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Influence of nitrogen levels and *G-amrut* on quality and soil properties of summer sesame under organic farming

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Abstract

The present investigation was conducted to examine the 8 treatments along with control to study “Influence of nitrogen levels and *G-amrut* on quality and soil properties of sesame under organic farming” during the summer season of 2022-23. The experiment was conducted at Organic Farm, Navsari Agricultural University, Navsari (Gujarat). The variety which was taken in the experiment was Gujarat Til-3. The experiment was laid out in Randomize block design. The field of experiment consisted treatments viz., T₁: Control, T₂: 100% RDN through Bio-compost, T₃: 100% RDN through Bio-compost + 2% *G-amrut*, T₄: 75% RDN through Bio-compost + 2% *G-amrut*, T₅: 50% RDN through Bio-compost + 2% *G-amrut*, T₆: 100% RDN through Bio-compost + 500 l/ha *G-amrut*, T₇: 75% RDN through Bio-compost + 500 l/ha *G-amrut* and T₈: 50% RDN through Bio-compost + 500 l/ha *G-amrut*. On the basis of results obtained in the present investigation, the quality parameters like crude protein content did not significantly differ but the protein yield, oil content and oil yield were noted significantly higher under treatment T₃ (100% RDN + 2% *G-amrut*) with value of 293 kg/ha, 46.87% and 670 kg/ha, respectively. Whereas, application of T₆ (100% RDN + 500 l/ha *G-amrut*) recorded significantly higher available N (302 kg/ha), P₂O₅ (48 kg/ha) and K₂O (511 kg/ha) and Organic carbon (0.99 per cent). These results emphasize the need for the use of *G-amrut* and compost enhancing the nutrient availability, quality and soil health of summer sesame.

Keywords: Sesame, Biocompost, *G-amrut*

Introduction

Organic farming is the original type of agriculture and has been practiced for thousands of year. The traditional belief is that organic manure promotes quality while mineral fertilizers promote quantity. In organic farming, it is important to work constantly to build a healthy soil that is rich in organic matter and has all the nutrients that the plants need. Oilseed are backbone of agriculture economy of India since long and considered as the second largest agricultural commodity after cereal. With an annual average yield of about 29 million tons, India stands as fourth leading oilseeds producing countries, next only to the USA, China, Brazil. Sesame is also known as gingelly, til, benne seed. Sesame plays an important role in agricultural and industrial economics of our country. India occupies a very prominent place in the oil seeds producing countries of the world as it produces large variety of oilseed crop among the six major oil seed crops viz., groundnut, sesame, castor, rapeseed, mustard and linseed. Sesame stand next to groundnut so far as the production of edible oil is concerned.

The area under oilseeds in India is 28.79 million hectares, the oilseed production is exceeding 40 million tonnes in 2022-23 and productivity of sesame is 400-500 kg/ha in 2024-25. The production of sesame in India was 8.29 lakh tonnes in 2024-25 (Anon., 2024).

The combine use of compost and *G-amrut* helps to restore and sustain soil fertility and crop productivity. It favorably affects the physical, chemical and biological environment of soil. Adoption of appropriate integrated nutrient management strategies holds a great potential in boosting the sesame production. Therefore, combine use of compost and *G-amrut* is crucial not only for increasing the yield but also for the improvement of soil health.

Materials and Methods

The field experiment for the present investigation was conducted at Organic Farm, Navsari

(Gujarat) during the year 2022-23. The data of soil analysis revealed that the soil of experimental plot was clay in texture, the soil of experimental field was clayey in texture, medium in available nitrogen (302 kg/ha) and available phosphorus (48kg/ha) and high in available potassium (511 kg/ha). The soil reaction was slightly alkaline (7.60 pH) with normal electric conductivity (0.39 dS/m). During the crop period, the mean maximum and minimum temperature ranged between 35.5 °C - 30.6 °C and 14.6°C-27°C, respectively. The maximum and minimum humidity ranged between 27 to 64 per cent to 93 to 95

per cent, respectively. The field experiment consisted of combine use of compost and *G-amrut*. The recommended dose of nitrogen for summer sesame is 50 kg/ha. The sesame cv. Gujarat Til-3 was sown with spacing 45 cm between two rows. The required quantity of well decomposed bio-compost was incorporated and mixed well within the soil at the time of land preparation. The sowing was done by line sowing method. The five plants were tagged in the net rows of each treatment plot for recording the observations during the experiment.

