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RESEARCH PAPER

Yield Response and Economic Benefits of Mungbean and Soybean under Strip Tillage in Patuakhali District of Bangladesh

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ABSTRACT

The efficiency of cropping systems is typically low in coastal areas, with tidal non-saline ecosystems being mostly affected. The objective of this study is to evaluate the effect of strip tillage on the agronomic performance and profitable return of mungbean and soybean cultivation. From February to May 2017, the experiment was conducted in four farmers' fields at Jalisha village in Dhumki upazilla of Patuakhali district to investigate how strip tillage influences the yield and economic performance of mungbean and soybean in a post-tide ecosystem. The experiment comprised of two tillage methods viz. conventional tillage and strip tillage and two dry season crops viz. mungbean and soybean. The experiment was laid out in a split plot design with 4 replications. Results showed that tillage method significantly influenced the yield of mungbean and soybean. Strip tillage performed better in respect of seed yield of both mungbean and soybean as compared to conventional tillage due to higher moisture content taken during the experimental period. The highest plant height at harvest (29.08 cm), plant population per meter row (11.58), number of branches/plant (2.65), pods/plant (11.11), pod length (6.60 cm), number of seeds/pod (7.97), seed yield (1.04 t/ha), Stover yield (1.22 t/ha) were recorded from strip tillage. Soybean produced the maximum values for plant height (30.54 cm), number of plants per meter of row (12.0), pods per plant (15.81), 100-seed weight (7.53 g), seed yield (1.11 t/ha), and stover yield (1.55 t/ha). Mungbean after Lalmota dhan produced the highest number of branches/plant (2.36). The highest pod length (7.75 cm) was produced by mungbean after BRRI dhan77. Interaction effect showed that plant height (33.18 cm), plant population per meter row (12.75), number of pod/plant (16.40), 100-seed weight (7.69 g), seed yield (1.21 t/ha) and stover yield (1.64 t/ha) were found highest from strip tillage with soybean. The highest gross return (Tk. 100080 ha^{-1}), net return (Tk. 67930 ha^{-1}) and BCR (3.21) were obtained from soybean with strip tillage. So, soybean under strip tillage was the best treatment combination in respect of yield and economic performance under post-tide ecosystem. The findings recommend that adopting strip tillage can expand both the yield performance and economic returns of mungbean and soybean, making it a promising practice for sustainable pulse production.

Keywords: Strip tillage, Economic performance, Mungbean, Soybean, Post-tide ecosystem

Introduction

Coastal zones (CZs) represent dynamic transitional regions where terrestrial and marine environments converge, making unique ecological, social, and economic systems designed by the constant interaction between land and sea. Coastal and offshore areas in Bangladesh cover about 2.85 million hectares which is more than 30% of the net cultivable area of the country (Karim et al., 1990). The present land use in the coastal area of Bangladesh consists mainly of growing one wet season rice and occasionally in some places Rabi crops. The land usually remains fallow during the dry season (January-May) in the non-saline ecosystem due to

delayed drainage of T. Aman rice field. Recent analysis (BARC, 2008) shows that 34% of arable land remains fallow during Rabi season. In the coastal region, heavy rainfall and high tide cause delay transplanting and delay harvest of T. Aman rice resulting delay sowing of Rabi crops. Delayed Rabi crops are subjected to heavy rainfall and tidal flood during the later period of their life span causing lower yields and sometimes total failure of crops. Soybean and mungbean can be grown as late planted Rabi crops as because they grow well in warm climate. Moreover, soybean is superior to mungbean in flood tolerance (Poehlman, 1991).

The surface soils dry out quickly in the dry season during land preparation due to heavy consistency of soil and causes germination failure of seeds in many cases. These necessitate minimum tillage rather than conventional tillage to minimize moisture loss. On the other hand, strip tillage is a modified form of minimum tillage. It is a conservation option and involves tillage of a targeted area (not more than 30% of the soil surface), whilst leaving crop residues on the surface, retaining moisture, organic matter and vastly increasing worm activity and fertility (Wolkowski et al., 2009). Strip tillage is done by a power tiller operated seeder (PTOS). It ensures proper placement, right amount and distribution of seeds and fertilizers into soil necessary for good germination and crop establishment for better crop yields. Hossain et al. (2014) reported that strip tillage system remains crop residue on the soil surface helps to preserve moisture and resist growing weeds especially in rainfed moisture stress environment. Onyari et al., 2010, Jahiruddin et al., 2014 and Islam et al., 2017 stated that tillage yielded as good as the high tillage. Mohammad et al. (2010) suggested that crop productivity, biological nitrogen fixation and water use efficiency in the rainfed environment can be improved with minimum tillage and crop residue retention. Farmers of Bangladesh are becoming more dependent on mechanical power. Now a day's power tillers are available and used all over the country.

