Indian Journal of Weed Science **49**(4): 381–384, 2017
DOI: 10.5958/0974-8164.2017.00098.3

Effect of weed management practices on productivity and profitability of jute fibre

Sarika Jena, Mukesh Kumar*[1], Sabyasachi Mitra[1], R.K. Paikray and A.K. Ghorai[1]
Jute Research Station, Odisha University of Agriculture and Technology, Kendrapara, Odisha 754 211

Received: 12 September 2017; Revised: 1 November 2017

ABSTRACT

A field experiment was conducted at Kendrapara, Odisha to find out suitable and cost effective weed management practices for jute. Different doses of pre-emergence butachlor (both liquid and granule formulation) and post-emergence (quizalofop-ethyl) herbicides followed by (*fb*) one hand weeding (HW) were tested in jute crop and the treatment effects were compared with unweeded and two hand weeding treatments. Application of quizalofop-ethyl 60 g/ha at 20 days after crop emergence (DAE) followed by one HW at 15-20 days after herbicide application recorded higher weed control efficiency (78.3%), plant height (351 cm), basal diameter (1.40 cm) and fiber yield (2.9 t/ha) of jute as well as higher B:C ratio (2.13) compared to other weed control treatments. Values of the said parameters recorded with the quizalofop-ethyl treatment were statistically at par with those recorded with two hand weeding. Butachlor 1.5 kg/ha *fb* one HW at 20 DAE was the next best treatment with respect to weed control efficiency (68.7%), plant height (341.0 cm), basal diameter (1.39 cm), fibre yield (2.64 t/ha), and B:C ratio (1.99). Thus application of pre-emergence herbicide butachlor 1.5 kg/ha or post-emergence herbicide quizalofop-ethyl 60 g/ha in combination with one manual weeding may be recommended to the jute growers as more effective and economic weed control practices compared to the existing manual weeding practice.

Key words: Butachlor, Quizalofop-ethyl, Jute, Weed control efficiency, Weed management, Yield

Jute (*Corchorus olitorius* and *C. capsularis*) crop has become an integral part of farming in Eastern India as it provides livelihood support to about four million farm families in this region and also generates employment to the tune of 10 million paid man days (Mahapatra *et al.* 2012). In addition to its biodegradability and its ability to be used as an annual renewable resource, the short growing period (100-120 days) of jute enables the farmers to fit the crop in the prevalent rice based cropping system during the pre-*Kharif* (summer) season even under rainfed condition. Jute also helps in the maintenance of the soil productivity as it adds significant amount of organic matter along with nutrients to the soil through leaf fall during its growth (Singh *et al.* 2015). Among the various factors contributing to high production cost of jute, heavy weed infestation is a major one and manual weeding operation alone contributes to 16.3% of the total production cost (Ghimire and Thakur 2013). Sinha *et al.* (2009) had reported that at present, around 65-70% cost of production is spent for weeding and retting only. Hot and humid climate coupled with intermittent rainfall during the jute-growing season, encourages weed growth resulting in severe crop-weed competition (Kumar *et al.* 2013) and yield losses up to 75 to 80% (Sarkar *et al.* 2005, Ghorai *et al.* 2013). Though, the chemical weed control methods are very effective to control grassy weeds in jute (Ghorai *et al.* 2004, Sarkar 2006), there is lack of selective herbicides, which can control the broad spectrum weed flora in jute (Kumar *et al.* 2013). Keeping the above facts, the present experiment was conducted to develop suitable weed management practices through effective integration of pre- or post-emergence herbicides with hand weeding (HW).

