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# IMPROVING YIELD OF TRANSPLANTED AMAN AND BORO RICE THROUGH TEGRA PACKAGE OF CULTIVATION

**M.A.Kader[1*], M.S.R. Mia[1], M.A. Kafi[1], M. S. Hossain[2] and N. Islam[1]**

[1]Department of Agronomy, BAU, Mymensingh
[2]Department of Agronomy and Haor Agriculture, Sylhet Agricultural University, Sylhet
Corresponding author: abdul.kader@bau.edu.bd

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## Abstract

The study investigated the yield performance of transplant *aman* rice cv. BRRI dhan49 and *boro* rice cv. BRRI dhan29 under improved package of cultivation (TEGRA) as compared to farmers' practice. TEGRA is a rice farming practice which includes use of quality seeds and healthy seedlings, transplanting with rice transplanter, use of herbicide, use of balanced fertilization and micronutrients, and preventive plant protection measures. The study during transplant *aman* season included two treatments on rice cultivation method viz. TEGRA package and farmers' practice while in *boro* rice four treatments viz. TEGRA package, farmers' practice with high inputs, farmers' practice with medium inputs and farmers' practice with low inputs. The yield and plant characters of both transplant *aman* and *boro* rice were significantly influenced by the TEGRA package of cultivation as compared to farmers' practice. TEGRA package of cultivation as compared to farmers' practice increased the grain yield by 18.3% in transplant *aman* rice and by 80% in *boro* rice with less cost of production as compared to farmers' practice, which eventually resulted 23% increase in gross return and 400% in net return. As a result, the benefit cost ratio of TEGRA package was much higher (1.35 and 2.20 during transplant *aman* rice and *boro* rice, respectively) compared to that of farmers' practice (1.07 and 1.30).

## Introduction

Rice is the most important staple food in Bangladesh covering more than 80% of the food grains consumed in the country. Currently, 11.47 m hectares of land is occupied with rice cultivation having an annual production of about 34.36 million tons with an average yield of about 3.0 t $ha^{-1}$ (BRRI, 2015a). On an average, the yield of the most popular transplant *aman* rice varieties ranges from 5.0 to 6.5 $tha^{-1}$, (BRRI 2015b). However, the grain yield of 7.78 $tha^{-1}$ of the variety BRRI dhan49 was also reported at filed level (Kamruzzaman, 2014).

The lower average yield of rice in the country is mainly due to inefficient management practices used by the farmers such as use of poor quality seeds, less care of seedlings in the nursery bed, manual transplanting, use of imbalanced fertilization, i improper weed and pest management practices etc Recently, a package of rice cultivation, known as TEGRA, has been developed. The package is comprised of use of high quality rice seeds, raising of seedlings with special care in tray, use of tender seedlings for transplanting using mechanical transplanter, application of herbicides, balanced fertilization and preventive crop protection measures. The availability of labor became very scarce with high wages of labor, manual transplantingleading to reduced profits to farmers. It has been reported that transplanting takes about 250-300 man-hours/ha which is roughly 25 percent of the total labor requirement of the crop (Singh *et al*. 1985).. Mechanical transplanting has become popular in many countries due to its multidimensional advantages. The TEGRA package is

expected to give at least 20% more yield to the farmers as compared to their own practice. Therefore, the present study was conducted to evaluate the growth and yield performance of transplant *aman* rice cv. BRRI dhan49 and *boro* rice cv. BRRI dhan29 under TEGRA package of cultivation and compare with farmers practices.

## Materials and Methods

The study was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh during the transplant *aman* season (July to November) in 2014 and *boro* season (December to June) in 2014-15 to ascertain the yield performance of transplant *aman* rice cv. BRRI dhan49 and *boro* rice cv. BRRI dhan29 under TEGRA package of cultivation as compared to farmers' practices. The study during transplant *aman* season included two treatments on rice cultivation method viz. TEGRA package and farmers' practice, while during *boro* season the experiment composed of four treatments on rice cultivation methods viz. TEGRA package of cultivation, farmers' practice with high inputs, farmers' practice with medium inputs and farmers' practice with low inputs. The major features of the agronomic practices followed in TEGRA package and farmers' practices are given in Tables 1-3. To know about the farmers' practice for transplant *aman* and *boro* rice cultivation, a questionnaire was prepared and collected from 20 farmers selected randomly from the village Boira, Mymensingh Sadar, Mymensingh and their cultivation practices such as seed collection, seedling raising technique, age of seedlings during transplanting, fertilizing dose and crop protection measures were noted. The experiments were laid out in a Randomized Complete Block Design (RCBD) with five replications with the unit plot size 10 m X 12 m to facilitate the use of rice transplanter.

