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Seedbed Manipulations for Weed Management in Wet Seeded Rice

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ABSTRACT

Experiments to compare different seedbed techniques and non-chemical methods in wet seeded rice were conducted during 2005-06 and 2006-07. The trials were laid out in a split plot design with three main plots, five sub-plots and three replications. Adopting stale seedbed technique either for 7 or 14 days significantly reduced the population of grass weeds. It gave successful control of broadleaf weeds too. Among the weed management treatments, pre-emergence spraying of (Sofit) pretilachlor+safener and concurrent growing of sesbania gave significant reduction in the population and dry weight of weeds. Pretilachlor spray exhibited the greatest influence on broadleaf weeds. Stale seedbed preparation significantly improved grain and straw yields of wet seeded rice compared to normal seedbed. An increase in stale seedbed period contributed to corresponding increase in yields as evident by higher grain and straw yields in plots with stale seedbed for 14 days. Among the weed control treatments tried, pretilachlor+safener sprayed and hand weeded plots gave higher yields.

Key words : Green manuring, non-chemical methods, stale seedbed, weed management, wet seeded rice

INTRODUCTION

A major impediment in the successful cultivation of rice in the tropics is heavy infestation of weeds. Herbicides are used extensively in rice production for the control of weeds, and now several herbicides are available for this purpose. However, increased awareness about the potential hazards of over use of herbicides put greater pressure on researchers to reorient their research towards non-chemical and non-hazardous means of weed management. Stale seedbed technique is recognized as a non-chemical weed management strategy, which is based on the principle of flushing out germinable weed seeds prior to the planting of the crop, thus depleting the seedbank in the surface layer of soil and reducing subsequent emergence of weeds. The strategy may work well in decreasing the intensity of annual weeds in cropped fields, and thus, reducing or even eliminating the dependence on herbicides. Moorthy (1992) reported that appropriate land preparation and sowing seeds on a stale seedbed could be effectively used for the integrated management of weeds in rainfed upland rice. According to Saikia and Pathak (1993), stale seedbed suppressed weeds better than the conventional seedbed method and allowed better crop growth. The present study was undertaken with the main objective of standardizing stale seedbed strategy and subsequent cultural practices for wet seeded rice.

MATERIALS AND METHODS

The experiment was conducted in the field of a farmer in Kole lands of Thrissur district, Kerala, during the *Mundakan* (**rabi**) season of 2005-06 and 2006-07. The experimental site has a typical humid tropical climate, and is located at 10°30′ N latitude and 76°4′ E longitude and 1 m below sea level. The Kole land soils are clayey in texture (Inceptisols) with a soil pH 5.0.

'Jyothy', a red kernelled, short duration rice cultivar of 115 days duration was used for the study. The experiment was laid out in a split plot design with three seedbed treatments as main plots, five weed control methods as sub-plots and three replications in a plot size of 5 x 4 m. The main plot treatments included normal wet sowing (line sowing), stale seedbed for seven days (by keeping the field drained and destroying the weeds by letting in water on 7th day) and stale seedbed for 14 days (by keeping the field drained and destruction of weeds by letting in water on 14th day). The sub-plot treatments included no weeding, hand weeding at 20 days after sowing (DAS), pre-emergence spray of pretilachlor+safener (Sofit 30 EC) 0.45 kg/ha at 3 DAS, cono weeding at 20 DAS and concurrent growing of rice and dhaincha (*Sesbania speciosa*) and *in situ* green manuring on 30 DAS.

The experimental area was ploughed, puddled and levelled, and stale seedbeds were prepared as per

treatments by draining the field to facilitate germination of weed seeds. After the stale seedbed period, weed seedlings were destroyed by submerging the weed seedlings under water for 10 days. On the 10th day of flooding, water was drained from the plots, and the crop was sown. Line sowing of pre-germinated paddy seeds was done using a drum seeder. Water was again let in on the fifth day and the depth of water was gradually increased and maintained at 5 cm. In plots with dhaincha, seeds of dhaincha and rice were sown in alternate rows using a seed drill. Except for weed management, all other management practices were done as per the recommendations of Kerala Agricultural University (KAU, 2002).

Observations on weeds were recorded at 20 and 40 DAS. Grain and straw yields were recorded from the net plot area at harvest time. The data were subjected to analysis of variance and Duncan's multiple range test (DMRT).

