Growing healthy rice seedlings through soil solarization: a low cost technology for increasing rice productivity and profitability

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Abstract

Soil borne pathogens and nematodes cause every year heavy yield losses in rice in tropical countries like Bangladesh. Soil solarization can control soil borne diseases and nematodes. This technique showed potential to produced higher rice yields. A survey was conducted in Dinajpur district during 2001 to study the effect of soil solarization on rice yields and profitability and to document farmers' reactions on this technology. Results showed that transplanted monsoon rice yield increased up to 36% after using solarization to raise seedlings. Farmers received an additional gross return of about Tk. 10,276/ha by investing only Tk 941/ha extra cost for solarization. Farmers overall opinion about this technology was very high. They claimed it was very easy to do, low costing and helped to increase their livelihood through increased rice productivity and ultimately their household food security.

Media summary

Rice yield was increased of about 36% by using solarization technique for raising seedlings. Farmers earned additional gross return of about Tk. 10,276/ha by investing additional cost of Tk 941/ha.

Key Words:

Soil, Pathogens, Nematodes, Polythene, Marginal analysis, Gross margin

Introduction

Soil solarization is a method of heating soil by covering it with transparent polythene sheet to control soil borne diseases. Like other crops, many soil borne pathogens and nematodes attack transplanted monsoon rice. Soil borne pathogens and nematodes cause heavy rice yield losses every year in Bangladesh (Malaker *et al*. 2003). Soil solarization can control soil borne diseases and nematodes

by heating the soil through sunlight. Other additional beneficial effects include control of weeds, insect pests and release of plant nutrients resulting in increased crop growth (Katan 1981; Horiuchi 1984). Solarization is a non-chemical alternative for disease, insect pest and weed control. Soil solarization has potential application to IPM systems. It can be successfully used for disinfection of any seedbed to produce healthy seedlings of vegetable as well as rice crops.

Fig. 1 Effect of solarization on seedling vigour and root growth of rice seedlings

The land to be solarized is plowed and leveled properly. Beds are prepared according to the width of the polythene sheet. Beds are wrapped with polythene sheet and the margins are covered with soil to avoided air movement inside the bed. Care should be taken to avoided premature break down of the polythene sheet. If so, it should be immediately sealed with white plastic tape. Solarization is usually done in the hottest month of the year (April-May) for a period of 4 to 5 weeks (Chauhan et al., 1988).

This technology has been demonstrated in northwest Bangladesh for extensive adoption by government institutes, non-government organizations, Cornell University and CIMMYT. An attempt was made to economically analyze these on-farm demonstration results to assess the impact of raising healthy seedlings through soil solarization on productivity and profitability of transplanted Aman rice production.

Method

Among the demonstration plots 50 plots/farmers were selected randomly from different locations within the Dinajpur district. Data were collected from the selected demonstrated plots/farmers (who practiced this method) by using a pre-tested interview schedule during 2001. Marginal analysis was done by employing partial budgeting technique. The costs that vary for applying this technique were only considered for this analysis. Marginal Rate of Return (MRR) was estimated to highlight the benefits of the technology. This was calculated as,

$$\text{MRR (\%)} = \frac{\text{Marginal gross margin of solarization}}{\text{Marginal costs that vary for solarization}}$$

Where, marginal gross margin (MGM) refers to the additional increase in gross margin due to the changes treatment and marginal cost that vary (MCV) refers to the additional increase in the variable cost due to change in the treatments.

Results and Discussion

1. Yield and return

Yield of transplanted monsoon rice was significantly increased with seedlings raised through soil solarization compared to non-solarization. Average yield was 5.52 t/ha from solarized seedlings compared to 4.05 t/ha in non-solarized (Fig. 2, Table 1). Plots where solarized seedlings were used yielded about 36% higher over plots using non-solarized seedlings. Gross return was also higher for plots using solarized seedlings and was Tk. 38,647 /ha compared to plots using non-solarized seedlings (Tk. 28,371/ha).

