Original Research Article

Effect of tillage and nutrient management practices on quality parameters of rice fallow sesame

ABSTRACT

A field experiment was conducted at ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad to study the effect of tillage and nutrient management practices on quality parameters of sesame grown in rice fallows. The experiment was laid out in split plot design with 18 treatments comprised of three main plot treatments *i.e.,* A_1: Reduced tillage (Cultivator once) , A_2: Conventional tillage (Cultivator twice with rotavator once) and A_3 : Minimum tillage (tillage in the row zone/uprooting soil in the seed zone with hand held dibbler) with six sub-plot treatments *i.e.,* B_1 : Control , B_2 : 25% RDF, B_3 : 50% RDF, B_4 : 75% RDF, B_5 : 100% RDF and B_6 : 125 % RDF replicated three times. Results revealed that there was no significant influence of tillage and nutrient management practices on oil content and fatty acid composition. However, with increase in fertilizer dose upto 125% RDF there was a slight change in oil content. Significant effect of tillage and nutrient management was observed in oil yield. Conventional tillage proved to be beneficial as it increased oil yield significantly. With increase in fertilizer doses there was appreciable increase in linoleic and oleic acid content. But stearic acid, palmitic acid and linolenic acid contents decreased at higher fertilizer doses.

Key words: Fatty acid composition, rice fallow sesame, oil content, oil yield

1. INTRODUCTION

Next to cereals, oilseed crops are the second most significant factor affecting the agricultural economy. India ranks among the top importers of vegetable oils today despite generating the fifth-largest amount of oilseed crops globally. Vegetable oil utilisation, for both edible and industrial purposes, has increased significantly in recent years. (NMOOP, 2018) [6]. Nearly 72% of the total oilseeds area is restricted to rainfed cultivation, which is primarily practised by marginal and small farmers. The main reasons for the low productivity of oilseeds are a lack of appropriate technology, production under input-starved conditions, and dealing with biotic and abiotic stresses. The nation produced 361.009 (4^{th} adv est) lakh tonnes of oilseeds in 2020–21, followed by 332.192 lakh tonnes in 2019–20, with a high productivity level of 1284 kg ha^{-1} in 2017–18 and 1254 kg ha^{-1} in 2020–21 (DOD).[4]

Sesame is grown on 16.23 lakh hectares in India, producing 6.57 lakh tonnes, for an average productivity of 405 kg ha^{-1} (Indiastat, 2019-2020) [5]. Rainfed cultivation in marginal and submarginal soils under suboptimal management and input deficient conditions are the main causes of the crop's low output. However, there is potential to boost sesame yield by using more advanced production techniques. Rice fallow cultivation is one such method that provides a tremendous opportunity to raise the production potential of the crop. Sesame seed contain about 50% oil, 25% protein and 15% carbohydrate. The oil is utilised in margarine, salad dressings, and cooking (contains about 40% oleic and 40% linoleic acid). Due to the antioxidant sesamol, sesame oil have a long shelf life. The oil can be used to make soap, paint, fragrances, medicines, and pesticides. Sesame oil is considered to be anticholesterol and very therapeutic for heart conditions. Paradoxically, while being an energy-rich crop, sesame is grown in low-energy environments. Ranganatha, 2013.[11]. In most parts of country sesame is being grown in suboptimal conditions with poor management practices. With adoption of proper technologies improved seed yields and oil quality can be achieved. Suboptimal fertilizer application can considerably hinder oil quality Ramesh *et al* 2020. [10]. With this scenario, an experiment was conducted to analyze the effect of tillage and nutrient management practices on oil quality of rice fallow sesame.

2. MATERIALS AND METHODS

An experiment was conducted during the year 2022 at ICAR-IIRR, Rajendranagar, Hyderabad. The farm is situated at an altitude of 494 m above mean sea level on 17^0 32' N latitude and 78^0 38' E longitude. The soil of the experimental field was low in organic carbon (0.42%), available N (215 kg ha^{-1}), high in available P (37 kg ha^{-1}) and K (365 kg ha^{-1}). The experiment was laid out in a split-plot design with 18 treatments comprised of three main plot treatments *i.e.,* A_1: Reduced tillage (Cultivator once) , A_2: Conventional tillage (Cultivator twice with rotavator once) and A_3 : Minimum tillage (tillage in the row zone/uprooting soil in the seed zone with hand held dibbler) with six sub-plot treatments *i.e.,* B_1 : Control , B_2 : 25% RDF, B_3 : 50% RDF, B_4 : 75% RDF, B_5 : 100% RDF and B_6 : 125% RDF replicated three times. (Recommended dose of fertilizer : 80:20:20 kg N, P_2O_5, K_2O ha^{-1}).

