

SEQUENTIAL APPLICATION OF PRE- AND POST- EMERGENCE HERBICIDES FOR CONTROLLING WEEDS IN OLITORIOUS JUTE

M. M. Rahman^{1*}, M. Y. Pinki¹ and A. K. Hasan¹

ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during April to September, 2014 to find out the weed control efficacy of different pre-emergence and post-emergence herbicides in tossa jute (*Corchorus olitorious*). Two pre-emergence herbicides viz. pendimethalin and pretilachlor; and three post-emergence herbicides viz. metamifop, quizalopfop-p-ethyl and fenoxapro-p-ethyl; were used in the experiment. Ten weed control treatments viz. no weeding control (T₁), weed free control (T₂), pendimethalin fb one hand weeding (T₃), pretilachlor fb one hand weeding (T₄), pendimethalin fb metamifop (T₅), pretilachlor fb metamifop (T₆), pendimethalin fb quizalopfop-p-ethyl (T₇), pretilachlor fb quizalopfop-p-ethyl (T₈), pendimethalin fb fenoxapro-p-ethyl (T₉) and pretilachlor fb fenoxapro-p-ethyl (T₁₀) were used in a randomized complete block design with three replications. Weed control treatments significantly affected weed density and dry weight and exerted significant effects on plant height, plant diameter, stick diameter, green weight plant⁻¹, green weight of bark plant⁻¹, green weight of stick of plant⁻¹, dry fibre weight plant⁻¹, dry stick weight plant⁻¹, fibre yield and stick yield. The result revealed that application of pretilachlor fb fenoxapro-p-ethyl produced the lowest weed density and dry matter and resulted in the highest fibre and stick yield. The present study concludes that the highest weed control in tossa jute could be possible by applying pretilachlor @ 1 L ha⁻¹ at 2 days after sowing (DAS) followed by fenoxapro-p-ethyl @ 0.75 L ha⁻¹ at 25 DAS.

Keywords: Herbicide, hand weeding, weed density, weed dry matter, fiber yield, stick yield

INTRODUCTION

Weed infestation is a serious constraint of jute (*Corchorus olitorious*) production as the hot and humid climate during the jute growing season encourages profuse weed growth. Weeds compete with jute plants from seedling stage to harvesting stage and reduces fibre yield to about 75 to 80% under irrigated condition and 87% under rainfed condition (Jena *et al.*, 2017). The weeding operation is traditionally done manually in the jute field and other weeding operations include raking, hoeing and hand picking to suppress the growth or to remove the growing weeds from the jute field (Alam, 2003). The cost of hand weeding comes out as high as 33% of total cost of production in jute (Islam, 2014). About 35 to 40% of total man-days and 22 to 27% of total cost of jute cultivation is required for weeding and thinning (Islam, 2014).

Generally, three to four hand weeding are needed in jute depending upon the nature of weeds and intensity of their infestation. This traditional method of weed control is very much laborious and time consuming. Moreover, weed control at the critical period by traditional method may not be possible due to the unfavorable weather condition and at the period of peak labor demand. At present, the labour shortage and increased wage rate is forcing farmers to search for alternative weed control measures. In such situation, the use of herbicide may be the best alternative in controlling weed as it can help in controlling weeds more easily and cheaply. Weed competition at early and late growth stages can be eliminated through the use of pre-emergence and post-emergence herbicide (Sarkar *et al.*, 2005). Herbicides are used in weed control in the advanced countries of the world. In Bangladesh sufficient information are not available about the effectiveness of herbicide in controlling weeds especially in

¹Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

*Corresponding Author, Email: rahmanag63@gmail.com

jute. The present study was, therefore, undertaken to examine the effect of pre- and post-emergence herbicides in controlling weeds and also on the yield performance of jute with a view to find out the best herbicide sequences for jute cultivation.

MATERIALS AND METHODS

Site and Soil

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh, during the period from April to September 2014. The field was a well-drained medium high land belonging to the Brahmaputra Alluvial Soil tract having silty loam soil with pH value of 6.6. The soil contained 1.60% organic matter, 0.140% total nitrogen, 14.67 ppm phosphorus, 0.082 meq 100 g⁻¹ potassium, 35.43 ppm sulphur and 0.45 ppm zinc.

Experimental Treatment and Design

The experiment used 10 treatments consisting of sequential application of pre- and post-emergence herbicides along with hand weeding, weed free check and weedy check. Two pre-emergence herbicides viz. pretilachlor and pendimethalin; and three post-emergence herbicides viz. metamifop, quizalofop-p-ethyl, and fenoxapro-p-ethyl were used and the 10 treatments viz. No weeding (T₁), Weed free control (T₂), pendimethalin + one hand weeding (T₃), pretilachlor + one hand weeding (T₄), pendimethalin + metamifop (T₅), pretilachlor + metamifop (T₆), pendimethalin + quizalofop-p-ethyl (T₇), pretilachlor + quizalofop-p-ethyl (T₈), pendimethalin + fenoxapro-p-ethyl (T₉) and pretilachlor + fenoxapro-p-ethyl (T₁₀) were assigned in a randomized complete block design (RCBD) with three replications. There were 30 unit-plots and the size of each plot was 12 m² (4 m × 3 m).

