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PERFORMANCE OF MUNGBEAN AS GREEN MANURING CROP IN AGROFORESTRY SYSTEMS

M.A.M. Sarker[1], M.M.U. Miah[1], M.I. Hossain[2] and M.H.A. Amin[1]
[1]Department of Agroforestry, Hajee Mohammad Danesh Science and Technology University, Dinajpur, [2]Bangladesh Tea Research Institute (BTRI), Srimangal, Sylhet

Abstract: A field experiment was conducted at the Agroforestry Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur during April to July 2005 to examine the performance of mungbean varieties as green manuring crop under different tree-crop agroforestry systems. The treatments of the experiment were three tree species with the control one viz. open field (T_1), Mango (T_2), Ghoraneem (T_3), Ipil-ipil (T_4) and five varieties of mungbean, viz.V_1 (BARI Mug-3), V_2 (BARI Mug-4), V_3 (BARI Mug-5), V_4 (BARI Mug-6) and V_5 (Local variety). Considering varietals performance, BARI Mug-6 showed the best performance compared to other varieties in respect of biomass contribution except root weight/plant at 50 DAS. In case of tree effect, the best contribution was found in T_1 (open field) and the lowest in T_3 (Ghoraneem) compared to other tree species in biomass production. Considering interaction effect, BARI Mug-6 was the best performer (V_4T_1combination) compared to other combinations in biomass contributing parameter except root weight per plant. In term of varietals performance for yield BARI Mug-5 was found the best variety over other varieties. The result clearly revealed that the production of mungbean under the agroforestry species ranked as Mango>Ipil-ipil>Ghoraneem and the best variety BARI Mug-5 for yield while BARI Mug-6 for biomass.
Key words: Mungbean varaities, Greenmanure, Biomass and Agroforestry

Introduction

Bangladesh is situated in the north eastern part of south Asia. To meet the food, shelters, fuel, fodder etc for a over populated country like Bangladesh, soils are intensively cultivated without considering soil health. Introduction of green manuring crops in different agroforestry systems, developed in the poor soils, is beneficial from the aspect of maintaining soil health. On the other hand, Bangladesh agriculture has been suffering from acute shortage of biomass to regenerate her soil from degradation or depletion of organic matter due to intensive cropping. The scale of reduction (0.01%/ year) dry basis of the level of organic matter is alarming. These problems can be solved partially through the incorporation of leaves litter of perennial species of agroforestry system. But the problem can be addressed significantly by growing green manuring crops at the beginning of agroforestry practice or to introduce green manuring crops in the cropping pattern. A huge amount of organic matter is added into crop land soil from green manuring crops cultivation than using farmyard manure and use of any other organic source (Ullah *et al.*, 2002). Although green manuring crops give various adventitious status to soil and may cause the maximum production of above crops, but farmers are not interested as it has no direct economic return. Mungbean (*Vigna radiata* L. Wilczek) is one of the important pulse crops in Bangladesh for its high digestibility and good flavor flatulent effects. It ranks fifth in terms of area under production but first with respect to price (Rahman and Miah, 1988). It is an important source of different vitamins and minerals. Biological nitrogen fixation (BNF) technology in the form of *Rhizobium* inoculant is used mungbean, which can be an attractive alternative of expensive urea fertilizer. It can fix atmospheric nitrogen with the help of *Rhizobium* bacteria and increases the nitrogen nutrition in soil within profit/cost ratio of 27/1 (Sattar and Ahmed, 1992). Many works have done about Mungbean varieties in different aspect BARI, BINA released several varieties of Mungbean but performances of Mungbean varieties in agroforestry systems are not tested. With the view, the investigation was undertaken to investigate the varital performance of five mungbean varieties especially for biomass contribution and grain yield in agroforestry system.

