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Weed dynamics, shift in weed flora and weed control practices in jute (*Corchorus olitorius* L.) under *terai* agro-climatic region of West Bengal

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ABSTRACT

Field experiments were conducted at research farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal as well as farmers' field during the pre-Kharif season of 2006 and 2007 to generate information on weed dynamics, shifting of weed flora and to work out weed control practices with its economics in jute. In weed dynamics with periodical emergence of weeds, major weeds were Cyperus rotundus, Cynodon dactylon (20 days after sowing - DAS), Cyperus iria, Cynodon dactylon, Ageratum conyzoides, Ludwigia parviflora (40 - 60 DAS), Cynodon dactylon, Setaria glauca, Paspalum scrobiculatum, Cyprus iria, Fimbristylis miliacea, Ageratum conyzoides, Spilanthes calva, Spilanthes paniculata and Ludwigia parviflora (60 DAS onwards).In weed control practices, fluchloralin @ 0.70 kg ha^{-1} as pre-plant surface application followed by grubber at 30 DAS was effective in controlling weeds with high fibre yield, highest net return and highest benefit: cost ratio of 26.3 q ha^{-1}, Rs. 24,397/- and 1.52, respectively, obtained in farmers' field in 2007. Mulching with rice straw @ 10 t/ha followed by hand weeding at 25 DAS was also effective in controlling weeds and registering high fibre yield (24.1 to 29.4 q ha^{-1} on farmers' field in 2006 and 2007). However, cost involved in rice straw reduced the net return and benefit: cost ratio. Stale seedbed followed by grubber at 30 DAS was effective in controlling weeds, however, delay in sowing for the period of 10 to 15 days resulted in significant reduction on crop performance. Post-emergence herbicide quizalofop ethyl @ 50 g ha^{-1} at 20 DAS was effective on grasses only, but could not lower weed pressure of sedges and broadleaved weeds and gave lower fibre yield. Fluchloralin @ 1.00 kg ha^{-1} as pre-emergence caused phytotoxicity to jute plant and hence not suggested.

Key words: Economics, shift in weed flora, weed dynamics, weed control efficiency, weed control practices

Jute *(Corchorus olitorius* L.) is a commercial fibre crop of eastern India. Jute crop suffers from heavy weed infestation during the early stage of its growth, which significantly reduces the fibre yield (Bandyopadhyay *et al.,* 1994) ranging from 52 - 55% in *C. capsularis* and 59–75% in *C. olitorius* (Sarkar *et al.*, 2005). Manual weeding alone consumes about 35% of total cost of cultivation in jute (Saraswat, 1980) and this manual energy (543 MJ/ha) is 4.5 times more than the land preparation (Borkar *et al.*, 1999). Maximum control of weeds was achieved with hoeing and hand weeding (Prusty *et al.*, 1988), while mixed cropping of red amaranthus with jute resulted in 22–25% more suppression of weed biomass as compared to hand weeding (Ghorai, 2007). Mulching with paddy straw reduced the weed biomass by 68–82% (Ghorai *et al.* 2004) and better weed control in jute was observed with pre-emergence application of fluchloralin @ 1.0 kg ha^{-1} + hand weeding (Rajput, 2000) or trifluralin @ 0.75 kg ha^{-1}, 1 day before sowing (Sarkar *et al.*, 2005). Post-emergence spray of quizalofop ethyl + adjuvant controlled the grassy weeds very effectively (Ghorai *et al.* 2004). Therefore, application of herbicides along with hand-weeding appeared effective as compared with only manual weeding. Terai agro-climatic region of West Bengal is characterized with high humidity and high rainfall. Pre-monsoon and monsoon shower during jute growing season evoke profuse weed growth and also causes severe weed menace in jute. This has necessitated an alternative and effective weed control practices than manual weeding. Keeping this in view, field experiment was conducted at research farm of Uttar Banga Krishi Viswavidyalaya located at Cooch Behar, West Bengal as well as farmers' field to generate information on weed dynamics, shift in weed flora and to work out weed control practices with its economics in jute.