***Corresponding author:** mukesh.agro@gmail.com
[1]ICAR-Central Research for Jute and Allied Fibres, Barrackpore, Kolkata 700120

MATERIALS AND METHODS

The experiment was conducted during pre-*Kharif* seasons of 2013 and 2014 at Jute Research Station, Kendrapara, Odisha (19^{0}34'N latitude and 86^{0}30'E longitude). The soil of the experimental plot was sandy loam, low in organic carbon (0.45%) and available nitrogen (232 kg/ha), medium in phosphorus (33 kg/ha) and high in potassium (354 kg/ha) and the pH of the soil was 4.7. The experiment was carried out in a randomized block design, with seven treatments, replicated thrice. The experimental plot size was 5 × 4 m and a space of 1.0 m was kept between the plots, blocks and also around the field. Jute cultivar '*JRO 524*' was sown at a spacing of 30

× 10 cm. Nitrogen, phosphate and potash were added 60:30:30 kg/ha during both the years of experimentation while farm yard manure was added 5 t/ha as recommended for Odisha. The crop was sown on 12th and 4th April during 2013 and 2014, respectively. Herbicides as per treatments were applied using 500 litres of water/ha with a flat fan nozzle attached in a high volume knapsack sprayer 24 hrs after sowing. Granular herbicides were applied by mixing with sand 30 kg per hectare basis. Harvesting of jute crop was done on 31st and 23rd August in 2013 and 2014, respectively. Weed samples were collected periodically with 50 × 50 cm quadrate from all the treatments, dried in shade and then were oven dried at 65 ± 5 ^{0}C and the weed biomass was expressed in t/ha. To have overall picture of ecological importance of a weed species, importance value index (IVI) of a plant species was calculated by adding relative frequency, relative density and relative dominance from the species wise weed sample collected from unweeded plot. Weed control efficiency (WCE) and weed index (WI) were calculated at the time of harvest using the formula:

WCE= $[(WD_c-WD_t) / WD_c] \times 100$ where WCE = weed control efficiency, WD_c = weed biomass in control plot and WD_t = weed biomass in treated plot

WI = $(Y_f-Y_t)/Y_f \times 100$ where WI = weed index, Y_f = yield of weed free plot, and Y_t = yield from treated plot.

Data on biological parameters such as plant height, basal diameter were recorded from ten plants randomly selected from second row of each plot at the time of harvest. Harvesting of jute crop was done on 31st and 23rd August in 2013 and 2014, respectively. The jute fibre obtained after retting were sun dried and fibre yield was expressed in t/ha. The data on weed biomass, plant height, basal diameter and fibre yield of jute were analysed statistically using ANOVA.

RESULTS AND DISCUSSION

Weed flora

A total of ten weed species were recorded in weedy plot (**Figure 1**), which comprised of four grass weeds, *viz*. *Echinochloa colona* (L.) Link (IVI - 47.8%), *Paspalam digitatum* L. (IVI - 27.7), *Cynodon dactylon* L. (IVI - 30%), *Eleusine indica* Gaertn (IVI - 41%); five broad-leaved weeds, *viz*. *Portulaca oleracea* L. (IVI- 33.1%), *Melochia corcorifolia* L. (IVI - 26.2%), *Cleome viscosa* L. (IVI - 30.3%), *Euphorbia hirata* L. (IVI - 4.1%), *Scoparia fulvis* L. (IVI - 19.7%) and only one sedge

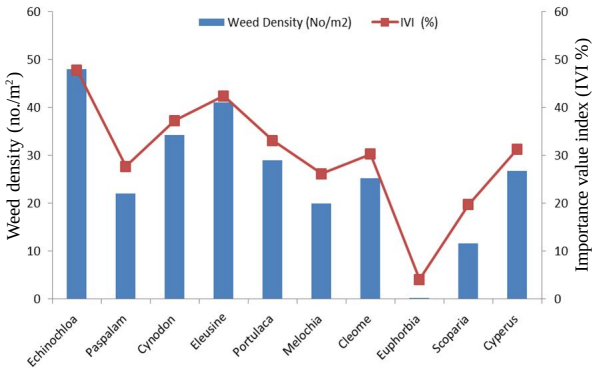


Figure 1. Weed dynamics in unweeded plot in experimental field

Cyperus rotundus L. (IVI - 26.7%). The data on weed flora indicated the dominance of grass weeds among, which *Echinochloa colona* was the most dominant one.