Crop Husbandry

Jute seed was sown in well prepared land on 25 April 2014 in 25 cm apart rows continuously at 2-3 cm depth using a seed rate of 7 kg ha⁻¹. After sowing, the seeds were covered with soil by light laddering. The field was fertilized with urea, TSP, MP, and gypsum and zinc sulphate @ 100-30-45-45-11 kg ha⁻¹. The entire amount of TSP, MP, gypsum, zinc sulphate and one third of urea were applied at the time of final land preparation. The rest two-third of urea was top dressed in two installments at 30 and 45 days after sowing (DAS). Pre-emergence herbicides viz. pendimethalin and pretilachlor were applied at 2 DAS by hand sprayer @ 2.50 and 1.0 L ha⁻¹, respectively. Early post emergence herbicides viz., metamifop, quizalofop-p-ethyl and fenoxapro-p-ethyl were applied at 25 DAS by hand sprayer @ 0.75, 0.65 and 0.75 L ha⁻¹, respectively. For one hand weeding treatment, weeding was done at 25 DAS while for weed free treatment frequent hand weeding was done to remove all the weeds from the field so that no weeds can grow in the field and compete with the crop.

Harvesting and processing

Crop was harvested on 26 September 2014 at the time of flowering. From each individual plot 5 samples were randomly selected for collecting necessary data. The harvested crops of the plots were tied loosely in bundles and placed in pond water for retting. The retting process was completed by 21 days of placement in pond water. After proper retting the fibres were extracted by stripping and washing thoroughly in water. Then the extracted fibres were dried in the sun on bamboo bar and the jute sticks were also dried in the field.

Data recording

Weed parameters

Data on weed density and dry matter were recorded from each plot at 20 DAS, 40 DAS, 60 DAS and 95 DAS of the jute plants by using 0.25 m × 0.25 m quadrat. The quadrat was placed in three spots

Sequential application of herbicides for controlling weeds in jute

in a unit plot at random. The weeds within the quadrat were uprooted, counted and converted to number m⁻². The uprooted weeds were cleaned and dried in an electric oven for 72 hours and the dry weight was expressed in g m⁻².

Plant parameters

Data on leaf greenness (SPAD value), plant height, plant population, plant diameter, stick diameter, bark diameter, green weight plant⁻¹, green weight of bark plant⁻¹, green weight of stick of plant⁻¹, dry fibre weight plant⁻¹, dry stick weight plant⁻¹, fibre yield and stick yield were recorded. SPAD value was measured by SPAD 502, Minolta, Japan at 60 DAS. Fibre and stick were collected plot wise and weighed. Then fibre and stick yield plot⁻¹ were converted to t ha⁻¹.

Statistical analysis

The recorded data were compiled and tabulated in proper form and subjected to statistical analysis. Analysis of variance was done following RCBD with the help of computer package program MASTAT and mean differences were adjudged by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Infesting weed species in the jute field

Twenty-five weed species belonging to thirteen families were found in the field of which seventeen were annuals and eight were perennial (Table 1).

