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Impact of Alley Cropping on Wheat Productivity

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Abstract: *A field experiment was conducted to investigate the effect of pruned materials of two hedgerow species on wheat production and soil nutrient changes at different nitrogen levels in the research farm of the BangabandhuShiekhMujiburRahman Agricultural University (BSMARU) during November 2012 to March 2013. The design of the experiment was split plot, where two multipurpose tree species (MPTS) namely Gliricidiasepium and Leucaenaleucocephala were arranged in main plots and five different doses of nitrogen (0, 25, 50, 75 and 100 % of recommended dose) with pruned materials were distributed to sub plots. Alley widths of both tree species were 6.0 meter. There were also control plots where full dose of recommended nitrogen was applied but no pruned material (PM) was incorporated. The grain yield of wheat varied significantly by the mean effect of two tree species. The grain yield was statistically similar to Gliricidiasepium (3.63 t ha^{-1}) and Leucaenaleucocephala (3.31 t ha^{-1}). Interaction of effect tree species and N dose on grain yield was significant. The highest grain yield was found in N_{100}×GS combination (3.93 t ha^{-1}) which was statistically similar to N_{25}×GS, N_{50}×GS, N_{75}×GS, $N2_5$×LL, N_{50}×LL, N_{75}×LL and N_{100}×LL combinations. The lowest yield was found in N_{25}×C (2.27 t ha^{-1}) and N_{75}×C (2.47 t ha^{-1}).However growth, yield and yield contributing characters of wheat did not vary much between L. leucocephala and G. sepium.*
Keywords: *Wheat, Alley cropping, Pruning, Productivity, Yield*

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I. Introduction

Bangladesh is a small deltaic country with a large population of 161 million with cultivable land of 8.44 million ha is being used for agricultural purpose which has low productivity due to the poor soil health. As a part of development works, housing facilities for the increased population, new industries and infrastructures are building up at the cost of shrinking this cultivable land. To feed the increasing population, farmer has to intensity farming on these low productive and limited lands. Due to intensive cultivation, soil fertility is reducing rapidly, and consequently reducing the crop yield. As a result, the natural soil ecosystem has rapidly degrading and farm agro-ecosystem losing its integrity and health as well as polluting the environment. The organic matter content which is an indicator of soil health is depleted to less than critical value of 1 percent (Hossain and Kashem, 1997) in most of the areas (about 60 percent) of cultivable land during the last 20-25 years. To address the issue of crop environment and crop productivity, the concepts like organic farming, ecological farming and regenerative agriculture are now being the subject of discussion. Now-a-days, alley cropping is considered as an ideal technology for sustainable crop production where agricultural crops are grown in the inter-space between rows of planted shrubs/tree species, preferably legumes, which are periodically pruned to minimized tree-crop competition for growth resources such as water, nutrient and light (Tossah*et al*., 1999). Pruned materials are applied in soil for releasing nutrients to improve the growth and development of associated crops through improving the physiochemical characteristics of soils (Miah*et al*., 1993). In addition, fast growing leguminous trees/shrubs species are grown because it usually recycles nutrients, contribute biological nitrogen fixation (Kang *et al*., 1985). In alley cropping systems, trees and/shrubs are generally planted in a single or multiple row. The spacing between alley widths is determined by the primary purpose of the alley cropping and the size of agronomic, horticultural, or forage crop grown (Anonymous, 1997). Size of alleys is also dependent upon the easy intercultural operations. A wider spacing minimizes the tree-crop competitions and a narrow spacing maximizes the weed control (Vanlauwe*et al.*, 1998) as well as tree crop competitions. Among the evaluated tree species for alley cropping *Gliricidiasepium* and *Leucaenaleucocephala*are the two most suitable species which are used in alley cropping in many parts of the world. These two species biologically fix N, can be established easily by direct seeding, withstand repeated pruning, produce large amounts of biomass. Any nitrogenous fertilizer saving by maintaining the crop productivity through alley cropping system would be immense value particularly for the resource poor farmers of Bangladesh. This information will help the farmers for reducing their production cost. Eventually, it will be considered as suitable technology both economically and environmentally.

Wheat (*Triticumaestivum)* is the second most important cereal crop in Bangladesh after rice and one of the major food crops of the world. About two-thirds of total population in the world lives on wheat grains for their subsistence. Annual wheat consumption is increasing day by day whereas, production is decreasing. This is mainly due to use of low yielding varieties and improper management by the farmers (FAO, 1987). The sharp declining trend of production needs to be improved quickly. With the advancement of research in this field, the modern varieties have been evolved along with the improvement of cultural practices; as a result the total wheat production of the country went up. In 1998-99, the wheat production was 1.8 million tons from an area of 0.81 million hectares (BBS, 2001). Subsequently, wheat covered 0.706 million hectares of land and production was 1.507 million metric tons of grain in 2002-2003 (BBS, 2004). The average yield of wheat in many wheat growing countries like China , Japan, Chile, Zimbabwe and India are 3.5, 3.6, 3.5, 4.9 and 2.4 ton ha^{-1} . The average yield of wheat in Bangladesh is about 2.15 ton ha^{-1} which is very low as compared to other wheat growing countries (BBS, 2010).