The objective of this study is to assess how strip tillage influences the agronomic performance and profitability of mungbean and soybean production. The turn-around time between T. Aman rice harvest and Rabi crop seeding is very narrow. After harvesting of T. Aman rice, farmers do not have enough time for land preparation with current conventional tillage practices and it resulted in delayed Rabi crop sowing and high risk of soil moisture losses. Therefore, strip tillage being a quick and conservation technique may be a good technology for sustainable intensive farming in coastal Bangladesh.

Materials and Method

Study Area: The experiment was shown at Jalisha village in the central part of Dumki upazila, Patuakhali district (22°27.816' N, 90°23.218' E; 3 m above sea level). The site characterizes a tidal, non-saline coastal ecosystem within the Ganges Tidal Floodplain (AEZ-13), considered by non-calcareous clay soils formed from river borne silt deposits, (UNDP and FAO, 1988). The experimental field was medium-high land with poor drainage. The soil was clay loam with pH 6.2, organic matter 1.65%, EC 1.38 dS/m, total N 0.09%, available P 2.6 ppm, available K 0.24 me/100 g, available S 35 ppm, and available Zn 1.01 ppm. The area has a subtropical climate, presenting high temperatures and heavy rainfall during the Kharif season (April–September) and low rainfall with cooler temperatures in the Rabi season (October–March).

Planting materials: Soybean (Sohag PB1) and BARI mung-6 were used for this experiment. These are the most popular variety of the locality.

Sohag (PB-1)

Sohag (PB-1) was released in 1991. It has good capability to preserve viability. Plant height of this variety is 20-35 cm and protein content are 40-50%. Oil content is 21-22%. This variety is resistant to yellow mosaic virus.

BARI Mung-6

It was developed by Bangladesh Agriculture Research Institute (BARI), Gazipur, Bangladesh and released in 2003. Main characteristics include plant height 40-45 cm, photo insensitive and can be grown in Kharif-I, Kharif-II and late Rabi.

Land preparation: T. Aman rice was the preceding crop in the experimental field. After harvest, 15–20 cm of stubble was reserved for strip tillage, which was done using a power tiller operated seeder (PTOS). In the conventional tillage system, land was set with a power tiller, using three passes for line sowing and two passes for broadcasting, consistent with local farmers' practices.

Experimental treatments:

Factor A. Tillage Methods: Two tillage methods were tested: Conventional tillage and Strip tillage.

Factor B. Rabi crops: Two crops: Mungbean and Soybean

Mungbean (BARI mung-6) after BRRI dhan77, Mungbean (BARI mung-6) after Lalmota dhan and Soybean (sohag) after BRRI dhan77.

Replication: 4

Experimental design and layout: The experiment was laid out following split plot design with four replications. Tillage method of Rabi crops was assigned in the main plot and crop in the sub-plot. Four farmers were selected on the basis of base line survey and in consultation with DAE personnel's for conducting the experiment. Each farmer having medium high land was treated as one replication. There were 40-unit plots of same size (12 m × 2.5 m). Sub-plot to sub-plot distance was 0.50 m. The main plot to main plot distance was wide enough (2.0 m) to enable turning of power tiller.

Data collection

Soil moisture: Soil moisture was determined using a digital soil moisture meter (Model: PMS-714) in the experimental field of *Rabi* crops at 15 days interval during the experimental period. Readings were taken on three spots in each plot at 15 cm depth.

Plant population: Plant population per meter row was counted at maturity stage of each crop.

Plant height: The plant height was measured from the ground level to the highest tip of the stem for the five sampled plants. This was done with the use of a meter rule at the various sampling periods and at harvest maturity. The average plant height was calculated for each treatment.

Number of pods per plant: For pod number, five plants were taken from each plot excepting the harvest area and all the pods were plucked. These were then counted manually and the average pod number was calculated.

