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Production potential of organic summer sesame as influenced by compost, foliar nutrients and biofertilizers

AR Gabhane, PA Gite, VA Khadse, PR Kadu and PN Patle

Abstract
The field experiment was conducted during the summer season of 2016-17, to study the "Production potential of organic summer sesame as influenced by compost, foliar nutrients and biofertilizers" on the research field of Agronomy Farm, Department of Agronomy, Dr. PDKV, Akola.The experiment was laid out in Randomize block design with ten treatments and three replications with the application of different organic sources. On the basis of results obtained in the present investigation, application of compost @ 3.3 t ha^{-1}+ soil application of Azatobactor and PSB @ 10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9) recorded the significantly highest yield of sesame seed and stover followed by application of compost @ 3.3 t ha^{-1}+ soil application of Azatobactor and PSB @ 10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK (T_6). Quality parameters like test weight, oil and protein content by sesame has been increased due to use of organic sources application. Highest test weight, oil and protein were recorded by the application of compost @ 3.3 t ha^{-1}+ soil application of Azatobactor and PSB @ 10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9). On the basis of results GMR, NMR and B:C ratio, Highest GMR, NMR and B:C ratio were recorded in treatment application of compost @ 3.3 t ha^{-1}+ soil application of Azatobactor and PSB @ 10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9).

Keywords: Compost, Azotobactor, PSB, yield, Protein content, Oil content, GMR, NMR, B:C.

Introduction
Sesame (*Sesamum indicum* L.) is a flowering herbaceous annual plant in the genus *Sesamum*. It belong to the family Pedaliaceae and origin is South-Western Africa (Indu and Savithri, 2003) [11]. It is also known as gingelly, til, benne seed and popularly as 'Queen of Oilseeds' due to its stabilized keeping quality contributed by high degree of resistance to oxidation and rancidity (Bedigian and Harlan, 1986) [8]. Sesame grown on an area of 7.54 million hectares with a production of 3.34 million tonnes in the world with a productivity of 443 kg ha^{-1} (Anonymous, 2012[a]) [3]. India ranks first in area (29%), production (26%) and export (40%) of sesame in the world (Anonymous 2010) [2] The productivity of sesame in India is 474 kg ha^{-1} (Anonymous, 2017[a]) [5]. India is a major exporter to number of countries and has earned the foreign exchange of `2800 crore (Ranganatha *et al.*, 2014) [12].
During the year 2015-16 Maharashtra state has area under kharif, rabi and summer sesame as 0.28, 0.02 and 0.30 lakh hectares respectively with production as 0.03, 0.01 and 0.04 lakh tonnes respectively. The productivity of sesame during 2015-16 was 107, 500 and 133 kg ha^{-1} in kharif, rabi and summer season (Anonymous, 2017[b]) [6]. In Vidarbha region has 117 ha area with 40 tonnes production and with an average productivity 341 kg ha^{-1} in 2010-11 (Anonymous, 2012[b]) [4]. The use of organic manures has been the traditional means of maintaining soil fertility. Most of the organic compost provide a balanced sources of nutrients for crops. Organic compost have a direct effect on plant growth like any other commercial fertilizer. These compost contain nutrient in small amount, therefore the quantity requirement of these organic sources is more to fulfill the crop needs. Besides, the major nutrients, organic compost also contain traces of micro-nutrients and also provide food for soil microorganisms. This increases activity of microbes which in turn helps to convert unavailable plant nutrients into available and fixing the atmospheric nitrogen apart.

Materials and Methods
A field experiment was conducted during summer 2016-2017 under irrigated condition at the Centre for organic agriculture research and training, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. It is situated in subtropical region between $22^0 42`$N latitude and $77^0 02`$E longitudes. The altitude of the place is 304.42 m above mean sea level.

The soil of the experimental area was medium deep black, clay loam texture with, high water holding capacity and moderately alkaline in reaction. The result of the chemical analysis indicated that, the soils have pH 8.3 with electrical conductivity 0.30 dSm^{-1}, $CaCO_3$ was 3.60 % and organic carbon content was 5.10 g kg^{-1}. The available nitrogen and phosphorus content of soil was low i.e. 210.8 and medium 17.94 kg ha^{-1} respectively. However, soils were sufficiently higher in available potash content (406.8kg ha^{-1}). Bulk density, hydraulic conductivity, MWD and AWC were recorded as 1.34 Mg m^{-3}, 0.60 cm hr^{-1}, 0.57 mm and 19.07 % respectively.

