Performance Evaluation of Non-Puddled Rice Transplanting Methods[1]

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Abstract

Rice transplanting is the most common method of rice establishment in the lowland areas. As a traditional practice, in Nepal and elsewhere, transplanting is done on well tilled and puddled soil. Puddling not only consumes much energy and time from the tillage point of view but also consumes a large quantity of the total water requirement in rice.

This paper reports on a recent experiment that is evaluating a new conservation agriculture rice crop establishment method, zero-till transplanted rice that is attempting side step the submergence problem while keeping all the other CA traits in place. The main objectives of the experiment were to evaluate non-puddled rice transplanting technique with different tillage options and to observe effect of mulching on weed control and rice grain yield.

The experiment consisted of three treatments viz. manual rice transplanting on tilled plot, manual rice transplanting in power tiller strip tilled plot and transplanting of rice with manual rice transplanter in zero-tilled plot. The experiment was conducted in 2005 and 2006 rice season at National Wheat Research Program, Bhairahawa.

Grain yield different among the treatments was highly significant in both the years. First year, strip-tillage produced the highest mean grain yield of 5940 kg/ha followed by no-till TPR(5564 kg/ha) and tractor land preparation (5207 kg/ha). All the treatments showed significantly higher grain yield than their respective mulched treatment. Second year, no-till TPR produced the highest mean grain yield of 6321 kg/ha followed by strip-tilled TPR (5910 kg/ha) and tractor land preparation TPR (5832 kg/ha). Like first year, grain yields in all the treatments were higher than their respective mulched treatments. The yield differences in no-till TPR and strip-tilled TPR were significant but it was not significant in tractor land preparation treatment.

Introduction:

In Nepal, Rice transplanting is the most common method of rice establishment in the lowland. As a traditional practice, in and Nepal and elsewhere, transplanting is done on well tilled and puddled soil. Puddling not only consumes much energy and time from the tillage point of view but also consumes a large quantity of the total water requirement in rice[6].

Perhaps 80 % of all monsoon rice, has a spring fallow after its winter crop. Tillage for monsoon rice usually begins 1-2 months prior to onset of rain to control weeds. An additional tillage will commence in early June again for weed control and to open the ground for just prior to the rains. If rains are delayed more than a month additional dry land tillage may be necessary. Once the onset of monsoon begins farmers scramble to get their fields puddle. This time of year tillage services are at a premium and rental costs can go nearly double. In short, tillage for monsoon rice is costly and farmers need to spend a considerable amount time and money in land preparation.

Rice transplanting is costly and cumbersome. Labor shortages at the peak work period aggravate the situation, and farmers are forced to transplant seedlings at less than the optimal stage (GS Giri).

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[6] by some estimates nearly 20% of all water for monsoon rice)

Puddling to a greater extent creates soil physical condition detrimental to the following crop in rice based cropping system (Hobbs P. and Morris M., 1996). Puddling makes land preparation difficult for the following wheat or other winter crops, resulting in cloddy soil structure, loss of soil moisture, delayed planting and inadequate seed-soil contact (Sharma et.al, 1995).

Additionally, there has been a great deal of work in Nepal on forms of alternative RCE. SK Adhikari et al tested seedling broadcasting against traditional method in rice establishment and reported that yield different was not significant, but there was 57% saving in labor cost in transplanting. Rice drum seeder has also been widely tested as an alternative method to traditional transplanting. It has been observed that direct (wet) seeding with drum seeders had higher marginal return by 21% to 25% compared to traditional transplanting method (G Sah et al). In another experiment, direct seeded (non puddled) rice produced significantly higher straw yield and similar grain yield to that of transplanted rice (J Tripathi et al). In another experiment, farmers' field experiment found that power tiller direct seeded rice was significantly superior to hand broadcasted dry direct seeded rice and conventionally transplanted rice, however it was marginally superior to hand broadcasted wet seeded rice (J Tripathi, GS Giri and NK Shakya). Similarly, use of IRRI model rice transplanter could save 2/3 of the total rice establishment cost (VK Gami and S Justice).

As above mentioned technologies are not in wide adoption, there is a need for finding suitable rice establishing option that avoids field puddling. Considerable research works have been done on direct rice seeding but there is almost no data available on non-puddled rice transplanting. Therefore a rice transplanting experiment was conducted at NWRP, Bhairahawa starting from Kharif season 2004 to explore the possibility of avoiding field puddling through non-puddled rice transplanting.

Objectives:

- To evaluate non-puddled rice transplanting technique with different tillage options
- To observe effect of mulching on weed control and rice grain yield

Materials and Methods:

The experiment consisted of three treatments viz. Manual rice transplanting on tilled plot, Manual rice transplanting in power tiller strip tilled plot and Transplanting of rice with manual rice transplanter in zero-tilled plot. Three plots each containing three kattha were selected at NWRP, Bhairahawa for the experiment. One fourth of each experimental plot was mulched with 2.5 cm thick chopped wheat straw after wheat harvest. The plots were inundated and left as such for a week for the weeds to come. Glyphosate @ 12 ml/lit and 500 lit/ha was sprayed in the plots except in the mulched area.