RESULTS AND DISCUSSION

Population and Dry Weight of Weeds

Echinochloa crusgalli and *E. stagnina* were the major grass weeds found in the experimental field. Among

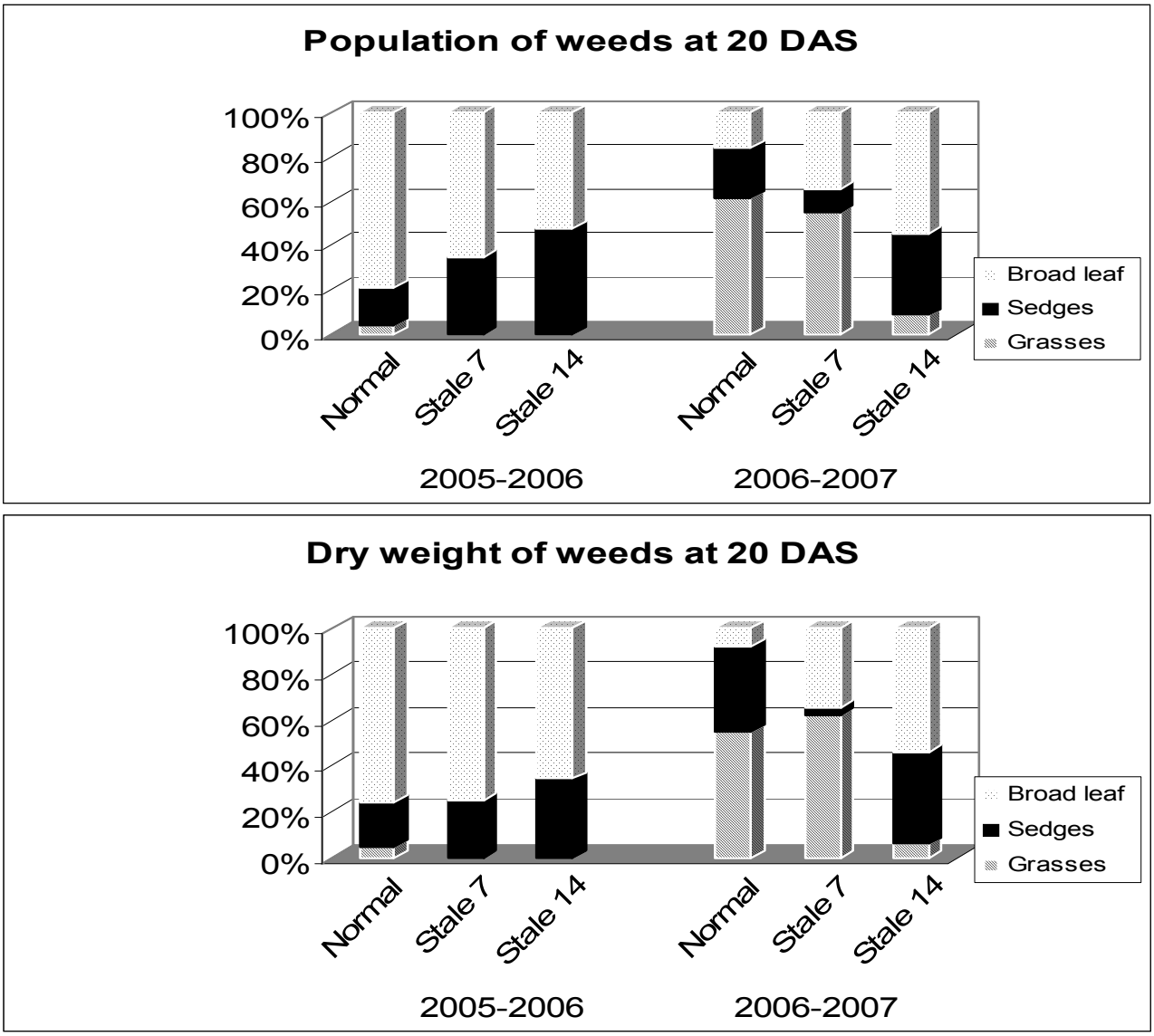

Fig. 1. Population and dry weight of grasses, sedges and broadleaf weeds at 20 DAS as influenced by seedbed preparation.

