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Fibre yield and fibre weight of mesta varieties as influenced by spacing and nutrient sources

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ABSTRACT
Mesta is one of the important crops which provide fibre, forage and paper pulp. Field experiment was conducted at 19E block at field unit GKVK, University of Agricultural Sciences, Bangalore which is located at a latitude of 12058' north, longitude of 7703' east and at an altitude of 930 m above mean sea level in Eastern dry zone (zone 5) of Karnataka to study the fibre weight and fibre yield of mesta as influenced by varieties, spacing and nutrient sources. The fibre weight per plant differed significantly due to different plant spacing, varieties and nutrient sources. Among the varieties, variety HS-108 recorded significantly higher fibre weight per plant (3.54 g) than variety AMV-4 (2.99 g). Significantly higher fibre weight per plant was recorded under 45 cm x 10 cm spacing (3.40 g) than 30 cm x 10 cm (3.13 g). Further, application of 5 t of FYM per ha along with 40:20:20 kg NPK per ha fertilizer registered higher fibre weight per plant (3.68 g) compared to 100 per cent N equivalent through FYM (2.83 g). The fibre yield differed significantly due to different plant spacing, varieties and nutrient sources. Among the varieties, variety HS-108 recorded significantly higher fibre yield (948 kg/ha) than variety AMV-4 (850 kg/ha). Significantly higher fibre yield was recorded under 45 cm x 10 cm spacing (923 kg/ha) than 30 cm x 10 cm (875 kg/ha). Further, application of 5 t of FYM per ha along with 40:20:20 kg NPK per ha fertilizer registered higher fibre yield (962 kg/ha) compared to 100 per cent N equivalent through FYM (803 kg/ha). The interaction effects between varieties, plant spacing and nutrient sources were found to be significant

Key words : Mesta, Variety, Nutrient, Fibre, Spacing

INTRODUCTION

Mesta is one of the important crops which provides fibre, forage and paper pulp and has broadened our agricultural diversity to reduce pressure on forest resources. It is one of the important bast fibre crops which stand next to jute in production. It is the nearest ally of jute and plays an effective role in supplementing the short supply of jute industry. In recent years, this crop is gaining the attention of research workers since it is also used as a raw material in the paper industry substituting bamboo and eucalyptus whose supply is becoming scarce day by day. Mesta fibre is used as an alternative to jute fibre or for blending with jute in the manufacture of jute goods *viz.*, cordage, sackings, hessains, canvas and rough sack cloths. It is also used for making ropes, twines, fishing nets etc. The stalks are used in making paper pulp, structural boards, blends with wood pulp and for thatching huts. 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. The crop possesses fleshy red calyces, which are used for preparing natural dyes, jam, jellies, pickles etc. and the leaves for preparing pickles and also as leafy vegetable. It also acts as a natural fibre substitute for fibre glass. It serves as raw material for automobile dash boards, carpet padding and is also used in moulded plastics.

MATERIALS AND METHODS

The experiments was conducted in 19E block at field unit GKVK, University of Agricultural Sciences, Bangalore which is located at a latitude of $12^0$58' north, longitude of $77^0$3' east and at an altitude of 930 m above mean sea level in Eastern dry zone (zone 5) of Karnataka. The soil of the experimental site was red sandy loam. The soil was near neutral in pH with low organic carbon content. The soil was also found to be medium in available nitrogen, available phosphorus, and available potassium content.

The experiment comprised of 16 treatment combinations consisting of two varieties, two spacing trails and four nutrient treatments.

Treatment details:

Replication : Three
Design : Split-split plot design
Main plot treatment: varities (V)
1) AMV-4 (V_1)
2) HS-108 (V_2)
Sub plot treatment : Plant spacing (S)
1) 30 cm x 10 cm (S_1)
2) 45 cm x 10 cm (S_2)
Sub-sub plot treatment: N sources (N)
1) 40:20:20 kg NPK/ha (N_1)

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2) 40:20:20 kg NPK/ha + 5 t/ha FYM (N_2)
3) 30:20:20 kg NPK/ha + 7.5 t/ha FYM (N_3)
4) 100 per cent N equivalent through FYM (N_4)

Treatment combinations:

