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Integrated nitrogen management, humic and fulvic acids on performance of sesame (*Sesamum indicum*)

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ABTRACT

Integrated nitrogen management,humic and fulvic acids on performance of sesame (Sesamum indicum)were studied with different nutrient sources viz., 100% recommended dose of nitrogen through inorganic fertilizer with 1% foliar spray of humic acid and fulvic acid at branching and flowering; 75% recommended dose of nitrogen through inorganic fertilizer with 25% nitrogen through farm yard manure, vermicompost and poultry manure and 1% foliar spray of humic acid and fulvic acid at branching and flowering.100% recommended dose of nitrogen through inorganic fertilizer with 1% foliar spray of humic acid at branching and flowering had significant effect on growth attributes of sesame such as plant height (169.3 cm), number of branches/plant (5.36), number of capsules/plant (107.71), number of seeds/capsule (53.75)at harvest and seed yield/plant (12.07 g) Significantly higher seed yield of 1058 kg ha^{-1} as well as higher net realization of Rs.36664ha^{-1} and benefit cost ratio of 2.33 were realized with this treatment.

***Keywords*:** *Fulvic acid, humic acid,recommended dose of nitrogen,sesame*

Sesame (*Sesamum indicum*) is an important oilseed crop from which semi-drying vegetable oils are obtained. Gujarat is the largest producer of sesame in India, with an area of 2.34 lakh ha with the production of 1.24 lakh tonnes leading to average productivity of 525 kg ha^{-1} (DA&C, 2013-14). Though sesame is cultivated with the application of inorganic fertilizers, productivity of the crop has been stagnating, and this is associated with indiscriminate use of chemical fertilizers and resulting nutrient imbalances in soil.

In order to reduce the cost of cultivation and improve the overall sustainability of production, a nutrient strategy combining organic and inorganic sources of nitrogen was thought essential. Integrating this with humic and fulvic acids, which have been known to promote the plant growth and yield in several crops, would be viable proposition to achieve sustainability. Humic acid spray has been reported to significantly improve yield attributes and grain yield, oil and protein content of niger (Tadayyon *et al.*, 2017), while Moradi *et al.*(2017) reported that fulvic acid increased seed yield and oil content of safflower.

Hence the present investigation was carried out to identify an integrated nitrogen management source for sesame, as well as to assess the effects of humic and fulvic acids on performance and productivity of the crop.

MATERIALS AND METHODS

The experiment was conducted during the *kharif* season, from July to October 2016 in Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat. The treated seeds (Thiram @ 3 g kg seed^{-1}) of sesame variety 'Gujarat Til-2' were sown in shallow furrows and covered properly with the soil. The soil of the experimental plot fell in the textural class loamy sand, and had low organic carbon (0.32%) and available nitrogen (165.46 kg ha^{-1}), medium available phosphorus (39.82 kg ha^{-1}) and potash content (269.54 kg ha^{-1}). Electrical conductivity was very low (0.11 dS m^{-1}) showing that the soil was free from salinity hazard. The soil pH was 7.82.

Randomized block design was adopted for the experiment.There were nine treatments which were replicated four times. They were T_1-100% of recommended N fertilizer dose through inorganic fertilizer; T_2-100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering; T_3-100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of fulvic acid at branching and flowering; T_4-75% of recommended N fertilizer dose through inorganic fertilizer and 25% N through FYM and 1% foliar spray of humic acid at branching and flowering; T_5-75% of recommended N fertilizer dose through inorganic fertilizer and 25% N through vermicompost and 1% foliar spray of humic acid at branching and flowering; T_6-75% of recommended N fertilizer dose through inorganic fertilizer and 25% N through poultry manure and 1% foliar spray of humic acid at branching and flowering; T_7-75% of

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recommended N fertilizer dose through inorganic fertilizer and 25% N through FYM and 1% foliar spray of fulvic acid at branching and flowering; T_8-75% of recommended N fertilizer dose through inorganic fertilizer and 25% N through vermicompost and 1% foliar spray of fulvic acid at branching and flowering; T_9-75% of recommended N fertilizer dose through inorganic fertilizer and 25% N through poultry manure and 1% foliar spray of fulvic acid at branching and flowering. The recommended dose of NPK for sesame was 50:25:00 kg ha^{-1}.