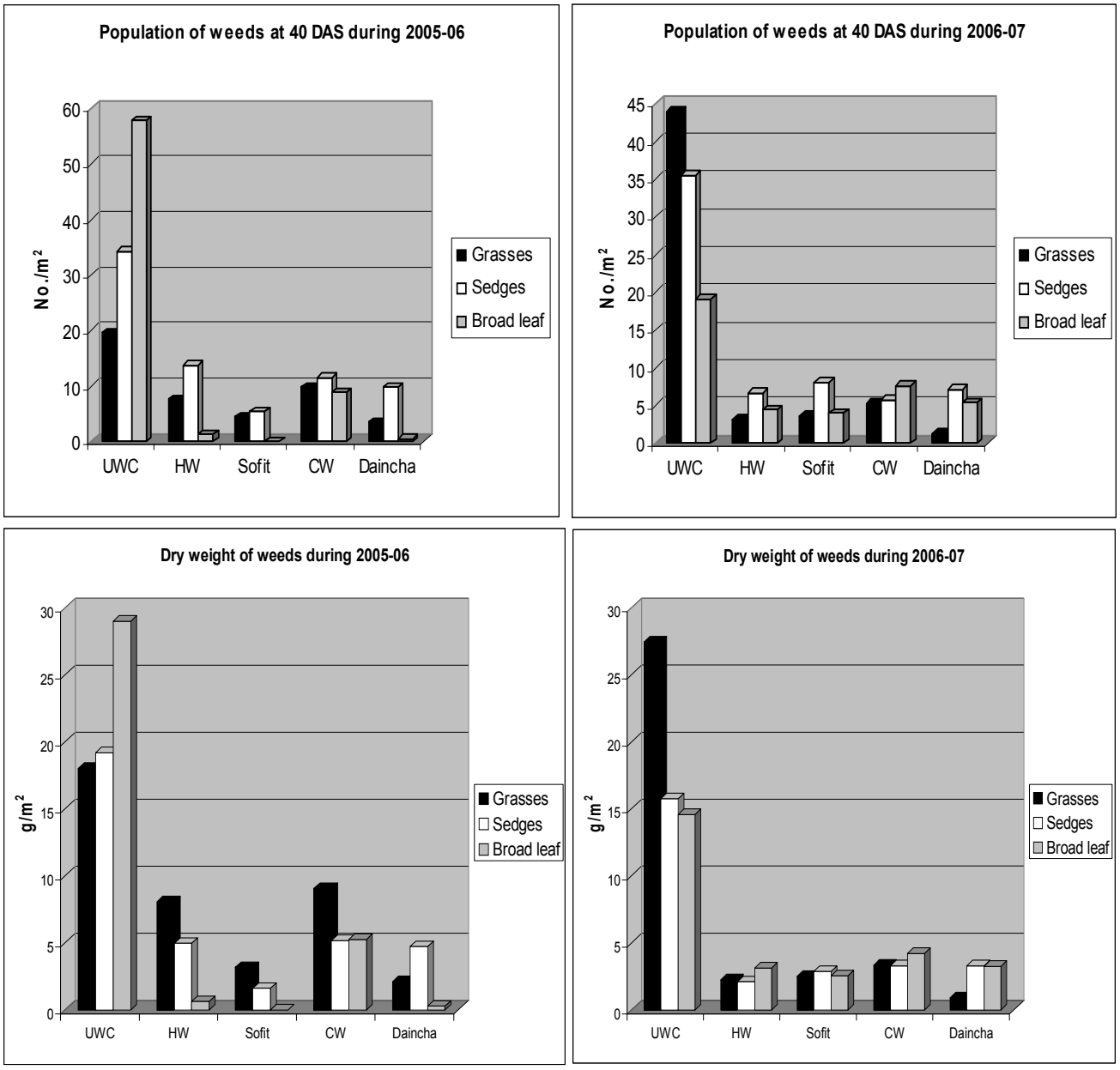

Fig. 2. Effect of weed control methods on population and dry weight of weeds at 40 DAS (UWC–Unweeded control, HW–Hand weeding, Sofit–Pretilachlor+safener, CW–Cono weeding).

sedges, *Cyperus iria* and *Fimbristylis miliacea* were dominant. At 20 DAS, *Lindernia crustacea*, *Ludwigia perennis* and *Sphenoclea zeylanica* were the important broadleaf weeds.

