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Effect of foliar nutrition of nitrogen and potash on seed yield and economics of sesame (*Sesamum indicum* L.) in North Coastal zone of Andhra Pradesh

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Abstract
Field studies were carried out at Agricultural Research Station, Yellamanchili, Visakhapatnam Dist., Andhra Pradesh during *rabi*, 2017-18 to reveal the effect of foliar nutrition of nitrogen and potash through urea and Muriate of potash on growth, yield and economics of sesame with eight treatments replicated thrice in randomized block design. The results revealed that application of 100% RDF as soil application + Urea @ 2% foliar spray at flowering stage & capsule formation stage gave significantly higher seed yield and monetary returns followed by 100% RDF as soil application + Muriate of Potash (MOP) @ 2% foliar spray at flowering stage & capsule formation stage.

Keywords: Foliar nutrition, sesame, seed yield, economics

Introduction
Sesame, an oilseed crop which is being cultivated since ancient times and was believed to be originated from Ethiopia in South Africa and also from India. It possesses the antioxidants *viz*., sesamin and sesamolin and vitamin-E which gives immunity to the body and good for skin, respectively. The presence of antioxidants and tocopherol contributes for more shelf life than any other oils. Having possessed these unique qualities, it is often called as "Queen of oilseeds". In India, the area, production and productivity of sesame are 1.75 m ha, 0.77 m t and 410 kg ha^{-1}, respectively (Ministry of Agriculture & Farmers welfare, G.O.I, 2018) whereas in Andhra Pradesh the statistics were 0.64 lakh ha, 0.17 lakh tonnes and 257 kg ha^{-1}, respectively (Agricultural Statistics at a glance, 2016-17).
The main reason for low yields of sesame may be attributed to its cultivation in varied land situations under rainfed conditions. Management practices such as fertilization is very crucial to boost up the yields. As the crop is being cultivated in Summer also, soil application of nutrients becomes a constraint due to frequent irrigations to the crop. The plants may not absorb the nutrients through chemical fertilisers due to insufficient water holding capacity and organic matter in the soil. Therefore, to enhance the efficiency of absorption of nitrogen and potash, foliar sprays of these important nutrients is need of the hour under changing climate which helps in quick regain under drought and prevents loss of nutrients through leaching during irrigation. Therefore, the present study was taken up.

Materials and Methods
Field study was carried out at Agricultural Research Station, Yellamanchili, Visakhapatnam Dist., Andhra Pradesh during *rabi*, 2017-18 in a randomized block design with eight treatments replicated thrice to unveil the impact of foliar nutrition of nitrogen and potash. The soils are sandy loam in nature, slightly alkaline (pH 7.6), with 0.20% organic carbon and 157, 18 and 92 kg ha^{-1} of N, P and K, respectively. The treatments comprised of soil application of 100% RDF (40 kg N + 20 kg P_20_5 + 20 kg K_2O/ha) ($T_{1)}$, T_1 + urea @ 2% foliar spray at flowering stage, T_1 + urea @ 2% foliar spray at capsule formation stage, T_1 + urea @ 2% foliar spray at flowering stage + capsule formation stage, T_1 + MOP @ 2% foliar spray at flowering stage, T_1 + MOP @ 2% foliar spray at capsule formation stage, T_1 + MOP @ 2% foliar spray at flowering stage + capsule formation stage along with control. Sesame cv. YLM-66 was sown @ 5 Kg seeds/ha in rows spaced at 30 cm.

Thinning and gap filling were completed at 7 days after germination and plant to plants distance was maintained at 10 cm in a row. Fertilization was given in the form of urea, single superphosphate and muriate of potash in which half of the total nitrogen was applied at the time of sowing and rest of nitrogen was top dressed at a month after germination whereas total P_2O_5 and K_2O were applied basally and as per the treatment schedule. Other recommended package of practices was followed to raise a good crop. The growth and yield attributing parameters such as plant height, number of branches and capsules per plant were recorded along with seed yield at harvest. The data obtained was subjected to statistical analysis suitably and the economics was worked out.

Results and Discussion

Effect on Growth and Yield

Foliar application of urea and MOP integrated with RDF over application of RDF alone gave good response (Table1). Significantly higher plant (100.1 cm) was obtained with soil application of 100% RDF + foliar nutrition with urea @ 2% at flowering stage + capsule formation stage (T_4) which might be due to supplemental nitrogen in the form of urea given through foliar application at crucial stages *i.e*., flowering and capsule formation stages which promoted the vegetative growth.

