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QUALITY AND YIELD POTENTIAL OF SUMMER SESAME (*SESAMUM INDICUM* L.) AS INFLUENCED BY SOWING TIME AND NUTRIENT MANAGEMENT IN MIDDLE GUJARAT

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ABSTRACT
A Field experiment was conducted to evaluate the effect of sowing time and nutrient management on quality and yield potential of sesame during summer season of 2014. The experiment was laid out in a split plot design with four replications consisting of 15 treatments, namely, main plots: 3 sowing time (10th February, 20th February and 01st March) and sub plots: five nutrient management levels (50 % RDF + 5 t FYM ha^{-1}, 50 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer, 75 % RDF + 5 t FYM ha^{-1}, 75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer and 100 % RDF). The research results indicated that sowing at 20th February recorded higher yield attributes, seed and stalk yields, harvest index and quality parameters over the sowing at 10th February and 01st March. However, yield attributes except test weight, seed and stalk yields recorded at sowing 01st March was at par with sowing at 20th February whereas, sowing time had no significant effect on harvest index and oil content. Among nutrient management levels application of 75% RDF + 5 t FYM ha^{-1} + Bio-fertilizer (*Azospyrillium* + PSB) proved superior in all these parameters over remaining nutrient management levels.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest and most important oilseed crop. Today, India has achieved self-sufficiency in cereal food production but still vegetable oil needs to reach at the stage of self-sufficiency. In India, sesame occupies about 17.50 lakh hectares area with annual production of 6.13 lakh tones having an average productivity of 350 kg ha^{-1} (Anonymous, 2014). Sesame is cultivated on a large area in states of Maharashtra, Uttar Pradesh, Rajasthan, Orissa, Andhra Pradesh, Tamil Nadu, West Bengal, Gujarat and Karnataka. In Gujarat, it occupies an area of about 73,608 hectares with an annual production of 27,511 tones. Sesame seeds are rich source of food, nutrients, edible oil (50 %), bio-medicine as well as 6355 Kcal kg^{-1} energy (Kumar and Goel, 1994). Along with the seeds are also rich in protein i.e. 20.28 %, sugar 14-16 % and minerals 5-7 % (Dhinosa and Gupta, 1973). Sesame oil has excellent nutritional, medicinal, cosmetic and cooking qualities, for which it is known as "Queen of oilseed crops". Due to the presence of potent antioxidants, sesame seeds are called as 'The seeds of immortality'.

Production potentiality of a genotype can be fully exploited by adopting suitable agronomic practices. Among the available higher production technology selection of appropriate sowing time according to specific location and region is imperative phenomena to fully exploit the genetic potentiality of a variety as it synchronizes the optimum environmental conditions such as temperature, light, humidity, rainfall etc. with the different growth phases of the crop and results in boosting production of summer sesame (Salmasi *et al.,* 2006). It is fact that particular genotypes do not exhibit the same phenotypic characteristics in all environmental circumstances. The responses of qualities, yield attributes and yield potential as well of genotype varies for a specific or different date of sowing (Dinda *et al.,* 2015).

It is also evidence that the plant nutrient deficiency in Indian soils is increasing and the disproportionate use of fertilizers has widened soil imbalance in terms of NPK ratio. Integrated approach by using both organic and inorganic nutrient sources along with bio-fertilizers seems to be a viable substitute method to obtain higher yields and economic advantages in sesame with standard quality oil further, integrated nutrient management system has become a recognized approach to evaluate the effect of different levels of organic and inorganic sources of nutrients in combination with bio-fertilizers on growth, yield and quality of sesame (Reddy *et al.,* 2014). An attempt was therefore made to test the quality and yield potential of summer season sesame under different sowing times and nutrient management levels in middle Gujarat.