Table 1: Initial physico-chemical properties of the experimental soil

Sr. No.	Particulars	Soil depth (0-15 cm)	Method of analysis
A) Physical Properties of soil			
1.	Sand (%)	18.50	International Pipette Method (Piper, 1966) ^[12]
2.	Slit (%)	25.00	
3.	Clay (%)	56.50	
4.	Textural Class	Clay	
B) Chemical Properties of soil			
1.	pH _(1:2.5)	7.60	Potentiometric (Jackson, 1973) ^[6]
2.	EC _(1:2.5) (dS/m)	0.39	Conductometric (Jackson, 1973) ^[6]
3.	Organic Carbon (%)	0.85	Walkley and Black (Jackson, 1973) ^[6]
4.	Available N (kg/ha)	288	Alkaline KMnO ₄ (Subbiah and Asija, 1956) ^[15]
5.	Available P ₂ O ₅ (kg/ha)	47	Spectrophotometric (Olsen <i>et al</i> , 1954) ^[9]
6.	Available K ₂ O (kg/ha)	511	Flamephotometric (Jackson, 1973) ^[6]
8.	DTPA extractable Fe (mg/kg)	18.53	Atomic absorption spectrophotometric method (Lindsay and Norvell, 1978) ^[8]
9.	DTPA extractable Mn (mg/kg)	29.5	
10.	DTPA extractable Zn (mg/kg)	0.79	
11.	DTPA extractable Cu (mg/kg)	1.66	

Methodology

The *G-amrut* for foliar spraying and drenching with irrigation water were prepared by mixing fresh ground leaves with cow urine in 1:1 ratio followed by fermentation. This mixture was kept for anaerobic decomposition for 45 days and was shaken well every day in morning or evening. While spraying residue and extract of formulation were separated by passing the mixture through a sieve cloth. The extract was collected into flask. The formulation prepared was fermented 45 days before spraying and drenching. The spraying was done at 30, 45 and 60 DAS and the extract was prepared every time using fresh leaves. In order to record various quantitative observations, five plants were selected from each net plot by using random table for periodical observations. The selected plants were labelled with proper notations and observations on growth and yield attributing characters were recorded. Total biological yield, seed yield and stover yield were recorded from net plot area. Formulation of *G-amrut*:1 kg *Gliricidia* leaves +1 lit Cow urine + 8liter water.

Table 2: Properties of *Gyricidia* leaves and cow urine

Parameter	<i>Gyricidia</i> leaves	Cow urine
N (%)	2.10	0.367
P (%)	0.127	0.078
K (%)	1.56	0.091
Ca (%)	3.01	0.000
Mg (%)	0.72	0.045
S (%)	0.082	0.008
Fe (ppm)	256.81	36.880
Mn (ppm)	110.65	5.075
Zn (ppm)	13.65	5.040
Cu (ppm)	2.75	2.070

Results and Discussion

Effect on soil p^h ec and organic carbon after harvest of summer sesame

The range of P^H and EC in the treatments did not differ significantly in soil pH after harvest of crop. Numerically the highest value of P^H and EC was 7.56 and 0.42 dS m⁻¹ recorded under control (T₁) treatment, respectively.

The organic carbon content was significantly higher in T₆ (100% RDN + 500 l/ha *G-amrut*) treatment 0.99 per cent, However, treatments T₂ (100% RDN), T₃ (100% RDN + 2% *G-amrut*), T₄ (75% RDN + 2% *G- amrut*) and T₇ (75% RDN + 500 l/ha *G-amrut*) recorded at par values 0.86, 0.96, 0.94 and 0.89 per cent organic carbon content with T₆.