The land preparation was done accordingly with respect to main plot treatments. In reduced tillage treatment, the field was ploughed with cultivator once. In conventional tillage treatment, the field was ploughed twice with cultivator followed by once with rotavator. Whereas in minimum tillage treatment combinations, tillage was done only in the row zone by uprooting the soil with help of hand held dibbler. Fertilizer application was done in accordance with the sub-plot treatment imposition. Nitrogen was applied in form of urea, phosphorous in form of diammonium phosphate and potassium was applied in form of murate of potash. In all the treatment combinations, the entire dose of P_2O_5 and K_2O were applied at the time of sowing. Whereas, nitrogen was applied in two equal splits (half each at basal and at 30 DAS). No fertilizer was applied in the control plot. Proper crop management practices were followed with need based irrigation and plant protection measures. Crop was harvested at 95 DAS and seeds were analysed for oil content and fatty acid composition. The oil content of the seed for each treatment was determined with the help of continuous type pulsed Nuclear Magnetic Resonance (NMR-oxford MQC) as suggested by Tiwari *et al.* (1974) [15]. Fatty acid composition was determined using an gas chromatograph (GC). The data recorded was statistically analyzed following procedure described by Gomez and Gomez (1984) [3].

3.RESULTS AND DISCUSSION

3.1 Oil content

Results indicated that oil content of rice fallow sesame was not significantly influenced by tillage and nutrient management practices. However higher oil content was achieved under conventional tillage (52.13%) over minimum (51.96%) and reduced tillage (51.83%). Among nutrient management practices highest oil content was obtained with application of 125% RDF (52.43 %) over application of 100 % RDF (52.33%), 75% RDF (52.24%), 50 % RDF (52.04%), 25% RDF (51.49%). Lowest oil content was obtained with control treatment (51.32%). There was an increase in oil content with increased fertilizer doses. Results were in conformity with Malik *et al.* (2003) [7], Mukherjee (2020) [8] and Patel *et al*. (2020) [9]. However no significant difference was observed with nutrient management practices. Interaction effect was also found to be non significant.

3.2 Oil yield

Oil yield of rice fallow sesame was significantly influenced by tillage and nutrient management practices. Conventional tillage recorded highest oil yield (205.35 kg ha^{-1}) over reduced (187.50 kg ha^{-1}) and minimum tillage (174.85 kg ha^{-1}). Lowest oil yield was recorded with minimum tillage treatment. These results were corroborated with Sree *et al.* (2006) [13] and Umesh *et al*. (2020) [16]. With increase in tillage intensity there was progressive increase in oil yield. Appreciable increase in oil content and seed yield under conventional tillage might be attributed to increased oil yield. An increase in oil yield was noticed with increase in fertilizer doses up to 125% RDF. Significantly highest oil yield was achieved with application of 125% RDF (220.91 kg ha^{-1}) which was statistically similar with application of 100 % RDF (213.11 kg ha^{-1}) and 75% RDF (201.38 kg ha^{-1}). Considerably lower oil yields were recorded with application of 50% RDF (189.13 kg ha^{-1}), 25% RDF (163.17 kg ha^{-1}) and control (147.70 kg ha^{-1}). Significantly lowest oil yield was obtained with control treatment. Significant increase in seed yield under higher fertilizer doses can be attributed to higher oil yield. These research findings were in similarity with Reddy *et al*. (2002)[12], Thanki *et al.* (2014) [14] and Umesh *et al*. (2020) [16].

