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Effect of integrated weed management practices on growth characters of jute (*Corchorus olitorius*)

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Abstract

A field experiment was conducted at Central Demonstration Farm (CDF) Wani Rambhapur, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *kharif* season of 2023-24 with a objective to study the effect of different integrated weed management practices on growth of jute. The experiment was laid out in Randomized Block Design with eight treatments and three replications. The growth characters viz., plant height, number of branches, leaf area index and dry matter accumulation were significantly influenced due to different application of herbicides. Maximum values of growth characters were recorded by farmer practices consisting of two weeding 15-20 and two hoeing 30-35 DAS (T₇) which was at par with Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (T₁) Thus, the combination of manual weeding and hoeing or Pendimethalin application may be suggested to farmers for successful cultivation of jute.

Keywords: Integrated weed management, jute, pendimethalin, growth, farmer practices

Introduction

Jute fiber, scientifically classified as *Corchorus olitorius* L., is widely recognized as the "golden fiber" due to its exceptional versatility and eco-friendly properties. This annual, short-day herbaceous plant primarily yields its fiber from two cultivated species within the *Corchorus* genus: *Corchorus capsularis* L., known as white jute, and *Corchorus olitorius* L., or tossa jute. Belonging to the Malvaceae family, jute is not only a significant agricultural commodity but also an integral component of the textile and packaging industries, demonstrating an increasing global demand.

Jute production is predominantly concentrated in the Indian subcontinent, particularly in India and Bangladesh, which together account for over 60% of the world's jute output (Singh *et al.*, 2018) [8]. As of recent estimates, India has cultivated jute across 6.6 lakh hectares, yielding approximately 1.7 million tonnes, primarily in the eastern and northern states of West Bengal, Odisha, Assam, Tripura, Bihar, and parts of Uttar Pradesh. West Bengal stands out as the largest contributor, responsible for over 80% of India's jute acreage and production.

Despite its potential, jute cultivation faces significant challenges, notably from weed infestations, which can drastically reduce yields as much as 75% in some cases (Ghorai, 2008) [3]. The presence of competitive weeds, particularly during the initial growth stages of jute, hinders growth and reduces fiber quality. Conventional manual weeding is effective, constitutes a substantial portion approximately 40% of the total cost of jute cultivation.

To combat these challenges, there is an urgent need to implement integrated weed management (IWM) practices that combine the use of chemical herbicides with cultural techniques. Such an approach has shown promise in enhancing crop yield while reducing production costs, ultimately supporting the sustainability of jute farming (Hossain *et al.*, 1983) [2]. This study aims to explore the efficacy of various IWM strategies, including the application of pre-emergence and post-emergence herbicides alongside manual weeding techniques, to improve the growth of jute.

The current investigation titled "Integrated Weed Management in Jute (*Corchorus olitorius*)" will address the utmost need for effective weed management strategies in jute cultivation.

The study will contribute to optimizing agricultural practices in jute production, thereby enhancing productivity and economic returns for farmers in the region.

Materials and Methods

The experiment was conducted *kharif* season of 2023-24 undertaken at Subtropical conditions of Central Demonstration Farm (CDF) Wanirambhapur, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola situated at 22°42' North latitude and 77°02' East longitude and altitude of 307.4 m above the sea level. Soil of experimental plot was clayey in texture and slightly alkaline in nature with low in available Nitrogen (216 kg/ha), moderate in phosphorus (14.50 kg/ha) and very high in potash (338.35 kg/ha). The experiment was carried out in a randomized block design, with eight treatments and three replications. The treatments comprised of Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (T₁), Butachlor 50 EC (PE) @ 1.0 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (T₂) Pretilachlor 50 EC (PE) @ 0.60 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (T₃), Metolachlor 50 EC (PE) @ 0.50 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (T₄) Propaquizafop 10% EC (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS (T₅) Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS (T₆), Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS (T₇) and Weedy check (T₈) respectively. The Gross size of experimental plot was 5.40×5.40 m and Jute cultivar 'JRO-524' was sown with spacing of 45 x 10 cm² apart. Jute crop was fertilized with basal dose of nitrogen, phosphorous and potassium @ 80:40:40 NPK Kg ha⁻¹. Seed of JRO 524 was sown @ 5 kg ha⁻¹ on 17th July of 2023 after receiving sufficient amount of precipitation. Herbicides as per treatments were applied using 300 litres of water/ha with a flat fan nozzle attached in a high-volume knapsack sprayer immediately within 24 hrs after sowing. Weed samples were collected periodically with 1×1 m² quadrat from all the treatments, dried in shade and then were oven dried at 65 ± 5 °C and the weed dry matter