Materials and Methods

The experiment was conducted in the Agroforestry Farm of Hajee Mohammed Danish Science and Technology University, Dinajpur during April to July 2005. The experimental site was medium high land, and the soil was sandy loam in texture belonging to the Old Himalayan Piedmont Plain under Agro-ecological zone 01. The pH of the soil was 5.1, organic matter content 1.06%, total nitrogen 0.103%, phosphorus 24.0 µg/g soil, potassium 0.26 me/100 g soil (Soil was previously tested by SRDI, Dinajpur). Treatments of the study were Factor A: Green manuring crops (mungbean varieties) viz. V_1 = BARI Mug-3, V_2 = BARI Mug-4, V_3 = BARI Mug-5, V_4 = BARI Mug-6, and V_5 = Local variety Factor B: Agroforestry species, T_1 = Open field (control), T_2 = Mango (*Mangifera indica*), T_3 = Ghoraneem (*Melia azedarach*) and T_4 = Ipil-ipil (*Leucaena leucocephala*). The treatments were arranged in two factorial Randomized Complete Block Design (RCBD) with four replications. The size of unit plot was 2.5 m × 2.5 m. Adjacent plots and neighboring blocks were separated by 0.5 m and 3.0 m respectively. The edge of the plot was 25 cm apart from the base of the trees as 3 m x 3 m spacing were maintained for tree plantation. The age of the trees was only one year although the growth was notable. The land preparation and intercultural operation were properly maintained while fertilizer was applied according to the recommended doses. Mature pods were plucked by hand time to time and final plucking was done at 75 days after sowing (DAS). After final plucking total biomass was incorporated into the soil (except pod). The data were collected at two times, first one was at 50 DAS and last one was at 75 DAS. Data were analyzed statistically following ANOVA technique and means separations were adjusted by DMRT test at 1% level of significance.

Results and Discussion

Shoot weight: Significantly the highest shoot weight/plant (above ground biomass) at 50 and 75 DAS were recorded 16.56 g and 30.12 g respectively in V_4 which was followed by V_3 and then V_2 (at 50 DAS 13.56 g and 12.99 g produced by V_3, V_2 and 22.46 g, 22.00 g were produce by V_3, V_2 at 75 DAS respectively) although the value of shoot weight/plant in V_3 and V_2 was statistically identical (Table 1). Significantly

the lowest shoot weight/plant was found in both 50 and 75 DAS in V_5. At 50 DAS, effect of trees on shoot weight/plant of mungbean was insignificant (Table 2). Although numerically the highest shoot weight/plant was obtained in T_1 (open field) that was followed by T_3 (Ghoraneem). The lowest value was found in T_4 (Ipil-ipil). At 75 DAS, significantly the lowest shoot weight/plant (18.03g) was found under Ghoraneem (T_3) and the highest value of shoot weight/plant obtained from open field (T_1).The second highest shoot weight/plant (19.89 g) was recorded under mango (T_2). At 75 DAS significant effect was found due to various shade created by different canopy of MPTs. From the interaction effect, significantly the highest shoot weight/plant at 50 DAS and 75 DAS were recorded 17.76 g and 32.67 g respectively in V_4T_1. Significantly the lowest shoot weight/plant was recorded in both 50 DAS (6.39 g) and 75 DAS (8.55 g) in V_5T_3 (Table 3). The reduction of shoot weight of mungbean under tree might be due to reduction of photosynthesis. Crookston *et al.* (1975) reported that shading reduced leaf number, leaf area and theachness of dry bean. They also reported 38% decrease in photosynthesis per unit area of shaded leaves.

Root weight: At 50 DAS, significantly the highest root weight/plant (6.44 g) was recorded in V_2 that was followed by V_4 (5.67 g) and the lowest value was found in V_5 (3.54 g). 0n the other hand, V_4 produced significantly the highest root weight/plant (6.85 g) at 75 DAS that was followed by V_2 (6.29 g). Significantly poor performance was found in V_5 (4.81 g) at 75 DAS (Table 1). The effect of trees on root weight/plant was found similar to that of weight/plant. At 50 DAS, effect of trees on root weight/plant of mungbean was insignificant (Table 2). Although numerically the highest root weight/plant was obtained in T_1 (open field) that was followed by T_3 (ghoraneem). The lowest value was found in T_4 (Ipil-ipil).At 75 DAS, significantly the lowest root weight/plant (4.88g) was found under ghoraneem (T_3) and the highest value of root weight/plant obtained from open field (T_1).The second highest root weight/plant (6.12g) was recorded under mango (T_2). At 75 DAS, significant effect was found due to various shade created by different canopy of MPTs. From the combined effect, the highest root weight/plant at 50 DAS and 75 DAS was produced 7.72g & 8.78g respectively in V_2T_1. Significantly the lowest root weight/plant was produced in V_5T_3 (2.37 g) at 50 DAS and in V_IT_3 (3.15) at 75 DAS (Table 3).