Effect on weeds

Weed biomass increased with increase in crop growth in unweeded plot and it reached up to 0.89 - 0.93 t/ha at 45 DAS which resulted in higher weed index (35.36) in this treatment **(Table 1).** The vigorous growth of weeds in the control plots resulted in increased competition with jute crop for natural resources like sunlight, soil nutrient and moisture, which finally led to highest weed index during both the years. All weed control treatments significantly (p=0.05) reduced the weed biomass at 30 and 45 DAS compared to unweeded control. Application of quizalofop-ethyl 60 g/ha *fb* one HW significantly (p=0.05) reduced the weed biomass as compared to the remaining treatments, though, it was at par with two hand weeding treatment. Pre-emergence application of butachlor (EC) 1.0 or 1.5 kg/ha *fb* one HW also reduced the weed density in the early growth stages of jute but the second flush of weeds emerged thereafter in the butachlor treated plots. Butachlor (EC) at a higher dose (1.5 kg/ha) was also found more effective in controlling weeds compared to recommended doses of butachlor (1.0 kg/ha) or its application in granular form. The superiority of quizalofop-ethyl (60 g/ha) over butachlor (both in liquid or granular form) may be attributed to the fact that the experimental plots were dominated with grass weeds. Similar results were observed earlier in jute by Ghorai *et al.* (2013, 2013a, 2014) and in ramie by Kumar *et al.* (2015a). Weed control efficiency (WCE) of the treatments tested varied from 63.2 to 78.7% with two hand weeding and quizalofop-ethyl treatment showing the much higher WCE value (78.5–78.7%) as both the treatments provided more weed free situation to the

Table 1. Effect of weed management practices on weed biomass at different crop growth stages

Treatment	Weed biomass (kg/ha)						WCE (%)	WI
	15 DAS		30 DAS		45 DAS			
	2013	2014	2013	2014	2013	2014		
Butachlor 50% EC 1.0 kg/ha as PE + one HW at 20 DAE	116	114	134	139	233	243	67.9	11.6
Butachlor 50% EC 1.5 kg/ha as PE + one HW at 20 DAE	106	110	144	149	221	225	68.7	8.85
Butachlor 5G 1.0 kg/ha as PE + one HW at 20 DAE	123	122	173	179	258	266	63.24	12.25
Butachlor 5G 1.5 kg/ha as PE + one HW at 20 DAE	120	119	166	177	239	256	64.2	10.6
Quizalofop-ethyl 5% EC 60 g/ha + sticker 1 ml/ L at 15 DAE + one hand at 15-20 days after herbicide application	158	158	115	112	64	63	78.5	0.0
Unweeded check	160	197	399	415	890	933	0.0	35.56
Two hand weedings weeder at 20 DAE and 40 DAE	139	141	129	133	54	55	78.7	3.94
LSD (p=0.05)	40	31	43	43	65	77	-	-

PE: Pre-emergence; HW: Hand weeding; DAE: Days after emergence of crop; WCE: Weed control efficiency, WI: Weed index

jute crop compared to the rest of the weed control treatments (**Table 1**). Interestingly, application of butachlor (EC) 1.5 kg/ha followed by one HW also showed 68.7% WCE possibly due to suppression of most of the grassy/narrow leaved weeds, which constituted the major share of total weed density. Effective control of grass weed and some broad-leaved weed through application of butachlor (EC) as pre-emergence herbicide followed by one hand weeding had also been reported earlier in jute (Ghorai *et al.* 2013).

Effect on crop growth and fibre yield

The yield attributes (basal diameter and plant height) as well as fibre yield of jute crop was significantly influenced by the various weed control methods as all the weed control treatments significantly (p=0.05) increased the plant height, basal diameter and fibre yield of the crop over un-weeded control in both the years (**Table 2**). Maximum values of fibre yield of jute was recorded with the plots receiving quizalofop-ethyl treatment during the individual years (2.85 - 2.94 t/ha) followed by two hand weeding (2.74 - 2.75 t/ha) and butachlor (EC) (butachlor 1.5 kg/ha + 1 HW at 20 DAS) (2.59 - 2.68 t/ha). Similar trend was observed in the pooled data also. Maximum value of plant height in jute was recorded with two hand weeding treatment followed by quizalofop-ethyl treatment while the latter recorded maximum values of basal diameter of the crop during both the years (**Table 2**). The results indicated that all the weed control treatments were almost equally effective in controlling the weed growth thereby minimizing the crop – weed competition. The relatively higher fibre yield of jute recorded with quizalofop-ethyl or butachlor (EC) at higher dose (1.5 kg/ha) was possibly due to better control of grassy weeds as compared to other herbicides under study. A negative correlation was