Number of seeds per pod: The number of seeds per pod was also determined by taking five random plants from the harvested plants. Pods were shelled and seeds were counted and then the average was calculated.

Seed yield (t ha^{-1}): The seeds collected from 10 m^2 of each plot was sun dried properly. The weight of seeds was taken and converted the yield in t ha$^{-1.}$

Stover yield (t ha^{-1}): After threshing of harvested plants remaining Stover weight was taken and converted to yield in t ha^{-1}.

Economic analysis: The economic analysis for each crop considered total variable cost, gross return, net return, and the benefit–cost ratio. Input expenses were determined using prevailing local market prices, and returns were calculated based on the market prices of the harvested crops.

Data analysis

All data were statistically analyzed through analysis of variance (ANOVA) using the MSTAT-C software. Mean comparisons were carried out with Duncan's Multiple Range Test, following the procedure outlined by Gomez and Gomez (1984), at significance levels of 5% and 1%.

Results and Discussion

Soil moisture variation under different tillage methods: The data showed that the soil moisture at different days after sowing that strip tillage always maintained higher soil moisture after seeding under strip tillage method compared to conventional tillage. The maximum soil moisture content (45.58%) at 15 cm soil depth was observed at 30 days after sowing under strip tillage technique as against 38.63 % under conventional tillage. Hossain et al. (2014) also observed that the higher soil moisture was maintained at 35 days after seeding under strip tillage than full tillage treatments.

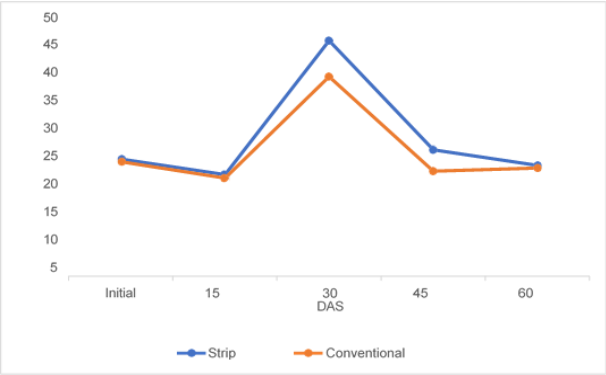

Figure 1. Soil moisture (%) at different days after seeding (DAS)

Effect of crop on plant height: Significant variations of plant height among the crops were found at harvest. Results revealed that the tallest plant (30.54 cm) was obtained from soybean and the shortest one (26.2 cm) from mungbean after Lalmota dhan (Fig 2). The variation in plant height was due to different plant species and variation in growth behavior. Variation in plant height might be attributed to the genetic characters which was also stated by Farghali and Hossein (1995).

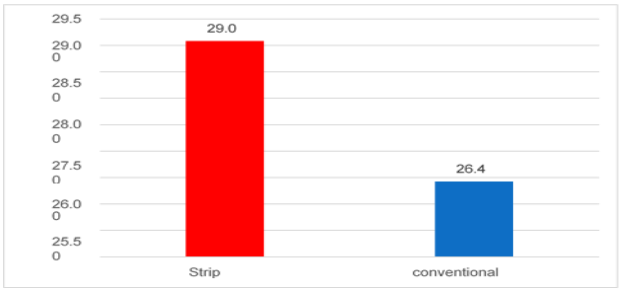

Figure 2. Effect of tillage on plant height

Interaction effect of tillage and crop on plant height: The effect of interaction between tillage and crop on plant height was not significant (Fig 3). However, numerically the longest plant height (33.18 cm) was obtained from strip tillage with soybean. Whereas the shortest (25.13 cm) was obtained from mungbean after Lalmota dhan with conventional tillage.

