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Effect of Nutrient management on Seed yield and Oil yield of Mesta

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ABSTRACT

A field experiment was conducted during *kharif*, 2022 at Agricultural Research Station Farm, Amadalavalasa, Andhra Pradesh to study the effect of nutrient management on seed yield and oil yield of mesta. The total number of capsules per plant, seed yield and oil yield were significantly influenced by the different treatments imposed to the crop. Significantly higher number of capsules per plant (17 no.), seed yield (772 kg ha^{-1}) and oil yield (138 kg ha^{-1}) were recorded with 100% Recommended Dose of Fertilizer + 25% N through Vermi Compost + Biofertilizers (*Azospirillum* + PSB) + 2% KNO_3 as a foliar spray over 125% RDF and control.

Key Words: *Mesta, RDF, Biofertlizers, FYM, VC and Foliar spray*

Mesta (*Hibiscus sabdariffa var. altissima*) is essentially an important tropical cordage crop of the orient. It belongs to the family Malvaceae. In India, it is being grown over an area of 61.79 thousand ha with a production of 534.06 thousand bales and yield of 1556 kg ha^{-1}. It is cultivated as fibre crop in drier tracts of Deccan comprising of Andhra Pradesh, West Bengal, parts of Karnataka, Maharashtra, Madhya Pradesh, Assam and Bihar. Andhra Pradesh is a leading state in the country with respect to both area (6.6 thousand ha) and production of 57.45 thousand bales (Status of Jute and Mesta in India, 2018) which accounts for 30% of the area and 42% of production.

Mesta is one of the important fibre crops which provides fibre, forage and paper pulp and has broadend our agricultural diversity to reduce pressure on forest resources. In recent years, it has been proved that the crop could be allowed to grow upto seed setting stage and the sticks after seed collection can be utilized for pulp production to manufacture all types of paper including newsprints. Its seed contains 18 to 20 per cent oil, which can be directly used in soaps and other industries.

Basically mesta is the *kharif* crop. Weather of this season is hot, humid and rainy (Mollah *et al*., 2019). Nitrogen fertilizer losses rapidly through denitrification, volatilization and leaching. Under such situation the foliar application of N may supplement the soil applied nutrients to meet the high demand of the crop during the critical period of crop (Ahmed and Ahmed, 2005). Farmers are in practice of using more and more nitrogenous and phosphatic fertilizers and this practice leads to depletion of potash in crop grown area. Potassium improves yield and quality of seed besides providing resistance to environmental stress (Sharma *et al.*, 2000). Foliar nutrition when used as a supplement the crop gets benefitted from foliar applied nutrients when the roots are unable to meet the nutrient requirement of the crop at its critical stage (Ebelhar and Ware 1998). Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen through plant roots. They solubilise insoluble soil phosphates to soluble forms and produce plant growth substances in the soil. Keeping in view of above points, the present investigation was carried out to find out the effect of foliar feeding and liquid biofertilizers on mesta.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station Farm, Amadalavalasa during *kharif*, 2022 on a sandy loam soil with neutral in reaction, and non-saline in nature. The soil was low in organic carbon and available nitrogen, medium in available phosphorus, high in available potassium.

The experiment was laid out in Randomized Block Design with nine treatments replicated thrice. The treatments were comprised of T_1: Control, T_2: 100% (Recommended Dose of Fertilizer) + 25% N through (Vermi Compost) + Biofertilizers

(*Azospirillum* + PSB), T_3: 100% RDF + 25% N through FYM + Biofertilizer (*Azospirillum* + PSB), T_4: T_2 + 2% Urea (Foliar spray), T_5: T_3 + 2% Urea (Foliar spray), T_6: T_2 + 2% KNO_3 (Foliar spray), T_7: T_3 + 2% KNO_3 (Foliar spray), T_8: 125% RDF and T_9: 150% RDF . The test crop AMV -10 variety of mesta was cultivated during *kharif* with a seed rate of 5 kg ha^{-1} and recommended fertilizer dose of 40-20-20 kg N, P_2O_5 and K_2O kg ha^{-1}.