MATERIALS AND METHODS

Field experiment was conducted during *pre-Kharif* season of 2006 and 2007 at research farm of Uttar Banga Krishi Viswavidyalaya (25^{0}57' N-27^0 N latitude and 88^{0}25' E-89^{0}54' E longitude), Pundibari, Cooch Behar, West Bengal and in the farmers' field (Patlakhawa village of Cooch Behar II Block, Cooch Behar, W.B). The climate in this region is humid and characterized with high rainfall (300 cm/annum). The soils are sandy to sandy loam in texture with pH 6.07, 0.58% organic carbon and 185.2, 17.6 and 75.3 kg ha^{-1} of available nitrogen, phosphorus and potassium, respectively, at research farm. Eleven treatment combinations were T_1- quizalofop ethyl @ 50 g ha^{-1} as post-emergence at 20 days after sowing (DAS), T_2- grubber at 15 and 30 DAS, T_3- stale seedbed (first flush of weeds destroyed through glyphosate @ 2.00 kg ha^{-1} before sowing of crop), T_4- stale seedbed followed by (fb) grubber at 30 DAS, T_5- stale seedbed fb fluchloralin @ 1.00 kg ha^{-1} as pre-emergence, T_6- mulching with rice straw @ 10 t ha^{-1} at 3 days after emergence (DAE) fb hand weeding at 25 DAS, T_7- fluchloralin @ 1.00 kg ha^{-1} as pre-emergence fb grubber at 30 DAS, T_8- amaranthus (200 g seed ha^{-1} as intercrop) at inter-row space fb grubber at 30 DAS (additional 20 kg N ha^{-1} was added after harvesting of amaranthus at 20 DAS), T_9- farmer's practice (3 hand weeding at 15, 35 and 55 DAS), T_{10}- weedy situation and T_{11}- complete weed-free situation. These

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treatments were laid out in randomized block design with three replications. During 2007, dose and time of application of fluchloralin was changed from pre-emergence @ 1.00 kg ha^{-1} (causing severe toxicity to jute) to pre-plant surface application @ 0.70 kg ha^{-1} both at research farm and farmers' field. The variety JRO 524 was grown both in research farm and farmers' field.

The observation on weed dynamics in farmers' field in terms of absolute density, relative density, absolute frequency, relative frequency, important value and summed dominance ration of the weeds have been made by the formula, as suggested by Raju (1997).

$$\text{Absolute density (AD)} = \frac{\text{Total number of individuals of species in all quadrates}}{\text{Total number of quadrates employed}}$$

$$\text{Relative density (RD \%)} = \frac{\text{Absolute density for a given species}}{\text{Total absolute density for all species}} \times 100$$

$$\text{Absolute (F \%) frequency} = \frac{\text{Quadrates in which species occurs}}{\text{Total number of quadrates employed}} \times 100$$

$$\text{Relative frequency (RF \%)} = \frac{\text{Absolute frequency value for a species}}{\text{Total of absolute frequency value for all species}} \times 100$$

$$\text{Importance value Index (I.V.I. \%)} = \text{Relative density} + \text{Relative frequency}$$

$$\text{Summed Dominance Ratio (SDR)} = \frac{\text{Importance value}}{2}$$

Weed count was made in quadrate having the size of 0.25 m^2 from four randomly selected spots in all treatments. Dry weight was recorded separately for grasses, sedges and broad leaf weeds.

RESULTS AND DISCUSSION

Weed flora and weed dynamics

Dominant weed flora of jute comprised 11 weed species of which 4 belonged to grass, 3 to sedge and 4 to broadleaved weed. Major weed flora were *Cyperus rotundus* L. (during first 20 DAS), *Cynodon dactylon* (L.) Pers., *C. iria* L. (40 DAS), *Ageratum conyzoides* L., *Spilanthes calva* L., *Spilanthes paniculata* L. and *Ludwigia parviflora* (Roxb.) (40 – 60 DAS), *Cynodon dactylon* (L.) Pers., *Setaria glauca* (L.) Beauv *and Paspalum scrobiculatum* (L) Berg., *Cyperus iria* L., *Fimbristylis miliacea* (L.) Rahl., *Ageratum conyzoides, Ludwigia parviflora* (Roxb.) and *Spilanthes calva* L., *S. paniculata* L. (60 DAS onwards). Among the weed flora in jute, *Cynodon dactylon* (L.) Pers., *Cyperus iria* L., *Ageratum conyzoides* L. and *Ludwigia parviflora* (L) Roxb. had long emergence profile whereas the weeds *Cyperus rotundus* L., *Paspalum scrobiculatum* (L) Berg., *Setaria glauca* (L) Beauv, *Fimbristylis miliacea* (L.) Rahl and *Physalis minima* L. had narrow emergence profile during the crop growth (Table 1). High growth rate of sedges caused steep increase in dry matter production during first 20 DAS and after that it became constant up to 30 DAS. Beyond 30 DAS there was moderate increase in dry matter production of sedges up to 60 DAS after that it showed decreasing trend (Fig. 1). Growth rate of grasses was slow in terms of dry matter accumulation during first 20 DAS, which was followed by steep increase in dry matter production up to 50 DAS and after that it became almost constant up to harvest. Slow growth rate of broadleaved weeds was noticed during first 40 DAS and after that rapid growth led to steep increase in dry matter production up to harvest.