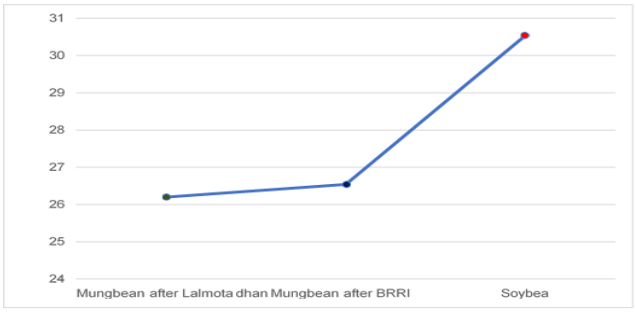

Figure. 3. Interaction effect of crop on plant height

Effect of tillage on plant population: The plant population was not-significantly affected by different tillage methods (Table 1). Numerically the plant population per meter row was highest (11.58) in strip tillage and the lowest plant population per meter row (10.75) was found in conventional tillage. Similar result was found by Hossain et al. (2014) who recorded the highest number of plant population (30.00) m^{-2} in strip tillage and the lowest (23.00) m^{-2} plant population was found in conventional tillage. After strip tillage seed-soil contact was increased because seeds are completely covered by soil. Similar depth and regular distance may create this type of result.

Effect of crop on plant population: The plant population was significantly affected by different crops (Table 2). The highest number of plant population (12.00) per meter row was recorded from soybean and the lowest number of plant population (10.75) was obtained from mungbean after BRRI dhan77.

***Interaction effect of tillage and crop on plant population*:** Interaction effect of tillage and crop had no significant influence on the plant population (Table 3). Numerically the highest plant population (12.75) per meter row was obtained from the treatment combination of strip tillage with soybean. The lowest (10.45) was from the treatment combination of conventional tillage with mungbean after BRRI dhan77. Hossain *et al.* (2014) similarly recorded higher plant population (m^{-2}) of wheat, lentil and mungbean in strip tillage than conventional tillage.

Table 1. Effect of tillage on plant population and number of branches $plant^{-1}$

Tillage	Plant population per meter row	Number of branches $plant^{-1}$
Strip	11.58	2.65 a
Conventional	10.75	1.94 b
Sẋ	0.3535	0.1004
Level of significance	NS	**
CV (%)	36.65	22.95

*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Non-significant

Table 2. Effect of crop on plant population and number of branches $plant^{-1}$

Crop	Plant population per meter row	Number of branches $plant^{-1}$
Mungbean after Lalmota dhan	10.76 b	2.36
Mungbean after BRRI dhan77	10.75 b	2.23
Soybean	12.00 a	2.25
Sẋ	0.3317	0.2121
Level of significance	*	NS
CV (%)	5.32	7.09

*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Non-significant

Table 3. Interaction effect of tillage and crop on plant population and number of branches $plant^{-1}$

Tillage	Crop	Plant population per meter row	Number of branches $plant^{-1}$
Strip	Mungbean after Lalmota dhan	11.00	2.83 a
	Mungbean after BRRI dhan77	11.00	2.44 abc
	Soybean	12.75	2.70 ab
Conventional	Mungbean after Lalmota dhan	10.50	1.90 c
	Mungbean after BRRI dhan77	10.45	2.18 bc
	Soybean	11.25	1.80 c
Sẋ		0.5204	0.2193
Level of significance		NS	*
CV (%)		5.32	7.09

*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS= Non-significan

Table 4. Effect of tillage on number of pod $plant^{-1}$ and length of pod

Tillage	Number of pod $plant^{-1}$	Length of pod (cm)
Strip	11.11	6.60
conventional	10.21	6.05
Sẋ	0.49	0.18
Level of significance	NS	NS
CV (%)	52.07	25.27

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Effect of tillage on number of pod plant^{-1} Number of pod plant^{-1} was not-significantly affected by tillage. Because no. of pod/plant is mainly dependenton plant genetics and other agronomic and natural factors such as irrigation, planting time, solar radiation etc. Production of pods plant^{-1} was higher (11.11) in strip tillage and conventional tillage produced lower number (10.21) of pods plant^{-1} (Table 4).

Effect of crops on number of pod plant^{-1} Number of pod plant^{-1} was significantly affected by crop. The highest number of pods (15.81cropssant^{-1} was produced by soybean (Table 4 & 5). The lowest number of pods (8.05) plant^{-1} was produced by mungbean after Lalmota dhan. This might be due to differences in genetical characters. Also use efficiency of nutrients in soil and environmental favorable conditions may help soybean to produce more pod than mungbean.