Table 1. Major features of agronomic practices for transplant *aman* rice cv. BBRI dhan49 under TEGRA package and farmers' practice

| Cultivation practices | TEGRA | Farmers' Practice |
|---|---|---|
| Quality of seeds | Foundation seed from Bangladesh Agricultural Development Corporation (BADC) | Farmers' own seed |
| Method of raising seedling | Tray method | Conventional method in nursery |
| Age of seedling (days) | 18 | 27 |
| Method of transplanting | Transplanter | Manual |
| Spacing of transplanting | 30cm x 14cm | 25cm x 15cm |
| Crop protection | Advanced care as per the protocol | Care taken as and when necessary |
| Fertilizer dose* kgha$^{-1}$ | | |
| Urea | 185 | 200 |
| TSP | 120 | 120 |
| MoP | 85 | 80 |
| Gypsum | 70 | 45 |

Table 2. Major features of agronomic practices for *boro* rice cv. BBRI dhan29 under TEGRA package and farmers' practice

| Cultivation practices | TEGRA package | Farmers' practice with High inputs | Farmers' practice with medium inputs | Farmers' practice with low inputs |
|---|---|---|---|---|
| Quality of seeds | Foundation seed from BADC | Farmers' own seed | Farmers' own seed | Farmers' own seed |
| Method of raising seedling | Tray method | Conventional method | Conventional method | Conventional method |
| Age of seedling (days) | 30 | 45 | 45 | 45 |
| Method of transplanting | Transplanter | Manual | Manual | Manual |
| Spacing of transplanting | 30 cm x 14 cm | 25 cm x 15 cm | 25 cm x 15 cm | 25 cm x 15 cm |
| Crop protection | Advance care as per the protocol | As and when necessary | As and when necessary | As and when Necessary |
| Fertilizer dose* $kgha^{-1}$ | | | | |
| Urea | 296.4 | 393 | 280 | 167 |
| TSP | 103.74 | 130 | 104 | 72 |
| MoP (MoP) | 111.15 | 36 | 26 | 16 |
| Gypsum | 59.28 | 112 | 82 | 56 |

***** Under TEGRA Package Grozin (Zn fertilizer) @7.5 kg $ha^{-1}$, Boron @ 2.5 kg $ha^{-1}$, Megma (Mg fertilizer) @ 15 kg $ha^{-1}$ and Thiovit ( fungicide) 7.5 kg $ha^{-1}$ were applied.

Table 3. The protocol of plant protection measures taken in in transplant *aman* and *boro* rice under TEGRA package of cultivation

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Riffit (pre-emergence herbicide) + Lesar (systemic herbicide) (3-7 days of land preparation) | 1st Urea and Thiovit (fungicide) (10-15 DAT) | Virtako (insecticide) (15-20 DAT) | 2nd Urea and Land drying (25-30 DAT) | 3rd Urea, MoP and Virtako (insecticide) (35-40 DAT) | Amistertop (fungicide) (50-55 DAT) | Score (fungicide) (55-60 DAT) | Plenum (insecticide) (65-70 DAT) | Amistertop (fungicide) + Filia (fungicide) (70-75 DAT), if diseases seen |

For TEGRA package, the seedlings were grown in tray with growing media of soil, ash and compost mixture (Fig.1A) and seedlings were transplanted using mechanical transplanter with 30 cm X 16 cm spacing (Fig. 1B). Growing of seedlings in the media is required for machine transplanting of the seedlings For farmers' practice, seeds were collected from the farmers and the seedlings were transplated manually with 25 cm X 15 cm spacing followed by the farmers. . Intercultural operations like gap filling, irrigations etc. were done as and when necessary. At crop maturity data on yield contributing characters were collected. Then grain yield was converted at 14% moisture and straws sun dried properly and then weighed. Data collected on different parameters were statistically analyzed using software,(MSTAT) and mean comparisons were made by Duncan's Multiple Range Test (Gomez and Gomez, 1984).