3.3 Fatty acid composition

Results revealed that fatty acid profile of rice fallow sesame was not influenced by tillage and nutrient management practices. Conventional tillage managed to obtain comparatively lesser amounts of palmitic acid (9.84%) and linolenic acid (0.30%) but higher amounts of oleic (41.49%) and linoleic acid

(43.07%). Highest palmitic acid content was seen in reduced tillage (10.27%) followed by minimum tillage (9.90%). Stearic acid content was found to be maximum with reduced tillage (5.09%) followed by conventional tillage (5.00%). While lowest stearic acid content was found in minimum tillage (4.91%). Comparatively lower oleic acid (41.27%) and linoleic acid (42.54%) was seen with reduced tillage when compared with minimum tillage. A considerable reduction in contents of palmitic acid , stearic acid and linolenic acid was noticed with application of higher fertilizer doses upto 125% RDF. However, oleic and linoleic acid content increased with higher fertilizer doses as reported by Boydak *et al* (2010) [2]. Highest linoleic acid content was obtained with 125% RDF (43.48%) and lower content was recorded with control treatment (42.18%). Lowest palmitic acid (9.68%), stearic acid (4.76%) and linolenic acid (0.28%) was observed with 125% RDF. These results were in conformity with Ali and Ullah (2012) [1], Ramesh *et al* (2020) [10] and Zapletalova *et al* (2021)[18]. Comparatively increased palmitic acid, stearic acid and linolenic acid content was noticed with lower fertilizer doses. Conversely increased linolenic acid content with nitrogen treatment was observed by Yalcin (2011) [17].

4.CONCLUSION

Sesame cultivation is mainly restricted to rainfed cultivation under sub optimal management conditions. Sesame being oilseed crop demands appreciable nutrition for a profitable production. When crop is grown in rice fallows, adequate fertilization is must to ensure optimum yields. Further poor physical condition of soil in rice fallows require adequate tillage practices. Thus tillage and nutrient management practices plays a significant role in enhancing sesame yield in rice fallow. This impact of yield as affected by tillage and nutrient management practices is reflected on oil quality. From results of the study it is evident that there was no significant influence of tillage and nutrient management on oil content and fatty acid composition of rice fallow sesame. However, there was a significant influence observed in oil yield. With increase in fertilizer doses upto 125% RDF there was a considerable increase in oil content and oil yield. Among tillage practices, conventional tillage managed to achieve higher oil yield and oil content. Similarly, data on fatty acid composition revealed that there was an increase in oleic and linoleic acid content with increase in fertilizer doses, but stearic, palmitic and linolenic acid content got decreased with increased nutrient levels. Hence it can be concluded that high fertilizer doses improves oil quality in the context of improved oil content, oil yield and linoleic acid content. Conventional tillage to some extent influenced oil quality by providing optimum soil conditions for better crop growth and seed yield which reflected on oil quality. However, overall effect of tillage on quality parameters was found to be non significant.

Table 1: Oil content, Oil yield and Fatty acid composition of rice fallow sesame as influenced by different tillage and nutrient management practices

Treatments	Oil content (%)	Oil yield (kg ha^{-1})	Palmitic acid (%)	Stearic acid (%)	Oleic acid (%)	Linoleic acid (%)	Linolenic acid (%)
Main plot treatments							
A_1: Reduced tillage (Cultivator once)	51.83	187.50	10.27	5.09	41.27	42.54	0.35
A_2: Conventional tillage (Cultivator twice with rotavator once)	52.13	205.35	9.84	5.00	41.49	43.07	0.30
A_3 : Minimum tillage (tillage in the row zone/uprooting soil in the seed zone with hand held dibbler)	51.96	174.85	9.90	4.91	41.38	42.87	0.35
SEm (±)	0.29	4.22	0.27	0.06	0.13	0.41	0.02
CD (p=0.05)	NS	16.56	NS	NS	NS	NS	NS
Subplot treatments							
B_1 : Control	51.32	147.70	10.38	5.30	40.90	42.18	0.36
B_2 : 25% RDF	51.49	163.17	10.34	4.99	41.14	42.57	0.37
B_3 : 50% RDF	52.04	189.13	10.08	5.07	41.26	42.76	0.35
B_4 : 75% RDF	52.24	201.38	9.85	4.97	41.37	42.85	0.34
B_5 : 100% RDF	52.33	213.11	9.69	4.90	41.67	43.12	0.31
B_6 : 125 % RDF	52.43	220.91	9.68	4.76	41.95	43.48	0.28
SEm (±)	0.40	7.99	0.23	0.12	0.27	0.37	0.03
CD (p=0.05)	NS	23.07	NS	NS	NS	NS	NS
Interaction							
Sub treatment at same level of main treatment							
SEm (±)	0.70	10.61	0.67	0.16	0.32	1.01	0.05
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS
Main treatment at same/different level of sub treatment							
SEm (±)	0.70	13.35	0.46	0.21	0.45	0.71	0.05
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS

5. Reference

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