Seedbed preparation significantly influenced the population build-up and dry matter accumulation by grasses, sedges and broadleaf weeds. Stale seedbed treatment either for 7 days or 14 days gave complete control of grasses during the first year and significantly lowered their numbers during the second year (Fig. 1). The main plot treatments gave successful control of broadleaf weeds too. However, no significant differences were noticed with respect to number and dry weight of sedges at 20 DAS between normal seedbed and stale seedbed plots.

The differential response of grasses, sedges and broadleaf weeds to forced germination could be explained by their relative seed dormancy and longevity

Table 1. Dry weight of grasses, sedges and braodleaf weeds at 40 DAS during 2005-06 (g/m^2)

Weed control treatments	Seedbed treatments									Sub-plot mean		
	Normal seedbed			Stale seedbed (7 days)			Stale seedbed (14 days)			Grasses	Sedges	Broadleaf weeds
	Grasses	Sedges	Broadleaf weeds	Grasses	Sedges	Broadleaf weeds	Grasses	Sedges	Broadleaf weeds			
No weeding	4.07*^{ab} (16.29)	4.95^{a} (24.27)	6.16^{a} (37.71)	3.82^{ab} (14.09)	4.11^{a} (16.47)	5.44^{a} (2.917)	4.83^{a} (23.64)	4.08^{a} (16.81)	4.38^{b} (20.17)	4.24^{a} (18.01)	4.38^{a} (19.18)	5.33^{a} (29.02)
Hand weeding	3.27^{bc} (11.01)	1.96^{bcd} (3.36)	0.71^{c} (0)	3.36^{bc} (10.76)	2.82^{b} (7.64)	0.71^{e} (0)	1.67^{de} (2.44)	1.95^{bcd} (3.95)	1.45^{de} (1.88)	2.76^{b} (8.07)_	2.24^{b} (4.98)	0.95^{c} (0.63)
Pretilachlor	2.39^{cd} (5.24)	1.25^{d} (1.43)	0.71^{e} (0)	1.61^{de} (2.49)	1.13^{d} (0.89)	0.71^{e} (0)	1.40^{de} (1.73)	1.72^{cd} (2.53)	0.71^{e} (0)	1.80^{c} (3.16)	1.36 (1.62)	0.71^{c} (0)
Cono weeding	3.77^{ab} (13.89)	2.08^{bcd} (3.92)	3.37^{c} (11.12)	3.41^{bc} (11.33)	2.86^{b} (8.01)	0.78^{e} (0.12)	1.47^{de} (2.00)	2.01^{bcd} (3.60)	2.18^{d} (4.53)	2.88^{d} (9.08)	2.33^{b} (5.18)	2.11^{b} (5.26)
Sesbania	2.45^{cd} (5.61)	1.68^{cd} (2.79)	0.71^{e} (0)	1.02^{e} (0.72)	4.23^{a} (5.81)	0.71^{e} (0)	0.71^{e} (0)	2.44^{bc} (5.56)	1.05^{e} (0.83)	1.39^{c} (2.11)	2.18^{b} (4.72)	0.82^{c} (0.28)
Mean	3.19^{a} (10.41)	2.38^{a} (7.15)	2.33^{a} (9.77)	2.64^{ab} (7.88)	2.68^{a} (7.74)	1.67^{c} (5.86)	2.02^{b} (5.96)	2.44^{a} (6.49)	1.95^{b} (5.48)			

*√x+0.5 transformed values. Original values are in parentheses. Treatments having common superscript(s) do not differ significantly.

Table 2. Dry weight (g/m^2) of grasses, sedges and braodleaf weeds at 40 DAS during 2006-07