MATERIALS AND METHODS

The field experiment was conducted at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India (22Ú35' N latitude and 72Ú55' E longitude; 45.1 m above mean sea level) during summer season of 2014. The soil of experimental field was loamy-sand, alkaline in reaction (pH 8.14) having 242.3 kg ha^{-1} available N (Alkaline permanganate method, A.O.A.C., 1970), high level of available

phosphorus (53.2 kg ha^{-1}, Olsen's method, Jackson, 1973) and medium in available potassium (211.7 kg ha^{-1}, Flame Photometer method, Jackson, 1973) in 0-15 cm soil depth at the start of the experiment. Seed rate of 2.5 kg ha^{-1} of sesame var. Gujarat Til-2 was used for experimentation. The experiment was laid out in a split plot design with four replications. The different sowing time (3) were allocated in main plots and nutrient management levels (5) in sub plots. The three sowing time used were D_1: 10th February, D_2: 20th February and D_3: 01st March and five nutrient management levels were N_1: 50 % RDF + 5 t FYM ha^{-1}, N_2: 50 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer, N_3: 75 % RDF + 5 t FYM ha^{-1}, N_4: 75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer and N_5: 100 % RDF. FYM was incorporated in the soil before sowing of sesame crop as per the treatments. The seeds were inoculated with liquid bio-fertilizers (*Azospirillum* + Phosphorus solubilising bacteria) @ 20 ml each kg^{-1} seed at the time of sowing as per treatments. The sources of fertilizers used in the experiment were urea @ 50 kg ha^{-1} and di ammonium phosphate (DAP) @ 25 kg ha^{-1}. Half dose of nitrogen and full dose of phosphorus according to treatments were applied at the time of sowing. Remaining half dose of nitrogen was top dressed at 30 days after sowing as per treatments.

RESULTS AND DISCUSSION

Sowing time

Sowing on 20th February recorded significantly higher number of capsules plant number of capsules plant^{-1} (54.78), number of seeds capsule^{-1} (62.61), seed (1101 kg ha^{-1}) and stalk (2454 kg ha^{-1}) yields as compared to the sowing 10th February, but it remained at par with sowing on 01st March. The extent of increase in the seed and stalk yields under sowing date of 20th February was 43.36 % and 30.81 %, respectively over sowing date 10th February. Sowing date of 10th February produced significantly the lowest seed (768 kg ha^{-1}) and stalk (1876 kg ha^{-1}) yields than other sowing dates (Table 1). The higher seed and stalk yields under sowing on 20th February may be attributed to favorable climatic conditions, harnessing of more solar radiation as evidenced through higher dry matter production and higher values for the entire yield contributing traits, which in turn has increased the seed and stalk yields. Improved seed and stalk yields as explained above again lead to significant increase in biological yield. This result was in line with the findings of Salmasi *et al.* (2006), Patel *et al.* (2010) and Sivagamy and Rammohan (2013). However, the results further revealed that different sowing dates did not show their significant influence on the harvest index and test weight of sesame seeds. Oil yield (522.9 kg ha^{-1}) was significantly higher under treatment D_2 (20th February) than sowing date D_1 (10th February), but was remained at par with treatment D_3 (01st March) (Table 1). However, different sowing time did not found their significant influence on oil content (%) in the seeds. It was might be due to genetic makeup of crop plants in performing different climatic conditions and fertility status of the soil, ultimately it reflected into better quality and yield parameters. The results are in close agreement with observations of Olowe (2007); Sivagamy and Rammohan (2013).

Nutrient management

The number of capsules plant^{-1} (54.86), number of seeds capsule^{-1} (61.89) and test weight (3.46) were significantly higher under treatment N_4 (75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer) than all other treatments, but it did not differ statistically with treatment N_3 (75 % RDF + 5 t FYM ha^{-1}) (Table 1). Significant increase in number of capsules plant^{-1} and number of seeds capsule^{-1} with nutrient management through organic and inorganic sources could be attributed to increased dry matter accumulation, dry matter partitioning and indirectly higher nutrient uptake by crop. In physiological terms, the test weight of sesame is largely governed by source (photosynthesis) and

Table 1: Effect of sowing time and nutrient management levels on yield attributing characters, seed and stalk yields, harvest index and quality parameters of sesame