Table 1. Weed species infesting the experimental jute field

Sl. No.	Local name	Scientific name	Family	Morphological type	Life cycle
1	Boro shama	<i>Echinochloa crusgalli</i>	Gramineae	Grass	Annual
2	Choto shama	<i>Echinochloa colonum</i>	Gramineae	Grass	Annual
3	Angta	<i>Paspalum scrobiculatum</i>	Gramineae	Grass	Perennial
4	Sushni shak	<i>Marsilea quadrifolia</i>	Marsileaceae	Broad leaf	Annual
5	Joina	<i>Fimbristylis miliacea</i>	Cyperaceae	Sedge	Annual/perennial
6	Panilong	<i>Ludwigia hyssopifolia</i>	Onagraceae	Broad leaf	Annual
7	Angulee ghash	<i>Digitaria sanguinalis</i>	Gramineae	Grass	Perennial
8	Subuj nakful	<i>Cyperus defformis</i>	Cyperaceae	Sedge	Perennial
9	Halud nakful	<i>wahlenbergia marginata</i>	Campanulaceae	Sedge	Annual
10	Mutha	<i>Cyperus rotundus</i>	Cyperaceae	Grass	Perennial
11	Chira ghash	<i>Eragrotis gangetica</i> ,	Gramineae	Grass	Annual
12	Matichech	<i>Fimbristylis dipphylla</i>	Cyperaceae	Sedge	Annual
13	Durba	<i>Cynodon dactylon</i>	Gramineae	Herd	Perennial
14	Lazzabati	<i>Mimosa invisa</i>	Leguminosae	Sedge	Perennial
15	Ghagra	<i>Xanthium italica</i> ,	Compositae	Herd	Annual
16	Kanainala	<i>Cyanitos axillaris</i>	Commelinaceae	Grass	Annual
17	Chapra	<i>Eleusine indica</i>	Gramineae	Grass	Annual
18	Kanaibashi	<i>Commelia benglensis</i>	Commelinaceae	Grass	Annual
19	Latka	<i>Lupia germinata</i>	Verbanaceae	Grass	Annual
20	Hazardana	<i>Phylanthus niruri</i>	Euphobiaceae	Grass	Annual
21	Fulka	<i>Leprochloa chinensis</i>	Gramineae	Grass	Annual
22	Khetpatri	<i>Hedyotis corymbosa</i>	Scrophulariaceae	Herb	Annual
23	Fushka begun	<i>polygonum coccineum</i>	solanaceae	Grass	Annual
24	Bish katali	<i>Paspalum commersoni</i>	Polygonaceae	Herb	Annual
25	Gaicha	<i>Polygonum orientale</i>	Gramineae	Grass	Annual

The most important weed species throughout the growing season were *Echinochloa crusgalli*, *Echinochloa colonum*, *Paspalum scrobiculatum*, *Marsilea quadrifolia*, *Fimbristylis miliacea*,

Ludwigia hyssopifolia, *Digitaria sanguinalis*, *Cyperus defformis*, *Wahlenbergia marginata*, *Cyperus rotundus*, *Eragrotis gangetica*, *Fimbristylis dipphylla*, *Cynodon dactylon*, *Mimosa invisa*, *Xanthium italica*, *Cyanitos axillaris*, *Eleusine indica*, *Commelia benglensis*, *Lupia germinata*, *Phyllanthus niruri*, *Leprochloa chinensis*, *Hedyotis corymbosa*, *Polygonum coccineum*, *Paspalum commersoni*, *Polygonum orientale* and *Eclipta alba* having higher degree of infestation.

Weed density and dry matter

Weed density (no. m⁻²) and dry matter (g m⁻²) at 20, 40, 60 and 95 DAS were significantly affected by the herbicide treatments (Figure 1 and 2). In all the dates, the highest weed density and dry matter were found in weedy plots and the lowest in pretilachlor + fenoxapro-p-ethyl treated plots. It was noted that all the herbicide treated plots reduced weed density and dry matter significantly. The weed density in weedy plots at 20, 40, 60 and 95 DAS were 80, 93, 97 and 51 (no. m⁻²) while those in pretilachlor + fenoxapro-p-ethyl treated plots were 20, 23, 26 and 15 (no. m⁻²). The weed dry matters in weedy plots were 11.60, 13.65, 14.67 and 18.91 (g m⁻²) while that for pretilachlor + fenoxapro-p-ethyl treated plots were 2.75, 4.37, 7.76 and 5.81 (g m⁻²) in 20, 40, 60 and 95 DAS, respectively. The lowest weed density and dry matter in pretilachlor + fenoxapro-p-ethyl treated plots exhibited their excellent performance in weed control. Faruq (2013) reported in that application of pretilachlor @ 1.5 L ha⁻¹ showed the best performance in reducing weed density.

