because balanced amount of nutrients is applied to crop through soil and foliar way that improves quality and protein content. Similar results are found by Moradi *et al.* (2020) [6].

Interaction of solid and liquid fertilizer also affects oil content. Maximum oil content is attained with the application of 3% panchgavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP and lowest seed yield with 2% urea + 1% DAP solution application. Because balanced amount of nutrients is applied to crop through soil and foliar way affects oil content. Similar results are found by Moradi *et al.* (2020) [6].

Table 1: Influence of integrated nutrient management on plant height (cm) of sesame crop.

Treatments	Plant height (cm)		
	30 DAS	60 DAS	At harvest
Solid fertilizer			
SF ₁ - 100% RDF	31.80	57.53	82.13
SF ₂ - 75% RDF	28.76	51.80	73.33
SF ₃ - 50% RDF	26.33	43.73	66.27
S.Em±	0.19	2.07	2.29
CD 5%	0.37	4.21	6.04
Liquid fertilizer			
LF ₁ - 5% Panchagavya Solution	22.33	40.11	61.05
LF ₂ - 5% Vermi wash solution	25.22	44.33	66.25
LF ₃ - 2% Urea solution + 3% Vermi wash solution	32.22	57.78	81.56
LF ₄ - 2% DAP solution	30.44	52.33	76.31
LF ₅ - 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution	34.11	60.56	84.01
SEm±	0.36	2.01	2.29
CD 5%	0.76	4.08	5.88

Table 2: Influence of integrated nutrient management on number of leaves plant⁻¹ of sesame crop.

Treatments	Number of leaves plant ⁻¹		
	30 DAS	60 DAS	At harvest
Solid fertilizer			
SF ₁ - 100% RDF	26.13	41.23	34.53
SF ₂ - 75% RDF	23.87	37.73	30.47
SF ₃ - 50% RDF	21.31	31.13	26.07
SEm±	0.21	2.93	2.06
CD 5%	0.43	6.04	4.75
Liquid fertilizer			
LF ₁ - 5% Panchagavya Solution	18.89	27.55	22.89
LF ₂ - 5% Vermi wash solution	21.26	32.56	26.21
LF ₃ - 2% Urea solution + 3% Vermi wash solution	26.20	42.22	35.34
LF ₄ - 2% DAP solution	25.13	36.78	30.78
LF ₅ - 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution	27.40	44.45	41.56
SEm±	0.11	1.98	1.77
CD 5%	0.28	4.07	3.69

Table 3: Influence of integrated nutrient management on number of branches plant⁻¹ of Sesame crop.

Treatments	Number of branches plant ⁻¹		
	30 DAS	60 DAS	At harvest
Solid fertilizer			
SF ₁ - 100% RDF	3.07	5.72	7.22
SF ₂ - 75% RDF	2.71	5.22	6.61
SF ₃ - 50% RDF	2.28	4.77	5.97
SEm±	0.07	0.24	0.34
CD 5%	0.17	0.54	0.71
Liquid fertilizer			
LF ₁ - 5% Panchagavya Solution	2.14	4.31	5.56
LF ₂ - 5% Vermi wash solution	2.27	4.87	6.04
LF ₃ - 2% Urea solution + 3% Vermi wash solution	2.98	5.70	7.47
LF ₄ - 2% DAP solution	2.78	5.38	6.16
LF ₅ - 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution	3.14	5.92	7.79
SEm±	0.06	0.21	0.31
CD 5%	0.14	0.46	0.71

Table 4: Influence of integrated nutrient management practices on dry weight plant⁻¹ (g) of sesame crop.

Treatments	Dry weight plant ⁻¹		
	30 DAS	60 DAS	At harvest
Solid fertilizer			
SF ₁ - 100% RDF	1.85	13.42	22.38
SF ₂ - 75% RDF	1.72	12.86	20.93
SF ₃ - 50% RDF	1.59	11.34	19.92
SEm±	0.02	0.12	0.25
CD 5%	0.04	0.25	0.54
Liquid fertilizer			
LF ₁ - 5% Panchagavya Solution	1.31	10.76	18.54
LF ₂ - 5% Vermi wash solution	1.51	12.42	19.11
LF ₃ - 2% Urea solution + 3% Vermi wash solution	1.93	13.39	22.31
LF ₄ - 2% DAP solution	1.81	12.16	21.99
LF ₅ - 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution	2.03	14.56	23.44
SEm±	0.01	0.11	0.26
CD 5%	0.03	0.24	0.55

Table 5: Influence of integrated nutrient management on crop growth ($\text{g m}^{-2} \text{day}^{-1}$) rate of sesame crop.

Treatments	Crop growth ($\text{g m}^{-2} \text{day}^{-1}$)		
	30 DAS	60 DAS	At harvest
Solid fertilizer			
SF ₁ - 100% RDF	0.86	5.40	4.18
SF ₂ - 75% RDF	0.80	5.20	3.77
SF ₃ - 50% RDF	0.74	5.02	3.54
SEm±	0.01	0.05	0.05
CD 5%	0.02	0.13	0.11
Liquid fertilizer			
LF ₁ - 5% Panchagavya Solution	0.61	4.88	3.12
LF ₂ - 5% Vermi wash solution	0.70	5.09	3.16
LF ₃ - 2% Urea solution + 3% Vermi wash solution	0.90	5.35	4.16
LF ₄ - 2% DAP solution	0.84	5.30	4.12
LF ₅ - 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution	0.94	5.42	4.57
SEm±	0.006	0.06	0.21
CD 5%	0.01	0.12	0.45

Table 6: Influence of integrated nutrient management on protein content and oil content of sesame crop.

Treatment	Protein content (%)	Oil content (%)
Solid fertilizers		
SF ₁ - 100% RDF	11.50	45.40
SF ₂ - 75% RDF	10.75	43.47
SF ₃ - 50% RDF	9.99	37.07
SEm±	0.065	2.094
CD 5%	0.256	8.224
Liquid Fertilizers		
LF ₁ - 5% Panchagavya Solution	8.58	36.11
LF ₂ - 5% Vermi wash solution	9.74	39.78
LF ₃ - 2% Urea solution + 3% Vermi wash solution	11.74	46.89
LF ₄ - 2% DAP solution	11.46	42.78
LF ₅ - 3% Panchgavya solution +5% Vermi wash solution +2% Urea solution + 1% DAP solution	12.18	46.33
SEm±	0.086	1.152
CD 5%	0.247	3.327

Conclusion

On the basis of results from the experimentation, it can be concluded that among the solid fertilizers 100% RDF application results higher growth and quality, whereas in liquid 3% panchagavya solution + 5% vermiwash solution + 2% urea solution + 1% DAP performs best among all liquid fertilizers. Because higher fertility level fulfill the desired amount of nutrient need of plant where among liquid fertilizers higher content of macro and micro nutrients and rapid supply helps to perform best.

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