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Effect of Spacing and Detopping on Seed Yield of Sunhemp

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A B S T R A C T

The study entitled "Effect of spacing and detopping on seed yield of Sunhemp" was conducted in *Kharif* 2023 in split plot design with four replications. Two factors were studied viz., Spacing (S_1- 45 cm x 10 cm, S_2- 45 cm x 15 cm, S_3- 60 cm x 10 cm) in main plots and detopping (D_1- Control, D_2- 45 DAS and D_3- 60 DAS) in sub plots. The individual plant performance with respect to number of branches plant^{-1}, dry matter accumulation plant^{-1}, and days to 50 % flowering was found maximum under the spacing of 60 cm x 10 cm whereas seed yield ha^{-1} and stalk yield ha^{-1} was obtained maximum and significantly higher with the spacing 45 cm x 10 cm. Detopping at 45 DAS recorded maximum reduction in plant height and recorded maximum branches plant^{-1} and dry matter accumulation plant^{-1}, while number of capsule plant^{-1} found maximum under topping at 60 DAS. Seed yield plant^{-1} and test weight recorded maximum under the detopping at 45 at DAS. Seed yield ha^{-1} found maximum under detopping at 45 DAS while, stalk yield ha^{-1} was found maximum under detopping at 60 DAS. As regards of economics, spacing of 45 cm x 10 cm (S_1) recorded highest gross monetary returns (77136 Rs ha^{-1}) and net monetary returns (55312 Rs ha^{-1}), while detopping at 45 DAS (D_1) recorded maximum and significantly higher gross monetary return and net monetary returns.

Introduction

Sunhemp (*Crotalaria juncea* L.) is a fast growing annual crop. It is annual shrub cultivated as multipurpose legume especially for fine fiber in many countries including India. Sunhemp (*Crotalaria juncea* L.) also named as Indian hemp, Bombay hemp, or Banaras hemp. It is an important source of natural fiber. Traditionally, its fiber is used for preparation of ropes, wines, fishing nets, tatpatties, handmade paper etc. (Tripathi *et al.*, 2013). Sunhemp belongs to *leguminaceae* is most important green manure crop. It is grown in India over an area of 11 thousand ha with annual total production of 43.6 thousand tone of fiber with yield of 715 kg ha^{-1} (Anonymous, 2022). Average productivity in the country is around 600 kg ha^{-1}. India contributes 23 percent of production with 27 percent of world's area under cultivation. (Anonymous, 2022)

Spacing is one of the factor affecting seed yield of

different crops. It influences growth rate and crop yield as a result of inter plant competition for different inputs needed for growth and development. Thus investigation on spacing arrangements becomes mandatory for understanding the mechanism of yield enhancement. Topping is practice of removal of apical shoot of crop plant to divert the nutrient flow towards yield attributing characters. Apical topping breaks the apical dominance and induces development of lateral branches thereby increase the site for pod development. The practice of topping has proved to be effective in increasing the yield levels of different crops. Keeping these points in view the present investigation was carried out to study the effect of spacing and topping management practices on growth and seed yield of Sunhemp. (Tripathi and Sarkar, 2004). Hence, keeping above facts in view an experiment was laid out to study -

1. To study the effect of spacing on seed yield.
2. To study the effect of detopping on Sunhemp seed yield.
3. To work out the economics**.**

Materials and Methods

A field experiment was conducted during *kharif* season of 2023-24 at Agronomy Research farm, College of Agriculture, Nagpur. The investigation was carried out to find out the effect of spacing and detopping on seed yield of Sunhemp. The experiment was laid out in Split plot design with two factor namely spacing (Three spacing: (S_1- 45 x 10 cm, S_2- 45 x 15 cm, S_3-60 x 10 cm and detopping (D_1- No detopping, D_2-Detopping at 45 DAS and D_3-Detopping at 60 DAS), thus nine treatment combinations with four replications. The soil of experimental plot was clay in texture having slightly alkaline pH (7.6). As regard to fertility status it was medium in organic carbon (0.55 %), low in available nitrogen (264.30 kg ha^{-1}), medium in available phosphorus (21.16 kg ha^{-1}) and very high in available potassium (394.22kg ha^{-1}). Sunhemp variety K-12 was sown on 23rd June 2023 and harvested on 20th Nov 2023 and recommended dose of fertilizer was given at the time of sowing.

