RICE-BASED CROPPING SYSTEMEFFECT ON YIELD AND YIELD ATTRIBUTES ON PROMISING RELEASED SESAME VARIETIES

Abstract:

A field experiment was carried out at Agricultural College farm, Bapatla district,Andhra Pradesh, during the period from March 2023 to June 2023 to assess the performance of Sesame (*Sesamum indicum* L.*)*varieties under different fertilizer management practices in rice-based cropping system in Krishna Zone of AP.The experiment was laid out in a randomized block design with the factorial concept and three replications.The results showed that YLM 146 recorded significantly the highest seed yield (748 kg ha^{-1}) at harvest. The yield attributing characters like the number of capsules $plant^{-1}$ (67) and thenumber of seeds $capsules^{-1}$ (45)were found significantly to be the highest in the variety YLM 146.Concerning different fertilizer management practices,125% RDF + 1% foliar spray of 19:19:19 at the early budding and capsule formation stages recorded significantly higher seed yields (827 kg ha^{-1}). Yield attributes like number of capsules $plant^{-1}$ (96) and number of seeds $capsules^{-1}$ (51)were significantly highest in 125% RDF + 1% foliar spray of 19:19:19 at the early budding and capsule formation stages. Overall, the results showed that sowing of YLM 146 variety with125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage seems to be appropriate for getting higher seed yield in KrishnaZone of Andhra Pradesh.

Keywords: Fertilizer management practices, Growth, Sesame, Varieties, Yield, Yield attributes.

Introduction:

The rice-oil seed system is the dominant cropping system in the Krishna Zone of Andhra Pradesh,but the productivity is very low in the Krishna Zone of Andhra Pradesh over other parts of Andhra Pradesh due to inadequate management practices, including low-yielding varieties, lack of nutrient management and weed management practices. In this scenario, it is necessary to manipulate the production techniques to raise oil seed production levels in order to satisfy the rising demand. Among the different management factors, fertilizer management practices, and high-yielding varieties are pivotal in increasing production.Fertilizer management plays a key role in obtaining higher yields as it influences the early budding and capsule formation stage seed set. High-yielding cultivars also play an important role in boosting crop production due to their genetic potential that promotes higher productivity, disease resistance, and adaptability to adverse environmental conditions of varied pressures.

Rice fallow regionsprovideamplescopefor area expansionofoilseeds.In India, rice is cultivated both under irrigated and rainfedconditionsinvariouscroppingsystemsacrossthelengthandwidth of the country occupying about 43 million hectaresarea(Anonymous,2009).Rice-rice,rice-sugarcane,rice-groundnut,rice-vegetables,rice-pulses,rice-sunflower,rice-sesame, and rice-fallows are the prevalent rice-basedcroppingsystemsinvariouspartsofthecountry.The major area under rice production during *kharif* season in India remains fallow in the subsequent *rabi* due to various reasons, but lack of production technologies is considered as a major determinant. Being short-duration in nature, sesame is an ideal crop for cultivation in rice fallows (Chauhan *et al.*, 2016). To cope with the increasing demand for oilseeds in the country, sesame should be included as an integral part of rice fallow areas with a dual advantage of crop diversification for sustainable production and increasing the area under sesame. To utilize the rice fallow areas with sesame, location-specific and economically viable technology for better performance of sesame is required to be evaluated through a proper understanding of the system ecology and constraints for adoption.

Cereal-oil seed systems occupy an important position in crop rotation, especially in Krishna western delta command area of Krishna Zone of Andhra Pradesh. Rice in *kharif* season and sesame during *summe*r season is the newly followed cropping system in the Krishna agro-climatic zone under irrigated conditions. Sesame is considered the best crop in the binary rotation system, along with cereals. Continuous rice-rice crop rotation has led to the decline and deterioration of soil physical properties. This problem can be partly overcome by changing from rice-rice crop rotation to cereal-oilseed rotation system growth. Promotingrice-fallow sesame would also improve the sustainability ofthericeproductionsystem, as well as enhance production and augment income. Identifying the constraints in rabi cropping that can be addressed through appropriate technological intervention should be considered.Considering the scope for area expansion in rice fallowareas, this study was conducted to identify suitable sesame variety and nutrientlevels forthe rice-sesamecroppingsystem.

