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Integrated management of weeds in raw jute

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ABSTRACT

Net profit from raw jute (jute and mesta together are called raw jute) cultivation is very poor owing to its high cost involvement (35-40% of the total cost of cultivation) in conventional manual weeding process. So far only post-emergence grass weed killing herbicides have been found to be successful in jute. After controlling grassy weeds, *Cyperus rotundus* and other broad-leaved weeds have become menace to these fibre crops which were effectively controlled adopting stale seedbed technique (herbicides applied on established weeds 10 days ahead of sowing jute and mesta) in Bararckpore, West Bengal. In stale seedbed method in jute,(cv '*JRO-524*'), glyphosate 2.46 kg SL/ha and 2,4-D 2 kg/ha in combination, and glyphosate 2.46 kg SL/ha and pyrazosulfuron-ethyl 60g/ha in combination followed by one hand weeding were found promising to control mixed weed flora in jute field. After two years' cycle, these herbicide combinations reduced the *Cyperus rotundus* population by more than 80% over control and produced a mean of fibre yield of 28 to 3.04 t/ha and a maximum of 4.3 t jute fibre/ha in 2006-08. In mesta (cv. '*HC-583*'), in **s**tale seedbed method, butacholor 0.75 kg/ha and 2, 4-D 2 kg/ha in combination followed by 2-HW produced a mean fibre yield of 2.65 t/ha with a maximum 3.2 t mesta fibre/ha in 2007-08 and kept the mesta field free from weed for a couple of weeks. Pretilachlor (0.5 kg/ha) and paraquat (0.48 kg SL/ha) in combination, when applied 10 days ahead of mesta sowing on established weeds, it controlled mixed weed flora and produced a mean mesta fibre yield of 2.68 t/ha. Quizalofop-ethyl 5% EC 60 g/ha and Dhanuvit 0.5 to 0.6 l/ha at 21 DAE and one hand weeding produced a mean mesta fibre yield of 2.76 t/ha with a maximum of 3.45 t fibre/ha in 2007-08. Except chlorimuron-ethyl, other herbicides did not affect the soil microbial flora in post harvest jute soil. All these methods produced mean fibre yields at par with two manual weedings.

Key words: Chemical control, Integrated weed managment, Herbicde, Jute, Mesta

Raw jute [jute: C*orchorus olitorius* and mesta: *Hibiscus cannabinus*] is the cheapest sources of natural fibre in the world. Small and marginal farmers of Indo-Bangladesh sub-continent and other countries like China, Thailand, Nepal, Myanmar, Brazil, Congo, *etc*. grow raw jute in humid tropical climate mainly as a rainfed crop. Conventional manual weeding in raw jute involves around 40% of the total cost of cultivation (Saraswat 1974) and fibre yield reduction is up to 70% under unweeded situation. The weeding operation becomes very difficult particularly when weed flora establishes prior to crop sowing due to rain. In this context, it is imperative to mention that, after controlling grassy weeds, *Cyperus rotundus* (sedges) and other broad-leaved weeds (*Trianthema portulacastrum* and, *Ludwigia parviflora* in particular) have become menace to these fibre crops. Moreover, lack of sufficient human labour at peak weeding hour is also a bottleneck to manual weeding in jute. Effective chemical weed management in jute and mesta have also been less studied. Some viable chemical weed management technology is thus imminent to sustain raw jute fibre production by the small and marginal farmers. Stale seedbed technique has been found to be worthy in controlling composite weed flora in different field crops. A stale seedbed is one where initial 1-2 flushes of weeds are destroyed before planting a crop (Gupta 2000). In chemical method**,** quizalofop-ethyl, a post-emergence herbicide successfully controls grassy weed in jute field (Ghorai *et al*. 2008). Experiments were thus conducted to screen out suitable chemical weed control methods to combat composite weed flora in raw jute.

