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Weed management in jute by Trifluralin (48% EC) in the early jute-weed competition phase

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ABSTRACT

A field experiment was conducted at Central Research Institute for Jute and Allied Fibres (ICAR), Barrackpore, West Bengal to find out an effective pre-emergence herbicide for weed management in jute (cv. JRO 8432). Grasses, broadleaved weeds and sedges were found in the experimental field with highest intensity of infestation by grasses (90-95%). The predominant grass was *Echinochloa colona* (L.) Link. *Phyllanthus niruri* L., *Physalis minima* L. and *Cleome* sp were the dominant broadleaved weeds and the only sedge was *Cyperus rotundus* L. Trifluralin at 0.75-1.0 kg a.i./ha resulted higher weed control efficiency (86 – 91%) at 8 WAS as compared to two manual weeding and the same trend was observed throughout the growth of jute. Among the different doses of Trifluralin, 0.75 kg a.i./ha gave the highest weed control efficiency for all date of observations, whereas, Trifluralin at 1.0 kg a.i./ha favoured growth of sedge weeds due to absolute control of *Echinochloa colona* leaving little interspecific competition for sedge. Application of 0.75-1.0 kg a.i./ha of Trifluralin at 1 day before sowing as pre-plant soil incorporation controlled grass and broadleaf weeds for a wider period starting from the early crop-weed competition phase and yielded better (28 – 44% more) than the conventional two manual weeding. In the recommended dose of Trifluralin (up to 1 kg a.i./ha), there was no problem of residue in soil after the harvest of jute crop as evidenced from bioassay and HPLC studies.

Key words: Weed management, Jute (JRO 8432), Trifluralin, Pre-emergence, Yield

Jute is a very important cash crop of West Bengal and adjoining states. In this important bast fibre crop, about 35% of the total cost of production goes to weeding only if done manually (Saraswat, 1980) and thereby drastically reduce profitability. Moreover, it was also estimated that 75-80 % of fibre yield is lost due to weed infestation which is quite common in most of the jute growing situations (Sahoo and Saraswat, 1988). Some recent findings showed that Quizalofop ethyl (5% EC) as post emergence application could control only the grassy weeds (Ghorai *et al.*, 2004; Bhattacharya *et al.*, 2004). Factors like hot and humid climate with intermittent rainfall during the jute sowing season (first fortnight of April) in alluvial plains encourage profuse weed growth (Saraswat, 1999) resulting severe weed infestation during the early crop growth phase in jute. Therefore, weed free condition in the early stages of growth in jute always maintains higher productivity (Saraswat and Sharma, 1983). Only a few pre-emergence herbicides found moderately effective to control jute weeds so far. Therefore, a field experiment was designed to find a more effective pre-emergence herbicide for controlling weed in the early growth phase of jute in the alluvial plains of West Bengal.

MATERIALS AND METHODS

A field experiment was conducted at Central Research Institute for Jute and Allied Fibres (ICAR), Barrackpore, West Bengal to find an effective pre-emergence herbicide for weed management in jute by deploying Trifluralin (48% EC) received from DE-Nocil Crop Protection Pvt Ltd (now Dow Agro Sciences India Pvt. Ltd.), Mumbai. There were earlier reports that Trifluralin could effectively control both the grassy and broadleaved weeds in some relatively smaller seeded dicotyledonous field crops such as Sesame (Grichar *et al.*, 2001), Mung (Malik *et al.*, 2000) and Linseed (Turley, 2001) and therefore, Trifluralin was selected and tested as pre-emergence herbicide for jute weed management.

The experiment was conducted in medium fertile neutral soil (pH 7.1) following randomised block design with eight treatments replicated thrice with a plot size of 4 m x 3 m. The eight treatment combinations were T_1: unweeded control, T_2: [two hand weeding (HW) at 3 and 5 weeks after sowing