Material and Methods

A field experiment was conducted at an Agricultural college farm, Bapatla, Krishna Zone of Andhra Pradesh, during the summer of 2022 to 2023 in a rice fallow situation. The experimental site is at an altitude of 5.49 meters above mean sea level, 15^0 54' North latitude, 80^0 30' East longitude, and about 7 km away from the Bay of Bengal. It is located in the coastal area of the Krishna Agro Climatic Zone of Andhra Pradesh, India. The climate of Andhra Pradesh is generally hot and humid. The experimental site was homogeneously fertile with flat and smooth topography and uniform texture.The soil was found to be sandy loam, slightly acidic in reaction, low in organic carbon (0.3%), low in available N (238kg ha^{-1}), low in available P_2O_5 (23kg ha^{-1}), and highin available K_2O (380kg ha^{-1}).

The experiment was laid out ina randomized block design with a factorial conceptand three replications.Factor Aincludes three varieties vizYLM 66, YLM 142, and YLM 146, and Factor B includes five fertilizer management practices. Control, 50% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage, 75% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage, 100% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage, 125% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage. The dibbling method of sowing was followed with a spacing of 30 cm x 15 cmand a gross plot size of 5.4 m x 4.5 m. As fertilizers were applied, 2 foliar sprays of nutrients 19:19:19 (N:P:K) @ 10gL^{-1} were given at 40 DAS, and one more spray was applied at 50 DAS.No.of 5 tagged plants from the net plot area was measured. The total number of capsules from the five tagged plants was counted at harvest, and then an average number of capsules $plant^{-1}$ and no. of seeds $capsule^{-1}$ was calculated. Seed yield from a square meter area was recorded and expressed in kg ha^{-1}.

Results and Discussion

Seed yield

Data recorded on the seed yield of sesame as influenced by varieties and fertilizer levels arepresented in Table 1.The seed yield obtained in YLM -146 was higher by significantly influenced by varieties; the highest seed yield (748 kg ha^{-1}) was recorded with variety YLM 146 (V3), which was superior to the rest of the varieties, whereas the lowest seed yield (520 kg ha^{-1}) was observed in variety YLM 66 (V_1). Seed yield in YLM-146 was higher by 21.4 and 43.84 percent over YLM-142 and YLM-66, respectively. The increase in seed yield of YLM-142 over YLM-66 was 18.4 percent. These findings are in line with the findings of Raja *et al.* (2007a), Nahar *et al.* (2008), and Jat *et al.* 2017a).

Increasing the fertilizer levels, there was a significant increase in seed yield. Application of 125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage (T5) recorded the highest seed yield of 827 kg ha^{-1}. This was significantly superior to other fertilizers. Applying 100% RDF +1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage gave (T4) 720 kg ha^{-1} was on par with 100% RDF +1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage (T_3). The percent increase in seed yield with a fertilizer level was 14.8, 27.8, 63.1, and 42.7 over T4, T3, T2, and T1 treatments, respectively. The gain in seed yield due to 25% enhancement in fertilizer dose (125% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage) over the recommended dose of NPK applied to soil (100% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage) was worked out to be 14.8.0%, clearly showing that the currently recommended dose of NPK (40:20:20 kg NPK ha^{-1}) was suboptimal. The lowest seed yield (429 kg ha^{-1}) was recorded with control (T_1) and found statistically inferior to the rest of the treatments.

The improvement in seed yield with enhanced fertilizer level might be attributed to better availability and uptake of nutrients, which might have led to efficient metabolism. Higher levels of biomass accumulation and efficient translocation of photosynthates from source to sink might be responsible for the increased seed yields. The increase in sink capacity resulted in improved yield attributes, which was evidenced in Table 2,and consequently raised the grain yield of sesame. This is further supported by the fact that the soil of the experimental field was low in nitrogen (238 kg ha^{-1}). Thus, an increase in nitrogen supply might have increased all the growth parameters, attributing characteristics that ultimately contributed to an increase in seed yield. The above results conform with the findings of several researchers such as Shehu *et al.* (2010) Kashani *et al.* (2015), Hasan*et al.* (2013),and Jasemi*et al* (2013).