The details of the treatment combinations were as follows. T_1 : AMV-4 + 30 cm X 10 cm+ 40:20:20 kg NPK/ha, T_2 : AMV-4 + 30 cm X 10 cm + 40:20:20 kg NPK/ha+ 5 t FYM/ha, T_3 : AMV-4 + 30 cm x 10 cm + 30:20:20 kg NPK/ha+ 7.5 t FYM/ha, T_4 : AMV-4 + 30 cm X 10 cm + 100 per cent N equivalent through FYM T_5 : AMV-4 + 45 cm X 10 cm + 40:20:20 kg NPK /ha T_6 : AMV-4 + 45 cm X 10 cm + 40:20:20 kg NPK/ha+ 5 t FYM/ha T_7 : AMV-4 + 45 cm X 10 cm + 30:20:20 kg NPK/ha+ 7.5 t FYM/ha T_8 : AMV-4 + 45 cm X 10 cm + 100 per cent N equivalent through FYM T_9 : HS-108 + 30 cm X 10 cm + 40:20:20 kg NPK ha^{-1}, T_{10} : HS-108 + 30 cm X 10 cm + 40:20:20 kg NPK/ha+ 5 t FYM/ha T_{11} : HS-108 + 30 cm X 10 cm + 30:20:20 kg NPK/ha+ 7.5 t FYM/ha T_{12} : HS-108 + 30 cm X 10 cm + 100 per cent N equivalent through FYM T_{13} : HS-108 + 45 cm X 10 cm + 40:20:20 kg NPK ha^{-1}, T_{14} : HS-108 + 45 cm X 10 cm + 40:20:20 kg NPK/ha+ 5 t FYM/ha T_{15} : HS-108 + 45 cm X 10 cm + 30:20:20 kg NPK/ha+ 7.5 t FYM/ha T_{16} : HS-108 + 45 cm X 10 cm + 100 per cent N equivalent through FYM. The randomly ten plants were selected from the net plot and then the fibre was extracted from these plants and weight was recorded in grams. Mean fibre yield of 10 plants was taken as fibre weight per plant and all the stalks from the net plot were subjected to retting and fibre was extracted. Then the fibre was air dried and weight was recorded including 10 plants fibre weight and was expressed as fibre yield per plot in kilograms. Later, it was converted into kilograms per hectare.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Performance of varieties:

Pooled data of two years revealed that the varieties had differential yield potentials and significantly differed with regard to fibre yield. The variety HS-108 produced higher fibre yield (948 kg/ha) when compared to AMV- 4 (850 kg/ha). HS-108 showed 11.5 per cent yield advantage over AMV- 4 (Table 1). Sardana *et al*. (1983), Naidu *et al.* (1996), Anonymous (1999), and Sarma (1999) reported significantly superior fibre yields with new improved varieties over local varieties. Varietal differences with respect to fibre yield was also observed by Krishnamurthy *et al.* (1994), and Anuradha and Rao (1999).

Variation in fibre yield among the varieties could be attributed mainly to their variability in production of fresh biomass and dry stalk yields per hectare at harvest. Variation in fibre yield among the varieties also depends on fibre produced by individual plants. Among the varieties, fibre weight (pooled) was significantly higher with HS-108 (3.54 g/plant) compared to AMV- 4 (2.99 g/plant). HS-108 registered 18.4 per cent higher fibre weight per plant over AMV- 4. Therefore, higher fibre yield of HS-108 variety could be attributed to its ability to yield more fibre per plant. Aruna *et al.* (1988) opined that fibre weight per plant had highest direct effect on fibre yield per hectare.

Effect of plant spacing:

Plant spacing adjustment is an important agronomic manipulation for attaining higher yields. Maintenance of optimum plant population helps to utilize available moisture, nutrients, solar radiation efficiently and enable the crop to produce higher yields.

In the present investigation, intra-row spacing of 10 cm with an inter row spacing of 30 cm and 45 cm were maintained. Pooled data revealed that, fibre yield of mesta vary significantly due to increase in plant population from 0.25 to 0.38 million plants per ha. Significantly higher fibre yield (923 kg/ha) was obtained under 45 cm x 10 cm plant spacing as compared to 30 cm x 10 cm plant spacing (875 kg/ha) (Table 1), (Morwal *et al*., 1998).

Fibre yield also depends on the fibre contribution from individual plants. Fibre weight per plant showed almost inverse relationship with number of plants per unit area and it decreased significantly with increase in plant population by decreasing inter row spacing from 45 cm to 30 cm. Fibre weight under 45 cm x 10 cm (3.40 g/plant) spacing was significantly superior over 30 cm x 10 cm plant spacing (3.13 g/plant) (Table 1). This loss in fibre weight per plant at higher plant population might not have been compensated by the increased number of plants per unit area resulting in lower fibre yield per hectare. Increased plant height and stem girth under 45 cm x 10 cm plant spacing had favourable influence on fibre weight per plant and fresh biomass yield and showed significant improvement in dry stalk and fibre yield per ha. Reduced plant height and stem girth at higher plant populations under 30 cm x 10 cm plant spacing could be attributed to increased inter plant competition for growth resources *viz.,* moisture, nutrients and solar radiation.