Shift in weed flora

The present investigation indicated shift in weed flora especially in broadleaved weeds from *Chenopodium album, Corchorus acutangulus, Commelina benghalensis, Euphorbia hirta* to *Ageratum conyzoides, Spilanthes calva, Spilanthes paniculata, Physalis minima* and *Ludwigia parviflora* during last 12 years of jute cultivation. Bandyopadhyay *et al.* (1994) revealed predominant weed flora in jute as *Cynodon dactylon, Eleusine indica, Cyperus rotundus, Cyperus iria, Chenopodium album, Corchorus acutangulus, Commelina benghalensis* and *Euphorbia hirta* through experiments conducted during summer season of early 90's at Cooch Behar.

Weed control efficiency

Among the different treatments, high weed control efficiency was measured in farmers' practice, mulching fb hand weeding at 25 DAS, fluchloralin @ 1.00 kg ha^{-1} as pre-emergence fb grubber at 30 DAS and stale seedbed fb pre-emergence of fluchloralin @ 1.00 kg ha^{-1}.

Table 1: Relative density (RD) and importance value index (IVI) of weeds appearing at different growth stages of jute on research farm

Weed	RD (%)								IVI (%)							
	20 DAS		40 DAS		60 DAS		At harvest		20 DAS		40 DAS		60 DAS		At harvest	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Cyperus rotundus	48.1	44.7	17.4	17.2	-	-	-	-	65.0	61.4	34.1	33.8	-	-	-	-
Cynodon dactylon	25.6	27.3	32.5	34.1	18.3	17.0	19.5	17.8	42.6	43.9	49.2	50.8	25.9	24.7	31.5	29.8
Cyperus iria .	-	-	35.3	36.3	25.2	26.8	22.9	22.9	-	-	45.3	46.3	32.9	34.5	34.9	34.9
Ageratum conyzoides	14.1	13.9	7.6	15.4	22.3	22.2	22.3	33.3	31.1	30.5	17.5	32.1	30.6	29.9	30.6	45.3
Ludwigia parviflora	7.6	9.3	8.1	12.1	9.9	10.1	9.93	7.8	24.6	26.0	18.1	28.7	17.6	17.8	17.6	19.8
Physalis minima	2.2	2.8	1.3	2.6	1.3	1.4	-	-	19.2	19.5	11.3	12.7	9.0	9.1	-	-
Spilanthes calva	-	-	1.8	1.7	0.5	0.6	0.48	1.4	-	-	11.8	11.7	6.2	9.00	8.2	13.4
Digitaria ciliaris	-	-	-	-	14.8	13.9	4.8	4.4	-	-	-	-	23.4	22.2	12.5	12.1
Setaria glauca	-	-	-	-	-	-	4.4	3.8	-	-	-	-	-	-	16.4	15.8
Fimbristylis miliacea	-	-	-	-	8.5	7.2	8.8	9.4	-	-	-	-	16.2	14.9	20.8	21.4
Paspalum scrobiculatum	-	-	-	-	-	-	2.6	3.2	-	-	-	-	-	-	14.6	15.2