Interaction effect

The seed yield of sesame was found to be the highest with V_3 (YLM -146) at T5 (125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage, which was superior to the rest of the treatment combinations) which was however found statistically superior to rest of combinations. The variety YLM -146 at 100% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage was subsequent height seed yield but it was on par with the same variety with 75% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage, this is indicating that the supplemental 1% foliar feeding over the application of 75% RDF to soil was inadequate in realization of the highest seed yield as compared to 100% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage, in rice fallows of sesame (Table 1a). The lowest seed yield was realized with variety V_1(YLM-66) at T_1 (control). Similar results were confirmed by Kashani *et al.* (2015) and Mekonnen *et al.* (2016).

Yield attributes

No. of capsules plant^{-1}

Data recorded on no.of capsules plant^{-1} are presented in Table 2. Number of capsules plant^{-1} was significantly affected due to different varieties and nutrient levels but not their interaction.No. of capsules plant^{-1} (67) obtained with YLM-146 (V_3) were found significantly higher compared to YLM-66 (V_1) but it was on par with YLM-142 variety (V_2). However, a minimum number of capsules, plant^{-1}(60), was observed in a variety of YLM 66 (V_1). This may be due to the hereditary behavior of sesame varieties and their different growth habits. Similar type results were also reported by Throve et al. (2011), Kashani et al. (2015), and Jat *et al.* (2017).

In the case of fertilizer levels, application of 125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage (T5) significantly produced a maximum no. of capsules plant-1(96), which was superior to the rest of the fertilizer levels. The no. of capsules plant^{-1} was found to be significantly higher with 100 % RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage (T_4) over to 50 % RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage (T_3) and control (T_1) treatment but it was on par with 75% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage (T_4). In comparison, the minimum no. of capsule plant^{-1}(35) was recorded under control (T_1). Its role in various biochemical processes in the plant has been described by many scientists. Nitrogen by virtue of its link in the photosynthetic process and cell division, cell partitioning increased the dry matter accumulation at higher N levels. This higher dry matter and its partitioning might have resulted in more no. of capsules plant^{-1} in sesame. Also, this might be due to more vigorous and luxuriant vegetative growth due to nitrogen application, which in turn favoured a better partitioning of assimilates from source to sink. The present results were in accordance with the findings of Subramanian and Ganesaraja (1992) and Kushwaha (2013).

No. of seeds per capsule

Data about the effect of various varieties and fertilizer levels on the number of seeds capsule^{-1}are presented in Table 2, revealing that no. of seeds capsule-1 significantly differs with varieties and fertilizer levels.The number of seeds per capsule with YLM-146 (V3) produced a maximum no. of seeds per capsule (45), and it was significantly higher compared to YLM-66 but found statistically at par with YLM-142 (V_2) and the minimum no. of seeds per capsule (40) was recorded in variety YLM 66 (V_1). These findings are in line with the findings of Throve *et al.* (2011), Jat *et al.* (2017) and Meena (2013).

The application of nutrients significantly increased the number of seeds per capsule. Application of 125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage(T_5) recorded a significantly higher number of seeds per capsule (51) which was on par with 100% RDF +1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage(T_4). Whereas the lowest number of seeds per capsule was recorded with control (T_1). This might be due to an improved source-sink relationship, with efficient translocation of photosynthates to the grains. Reverse is the case of lower fertilizer levels; hence, low number of filled grains per ear head was recorded with fertilizer levels. These results conform to the findings of Meena (2013), Hasan et al. (2013),and Jat *et al.* (2017a).