Under these circumstances, we have to expedite the food (wheat) production through exploitation of natural resources. There must be clear strategy for investment and resources accumulation in the agriculture sector to increase productivity of food crops and farm income maintaining soil fertility. Alley cropping systems is a sustainable farming system that has the potentiality to produce more food from the diminishing land resources need to be developed through maintaining crop productivity.In view of the above circumstances, a study was undertaken with the following objectives:to evaluate the productivity of wheat grown under different alley consisted with two different tree species at varying nitrogen levels.

II. Materials And Methods

The experiment was conducted at the Bangabandhu Sheikh MujiburRahman Agricultural University (BSMARU) research farm of the Department of Agroforestry and Environment, Gazipur during the period from November, 2012 to March, 2013. The experimental site was located at the centre of Modhupur Tract of $24^{0}09'$ N latitude and $90^{0}26'$E longitude with an elevation of 8.5 meters from sea level. The site was previously a Shal forest, which was cleaned and developed for research purpose. The experiment was set on the alley of *Gliricidiasepium* and *Leucaenaleucocephala* which were established in the upland corner of the farm.

Experimental design and treatment

The experimental was laid out in a split-plot design, with three replications. Tree species were arranged in main plots and different doses of nitrogen were distributed into sub plot. Tree species used in main plots were as follows:

Factor A: Two tree species with control

Gliricidiasepium(*G. sepium*)

Leucaenaleucocephala(*L. leucocephala*)

Control (Without tree species)

Factor B: Nitrogen levels (5)

N_0 (zero dose of N) + Pruned materials (PM)

N_{25} (25% of recommended N dose) + PM

N_{50} (50% of recommended N dose) + PM

N_{75} (75% of recommended N dose) + PM

N_{100} (100% of recommended N dose) + PM

The alley width was 6.0 m. Every alley was divided into 15 unit plots comprising three replications and five levels of nitrogen. The unit plot length was 5 m. So, total area of a unit plot was 6m x 5m.

There were control treatments which received recommended nitrogen dose but no pruned material was used for growing crops to compare the results with crop yields under alley cropping system. Urea was used as the source of different nitrogen doses.

Test crop

The wheat variety BARI GOM 23 (BIJOY) was used in the experiment. The seeds were collected from the Wheat Research Centre, Bangladesh Agricultural Research institute (BARI), Gazipur, Bangladesh.

Collection of data
The following yield and yield contributing parameters were observed:

Total dry matter per square meter
After harvesting sample were collected from the field and dried in the sun. Then crop samples were dried in oven. After oven drying in oven total dry matter weight were taken.

Spike Length
A measurement scale was used to measure the spike length in centimeter. Five randomly selected plants were taken from each plot to take average length of spike.

Number of spike per square meter
Five randomly selected plants were taken from each plot and average numbers of spike were counted.

Thousand grain weight
Thousand grain weights were measured by weighing of 1000 grains adjusted to 12% moisture content with the help of an electric balance.

Grain yield
The mature seeds of all plots were harvested, cleaned and dried. First plot yield was obtained in kg. Then plot yield was converted into t/ha.

Straw yield
After collecting grain, straw yield was obtained in kg firstly. Then plot yield was converted into t/ha.

Statistical analysis
The data relating to growth yield and yield contributing characters of wheat and tree performance were subjected to analysis of variation (ANOVA) with the help of computer "MSTATC" program. Analysis of variance was done according to Gomez and Gomez (1984).

III. Results And Discussion

1. Total dry matter per square meter

Effect of tree species

Total dry matter of wheat did not vary significantly by *Gliricidiasepium*and *Leucaenaleucocephala* tree species. In general the highest dry weight per five hills at 30 and 45 DAS (1.08 and 9.63 g) were recorded under *Gliricidiasepium*(Table 1)followed by control plot (1.06 and 8.04 g) and the lowest weight of dry matter per five hills (0.82 and 6.74 g) was obtained under *Leucaenaleucocephala.* At 60 DAS, the variation pattern of dry matter per five hills of wheat was almost similar in case of *Gliricidiasepium* and *Leucaenaleucocephala* . But in case of control plot it was 23.81g. At 75 and 90 DAS, 49.52 and 137.40 g were recorded under *Gliricidiasepium*followed by *Leucaenaleucocephala* (45.29 and 127.90 g) and the lowest weight of dry matter per five hills (40.72 and 116.10 g) was obtained in control plot.

Response of nitrogen level

Total dry matter of wheat did not fluctuate significantly by *Gliricidiasepium*and *Leucaenaleucocephala* tree species. In general at 30, 45 and 60 DAS the highest dry matter per five hills were found to be 1.17, 8.69 and 21.57g respectively in N_{50}+PM. At 30 DAS the lowest dry matter per five hills was 0.91g in N_{25}+PM followed by N_0+PM, N_{100}+PM and N_{75}+PM. At 45 DAS the lowest dry matter per five hills was 7.09g in N_{75}+PM. But at 60 DAS it was 19.77 in N_0+PM. At 75 DAS the highest weight of dry matter per five hills was 54.15g in N_{100}+PM and the lowest was 45.09g in N_0+PM. In N_{25}+PM, N_{50}+PM and N_{75}+PM it was 46.37, 48.45 and 48.48g respectively. At 90 DAS the highest weight of dry matter per five hills was 142.50g in N_{100}+PM and the lowest was 105.20g in N_0+PM but in N_{25}+PM (133.40) and N_{50}+PM (133.80g) it was almost similar. The plants with higher N level may be intercepted more light, which might be due to large and dense canopy of wheat. The rate of dry matter production is often proportional to the intercepted radiation (Biscoe and Gallegher 1977).

