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Weed management in rice based cropping system under conservation agriculture

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Abstract
A study conducted at the college farm of Professor Jayashankar Telangana State Agricultural University, Rajendranagar (PJTSAU), Hyderabad, examined the relationship between the dynamics of weeds and crop yield amid long-term tillage and residue management practices. The trial was set up as a split plot, with weed management as the sub plot (W1- Recommended herbicides, W2-Integrated weed management (herbicide + hand weeding), and W3-Unweeded) and tillage and residue management as the main plot (T_1-CT (Transplanted), T_2- CT (Transplanted), T_3-CT (Direct-seeded), T_4- ZT (Direct-seeded), and T_5- ZT (Direct-seeded) + R).
The rice crop planted by CT (transplanted) in the 2017 kharif season was found to have the lowest and similar weed dry matter content and weed densities / m^2, which was much superior than the tillage techniques utilised by ZT, ZT+R, and CT (directed seeded). This was observed at 30 DAT/60 DAS. In turn, CT (directly seeded) demonstrated reduced weed dry matter content than ZT and ZT-R. After sixty days, a similar pattern was observed. Similarly, IWM practices at 30, 60, 90 DAS and harvest showed markedly reduced weed density and dry matter/m2 and showed no discernible difference from chemical control. The results indicate that of all the tillage treatments examined, the CT transplanted approach produced the highest yields of grain and straw, and that the yields of ZT and ZT+R treatments, sowed under the aerobic system (direct seeding), with comparable yields of grain and straw, came next. With CT transplanted treatments, test weight, grains/panicle, and productive tillers were seen to be much higher than with CT, ZT, and ZT+R treatments, which were thereafter comparable with one another. Lower weed index values were a direct result of increased yield in CT transplanted treatment areas. Grain and straw production increased as a result of IWM practice, which also produced more productive tillers, grains/panicle, and test weight that were comparable to those obtained after chemical treatment. Meanwhile, un weeded control yielded far less of these results.

Keywords: Conservation agriculture, integrated weed management, rice-based cropping system

Introduction
The continuous use of resource-intensive farming techniques in human endeavours to produce an abundance of food has led to a decline in soil health and a degradation of ecosystem services and processes. A system known as conservation agriculture (CA) aims to improve the biological functions of the agro-ecosystem while using minimal mechanical techniques and sparingly applied chemical inputs in order to promote agricultural sustainability (FAO, 2021) [5]. It has become a common practice to reduce the negative effects of traditional agriculture, which is energy- and resource-intensive. The main elements of CA are diversification, permanent soil cover, and minimal soil disturbance (Jasrotia 2023) [6]. One of the main obstacles to the adoption of conservation agriculture is weeds. This is because weeds require minimal soil disturbance from mechanical tillage, which means that weeds can be controlled by seeding directly into tilled soil, ceasing tillage entirely once the soil has been restored to a healthy state, and minimizing soil disturbance from cultural operations. Because decreased tillage was unable to prevent weed interaction, the application of conservation agriculture has frequently resulted in lower yields. A number of weed species, including Cyperus rotundus (Chauhan and Opena, 2012) [4], Echinochloa crus-galli (Ntanos and Kouroubas, 2000) [9], Leptochloa mucronata (Chauhan and Johnson, 2011) [3], Echinochloa colona (Rabbani *et al*., 2011) [10], and Scirpus dichotomus (Begum *et al*., 2009) [2], are responsible for the reduction of rice yield.

On the other hand, post-emergence broad spectrum herbicides have recently evolved, offering conservation agriculture a chance to manage weeds (Ali *et al* 2019) [1]. In both conventional and conservation tillage systems, crop yields can be comparable provided weeds are managed and crop stands remain consistent (Mahajan *et al*., 2002) [7]. Rice grain yield and weed biomass showed a substantial negative correlation, while Mitra (2022) [8] found a strong positive link between rice grain yield and weed management efficiency.Cropping systems have a significant impact on California's weed flora as well. A field experiment was carried out at AICRP on Weed Management, Rajendranagar, PJTSAU, Hyderabad, to investigate all these parameters on the sustainability of crop production.

