Table 2. Comparison of stale seedbed and conventional methods in terms of crop establishment, weed population, and rice yield.

Weed method control	Crop plants (no. m^{-2} at 18 DAS)[a]	Weeds (no. m^{-2} at 70 DAS)				Grain yield (t ha^{-1})	Weed control cost ($ ha^{-1})
	Rice seedlings	Grass	Sedge	Broadleaf weeds	Wild rice		
Hand-weeded at 23 DAS	206	81	68	31	4	5.6	60.00
Unweeded	211	73	59	36	7	2.4	0
Preemergence application of butachlor at 0.8 kg ai ha^{-1} at 5 DAS	174	14	8	6	6	5.2	17.50
Stale seedbed	201	2	4	7	0	6.1	0
CD (0.05)	9.1	8.7	9.4	6.4	2.3	0.5	
CV	6.7	10.9	13.2	12.7	34.7	11.5	

[a]DAS = days after sowing, CD = critical difference, CV = coefficient of variation.

the adaptability of the stale seedbed system in farmers' fields. Results clearly showed that the stale seedbed is a no-cost, weed-control, productivity-facilitating system. Yield improvement over other systems is due to the direct effect of organic transformation of the soil environment and to efficient weed control. The stale seedbed system is also an effective tool to improve the quality of crop production in areas where wild rice is a problem.

The stale seedbed is not effective in a manually transplanted system, however, because of the emergence of secondary weed flushes as a result of soil disturbances. The minimal soil disturbance in using a mechanical transplanter is expected to make the stale bed system widely adaptable in countries such as Japan and Korea, where transplanting is mainly done using a transplanter.

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Influence of long-term crop management practices on grain yield and incidence of brown planthopper in rice

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A correct ratio between organic and inorganic sources of nutrients is essential to ensure optimum yield in any crop, including rice. A long-term experiment to study the influence of organic and inorganic nutrient sources on rice yield started in the 1991 kharif season at ARS, Siruguppa, in the Tungabhadra project area of Karnataka, India. The experiment was laid out in a randomized block design with four replications at a fixed site. Different levels of inorganic fertilizers (NPK), organic sources (farmyard manure, *Gliricidia*, *Sesbania*), and plant population were included as treatments (see table). A common dose of zinc (at 20 kg ha^{-1}) in the form of zinc sulfate was applied to all treatments. Rice variety BPT-5204 was planted every kharif season at 20 × 10-cm spacing, except in treatments where 25% more seedlings were transplanted, which used a spacing of 15 × 10 cm. Brown planthopper (BPH) was recorded in the 1999 kharif season 90 d after transplanting (DAT) on 10 hills in each treatment and computed per hill. Both grain yield and BPH population data were subjected to statistical analysis.

The BPH population varied significantly among treatments even though lower pest incidence occurred during the 1999 kharif season (see table). The variation would have been more pronounced if the BPH population buildup had been high. The BPH population was significantly higher in treatments T9 and T10, which received more nutrients from both inorganic and organic sources. The higher amount of N applied in T9, coupled with more plant population (T10), resulted in a higher BPH population. Hence, caution must be exercised when giving advice on applying higher N doses. The highest grain yield during the 1999 kharif season was recorded in T10 (6.5 t ha^{-1}) and was on a par with T3 (6.2 t ha^{-1}), T4 (6.3 t ha^{-1}), T7 (6.0 t ha^{-1}), T8 (6.4 t ha^{-1}), and T9 (6.3 t ha^{-1}). Applying 100:50:50:20 kg NPKZn ha^{-1} as only inorganic fertilizer (T1) resulted in lower grain yield and BPH population

Influence of long-term crop management practices on grain yield and incidence of brown planthopper (BPH) in rice at Siruguppa, Karnataka, India.

Treatment no.	Treatment[a] N:P:K:Zn (kg ha^{-1})	BPH hill^{-1} (no.) (90 DAT)	Yield (t ha^{-1}) (1999 kharif)	Mean yield (t ha^{-1}) (1991-98 kharif)
T1	100:50:50:20	2.60 f	5.3 c	4.3
T2	150:75:75:20	3.57 ef	5.9 b	5.0
T3	200:100:100:20	6.93 c	6.2 ab	5.1
T4	T2 + FYM (5 t ha^{-1})	4.57 de	6.3 ab	5.1
T5	T2 + Gli. (3 t ha^{-1})	4.70 de	5.9 b	5.2
T6	T2 + Ses. (5 t ha^{-1})	4.83 de	5.9 b	5.1
T7	T2 + FYM (5 t ha^{-1}) + Gli. (3 t ha^{-1}) + Ses. (5 t ha^{-1})	5.57 cd	6.0 ab	5.2
T8	T2 + 25% more PP	4.63 de	6.4 ab	4.9
T9	T3 + FYM (5 t ha^{-1}) + Gli. (3 t ha^{-1}) + Ses. (5 t ha^{-1})	9.00 b	6.3 ab	5.3
T10	T9 + 25% more PP	11.27 a	6.5 a	5.2

[a]Numbers in a column followed by the same letter do not differ significantly at 5% by Duncan's multiple range test. Gli. = *Gliricidia*, Ses. = *Sesbania*, DAT = days after transplanting, PP = plant population.

during the 1999 kharif season. The mean yield over the 1991-98 kharif seasons also indicated a similar trend. Results suggest that applying medium fertilizer doses (150:75:75:20) with organic manures, combined with a normal plant population, gave better yields than using a higher dose of organic and inorganic nutrient sources coupled with a higher plant population, without encouraging BPH incidence.

Effect of intercropping grain legume and green manure for multiple use on rice

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Multipurpose legumes can be grown in the summer, grain and haulms harvested (for fodder), and the ratooned regrowth used as green manure for the following rice crop. By adopting such a system, farmers get additional income from legume grains, fodder for animals, and green manure for rice. One such system involving red gram and green gram intercropped with two green manure crops was evaluated.

Field experiments were conducted at TNAU, Coimbatore, during the summer (Mar-Jun) and monsoon (Jul-Oct) seasons. The soil of the experimental field was black clay, classified taxonomically as Vertic Ustochreft, with low available N, medium available P, and high available K. Prerice crops included grain legumes, such as green gram (*Vigna radiata*) variety CO 45 and red gram (*Cajanus cajan*) variety ICPH 73, and green manure crops *Sesbania rostrata* and *S. aculeata*. In the intercropped stand, grain legumes and green manure crops were raised in a 3:1 proportion. The grain legume and green manure treatments were laid out in a randomized block design and replicated thrice.

The green manure crops were cut 45 d after sowing at a height of 30 cm from the ground using sickles. Immediately after cutting, plants were irrigated and allowed to regenerate. Green gram was harvested and the haulms were removed for fodder. Red gram was harvested by picking the pods; the remaining red gram stalks and green manure biomass were cut and incorporated *in situ*. These were allowed to decompose for 10 d and then the succeeding rice crop was transplanted. Variety CO 45 was raised in a split-plot design and replicated thrice with eight treatment combinations of grain legumes and green manure crops in the main plots and three levels of N (0, 50, and 100 kg ha^{-1}) in the subplots. Biometric observations and yield were recorded at different stages of crop growth for prerice crops and rice.

Results indicated that *S. rostrata* yielded significantly higher biomass than *S. aculeata* and hence contributed significantly more to rice. The intercrop treatments resulted in significantly higher biomass and N accumulation over the sole grain treatments. Grain legumes yielded 0.3–0.4 t ha^{-1} when intercropped with green manure crops. The green manure crops