The significant increase in OC content was observed in all the treatments, where organic biomass was added for N supply through RDN through biocompost, whereas in control was not added. This might be attributed to contribution of OC to the soil in form of organic source added to RDN. Similarly, also Chhibba (2010) reported that the incorporation of crop residue and FYM alone or in combination with green manuring significantly increase carbon content in soil. The results are in conformity with the findings of Ramesh *et al.* (2009) ^[13], Yadav *et al.* (2020) ^[18] in soybean and Hirapara *et al.* (2020) ^[5] in sesame.

Effect on nutrient status of soil after harvest of summer sesame

The range of available N in the treatments varied from 252 to 302 kg/ha. The highest nitrogen content 302 (kg/ha) was recorded in the treatments T₆ (100% RDN + 500 l/ha *G-amrut*) and it was statistically at par with all other treatments except T₅ (272 kg/ha), T₈ (271 kg/ha) and T₁ (252 kg/ha). Lower amounts

of available N (252kg/ha) was found in the control treatment (T₁). The nitrogen content of whole soil also increases under the influence of organic matter. In the present study nitrogen supplied in soil through organic source. The increase in available nitrogen content of soil might be attributed to direct effect of organic nitrogen supplied in form of compost that slowly mineralized in soil after the composting process. In case of available P₂O₅, significantly the highest available P₂O₅ (48 kg/ha) registered under treatment T₆ (100% RDN + 500 l/ha *G-amrut*) and it was at par with 43 kg/ha in T₃ treatment.

The increase in the available P and K may also primarily due to higher amounts of P and K added to the soil through organic manures compared in the urea. The increase in available P could as described to the organic acids, which were released during microbial decomposition of OM and helped in the solubilization of native phosphates, as a result, the available P content increased.

Available K₂O significantly higher values of available potash (511 kg/ha) was recorded in treatment T₆ (100% RDN + 500 l/ha *G-amrut*) and it statistically remained at par with the T₃ and T₄ with values 506 and 476 kg/ha, respectively. The lower amount of available P₂O₅ and K₂O were recorded in treatments T₁ (control) 31 kg/ha and 408 kg/ha, respectively. The increase availability of K may be due to beneficial effect of organic manures on the reduction of K fixation and release of K due to interaction of organic material with clay beside the direct K addition the soil. Another reason for K, buildup of soil available K by the addition of potassium through *gliricidia* green leaf extract as *G-amrut* might had fact as *gliricidia* leaves contains higher amount of K, which when applied in the soil, its

solubilizing action of certain organic acids produced during decomposition results in greater capacity to hold K in the available form. Similar results were observed by Ramesh *et al.* (2009) [13], Hirapara *et al.* (2020) [5] in sesame, Panghate *et al.* (2020) [10], Srikant *et al.* (2020) and Yadav *et al.* (2020) [18] in soybean.

Effect on DTPA extractable micronutrients in soil

The results revealed that the status of DTPA extractable micronutrient Fe, Mn, Cu and Zn (mg/kg) ranged from 17.61 to 21.71 mg/kg, 28.22 to 30.90 mg/kg, 0.67 to 0.82 mg/kg and 1.40 to 1.63 mg/kg, respectively when *G-amrut* applied in different method with different rate of RDN. In case of all the micronutrients studies the lowest value of relevant element was observed in control treatment and highest with 100% RDN. Available Fe and Zn were significantly affected due to the *G-amrut* treatment showing higher value 21.71 mg/kg and 0.82 mg/kg, respectively under treatment T₃ (100% RDN + 2% *G-amrut*) followed by 20.10 mg/kg and 0.77 mg/kg under T₄ (75% RDN + 2% *G-amrut*) and 20.6 and 0.78 under T₆ (100% RDN + 500 l/ha *G-amrut*) treatments, respectively. Application of *G-amrut* in soil also reduced soil pH and thus, increased the availability of Fe and Mn either by increasing their solubility or by decreasing their oxidation rates. Kumavat *et al.* (2013) reported similar increase in available Fe, Cu, Zn and Mn after harvest of crop when panchgavya was applied in soil of Rajasthan. Such effect on nutrient availability was also observed by Hirapara *et al.* (2020) [5] in sesame, Yadav *et al.* (2020) [18] and Panghate *et al.* (2020) [10] soil after harvest of crop.