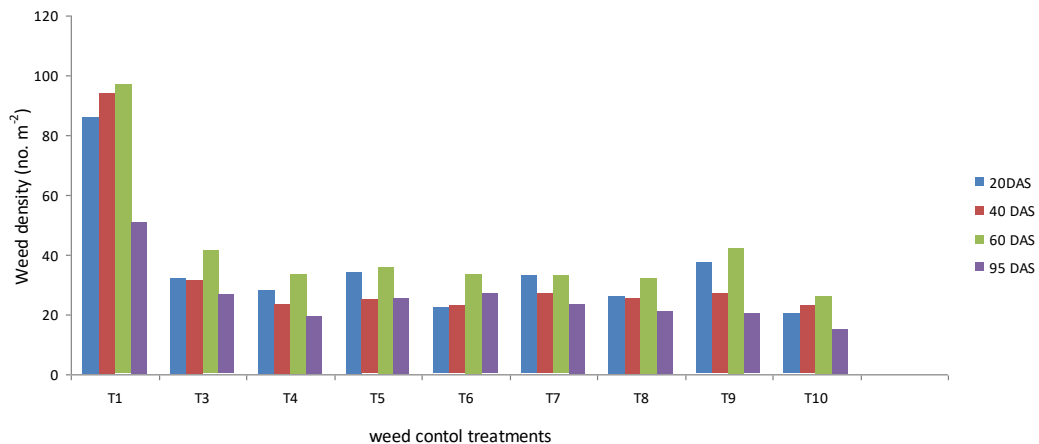


Fig. 1: Effect of herbicidal weed control treatments on weed density (no. m⁻²) at different growth stages. No weeding = T₁, weed free = T₂, Pendimethalin + one hand weeding = T₃, Pretilachlor + one hand weeding = T₄, Pendimethalin + metamifop = T₅, Pretilachlor + metamifop = T₆, Pendimethalin + quizalofop-p-ethyl = T₇, Pretilachlor + quizalofop-p-ethyl = T₈, Pendimethalin + fenoxapro-p-ethyl = T₉, Pretilachlor + fenoxapro-p-ethyl = T₁₀

Sequential application of herbicides for controlling weeds in jute

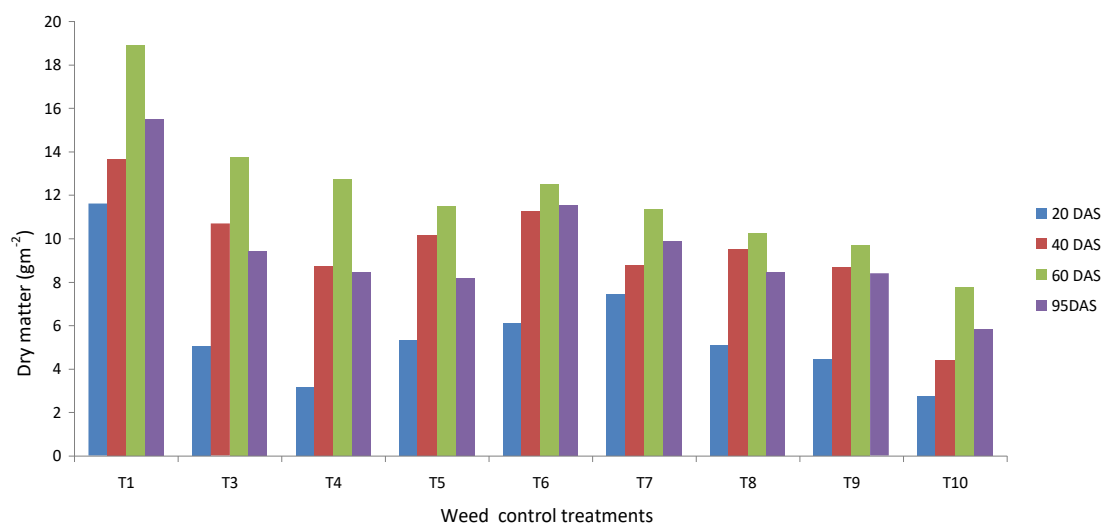


Fig. 2: Effect of herbicidal weed control treatments on weed dry matter (g m^{-2}) at different growth stages. No weeding = T₁, weed free = T₂, Pendimethalin + one hand weeding = T₃, Pretilachlor + one hand weeding = T₄, Pendimethalin + metamifop = T₅, Pretilachlor + metamifop = T₆, Pendimethalin + quizalopfop-p-ethyl = T₇, Pretilachlor + quizalopfop-p-ethyl = T₈, Pendimethalin + fenoxapro-p-ethyl = T₉, Pretilachlor + fenoxapro-p-ethyl = T₁₀

Crop density, dry matter and plant height

Density (m^{-2}), dry matter (g m^{-2}) and height (cm) of jute plants were significantly affected by herbicide treatments (Table 2).

Table 2. Effect of herbicidal weed control treatments on plant number, dry weight of plants at 60 DAS and plant height at 60 and 150 DAS

Treatment	Plant density (m^{-2})	Plant height (cm) at 60 DAS	Dry weight plant ⁻¹ at 60 DAS (g)	Plant height (cm) at 150 DAS
No weeding	24 ab	96.0 e	90.3 e	338.3 b
Weed free control	24 ab	144.8 de	136.7 bc	398.3 ab
Pendimethalin + one hand weeding	20 b	120.8 bc	114.5 de	391.6 ab
Pretilachlor + one hand weeding	25 ab	132.3 c	113.3 de	385.0 ab
Pendimethalin+ metamifop	30 a	105.4 de	106.6 de	395.0 ab
Pretilachlor + metamifop	20 b	134.5 c	129.6 c	405.0 a
Pendimethalin + quizalopfop-p-ethyl	26 ab	113.3 cd	110.2 d	378.3 ab
Pretilachlor + quizalopfop-p-ethyl	26 ab	105.5 de	133.2 bc	413.3 a
Pendimethalin+ fenoxapro-p-ethyl	26 ab	154.6 b	138.8 b	407.3 a
Pretilachlor + fenoxapro-p-ethyl	29 a	162.1 a	150.6 a	437.3 a
Level of significance	**	**	**	**
CV%	8.96	6.77	6.95	7.81

In a column, with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** = Significant at 1% level of probability.