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MATERIALS AND METHODS

Experiments were conducted for two consecutive years from 2006-07 and 2007-08, at Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata, West Bengal, India. The experimental soil was sandy clay loam in texture with 44% sand, 28% silt and 28% clay. Its available nitrogen, phosphorus and potassium content

was 180, 34 and 133 kg/ha, respectively. Experiments were conducted in randomised block design with ten treatments replicated thrice. The jute cultivar cv. '*JRO-524*' and mesta cultivar cv. '*HC 583*' were grown in the experiments. The crop was sown on June 2006 (stale seedbed) in the first year and on May 2007 in the second years of experiments. For stale seedbed method the herbicidal combinations were sprayed on established weeds ten days ahead of raw jute sowing. After complete death of mixed weed flora, the soil was ploughed and jute and mesta were sown. The treatment setup was: i) unweeded control (M: mesta), ii) hand weeding twice (M), iii) quizalofop-ethyl 5% EC (60 g/ha) + dhanuvit 0.6 l/ha at 21 DAE + 1 HW (M), iv) quizalofop ethyl 5% EC, (60 g/ha) + chlorimuron-ethyl (CME 37.5 g/ha, at 21 DAE) + 1HW (M), v) quizalofop-ethyl 5% EC, 60 g/ha + chlorimuron ethyl (CME 37.5/ha) at 21 DAE + HW (J: jute), vi) 2,4-D (2 kg/ha) + butachlor 50% EC (0.75kg/ha) 10 days before sowing on established weeds (stale seedbed) + 1 HW (M) vii) Glyphosate (2.46 kg SL/ha) + 2,4-D (2 kg/ha, stale seed bed) + 1 HW (J), viii) glyphosate (2.46 kg SL/ha) + 2,4-D (2 kg/ha) + chlorimuron-ethyl (CME, 37.5 g/ha, stale seedbed) + 1HW (J), ix) pretilachlor (0.50 kg/ha) + paraquat (0.48 kg SL/ha, stale seedbed) + 1HW (M), x) glyphosate (2.46 kg SL kg SL/ha) + pyrazosulfuron-ethyl 10WP (PSE,60g/ha, stale seedbed) + 1 HW (J). Weed samples were collected at 15 Days after emergence of raw jute following standard procedure for count. Whole plot weeds were collected to find out the weed dry matter production/ha. Soil samples were collected for soil microbial analysis immediately after jute and mesta harvest. The crop was harvested near 110 to 120 days of crop age. Data were analysed using statistical package MSTAT-C.

RESULTS AND DISCUSSION

Weed flora

Weed flora consisted of i) Grasses: *Echinochloa colona*, *Digitaria* spp. ii) Sedges: *Cyperus difformis* and *Cyperus rotundus*. iii) Broad-leaved weeds: *Ludwigia purviflora*, *Trianthema* spp. Broad-leaved weeds and *Cyperus difformis* dominated the weed population in the experimental plots.

Fibre yield

In rainy season, stale seedbed technique was found to be very promising for composite weed control in raw jute field. Fibre yield during 2006 was relatively lower than that obtained in 2007 due to excess rainfall in 2006. In stale seedbed method, i) glyphosate 2.46 kg SL/ha + 2,4-D 2 kg/ha, and ii) glyphosate 2.46 kg SL/ha+ pyrazosulfuron-ethyl (PSE) 60 g/ha followed by 1 HW was found promising for controlling wide range of weeds at early stage. These two combinations reduced the *Cyperus rotundus*, broad-leaved, grassy and *Cyperus difformis* weed population. After two years' cycle, it reduced the *Cyperus rotundus* population by more than 80% over control (Table 1) and produced comparable mean fibre yield of 2.7 to 3.0 t/ha with a maximum of 3.9 to 4.3 t/ha in 2007-08. These combinations did not affect mustard crop in sequence and maintained significantly lower *Cyperus rotundus* population (14-38/m^2) than unweeded control and manual weeding twice (53-76/m^2).