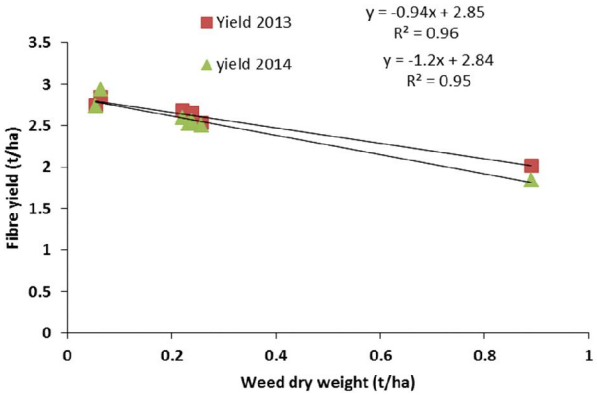


Figure 2. Regression analysis of weed biomass and fibre yield

observed between weed biomass and fibre yield of jute (**Figure 2**). The regression equation clearly showed that an increase of 0.1 t/ha in weed biomass resulted in decrease of fibre yield by 0.095 and 0.12 t/ha in 2013 and 2014, respectively. The results corroborated the earlier findings of Kumar *et al.* (2015).

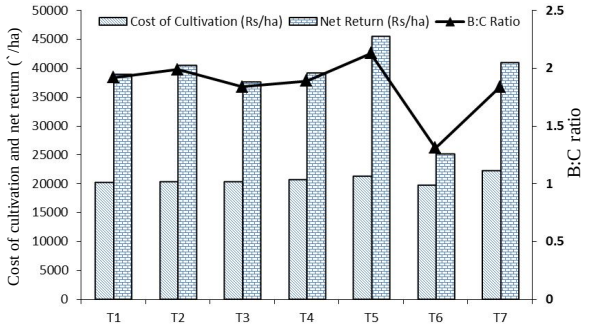
Economics

Application of pre- and post-emergence herbicides followed by one hand weeding recorded significantly higher return over unweeded control and were also comparable to two hand weeding (**Figure 3**). Highest net return (` 45,400/ha) and B:C ratio (2.13) were observed with post-emergence application of quizalofop-ethyl (60 g/ha) + one HW treatment followed by butachlor (EC) (1.5 kg/ha) + 1 hand weeding at 15 DAE (` 40390/ha and 1.98, respectively). The results were in accordance with the findings of Alam *et al.* (2010), who also observed that herbicide application followed by one hand weeding lead to effective weed control along with increased yield as well as better economic return.

Table 2. Effect of weed control treatments on yield attributes and fibre yield of jute

Treatment	Plant height (cm)		Basal diameter (cm)		Fibre yield (t/ha)		
	2013	2014	2013	2014	2013	2014	Pooled
Butachlor 50% EC 1.0 kg/ha as PE + one HW at 20 DAE	335.7	330.0	1.32	1.31	2.62	2.52	2.57
Butachlor 50% EC 1.5 kg/ha as PE + one HW at 20 DAE	341.7	343.0	1.29	1.39	2.68	2.59	2.64
Butachlor 5 G 1.0 kg/ha as PE + one HW at 20 DAE	336.3	341.3	1.17	1.38	2.53	2.50	2.52
Butachlor 5 G 1.5 kg/ha as PE + one HW at 20 DAE	334.0	331.0	1.23	1.33	2.65	2.55	2.60
Quizalofop-ethyl 5 % EC 60 g/ha + sticker 1 ml/ L at 15 DAE + one hand at 15-20 days after herbicide application	343.7	358.3	1.31	1.49	2.85	2.94	2.89
Unweeded check	309.3	297.0	1.01	1.12	2.02	1.84	1.93
Two hand weedings weeder at 20 DAE and 40 DAE	347.7	352.6	1.28	1.44	2.75	2.74	2.74
LSD (p=0.05)	15.55	35.5	0.215	0.12	0.55	0.55	0.36