Table 1 : Fibre weight (g/plant) and fibre yield (kg/ha) of mesta varieties as influenced by plant spacing and nutrient source at harvest stage (Pooled)

Treatments		Fibre weight (g/plant)			Fibre yield (kg/ha)		
		2007	2008	Pooled	2007	2008	Pooled
Variety (V)							
AMV-4 (V_1)		2.85	3.14	2.99	819	880	850
HS-108 (V_2)		3.41	3.66	3.54	921	974	948
S.E. ±		0.01	0.04	0.03	2.49	4.28	3.39
C.D. (P=0.05)		0.02	0.16	0.09	6.72	12.43	9.18
Plant Spacing (S)							
30 cm x 10 cm (S_1)		3.00	3.26	3.13	845	905	875
45 cm x 10 cm (S_2)		3.26	3.54	3.40	896	949	923
S.E. ±		0.01	0.04	0.03	2.57	3.79	3.18
C.D. (P=0.05)		0.02	0.10	0.09	7.14	10.54	8.84
Nutrient source (N)							
40:20:20 kg/ha (N_1)		3.42	3.70	3.56	904	943	924
40:20:20 kg/ha + 5 t FYM/ha (N_2)		3.53	3.82	3.68	948	975	962
30:20:20 kg/ha + 7.5 t FYM/ha (N_3)		3.26	3.62	3.44	891	923	907
100 per cent N equivalent through FYM (N_4)		3.20	2.46	2.83	738	868	803
S.E. ±		0.01	0.05	0.03	3.60	5.82	4.71
C.D. (P=0.05)		0.02	0.11	0.09	7.44	12.00	9.72
Interactions							
VxS	S.E. ±	0.01	0.11	0.06	7.16	11.45	9.31
	C.D.(P=0.05)	0.03	NS	0.12	20.31	NS	20.01
VxN	S.E. ±	0.02	0.15	0.08	10.14	16.62	13.38
	C.D.(P=0.05)	0.05	0.33	0.16	22.74	37.65	27.02
SxN	S.E. ±	0.02	0.15	0.08	10.21	16.14	13.2
	C.D.(P=0.05)	0.04	NS	0.16	21.70	34.15	27.93
VxSxN	S.E.±	0.13	0.07	0.10	5.09	8.22	6.66
	C.D.(P=0.05)	0.35	NS	0.20	14.76	24.66	19.96

DAS-Days After Sowing; FYM- Farm Yard Manure; NS-Non-Significant

Effect of nutrient sources:

The production efficiency of a crop though depends on its genetic potential, its yield could be improved to a perceptible magnitude through proper nutrient management, and further the nutrient requirement of a crop varies with the variety. Therefore, study was conducted to find out the optimum requirement of the nutrients for higher yields.

The combined application of N both as organic and inorganic recorded significantly higher yield than N supplied either through organic or inorganic sources alone. Significant increase in fibre yield was noticed with application of 5 t FYM / ha along with the recommended dose of fertilizer followed by application of recommended dose of fertilizer alone. Application of 5 t FYM/ha along with the recommended dose of fertilizer recorded significantly higher fibre yield (962 kg/ha) when compared to application of 100 per cent N equivalent through FYM alone (803 kg/ha). Application of 5 t FYM/ha along with the 40:20:20 kg NPK per ha showed 19.80 per cent higher yield over application of 100 per cent N equivalent through FYM alone and it was 4.11 per cent superior over application of 40:20:20 kg NPK per ha alone. The yield was increased with combined application of organic and inorganic sources. The results of present study are in conformity with the findings of Venkatakrishnan *et al.* (2004)

The production rate of fibre increased with the combined application of organic and inorganic sources of nitrogen. It indicates that response to applied nutrients was maximum for integrated nutrient management (962 kg/ha) when compared to application inorganic source (924 kg/ha) and organic source alone (803 kg/ha).The results also corroborate the findings of Biwas (2004) and Venkatakrishnan *et al.* (2004).

Variation in fibre yield due to various levels and sources of nitrogen may be attributed to their influence on fresh biomass and dry stalk yields per hectare at harvest which are the main yield determining factors. Unlike other crops, fibre yield in mesta is mainly depending on the vegetative growth and production of total biomass in terms of stalk (stem) yield. This was in conformity with Krishnamurthy *et al.* (1994), Naidu *et al.* (1996), Ali *et al.* (1994) and Guggari (2002).

Fibre yield is also related to fibre contribution by individual plants. Fibre weight per plant (pooled) increased significantly with application of 5 t FYM pet ha along with 40:20:20 kg NPK per ha (3.68 g/plant) as compared to application of 40:20:20 kg NPK per ha alone (3.56 g/ plant) and application of 7.5 t FYM per ha along with 30:20:20 kg NPK per ha (3.44 g/plant). Similarly, application of 100 per cent N equivalent through FYM alone recorded significantly lower fibre weight (2.83 g/ plant). It could be reasoned for application of N as organic and inorganic source which ensured the continuous release of N, synchronizing with the crop requirement at different phenophases which has resulted in higher yield and yield parameters, thus suggesting that application of fertilizer along with organic manure was more advantageous (Biwas, 2004 and Venkatakrishnan *et al.*,2004).