(WAS), recently published works (Ghorai *et al.*, 2004 and Bhattacharya *et al.*, 2004) in jute weed management deployed hand weeding twice at 3 and 5 WAS], T_3: Trifluralin @ 0.50 kg a.i/ha, T_4: T_3 + one HW at 5 WAS, T_5: Trifluralin @ 0.75 kg a.i/ha, T_6: T_5 + one HW at 5 WAS, T_7: Trifluralin @ 1.0 kg a.i/ha and T_8: T_7 + one HW at 5 WAS. Trifluralin was applied as pre-plant soil incorporation one day before sowing of jute seeds when the soil moisture content was 23% gravimetrically. Jute seed (JRO 8432, test weight 2 g) was sown in line with a row spacing of 25 cm in the second week of April and accordingly harvested at 120 days crop age. All other standard recommended agronomical practices including plant protection measures for olitorius jute were followed in the experimental crop. Biometrical observations on jute plant height, basal diameter, fibre yield, stick yield, type of weeds, and dry weight of different categories of weeds were taken at regular intervals. Residue of Trifluralin in soil if any was estimated both by bioassay (Oat, *Avena fatua*) and HPLC technique.

RESULTS AND DISCUSSION

Associated weeds

The experimental field was infested by three category of weeds namely grasses, broad-leaved and sedges. The only predominant grass was *Echinochloa colona* (L.) Link. *Phyllanthus niruri* L., *Physalis minima* L. and *Cleome* sp were the dominant broadleaved weeds and the sedge species was *Cyperus rotundus* L. In the recent past, presence of similar weed communities in jute field was reported by Ghorai *et al.*, 2004.

Total weed biomass

Grasses were the most predominant weed category among all types of weeds in jute field. The relative dry weight (RDW) of grasses was 98.8 which was very high as compared to the RDW of sedges (1.21) at 3 WAS in the unweeded control treatment (Table 1). The total weed biomass was 209.78 g/m^2 in unweeded plots at 3 WAS. In the hand weeded plots the percent distribution of three categories of weeds at 8 WAS were different, where the RDW were 92.3, 6.2 and 1.5 (of 67.02 g/m^2) for grasses, sedge and broadleaved weeds respectively. It was also observed that the weed complex was shifted towards sedges, when the grass weed was controlled by the application of Trifluralin. For instance, at 3 WAS, the dry weight of grass was 23.71 g/m^2 and the sedge was 23.42 g/m^2 in T_5 (Trifluralin 0.75 kg a.i./ha), whereas, Trifluralin at 1 kg a.i./ha reduced the grass biomass to 13.41 g/m^2 but the dry weight of sedge was increased to 32.04 g/m^2, without much affecting the broadleaved biomass. Therefore, the increase in total dry weight of weeds from 0.75 kg a.i./ha to 1 kg a.i./ha is purely contributed by the increased biomass of sedge weeds, which occupied the vacant space created due to control of grass by Trifluralin. Similar trends were continued at 8 and 12 WAS.

Table 1 Effect of different weed management methods on dry weight of weeds and weed control efficiency

	Treatments	Weed dry weight (g/m^2)			Weed control efficiency (%)		
		WAS			WAS		
		3	8	12	3	8	12
T_1	Unweeded control	209.78	598.98	550.12	-	-	-
T_2	2 HW at 3 and 5 WAS	202.03	67.02	68.46	3.69	88.81	87.56
T_3	Trifluralin @ 0.50 kg a.i/ha	58.21	82.66	87.85	72.25	86.20	84.03
T_4	Trifluralin @ 0.50 kg a.i/ha +1 HW	63.40	26.29	27.87	69.78	95.61	94.93
T_5	Trifluralin @ 0.75 kg a.i/ha	48.22	55.17	132.68	77.01	90.79	75.88
T_6	Trifluralin @ 0.75 kg a.i/ha + 1 HW	43.35	49.26	26.81	79.34	91.78	95.13
T_7	Trifluralin @ 1.00 kg a.i/ha	50.83	79.76	159.85	75.77	86.68	70.94
T_8	Trifluralin @ 1.00 kg a.i/ha + 1 HW	41.29	37.91	27.88	80.32	93.67	94.93
	CD (P = 0.05)	11.50	15.47	26.54			

Weed control efficiency (WCE)

Trifluralin at 0.75 – 1.0 kg a.i./ha resulted higher WCE (86 – 91%) at 8 WAS as compared to conventional two manual weeding and the same trend was observed throughout the growth of jute (Table 1). Among the different doses of Trifluralin, 0.75 kg a.i./ha gave the highest WCE due to optimization of grass population which not triggered excessive growth of sedge weed (as in case of 1 kg a.i./ha) for all date of observations.