Seed weight (g)

Significantly highest test weight (2.9 g) was observed with the application of125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage (T_5) over to 50% RDF +1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage (T_2)and control (T_1) but it was on par with 100% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage (T_4) and 75% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage (T_3).The increase in thousand grain weight might due to higher nitrogen levels and efficient dry matter partitioning besides better translocation to the sink, leading to the formation of large-sized grains due to adequate availability of nutrients at the time of grain filling. This is ultimately accountable for higher test weight. This is in accordance with the results reported by Gutu et al. (2016), Chakraborty (2013), Swain et al. (2020), and Zebene and Negash(2022).

Conclusion

Seed yield and yield attributes were highest with variety YLM 146 and fertilizer management practice of application of 125% RDF + 1% foliar spray of 19:19:19 at the early budding stage and early capsule formation stage, which indicates that YLM 146 coupled with 125 % RDF application seems to be appropriate for getting higher seed yield and yield attributes in Krishna Zone of Andhra Pradesh.

Table 1. Seed yield of *sesamum* varieties as influenced by different nutrient management practices

Treatments	**Seed yield (kg ha^{-1})**
Varieties (A)	
V_1: YLM 66	520
V_2: YLM 142	616
V_3: YLM 146	748
Sem(±)	19.59
CD (P=0.05)	57
Fertilizer levels (B)	
T_1: Control	429
T_2: 50% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	507
T_3: 75% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	647
T_4: 100% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	729
T_5:125% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	827
S.Em(±)	25.30
CD (P=0.05)	73
Interaction (A x B)	
S.Em(±)	43.81
CD (P=0.05)	127

Table 1a Interaction between varieties and nutrient management practices on sesame seed yield (kg ha-1).

Fertilizer Levels	**Variety**		
	V_1	**V_2**	**V_3**
T_1	335	402	552

T_2	397	531	593
T_3	561	690	691
T_4	681	696	811
T_5	627	760	1093
S.Em±	43.8		
CD (P=0.05)	171.0		

Fig. 1. Interaction between varieties and nutrient management practices on seed yield (kg ha^{-1}) of sesame.

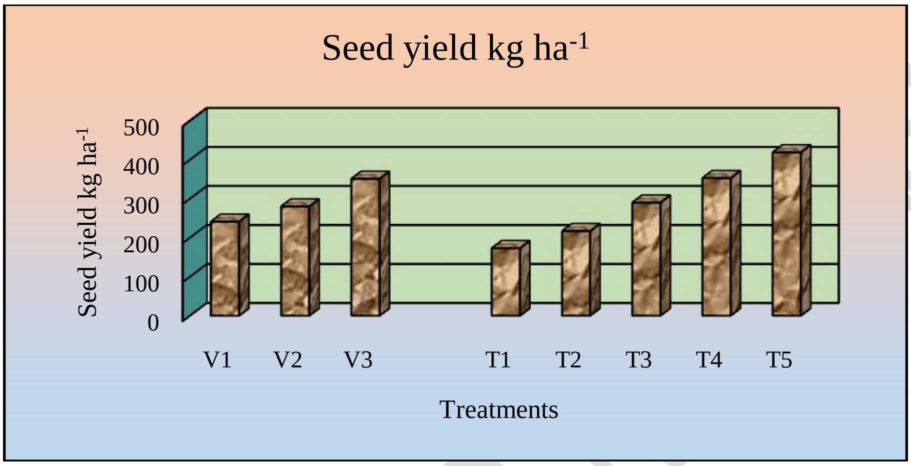


Table 2: Yield attributes and oil yield (kg ha^{-1}) of sesame as influenced by different nutrient levels during the *summer* season

Treatments	No. of capsule plant^{-1}	No. of Seeds capsule^{-1}	1000 seed weight (g)
T_1: Control	35	32	2.3
T_2: 50% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	42	38	2.4
T_3: 75% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	72	43	2.8
T_4: 100% RDF +1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	78	50	2.8
T_5: 125% RDF + 1% foliar spray of 19:19:19 at early budding stage and early capsule formation stage	96	51	2.9
S.Em (±)	2.6	1.1	0.1
CD (P=0.05)	7 .0	4.0	0.3

Fig. 2. No. of capsule pant^{-1} of sesamum varieties as influenced by different nutrient management practices