FYM @ 2 t ha^{-1} and VC @ 1t ha^{-1} were added seven days before sowing on dry weight basis to the experimental plots except for control (T_1). Liquid biofertilizers *viz*., *Azospirillum* @ 0.5 L ha^{-1} mixed well with seeds and shade dry and then used for sowing. Phosphorus soluiblizing bacteria (PSB) @ 1.5 L ha^{-1} thoroughly mixed with well decomposed farm yard manure (FYM) @ 100 kg ha^{-1} applied to the field under optimum moisture condition. The recommended dose of phosphorus, potassium and 50 per cent of nitrogen were applied as basal dose at the time of sowing to the respective treatments. The remaining 50 per cent nitrogen was applied in two equal splits at 30 and 60 days after sowing. Nitrogen in the form of urea, phosphorus in the form of single super phosphate and potassium in the form of muriate of potash were applied. Foliar spray of urea, KNO_3, was done as per the concentrations mentioned in the treatment details before flowering using a knapsack sprayer.

The parameters number of capsules per plant, total number of seed per capsule, 100 seed weight, seed yield, oil content and oil yield were worked out duly following the procedures prescribed.

RESULTS AND DISCUSSION

Number of capsules per plant

Significantly higher number of capsules per plant (17 no.) were recorded in treatment T_6 *i.e*., 100% RDF + 25% N through VC +Biofertilizers (*Azospirillum* + PSB) + 2% KNO_3 as foliar spray and it was on par with all the treatments tested except T_8 (125% RDF) and T_1 (control). Significantly lower number of capsules per plant (9 no.) was observed in the control (T_1) over rest of the treatments (Table 1).

Number of seeds per capsule

Number of seeds per capsule ranged from 23 to 29 with mean value of 24.44 and revealed that there was no significant variation among the different treatments when compared to control (no fertilizers) (Table 1). Higher number of seeds capsule^{-1} (29 no.) were observed in treatment T_6 that received 100% RDF + 25% N through VC +Biofertilizers (*Azospirillum* + PSB) + 2% KNO_3 as foliar spray and it was statiscally on par with all treatments where as lower number of seeds per capsule (23 no.) were recorded in T_1 (control).

100 seed weight (g)

Data on 100 seed weight of mesta furnished in Table 1 showed that there was no significant difference among different treatments imposed to the crop. However, 100 seed weight recorded in T_6 *i.e*., T_2 + 2% KNO_3 as foliar spray (2.90) was higher among different treatments and lower seed weight (2.64) was recorded by control with a mean value of 2.77.

Seed yield (kg ha^{-1})

Significantly higher seed yield was recorded with the application of 100% RDF + 25% N through VC + Biofertilizers (*Azospirillum* + PSB) +2% KNO_3 as foliar spray (772 kg ha^{-1}) compared to control and 125% RDF and lower seed yield of 507 kg ha^{-1} was recorded in the control (Table 1).

Though significant seed yield differences were not observed among the biofertilizer treatments with or without the addition of foliar spray, KNO_3 treatments recorded numerically higher seed yields followed by urea foliar spray treatments followed by biofertilizer treatments in combination with 100% RDF.

Higher seed yield in foliar application combined with biofertilizers applied to soil might be due to foliar application of nutrients helped in more photosynthetic activity as a result of higher N, P and K uptake and better partitioning of dry matter and photo-assimilates towards reproductive structures (Norton *et al.,* 2005) and thereby higher biomass (Shivamurthy and Biradar 2014), which resulted in higher number of capsules realized to higher seed yield. Similar results were reported by Laxman *et al.* (2017), Ratnakumari *et al.* (2014), Sritharan *et al.* (2013), Shah *et al.* (2012), Saravanan *et al.* (2012) and Raju *et al.* (2008) in other fibre crop (Cotton).The lower yields were mainly due to the non-availability of potassium during capsule development stages as applied potassium has fixed in soil (Pervez *et al.,*

2008) under moisture stress conditions of rainfed agriculture. In addition to this, the stress condition resulted in poor uptake of N, P and K and might have not met the plant requirement of these nutrients for growth and development resulting in lower yield attributes thereby lower yield.