Weed control treatments	Seedbed treatments									Sub-plot mean		
	Normal seedbed			Stale seedbed (7 days)			Stale seedbed (14 days)			Grasses	Sedges	Broadleaf weeds
	Grasses	Sedges	Broadleaf weeds	Grasses	Sedges	Broadleaf weeds	Grasses	Sedges	Broadleaf weeds			
No weeding	7.09*^{a} (50.00)	3.94^{a} (15.09)	3.66^{ab} (13.20)	4.80^{b} (22.53)	4.11^{a} (17.89)	4.45^{a} (19.35)	3.12^{c} (9.85)	3.85^{a} (14.33)	3.34^{abc} (11.27)	5.00^{a} (27.46)	3.97^{a} (15.77)	3.82^{a} (14.60)
Hand weeding	1.88^{def} (3.79)	1.16^{b} (1.01)	1.41^{d} (1.93)	1.39^{def} (1.67)	1.55^{b} (2.32)	1.74^{d} (3.24)	1.29^{ef} (1.35)	1.86^{b} (2.99)	2.11^{cd} (4.20)	1.52^{bc} (2.27)	1.52^{b} (2.11)	1.75^{b} (3.12)
Pretilachlor	2.29^{cde} (4.81)	1.84^{b} (2.93)	1.05^{d} (0.84)	1.35^{def} (1.48)	1.15^{b} (0.97)	1.72^{d} (3.19)	1.26^{ef} (1.24)	2.29^{b} (4.77)	1.94^{cd} (3.64)	1.63^{bc} (2.51)	1.76^{b} (2.89)	1.57^{b} (2.56)
Cono weeding	2.49^{cd} (5.77)	2.11^{d} (4.37)	1.40^{d} (2.40)	1.30^{ef} (1.72)	1.66^{b} (3.37)	2.41^{bcd} (5.47)	1.73^{def} (2.60)	1.51^{b} (2.12)	2.19^{cd} (4.80)	1.84^{b} (3.36)	1.76^{b} (3.29)	2.00^{b} (4.22)
Sesbania	1.50^{def} (2.11)	1.42^{b} (2.03)	1.49^{d} (1.73)	0.71^{f} (0)	2.21^{b} (4.59)	2.52^{bcd} (6.44)	1.00^{f} (0.67)	1.94^{b} (3.35)	1.36^{d} (1.57)	1.07^{c} (0.92)	1.86^{b} (3.32)	1.79^{b} (3.25)
Mean	3.05^{a} (13.30)	2.10^{a} (5.09)	1.80^{b} (4.02)	1.91^{b} (5.48)	2.14^{a} (5.83)	2.57^{a} (7.54)	1.68^{b} (3.14)	2.29^{a} (5.51)	2.19^{ab} (5.10)			

*√x+0.5 transformed values. Original values are in parentheses. Treatments having common superscript(s) do not differ significantly.

characteristics. Perez *et al*. (1998) observed 69% germination of *E. crusgalli* by shallow ploughing and watering on account of the fairly low dormancy and longevity characters. When seeds are forced to germinate by seedbed preparation, seed germination occurs exclusively from the very first centimeter of the top layer of the seed bank (Benvenuti *et al*., 2001). Ferrero *et al*. (1999) observed that the seeds of plants belonging to family Poaceae were deposited in the top 0-10 cm layer of the soil.

Among the sub-plot treatments, pre-emergence spraying of pretilachlor+safener 0.45 kg/ha on the third day after sowing and concurrent growing of dhaincha gave significant reduction in the population and dry weight of weeds (Fig. 2; Tables 1 and 2). Pretilachlor spraying exhibited the greatest influence on broadleaf weeds. Better control of rice weeds by the pre-emergence spraying of pretilachlor + safener at 0.4 kg/ha in puddled rice was reported by Mohankumar (1995). The weed control effect of sesbania in rice-sesbania *in situ* green manuring system was reported by Weerakoon *et al*. (1992).

Grain and Straw Yields

Stale seedbed preparation has brought about an increase in grain and straw yields than normal seedbed (Tables 3 and 4). During both the years, higher grain yield of 7213 and 7157 kg/ha was produced by stale seedbed for 14 days, followed by stale seedbed for 7 days (6860 and 7052 kg/ha). Among the weed control treatments, during 2005-06, hand weeded plots recorded the maximum grain yield of 8383 kg/ha and this was at par with pretilachlor spray (8100 kg/ha). However, in 2006-07, pretilachlor recorded the highest grain yield of 8212 kg/ha. Hand weeded plots showed the next best grain yield (8093 kg/ha). During both the years of experiment, concurrent growing and incorporation of dhaincha by cono weeding recorded grain yield at par with plots with cono weeding alone. The lowest grain yield was obtained in normal seedbed and in unweeded plots. Stale seedbed (14 days) with hand weeding and stale seedbed (7 days) with pretilachlor were at par in grain yields. During 2006-07, combination of pre-emergence spray of pretilachlor with stale seedbed for 14 days gave the highest grain yield. Stale seedbed followed by hand weeding was at par with stale seedbed for seven days followed by pretilachlor.