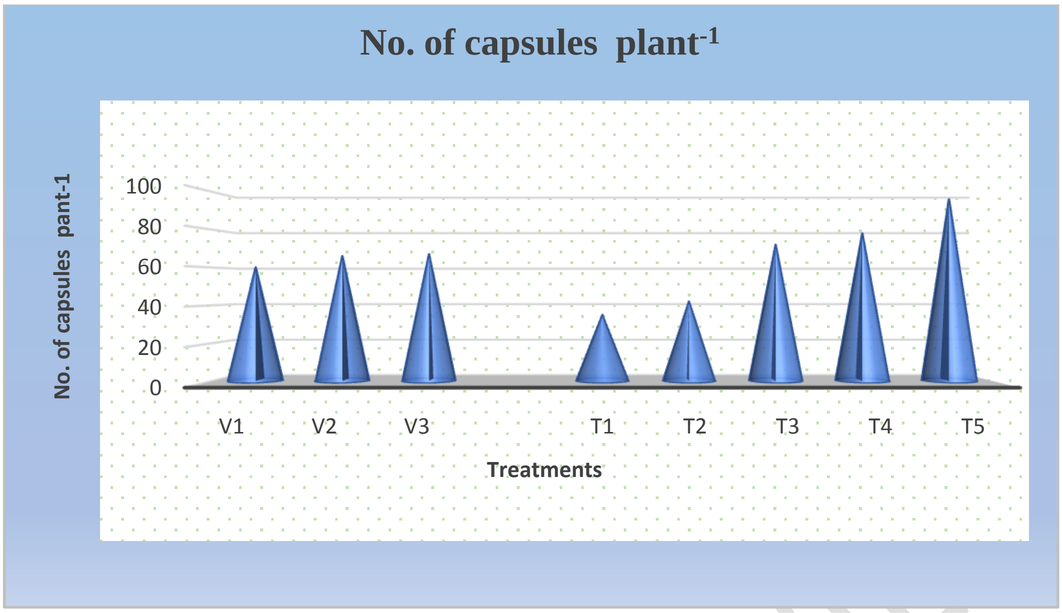
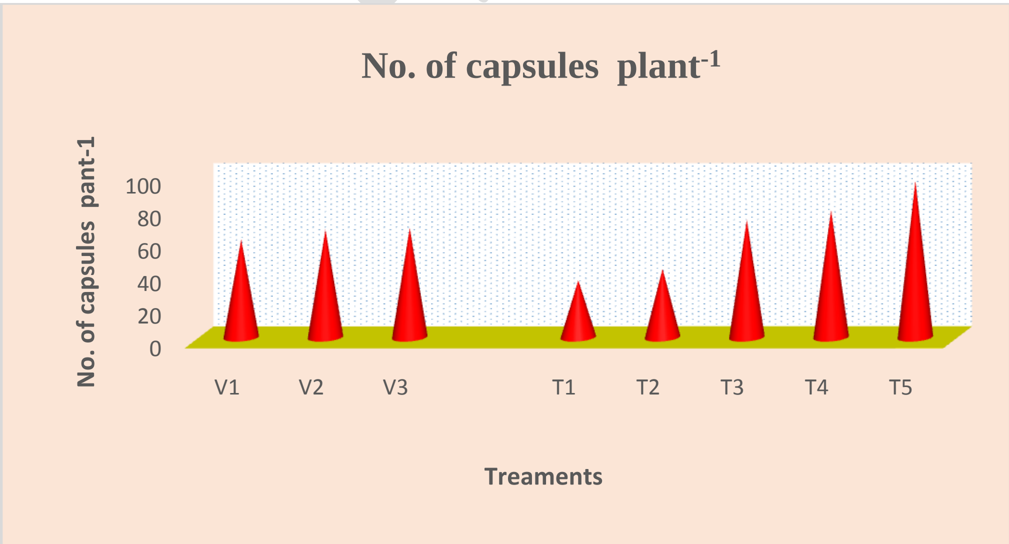


Fig. 3. No. of Seeds capsule^{-1} of sesamum varieties as influenced by different nutrient management practices



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