Significantly higher number of branches per plant (4.97) was obtained with the soil application of 100% RDF + foliar nutrition with urea @ 2% at flowering stage + capsule formation stage (T_4) followed by T_7- *i.e*., soil application of 100% RDF + foliar nutrition with MOP @ 2% at flowering stage + capsule formation stage (4.54). It might be due to more availability of nitrogen at critical stages *i.e*., flowering and capsule formation stages, which plays a vital role in cell division. The enhanced meristematic activity and consequent vertical extension of growth due to consistent availability of nutrients led to more branches. These results are in conformity with the findings of Deshmukh *et al*. (2014).

Soil application of 100% RDF + urea @ 2% foliar spray at flowering stage + capsule formation stage (T_4) recorded significantly higher seed yield (590 kg ha^{-1}) and number of capsules per plant (96.2) over other treatments followed by 100% RDF as soil application + MOP @ 2% foliar spray at flowering stage + capsule formation stage (T_7) with grain yield of 538 kg ha^{-1} and no. of capsules per plant was 85.0 respectively. Additional quantity of nitrogen supplied from urea through foliar sprays at crucial stages *i.e*., flowering and capsule formation stages in addition to the RDF might have enhanced all the growth and yield attributing parameters which led to increase in seed yield. These results are in agreement with the findings of Martin Stanley and Basavarajappa (2014).

Table 1: Growth, Yield attributes and Yield of sesamum as influenced by foliar spray of Urea and Muriate of Potash (MOP)

Treatments	Plant height (cm)	No. of branches / Plant	No. of capsules / Plant	Seed yield (Kg/ha)
T_1- 100% RDF (Soil application)	64.4	3.77	63.9	436
T_2- T_1 + urea @ 2% foliar spray at flowering stage	85.5	4.52	83.2	524
T_3- T_1 + urea @ 2% foliar spray at capsule formation stage	70.2	3.96	70.4	463
T_4- T_1 + urea @ 2% foliar spray at flowering stage + capsule formation stage	100.1	4.97	96.2	590
T_5- T_1 + MOP @ 2% foliar spray at flowering stage	73.6	4.10	72.5	471
T_6- T_1 + MOP @ 2% foliar spray at capsule formation stage	68.7	3.84	65.7	442
T_7- T_1 + MOP @ 2% foliar spray at flowering stage + capsule formation stage	89.3	4.54	85.0	538
T_8- Control	52.8	3.23	45.4	345
SEm ±	3.07	0.14	2.96	16.16
CD (P = 0.05)	9.07	0.41	9.14	47.03
CV%	8.3	6.0	6.2	9.8

Effect on Economics

The economics and B:C ratio of sesame as affected by foliar nutrition of urea and MOP are presented in Table 2. The input and output prices of commodities prevalent during the year of trial were taken for calculating cost of production. Soil application of 100% RDF + foliar nutrition with urea @ 2% at flowering stage + capsule formation stage (T_4) recorded highest gross returns (Rs.47200 ha^{-1}) and net returns (Rs.33450 ha^{-1}) followed by soil application of 100% RDF + foliar nutrition with MOP @ 2% at flowering stage + capsule formation stage (T_7) with gross returns of Rs. 43040 ha^{-1} and net returns of Rs. 29070 ha^{-1} respectively. The highest benefit cost ratio (2.43) was obtained with soil application of 100% RDF + foliar nutrition with urea @ 2% at flowering stage + capsule formation stage (T_4) and it was followed by T_1 + foliar nutrition with urea @ 2% at flowering stage (T_2) with B:C ratio of 2.13. These results are in accordance with the findings of Mahajan *et.al*. (2016).

Table 2: Economics and B:C ratio of sesamum as influenced by foliar application of Urea and Muriate of Potash (MOP)

Treatments	Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C Ratio
T_1- 100% RDF (Soil application)	34880	13010	21870	1.68
T_2- T_1 + urea @ 2% foliar spray at flowering stage	41920	13380	28540	2.13
T_3- T_1 + urea @ 2% foliar spray at capsule formation stage	37040	13380	23660	1.77
T_4- T_1 + urea @ 2% foliar spray at flowering stage + capsule formation stage	47200	13750	33450	2.43
T_5- T_1 + MOP @ 2% foliar spray at flowering stage	37680	13490	24190	1.79
T_6- T_1 + MOP @ 2% foliar spray at capsule formation stage	35360	13490	21870	1.62
T_7- T_1 + MOP @ 2% foliar spray at flowering stage + capsule formation stage	43040	13970	29070	2.08
T_8- Control	27600	10010	17590	1.76

Conclusion

The results obtained can be concluded as nitrogen supplements through foliar nutrition in the form of urea at crucial stages such as flowering and capsule formation stages along with the recommended dose of fertilization through soil application resulted in higher seed yield and monetary returns in sesamum.

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