Nodule weight: Significantly the highest nodule weight/plant was produced by V_4 (0.38 g) and the lowest value was found in V_5 (0.22 g) at 50 DAS.The trend of variation in nodule weight/plant at 50 DAS was similar to root weight/plant at 75 DAS. At 75 DAS, maximum nodule weight/plant was found in V_4 (0.27 g) that was followed by V_3 (0.18 g) and V_1 (0.18 g).The lowest value was found in V_2 (0.13 g) (Table 1). At 50 DAS, effect of trees on nodule weight/plant of mungbean was insignificant (Table 2). Although numerically the highest nodule weight/plant was obtained in T_1 (open field) that was followed by T_3 (ghoraneem). The lowest value was found in T_4 (Ipil-ipil). At 75 DAS, significantly the lowest nodule weight/plant (0.15g) was found under ghoraneem (T_3) and highest value of nodule weight/plant obtained from open field (T_1).The second highest nodule weight/plant (0.19g) was recorded under mango (T_2). At 75 DAS significant effect was found due to various shade created by different canopy of MPTs. In case of combined effect, the highest nodule weight/plant at 50 DAS was 0.43 g in V_4T_1which was followed by V_3T_4 (0.34 g). The lowest value of the same at 50 DAS was 0.14 g in V_2T_3. The highest nodule weight/plant at 75 DAS was found in V_4T_1 (0.34g) which was followed by V_4T_2 (0.29 g). The lowest value of nodule weight/plant was 0.10 g at 75 DAS in V_2T_3 (Table 3).

Total biomass: Significantly the highest biomass/ plant at 50 DAS and 75 DAS were recorded 22.62 g and 45.26 g respectively in V_4 which followed by V_3, V_2 (Table 1) although the value of biomass/plant in V_3 (18.67 g at 50 DAS, 39.37 g at 75 DAS) and V_2 (18.37 g at 50 DAS and 40.14 g at 75 DAS) was statistically identical. Significantly the lowest biomass/plant was found in both 50 DAS and 75 DAS in V_5. Significantly the highest total biomass/ha at 50 DAS and 75 DAS were found 814.4 kg and 1629.65 kg respectively in V_4 which followed by V_3, V_2 (Table 1) although the value of total biomass/ha in V_3 (672.2 kg at 50 DAS and 1413.09 kg at 75 DAS) and V_2 (673.7 kg at 50 DAS and 1445.23 kg at 75 DAS) was statistically identical. The significantly the lowest total biomass/ha was found in both 50 DAS and 75 DAS in V_5.

At 50 DAS, effect of trees on total biomass/plant of mungbean was insignificant (Table 2). Although numerically the highest total biomass/plant was obtained in T_1 (open field) that was followed by T_3 (ghoraneem).The lowest value was found in T_4 (Ipil-ipil). At 75 DAS, significantly the lowest total biomass/plant (30.88g) was found under ghoraneem (T_3) and the highest value of total biomass/plant obtained from open field (T_1).The second highest total biomass/plant (35.40g) was recorded under mango (T_2). At 75 DAS, significant effect was found due to various shade created by different canopy of MPTs. Significantly the highest total biomass/ha at 50 DAS and 75 DAS were recorded as 689.86 kg and 1441.23 kg respectively in T_1 (Table 2) which was followed by T_2 (at 50 DAS 618.42 kg and at 75 DAS 1274.56 kg).

Table1. Effect of mungbean on biomass contribution as green manuring crop in agroforestry system.