PE: Pre-emergence; HW: hand weeding; DAE: Days after emergence of crop



(T_1: Butachlor 50% EC 1.0 kg/ha + 1 HW at 15 DAE; T_2: Butachlor 50% EC 1.5 kg/ha + 1 HW at 15 DAE; T_3: Butachlor 5G 1.0 kg/ha +1 HW at 15 DAE ; T_4: Butachlor 5G 1.5 kg/ha + 1 HW at 15 DAE ; T_5: Quizalofop-ethyl 60 g/ha at 20 DAE +1 HW at 15 days after herbicide application ; T_6: Un weeded check ; T_7: Two HW)

Figure 3. Economics of different weed management practices

It was concluded that application of pre-emergence herbicide butachlor (EC) 1.5 kg/ha followed by one hand weeding at 15 DAE or application of post-emergence herbicide quizalofop-ethyl 60 g/ha with one hand weeding at 15 days after herbicide application effectively controlled the weeds, increased fibre productivity and profitability in jute cultivation.

REFERENCES

Alam ATMM, Hossain MS, Islam MM, Ahmed I and Hamidi MA. 2010. Effect of weeding and thinning practices on fibre yield and economics of desi jute. *Bangladesh Journal of Weed Science* **1**(1): 31- 34.

Ghimire TB and Thakur NS. 2013. Constraint and opportunity of raw jute production: A case study of eastern Terai, Nepal. *Agronomy Journal Nepal* **3**: 117-122.

Ghorai AK, Chakraborty AK, Pandit NC, Mondal RK and Biswas CR. 2004. Grass weed control in jute by Targa super (quizalofop-ethyl 5% EC). *Pestology* **28**: 31-34.

Ghorai AK, De Rajib, Chowdhury H, Majumdar B, Chakraborty A and Kumar Mukesh. 2013. Integrated management of weeds in raw jute. *Indian Journal of Weed Science* **45**(1): 47-50.

Ghorai AK, Choudhary H, Kumar Mukesh Kumar S. 2013a. Technology for Weed management in jute. *Indian Farming* **63**(6): 12-14.

Kumar Mukesh, Ghorai AK, Singh A and Kundu DK. 2015. The critical period for weed competition in relation to yield of jute (*Corchorus olitorius* L.) *Journal of AgriSearch* **2**(3): 225-228.

Kumar Mukesh, Ghorai AK, Naik RM, Kundu DK and Mitra S. 2015a. Use of post-emergence herbicides to control weeds in ramie (*Boehmeria nivea* L). *Indian Journal of Weed Science* **47**(4): 1-5

Kumar Mukesh, Ghorai AK, Mitra S and Kundu DK. 2013. Major weed flora in jute and their management. *Technical Bulletin CRIJAF* (1/2013). 49 p.

Mahapatra BS, Mitra S, Kumar Mukesh, Ghorai AK, Sarkar SK, Kar CS, Kundu DK, Satpathy S and Karmakar PG. 2012. An overview of research and development in jute and allied fibre crops in India. *Indian Journal of Agronomy* **57**(3rd IAC Special Issue): 72-82.

Sarkar S. 2006. Weed management in jute (*Corchorus olitorius* L.) by post-emergence herbicides. *Journal of Tropical Agriculture* **44**(1-2): 71-73.

Sarkar S, Bhattacharjee AK and Mitra S. 2005. Weed management in jute by trifluralin (48% EC) in the early jute weed competition phase. *Journal of Crop and Weed* **2**(1): 30-33.

Singh SR, Maitra DN, Kundu DK, Majumdar B, Saha AR and Mahapatra BS. 2015. Integrated fertilizer prescription equations for recommendations of fertilizers in jute-rice-garden pea sequence on alluvial soil of eastern India. *Communications in Soil Science and Plant Analysis*, 46: 1-15.

Sinha MK, Mitra Sabyasachi, Ramasubramanain T and Mahapatra BS. 2009. Crop diversification for profitability in jute and allied fibre crops. *Indian Journal of Agronomy* **54**(3): 221-225.