The highest jute plant density (29 plants m^{-2}) was obtained from pretilachlor + fenoxapro-p-ethyl treated plot. The second highest (26 plants m^{-2}) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest plant density (24 plants m^{-2}) was observed in no weeding treatment. The highest plant dry matter (170.6 g m^{-2}) was found by the pretilachlor + fenoxapro-p-ethyl. The second

highest dry weight of plant (64.80 g m^{-2}) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest dry weight of plant (90.32 g m^{-2}) was observed in no weeding control plots. The tallest plant height (162.1 cm) was found by the pretilachlor + fenoxapro-p-ethyl treatments. The second highest plant height (154.6 cm) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest plant height (96 cm) was observed in no weeding treatment. In the weedy check plots, crop weed competition was higher and the weed suppressed the jute plant growth which might resulted in the reduced number of plants, dry matter and plant height. On contrary, different herbicides reduced weed population and thereby decreased crop weed competition during entire growth stage (Borgohain et al., 1990, Gogoi et al., 2000, Alam et al., 2010).

Leaf Chlorophyll content

SPAD reading of jute leaves was significantly affected by the herbicide treatments (Figure 3). The highest SPAD value (67.67) was observed in pretilachlor + fenoxapro-p-ethyl treated plots. The second highest SPAD value (64.80) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest SPAD value (55.37) was observed in no weeding treatments. The result indicates that the plant did not suffer from any toxicity due to herbicide treatment throughout the growing season of jute.

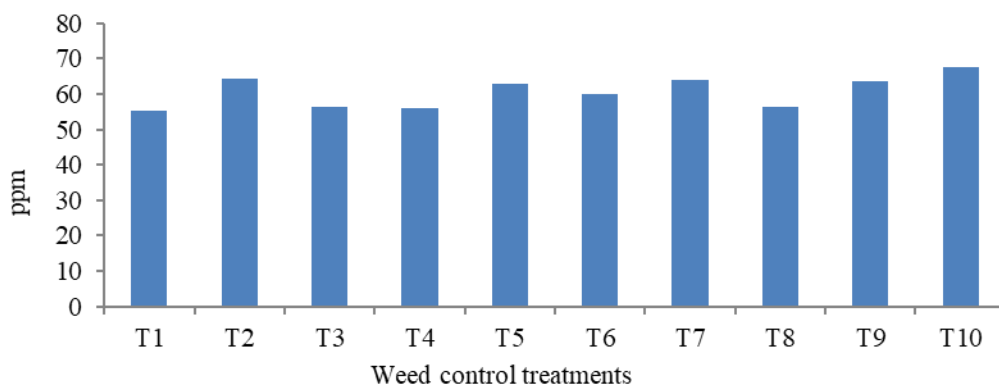


Fig. 3: Effect of herbicidal weed control treatments on chlorophyll content at 60 days after sowing. No weeding = T₁, weed free = T₂, Pendimethalin + one hand weeding = T₃, Pretilachlor + one hand weeding = T₄, Pendimethalin + metamifop = T₅, Pretilachlor + metamifop = T₆, Pendimethalin + quizalofop-p-ethyl = T₇, Pretilachlor + quizalofop-p-ethyl = T₈, Pendimethalin + fenoxapro-p-ethyl = T₉, Pretilachlor + fenoxapro-p-ethyl = T₁₀

Plant and stick diameter of jute

Jute plant diameter at base, middle and top were significantly affected by the herbicide treatments (Figure 4). At 150 DAS, the highest base diameter (20.69 mm) was found in pretilachlor + fenoxapro-p-ethyl and the second highest (19.78 mm) by pendimethalin + fenoxapro-p-ethyl treated plots while the lowest (12.49 mm) was observed in no weeding plots. Among the weed management practices, pretilachlor + fenoxapro-p-ethyl helped to create good growth of jute from germination to 150 DAS. The similar result was found for middle diameter and top diameters. Pretilachlor + fenoxapro-p-ethyl treated plots showed the highest middle diameter (15.73 mm) and second highest value (14.80 mm) was found in pendimethalin + fenoxapro-p-ethyl treated plots. The lowest middle diameter (9.90 mm) was found in no weeding treated plots. The highest top diameter (9.37 mm) was found in pretilachlor + fenoxapro-p-ethyl and the second highest (9.22 mm) was produced by pendimethalin + fenoxapro-p-ethyl treated plots while the lowest value (6.34) was found in no weeding plots. The highest stick base diameter (17.24 mm) was found in pretilachlor + fenoxapro-p-ethyl and the second highest (15.81mm) in pendimethalin + fenoxapro-p-ethyl treated plots (Figure 5). The lowest base diameter of