Objectives

To track the dynamics of weeds and rice crop yield during kharif in a long-term rice-based cropping system (rice, maize, and green manure) using several establishing techniques

Methodology
Techniques
Design: Split-plot
Replications: 3
Main plot size: 4.2 m x 36 m
Sub plot size: 4.2m x 12m

Date of sowing
Aerobic rice: 30-07-2017
Date of transplanting: 20-08-2017
Year of initiation: *kharif*, 2014

Table 1a: Treatments details, a) tillage and residue management (Main plot)

Treatment	*Kharif* (Rice)	**Rabi* (winter maize)	**Summer (Green manure)
T_1	CT (Transplanted)	CT	-
T_2	CT (Transplanted)	ZT	ZT
T_3	CT (Direct -seeded)	CT	ZT
T_4	ZT (Direct -seeded)	ZT	ZT
T_5	ZT (Direct -seeded) + R	ZT + R	ZT

Table 1b): Weed management (sub plot)

Treatment	Rice
W_1: Chemical Recommended herbicide Aerobic rice Transplanted rice	Pendimethalin PE a$T_1$000g/ ha *fb* bispyribac sodium at 25g ha^{-1} *as* PoE at 20 -25 DAS (2-3 weed leaf stage) *fb* 2,4-D sodium salt @1000g/ha at 60 DAS Bensulfuron methyl (0.6%) + Pretilachlor (6%) 6.6% GR at 0.66kg/ha as PE at 3-5 DAT *fb* bispyribac sodium at 25g ha^{-1} *as* PoE at 20 -25 DAS (2-3 weed leaf stage)
W_2: IWM	Bispyribac sodium 25 g/ha as early PoE at 15 DAT (2-3 weed leaf stage) *fb* HW at 40 DAT and 60 DAS (Aerobic and transplanted rice)
W_3: Unweeded	No weeding

The experiment was carried out in the college farm of Professor Jayashankar Telangana State Agricultural University, Rajendranagar (PJTSAU), Hyderabad. The location of the farm is at 17o19' N latitude and 78o23' E longitude, which is 542.3 m above mean sea level. With MTU -1010 serving as the test variety, the experiment was set up in a split plot design with five tillage treatments as main plots and three weed management treatments as subplots. It was then reproduced three times. The nursery was staffed on July 30, 2017, the day of the aerobic rice planting. On August 20, 2017, twenty-two-day-old seedlings were transplanted. All of the P, fifty percent of the potassium, and one-third of the N were applied at the time of planting. The residual nitrogen was applied in proportional amounts of 20 and 40 DAT (180-60-40 NPK kg/ha) to both transplanted and aerobic paddy. Herbicide treatments were implemented in accordance with the work's technical programme, and the entire package of practices was adhered to in accordance with PJTSAU's recommendations. Data on transplanted rice growth and yield characteristics were collected at 30 DAT/60 DAS, 60 DAT/90 DAS, and 90 DAT/120 DAS (harvest).

Results and Discussions
Weed dry matter (g/m^2)
Data on weeds showed that, during different phases of crop growth, tillage and weed management techniques had a major impact on the generation of dry matter from weeds. As compared to ZT and ZT+R tillage techniques, and in turn, CT (directed seeded) weed dry matter above ZT and ZT-R, CT (transplanted) showed the lowest and at par drymatter/m2 with each other and were considerably superior at 30 DAT/60DAS. A comparable pattern was noted 60 DAS. IWM practices at 30 and 60 showed noticeably less weed dry matter, but these results were comparable to chemical control, and these two treatments were far better than unweeded control. The relationship between tillage and weed management practices was not found to be significant at any stage of crop growth.

Weed density (No/m^2)
The density of weeds was significantly impacted by tillage and weed control techniques. Conventional transplanted rice treatments (CT) yielded noticeably lower weed density than ZT and ZT+R treatments sown under aerobic system. CT (direct seeded) treatment also yielded lower weed density than ZT and ZT+R were comparable with each other at all stages. At all crop growth stages, IWM practice was far superior than unweeded control, with the exception of 90 DAS/60 DAT, when chemical control treatment was comparable to unweeding control. Comparably, IWM practice at 30, 60, 90 DAS, and harvest resulted in significantly reduced weed density and did not differ significantly from chemical control.

Growth and growth attributes of rice
During the growing season, conventional (transplanted) rice treatments showed a considerable increase in plant height, crop dry matter, and tiller production. These were followed by CT,

ZT, and ZT+R treatments sown under aerobic system (directed seeding), which were comparable to each other. When it came to weed management techniques, IWM practice was noticeably better than unweeded control and shown a considerable rise in plant height. It also did not differ much from chemical weed management techniques. Tillage and weed management techniques did not significantly affect any of these growth-attributing characteristics in their interaction.

