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# PERFORMANCE OF LENTIL VARIETIES UNDER RELAY AND MINIMUM TILLAGE CONDITIONS IN T.AMAN RICE

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## Abstract

A study on comparative productive efficiency and feasibility of lentil varieties both at relay and minimum tillage were conducted at the Regional Agricultural Research Station, BARI, Ishurdi, Pabna, Bangladesh during the *Rabi* season of 2007-08 and 2008-09. Three lentil varieties viz. BARI Masur-2, BARI Masur-3 and BARI Masur-4 and two sowing methods viz. relay sowing and furrow sowing (Minimum tillage) were compared. The highest seed yield (1.59 t/ha) was obtained from BARI Masur-4 because of highest number of pods/plant and plant population/$m^2$ while lowest from BARI Masur-2 (1.39 t/ha). The sowing methods had significant effect on the seed yield of lentil. Crops sown in furrows produced higher seed yield (1.60 t/ha) than that of crops in relay sowing. The interaction effect between varieties and sowing methods also had significant effect on the seed yield and yield attributes. The lentil variety BARI Masur-4 when grown in furrows gave the highest seed yield (1.70 t/ha). Though seed yield and gross return were highest in furrow sowing but highest benefit cost ratio (4.67) was found in relay sowing method.

Keywords: Lentil, relay, minimum tillage

## Introduction

Lentil is grown in many regions following the Transplant *Aman* rice crops in Bangladesh. Recently many high yielding varieties of T.Aman rice has been released but due to long duration variety of rice, it is difficult to cultivate lentil timely. Hence, lentil yields in the T.Aman rice area are much lower. On the other hand, delay sowing of lentil results in poor growth and ultimately lower yield (Anon., 1990). Thus, there is a need to develop a method, which would facilitate timely sowing of lentil in rice fields where T.Aman rice-lentil cropping system is followed. Delay sowing of lentil is one of the main constraints in harvesting good yield of the crop planted after rice (Mahmood *et al.*, 2003). Relay cropping technology (zero tillage) is one of the method where growing a crop few days before harvesting of another crop. In Bangladesh, many crops viz. lentil, grasspea, chickpea, field pea, mustard etc are relayed with T.Aman rice. This cropping is generally adopted in areas where T.Aman harvesting delayed and/or land remains moist which takes few to more days to become optimum condition

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for land preparation. Under this situation, farmers can grow the crop in optimum time by adopting relay cropping. Moreover, this practice makes the best use of the residual moisture of rice field. Relay cropping is beneficial in terms of utilize residual moisture from previous crop and reduced planting cost (Saleem *et al.*, 2000; Malik *et al.*, 2002; Jabbar *et al.*, 2005). Roysharma *et al.* (1984) reported from India that relay cropping of lentil produced 1.27 t/ha compared with 0.54 t/ha when planting was done after the rice harvest. They also said that after the harvest of rice, row planting was better than broadcast. Chakraborty *et al.* (1976) also reported high productivity of lentil (2.25 t/ha) under relay cropping with late Aman rice. Nazir *et al.* (1992) also reported that inter-relay cropping system is very effective technique for increasing production per unit area. The monocropping system of lentil decreased day by day due to increase of production area of staple food crop (rice) and other cereals crop like wheat and maize.

As such minimum tillage may also be adopted besides relay cropping. In this case, after harvest of T.Aman rice, furrows can be made between the rice rows and seeding could be done in the furrows. Joy *et al.* (1986) and Sharma *et al.* (1987) reported that legumes grown after rice at zero/minimum tillage are less affected by the compact puddled soil than the cereal crops probably due to their deep rooting system. Lentil genotypes show wide variation with respect to their productivity, stability and adaptability. However, performance of different lentil varieties needs to be evaluated for productive efficiency and economic feasibility under relay and minimum tillage condition.

## Materials and Method

The experiment was conducted at the Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during the rabi season of 2007-08 and 2008-09 to find out the comparative productive efficiency and feasibility of lentil varieties under relay and minimum tillage. The climate of the experimental site was subtropical in nature. The two years average total rainfall of 36.54 mm (about 53% of which falls in the last quarter of January), average minimum temperatures of 7–10 $^0$C, and average maximum temperatures of 28–31 $^0$C occurred during the growing periods (Fig.2). The experimental field was medium high and the soil was clay loam in texture having 7.50 $p^H$, 1.35% organic matter, 0.071% total nitrogen, 11µg/ml available phosphorus, 0.12 meq/100g soil available potassium, 15 µg/ml sulphur, 0.66 µg/ml boron and 2.0 µg/ml zinc. Which indicated that soil contain amount of total nitrogen, Phosphorus, potassium below the critical level (0.10 %, 14 µg/ml, 0.20 meq/100g); sulphur, boron above the critical level (14, 0.20 µg/ml) and zinc equal to critical level (2.0 µg/ml). The experiment was laid out in a split-plot design with three replications. Three lentil varieties viz. BARI Masur-2, BARI Masur-3 and BARI Masur-4 and