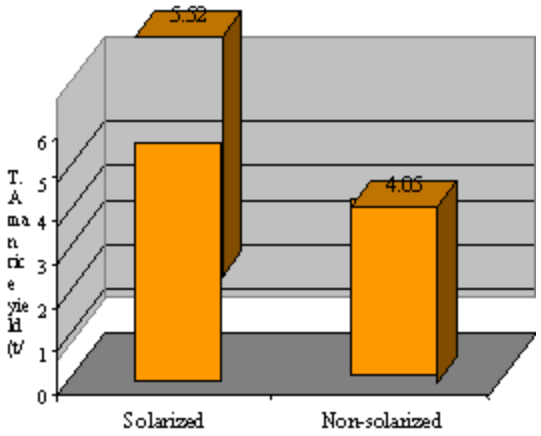

Fig. 2 Yield of T. Aman rice from Solarzsed VS non-solarized seedlings

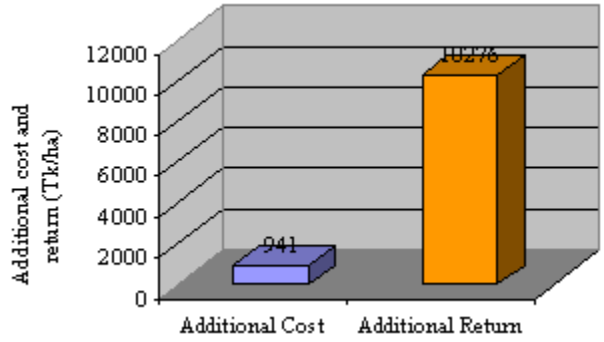

Fig. 3 Additional cost and return of solarization technology in T. Aman rice production

2. Cost that vary and gross margin

All the npractices of seedling raising and rice cultivation were the same for plots using either solarized and non-solarized seedlings. In solarized plots, the polythene and labour costs (Tk. 941/ha = $ 17) were considered as ‘cost that vary’. The gross margin for solarized seedling plots was Tk. 37,706/ha whereas it was Tk. 28,371/ha in non-solarized plot (Table 2).

3. Marginal analysis

Marginal analysis showed that solarized system gave 992% marginal rate of return on investment (Table 2). This result signifies that if solarization method is used rice seedling raising, it will maximize the rate of return to capital investment.

4. Farmers comments on solarization technique

About 89% of sample farmer said that the germination rate of seeds in solarized plots was higher than non-solarized plots. About seventy-eight percent farmers thought that solarized plots showed faster seedling growth and less insect infestation than non-solarized plots. About 33% of sample farmers responded that there was less weed infestation than in non-solarized plots, and the same percent of farmers said that seedlings in solarized plots were more healthy (Table 3).

Conclusion and recommendations

- Plots using solarized seedlings gave 5,521 kg yield per hectare which is about 36% higher (1,468kg/ha) compared to plots using non-solarized seedlings. This is one of the key advantages of solarization method.
- There were some other relative advantages such as higher germination rate, higher growth rate, less insect and weed infestation and more healthy seedling were found in solarized method that influence in yield increasing.
- From marginal analysis it was found that seedlings from soil solarization plot gave higher profit and higher MRR (992%).

Table 1. Cost that vary, grain yield and return of plots using solarized and non-solarized rice seedlings.

Items	Solarized plot seedlings	Non-Solarized plot seedlings
Cost that vary (Tk/ha)*	941	0
Yield (kg/ha)	5,521	4,053
Gross return (Tk/ha)	38,647	28,371
Gross margin (Tk/ha)	37,706	28,371
Additional cost over non-solarized (Tk/ha)	941	-
Additional GM over non-solarized (Tk/ha)	9,535	-
Yield increase (%) over non-solarized	36	-

*1 US $ = Tk 57, Note: Price of rice @ Tk. 7/kg

Table 2. Marginal analysis of T. Aman rice production through using solarization technique

Technology	Cost that vary (Tk/ha)	Yield (Kg/ha)	Gross return (Tk/ha)	Gross margin (Tk/ha)	MGM (Tk/ha)	MCTV (Tk/ha)	MRR (%)
Solarized plot seedlings	941	5521	38647	37706	9535	941	992
Non-Solarized plot seedlings	0	4053	28371	28371	-	-	-

MGM: Marginal Gross Margin; MCTV: Marginal ‘Cost That Vary’; MRR: Marginal Rate of Return

Table 3. Farmers comment on solarization technology

Comments	% of farmers
Higher germination rate over non-solarized plots	89
Higher growth rate of seedling in solarized plots	78
Less insect infestation over non-solarized plots	78
Less weed infestation over non-solarized plots	33
More healthy seedling in solarized plots than non-solarized	100

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