Well decomposed farmyard manure, vermicompost, and poultry manure were applied as per treatments immediately after opening the furrows and covered with soil. Humic acid and fulvic acid were applied as 1% foliar sprays as per treatments at the time of branching and flowering stage. The recommended dose of nitrogen (50 kg ha^{-1}) was applied through urea as per treatments. 50% of recommended N fertilizer dose was applied basally and remaining 50% of recommended N fertilizer dose was applied at 30 DAS. The quantity of phosphorus supplied from FYM was 4.57 kg ha^{-1}, from vermicompost was 2.5 kg ha^{-1}, and from poultry manure was10.57 kg ha^{-1}. Phosphorus and sulphur obtained from organic manures and SSP respectively were deducted from the total requirement of the crop (25 kg P_2O_5 ha^{-1} and 20 kg S ha^{-1}), and remaining phosphorus required was supplied from SSP, and remaining S from gypsum, as basal dose.

Plant population and plant height at 30 and 60 days after sowing and at harvest were recorded. Number of branches/plant, number of capsules/plant, number of seeds/capsule, and seed yield/plant were recorded at harvest from the net plot. At harvest, the grain yields were determined and expressed on per hectare basis.

Statistical processing of data was done as per standard procedure recommended by Panse and Sukhatme (1967). To compare treatment means, Duncan's new multiple range test as described by Steel and Torrie (1980) was adopted.

RESULTS AND DISCUSSION

Plant population at 30, 60 DAS and harvest was not significantly influenced due to humic and fulvic acid with INM treatments (Table 1). The data indicated a significantly higher plant height of 45.9 cm at 30 DAS. Plant heights of 112.9 and 169.3 cm at 60 DAS and at harvest respectively, were recorded with treatment T_2-100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering, which was significantly higher than other treatments. Kumara *et al.* (2014) and Patel *et al.* (2014b) reported that optimum application of nitrogen and P_2O_5 through inorganic fertilizers promoted the supply of N and P at the early stages of sesame growth. Application of humic acid enhanced cell multiplication and enlargement and length of internodes by producing growth regulating hormones (auxin, gibberellins, vitamins etc.).Vani (2015) found that 100 % of recommended fertilizer dose had given the highest growth and yield attributes followed by 100 % of recommended N fertilizer dose + 1% foliar spray of humic acid at branching and flowering in sesame.

Significantly higher number of branches/plant at harvest (5.36) was found with treatment T_2-100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering over other treatments but it was at par with T_3, T_5 and T_1. However, the magnitude of increase in a number of branches per plant at harvest under treatment T_2 was to the tune of 23.78 and 64.41 per cent, respectively over treatment T_1 and T_7.

An analysis of the data given in Table 1 brought out that the highest number of capsules/plant at harvest (107.71) were produced with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) and it was superior to all other treatments. Treatment T_7 (75% of recommended N fertilizer dose through inorganic fertilizer with 25% N through FYM and 1% foliar spray of fulvic acid at branching and flowering) registered significantly lower number of pods per plant at harvest (64.13), and it was at par with T_4, T_9 and T_6. The present findings were similar to that of Rajpar *et al.* (2011) and Jape *et al.* (2013) who reported that higher dry matter per plant could be ascribed to the availability of readily available nitrogen for rapid initial growth and cumulative improvement in most of the growth parameters as a result of the availability of macro and micronutrients with humic acid foliar spray at branching and flowering along with inorganic fertilizer.The increase in the availability of nutrients by secretion of certain enzymes and growth-promoting hormones increased the number of branches at harvest, and also plant height which resulted in a favourable effect on capsules/plant at harvest.

As per the data furnished in Table. 2, significantly higher number of seeds/plant at harvest (53.75) was obtained with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) as compared to the rest of the treatments. The test weight (3.26 g) of sesame was significantly higher with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) as compared to all other treatments.