Yield and yield attributes of rice

Weed control techniques and tillage affected yield parameters such as test weight, grains/panicle, and productive tillers. When compared to the CT, ZT, and ZT+R treatments sown in an aerobic system (directed), the CT transplanted treatments showed considerably higher productivity in tillers, grains/panicle, and test weight. Out of all the tillage treatments examined, the CT transplanted treatment recorded a higher grain and straw yield and did not differ substantially from the other CT transplanted treatment; in turn, these were comparable to each other. Then came the aerobic system (direct seeding) CT, ZT, and ZT+R treatments, which produced average grain and straw yields. Lower weed index values were correlated with increased yield in CT transplanted treatments. IWM practice produced a yield of grain and straw that was much higher than that of unweeded control and comparable to that of chemical treatment.

Economics

Treatments using CT transplantation produced notably increased BC ratios, net returns, and gross returns. The most economical way to manage weeds was chemical weeding (PE of pendimethalin @ 1000 g/ha, fb bispyribac sodium at 25 g/ha as PoE at 20–25 DAS (2–3 weed leaf stage), and 2,4-D sodium salt at 60 DAS). It produced greater net returns (Rs 16026 /ha), net returns, and a BC ratio of 1.45. Higher cultivation expenditures brought on by manual weeding resulted in a reduced BC ratio in IWM practice.

Table 2: Effect of tillage and weed management practices on weed dry matter and weed density in rice- maize -green manure Cropping system (*kharif*, 2017)

Main plots	Treatments	Weed Dry Matter (g/m^2)		Weed Density	60 DAS
		30 DAS	60 DAS	30 DAS	
T_1	CT (Transplanted)	4.19(16.6)	5.80(32.67)	4.47(19.00)	5.91(34.33)
T_2	CT (Transplanted)	4.17(16.4)	5.94(34.4)	4.38(18.22)	6.02(35.33)
T_3	CT (Direct -seeded)	14.26(202.5)	15.75(247.23)	7.56(56.22)	6.75(44.67)
T_4	ZT (Direct -seeded)	16.98(288.5)	17.69(326.44)	9.14(82.55)	15.11(227.33)
T_5	ZT(Direct -seeded) + R	15.81(249.0)	18.09(291.92)	9.06(81.18)	14.79(217.78)
SEm		0.22	0.13	0.16	1.05
LSD (P=0.05)		0.72	0.46	0.53	3.5
Sub Plots					
W_1	Chemical	10.08(100.7)	11.09(122.18)	8.21(66.53)	7.45(54.60)
W_2	IWM	8.86(77.5)	9.62(91.61)	4.86(22.66)	6.52(41.53)
W_3	Unweeded control	16.93(285.7)	18.76(351.07)	9.58(90.80)	15.50(239.53)
SEm		0.39	0.13	0.31	0.7
LSD (P=0.05)		0.131	0.4	0.96	2.1
Interaction					
C.D(P=0.05)		NS	NS	NS	NS

*Figures in parenthesis are original values and data is subjected to square root transformation

Table 3: Effect of tillage and weed management practices on plant height and crop drymatter of rice in rice -maize–green manure cropping system (kharif, 2017)

Main plots	Treatments	Plant Height (cm)				Tillers (No/m^2)			
		30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest
T_1	CT (Transplanted)	34	54	68	72	128	291	335	266
T_2	CT (Transplanted)	33	53	67	71	127	283	319	277
T_3	CT (Direct -seeded)	30	52	56	68	89	180	230	169
T_4	ZT (Direct -seeded)	29	46	51	55	68	111	125	89
T_5	ZT(Direct -seeded) + R	29	39	41	58	75	153	170	134
SEm		0.48	2.99	1.87	1.98	2.07	4.66	5.71	3.79
LSD (P=0.05)		1.58	9.93	6.21	6.57	6.88	15.43	18.91	12.57
Sub Plots									
W_1	Chemical	32	50	60	68	112	223	259	207
W_2	IWM	32	52	64	66	111	248	281	240
W_3	Unweeded control	29	44	46	61	69	141	168	113
SEm		0.3	1.12	1.30	1.65	1.15	2.73	3.78	2.59
LSD (P=0.05)		0.91	3.35	3.87	4.92	3.42	8.11	11.25	7.72
Interaction									
C.D(P=0.05)		NS	NS	NS	NS	NS	NS	NS	NS

Table 4: Effect of tillage and weed management practices on tillers, yield and yield attributes of rice in rice -maize –green manure cropping system (*kharif*, 2017)

Main plots	Treatments	No o grains / panicle	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	CT (Transplanted)	118	20.61	5,338	7,463
T_2	CT (Transplanted)	118	21.00	5,237	8,562
T_3	CT (Direct -seeded)	101	16.97	2,409	3,289
T_4	ZT (Direct -seeded)	68	11.17	535	780
T_5	ZT(Direct -seeded) + R	64	12.28	918	1,256
SEm		1.82	0.80	86	146.84
LSD (P=0.05)		6.05	2.60	286	486.31
Sub Plots					
W_1	Chemical	95	17.08	3,389	4882
W_2	IWM	102	17.53	3,641	5494
W_3	Unweeded control	85	14.60	1,632	2434
SEm		1.24	0.53	29	166
LSD (P=0.05)		3.68	1.59	86	493
Interaction					
C.D(P=0.05)		NS	NS	NS	NS