Interaction effects:

Interaction of variety and plant spacing:

Fibre yield (pooled), decreased with increase in plant population in both the varieties. HS-108 planted at 45 cm x 10 cm plant spacing (lower plant population) recorded significantly higher fibre yield of 976 kg per ha compared to the variety AMV- 4 recording 830 kg per ha planted at 30 cm x 10 cm (higher plant population). Higher fibre yield of 3.68 g per plant was the resultant of higher fibre weight of variety HS-108 at lower plant population compared to the variety AMV- 4 planted at 30 cm x 10 cm (2.83 g/plant) (Table 2). Higher fibre weight per plant of HS-108 at lower plant population could be attributed to production of taller plant, stem diameter producing higher total dry matter production per plant. This may also be due to higher fresh biomass and dry stalk yield per plant.

Interaction of variety and nutrient sources:

Fibre yield (pooled), differed significantly due to the interaction of variety of nutrient sources. Variety HS-108 in combination with 5 t FYM per ha and 40:20:20 kg NPK per ha recorded significantly higher fibre yield (1027 kg/ ha) compared to the variety AMV- 4 supplied with 100 per cent N equivalent through FYM alone (782 kg/ha) (Table 2). Higher fibre yield in variety HS-108 in combination with the conjugative application of both organic and inorganic nutrient source was a result of higher fibre weight (4.00 g/plant) compared to the variety AMV- 4 combined with the application of FYM alone (2.26 g/plant). Higher fibre weight per plant of variety HS-108 could be attributed to higher plant height, stem diameter and higher total dry matter production per plant.

Interaction of plant spacing and nutrient source:

Fibre yield (pooled) differed significantly due to the interaction of plant spacing and nutrient sources. Application of 5 t FYM per ha and 40:20:20 kg NPK per ha under 45 cm x 10 cm plant spacing recorded significantly higher fibre yield (1000 kg/ha) (Table 3) compared to the application of 100 per cent N equivalent

Table 2 : Fibre weight (g), fibre yield (kg/ha), on dry weight basis of mesta varieties as influenced by plant spacing and nutrient source at harvest stage (Pooled)

Treatments	Variety (V)			
	Fibre weight (g)		Fibre yield (kg/ha)	
	V_1	V_2	V_1	V_2
Plant Spacing (S)				
30 cm x 10 cm (S_1)	2.83	3.40	830	915
45 cm x 10 cm (S_2)	3.13	3.68	869	976
S.E ±		0.06		9.31
C.D. (P=0.05)		0.12		20.01
Nutrient source (N)				
40:20:20 kg/ha (N_1)	3.24	3.89	981	867
40:20:20 kg/ha + 5 t FYM/ha(N_2)	3.35	4.00	896	1027
30:20:20 kg/ha + 7.5 t FYM/ha (N_3)	3.06	3.74	855	960
100 per cent N equivalent through FYM (N_4)	2.26	2.51	782	815
S.E ±		0.08		11.38
C.D. (P=0.05)		0.16		27.02

V_1- AMV-4; V_2 – HS-108 ; FYM-Farm Yard Manure ; DAS –Days After Sowing

Table 3 : Fibre weight (g), fibre yield (kg/ha on dry weigh basis of mesta varieties as influenced by plant spacing and nutrient source at harvest stage (Pooled)

Treatments	Spacing (S)			
	Fibre weight (g)		Fibre yield (kg/ha)	
	S_1	S_2	S_1	S_2
Nutrient source (N)				
40:20:20 kg/ha (N_1)	3.43	3.71	898	949
40:20:20 kg/ha + 5 t FYM/ha (N_2)	3.52	3.84	923	1000
30:20:20 kg/ha + 7.5 t FYM/ha (N_3)	3.20	3.60	882	933
100 per cent N equivalent through FYM (N_4)	2.30	2.46	788	809
S.E. ±		0.08		13.20
C.D. (P=0.05)		0.16		27.93

S_1- 30 cm x 10 cm ; S_2 – 45 cm x 10 cm ; FYM-Farm Yard Manure ; DAS –Days After Sowing

through FYM alone with 30 cm x 10 cm plant spacing (788 kg/ha). Higher fibre yield at 45 cm x 10 cm plant spacing in combination with the conjugative application of both organic and inorganic nutrient source is a result of higher fibre weight of variety HS-108 with the same combination (3.84 g/plant) compared to 30 cm x 10 cm plant spacing combined with the application of 100 per cent N equivalent through FYM alone (2.30 g/plant). Higher fibre weight per plant could be attributed to higher plant height, stem diameter and higher total dry matter production per plant.

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