accumulation was expressed in g/m². Data on growth parameters such as plant height was recorded from ten plants randomly selected from second row of each plot at the time of harvest. Harvesting of jute crop was done on 6th November 2023, respectively. The data on plant height, number of leaves per plant, number of branches per plant, leaf area per plant, Leaf Area Index, dry matter accumulation per plant, weed density and weed dry matter accumulation of jute were analysed statistically using ANOVA.

Results and Discussion

Weed flora

The predominant weed flora observed in experiment field were viz., *Cyperus rotundus* L., *Cynodon dactylon*, *Commelina benghalensis*, *Parthenium hysterophorus*, *Alternanthera triandra* L., *Euphorbia geniculate*, *Phyllanthus niruri* L., *Xanthium strumarium* L., *Tridax procumbens* etc

Plant height (cm)

The plant height of jute crop was significantly influenced due to different integrated weed management practices at 40 DAS, 60 DAS, 80 DAS and at harvest except at 20 DAS it was found non-significant. The maximum plant height of jute was recorded in the treatment T₇ (46.50) and it was found at par with T₁ Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS, T₆ Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS, T₅ Propaquizafop 10% EC (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS, T₃ Pretilachlor 50 EC (PE) @ 0.60 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS treatment. The treatment T₈ (weedy check) recorded minimum plant height (37.22) at 40 DAS. Similar trends with recorded to plant height was observed at 60 DAS, 80 DAS and at harvest of jute crop under integrated weed management practices (IWMP). This result is in agreement with Singh *et al.* (2015)^[7] and Sign *et al.* (2018)^[8].

Table 1: Effect of integrated weed management practices (IWMP) on Plant height (cm), Number of leaves plant⁻¹ and Number of branches plant⁻¹

Treatment		Plant height (cm)					Number of leaves plant ⁻¹				Number of branches plant ⁻¹			
		20 DAS	40 DAS	60 DAS	80 DAS	At harvest	20 DAS	40 DAS	60 DAS	80 DAS	40 DAS	60 DAS	80 DAS	At harvest
T ₁	Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	12.57	46.50	83.69	130.56	133.17	7.90	21.42	58.04	81.26	2.34	4.21	9.81	9.81
T ₂	Butachlor 50 EC (PE) @ 1.0 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	10.60	39.22	71.27	111.18	113.40	6.67	17.72	48.03	67.24	1.94	3.48	8.12	8.12
T ₃	Pretilachlor 50 EC (PE) @ 0.60 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	11.67	43.17	77.70	121.22	123.65	7.34	19.88	53.87	75.41	2.17	3.91	9.21	9.21
T ₄	Metolachlor 50 EC (PE) @ 0.50 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	10.73	39.71	71.48	111.51	113.74	6.75	18.29	49.58	69.41	2.00	3.60	8.38	8.38
T ₅	Propaquizafop 10% EC (POE) @ 0.50 kg a.i. ha ⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS	11.80	43.66	78.59	122.60	125.05	7.42	20.11	54.50	76.30	2.20	3.95	9.19	9.19
T ₆	Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha ⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS	11.87	43.91	79.03	123.29	125.76	7.46	20.24	54.84	76.78	2.21	3.98	9.27	9.27
T ₇	Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS	12.57	46.50	83.69	130.56	135.83	7.95	21.86	59.58	83.39	2.40	4.33	10.10	10.10
T ₈	Weedy check	10.60	39.22	71.27	111.18	107.39	6.37	16.93	45.87	64.22	1.85	3.33	7.76	7.76
S.E (m)±		0.54	2.05	3.58	5.63	5.68	0.34	0.97	2.64	3.74	0.11	0.21	0.48	0.11
CD at 5%		1.65	6.28	10.99	17.26	17.43	1.04	2.96	8.11	11.49	0.34	0.64	1.48	0.34
GM		11.50	42.55	76.67	119.61	122.25	7.23	19.56	53.04	74.25	2.14	3.85	8.98	2.14

