INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Pre-Seeded Mulch Technology for Direct Seeding in Wet Land Rice

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Abstract:
Direct seeding in rice is a popular practice that saves cost of crop establishment. However, weeds pose a serious challenge to crop growth and yield in direct seeded rice. To ensure uniform crop stand and manage weed growth, a novel method of use of Pre- seeded mulch has been developed. Pre-seeded mulch developed from organic waste materials have a residence time of 60 days in soil. Paddy seeds fixed in these sheets, when laid in the field got 95% seed germination. Weed control efficiency in terms of weed count and weed dry matter, of the technology is significantly higher than the hand weeding. Rice yield and yield attributes were also high for the pre- seeded mulch technology compared to wet seeding and transplanting.

Keywords: *Direct seeding in rice, weed control, pre seeded mulch technology, rice yield*

1. Introduction

Cultivation of rice is being practiced in different ways in different part of the world. Two important methods of rice establishments are direct seeding and transplanting. In direct seeding when dry seeds are sown into the dry(unsaturated)soil by broadcasting, drilling or dibbling, it is called dry seeding and, when the dry or germinated seeds are sown into the wet(saturated) puddled soil it is called wet seeding. In both the cases sowing is done in to the main field. Transplanting involves the replanting of rice seedlings grown in nurseries in to puddled soils. At present rice cultivation is shifting towards direct seeding method in many parts of the world like Japan, Korea, Philippines and India (Akhgari 2004) due to high technology, high labour cost and shortage of skilled labour (Pandey *et al*,2002&Dawe2005).Depending on the nature of the production system, direct seeding methods offers 50% reduction in labour requirement and the work days are spread over a longer period than with transplanting (Singh *et al.* 1994). At present, globally 23% of rice is direct seeded (Rao *et al.*2007). In addition to the low labour cost, direct seeded rice(DSR)methods have several advantages over transplanting and received much attention because of its low input demand (Sing *et al.* 2005). The direct seeded rice crops are faster and easier to plant, less labour intensive and consume less water(Jahangir *et al.*2005,Bal Subramanian & Hill 2002).

Though DSR methods of rice cultivation is getting wider acceptance in the changing environment, the use of transplanting methods for yield became customary. Yield in DSR is lower than transplanting owing to poor crop stand and high weed infestation (Sing *et al.*2005). Moreover, cost for weed control is usually higher than transplanting. High weed infestation is a major constraint for wide adoption of DSR (Rao *et al.* 2007).IRRI(1996) reported that weed growth in un weeded plots reduced rice yield as much as 45% in direct seeded rice. So the key to success of DSR is the availability of efficient weed control technique. Many farmers depend on herbicides for weed control. However, weed species resistant to herbicides have been reported in countries with high adoption rate of direct seeding (Itoh *etal.*1999). Multiple resistance to several chemical classes of herbicides has occurred in a single weed species commonly found in the rice fields in California, USA(Fischer *et al.* 2000).In addition, success of weedicide is highly depending on factors like rainfall. Public are also more concerned with the ill effect of herbicide on environment. In an organically managed situation it is impossible to apply herbicide. Plastic and paper mulching has become an alternative technique for reducing agrochemicals in rice. Use of paper mulch has got much attention as it is biodegradable (Lee *et al.*2005) but it got the problem of high cost and occurrence of weeds due to tearing of paper made up of waste paper (Jeon *et al.*2007).The use of plastic mulch has also

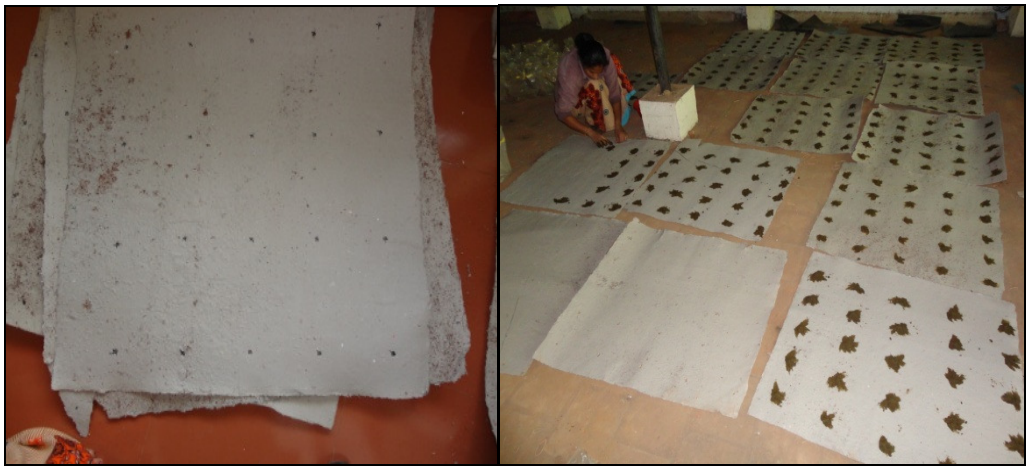
become a standard practice for many farmers to control weeds (Singh *et al.*2007). Though weed management in direct seeded rice could be achieved by rice straw mulching (Devasinghe*et al.* 2011) problem of non uniform crop stand still exist.
In the current work, attempt has been made to develop an organic mulch made up of waste paper and other organic materials with paddy seeds fixed in this sheets at required spacing (pre seeded mulch- PSM). Trials were also conducted to test the field performance, its weed control efficiency and yield in puddled fields.