Interaction effect of tillage and crop on number of pod plant^{-1} Number of pod plant^{-1} was not significantly affected by the interaction effect of tillage and crop (Table 5). Numerically the highest number of pod plant^{-1} (16.40) was produced by treatment combination of strip tillage with soybean. The lowest (7.50) was from the treatment combination of conventional tillage with mungbean after Lalmota dhan. Rahman *et al. (*2016) reported similar result who stated that the highest number of pod plant^{-1} (35.20) was produced by strip tillage with BINA mung-8. The lowest number of pod plant^{-1} (34.53) was produced by strip tillage with BARI mungbean-6.

Table 5. Effect of crop on number of pod plant^{-1} and length of pod

Crop	Number of pod plant^{-1}	Length of pod (cm)
Mungbean after Lalmota dhan	8.05 b	7.52 a
Mungbean after BRRI dhan77	8.11 b	7.75 a
Soybean	15.81 a	3.71 b
Sẋ	0.632	0.1323
Level of significance	**	**
CV (%)	16.76	5.93

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Table 6. Effect of tillage on seed pod^{-1} and 100 seed weight

Tillage	Seed pod^{-1}	100 seed weight (gm)
Strip	7.97	6.36 a
Conventional	7.73	6.12 b
Sẋ	0.764	0.052
Level of significance	NS	*
CV (%)	9.44	7.27

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Table 7 Effect of crop on seed pod^{-1} and 100 seed weight

Crop	Seed pod^{-1}	100 seed weight (gm)
Mungbean after Lalmota dhan	10.47 b	5.63 b
Mungbean after BRRI dhan77	10.56 a	5.56 b
Soybean	2.50 c	7.52 a
Sẋ	0.1541	0.1936
Level of significance	**	**
CV (%)	5.56	4.23

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Effect of tillage on Seed pod^{-1} Tillage method did not-significantly affect the seeds pod^{-1}. Numerically strip tillage produced 7.97 seeds pod^{-1} while conventional tillage produced 7.73 seeds pod-1 (Table 6).

Effect of crop on Seed pod^{-1} Production of seeds pod^{-1} varied significantly among different crops. The highest number of seeds pod^{-1} (10.56) was produced by mungbean after BRRI dhan77 (Table 7), while lowest (2.50) number of seeds pod^{-1} was obtained from soybean.

Interaction effect of tillage and crop on seed pod^{-1} Number of seeds pod^{-1} was not significantly affected by interaction effect of tillage and crop (Table 8). The

highest seeds pod^{-1} (10.87) was found from the treatment combination of strip tillage with mungbean after Lalmota dhan. The lowest number of seeds pod^{-1} (2.50) was from the treatment combination of conventional tillage with soybean.

Effect of tillage on seed yield: Tillage exerted significant effect on seed yield (Table 9). Higher seed yield (1.04 t ha^{-1}) was obtained from strip tillage, while conventional tillage recorded lower seed yield (0.88 t ha^{-1}). Higher seed yield from strip tillage might be due to higher conservation of soil moisture (as conventional tillage soil remains loose but strip tillage soil remains compact) in strip tillage which led to produce higher plant height, number of pod plant^{-1}, pod length, number of seeds pod^{-1} and 100-seed weight. Luna and Staben (2002) identified that average sweet corn yield was higher (8.9 ton/acre) from strip-till fields than from conventional tillage.

***Effect of crop on seed yield*:** The results of statistical analysis indicated that seed yield was significantly affected by crop spp. Table 10). The highest grain yield (1.11 t ha^{-1}) was produced from soybean, whereas the lowest seed yield (0.86 t ha^{-1}) was recorded from mungbean after Lalmota dhan. The yield of soybean is higher than mungbean due to crop of different genus. Soybean had higher plant height, number of pod plant^{-1} and higher 100-seed weight than mungbean.

The University of Minnesota Extension conducted a research in southern Minnesota comparing soybean yields in a rotation following strip-tilled corn in chisel-plowed, no-till and strip-till fields (DeJong and Vetch, 2007). The yields in 2006 and 2008 were similar, reflecting soybean versatility in various tillage systems.

The average yield of mungbean and soybean was low. This was due to the fact that the crop field was flooded at fruiting stage and lasted for 12 days. Flooding seriously affected the crops and caused drastic reduction in yield.