Number of leaves plant⁻¹

The mean number of leaves plant⁻¹ was found to be increased from 20 DAS to 80 DAS in crop age. There after decreased at harvesting due to advancement in age till maturities and dropping of older leaves by senescence. The maximum rate of leaves production was observed between 40 DAS to 80 DAS in jute crop. Significantly, maximum leaves plant was recorded in treatment T₇ i.e., Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS followed by T₁ Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS, T₆ Quisalofof ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS at all growth stage of crop. The lowest number of functional leaves recorded under treatment T₈ (weedy check) affects overall growth of plant.

The result of present investigation was in conformity with the finding of Akram *et al.* (2021) [1].

Number of branches plant⁻¹

The integrated weed management practices (IWMP) had significant effect on number of branches plant⁻¹ at all stages of growth under study. The farmer weed management practices i.e., T₇ farmer practices 2 weeding and 2 hoeing at 15-20 DAS and 30-35 DAS produced significant effect on production of number of branches plant⁻¹ at harvest (10.10) and it was found at par with weedicide treatment T₁ Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (9.81), T₆ Quisalofof ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS (9.2), T₃ Pretilachlor 50 EC (PE) @ 0.60 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (9.21) treatments. Whereas, significantly lower number of branches plant⁻¹ was recorded under weedy check T₈ treatment (7.76). The number of branches per plant might be due to more under T₇ treatment was less crop weed competition for nutrient, light and moisture that resulted into more number of branches per plant.

Leaf area per plant (dm²)

The efficient interception of radiant energy incident on leaves of jute crop can be achieved due to reduction in crop weed competition by integrated weed management practices. Reduction in crop weed competition for radiant energy, nutrient and moisture by adopting integrated weed management practices for improving the productivity of crop.

The data revealed that mean leaf area per plant (dm²) was

increased the from 40 DAS to 80 DAS and it was at peak during 60 DAS to 80 days. The leaf area (dm²) per plant was significantly influenced due to different integrated management practices. Treatment T₇ (Farmer practices 2 weeding and 2 hoeing) recorded significantly maximum leaf area per plant (dm²) at 40 DAS, 60 DAS and 80 DAS which was at par with treatment T₁ Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS, T₆ Quisalofof ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS, and rest of the treatment. The lowest leaf area (dm²) plant⁻¹ was recorded by the treatment Weedy check (T₈).

Leaf Area Index (LAI)

The data depicted Table 2 revealed that mean leaf area index increased from 40 DAS to 80 DAS and it was maximum during 60 DAS to 80 days. The leaf area index per plant was significantly influenced due to different integrated management practices. Treatment T₇ (Farmer practices 2 weeding and 2 hoeing) recorded significantly maximum leaf area index at 60 DAS, 80 DAS while was at par with treatment T₁ (Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS), T₆ (Quisalofof ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS and rest of the treatment. The lowest leaf area index was obtained by treatment (T₈). Maximum value of LAI was (8.46) at 80 DAS under treatment T₇ (hand weeding twice), which was at par with T₁ and T₆ treatments. At harvest LAI value reduced due to senescence of leaves. LAI is a better determinant of crop growth (Watson 1952, 1963). The rate of dry matter production consists of LAI, appears to be more related to yield (Tsuno, 1971).