An increase in stale seedbed period contributed to increase in the yields as evident by higher grain yield in plots with stale seedbed for 14 days. The main factor which contributed to increased grain production was the absence of competition for growth factors. As Ampong-Nyarko and De Datta (1991) suggested that competition and yield reduction occurred when one of the limiting resources fell short of the combined requirements of crop and associated weeds.

Among the sub-plot treatments, pretilachlor spray facilitated weed free environment during the germination and vegetative growth period of the crop. Hand weeding controlled the weeds at the critical period of crop-weed competition. Thus, these two treatments gave better grain and straw yields. Mohankumar (1995) observed rice grain yields in plots with pre-emergence spray of pretilachlor+safener to be at par with hand weeding twice under puddled condition.

Table 3. Grain yield of rice (kg/ha) as affected by different treatments

Weed control treatments	2005-06				2006-07			
	Seedbed treatments				Seedbed treatments			
	Normal seedbed	Stale seedbed (7 days)	Stale seedbed (14 days)	Mean	Normal seedbed	Stale seedbed (7 days)	Stale seedbed (14 days)	Mean
No weeding	3183^{i}	4150^{h}	5217^{g}	4183^{c}	2065^{j}	3328^{i}	3580^{h}	2991^{d}
Hand weeding	7767^{c}	7767^{b}	8383^{a}	8069^{a}	7963^{cde}	8075^{c}	8241^{b}	8093^{b}
Pretilachlor	7633^{c}	8308^{ab}	8100^{ab}	8014^{a}	7988^{cd}	8225^{b}	8422^{a}	8212^{a}
Cono weeding	6408^{f}	6725^{e}	7150^{d}	6761^{b}	7625^{g}	7839^{def}	7740^{fg}	7735^{c}
Sesbania	6342^{f}	7058^{e}	7217^{d}	6872^{b}	7843^{def}	7792^{f}	7803^{ef}	7813^{c}
Mean	6266^{c}	6860^{b}	7213^{a}		6697^{c}	7052^{b}	7157^{a}	

Treatments having common superscript(s) do not differ significantly.

Table 4. Straw yield of rice (kg/ha) as affected by different treatments

Weed control treatments	2005-06				2006-07			
	Seedbed treatments				Seedbed treatments			
	Normal seedbed	Stale seedbed (7 days)	Stale seedbed (14 days)	Mean	Normal seedbed	Stale seedbed (7 days)	Stale seedbed (14 days)	Mean
No weeding	2792^{i}	3517^{h}	3983^{g}	3430^{c}	1566^{e}	2813^{d}	3080^{d}	2486^{d}
Hand weeding	4925^{cd}	5752de	5783^{a}	5153^{a}	4483^{a}	4333^{ab}	4417^{ab}	4411^{ab}
Pretilachlor	4448^{ef}	5333^{b}	5817^{a}	5199^{a}	4378^{ab}	4617^{a}	4537^{a}	4511^{a}
Cono weeding	3925^{g}	4867^{cd}	5933^{a}	4908^{b}	4033^{bc}	4282^{ab}	4367^{ab}	4227^{bc}
Sesbania	4233^{fg}	5200^{bc}	5900^{a}	5111^{a}	3777^{c}	4253^{ab}	4217^{ab}	4082^{c}
Mean	4064^{c}	4933^{b}	5483^{a}		3648^{b}	4060^{a}	4123^{a}	

Treatments having common superscript(s) do not differ significantly.

The yield attributes such as panicle length, number of filled grains, 1000-grain weight and number of productive tillers were improved by the adoption of stale seedbed technique for 14 days. Thus, the yield increase in these plots is mainly due to a steady improvement in the yield attributes. This explanation is applicable to the yield improvement in the pretilachlor sprayed and hand weeded plots also. Unweeded plots recorded lower yield contributing parameters obviously because of severe crop-weed competition.

From the study, it can be concluded that stale seedbed technique is an efficient tool for the management of weeds under wet seeded condition. Combination of stale seedbed technique with pre-emergence spray of herbicides or with hand weeding or concurrent growing of green manure crops will give better control of weeds and better grain yields.

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