Mulching and weed management effects on performance of non-puddled transplanted rice (*Oryza sativa* L.)

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Introduction

Farmers' in the tropics and subtropics of Asia traditionally transplant rice seedlings in puddled soil (Singh *et al*., 2014) for easy crop establishment and weed control. This traditional puddling method is labour and capital intensive and destructive to soil health and economic environment in various ways (Islam *et al.,* 2014). Adoption of non-puddled rice cultivation might be a very good alternative to puddled transplanting but is criticized for high weed pressure. Herbicides can control weeds but are threatened for resistance to weeds. Mulching may be used as an alternative to herbicides. Non-puddled rice transplanting technology based on mulch retention are being developed in Bangladesh but the optimum weed control for crops in the cropping sequence is yet to be developed. This present study was under taken to determine the effectiveness of mulch retention relative to herbicides and hand weeding on weed control and yield of non-puddled rice transplanted after mustard.

Materials and Methods

The on-farm experiment was conducted at Durbacahra village of Bangladesh (24.75^0 N and of 90.50^0 E) during 15 November-30 June in 2014 and 2015. *Boro* rice, cv. *BRRI dhan28*, was transplanted with a combination of six tillage and weed control practices *viz.,* (i) Conventional tillage (CT)+ 2 hand weeding (HW) (Control); (ii) Glyphosate (Gly)+strip tillage (ST)+1HW; (iii) Gly+ST+pre-emergence (PE) herbicide (pendimethalin); (iv) Gly+ST+post-emergence (PO) herbicide (ethoxysulfuron); (v) Gly+ST+PE+PO; (vi) Gly+ST+ weed-free (WF), and two levels of mustard mulch *viz.,* (M_0) no-mulch and (M_{50}) 50% mulch by height. In tillage practice, CT consisted of two passes primary tillage by 2WT and ST by Versatile Multi-crop Planter (VMP) in single pass operation. Three days before ST, glyphosate (Roundup®) was applied @ 75 mL/10 L water. PE was sprayed three DAT and PO at 25 DAT @ of 50 ml 10 L^{-1} of water and 1 g L^{-1} of water, respectively. Four hand weeding was done to keep the plots weed free. Weed densities were recorded from 0.25m × 0.25m randomly at four locations of each plot at 25, 45, 65 DAT and crop harvest. Weed biomass was assessed by oven drying at 70^0C for 72 hours. The crop was harvested at maturity on 7 May in 2014 and 2 May in 2015 from three quadrates measuring 3m × 3m each and then yield attributes and yield recorded at 14% moisture content. Data were subjected to ANOVA using STATISTIX and means separated by DMRT.

Results and Discussions

After two season rice cultivation in 2014 and 2015, 22 weed species were identified belonging to 10 families (Table 1). Seven weed species belonged Poaceae, five to Cyperaceae and two to each Amaranthaceae and Asteraceae and one of each Campanulaceae, Commelinaceae, Convolvulaceae, Onagraceae, Oxalidaceae, and Polygonaceae. Annuals were dominant over perennials and broadleaved over grasses and sedges.

CT produced the higher number of weed species compared to ST (Table 1). In CT, 15 weed species found in 2014 but 17 species with two new viz., *Ipomoea aquatica* and *Scirpus*

mucronatus in 2015. In ST, 12 weed species recorded in 2014 but 11 in 2015 with the absence of *Jussiaea decurrens*. Among 12 species found in ST, five species (*Mikania micrantha* Kunth., *Sphilanthes acmella*, *Cyperus nemoralis*, *Scirpus mucronatus* and *Jussiaea decurrens* were not found in CT.

Two years' data reveals among the treatment combinations, CT produced about 30% higher weed density and 40% higher weed biomass compared to ST. Spraying PE followed by PO reduced weed density by 40% in 2014 and 50% in 2015 and biomass by 70% in both the year. Mulch reduced weed density by 20% in 2014 and 16% in 2014 and biomass by 27% in 2014 and 34% in 2015 (Figure 1). The highest grain yield (30% higher over CT without mulch) was obtained from the interaction of Gly+ST+ WF with 50% mulch while the highest BCR (40% higher over CT without mulch) was obtained from the interaction of Gly+ST sprayed at PE followed by PO with 50% mulch (Figure 1).

Conclusions

In non-puddled system, spraying a pre-emergence herbicide followed by a post-emergence with the 50% retention of previous crop mulch could control weeds more effectively over manual weeding and attributes the highest benefits.