Dry matter accumulation (g/m²)

The status of dry matter accumulation of jute per plant. All the weed management methods produced significantly higher amount of dry matter compared to weedy check. At 20 DAS higher dry matter accumulation (2.40 g/m²) recorded with T₁. However, higher dry matter (53.98 g/m²) recorded with hand weeding and hoeing twice (20 and 40 DAE) at harvest, followed by T₁ with the value 49.49 g/m². After 40 days stem dry weight was increased rapidly and maintained higher dry weight since senescence of the jute. This result tunes with Hoossain *et al.*, (1983) [2], Talukder (1992) [9] and Talukder *et al.* (2001) [10].

Table 2: Effect of integrated weed management practices (IWMP) on Leaf area plant⁻¹ (dm²), Leaf Area Index (LAI) and Dry matter accumulation plant⁻¹ (g)

Treatment		Leaf area plant ⁻¹ (dm ²)				Leaf Area Index (LAI)				Dry matter accumulation plant ⁻¹ (g)				
		20 DAS	40 DAS	60 DAS	80 DAS	20 DAS	40 DAS	60 DAS	80 DAS	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
T ₁	Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	7.86	33.02	99.37	111.36	0.17	0.73	2.21	2.47	2.40	5.05	17.67	35.35	49.49
T ₂	Butachlor 50 EC (PE) @ 1.0 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	6.68	28.05	84.16	94.31	0.15	0.62	1.87	2.10	1.85	4.29	15.23	29.81	41.74
T ₃	Pretilachlor 50 EC (PE) @ 0.60 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	7.44	31.26	93.77	105.09	0.18	0.69	2.08	2.34	2.04	4.69	16.41	32.82	45.94
T ₄	Metolachlor 50 EC (PE) @ 0.50 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	6.86	28.82	86.46	96.89	0.15	0.64	1.92	2.15	1.95	4.46	15.63	31.25	43.75
T ₅	Propanil 50 EC (POE) @ 0.50 kg a.i. ha ⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS	7.44	31.27	93.80	105.12	0.17	0.69	2.08	2.34	2.06	4.74	16.60	33.19	46.47
T ₆	Quisalofof ethyl 5% (POE) @ 0.50 kg a.i. ha ⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS	7.48	31.44	94.93	106.55	0.17	0.70	2.11	2.37	2.07	4.77	16.69	33.38	46.73
T ₇	Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS	8.06	34.21	102.97	115.53	0.17	0.76	2.29	2.57	2.20	5.51	19.28	38.56	53.98
T ₈	Weedy check	6.42	26.98	80.94	90.71	0.14	0.60	1.80	2.02	1.64	3.77	13.20	26.40	36.96
S.E (m)±		0.34	1.42	4.36	4.92	0.01	0.03	0.10	0.11	0.11	0.25	0.89	1.72	2.41
CD at 5%		1.06	4.35	13.36	15.09	0.02	0.10	0.30	0.34	0.33	0.76	2.74	5.27	7.38
GM		7.28	30.63	92.05	103.30	0.16	0.68	2.05	2.29	2.03	4.66	16.34	32.59	45.63

Table 3: Effect of integrated weed management practices (IWMP) on Weed density (no./m²) and weed dry matter accumulation (g/m²)