Table 1: Effect of nutrient management on yield attributes of mesta

Treatments	Number of capsules per plant	Number of seeds per capsule	100 Seed weight (g)	Seed yield (kg ha-1)
T_1: Control	9	23	2.64	507
T_2: 100% RDF + 25% N through VC + Biofertilizers (*Azospirillum* + PSB)	15	25	2.78	742
T_3: 100% RDF + 25% N through FYM + Biofertilizers (*Azospirillum* + PSB)	15	25	2.74	735
T_4: T_2 + 2% Urea (Foliar spray)	16	25	2.81	757
T_5: T_3 + 2% Urea (Foliar spray)	15	25	2.79	753
T_6: T_2 + 2% KNO_3 (Foliar spray)	17	29	2.9	772
T_7: T_3 + 2% KNO_3 (Foliar spray)	16	25	2.88	765
T_8: 125% RDF	12	24	2.71	671
T_9: 150% RDF	14	25	2.71	710
Mean	14.33	25.11	2.77	712.44
S.Em (±)	0.9	0.96	0.1	21.32
CD (P = 0.05)	2.7	NS	NS	64.02
C.V (%)	10.67	6.57	6.15	7.61

Table 2: Effect of nutrient management on oil content and yield of mesta

Treatments	Oil Content (%)	Oil Yield (kg ha-1)
T_1: Control	17.02	86
T_2: 100% RDF+25%N through VC +Biofertilizers (*Azospirillum* +PSB)	17.64	130
T_3: 100% RDF+25%N through FYM +Biofertilizers (*Azospirillum* +PSB)	17.62	129
T_4: T_2+2% UREA (Foliar spray)	17.79	134
T_5: T_3+2% UREA(Foliar spray)	17.77	133
T_6: T_2+2% KNO_3(Foliar spray)	17.89	138
T_7: T_3+2% KNO_3 (Foliar spray)	17.81	136
T_8: 125% RDF	17.31	116
T_9: 150% RDF	17.32	122
Mean	17.57	124.88
S.Em (±)	0.31	5.45
CD (P = 0.05)	NS	16.37
C.V (%)	12.17	10.32

Oil content

Oil content did not show any significant difference among different treatments imposed to crop However, oil content numerically varied from 17.02% to 17.89% with a mean value of 17.57% presented in Table 2.

Oil Yield

Significantly higher oil yield (138 kg ha^{-1}) was recorded in T_6 (T_2 + 2% KNO_3 as a foliar spray) followed by T_7 (T_3 + 2% KNO_3 as a foliar spray), T_4 (T_2+ 2% Urea as a foliar spray), T_5 (T_3 + 2% Urea as a foliar spray), T_2 (100% RDF + 25% N through VC +Biofertilizers (*Azospirillum* + PSB)), T_3 (100% RDF + 25% N through FYM + Biofertilizers (*Azospirillum* + PSB)) and T_9 (150% RDF) with values of oil yield (136, 134, 133, 130, 129 and 122 kg ha^{-1}) and all those treatments were statistically on par with each other. A significantly lower value was recorded in T_1 (86kg ha^{-1}) (Table 2).

Among the inorganic treatments, lower oil yield was recorded in T_8 (116 kg ha^{-1}) which was also on par with T_9 (122 kg ha^{-1}) and both treatments were significantly superior over control.

Treatments with foliar application of KNO_3 were found superior over treatments with foliar application of urea. This foliar application of nitrate salts at the beginning of the reproductive growth of plants involves a number of physiochemical changes which improved dry matter accumulation due to overall improvement in growth and high production of photosynthates leading to increased availability, absorption and translocation of nutrients which ultimately increased the yield of the crop tend to increase in oil yield. The results are in conformity with the earlier research findings in mustard by Raj and Mallick (2017).

From the present study, it can be concluded that soil application of biofertilizers at sowing will help the plant for uptake of nutrient during the early stages by improving soil fertility by fixing atmospheric nitrogen by plant roots and these solublise insoluble soil phosphates to soluble and produces plant growth substances in the soil. Foliar application of 2% KNO_3 at beginning of reproductive phase , the crop gets benefitted from foliar applied nutrients when the roots are unable to meet the nutrient requirement of the crop at its critical stage there by the higher seed cotton yield can be achieved.

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