2. Materials and Methods

The experiment has got two components: development of the preseeded mulch and testing its suitability in field situation.

2.1. Product Development

Product development part involved development of mulching sheets and development of pre-seeded mulch. Mulching sheets of 1m^2area were prepared using a mixture of pulp of waste paper and water Hyacinth, coir pith, Vermicompost and shredded coconut leaf in the ratio 60: 20: 10:5:5. The mulching sheet is having 0.8mm thickness and 270 gm/m^2 weight.
Insertion were made on the sheet at a spacing of 20X15 cm (spacing recommended for the selected variety). Two seeds each of rice variety Jyothi was fixed using wet cow dung and vermicompost slurry and dried (Fig. 1).This seeded organic sheet (pre - seeded mulch)was utilized for field trial.



(a) (b)

Figure 1 a) mulching sheet b) seeds fixed at definite spacing in mulching sheet

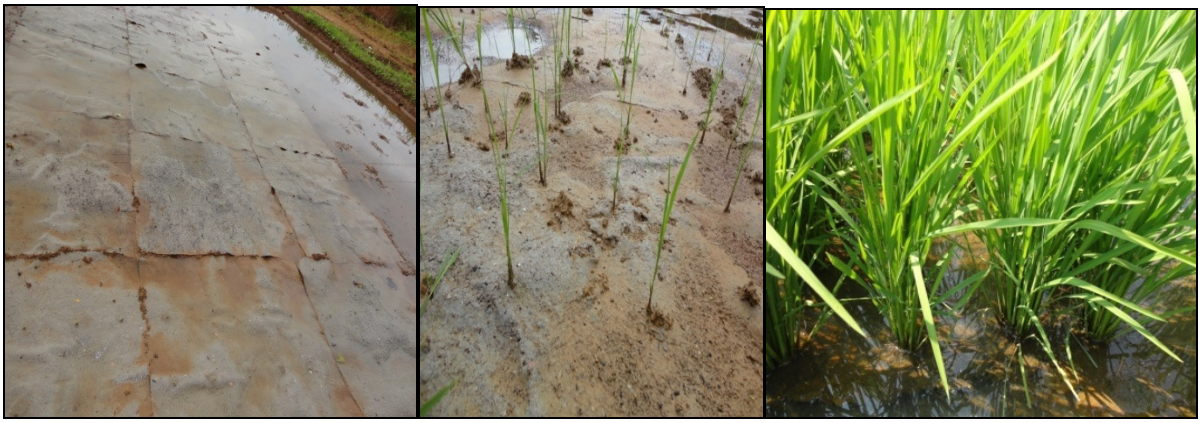
Field experiment
Field experiments were conducted to evaluate three methods of crop establishment. The plot size was 200$m^{2.}$ Seven replications were done in 3 locations.

Treatments-3
T1- Laying pre seeded mulch in puddle wetland with thin layer of water, seeded side facing down.
T2- transplanting in puddle soil at 20X15 cm spacing
T3-broad casting of non-sprouted seeds in puddled soil

Crop management practices as per Package of Practices recommended by Kerala Agricultural University were adopted. In T1 and T2, where basal doze of fertilizer was applied just before spreading the pre- seeded mulch and broadcasting @45:45:22.5 kg N, P_2O_5, and K_2O.Hossain *et al.*(2009) reported that basal doze of applying fertilizers are ideal at 2 days before mulching. For T2, 22 day old seedlings were transplanted and at that time the basal doze of fertilizers were applied. In all the treatments top dressing @45:0:22.5 kg N,P_2O_5,and K_2O was done30 days after the first doze. Water level was maintained at saturated level in initial days for facilitating the sprouting of the seeds. Seeding for all the treatments was done on the same day. One manual weeding was done in the broadcasted plots on25th day after sowing. Observations on weed count, weed type and weed biomass were taken on 50th day after sowing. Rice yield characteristics such as number of productive tillers, grain and straw yield was recorded and subjected to statistical analysis.

3. Results

Development of pre - seeded mulch
The mulching sheet prepared out of the bio wastes with a thickness of 0.8mm and average weight of 270 gm./ $m^2$was stable in puddle soil for 60 days. The rice seeds embedded to the sheets can very well come out of the sheet by piercing through the insertions already made in the sheet. 95% germination was recorded in the germination trial. Field view of pre seeded mulch is shown in figure 2.