Results and Discussion

Growth attributes

The spacing had no significant effect on the plant height at all stages of observation. This might be due to availability of sunlight and air for the growth of the plant without competition**,** however in detopping highest plant height (204.21 cm) was seen in detopping treatment (D_1) no detopping, while maximum number of branches per plant, dry matter accumulation, days to 50 % flowering and days to flower initiation recorded significantly higher under the spacing 60 x10 cm with plant detopped at 45 DAS.

The similar results are reported by Gopal *et al.,* (2016) that topping practice on 45 DAS had recorded maximum reduction in plant height at harvest as compared to 60 DAS, 75 DAS, and without topping.

Yield attributes

Various yield attributes of Sunhemp were taken at harvest. The number of capsule^{-1} (52.87), number of seed capsule^{-1} (7.51), seed yield plant^{-1} (18.90), stalk yield plant^{-1} (66.09)and 1000 seed weight (g) (37.60) were observed in spacing (S_3) 60 x 10 cm followed by (S_2) 45 x 15 cm and least was recorded in 45 x 10 cm while in case of detopping maximum number capsule^{-1} (55.99), number of seed capsule^{-1}(7.65), seed yield plant^{-1} (21.84), stalk yield plant^{-1} (79.17) and 1000 seed weight (g) (38.75 g) in detopping at 45 DAS and 60 DAS and least was recorded in no detopping treatment (D_1). Due to more number of branches plant^{-1}, there were also more capsule produced plant^{-1}. The findings are consistent with those of Tripathi *et al.,* (2013) and Mandal *et al.,* (2017)

Yield

Among yield, spacing 45 x 10 cm (S_1) recorded the highest seed yield (11.02 q ha^{-1}) and stalk yield (48.37 q ha^{-1}) followed by 60 x 10 cm and least was recorded at 45 x 15 cm.

In detopping highest seed yield (10.44 q ha^{-1}) and stalk yield (46.24 q ha^{-1}) were recorded in 45 DAS (D_2) and 60 DAS (D_3) and minimum was found to be in no detopping treatment (D_1).

The harvest index found maximum under the 45 x 10 cm spacing while in case of detopping recorded highest under detopping at 45 DAS. Similar results were found by Gopal *et al.,* (2016) in Dhaincha who revealed that topping on 45 DAS recorded significantly higher seed yield than topping on 60 DAS, 75 DAS and without topping. Nayak (2017) in Dhaincha also reported the

maximum stalk yield when row spacing was less. These results are in conformity with the present findings.

Table.1 Effect of spacing and detopping on growth attributes of Sunhemp

Treatments		Mean plant height (cm)	Mean number of branches plant^{-1}	Dry matter accumulation plant^{-1} (g)	Days to flower initiation	Days to 50 % flowering	No. of capsules plant^{-1}	No. of seeds capsule^{-1}	Seed yield plant^{-1} (g)	Stalk yield plant^{-1} (g)	Test weight (g) (1000) seeds
A	**Spacing levels (S)**										
	S_1– 45 x 10 cm	197.98	21.38	46.32	60.04	74.61	61.03	7.25	16.93	56.88	**37.87**
	S_2 – 45 x 15 cm	203.26	21.64	49.80	59.83	74.45	63.15	7.36	17.60	64.89	**37.60**
	S_3 – 60 x 10 cm	199.22	26.80	50.80	60.43	75.37	66.21	7.51	18.90	66.09	**37.53**
	SE(m) ±	1.63	0.82	1.21	0.31	0.60	1.41	0.07	0.46	3.70	-
	C.D. at 5%	NS	2.47	4.19	NS	NS	NS	NS	NS	NS	-
B	**De- topping levels (D)**										
	D_1- Control	204.21	20.16	33.89	57.67	71.70	40.71	7.16	10.64	32.08	**36.60**
	D_2 – 45 DAS	197.21	25.71	56.19	65.03	75.17	73.68	7.65	21.84	76.63	**38.75**
	D_3 – 60 DAS	199.04	23.95	56.85	57.61	77.57	75.99	7.32	20.97	79.17	**37.66**
	SE(m) ±	1.50	0.92	1.38	0.46	0.51	1.78	0.09	0.57	3.80	-
	C.D. at 5%	4.51	2.72	4.10	1.36	1.51	5.28	NS	1.69	11.30	-
C	**Interaction**										
	S.E. (m) ±	3.21	1.59	2.39	0.79	0.88	3.08	0.11	0.99	6.59	-
	C.D. at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	-