Sequential application of herbicides for controlling weeds in jute

stick (10.16 mm) was observed in no weeding treated plots at 150 DAS. The highest middle diameter of stick (11.22 mm) was found in pretilachlor + fenoxapro-p-ethyl treated plots and the second highest (10.15 mm) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest stick middle diameter (8.24 mm) was found in no weeding plots. The highest stick top diameter (8.26 mm) was found in pretilachlor + fenoxapro-p-ethyl and the second highest (8.07 mm) in pendimethalin + fenoxapro-p-ethyl treated plots. The lowest stick top diameter (5.67 mm) was found in no weeding treated plots. The result shows that pretilachlor + fenoxapro-p-ethyl and pendimethalin + fenoxapro-p-ethyl were more or less equally effective in controlling germination and growth of weeds throughout the growing period of jute crop.

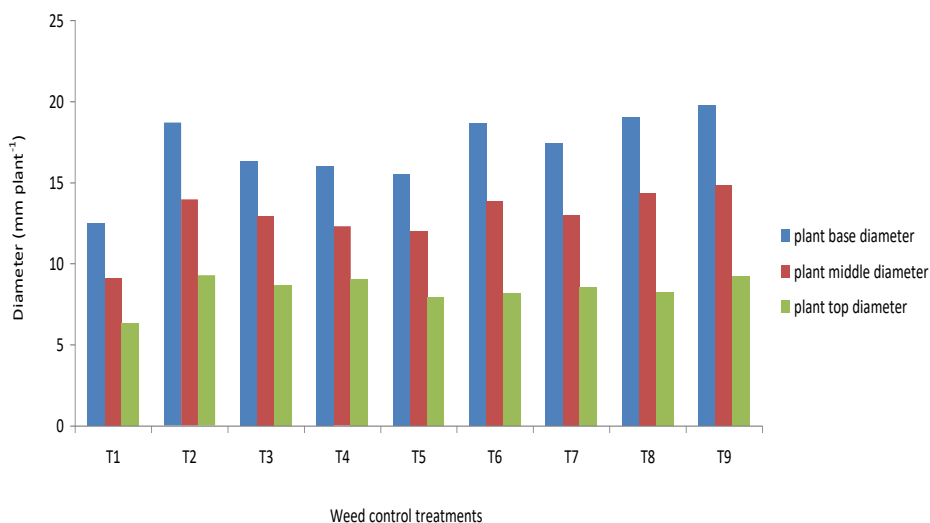


Fig. 4 Effect of herbicidal weed control treatments on plant diameter (base, middle and top) of jute at 150 DAS. No weeding = T₁, weed free = T₂, Pendimethalin + one hand weeding = T₃, Pretilachlor + one hand weeding = T₄, Pendimethalin + metamifop = T₅, Pretilachlor + metamifop = T₆, Pendimethalin + quizalopfop-p-ethyl = T₇, Pretilachlor + quizalopfop-p-ethyl = T₈, Pendimethalin + fenoxapro-p-ethyl = T₉, Pretilachlor + fenoxapro-p-ethyl = T₁₀

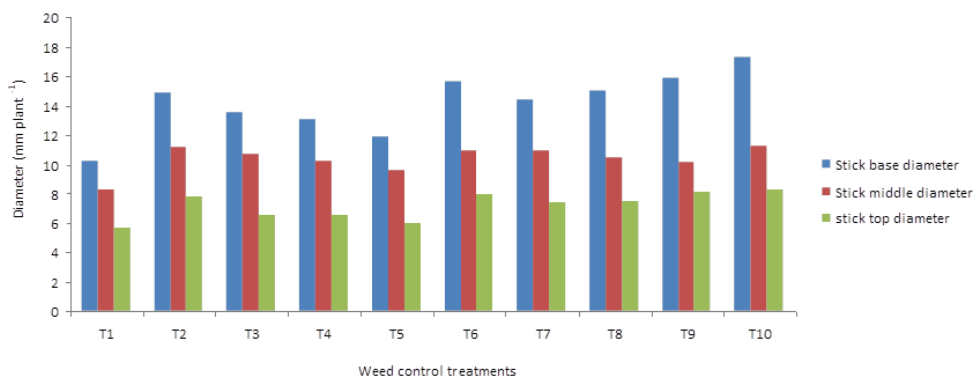


Fig. 5 Effect of herbicidal weed control treatments on stick diameter (base, middle and top) of jute at 150 DAS. No weeding = T₁, weed free = T₂, Pendimethalin + one hand weeding = T₃, Pretilachlor + one hand weeding = T₄, Pendimethalin + metamifop = T₅, Pretilachlor + metamifop = T₆, Pendimethalin + quizalopfop-p-ethyl = T₇, Pretilachlor + quizalopfop-p-ethyl = T₈, Pendimethalin + fenoxapro-p-ethyl = T₉, Pretilachlor + fenoxapro-p-ethyl = T₁₀

Fresh and dry bark and stick dry matter

Fresh and dry bark and stick weight of plants were significantly affected by the herbicide treatments (Table 3). The highest fresh bark weight (682.67 g m^{-2}) was produced in pretilachlor + fenoxapro-p-ethyl treated plot while the second highest value (637.67 g m^{-2}) was produced in pendimethalin + fenoxapro-p-ethyl treated plots.