Table 8. Interaction effect of tillage and crop on seed pod^{-1} and 100 seed weight

Tillage	Crop	Seed pod^{-1}	100 seed weight (gm)
Strip	Mungbean after Lalmota dhan	10.87	5.95 b
	Mungbean after BRRI dhan77	10.52	5.44 b
	Soybean	2.50	7.69 a
Conventional	Mungbeanafter Lal mota dhan	10.07	5.31 b
	Mungbean after BRRI dhan77	10.60	5.67 b
	Soybean	2.50	7.35 a
Sẋ		0.2182	0.1943
Level of significance		NS	*
CV (%)		5.56	4.23

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significan

Table 9. Effect of Tillage on grain yield and stover yield

Tillage	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Strip	1.04 a	1.22 a
Conventional	0.88 b	1.06 b
Sẋ	0.0158	0.913
Level of significance	**	**
CV (%)	5.58	2.93

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Table 10. Effect of crop on grain yield and stover yield

Crop	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Mungbean after Lalmota dhan	0.86 c	0.93 b
Mungbean after BRRI dhan77	0.92 b	0.96 b
Soybean	1.11 a	1.55 a
Sẋ	0.0158	0.0158
Level of significance	**	**
CV (%)	4.31	3.72

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Effect of tillage on stover yield: There was a significant effect of tillage on stover yield as observed in seed yield (Table 9). Higher (1.22 t ha^{-1}) stover yield was recorded from strip tillage and lower (1.06 t ha^{-1}) stover yield was recorded from conventional tillage. Higher stover yield produced from strip tillage might be due to higher in plant population and vegetative growth.

Effect of crop on stover yield: The crop had significant effect on stover yield (Table 10). Maximum stover yield (1.55 t ha^{-1}) was obtained from soybean. The lowest (0.93 t ha^{-1}) stover yield was recorded from mungbean after Lalmota dhan. The highest stover yield produced from soybean might be due to higher in plant height and vegetative growth.

***Interaction effect of tillage and crop on seed yield*:** The interaction effect of tillage and crop had significant effect on seed yield (Table 11). The performance of strip tillage with soybean was found superior to other treatment combinations, which produced the highest seed yield (1.21 t ha^{-1}) and the lowest seed yield (0.75 t ha^{-1}) was recorded from conventional tillage with mungbean after Lalmota dhan.

NDSU research during 2005-10 indicated that soybean yields of 2 bushels more per acre was with strip till compared with conventional till or no till (Endres *et al.*, 2010). Hossain *et al.* (2014) similarly recorded higher grain yield of wheat, lentil and mungbean in strip tillage whereas the lowest grain yield of wheat, lentil and mungbean was in conventional tillage. Rahman *et al. (*2016) found the highest seed yield (888.17 kg/ha) from BINA mung-5 and BARI mungbean-6 under strip tillage and the lowest seed yield (429.8 kg/ha) from BINA mung-8 under strip tillage.

Table 11. Interaction effect of tillage and crop on grain yield and stover yield

Tillage	Crop	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Strip	Mungbean after Lalmota dhan	0.97 b	1.04 c
	Mungbean after BRRI dhan77	0.95 b	0.99 c
	Soybean	1.21 a	1.64 a
Conventional	Mungbean after Lalmota dhan	0.75 d	0.81 e
	Mungbean after BRRI dhan77	0.88 c	0.92 d
	Soybean	1.01 b	1.46 b
Sẋ		0.02236	0.02236
Level of significance		**	**
CV (%)		4.31	3.72

*= Significant at 5% level of probability, **= Significant at 1% level of probability and NS= Non-significant

Table 12. Economic performance of different crops

Sl. No.	Crops	Tillage and sowing method	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Net benefits (Tk. ha^{-1})	BCR
1	Mungbeen after Lalmota dhan	Strip tillage and line sowing	0.97	1.04	79482	34090	45392	2.40
2	Mungbeen after Lalmota dhan	Conventional tillage and broadcasting	0.75	0.81	61620	30385	31235	2.02
3	soybean after BRRI dhan77	Strip tillage and line sowing	1.21	1.64	100080	32150	67930	3.11
4	soybean after BRRI dhan77	Conventional tillage and line sowing	1.01	1.46	83720	55400	28320	1.51
5	Mungbeen after BRRI dhan77	Strip tillage and line sowing	0.95	0.99	77980	33090	44890	2.35
6	Mungbeen after BRRI dhan77	Conventional tillage and broadcasting	0.88	0.92	72240	46340	25900	1.55