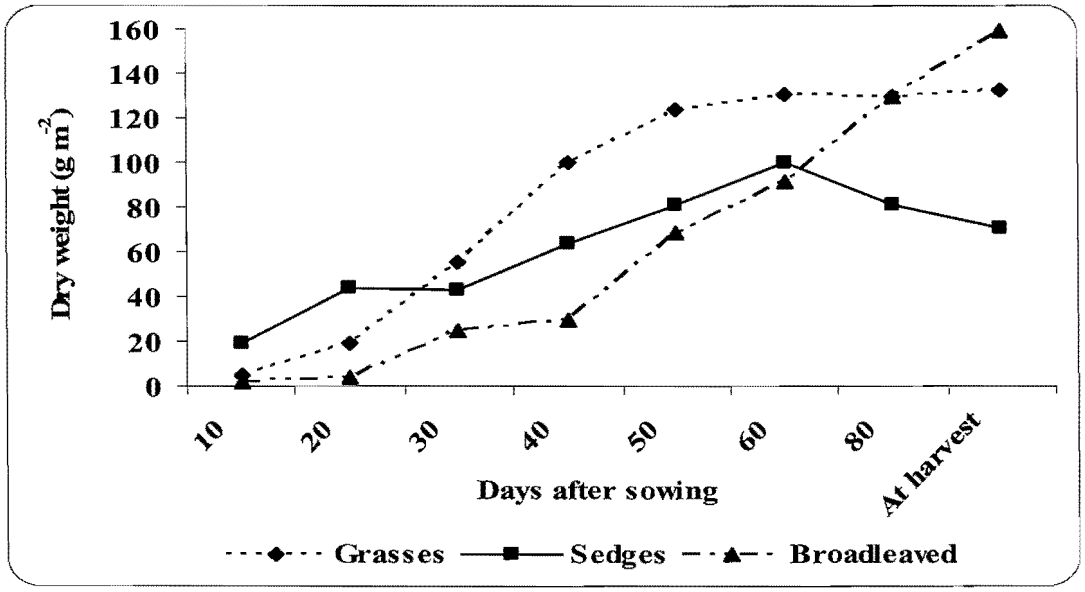

Fig.1. Course of dry weight of weeds' category in jute from weedy control plot of research farm (pooled data)

The lowest weed control efficiency was found in stale seedbed, amaranthus at inter-row spaces fb grubber at 30 DAS and quizalofop ethyl @ 50 g ha^{-1} at 20 DAS (Table 2).

Yield attributing characters

The highest basal diameter of jute was obtained in complete weed free situation, followed by farmer's practice, mulching fb hand weeding at 25 DAS without having any significant difference. The lowest basal diameter was obtained in fluchloralin @ 1.00 kg ha^{-1} + grubber at 30 DAS, followed by weedy, stale seedbed, stale seedbed fb pre-emergence fluchloralin @ 1.00 kg ha^{-1}, amaranthus at inter-row space fb grubber at 30 DAS, grubber at 15 and 30 DAS. Basal diameter in fluchloralin at 1.00 kg ha^{-1} fb grubber at 30 DAS and complete weedy situation were statistically at par among each other due to phytotoxicity of fluchloralin as pre-emergence (Table 2).

Yield

Significant differences in yield were not observed among the treatments comprising of complete weed free situation, farmer's practice, mulching fb hand weeding at 25 DAS owing to good control of weeds from the beginning. The lower yield was obtained in the treatment with fluchloralin @ 1.00 kg ha^{-1} as pre-emergence fb grubber at 30 DAS and stale seedbed treatments, which were similar weedy treatment. Though the treatments fluchloralin @ 1.00 kg ha^{-1} as pre-emergence fb grubber at 30 DAS and stale seedbed fb fluchloralin @ 1.00 kg ha^{-1} as pre-emergence were very much effective in controlling weed throughout the crop growth as revealed through higher weed control efficiency and weed index, but resulted in poor yield both at research

farm and farmers' field due to phytotoxicity to jute seedlings (Table 2). This was mainly because of soil texture and soil moisture as revealed by Saraswat and Sharma (1983). However, pre-plant surface application of fluchloralin @0.7 kg ha^{-1} fb grubber at 30 DAS resulted in jute yield similar to farmers' practice owing to non-toxicity of herbicide and good weed control. This treatment will perhaps be alternative to hand weeding and save human energy for other useful farm operations, as spelt out by Borkar *et al.* (1999).

Stale seedbed alone or in combination with grubber at 30 DAS proved less effective due to delay in sowing of jute for the period of 10 to 15 days and rapid emergence of weeds resulting from continuous rainfall. Quizalofop ethyl @ 50 g ha^{-1} was effective only on grasses, but paved way for emergence of sedges and broadleaved weeds resulting in higher weed competition and lowered fibre yield. Apart from farmers' practice, mulching with rice straw @ 10 t ha^{-1} at 3 days after emergence followed by hand weeding at 25 DAS recorded significantly higher plant height, basal diameter and fibre yield compared to other weed control practices (Table 2).