Variety	Shoot Weight/plant (g)		Root weight/plant (g)		Nodule weight/plant (g)		Total biomass production (Kg/ha)		Grain yield (Kg/ha)
	50DAS	75DAS	50DAS	75DAS	50DAS	75DAS	50DAS	75DAS	
V_1	10.47 c	16.21 c	3.58 d	4.88 c	0.24 c	0.18 b	507.7c	1018.17c	812.40b
V_2	12.99 b	22.00 b	6.44 a	6.29 b	0.28 b	0.13 c	673.7b	1445.23b	787.50c
V_3	13.56 b	22.46 b	4.80 c	6.18 b	0.29 b	0.18 b	672.2b	1413.09b	910.50a
V_4	16.56 a	30.12 a	5.67 b	6.85 a	0.38 a	0.27 a	814.4a	1629.65a	774.80c
V_5	7.07 d	9.72 d	3.54 d	4.81 c	0.22 c	0.15 c	392.9d	790.56d	382.00d
Level of significance	**	**	**	**	**	**	**	**	**

Table 2. Effect of trees on biomass contribution of mungbean as green manuring crop in agroforestry system.

Tree species	Shoot weight/plant (g)		Root weight/plant (g)		Nodule weight/plant (g)		Total biomass production (Kg/ha)		Grain yield (Kg/ha)
	50DAS	75DAS	50DAS	75DAS	50DAS	75DAS	50DAS	75DAS	
T_1	13.12	22.57a	5.7	6.93a	0.32	0.22a	689.86a	1441.23a	806.70a
T_2	11.86	19.89b	5.03	6.12b	0.27	0.19b	618.42b	1274.56b	754.80b
T_3	11.89	18.03d	5.71	4.88d	0.25	0.15d	571.03c	1111.68c	669.10d
T_4	11.2	19.09c	4.29	5.67c	0.29	0.17c	569.57c	1209.89b	703.10c
Level of significance	NS	**	NS	**	NS	**	**	**	**

NS= Not significan
** = Significant at 1% level of probability

Significantly the lowest value was measured as 569.57 kg at 50 DAS and 1111.68 kg at 75 DAS in T_4 and T_3 respectively. Significantly the highest total biomass/plant at 50 DAS was found 24.85 g in V_4T_1 that was followed by V_4T_4 (23.64 g) (Table 3).

Significantly the lowest biomass/plant at 50 DAS was found in V_5T_3 (9.00 g). Significantly the highest biomass/plant at 75 DAS was found 50.00 g in V_4T_1 that was followed by V_4T_2 (45.91 g).

Significantly the lowest biomass/plant at 75 DAS recorded in V_5T_3 (19.22 g). Significantly the highest total biomass/ha at 50 DAS was measured as 894.85 kg in V_4T_1 that was followed by V_4T_2 and V_4T_3 (Table 3).

Although the value of total biomass/ha in V_4T_2 (813.00 kg) and V_4T_3 (806.60 kg) was statistically identical. At 75 DAS, the highest value was measured as 1800.00 kg in V_4T_1that was followed by V_4T_2 (1652.85 kg) (Table 3). Although the value of total biomass/ha in V_4T_2 (1652.85 kg) and V_2T_1 (1689.86 kg) was statistically identical. The significantly lowest total biomass/ha was measured in both 50 DAS (328.15 kg) and 75 DAS (691.92 kg) in V_5T_3.

Planchon (1979) found similar biomass production in cereal crops. He reported that production of biomass and yield in crop plants largely depends on the function of leaf area and consequent photosynthetic activity. High photosynthetic rates are capable of producing high levels of root and shoot biomass.

Grain yield:

Significantly highest yield/ha was measured as 910.50 kg in V_3 which was followed by V_1 (812.40kg). The value of yield/ha in V_2 (787.50kg) and V_4 (774.80kg) was statistically identical. The significantly lowest value of yield/ha was given by V_5 (382.00kg).Significantly the highest yield/ha was measured as 806.70 kg in T_1 that was followed by T_2 (754.80 kg). Significantly the lowest yield/ha (669.10 kg) was found in T_3 (Table 2).

Interaction effect provides significantly the highest yield/ha 1019.00 kg in V_3T_1 followed by V_3T_2 (966.00 kg). The value of yield/ha in V_2T_1 (856.00 kg) and V_3T_4 (851.60 kg) was statistically identical. Significantly the lowest yield/ha (320.00 kg) was recorded in V_5T_3 (Table 3). Kumar *et al.* (1988) also observed the yield variation of forteen mungbean genotypes under reduced light caused by pearl millet.