Table 1: Plant growth and yield attributes of sesame as influenced by treatments

Treatments	Plant height (cm)			Number of branches/plant at harvest	Number of capsules/plant at harvest	Number of seeds/capsule at harvest	Test weight (g)
	30 DAS	60 DAS	At harvest				
T_1	96.3^{ab}	150.5^{ab}	9.50^{a}	4.33^{ab}	85.26^{b}	42.25^{b}	3.20
T_2	112.9^{a}	169.3^{a}	10.00^{a}	5.36^{a}	107.71^{a}	53.75^{a}	3.26
T_3	97.5^{ab}	149.8^{ab}	9.50^{a}	4.39^{ab}	86.58^{b}	43.61^{b}	3.23
T_4	90.0^{b}	136.0^{b}	8.25^{a}	3.63^{bc}	69.86^{bc}	34.93^{bcd}	3.03
T_5	97.3^{ab}	150.0^{ab}	9.25^{a}	4.38^{ab}	86.37^{b}	43.19^{b}	3.16
T_6	95.3^{b}	145.3^{b}	8.50^{a}	4.14^{bc}	80.99^{bc}	40.50^{b}	3.13
T_7	87.9^{b}	133.8^{b}	8.25^{a}	3.26^{c}	64.13^{c}	30.54^{e}	3.01
T_8	96.3^{ab}	150.3^{ab}	9.00^{a}	4.26^{b}	83.78^{b}	41.89^{b}	3.16
T_9	86.7^{b}	138.7^{b}	8.50^{a}	3.72^{bc}	74.42^{bc}	35.96^{bc}	3.10
SEm (±)	**0.60**	**4.95**	**6.20**	**0.31**	**5.88**	**2.81**	**0.05**
LSD (0.05)	**5.05**	**14.46**	**18.10**	**0.89**	**17.17**	**8.19**	**NS**
CV %	**13.34**	**10.37**	**8.44**	**14.65**	**14.32**	**13.77**	**1.66**

Note: T_1:100% RDN through inorganic fertilizer; T_2: T_1 + 1% foliar spray of humic acid (Branching + Flowering); T_3: T_1 + 1% foliar spray of fulvic acid (Branching + Flowering); T_4: 75% RDN through inorganic fertilizer + 25% N through FYM + 1% foliar spray of humic acid (Branching + Flowering); T_5:75% RDN through inorganic fertilizer + 25% N through vermicompost + 1% foliar spray of humic acid (Branching + Flowering); T_6:75% RDN through inorganic fertilizer + 25% N through poultry manure + 1% foliar spray of humic acid (Branching + Flowering); T_7:75% RDN through inorganic fertilizer + 25% N through FYM + 1% foliar spray of fulvic acid (Branching + Flowering); T_8:75% RDN through inorganic fertilizer + 25% N through vermicompost + 1% foliar spray of fulvic acid (Branching + Flowering)and T_9: 75% RDN through inorganic fertilizer + 25% N through poultry manure + 1% foliar spray of fulvic acid (Branching + Flowering); *Recommended dose of N fertilizer*

Table 2: Yield and economics of sesame as influenced by treatments

Treatments	Seed yield / plant(g)	Seed yield (kg ha^{-1})	Harvest index (%)	Gross realization (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net realization (Rs. ha^{-1})	BCR
T_1	9.29^{b}	883^{abc}	23.98	53685	26581	27104	2.02
T_2	12.07^{a}	1058^{a}	24.85	64282	27618	36664	2.33
T_3	9.96^{ab}	941^{ab}	24.21	57201	29831	27370	1.92
T_4	8.07^{bc}	711^{cd}	23.31	43258	28708	14550	1.51
T_5	9.55^{b}	887^{abc}	23.73	53948	30875	23073	1.75
T_6	8.77^{bc}	768^{bcd}	22.70	46728	28933	17795	1.62
T_7	6.96^{c}	640^{d}	23.21	38908	30920	7988	1.26
T_8	8.95^{bc}	789^{bcd}	22.04	48048	33087	14961	1.45
T_9	8.61^{bc}	759^{bcd}	23.75	46141	31146	14995	1.48
SEm (±)	**0.69**	**59.25**	**1.58**				
LSD (0.05)	**2.03**	**172.95**	**NS**				
CV %	**15.19**	**14.34**	**13.42**				