Rice variety Sabitri was selected for the experiment and Dapog method seed mats were prepared while preparing seedlings. Seed was soaked in water for 24 hours and incubated for 48 hours. After preparing land, 1m X 5m seed beds were raised 10-15 cm high and carefully leveled. Perforated plastic sheet was laid over the beds and 1 inch thick mud was sprayed evenly over it. Pre-germinated rice seed was over the mud and covered with wheat straw. Seed beds were irrigated 3 times a day. After five days, mulch was removed and beds were flooded. Same seedlings were used for manual transplanting.

For the full-till plot, land was tilled with 9-tine and harrowed. Field was flooded and allowed to remain so for about three days. Sixteen days old seedlings were transplanted on the plots without puddling. For the strip-till plot, the plot was tilled with power tiller strip-till drill with the tillage width of 6 cm. Plots were flooded and sixteen days old seedlings were transplanted manually without puddling. For the no-till plot, plots were inundated and allowed to remain as such for about three days. Rice was transplanted with IRRI-model manual rice transplanter without tilling.

Fertilizer was applied @100:30:30 N:P:K kg/ha. DAP was drilled with strip-till drill in the strip till plot, while, other fertilizers were broadcasted manually after transplanting. Insecticide Quinolphos was used to control insects.

On maturity, plants were harvested and observations on biomass, grain yield, No. of tiller/m2, plant height, panicle length, No. of filled/unfilled grain/Panicle and thousand grain weight were recorded. Five samples were collected from each treatment and each sample was treated as a replication. Collected data was analyzed using Genstat 5.

Results and Discussion

Effect of tillage

Tillage did not have any significant influence on grain yield and yield attributes in the first year. However, grain yield difference was highly significant in the second year, where zero-tilled transplanted rice produced the highest grain yield. Analysis of two year combine data did not show significant yield difference among the treatments but zero-tilled transplanted rice produced the highest grain yield. Tiller count and straw yield was significant, where zero-tilled treatment produced significantly higher number of tiller and highest straw yield.

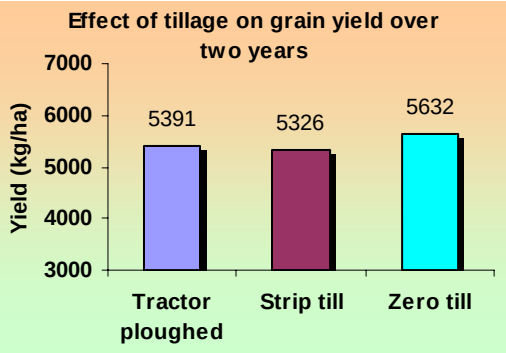


Table 1: Effect of tillage on rice grain yield and yield attributes over two years

Treatment	Tiller	TGW	Straw	Grain yield
Tractor ploughed	269.1	20.82	5805	5391
Strip till	284.3	20.30	5487	5326
Zero till	305.2	20.56	5948	5632
LSD	29.22	0.532	463.4	269.3
CV	14.2	3.6	11.2	6.9
F-test	HS	NS	HS	NS

Effect of mulching

Mulching had significant effect of grain yield the first year but did not show any significant effect in the second year. Mulching produced significantly lower grain yield than no-mulch in the first year but other yield attributing factors were the same. But in the second year, mulching did not show any significant effect on grain yield or other yield attributing factors. On analyzing the two year data, mulching produced significantly lower grain yield than the no-mulch treatment.

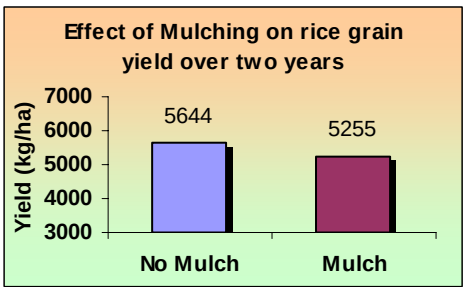
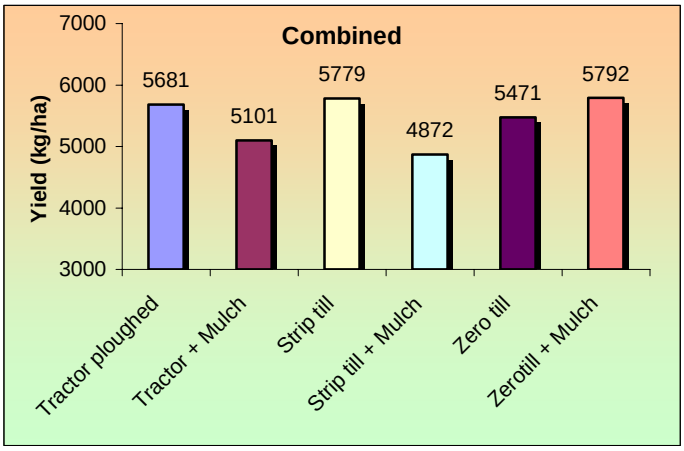