Treatments	Yield attributing Characters			Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest Index(%)	Quality parameters	
	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	Test weight (g) (1000 seed weight)				Oil content (%)	Oil yield (kg ha^{-1})
Sowing Dates (D)								
D_1: 10th February	50.76	54.92	3.29	768	1876	29.56	46.09	354.0
D_2: 20th February	54.78	62.61	3.39	1101	2454	31.84	47.50	522.9
D_3: 01st March	53.54	60.04	3.33	1084	2337	30.87	46.89	508.3
S. Em. ±	0.82	0.77	0.04	26	57	0.68	0.40	12.1
C.D. (p =0.05)	2.84	2.65	NS	90	196	NS	NS	42.0
C.V. (%)	6.91	5.80	4.82	11.79	11.38	9.91	3.82	11.74
Nutrient Management (N)								
N_1: 50 % RDF + 5 t FYM ha^{-1}	51.36	56.05	3.28	858	2023	29.78	45.89	393.4
N_2: 50 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer	52.17	58.09	3.29	952	2158	29.81	46.00	437.4
N_3: 75 % RDF + 5 t FYM ha^{-1}	54.41	60.91	3.35	973	2266	30.92	47.42	461.5
N_4: 75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer	54.86	61.89	3.46	1186	2440	32.79	48.48	574.1
N_5: 100 % RDF	52.34	59.02	3.31	954	2225	30.48	46.35	442.3
S. Em. ±	0.85	0.98	0.04	32	61	0.87	0.50	15.6
C.D. (p = 0.05)	2.44	2.82	0.13	92	176	NS	1.45	44.8
Interaction (D × N)	NS	NS	NS	Sig.	NS	NS	NS	NS
C.V. (%)	5.56	5.76	4.58	11.34	9.56	9.81	3.73	11.71

sink (seed) relationship, as it directly related to nutrients. The results are in close conformity with those of Aridoss *et al.* (2004) and Barik and Fulmali (2011). Different nutrient management practices showed conspicuous effect on the sesame seed and stalk yields (Table 1). The data revealed that the highest seed (1186 kg ha^{-1}) and stalk (2440 kg ha^{-1}) yields were recorded under the treatment N_4 (75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer) than other treatments, but remained at par with treatment N_3 (75 % RDF + 5 t FYM ha^{-1}) in case of stalk yield. The less availability of nutrients in treatment N_1 (50 % RDF + 5 t FYM ha^{-1}) resulted in the lowest seed (858 kg ha^{-1}) and stalk (2023 kg ha^{-1}) yields and the reduction in the seed and stalk yields under treatment N_1 was by 38.23 %, 20.61 % , respectively over treatment N_4 (75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer). It might be due to that synergistic relation between nutrients increased the plant height and vigorous growth of plant as well as more nutrient uptake and improved overall growth and development of the floral to primordial, due to proper fertilization coupled with increased net photosynthesis on the one hand and greater mobilization of photosynthates towards reproductive structures on the other hand, which might have increased the yield significantly. Similar results were obtained by Javia *et al.* (2010); Ravusaheb *et al.* (2010); Barik and Fulmali (2011).

Oil content in the seeds and oil yield of sesame were significantly influenced due to different nutrient management practices (Table 1). Significantly the highest oil content (48.48 %) and oil yield (574.1 kg ha^{-1}) were observed under application of 75 % RDF + 5 t FYM ha^{-1} + Bio-fertilizer (N_4), while the lowest oil content (45.89 %) and oil yield (393.4 kg ha^{-1}) were registered under the treatment 50 % RDF + 5 t FYM ha^{-1} (N_1). It was might be due to that better availability of desired and required nutrients in the crop root zone resulting from its solubilization caused by the organic acid produce from the decaying organic matter, ultimately reflected into higher oil content and u8yoil yield. The results are in close agreement with observations of Tripathy and Bastia (2012). Results further revealed that different nutrient management practices did not show their significant influence on harvest index.

Interaction (sowing time x nutrient management)

The interaction between sowing time and nutrient management practices was significant in respect of seed yield. The seed yield of sesame was significantly increased (1413 kg ha^{-1}) by combined application of D_2N_4 (sowing on 20th February and 75% RDF + 5 t FYM ha^{-1} + Bio-fertilizer) over other treatment combinations, which was at par with treatment combinations D_3N_4 (1324 kg ha^{-1}) and D_2N_5 (1269 kg ha^{-1}). In contrast, significantly lower (680 kg ha^{-1}) seed yield was observed in treatment combination D_1N_1 (sowing on 10th February and 50 % RDF + FYM), which was closely followed by treatment combination D_1N_5. The enhanced crop growth in terms of seed yield due to crop obtained optimum environment obtained by crop had also been reported by Muthusankaranarayanan *et al.* (2001).

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