Acknowledgment

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References

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Table 1. Comparison of weed flora in conventional and strip tillage during 2014 and 2015

Weed type	Name of the weeds	Family	Life cycle	Conventional tillage		Strip tillage	
				2014	2015	2014	2015
Broad-leaved	*Alternanthera sessilis* L.	Amaranthaceae	Annual	+	+	+	+
	A. philoxeroides Griseb.	Amaranthaceae	Perennial	+	+	-	-
	Eclipta alba L.	Asteraceae	Annual	+	+	+	+
	Mikania micrantha Kunth.	Asteraceae	Perennial	-	-	+	+
	Spilanthes acmella A.	Campanulaceae	Annual	-	-	+	+
	Cyanotis axillaris L.	Commelinaceae	Annual	+	+	+	+
	Ipomoea aquatica Forssk.	Convolvulaceae	Annual	-	+	-	-
	Jussiaea decurrens Walter.	Onagraceae	Annual	-	-	+	-
	Oxalis europea Jord.	Oxalidaceae	Perennial	+	+	-	-
	Polygonum coccineum Muhl.	Polygonaceae	Annual	+	+	-	-
Sedges	*Cyperus difformis* L.	Cyperaceae	Annual	+	+	+	+
	C. compressus L.	Cyperaceae	Annual	+	+	+	+
	C. nemoralis Cherm.	Cyperaceae	Perennial	-	-	+	+
	Fimbristylis miliaceae L.	Cyperaceae	Annual	+	+	+	+
	Scirpus mucronatus L.	Cyperaceae	Perennial	-	+	+	+
Grass	*Echinochloa colona* (L.) Link	Poaceae	Annual	+	+		-
	E. crussgalli (L.) Beauv.	Poaceae	Annual	+	+	+	+
	Eleusine indica (L.) Gaertn.	Poaceae	Annual	-	-	-	-

Cynodon dactylon (L.) Pers.	Poaceae	Annual	+	+	-	-
Leersia hexandra Sw.	Poaceae	perennial	+	+	-	-
Parapholis strigosa Dumort.	Poaceae	Annual	+	+	-	-
Leptochloa chinensis L.	Poaceae	Annual	+	+	-	-
Total			**15**	**17**	**12**	**11**

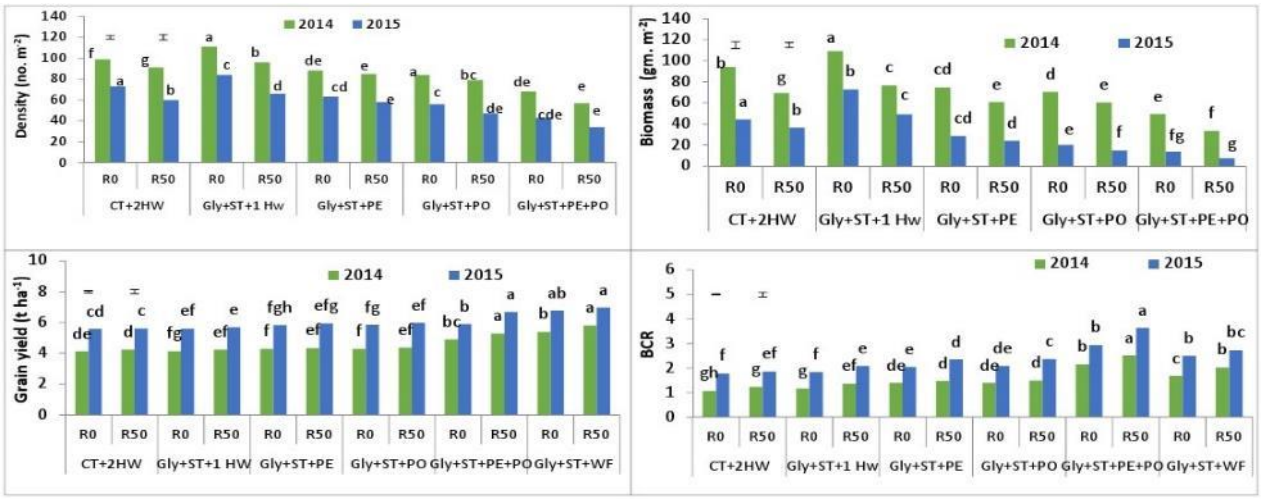

Figure 1. Mulching and weed management effect on weed density, weed biomass, grain yield and BCR of *Boro* rice during 2014 and 2015