Table 2: Effect of weed treatments on weed control efficiency, weed index, yield attributing characters and fibre yield of jute during 2006

Treatments	Weed control efficiency at 60 DAS (%)		Weed index (%)		Basal diameter (mm)		Plant height (m)		Fibre yield (q ha^{-1})	
	RF	FF	RF	FF	RF	FF	RF	FF	RF	FF
T_1	55.3	52.7	21.9	32.2	10.9	11.0	2.7	2.8	18.1	17.2
T_2	58.8	56.8	19.7	36.5	10.9	10.9	2.6	2.7	18.6	16.1
T_3	35.7	36.0	53.7	53.9	10.4	10.5	2.4	2.5	10.7	11.7
T_4	77.1	76.5	29.8	39.5	10.9	10.9	2.6	2.7	16.3	15.4
T_5	92.5	93.7	47.8	52.0	10.6	10.6	2.5	2.6	12.1	12.2
T_6	86.5	88.0	3.5	5.0	12.4	12.3	3.0	3.1	22.4	24.1
T_7	92.3	94.5	83.6	88.7	9.0	8.1	1.9	2.0	3.8	2.9
T_8	50.3	46.0	33.6	38.9	10.8	10.9	2.6	2.6	15.4	15.5
T9	96.8	98.2	3.4	3.5	12.4	12.5	3.1	3.1	22.4	24.5
T_{10}	0.00	0.00	81.4	78.8	9.1	9.1	2.0	2.1	4.3	5.4
T_{11}	100.00	100.00	0.00	0.00	12.5	12.6	3.1	3.1	23.2	25.4
SEm (±)					**0.37**	**0.33**	**0.06**	**0.09**	**0.46**	**0.48**
LSD(0.05)					**0.77**	**0.69**	**0.12**	**0.18**	**0.97**	**1.01**

RF-Research Farm, FF-Farmers' Field, DAS-Days after sowing and treatments details see in materials and methods section

Economics

The perusal of data (Table 3) on economic analysis revealed that maximum net return (₹ 21338/- and ₹ 24397/- at research farm and farmers' field, respectively) as well as benefit: cost ratio (1.34 and 1.52 at research farm and farmers' field, respectively) among the weed control practices was obtained in fluchloralin @0.70 kg ha^{-1} as pre-plant surface application fb grubber at 30 DAS. This was due to high weed control efficiency with least man days engagement and higher fibre yield (24.3 and 26.3 q ha^{-1}, respectively). Even though mulching with rice straw @ 10 t ha^{-1} fb hand weeding at 25 DAS resulted in higher weed control efficiency and fibre yield (26.8 and 29.4 q ha^{-1} at research farm and farmers field, respectively), however gave lower net return (Rs. 13686/- and Rs. 17687/-, respectively) and benefit: cost ratio (0.49 and 0.64, respectively) owing to high cost of rice straw mulch which in turn increased cost of cultivation. Further farmers' practice also gave lower values of net return (₹ 11383/- and ₹ 14468/- at research farm and farmers' field, respectively) and benefit: cost ratio (0.41 and 0.52, respectively) due to higher man days involved in hand weeding at 15, 30 and 55 DAS resulting in considerable increased of cost of cultivation (Table 3).

Thus weed control practice comprising of fluchloralin @ 0.70 kg ha^{-1} as pre-plant surface application fb grubber at 30 days after sowing can be recommended for controlling weeds as well as getting higher profit in jute cultivation under Terai agro-ecological region of West Bengal.

Table 3: Effect of different treatments on weed control efficiency, fibre yield, stick yield and economics of jute cultivation during 2007