Table 2: Effect of mulching on rice grain yield and yield attributes over two years

Treatment	Tiller	TGW	Straw	Grain yield
No Mulch	290.7	20.60	5987	5644
Mulch	281.8	20.52	5507	5255
LSD	23.86	0.434	378.3	219.9
CV	14.2	3.6	11.2	6.9
F-test	NS	NS	NS	HS

Tillage and mulching interaction

Grain yield difference was significant in the first year, where strip-tilled transplanted rice produced the highest grain yield of 5943 kg/ha followed by zero-tilled transplanted rice (5395 kg/ha) and tractor ploughing (5370 kg/ha).Tractor land preparation produced the lowest grain yield of 4527 kg/ha. The yield difference was highly significant the second year, where zero-tillage mulching treatment produced the highest grain yield of 6536 kg/ha followed by tractor ploughing without mulching (5991 kg/ha) and tractor ploughing with mulching (5674 kg/ha). Strip tillage with mulching produced the lowest grain yield of 5198 kg/ha.



Two year combine analysis of the data shows highly significant yield difference among the treatments. Zero-tillage with mulching produced the highest grain yield of 5792 kg/ha followed by strip-tillage (5779 kg/ha), tractor land preparation (5681 kg/ha), zero-tillage (5471 kg/ha), tractor ploughing with mulching (5101 kg/ha) and strip tillage with mulching (4872 kg/ha). This inconsistency in grain yield might be due to the change in soil structure that might be taking place in different ways in different treatments. As for the reduced yield in mulching, it is difficult to see the real impact on crop yield in short term, as it is the matter of organic content build up in the soil (J Tripathi, 2003).

Table 3: Effect of tillage and mulching interaction on rice grain yield and yield attributes over two years

Treatment	Tiller	TGW	Straw	Grain yield
Tractor ploughed	287.4	20.72	6200	5681
Tractor + Mulch	250.9	20.92	5411	5101
Strip till	289.1	20.29	5919	5779
Strip till + Mulch	279.5	20.31	5056	4872
Zero till	295.5	20.78	5841	5471
Zerotill + Mulch	314.9	20.34	6054	5792
LSD	41.33	0.752	655.3	380.9
CV	14.2	3.6	11.2	6.9
F-test	NS	NS	NS	HS

Observations:

Rice transplanting on mulched area was difficult. While transplanting with manual rice transplanter, field could not grab the seedlings. Either it had to be pressed much harder than the other areas or in some instances, pressed manually. In manually transplanted area, labors also complained that they had to press hard to establish seedlings. Labors complained that rice transplanting was more difficult than puddled field. Although they did not complain about the pain in hand, labor requirement was higher as compared to the traditional transplanting. Only 1-2 man-day/katha is required for normal transplanting but in these non-puddled field, 3 man-day/katha was required.

Main objective of the strip tillage was to plant on the strips. But this objective could not be fulfilled as the labors could not trace the strips in the flooded field. Hence, it became random transplanting.

Though not measured, water percolation rate was observed higher in all the fields. Water retained in the fields for very short time as compared to the puddled field. Among the fields, zero-till plot

retained water for longer duration than in other fields. This could be due to the tillage which could have increased the infiltration and percolation rate of the field.

Plant height in the mulched part was lower with respective non-mulched part in all the treatments in the first year. From the very beginning, plants turned yellow and, except with no-till TPR, could not recover. This could be due to the consumption of fertilizer by decomposing straw. But this phenomenon did not occur the second year. There was no any noticeable difference in plant height. Previous year's straw decomposition might have supplied the excess nitrogen needed to decompose the fresh straw.

As there was no pre-monsoon rain in the first year, straw suppressed weeds in the mulched area. But in the second year, there was heavy pre-monsoon rain, and hence, weeds were not suppressed by straw, as the main weed in the fields is a perennial weed-cynodon dactylon.

Conclusion and Recommendation

The authors feel that transplanted zero till rice provides lowland farmers with the same flexibility of timing the rice planting – establishment with the onset of monsoon rains as does the normal farmer practice. Non-puddled rice transplanting method could be a viable technology and an alternative to direct seeded rice when there is heavy rainfall. But, as this is a tillage type of experiment, no conclusion can be made from only two years data. Hence, few more years' data are needed to see the effects of tillage and mulching on soil.

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