Note: T_1:100% RDN through inorganic fertilizer; T_2: T_1 + 1% foliar spray of humic acid (Branching + Flowering); T_3: T_1 + 1% foliar spray of fulvic acid (Branching + Flowering); T_4: 75% RDN through inorganic fertilizer + 25% N through FYM + 1% foliar spray of humic acid (Branching + Flowering); T_5:75% RDN through inorganic fertilizer + 25% N through vermicompost + 1% foliar spray of humic acid (Branching + Flowering); T_6:75% RDN through inorganic fertilizer + 25% N through poultry manure + 1% foliar spray of humic acid (Branching + Flowering); T_7:75% RDN through inorganic fertilizer + 25% N through FYM + 1% foliar spray of fulvic acid (Branching + Flowering); T_8:75% RDN through inorganic fertilizer + 25% N through vermicompost + 1% foliar spray of fulvic acid (Branching + Flowering)and T_9: 75% RDN through inorganic fertilizer + 25% N through poultry manure + 1% foliar spray of fulvic acid (Branching + Flowering); *Recommended dose of N fertilizer; Sale price of sesame produce: Seed: Rs. 60 per kg; Stalk: Rs.0.25 per kg*

The seed yield per plant of sesame was also significantly higher (12.07 g) with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) followed by T_3 (9.96 g). Application of 75% of recommended N fertilizer dose through inorganic fertilizer with 25% N through FYM and 1% foliar spray of humic acid at branching and flowering (T_7) registered significantly lower seed yield/plant (6.96 g) compared to rest of the treatments. Increase in test weight and seed yield/plant was mainly because of increase in plant height (Table 1), number of branches/ plant at harvest (Table 1), number of capsules/plant at harvest and number of seeds per/capsule at harvest (Table 2), which resulted from the combined effect of humic acid foliar spray at branching and flowering and chemical fertilizers which favoured growth and productivity of sesame. Application of a formulated humic acid product has been reported to increase soybean yield (Lenssen *et al*., 2019). Integrated nutrient with application of 50% nitrogen (N) through farm yard manure (FYM) and remaining 50% through fertilizers has been reported to increase 1000 seed weight, seed yield, and the oil yield of sesame by Verma *et al*. (2012). Lower performance of sesame with integrated nitrogen management in this experiment might have been because lower level of substitution with organic sources. Fulvic acid was also seen to not produce beneficial effect as expected.

Significantly higher seed yield (1058 kg ha^{-1}) was produced with the treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) as compared to all other treatments, but it was found at par with treatments T_3 (941 kg ha^{-1}), T_5 (887 kg ha^{-1}) and T_1 (883 kg ha^{-1}) (Table 2). However, the harvest index was not significantly affected due to different integrated nitrogen management treatments.

The data on gross economic realization as influenced by different integrated nitrogen management treatments (Table 2) revealed that higher gross realization of Rs. 64282 ha^{-1} was accrued with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) followed by treatment T_3 (Rs. 57201 ha^{-1}). The lowest value (Rs. 38908 ha^{-1}) was noticed under treatment T_7 (75% of recommended N fertilizer dose through inorganic fertilizer with 25% N through FYM and 1% foliar spray of humic acid at branching and flowering).

Higher net realization of Rs. 36664 ha^{-1} was accrued with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering), followed by treatment T_3 (Rs. 27370 ha^{-1}). The lowest value (Rs. 7988 ha^{-1}) was noticed under treatment T_7 (75% of recommended N fertilizer dose through inorganic fertilizer with 25% N through FYM and 1% foliar spray of humic acid at branching and flowering).

Higher BCR of 2.33 was observed with treatment T_2 (100% of recommended N fertilizer dose through inorganic fertilizer and 1% foliar spray of humic acid at branching and flowering) followed by treatment T_1 (2.02). The lowest BCR of 1.26 was noted with treatment T_7 (75% of recommended N fertilizer dose through inorganic fertilizer with 25% N through FYM and 1% foliar spray of humic acid at branching and flowering). This could be attributed to higher seed and stalk yield obtained in these treatments. Similar results have been reported by Parihar *et al.* (2013**)** in mustard, Patel *et al.* (2014a), and Patel *et al.* (2014b) in sesame.