TVC= Total variable cost; Price of mungbean and soybean seed: Tk 80.00 kg^{-1} ; Price pulse straw: Tk.2.00 kg^{-1}

***Interaction effect of tillage and crop on stover* yield:** The interaction of tillage and crop had significant effect on stover yield (Table 11). The highest stover yield (1.64 t ha^{-1}) was found from strip tillage with soybean. The lowest stover yield (0.81 t ha^{-1}) was recorded from conventional tillage with mungbean after Lalmota dhan. Similarly, Rahman *et al. (*2016) found the highest stover yield (1874.25 kg/ha) from BINA mung-5 under strip tillage and the lowest stover yield (890.55 kg/ha) from BINA mung -8 (890.55 kg/ha) and BRRI mungbean-6 (1026 kg/ha) under strip tillage.

Economic performance

Analysis of cost and return revealed that the highest gross return (Tk. 100080 ha^{-1}), net return (Tk. 67930 ha^{-1}) and BCR (3.21) were obtained from soybean with strip tillage due to higher production of seed and stover by soybean with strip tillage method (Table 12). The lowest gross return (Tk. 61620 ha^{-1}) was obtained from mungbeen after Lalmota dhan with conventional tillage. The lowest net return (Tk. 25900 ha^{-1}) was obtained from mungbeen after BRRI dhan77 with conventional tillage and the lowest BCR (1.51) from soybean after BRRI dhan77 with conventional tillage. Hossain *et al.* (2014) reported that the strip tillage achieved higher grain yield in wheat, lentil and mungbean with a net saving in cost of sowing BDT 3050/- ha^{-1} than conventional tillage. The results revealed that in general, strip tillage contributed more than conventional tillage.

Conclusion and Recommendation

The experiment comprised of two types of tillage and two *Rabi* crops. Two types of tillage viz. strip tillage and conventional tillage were considered as factor A, while two crops mungbean after Lalmota dhan, mungbean after BRRI dhan77 and soybean after BRRI dhan77 were considered as factor B. Thus, there were altogether six treatment combinations. The two- factor experiment was laid out in a split plot design with four replications, where two types of tillage were assigned in main plot and crops were assigned as sub-plot treatment. The data on yield parameters like plant population, number of pod plant^{-1}, length of pod (cm), seeds pod-^{1}, grain yield (t ha^{-1}) and stover yield (t ha^{-1}) were recorded. The recorded data were statistically analyzed using 'Analysis of variance technique' with the help of MSTAT-C computer program and the mean differences were compared by Duncan's Multiple Range Test at 1% and 5% level of significance (Gomez and Gomez, 1984). Tillage had significant effect on yield and yield contributing characters of *Rabi* crops. Plant population (11.58 m^{-1} row), pods plant^{-1} (11.11), number of seeds pod^{-1} (7.97), grain yield (1.04 t ha^{-1}) and stover yield (1.22 t ha^{-1}) were recorded from strip tillage. Crop had significant effect on growth and yield contributing characters. The number of plant per meter (12.0), number of pod (15.81) plant^{-1}, seed yield (1.11 t ha^{-1}) and stover yield (1.55 t ha^{-1}) were obtained from soybean after BRRI dhan77. Mungbean after Lalmota dhan produced the The highest number of seeds pod^{-1} (10.56) were produced by

mungbean after BRRI dhan77. Analysis of variance revealed that the interaction effect among tillage method and crop on different yield and yield contributing characters of *Rabi* crops were found statistically significant. The number of pod plant^{-1} (16.40), seed yield (1.21 t ha^{-1}) and stover yield (1.64 t ha^{-1}) were obtained from strip tillage with soybean after BRRI dhan77. The seeds pod^{-1} (10.87), were produced by treatment combination of mungbean after Lalmota dhan with strip tillage. The highest gross return (Tk. 100080 ha^{-1}), net return (Tk. 67930 ha^{-1}) and BCR (3.21) were obtained from soybean after BRRI dhan77 with strip tillage.

Based on the above results, it may be concluded that almost all of the yield and yield contributing characters along with economics soybean performed the best under strip tillage. So, from the maximum yield and economic point of view the above treatment combination would be the best under post-tide ecosystem. However, further study is suggested for drawing final recommendation.

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