Treatments	Available soil nutrient status (kg/ha)			
	N	P ₂ O ₅	K ₂ O	Organic carbon (%)
T ₁ : Control	252	31	408	0.79
T ₂ : 100% RDN	277	39	434	0.86
T ₃ : 100% RDN + 2% <i>G-amrut</i>	296	43	506	0.96
T ₄ : 75% RDN + 2% <i>G-amrut</i>	293	42	476	0.94
T ₅ : 50% RDN + 2% <i>G-amrut</i>	272	35	422	0.82
T ₆ : 100% RDN + 500 l/ha <i>G-amrut</i>	302	48	514	0.99
T ₇ : 75% RDN + 500 l/ha <i>G-amrut</i>	289	41	465	0.89
T ₈ : 50% RDN + 500 l/ha <i>G-amrut</i>	271	33	426	0.82
SEm±	9.1	1.6	14.4	0.03
CD at 5%	28	5.0	44	0.1
CV (%)	6.0	7.0	6.0	6.79

Treatments	Micronutrients in soil (mg/kg)			
	Fe	Mn	Zn	Cu
T ₁ : Control	17.61	28.22	0.67	1.46
T ₂ : 100% RDN	19.52	29.02	0.75	1.59
T ₃ : 100% RDN + 2% <i>G-amrut</i>	21.71	30.90	0.82	1.63
T ₄ : 75% RDN + 2% <i>G-amrut</i>	20.10	29.73	0.77	1.61
T ₅ : 50% RDN + 2% <i>G-amrut</i>	19.05	28.96	0.75	1.55
T ₆ : 100% RDN + 500 l/ha <i>G-amrut</i>	20.56	30.37	0.78	1.62
T ₇ : 75% RDN + 500 l/ha <i>G-amrut</i>	19.55	29.16	0.76	1.60
T ₈ : 50% RDN + 500 l/ha <i>G-amrut</i>	18.84	28.46	0.73	1.51
SEm±	0.58	0.80	0.02	0.03
CD at 5%	1.77	NS	0.06	NS
CV (%)	5.2	4.7	4.7	4.3

Effect on quality of sesame

The quality parameters like crude protein content did not significantly differ but the protein yield, oil content and oil yield were noted significantly higher under treatment T₃ (100% RDN + 2% *G-amrut*) with value of 293 kg/ha, 46.87% and 670 kg/ha, respectively. The increased in oil content might be due to increased availability of nutrient through compost, biofertilizers

and foliar spray which has resulted in creations of maximum nutrients availability to sesame crop during growth and reproductive phase has resulted in higher seed oil content and seed yield as reported by Gabhane *et al.* (2019) [4]. The results of present studies corroborate with the findings of Choudhary *et al.* (2017) [2] in sesame, Takar *et al.* (2017) [16] in sesame and Vani *et al.* (2017) [17] in sesame.

Treatments	Oil content (%)	Oil yield (kg/ha)	Protein yield (kg/ha)
T ₁ : Control	41.24	435	199
T ₂ : 100% RDN	43.18	522	236
T ₃ : 100% RDN + 2% <i>G-amrut</i>	46.87	670	294
T ₄ : 75% RDN + 2% <i>G-amrut</i>	44.43	599	273
T ₅ : 50% RDN + 2% <i>G-amrut</i>	42.64	506	225
T ₆ : 100% RDN + 500 l/ha <i>G-amrut</i>	45.63	640	287
T ₇ : 75% RDN + 500 l/ha <i>G-amrut</i>	43.73	554	254
T ₈ : 50%RDN + 500 l/ha <i>G-amrut</i>	41.95	488	220
SEm±	1.04	35.1	12.5
CD at 5%	3.17	107	38
CV (%)	4.14	11	9

Conclusion

Among all the treatments, T₆ (100% RDN + 500 l/ha *G-amrut*) and T₃(100% RDN + 2% *G-amrut*) consistently demonstrated superior results in soil fertility after harvest of sesame cv. GT- 3.

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