two sowing methods viz. relay sowing and seed sowing in furrows at 40 cm apart rows were included in the study. In varietal characteristics, BARI Masur-2 needs 105-110 days to mature and its 1000 seed weight is about 12.50 g (at 8.0% moisture content) having an average yield of 1.8-1.9 ton/ha. BARI Masur-3 requires 100-105 days to mature having 1000 seed weight about 23.80 g (at 8.0% moisture content) which seed yield ranged from 1.9-2.0 ton/ha. BARI Masur-4 takes 110-115 days to mature and its 1000 seed weight about 19.84 g (at 8.0% moisture content) as well as seed yield ranged from 1.9-2.0 ton/ha (Afzal *et al.*, 1999). The lentil varieties were assigned to the main-plot and the sowing methods in the sub-plot. The unit plot size was 6m x 5m. The crop was fertilized with 20-18-20 kg N- P - K/ha (BARI, 2011). In case of relay sowing, the fertilizer was broadcast in the standing T. Aman crop just before relay sowing of seeds. Seed and fertilizer were placed in the same furrow in case of furrow sown crop. The seeds of lentil were broadcast in a standing rice crop after the excess water drained out i.e., 10 days before the rice harvest. The seed rate of BARI Masur-2 and BARI Masur-4 were used @ 40 and 35 kg/ha, respectively in relay and furrow method. In case of BARI Masur-3, 45 and 40 kg seed/ha were used in relay and furrow method, respectively. T.Aman rice was harvested at a height of straw 30 cm. The crop was sown on 31 October 2007 and 1 November 2008, respectively in case of relay sowing while in case of crop sown in furrows on 9 and 10 November 2007 and 2008, respectively. The crop was harvested in between 15-20 February in both the years, respectively. The changes of soil moisture level at different days after emergence is depicted in Fig. 1. Soil sample was collected from 0-30 cm depth and moisture content was calculated by oven dry method. Data on yield and yield components were recorded, statistically analyzed and mean values were adjudged by LSD test at 0.05 levels of probability.

## Results and Discussion

The result obtained from the two consecutive years was almost similar in yield and yield attributes and therefore pooled analysis was done.

### Effect of variety

The yield and yield contributing characters influenced by different lentil varieties are presented in Table 1. Plant population was insignificant among the lentil varieties. The plant height was significantly influenced by the different varieties where maximum plant height (30.93cm) was obtained from BARI Masur-4 followed by BARI Masur-3. Similar trend was also followed in case of seeds/pod and pods/plant. The highest 1000-seed weight was obtained from BARI Masur-3 (21.24g) while BARI Masur-2 gave the lowest (16.10g). The highest 1000-seed weight occurred in BARI Masur-3 due to bolder seed size as compared to others.

Weight of 1000-seed of BARI Masur-3 was 31.92% higher than BARI Masur-2 and 8.42% higher than BARI Masur-4. The maximum seed yield was obtained from BARI Masur-4 (1.59 t/ha) due to higher pods/plant and seeds/pod while lowest yield attributes resulted lower seed yield in BARI Masur-2.

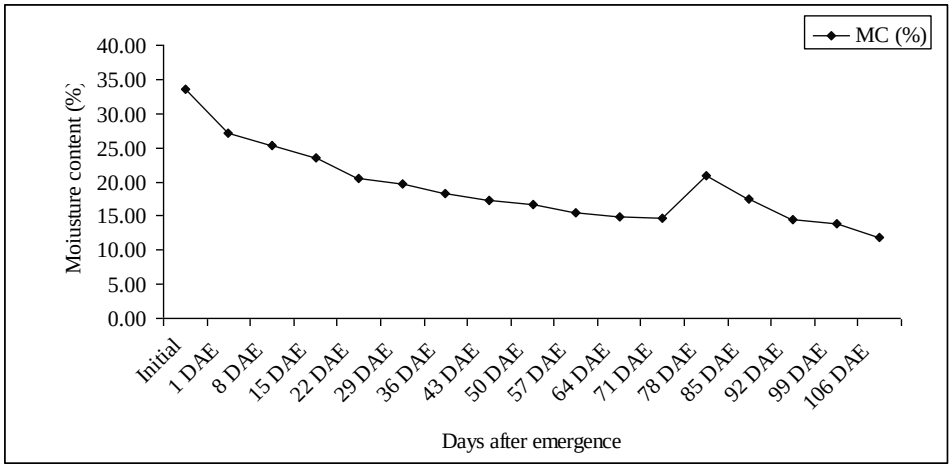


**Fig.1. Changes of soil moisture level (seven days interval) at different days after emergence during the growing period of lentil.**