In mesta, quizalofop-ethyl 60 g/ha + dhanuvit 0.5 to 0.6 l/ha applied at 21 DAE and one hand weeding produced comparable mean fibre yield (2.76 t/ha and 3.4 t fibre/ha in 2006 and 2007) compared to manual weeding twice (2.82 t/ha) (Table 1). This post-emergence herbicide quizalofop-ethyl 60 g/ha killed only grassy weeds at 7-10 days after its application and similar observations were recorded in jute also (Ghorai 2008). Under stale seedbed technique, butachlor 0.75 kg/ha + 2,4-D 2 kg/ha and pretilachlor 0.5 kg/ha + paraquat 0.48 kg SL/ha followed by one hand weeding produced comparable mesta fibre yield (2.6 to 2.8 t/ha) compared with manual weeding twice (2.8 t/ha). At 15 days after emergence of mesta, mixture of butachlor 0.75 kg/ha + 2,4-D 2 kg/ha reduced the sedge (*Cyperus rotundus*), broad-leaved, grassy and *Cyperus difformis* weed population by 89, 89, 15 and 99%, respectively over unweeded control. The combination of pretilachlor (0.5 kg/ha) and paraquat (0.48 kg SL/ha) reduced the broad-leaved and *Cyperus difformis* weed population by 99 and 76%, respectively. This method kept the mesta field free from weed for 15 to 21 days. It requires one wheel hoe at 15 days after emergence (DAE) and one manual weeding between 21 to 25 DAE for proper growth and development of mesta. These combinations did not affect mustard crop in sequence and maintained significantly lower *C. rotundus* population (35-54/m^2) than unweeded control and manual weeding twice (53-76/m^2, Table 1).

These herbicides when applied 10 days before sowing did not affect the germination and growth of jute and mesta. Post-emergent sedge killer, chlorimuron-ethyl killed sedges and broad-leaved weeds in jute and mesta field but showed phytotoxicity. However, after rain and application of nitrogen these plants recovered. These two herbicidal combinations did not affect the yield of mustard crop (1.57 to 1.71 t/ha) significantly over manual weeding twice (1.54 t/ha), while grown in sequences (Table 1).

Table 1. Composite weed control in jute and mesta using different herbicides and effect on fibre productivity

Treatment	Weed Cont at 15 DAE (no./m^2)			Fibre yield (t/ha)		*Cyperus rotundus* in mustard/m^2 (21 DAE)	Mustard yield (t/ha)
	Grasses	Sedge	Broad-leaved	2006-07	2007-08		
Quizalofop-ethyl (60g/ha) + 1 HW (M)	65	112	1059	2.08	3.45	76.7	1.61
Quizalofop-ethyl (60 g/ha) + CME (37.5g/ha) + 1HW (M)	39	164	1059	1.69	2.75	76.7	1.61
Quizalofop-ethyl (60 g/ha) + CME (37.5 g/ha) +1 HW (J)	39	122	1033	1.12	2.29	183.3	1.68
2,4-D (2 kg) + butachlor (0.75 kg/ha) + 1 HW (M) + 1 WH	17	36	19	2.08	3.22	54.3	1.75
Glyphosate (2.46 kg SL/ha) +2,4-D (2 kg/ha) +1 HW (J)	16	13	73	1.34	4.29	37.7	1.57
Glyphosate (2.46 kg SL/ha) + 2,4-D (2 kg/ha) + CME (37.5 g/ha) + 1 HW (J)	16	13	73	1.54	3.91	37.7	1.57
Pretilachlor (0.5 kg/ha) + paraquat (0.48 kg SL/ha) +1 HW (M)	35	330	89	2.57	2.80	34.7	1.75
Glyphosate (2.46 kg SL/ha) + PSE (60 g/ha) + 1 HW (J)	19	2	113	1.77	4.31	14.3	1.71
Unweeded control (M)	20	328	872	1.27	3.17	79.0	1.79
Hand weeding twice(M)	46	176	1120	2.16	3.49	53.0	1.54
LSD (P=0.05)	NS	337	576	0.32	0.61	33.1	NS

J = Jute , M = Mesta, CME= Chlorimuron-ethyl, PSE= Pyrazosulfuron-ethyl, HW = Hand weeding, WH= Wheel hoe