Treatment		Weed density (no./m ²)					Weed dry matter accumulation (g/m ²)				
		20 DAS	40 DAS	60 DAS	80 DAS	At harvest	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
T ₁	Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	7.67	7.80	12.00	18.17	14.67	4.33	3.33	5.50	9.17	8.67
T ₂	Butachlor 50 EC (PE) @ 1.0 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	12.67	12.33	24.67	35.33	27.33	5.00	4.33	11.33	17.00	14.33
T ₃	Pretilachlor 50 EC (PE) @ 0.60 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	7.67	9.76	22.33	32.67	22.50	4.00	5.22	10.00	15.00	13.50
T ₄	Metolachlor 50 EC (PE) @ 0.50 kg a.i. ha ⁻¹ fb 1 HW at 35-40 DAS	10.00	11.98	23.33	33.67	24.00	4.67	6.78	11.00	16.33	14.00
T ₅	Propaquizafop 10% EC (POE) @ 0.50 kg a.i. ha ⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS	16.67	9.00	21.67	29.33	19.00	8.00	5.00	9.67	14.33	10.50
T ₆	Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha ⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS	17.83	7.27	19.83	26.67	18.83	8.50	3.67	9.50	12.00	9.33
T ₇	Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS	4.00	4.93	9.33	18.00	15.33	2.00	3.33	5.33	8.67	8.50
T ₈	Weedy check	26.33	48.33	67.33	80.33	76.33	15.67	26.67	33.00	39.00	35.00
	S.E (m) ⁺	0.60	0.65	1.29	1.65	1.34	0.45	0.49	0.54	1.00	0.78
	CD at 5%	1.85	1.99	3.97	5.06	4.12	1.39	1.49	1.65	3.07	2.40
	GM	12.85	13.93	25.06	35.15	27.25	6.52	7.29	11.92	16.69	14.23

The monocot weeds count/m² was influenced significantly by different weed management practices, which led to significant reduction in monocot weeds count/m² at all the stages of observation compared to weedy check. Treatment Farmer practice-2 hoeing 15-20 days interval after sowing fb 2 HW (T₇) recorded lowest weed count and found significantly superior over all the treatment.

Weed density (no./m²)

Different integrated weed management practices significantly influenced the total weeds no/m². The Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS (T₇) was significantly superior over all other treatments from 20 DAS to at harvest. Among herbicidal treatments Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS resulted better in respect of weed density no/m² and had minimum count of weed. Followed by Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS

Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS it was found at par with Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS at all the growth stages and also at par with Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS

Performing manual weeding on two occasions led to a significant decrease in the presence of grasses. This reduction was achieved through a cultural form of mechanical weeding conducted at 15 and 30 days after emergence (Sarkar *et al.*, 2005; Sarkar, 2006) [6, 5].

Jena *et al.* (2017) [4] also reported that the combination of either a pre-emergence or post-emergence herbicide application along with a single round of manual weeding proved to be a successful strategy for effectively managing all types of weeds.

Weed dry matter accumulation (g/m²)

The total dry weight of weed as influenced by different integrated weed management treatments in jute at different growth stages differed significantly are presented in Table 16. Irrespective of growth stages the weed dry matter accumulation was minimum in Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS (T₇) compared to all other treatments throughout the growth period of crop like jute.

In present investigation, the weed dry matter accumulation of

weed was minimum at 20 DAT and was increased and reached to maximum at 80 DAs and slightly decrease at harvest.

The Farmer practices 2 weeding and 2 hoeing 15-20 and 30-35 DAS treatment was superior over rest of the treatments and weedy check recorded significantly higher weed biomass accumulation.

Among herbicides application of Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS (T₁) as PE observed significantly less weed dry weight over rest of the treatments and it was statistically at par with Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS PoE (T₆) at different growth stages. The highest reduction of weed dry matter was recorded with Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS ha⁻¹ (T₁) as PE this might be due to effective management of dominant annual and perennial grasses population and brought significant reduction in weed dry matter as compared to weedy check.

Similar observations were also furnished by Jena *et al.* (2017) [4] wherein it was observed that quizalofop-ethyl fb hand-weeding showed better control on weeds than the pre-emergence herbicides treatments.

Conclusion

Among the different integrated weed management practices the farmer practices (2 weeding and 2 hoeing at 15-20 and 30-35 DAS) recorded significant growth characters and it was found at par with pre emergence weedicide spray of Pendimethalin 38 EC (PE) @ 1.5 kg a.i. ha⁻¹ fb 1 HW at 35-40 DAS and post emergence weedicide spray of Quizalofop ethyl 5% (POE) @ 0.50 kg a.i. ha⁻¹ at 15-20 DAS fb 1 HW at 35-40 DAS for effective control of weeds in jute that resulted into significant improvement in growth attributes than weedy check treatment.

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