Growth of jute plant

As the correlation between plant height of jute and growth of jute plant is strongly positive, the general growth behaviour of jute was explained by the increase of plant height over the growing period. At 7 WAS, the highest plant height (81 cm) was recorded with 1.0 kg a.i./ha of Trifluralin which was at par with the plant height obtained with Trifluralin at 0.5 kg a.i./ha and 0.75 kg a.i./ha of Trifluralin + one hand weeding (Table 2). At all date of observations, unweeded control treatment produced the shortest jute plants. At harvest the highest plant height (321 cm) was recorded with Trifluralin at 1.0 kg a.i./ha + one hand weeding which was at par with the plant height obtained with 0.75 – 1.0 kg a.i./ha of Trifluralin (291 – 305 cm).

Table 2 Effect of different methods of weed management on plant height, fibre yield and economics in jute

	Treatments	Plant height (cm)						Fibre yield (q/ha)	NRPRI*
		Weeks after sowing							
		7	9	11	13	15	17		
T_1	Unweeded control	41	72	87	107	137	167	7.14	-0.16
T_2	2 HW at 3 and 5 WAS	49	112	154	190	223	259	24.41	0.79
T_3	Trifluralin @ 0.50 kg a.i/ha	75	139	180	216	247	283	26.01	1.75
T_4	Trifluralin @ 0.50 kg a.i/ha +1 HW	68	138	186	226	259	293	29.23	1.47
T_5	Trifluralin @ 0.75 kg a.i/ha	72	140	184	221	258	291	31.28	2.19
T_6	Trifluralin @ 0.75 kg a.i/ha + 1 HW	77	154	202	238	276	309	37.60	2.10
T_7	Trifluralin @ 1.00 kg a.i/ha	81	153	198	238	276	305	35.11	2.47
T_8	Trifluralin @ 1.00 kg a.i/ha + 1 HW	77	161	212	250	286	321	39.60	2.18
	CD (P = 0.05)	8.5	13.2	17.4	21.7	26.2	29.6	4.18	-

* NRPRI: Net return per rupee investment

Fibre yield

The highest fibre yield of jute (39.6 q/ha) was recorded with pre-plant soil incorporation of Trifluralin at 1.0 kg a.i./ha along with one hand weeding (at 5 WAS) which was at par with fibre yield (37.6 q/ha) obtained from plots treated with Trifluralin at 0.75 kg a.i./ha + one hand weeding (Table 3). Among the herbicidal treatments, Trifluralin at 1.0 kg a.i./ha produced the highest fibre yield (35.1 q/ha) which was at par with the fibre yield (31.3 q/ha) recorded with 0.75 kg a.i./ha of Trifluralin. The most significant part of the findings was that, Trifluralin at 0.75 and 1.0 kg a.i./ha resulted 28 and 44 % more fibre yield respectively as compared to the fibre yield recorded with conventional two hand weeding at 3 and 5 WAS (23.4 q/ha).

Net Return per Rupee Investment **(NRPRI)**

The highest NRPRI was 3.47 with Trifluralin 1 kg a.i./ha which was closely followed by the NRPRI (3.19) obtained from Trifluralin 0.75 kg a.i./ha. Earlier report (Sarkar and Bhattacharya, 2004) showed higher NRPRI (2.64) when the weeds were controlled by other pre-emergence herbicides instead of manual weeding in jute. It was also observed that wherever manual weeding was engaged the NRPRI was reduced drastically (Table 2).

Soil residue

The growth of bioassay plant species (*Avena fatua*) in the Trifluralin treated soil collected from jute field just after the harvest of jute was absolutely normal, hence no residue was there in the soil for the next crop in rotation. In addition, estimation of soil residue through HPLC technique detected no residue after the harvest of jute crop in soils collected from 0.5, 0.75 and 1 kg a.i./ha of Trifluralin treatments.

CONCLUSION

Pre-plant soil incorporation of 0.75 – 1.0 kg a.i./ha of Trifluralin at 1 day before sowing of jute seed (when the soil moisture content is not less than 20%) may control most of the grass and broadleaved weeds and thereby produce higher fibre yield (31 – 35 q/ha) of jute. This herbicidal method of weed management in jute is even better than the conventional two manual weeding as the former method yielded 28 – 44% more fibre as compared to the later method. Within the recommended dose of Trifluralin, there is no problem of residue in soil after the harvest of jute crop.

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