Table 2. Microbial population as affected by different weed control treatments in post-harvest jute and mesta soil

Treatment	Bacterial population (cfu x10^5/g soil	Actinomycetes population (cfu x10^5/g soil	Fungi population (cfu x10^5/g soil
Quizalofop-ethyl (60 g/ha) + 1 HW (M)	6.83	44.38	18.12
Quizalofop-ethyl (60 g/ha) +CME (37.5 g/ha) + 1HW (M)	3.50	44.38	18.12
Quizalofop-ethyl (60 g/ha) +CME (37.5 g/ha) +1 HW (J)	9.38	65.37	19.28
2,4-D (2 kg) + butachlor (0.7g kg/ha) + 1 HW (M)	14.37	119.37	18.75
Glyphosate (2.46 kg SL/ha) +2,4-D (2 kg/ha) +1 HW (J)	8.00	40.62	11.87
Glyphosate (2.46 kg SL/ha) + 2,4-D (2 kg/ha)+ CME (37.5 g/ha) + 1 HW (J)	3.10	40.62	11.87
Pretilachlor (0.5 kg/ha) + paraquat (0.48 kg SL/ha) +1 HW (M)	5.00	34.27	9.58
Glyphosate (2.46 kg SL/ha) + PSE (60 g/ha) + 1 HW (J)	8.75	48.78	19.37
Unweeded control (M)	7.50	29.37	11.25
Hand weeding twice (M)	7.08	44.37	12.50
LSD (P=0.05)	3.90	36.41	NS

J = Jute , M = Mesta, CME= Chlorimuron ethyl, PSE= Pyrazosulfuron ethyl

Microbial population

After crop harvest, when fungal and bacterial population of treated and control soils were compared, it was recorded that, the fungi and bacterial population of jute and mesta fields were not affected due to different herbicides, except in chlorimuron-ethyl in combinations with other herbicides and pretilachlor with paraquat (Table 2). The actinomycetes population were not affected due to different herbicides applied in jute and mesta soil. Post emergence herbicide quizalofop-ethyl 60 g/ha, butachlor 0.75 kg/ha in combinations with 2,4-D (2 kg/ha) and glyphosate (2.46 kg SL/ha) in combinations with 2,4-D (2 kg/ha) and pyrazosulfuron-ethyl (60 g/ha) did not affect the microbial population in jute and mesta soil (Table 2). Application of pretilachlor (0.5 kg/ha) and paraquat (0.48 kg Sl/ha) reduced the fungi (9.58 x cfu $x10^5$/g oven dry soil) and bacterial (5.0 cfu $x10^5$/g oven dry soil) population over untreated plots like in unweeded control (11.25 cfu $x10^5$/g and 7.5 cfu $x10^5$/g oven dry soil, respectively) and manual weeding twice (12.5 cfu $x10^5$/g and 7.08 cfu$x10^5$/g oven dry soil), respectively.

From the study it appears that in jute, glyphosate 2.46 kg SL and 2,4-D 2 kg/ha in combination and glyphosate 2.46 kg SL/ha and pyrazosulfuron-ethyl 60g/ha in combination followed by one hand weeding were found promising to control mixed weed flora. Repetitive applications of these combinations year after year can effectively reduce *C. rotundus* population by 80% without incurring any yield loss and it did not affect the yields of succeeding crop at all.

In mesta, butachlor (0.75 kg/ha) and 2,4-D (2 kg/ha) in combination and pretilachlor (0.5 kg/ha) and paraquat (0.48 kg SL/ha) in combination using stale seedbed method followed by one hand weeding can be used effectively without any loss in fibre yield compared to that achieved in manual weeding twice. Where grassy weeds dominated, quizalofop-ethyl 60 g/ha followed by one manual weeding can effectively control weeds instead of manual weeding twice. Except, chlorimuron-ethyl, other herbicides were safe to the soil and succeeding crops in sequence. Above herbicidal combinations can be effectively utilized for composite weed control in raw jute field where weed flora establishes prior crop sowing particularly in rainy season.

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