The experiment was laid out in randomized block design with ten treatments each replicated thrice. There were ten treatments combination comprising of different organic sources viz., Control (T_1), Compost @ 3.3 t ha^{-1} (T_2), soil application of Azotobactor and PSB @10.0kg ha^{-1} (T_3), liquid organic NPK 3 foliar spray (T_4), liquid organic sulphur one foliar spray (T_5), Compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @10.0 kg ha^{-1} + liquid organic NPK 3 foliar sprays (T_6), Compost @ 3.3 t ha^{-1}+ liquid organic NPK 3 foliar spray+ liquid organic Sulphur one foliar spray (T_7), soil application of Azotobactor and PSB @10.0 kg ha^{-1}+ liquid organic NPK 3 foliar spray+ liquid organic sulphur one foliar spray (T_8), Compost @3.3 t ha^{-1}+ soil application of Azotobactor and PSB @10.0kg ha^{-1}+ liquid organic NPK 3 foliar spray+ liquid organic Sulphur one foliar spray (T_9) and Compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @10.0kg ha^{-1} (T_{10}). The crop variety AKT – 101 was used with gross plot size of 5.4 m x 7.0 m and net plot size of 4.5 m X 6.6 m. Compost was applied at treatments T_2, T_6, T_7, T_9 and T_{10} before sowing by broadcasting. Soil application of Azotobactor and PSB at the time of planting in T_3, T_6 and T_9 treatments. Three foliar application of liquid organic NPK at 20 DAS, 40 DAS and 60 DAS and one foliar application of liquid organic sulphur at 45 DAS through carried out in T_4, T_5, T_7, T_8 and T_9 treatments.

Results and Discussion

Effect of organic sources on yield of summer sesame

The yield data pertaining to seed and stover of summer sesame is given in Table 1. Yield of seed and stover of sesame were found statistically significant under different organic treatments over control. The significantly highest yield of seed (11.51 q ha^{-1}) and stover (36.83 q ha^{-1}) were recorded by application of compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @ 10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9) which was statistically at par with the application of compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @ 10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK (T_6), compost @3.3 t ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_7), compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @10.0kg ha^{-1} (T_{10}). These treatments were significantly superior over control (T_1), compost @ 3.3 t ha^{-1} (T_2), soil application of Azotobactor and PSB @ 10.0kgha-^{1} (T_3), 3 foliar spray of liquid organic NPK (T_4), one foliar spray of liquid organic S (T_5) and soil application of Azotobactor and PSB @10.0 kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_8), whereas lowest yield was obtained in control (T_1) as 6.02 q ha^{-1}. The increase in seed and stover yield might be due to application of organic sources *viz.*, compost, biofertilizer and organic sprays, might be created maximum nutrient availability to sesame crop during growth and productive phase. These results are in conformity with Khaled *et al*. (2012) [10], Abdel Rahman (2014) [1] and Tomer and Khajanji (2009).

Effect of organic sources on quality parameters of summer sesame

The data pertaining to the quality parameter of soil as influenced by various organic treatments are presented in Table 2. and depicted in Fig. 1.

Test weight

Test weight (1000 seed weight) of sesame was ranged between 3.68 to 3.90. Test weight was increased due to application of organic sources over control. Highest test weight was recorded by application compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @ 10.0kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9) and lowest test weight was found in control (T_1).

This might be due to increased availability of nutrient through compost, biofertilizer and foliar spray which has resulted highest test weight. Similar finding also reported by Shriff *et al.* (2017). They have reported that application of orgnic manure recorded highest test weight.

Oil content

The oil content in sesame seed was observed in the range between 45.43 to 48.28%. Oil content was increased due to application of organic sources over control. Highest oil content was recorded with application of compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @ 10.0kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9) and lowest oil content was recorded by the treatment of control(T_1).

Increase in oil content might be due to increased availability of nutrient through compost, biofertilizer and foliar spray which has resulted maximum oil content. Similar findings are reported by Sonkamble *et al.* (2010) [16]. They have reported that the application of organic manure recorded maximum oil content.

Protein content

The protein content in sesame seed was observed in the range between 18.65 to 20.06 %. The significantly highest protein content in sesame seed (20.06%) was recorded by application of compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @ 10.0kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9) and which was statistically on par with treatments T_6, T_7 and T_{10} over other treatments.

The protein content of seed increased with the increase in nitrogen levels from organic sources. This might be due to higher availability of balanced nutrition.Similar finding are reported by Aruna and Reddy (1999) [7]. They have reported that application of organic manure @ 15 t ha^{-1} produced maximum protein in soybean seed. Similarly Choudhary *et al.* (2016) [9] and Sabbour *et al.* (2016) [13] also reported that application of organic manure along with biofertilizer recorded maximum protein content.

Effect of organic sources on economic of summer sesame

Net monitory returns and benefit: cost ratio are the ultimate sources to measure the economy of input used (Table 3). The

data in respect of net monitary returns and benefit cost ratio (B:C ratio) as influenced by organic sources for summer sesame are presented in Table 3. The highest gross monitory returns of the sesame was recorded in the T_9 with application of compost @ 3.3 t ha^{-1} + soil application of Azotobactor and PSB @10.0 kg ha^{-1} + 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (Rs. 86,326/-) and which was followed by (T_6) with application of compost @ 3.3 t ha^{-1} + soil application of Azotobactor and PSB @10.0 kg ha^{-1} + 3 foliar spray of liquid organic NPK (Rs. 80850/-). The highest net monitory return of the sesame was recorded in the T_9 with application of compost @ 3.3 t ha^{-1} + soil application of Azotobactor and PSB @10.0 kg ha^{-1} + 3 foliar spray of liquid organic NPK+ one foliar spray of liquid organic S (Rs.45923/-) which was attributed to maximum yield recorded in this treatment. The lowest net monitary returns were recorded in the treatment control (T_1).