(a) (b) (c)

Figure 2: a). Sheets laid in the field. b). Seedling emergence c) Tilling stage

Effect of pre seeded mulch on weeds

The weed count at 50 days after sowing showed that total weed count is 15.71/m^2in pre seeded mulch laid plots which is significantly lower than transplanting and wet seeding. Wet seeding plots recorded highest number of weeds(629.09/m^2)as shown in Table 1.

Planting/sowing methods	Weed count-grasses	Weed count-sedges	Weed count-broad leaved	Weed count-total
Pre seeded mulch	2.57	2.62	10.52	15.71
Transplanting	28.38	17.86	149.91	196.0
Wet seeding	99.48	42.76	484.67	629.09
C.D.(5%)	7.1	4.15	19.24	21.48

Table 1: Weed counts (per m^2)

There is significant reduction in weed count in plots where pre - seeded mulched was used. The weed dry weight also followed the same pattern of weed count as shown in Table2with lowest total weed dry weight recorded in mulched plots as10.29g/m^2 and highest value of 153.28 g/m^2 in direct seeded plots. With respect to different weed category also, pre seeded mulch recorded the lowest weed population. Irrespective of the treatments, the broad leaved weeds dominated the weed flora.

Planting/sowing methods	Weed dry weight – grasses	Weed dry weight – sedges	Weed dry weight -broad leaved	Weed dry weight – total
Pre seeded mulch	0.584	0.898	8.816	10.299
Transplanting	3.460	1.412	58.033	62.910
Wet seeding	17.153	9.288	126.837	153.281
C. D. (5%)	1.023	0.728	4.51	4.80

Table 2: Weed dry weight (g/m^2)

Effect of pre seeded mulch on yield of rice

The effect of different crop establishment methods on yield and tiller number of rice is shown Table 3. There is significant difference in grain and straw yield between treatments. Highest grain yield of 4970 kg/ha. was recorded in pre seeded mulch treatment and lowest yield of 2493 kg/ha. in direct seeded treatment. The straw yield also followed the same trend. The pre - seeded mulch treatment recorded the highest number of productive tillers/hill (17.52) followed by transplanting ((10.09).

Planting/sowing methods	Grain weight (kg/ha)	Straw weight (kg/ha)	Productive tillers/hill
Pre seeded mulch	4970	4945	17.524
Transplanting	3416	3410	10.095
Wet seeding	2493	2623	7.000
C.D. (5%)	88.8	86.6	0.997

Table 3: Yield and tiller number

4. Discussion

The mulching sheet prepared in this work was stable in the wet puddle field up to 60 days. By this time the competition between rice plant and weeds will be over. According to Mukherjee *et al.*(2008),critical period of weed –crop competition varied from 15-60 days after sowing in wet seeded rice. There is no hindrance to rice seed germination through the mulch sheet and hence it is suitable for crop establishment in rice. The seedling establishment of 95% recorded in current study is much higher than the reported value in drill direct sowing recycled paper mulch by Yamauchi (2001).

There is significant reduction in weed count and weed dry weight in pre-seeded mulched plots compared to transplanting and direct seeding. Hossain*et al.* (2006) reported that direct sowing culture of paddy with non-woven fabric mulch was effective in controlling weeds. In all the plots broad leaved weeds dominated the grasses and sedges in the present study. It is in contrast to the findings of Dere singha *et al.* (2001) which states that sedges dominated the direct wet seeded paddy straw mulched and control plots compared to grassy and broad leaved weeds. This may be due to the difference in predominance of local weed population and non-standing water situation maintained during the initial stages of seed establishment. The weed suppression property of the pre- seeded mulched plot may be due to hindrance to light transmission. Physical suppression is attributed to the weed control mechanism of mulching technology by Jeon *et al.* (2011).There is significant yield increase in pre seeded mulch technology compared to transplanting and direct seeding. The direct-sowing culture of a paddy with non-woven fabric mulch was found effective in labour saving and providing better yield(Sugimoto *et al*.2003). Increase in rice yield is mainly due to the significant increase in number of productive tillers in mulched plots compared to transplanted plots. According to Jaiswal &Singh (2001), Javaid *et al.*(2012) transplanted crop produced maximum paddy yield which was significantly higher than broadcasting and direct seeding techniques. The present technique, though it is a form of direct seeding, out yielded the transplanting method of crop establishment. Significant yield increase in pre-seeded mulched plots can be attributed to uniform crop stand, low competition from weeds for recourses and early crop establishment.

Pre seeded mulch technology is a new technique of direct seeding in rice, which is ideal for achieving uniform crop stand, weed control and higher yield. Technology is needed for mechanized seeding on rolling mulching sheets.

5. Acknowledgement

The financial assistance received from state planning board Govt. of Kerala for conducting the research project is greatly acknowledged.

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