Table.2 Effect of spacing and detopping on yield attributes and economics of Sunhemp

Treatments		Seed yield (q ha^{-1})	Stalk yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index	COC (Rs ha^{-1})	GMR (Rs ha^{-1})	NMR (Rs ha^{-1})	B:C ratio
A	**Main-Spacing (S)**								
	S_1– 45 x 10 cm	14.16	61.79	75.95	18.64	21825	77136	55312	**3.52**
	S_2 – 45 x 15cm	9.50	44.20	53.70	17.69	21265	52343	31078	**2.45**
	S_3 – 60 x 10cm	11.51	50.60	62.11	18.53	21370	63745	42375	**2.97**
	SE(m) ±	0.32	2.40	2.68	-	-	2270	2270	-
	C.D. at 5%	1.12	8.29	9.26	-	-	7853	7853	-
B	**De- topping levels (D)**								
	D_1- Control	6.97	32.23	39.21	17.77	20520	48812	28292	**2.37**
	D_2 – 45 DAS	14.35	61.55	75.90	18.90	21970	73113	51143	**3.32**
	D_3 – 60 DAS	13.85	62.81	76.66	18.06	21970	71300	49330	**3.24**
	SE(m) ±	0.37	2.34	2.64	-	-	2583	2583	-
	C.D. at 5%	1.10	6.94	7.85	-	-	7673	7673	-
C	**Interaction**								
	S.E. (m) ±	0.64	4.05	4.58	-	4474	4474	-	**4474**
	C.D. at 5%	**NS**	**NS**	**NS**	**-**	**NS**	**NS**	**-**	**NS**

Economics

Economics for each treatment combination was computed to find out economic feasibility of the

recommended practices. For spacing, the highest cost of cultivation (Rs 21825 ha^{-1}) was in (S_1) 45 x 10 cm and minimum was in 45 x 15 cm (S_2) and higher gross monetary returns (Rs 77136 ha^{-1}), net monetary returns (Rs 55312 ha^{-1}) and B:C ratio (3.52) were significantly maximum in spacing (S_1) 45 x 10cm and lowest in (S_2) 45 x 15 cm.

However, in detopping the highest cost of cultivation (Rs 21970 ha^{-1}), gross monetary returns (Rs 73113 ha^{-1}), net monetary returns (Rs 51143 ha^{-1}) and B:C ratio (3.32) were significantly maximum with detopping at 45 DAS (D_2) and minimum was without detopping (D_1).

Spacing of 45 x 10 cm recorded maximum and significantly higher Sunhemp seed yield (q ha^{-1}) over the 45 x 15 and 60 x 10 cm spacing.

Detopping at 45 DAS recorded maximum and significantly higher Sunhemp seed yield (q ha^{-1}) over no topping. Detopping at 60 DAS was at par with detopping at 45 DAS Spacing of 45 x 10 cm recorded highest gross monetary return (Rs ha^{-1}), net monetary return (Rs ha^{-1}) and B:C ratio in Sunhemp. Detopping at 45 DAS recorded highest gross and net monetary return (Rs ha^{-1}) and B:C ratio in Sunhemp.

Author contributions

Shubham A. Khobragade: Conceived the original idea and designed the model and wrote the manuscript. Dr. D.D. Mankar: Designed the model and the computational framework and analyzed the data.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval: Not applicable.

Consent to Participate: Not applicable.

Consent to Publish: Not applicable.

Conflict of Interest: The authors declare no competing interests.

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