Treatments	Weed control efficiency at 60 DAS (%)		Fibre yield (q ha^{-1})		Stick yield (q ha^{-1})		Total cost of cultivation (₹ ha^{-1})		Net return (₹ ha^{-1})		Benefit : cost ratio	
	RF	FF	RF	FF	RF	FF	RF	FF	RF	FF	RF	FF
T_1	49.3	46.3	11.4	13.2	32.1	37.0	16043.4	16043.4	1737.85	4498.35	0.11	0.28
T_2	54.7	56.2	13.2	15.0	37.1	42.2	15244.4	15244.4	5343.6	8147.6	0.35	0.53
T_3	29.5	33.2	11.8	12.4	33.1	34.7	16464.9	16464.9	1917.6	2829.85	0.12	0.17
T_4	76.4	78.6	12.5	14.6	34.9	41.0	17028.15	17028.15	2346.35	5721.1	0.14	0.34
T_5	68.3	70.3	17.3	19.1	46.8	51.7	17761.1	17761.1	9028.4	11794.6	0.51	0.66
T_6	86.4	90.4	26.8	29.4	72.4	79.4	27750.4	27750.4	13686.1	17687.35	0.49	0.64
T_7	79.3	83.2	24.3	26.3	63.2	68.4	15977.35	16004.35	21337.9	24396.65	1.34	1.52
T_8	48.3	51.6	11.2	11.4	30.3	31.0	15623.05	15623.05	7711.45	8035.45	0.49	0.51
T9	94.4	97.5	25.4	27.4	66.1	71.3	27635.9	27635.9	11383.6	14468.35	0.41	0.52
T_{10}	0.00	0.00	4.4	6.4	11.1	15.9	14117.9	14117.9	-7362.6	-4378.6	-0.52	-0.31
T_{11}	100.0	100.0	27.6	30.3	77.4	85.0						
SEm (±)			**0.59**	**0.73**	**2.51**	**1.77**						
LSD(0.05)			**1.24**	**1.52**	**5.24**	**3.70**						

RF-Research Farm, FF-Farmers' Field, DAS-Days after sowing, PPS-Pre plant surface application, fb - followed by Sale price of output: Jute fibre - ₹1275 q^{-1}, jute stick - ₹100/q, amaranthus - ₹4 kg^{-1}, Input price (kg): jute seed-₹ 40, seed of amaranthus-₹ 667, rice residue-₹ 0.80, Urea-₹ 4.78, SSP-₹ 3.22, MOP-₹ 4.45; Herbicides (lit.): quizalofop ethyl-₹ 1550, glyphosate-₹ 404, fluchloralin-₹594, labour wage-₹ 75.10 man day^{-1}, man days required ha^{-1}- mulching- 15, each hand weeding- 60, spraying of herbicide -5, grubber operation -7.5, Yield of amaranthus in inter row spaces of jute -1500 kg ha^{-1}

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REFERENCES

Bandyaopadhyay, P., Mitra, A. K. and Jana, P. K. 1994. Effect of weed-control method on growth, yield, herbicidal efficiency index and net profit of white jute (*Corchorus capsularis*).*The Indian J. Agril. Sci.,* **64:** 485-87.

Borkar, U.N., Palit, P. and Singh, D. P. 1999. Energy productivity of jute and sisal. *In*: *Jute and Allied Fibres-Agriculture and Processing* (Eds. Palit, P., Pathak, S. and Singh, D. P.), Golden Jubilee Publication, CRIJAF, Barrackpore, pp. 129-31.

Ghorai, A K. 2007. Weed management of jute (*Corchorus olitorius*) by soil solarisation. *Indian J. Agril. Sci.,* 77: 390-92.

Ghorai, A.K., Chakraborty, A.K., Pandit, N.C., Mondal, R. K. and Biswas, C.R. 2004. Grass weed control in jute by Targa super (quizalofop-ethyl 5% EC). *Pestol.,* **28**: 31–34.

Prusty, J. C., Behera, B., Parida, A. K. and Lenka, D. 1988. Effect of herbicides on fertilizer use economy in jute-rice cropping system. *Ind. J. Agron.,* **33**: 315–16.

Rajput, A. L. 2000. Integrated weed-management practices in white jute (*Corchorus capsularis*). *Ind. J. Agron.,* **45**: 782–86.

Raju, R. A. 1997. *Field Manual for Weed Ecology and Herbicide Research.* Agrotech Publishing Academy, Udaipur, pp. 78.

Saraswat, V. N. 1980. Ecology of weed of jute fields in India. *Trop. Pest Mangt.,* **26** :45-50.

Saraswat, V. N. and Sharma, D. K. 1983. Compararive efficiency of fluchloralin and diphenamid in controlling weed in jute fields. *Pesticides,* **17**: 37-39.

Sarkar, S., Bhattacharjee, A. K. and Mitra, S. 2005. Weed management in jute by trifluralin (48%) EC in the early jute-weed competition phase. *J. Crop and Weed,* **2**: 30-33.