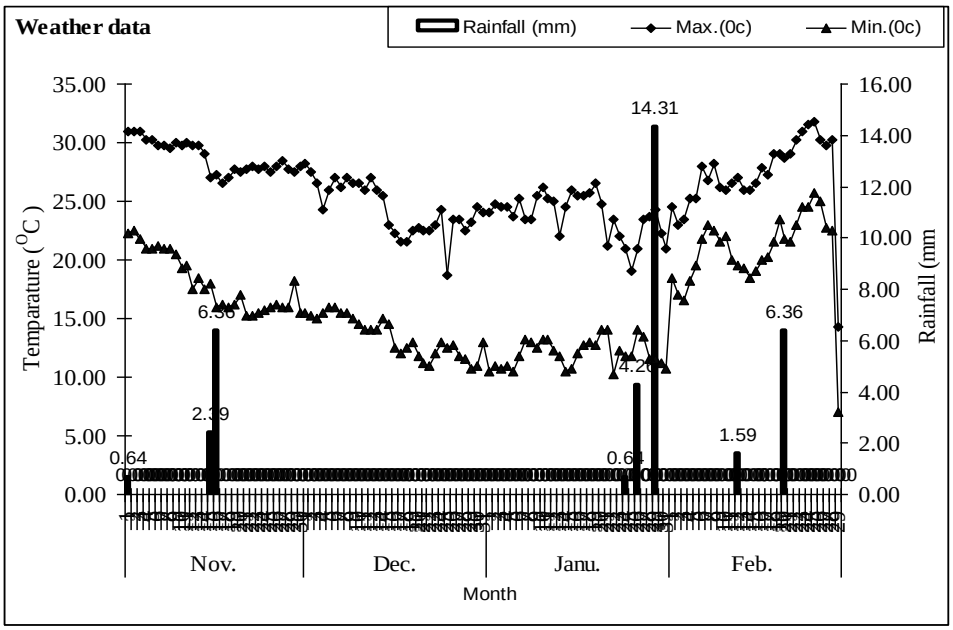


**Fig. 2. Two years prevailing mean maximum and minimum temperature and rainfall during the growing period of lentil (Source: BSRI).**

### Effect of sowing method

Sowing methods showed significant variations in different crop characters (Table 2). The maximum plant population (276/$m^2$) was recorded in crop sown in furrows while lowest in relay sowing method (268/$m^2$). It might be due to the damage of seeds in relay sowing method by insect and birds in the field before germination. On the contrary, the highest plant population was found in furrow sowing method because the seeds were covered by soil that ensures maximum germination of seeds. Plant height was significantly influenced by sowing method while highest plant height (31.34cm) was obtained from furrow sowing method. Similar trend were also observed in case of number of primary branches/plant (4.11), number of pods/plant (26.40), number of seeds/pod (1.89) and 1000-seed weight (19.38g). Seed yield was significantly affected by sowing method (Table 2). Furrow sowing method gave higher seed yield (1.60 t/ha) than that of relay sowing (1.37 t/ha). Seed yield benefits on an average was 17% higher in furrow sowing (Minimum tillage) than relay sowing. Furrow sowing method resulted higher seed yield due to higher yield attributes and plants/$m^2$.

**Table 1. Varietal performance of lentil on the seed yield and yield components (Pooled, 2007-2008 and 2008-09).**

| Treatments | Plant population /m $^2$ | Plant height (cm) | No. of primary branches / plant | No. of pods / plant | Number of seeds/pod | 1000- seed weight (at 9% MC) (g | Seed yield (t/ha) |
|---|---|---|---|---|---|---|---|
| BARI Masur-2 | 268 | 29.14 | 3.52 | 23.42 | 1.74 | 16.10 | 1.39 |
| BARI Masur-3 | 274 | 30.23 | 3.48 | 24.82 | 1.83 | 21.24 | 1.47 |
| BARI Masur-4 | 275 | 30.93 | 4.07 | 25.07 | 1.91 | 19.59 | 1.59 |
| LSD(0.05) | NS | 0.75 | 0.17 | 0.28 | 0.11 | 0.69 | 0.52 |
| CV (%) | 1.26 | 2.64 | 4.77 | 1.21 | 6.24 | 3.91 | 3.68 |

**Table 2. Effect of sowing methods on the seed yield and yield components of lentil (Pooled, 2007-2008 and 2008-09).**

| Sowing methods | Plant population /m $^2$ | Plant height (cm) | No. of primary branches / plant | No. of pods / plant | Number of seeds/pod | 1000-seed weight (at 9% MC) (g) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Relay sowing | 268 | 28.86 | 3.28 | 22.47 | 1.77 | 18.57 | 1.37 |
| Furrow sowing | 276 | 31.34 | 4.11 | 26.40 | 1.89 | 19.38 | 1.60 |
| LSD(0.05) | NS | 0.83 | 0.25 | 1.11 | 0.07 | 0.48 | 0.15 |
| CV (%) | 2.65 | 2.29 | 5.67 | 3.79 | 5.24 | 2.10 | 8.60 |