Table 5: Effect of tillage and weed management practices on grain and straw yield of rice in rice – maize- green manure cropping system (*kharif*, 2017)

Main plots		Grain yield (kg/ha)	Straw yield (kg/ha)	REY of Straw (kg/ha)	Total yield of rice (kg/ha)	CC (Rs/ha)	GR (Rs/ha)	NR (Rs/ha)	BC ratio
T_1	CT (Transplanted)	5,338	7,463	635	5,973	40250	87797	47547	2.2
T_2	CT (Transplanted)	5,237	8,562	728	5,965	40250	87686	47436	2.2
T_3	CT (Direct -seeded)	2,409	3,289	280	2,689	32450	39524	7074	1.2
T_4	ZT (Direct -seeded)	535	780	66	601	30410	8840	-21571	-
T_5	ZT (Direct -seeded) + R	918	1,256	107	1,025	30410	15065	-15345	-
		86	146.84						
SEm		286	486.31						
LSD (P=0.05)									
Sub Plots									
W_1	Chemical	3,389	4882	415	3,804	35754	55921	20167	1.6
W_2	IWM	3,641	5494	467	4,108	38742	60390	21648	1.5
W_3	Unweeded control	1,632	2434	207	1,839	28750	27033	-1717	-
SEm		29	166						
LSD (P=0.05)		86	493						
Interaction									
C.D(P=0.05)		NS	NS						

REY: Rice Equivalent Yields GR: Gross returns NR: Net returns. Price of paddy=Rs 14.7/kg Price of straw: 1.25/kg

Conclusion

The experimental results suggest that conventional transplanted rice, as opposed to direct sown aerobic rice, may offer a higher grain yield of 5,338 kg/ha with a BC ratio of 2.2 under traditional or zero till systems of practices.

Chemical weed control proved to be the most cost-effective weed management strategy studied, yielding better net returns (Rs. 21648/- per and B:C ratio 1.55), as well as higher B:C ratios (1.56) when combined with integrated weed management treatments since they lowered the expense of weeding.

References

1. Ali N, Akbar N, Anjum SA, Rehman A, Ishfaq M. Efficacy of different pre and post-emergence herbicides to control weeds in direct seeded rice. Pak J Weed Sci Res. 2019;25(4):289-302.
2. Begum M, Juraimi AS, Amartalingum R, Omar SRS, Man AB. Effect of *Fimbristylis miliacea* competition with MR220 rice in relation to different nitrogen levels and weed density. Int J Agric Biol. 2009;11:183-187.
3. Chauhan BS, Johnson DE. Phenotypic plasticity of Chinese Sprangletop (*Leptochloa chinensis*) in competition with seeded rice. Weed Technol. 2011;25:652-658.
4. Chauhan BS, Opeña J. Growth of purple nutsedge (*Cyperus rotundus*) in response to interference with direct-seeded rice. Weed Technol. 2012;26:506-509.
5. FAO. Conservation Agriculture; c2015. Available online: https://www.fao.org/conservation-agriculture/en/ (accessed on 19 October 2021).
6. Jasrotia P, Kumari P, Malik K, Kashyap PL, Kumar S, Bhardwaj AK, *et al*. Conservation agriculture based crop management practices impact diversity and population dynamics of the insect-pests and their natural enemies in agroecosystems. Front Sustain Food Syst; c2023. p. 7.
7. Mahajan G, Brar LS, Walia US. Phalaris minor response in wheat in relation to planting dates, tillage and herbicides. Indian J Weed Sci. 2002;34(1-2):114-115.
8. Mitra B, Patra K, Bhattacharya P, Ghosh A, Chowdhury A, Dhar T, *et al*. Efficacy of pre- and post-emergence herbicide combinations on weed control in no-till mechanically transplanted rice. Cogent Food Agric; c2022. p. 8. DOI: 10.1080/23311932.2022.2139794.
9. Ntanos DA, Koutroubas SD. Competition of barnyardgrass with rice varieties. J Agron Crop Sci. 2000;184:241-246.
10. Rabbani N, Bajwa R, Javaid A. Interference of five problematic weed species with rice growth and yield. Afr. J Biotechnol. 2011;10:1854-1862.