Considering the effects of interaction, the study reveled that V_3T_1 combination performed the best in all yield parameters except number of pod/plant and number of seed/pod.

Miah *et al.* (1995) reported that the mean light on crop rows decreased as they approached the tree rows across the alleys. The rate of decrease was greater than in pruned alleys. Rice and mungbean yield decreased more in unpruned conditions (13 kg/ha) than in pruned condition (9 kg/ha).

Table-3 Interaction effect of trees and mungbean varieties on biomass contribution as green manuring crop in agroforestry system

Treatment combinations	Weight/plant (g)		Root weight/plant (g)		Nodule weight/plant(g)		Total biomass Production (Kg/ha)		Grain yield (Kg/ha)
	50 DAS	75DAS	50DAS	75DAS	50 DAS	75DAS	50 DAS	75 DAS	
V_1T_1	10.71 ij	18.39 h	4.20 hi	5.24 fg	0.27c-g	0.20 e	547.03f	1172.88g	907.20c
V_1T_2	9.93 j	17.00 I	4.01 hi	4.90 gh	0.25fgh	0.16 gh	511.13fg	1082.16h	800.00ef
V_1T3	11.76hi	14.30 j	2.28k	3.15 k	0.21 gh	0.14 ij	513.35fg	858.24jk	766.40fgh
V_1T_4	9.50 j	15.15 j	3.04j	4.25 ij	0.22 gh	0.13ij	459.55gh	959.40i	776.00fg
V_2T_1	14.15ef	24.80 e	7.72 a	8.78 a	0.30 c-f	0.16 gh	798.60b	1689.86b	856.00d
V_2T_2	11.92hi	20.00 g	5.95 c	7.10 c	0.18 hi	0.14 ij	650.23de	1416.60e	792.00efg
V_2T3	11.57hi	19.11gh	4.92efg	6.30 de	0.14 I	0.10 k	599.03e	1283.76e	734.00hi
V_2T_4	12.13 h	20.00 g	5.59cde	7.00 c	0.25fgh	0.13 j	647.30de	1390.68e	768.00fgh
V_3T_1	15.42cd	26.01 d	5.57cde	7.22 c	0.34 fgh	0.22 d	767.97bc	1647.36b	1019.00a
V_3T_2	13.45fg	22.25 f	5.16def	6.50 d	0.24bcd	0.20 e	679.15d	1407.60e	966.00b
V_3T3	12.77 gh	20.11 g	3.87 I	5.00 gh	0.23 bc	0.15 hi	608.03e	1237.32fg	805.00ef
V_3T_4	12.61gh	21.50 f	4.62fgh	6.00 e	0.34 b	0.18 f	633.70de	1360.08e	851.60d
V_4T_1	17.74 a	32.67 a	6.68 b	7.92 b	0.43 a	0.34 a	894.85a	1800.00a	824.00de
V_4T_2	16.42bc	30.12 b	5.73 cd	7.00 c	0.41 a	0.29 b	813.00b	1652.85b	800.00ef
V_4T3	16.97 ab	28.12 c	5.10def	5.99 e	0.32 ab	0.20 e	806.60b	1487.16d	720.00i
V_4T_4	15.11dc	29.59 b	5.15def	6.50 d	0.38 d-g	0.26 c	743.22c	1578.60c	755.00ghi
V_5T_1	7.58 k	10.98 k	4.39ghi	5.53 f	0.26 efg	0.20 e	440.83h	896.04ij	427.20j
V_5T_2	7.58 k	10.11kl	4.32ghi	5.11g	0.27 efg	0.18 f	438.60h	813.60kl	416.20j
V_5T3	6.39 k	8.55 m	2.37 k	4.00 j	0.34bcd	0.17 fg	328.15i	691.92m	320.00l
V_5T_4	6.73k	9.25 ml	3.08 j	4.60 hi	0.27defg	0.18 f	364.08i	760.68l	365.00k
Level of significance	**	**	*	**	**	**	*	**	**

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