Fig.1 Seedlings grown with special care in tray (A) and transplanting with rice transplanter (B)

## Results and Discussion

**Yield and yield contributing characters of transplant *aman* rice cv. BRRI dhan49**

The effect of TEGRA package of cultivation was not significant in panicle length, grain numbers panicle$^{-1}$ , grain and straw yields (Table 4). The superior growth parameters of the crop under TEGRA package of cultivation was reflected in terms of number of total tillers m$^{-2}$, number of effective tillers m$^{-2}$ and 1000-grain weight (g). TEGRA package of cultivation produced significantly taller plant (103.8), higher number of total tillers hill$^{-1}$ (429.35), effective tillers hill$^{-1}$ (353.91) and 1000-grain weight (19.70 g) as compared to farmers' practice. Grain, straw and biological yields (grain yield + straw yield) of transplant *aman* rice cv. BRRI dhan49 under TEGRA package of cultivation were 5.88, 9.84 and 14.72, respectively as compared to farmers practice of 4.97, 6.24 and 11.21, respectively. The results revealed that the grain yield of rice cv. BRRI dhan49 increased by 18.3% under TEGRA package of cultivation as compared to farmers' practice whereas straw yield increased by 57.69% .The higher grain and straw yields obtained under TEGRA package of cultivation as compared to farmers' practice might be combined positive influence of all component technologies such as use of foundation seeds, better care of seedlings in the nursery, use of younger seedlings, better control of weeds and other pests, and use of balanced fertilization. Ali *et al*. (1992) also reported superior yield performance of rice with younger seedlings.

**Profitability of transplant *aman* rice cv. BRRI dhan49 as compared to farmers' practice**

TEGRA package reduces the production cost of transplant *aman* rice by more than Tk. 3000 as compared to the farmers' practice (Table 5). This higher production cost under farmers' practice might be because of traditional way of transplanting and weeding requires more number of labors. Thus the results reveal that TEGRA package of cultivation was not only superior in terms of yield but also incurred less cost of production as compared to farmers' practices, besides increase in gross return (23%) and net return (400%) as compared to farmers' practice (Table 5). As a result, the benefit cost ratio of TEGRA package was higher (1.70) compared to that of farmers' practice.

**Yield and yield contributing characters of *boro* rice cv. BRRI dhan29**

TEGRA package of cultivation method had significant effect in respect of yield and all yield contributing characters of *boro* rice. The result showed that among the four cultivation methods used in TEGRA package where produced the highest number of total tillers m$^{-2}$, number of effective tillers m$^{-2}$ and 1000 -grain weight (g) but farmers' practice with high

inputs did not give better results in yield components. The superior growth and yield parameters, adoption of TEGRA package produced the highest grain yield (10.89 t $ha^{-1}$) and straw yield (12.43 t $ha^{-1}$). On the other hand, farmers' practice with high inputs produced the lowest grain yield (6.17 t $ha^{-1}$). The results reveal that TEGRA package of cultivation increased grain yield of *boro* rice cv. BRRI dhan29 by 80% as compared to farmers' practices in general (average of farmers' practice with high , medium and low input). The increase of straw yield of the crop under TEGRA package of cultivation was 38.73% from that of farmers' practice with medium input. It is very clear from the results that TEGRA package of cultivation was much superior in producing grain and straw yield of *boro* rice cv. BBRI dhan29 as compared to any of the three farmers' practices.. Among the treatments on farmers practices, medium input was better than that of high t and low input.

**Profitability of *boro* rice cultivation under** TEGRA **package of cultivation as compared to farmers' practices**

The production cost of *boro* rice cv. BRRI dhan29 under TEGRA package of cultivation was lower of Taka 9000 and 4000 as compared to farmers' practice with high and medium inputs, respectively. However, the production cost of the crop under TEGRA package of cultivation was a little higher than that of farmers' practice with low inputs. The traditional way of transplanting and weeding under farmers' practice required increased labor cost as compared to TEGRA package of cultivation. Eventually, TEGRA package of cultivation produced the highest gross and net return as compared to the other farmers' practices. The BCR of TEGRA package of cultivation was 2.20 which was only 1.18 under farmers' practice with high input. Similar results were also found by Singh *et al*. (2005) who stated that the mechanical transplanting was most cost-effective providing maximum benefit cost ratio.