## Combined effect

The interaction effect between variety and sowing method was also found significant on all the characters under the study (Table 3). It was observed that furrow sowing method produced better results compared to relay sowing method in all the yield parameters. The highest seed yield (1.70 t/ha) was recorded from BARI Masur-4 when sown in furrows, which was similar to BARI Masur-3 at same method of sowing. The highest plant population/$m^2$, plant height, number of primary branches/plant, number of pods/plant and 1000-seed weight were contributed highest seed yield in these treatment combination. The lowest seed yield (1.29 t/ha) was found in BARI Masur-2 in relay sowing. Relay sowing method failed to show higher seed yield than furrow sowing.

**Table 3. Combined effects of varieties and sowing methods on the seed yield and yield components of lentil (Pooled, 2007-2008 and 2008-09).**

| Interaction (varieties × sowing methods) | Plant population /$m^2$ | Plant height (cm) | No. of primary branches / plant | No. of pods/ plant | Number of seeds/pod | 1000- seed weight (at 9% MC) (g) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|---|
| $V_1$ × R | 264 | 28.23 | 3.172 | 21.57 | 1.67 | 15.51 | 1.29 |
| $V_1$ × F | 271 | 30.05 | 3.870 | 25.27 | 1.82 | 16.68 | 1.50 |
| $V_2$ × R | 269 | 29.45 | 2.983 | 22.77 | 1.78 | 20.69 | 1.34 |
| $V_2$ × F | 278 | 31.04 | 3.977 | 26.87 | 1.89 | 21.78 | 1.60 |
| $V_3$ × R | 270 | 28.93 | 3.670 | 23.07 | 1.86 | 19.51 | 1.49 |
| $V_3$ × F | 279 | 32.93 | 4.475 | 27.07 | 1.97 | 19.68 | 1.70 |
| LSD(0.05) | 9.07 | 0.87 | 0.26 | 1.17 | 0.11 | 0.50 | 0.16 |
| CV (%) | 2.65 | 2.29 | 5.67 | 3.79 | 5.24 | 2.10 | 8.60 |

$V_1$ = BARI Masur-2, $V_2$ = BARI Masur-3, $V_3$ = BARI Masur-4, R= Relay sowing, F = Furrow sowing and MC = Moisture content.

## Soil moisture level

It is clear evident from the Fig.1 that trend of soil moisture level gradually decreased with time. Effective rainfall occurred between 71 to 78 days after emergence which lead rising soil moisture at 78 days after emergence. This curve also showed that crop take essential moisture from the soil and need no irrigation water supply for crop growth and development.

## Cost benefit analysis

In the present study relay cropping system generated substantial higher benefit than furrow sowing method. The highest seed yield (1.70 t/ha), gross return (Tk.

85000/ha) and gross margin (Tk. 61240/ha) was recorded in furrow sowing method but highest cost of cultivation was involved in furrow sowing. As a result, higher BCR was recorded from BARI Masur-4 in relay cropping. But cultivation of lentil in relay sowing was profitable as reported by Jabbar *et al.* (2005) who reported that rice/legumes relay cropping system such as rice/chickpea and rice/lentil proved to be more productive and economically viable.

**Table 4. Cost and benefit analysis of lentil varieties under relay and furrow sowing (minimum tillage) condition (average of two years ).**

| Treatments | Gross return (Tk./ha) | Total cost (Tk./ha) | Gross margin (Tk./ha) | BCR |
|---|---|---|---|---|
| $V_1 \times R$ | 64500 | 15960 | 48540 | 4.04 |
| $V_1 \times F$ | 75000 | 23760 | 51240 | 3.16 |
| $V_2 \times R$ | 67000 | 15960 | 51040 | 4.20 |
| $V_2 \times F$ | 80000 | 23760 | 56240 | 3.37 |
| $V_3 \times R$ | 74500 | 15960 | 58540 | 4.67 |
| $V_3 \times F$ | 85000 | 23760 | 61240 | 3.58 |

$V_1$= BARI Masur-2, $V_2$ = BARI Masur-3, $V_3$ = BARI Masur-4, R= Relay sowing and F = Furrow sowing

Market price:

Lentil seed: TK 50/kg

## Conclusion

Furrow sowing method was found superior to relay cropping in terms of highest seed yield of lentil but due to higher cost was involved in this system. As a result, relay cropping was found better benefit than furrow method of sowing. This technology could be demonstrated to resource poor farmers who have limited fund to grow lentil.

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