The highest benefit cost ratio was recorded in T_9 with application of compost @ 3.3 t ha^{-1} + soil application of Azotobactor and PSB @10.0 kg ha^{-1} + 3 foliar spray of liquid organic NPK+ one foliar spray of liquid organic S (2.14) which was followed by treatment T_6 (2.05).The similar findings are reported by Shwetha *et al.* (2009). They reported that treatment receiving compost + vermicompost + GLM has recorded higher net monitary return and maximum B:C ratio which could attributed to lower production cost. Similarly Vidyavathi *et al.* (2011) [18] also reported that maximum B:C ratio was found with the application of organic sources.

Table 1: Effect of organic sources on yield of summer sesame

Treatment		Yield (q ha^{-1})	
		Seed	Stover
T_1	Control	6.02	26.02
T_2	Compost @ 3.3 t ha^{-1}	9.52	31.27
T_3	Soil application of Azotobactor and PSB@10.0kg ha^{-1}	6.82	27.18
T_4	3 foliar sprays of liquid organic NPK	6.34	26.67
T_5	One foliar spray of liquid organic sulphur	6.21	26.30
T_6	$T_2 + T_3 + T_4$	10.78	35.93
T_7	$T_2 + T_4 + T_5$	9.94	34.91
T_8	$T_3 + T_4 + T_5$	7.09	27.94
T_9	$T_2 + T_3 + T_4 + T_5$	11.51	36.83
T_{10}	$T_2 + T_3$	9.85	33.94
SE (m) ±		0.56	1.20
CD at 5%		1.66	3.56

Table 2: Effect of organic sources on test weight, oil and protein content of summer sesame

Treatment		Test weight (g)	Oil (%)	Protein (%)
T_1	Control	3.68	45.43	18.65
T_2	Compost @ 3.3 t ha^{-1}	3.76	46.65	19.23
T_3	Soil application of Azotobactor and PSB@10.0kg ha^{-1}	3.72	45.54	19.06
T_4	3 foliar sprays of liquid organic NPK	3.73	45.59	19.03
T_5	One foliar spray of liquid organic sulphur	3.74	45.62	19.04
T_6	$T_2 + T_3 + T_4$	3.83	46.83	19.79
T_7	$T_2 + T_4 + T_5$	3.85	46.94	19.81
T_8	$T_3 + T_4 + T_5$	3.75	45.64	19.07
T_9	$T_2 + T_3 + T_4 + T_5$	3.90	48.28	20.06
T_{10}	$T_2 + T_3$	3.79	46.74	19.65
SE (m) ±		0.0061	0.18	0.25
CD at 5%		0.02	0.54	0.74

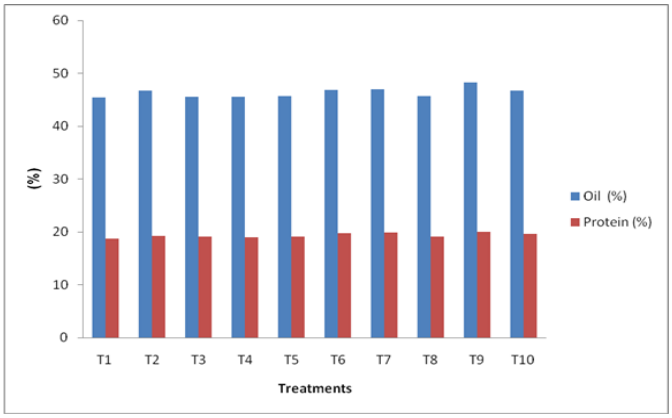

Fig 1: Effect of organic sources on quality parameters of summer sesame

Table 3: Effect of organic sources on economic of summer sesame

Treatment		GMR	NMR	B:C Ratio
T_1	Control	45157	20957	1.87
T_2	Compost @ 3.3 t ha^{-1}	71395	35117	1.97
T_3	Soil application of Azotobactor and PSB@10.0kg ha^{-1}	51150	24772	1.94
T_4	3 foliar sprays of liquid organic NPK	47550	17823	1.60
T_5	One foliar spray of liquid organic sulphur	46550	19793	1.74
T_6	$T_2 + T_3 + T_4$	80850	41355	2.05
T_7	$T_2 + T_4 + T_5$	74575	35162	1.89
T_8	$T_3 + T_4 + T_5$	53158	24833	1.88
T_9	$T_2 + T_3 + T_4 + T_5$	86326	45923	2.14
T_{10}	$T_2 + T_3$	73843	34265	1.87
SE (m) ±		4830	4830	-
CD at 5%		14352	14352	-

Conclusion

Application of compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @10.0kg ha^{-1}+ 3 foliar spray of liquid organic NPK + one foliar spray of liquid organic S (T_9) was found beneficial for sesame production, quality and nutrient uptake followed by treatment (T_6) i. e. compost @ 3.3 t ha^{-1}+ soil application of Azotobactor and PSB @10.0kg ha^{-1}+ 3 foliar spray of liquid organic NPK. Highest GMR, NMR and B:C ratio were recorded with application of organic sources.

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