## Conclusion

From the results of the study it could be concluded that TEGRA package of rice cultivation is advantageous in terms of yield and cost of production of both transplant *aman* and *boro* rice under Bangladesh context. The technology might play a very vital role in increasing rice production in the country if it is adopted at farmers' level successfully at large scale and therefore requires more research in this area.

Table 4. Yield and yield contributing characters of transplant *aman* rice cv. BRRI dhan49 as influenced by TEGRA package of cultivation and farmers' practice

| Treatments | No. of total tillers $m^{-2}$ | No. of effective tillers $m^{-2}$ | No. of non-effective tillers $m^{-2}$ | No. of grains $panicle^{-1}$ | No. of sterile spikelet $panicle^{-1}$ | 1000-grain weight (g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) | Biological yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| TEGRA | 429.35 a | 353.91 a | 78.06b | 128.5 b | 15.77 b | 19.70 a | 5.88 a | 9.84 a | 15.72a |
| Farmers' practice | 396.02 b | 335.79 b | 90.61a | 134.7 a | 20.90 a | 17.60 b | 4.97 b | 6.24 b | 11.21b |
| $LSD_{(0.05)}$ | 13.13 | 8.10 | 5.20 | 4.42 | 2.38 | 1.19 | 0.52 | 0.51 | 1.59 |
| CV (%) | 1.81 | 1.34 | 3.51 | 1.93 | 7.38 | 3.65 | 5.48 | 3.65 | 4.43 |

Table 5. Cost of production of transplant *aman* rice cv. BRRI dhan49 under TEGRA package of cultivation and farmers' practice

| Treatment | Total cost (Tk $ha^{-1}$) | Gross Return (Tk $ha^{-1}$) | Net Return (Tk $ha^{-1}$) | Benefit Cost Ratio (BCR) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| TEGRA package | 121354.75 | 163680 | 43325.25 | 1.35 |
| Farmer' practice | 124645.50 | 133030 | 8384.50 | 1.07 |

Table 6. Yield and yield contributing characters of *boro* rice cv. BRRI dhan29 as influenced by TEGRA package of cultivation and farmers' practices

| Treatment | No. of total tillers $m^{-2}$ | No. of effective tillers $m^{-2}$ | No. of non-effective tillers $m^{-2}$ | Panicle length (cm) | Number of grains $Panicle^{-1}$ | Number of sterile sikelets $Panicle^{-1}$ | 1000-grain weight (g) | Grain yield ($tha^{-1}$) | Straw yield ($tha^{-1}$) | Biological yield ($t\ ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| TEGRA package | 664.02 a | 639.50 a | 24.51 d | 22.97a | 137.9a | 18.03a | 22.24a | 10.89a | 12.435a | 23.32a |
| Farmers' practice (high input) | 558.53 b | 492.61 b | 65.39 a | 21.05c | 106.6b | 23.56b | 21.09b | 6.17c | 7.927c | 14.09c |
| Farmers' practice (medium input) | 549.83 b | 504.19 b | 45.25 c | 21.71a | 121.9b | 20.23a | 20.51b | 6.88b | 8.960c | 15.84b |
| Farmers' practice (low input) | 541.52 b | 499.44 b | 39.08 b | 20.91 | 117.3c | 18.93c | 20.76b | 6.39bc | 8.125b | 14.51c |
| $LSD_{(0.05)}$ | 36.85 | 36.65 | 6.78 | 0.501 | 5.13 | 1.33 | 1.18 | 1.09 | 0.257 | 1.25 |
| CV (%) | 4.04 | 4.34 | 9.79 | 1.49 | 3.02 | 4.79 | 3.54 | 6.96 | 2.56 | 5.06 |

Table 7. Cost of production of *boro* rice cv. BBRI dhan29 under TEGRA package of cultivation and farmers' practices

| Treatments | Total cost ($Tkha^{-1}$) | Gross return ($Tk\ ha^{-1}$) | Net return ($Tk\ ha^{-1}$) | Benefit Cost Ratio (BCR) |
|---|---|---|---|---|
| TEGRA method | 124198.5 | 275340 | 151141.5 | 2.20 |
| Farmers'practice (high input) | 133939.14 | 157764 | 23824.86 | 1.18 |
| Farmers' Practice (medium input) | 128283.63 | 176160 | 45635.75 | 1.37 |
| Farmers' practice (low input) | 121126.49 | 163220 | 42093.51 | 1.34 |

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