Higher yield and net returns can be secured from *kharif* sesame crop by application of 100% of recommended N fertilizer dose (50 kg N ha^{-1}) and RDP (25 kg $P_2O_5 ha^{-1}$) through inorganic fertilizer with 1% foliar spray of humic acid at branching and flowering.

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REFERENCES

DA&C. 2013-14. Oilseeds Division. Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India, Krishi Bhawan, New Delhi, www.nmoop.gov.in.

Jape, M.M., Deotale, R.D., Patil, S.R., Raut, S.M. and More, N.S. 2013. Response of foliar sprays of humic acid through cowdung wash on morpho-physiological, yield and yield contributing parameters of groundnut. *J. Soils and Crops,* **23**(2) : 321-326.

Kumara, B.H.P., Chittapur, B.M., Hiremath, S.M., Malligwad, L.H. Nadaf, H.L. and Koti, R.V. 2014. Effect of organics, natural mineral nutrition and phosphate solublizing bacteria on sesame (*Sesamum indicum*) yield and quality during *kharif* season. *Karnataka J. Agric. Sci.,* **27**(3) : 340-342.

Lenssen, A.W., Olk, D.C and Dinnes, D.L. 2019. Application of a formulated humic product can increase soybean yield. *Crop, forage and turfgrass manag.*, **5**(1) : 1-6.

Moradi, P., Pasari, B. and Fayyaz, F. 2017. The effects of fulvic acid application on seed and oil yield of safflower cultivars. *J. Cen. Eur. Agric.*, **18**(3) : 584-597.

Panse, V.G. and Sukhatme, P.V. 1967. Statistical Methods for Agricultural Workers (Second edition). *Indian Council of Agric. Res.,* New Delhi.

Parihar, L.B., Deotale, R.D., Raut, S.M., More, N.S. and Banginwar, A.D. 2013. Physiological responses of foliar application of humic acid through vermicompost wash on morpho-physiological,yield and yield contributing parameters of mustard (*Brassica juncea*). *J. Soils and Crops,* **23**(2): 292-298.

Patel, H.K., Patel R.M., Desai, C.K. and Patel, H.B. 2014a. Response of summer sesame (*Sesamumindicum*) to different spacing and levels of nitrogen under north Gujarat conditions. *Int. J. Agric. Sci.,* **10**(1) : 336-343.

Patel, N.A. Chauhan, S.A. Hajari, R.V. and Patel, J.S. 2014[b]. Effect of nitrogen management practices and different organic sources on growth and yield of *kharif* sesame (*Sesamum indicum*) under middle Gujarat conditions. *Trends in Biosci.,* **7**(18): 2736-2741.

Rajpar, I., Bhatti, M.B., Zia-ul-hassan, Shah, A.N. and Tunio, S.D. 2011. Humic acid improves growth, yield and oil content of mustard (*Brassica compestris*). *Pakistan J. Agric., Agric. Eng. Vet. Sci.,* **27**(2) : 125-133.

Steel, R.G.D. and Torrie, J.H. 1980. Principles and procedures of statistics. Publications of McGraw-Hill Book Company, New York.

Taddayon, A., Beheshti, S. and Pessarakli, M. 2017. Effects of sprayed humic acid, iron, and zinc on quantitative and qualitative characteristics of niger plant (*Guizotia abyssinica* L.). *J. Plant Nutr.*, **40**(11): 1644-1650.

Vani, K.P. 2015. Integrated nutrient management in summer sesame (*Sesamum indicum*). *Fourth Int. Conf. on Agric. &Hortic. Sci.* in July13-15,Beijing, China.

Verma, S., Saxena, R. and Singh, H.V. 2012. Integrated nutrient management in sesame (*Sesamum indicum* L.). *Bioinfolet*, **9**(4) : 576-579.