Table 3. Effect of herbicidal weed control treatments on green plant on fresh bark and sticks weight and dry fibre and stick weight of jute

Treatments	Fresh weight of plant (g m^{-2})	Fresh weight of stick (g m^{-2})	Fresh weight of bark (g m^{-2})	Dry weight of fiber (g m^{-2})	Dry weight of stick (g m^{-2})
No weeding	787.6 f	485.3 f	375.6 e	90.0 f	243.3 e
Weed free control	1287.0 c	646.0 cd	569.6 bc	102.0 c	339.3 bc
Pendimethalin + one hand weeding	1139.3 cde	653.0 cd	477.0 e	103.0 c	341.3 bc
Pretilachlor + one hand weeding	1181.0 cd	549.0 ef	629.0 b	105.0 c	377.0 b
Pendimethalin + metamifop	1039.3 e	648.3 cd	470.0 e	95.0 de	327.3 c
Pretilachlor + metamifop	1233.6 cd	721.6 bc	518.0 cd	96.0 cde	350.6 bc
Pendimethalin + quizalopfop-p-ethyl	1115.3 de	599.6 de	456.0 de	98.0 e	283.0 d
Pretilachlor + quizalopfop-p-ethyl	1274.0 b	656.3 cd	619.3 b	112.0 cd	359.3 bc
Pendimethalin + fenoxapro-p-ethyl	1360.6 ab	793.0 ab	637.6 ab	118.0 b	418.3 ab
Pretilachlor + fenoxapro-p-ethyl	1395.3 a	829.0 a	682.6 a	124.0 a	446.6 a
LS	**	**	**	**	**
CV (%)	6.20	6.58	9.95	5.50	6.35

In a column, with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** = Significant at 1% level of probability.

The lowest fresh bark weight (375.66 g m^{-2}) was observed in no weeding treatment. The highest fresh stick weight (829.00) was produced by the pretilachlor + fenoxapro-p-ethyl treatments and the second highest fresh stick weight (793.00 g m^{-2}) was produced in pendimethalin + fenoxapro-p-ethyl treated plots. The lowest fresh stick weight (485.33 g m^{-2}) was observed in no weeding treatment. Bark and stick dry weight of plant was significantly affected by the herbicide treatments (Table 3). The highest dry bark weight (124 g m^{-2}) was produced by the pretilachlor + fenoxapro-p-ethyl treatments. The second highest dry fibre weight (118 g m^{-2}) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest dry bark weight (90 g m^{-2}) was observed in no weeding treatment. The highest dry stick weight (446.66 g m^{-2}) was produced by the pretilachlor + fenoxapro-p-ethyl treatments. The second highest dry stick weight (418.33 g m^{-2}) was produced in pendimethalin + fenoxapro-p-ethyl treated plots. The lowest dry stick weight (243.33 g m^{-2}) was observed in no weeding treatment. The plots treated with pretilachlor + fenoxapro-p-ethyl and pendimethalin + fenoxapro-p-ethyl effectively controlled weed and that eventually reduced the competition of weed for moisture, space, light and nutrients with crop which ultimately reduced the fresh and dry bark weight (Alam *et al.*, 2010).

Fibre and stick yield of jute

Fibre and stick yield were significantly affected by the herbicide treatments. Figure 6 showed that pretilachlor + fenoxapro-p-ethyl treated plot produced the highest fibre yield (1.967 t ha^{-1}) and pendimethalin + fenoxapro-p-ethyl produced the second highest yield (1.870 t ha^{-1}). The lowest fibre yield (1.617 t ha^{-1}) was observed in no weeding treatment. The highest stick yield (2.833 t ha^{-1}) was produced by the pretilachlor + fenoxapro-p-ethyl treatments and the second highest stick yield (2.690 t ha^{-1}) was produced by pendimethalin + fenoxapro-p-ethyl treated plots. The lowest stick yield (2.21 t ha^{-1}) was observed in no weeding treatment. This was also due to severe competition of weed for

Sequential application of herbicides for controlling weeds in jute

moisture, space, light and This was also due to severe competition of weed for moisture, space, light and nutrients between weed and crop and eventually fibre yield was reduced (Alam *et al.*, 2010).

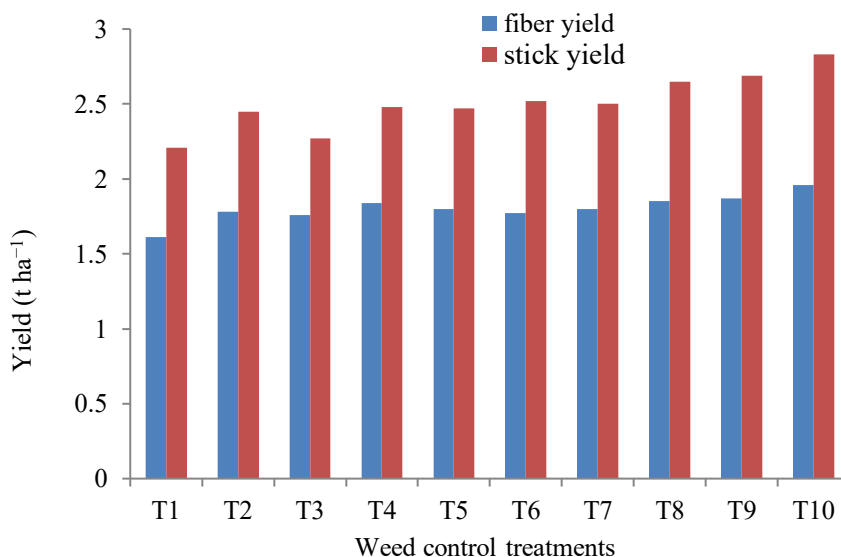


Fig. 6 Effect of herbicidal weed control treatments on green plant on fibre and stick yield of jute (No weeding = T₁, weed free = T₂, Pendimethalin + one hand weeding = T₃, Pretilachlor + one hand weeding = T₄, Pendimethalin + metamifop = T₅, Pretilachlor + metamifop = T₆, Pendimethalin + quizalopfop-p-ethyl = T₇, Pretilachlor + quizalopfop-p-ethyl = T₈, Pendimethalin + fenoxapro-p-ethyl = T₉, Pretilachlor + fenoxapro-p-ethyl = T₁₀)

CONCLUSION

Application of pre-emergence herbicide followed by post-emergence herbicide showed significant reduction in weed density and dry matter among the different weed control treatment combinations. The lowest weed density and dry matter was found in pretilachlor + fenoxapro-p-ethyl treated plots followed by pendimethalin + fenoxapro-p-ethyl treated plots. All crop characters such as plant height, plant diameter, stick diameter, green weight plant⁻¹, green weight of bark plant⁻¹, green weight of stick of plant⁻¹, dry fibre weight plant⁻¹ and dry stick weight plant⁻¹ were the highest in plots treated with pretilachlor + fenoxapro-p-ethyl which was followed by pendimethalin + fenoxapro-p-ethyl. Fibre yield (1.97 t ha⁻¹) and stick yield (2.83 t ha⁻¹) were the highest with pretilachlor + fenoxapro-p-ethyl while the second highest values (1.83 t ha⁻¹ and 2.690 t ha⁻¹) were found in pendimethalin + fenoxapro-p-ethyl treated plots. Therefore, it may be concluded that promising weed control is possible by application of pretilachlor @ 1 L ha⁻¹ or pendimethalin @ 2.5 L ha⁻¹ at 2 DAS followed by fenoxapro-p-ethyl @ 0.75 L ha⁻¹ at 25 DAS.

REFERENCES

- Alam, A. T. M. 2003. Present status and future strategies of weed management in jute field. *Bangladesh J. Jute Fabrics Res.* 29(1): 4-6.
- Alam, A. T. M. M., Hossain, M. S., Islam, M. M., Ahmed, I. and Hamidi, M. A. 2010. Effect of weeding and thinning practices on fibre yield and economics of deshi jute. *Bangladesh J. Weed Sci.* 1(1): 31-34.

- Borgohain, B., Thakuria, K. and Saikja, M. 1990. Weed management studies in *Capsularis* jute. *Indian J. Agron.* 35(4): 410-411.
- Gogoi, A. K., Rajkhowa, D. J. and Kandali, R. 2000. Effect of varieties and weed control practices on rice productivity and weed growth. *India. J. Agron.* 45(3): 580-585.
- Islam, M. M. 2014. Research advances of jute field weeds in Bangladesh: a review. *J. Sci. Tech.* 4(4): 254-268.
- Jena, S., Kumar, M., Mitra, S., Paikray, R. K. and. Ghorai, A. K. 2017. Effect of weed management practices on productivity and profitability of jute fibre. *Indian J. Weed Sci.* 49(4): 381-384.
- 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 Weeds.* 2: 30-33.