Table 1. Total dry matter of wheat at different growth stages grown in alleys consisting of two different tree species as affected by different nitrogen levels along with pruned materials

Treatment	Total dry matter of wheat (gm)				
	1st sampling (30 DAS)	**2nd sampling (45 DAS)**	**3rd sampling (60 DAS)**	**4th sampling (75 DAS)**	**5th sampling (90 DAS)**
Tree species					
Gliricidiasepium	1.08	9.63	18.82	49.52	137.4
Leucaenaleucocephala	0.82	6.74	18.89	45.29	127.9
Control	1.06	8.04	23.81	40.72	116.1
Nitrogen dose (%) + PM					
N_0 +PM	0.940	8.41	19.77	45.09	105.2
N_{25} +PM	0.916	7.84	21.53	46.37	133.8
N_{50} +PM	1.17	8.69	21.57	48.45	133.4
N_{75} +PM	0.96	7.09	20.81	48.48	120.9
N_{100} +PM	0.98	8.66	18.86	54.15	142.5
Nitrogen dose x Tree species					
N_0 x GS	1.05ab	7.90bcde	15.47 e	55.20 b	111.70 bc
N_{25} x GS	0.94ab	9.23bc	18.38 cde	44.73 b	127.21 abc
N_{50} x GS	1.23 a	10.80 ab	23.01 abcd	51.75 b	142.00 ab
N_{75} x GS	1.09ab	8.16bcde	19.94 bcde	55.37 b	162.54 a
N_{100} x GS	1.12ab	12.06 a	17.32 de	77.96 a	136.17 ab
N_0 x LL	0.82 b	8.54bcd	19.68 bcde	37.75 c	111.30 bc
N_{25} x LL	0.75 b	6.63cde	18.40 cde	40.06 b	125.38 abc
N_{50} x LL	1.01ab	7.57cde	21.71 abcde	47.80 b	142.40 ab
N_{75} x LL	0.79 b	5.61 de	17.14 de	55.86 b	121.60 abc
N_{100} x LL	0.76 b	5.36 e	17.53 de	56.42 b	149.30 ab
N_0 x C	0.94ab	8.80bc	24.15 abc	39.62 c	107.20 c
N_{25} x C	1.05ab	7.66cde	27.82 a	42.65 b	126.00 abc
N_{50} x C	1.29 a	7.71cde	20.00 bcde	45.78 b	131.81 ab
N_{75} x C	1.00 ab	7.49cde	25.36 ab	51.98 b	115.72 abc
N_{100} x C	1.05ab	8.56bcd	21.73 abcde	39.76 c	124.27 abc

In a column, means followed by a common small letter are not significantly different at 5% level by DMRT.
GS= *Gliricidiasepium*, LL= *Leucaenaleucocephala*
N_0 = 0% Nitrogen, N_{25} = 25% Nitrogen, N_{50} = 50% Nitrogen, N_{75} = 75% Nitrogen & N_{100} = 100% Nitrogen

Interaction effect of tree species and nitrogen

Interaction effect of tree species and nitrogen doses on total dry matter was found significant at each sampling dates (Table 1). At 30 DAS, significantly the highest weight of total dry matter per five hills of wheat (1.23g) was found in N_{50}×GS combination which was identical to that of N_{50}×C (1.29 g). The lowest weight of total dry matter per five hills of wheat (103.01g) was found in N_{25}×LL (0.75g) combination which were statistically similar to those of N_{75}×LL(0.79 g) and N_{100}×LL(0.76 g). At 45 DAS, significantly the highest weight of total dry matter per five hills of wheat (12.06g) was found in N_{100}×GS combination and the lowest was found in N_{100}×LL (5.36 g) combination. In these two sampling days the result revealed that *G. sepium* always showed the highest weight of total dry matter per five hills over *L.lecocephala*tree species. At 60 DAS, significantly the highest weight of total dry matter per five hills of wheat (27.82g) was found in N_{25}×C combination and the lowest was found in N_{100}×LL (5.36 g) combination. At 75 DAS, the

highest weight of total dry matter per five hills of wheat (77.96g) was found in N_{100}×GS combination and the lowest was found in N_{100}×C(39.76 g) combination which was statistically similar to N_0xLL (37.75g) combination. At 90 DAS, the highest weight of total dry matter per five hills of wheat (162.54g) was found in N_{75}×GS combination and the lowest was found in N_0×C (107.20g) combination. The weight of total dry matter per square meter of wheat was not affected by tree species where *G. sepium* produced relatively the highest weight of total dry matter per square meter, which was followed by *L. leucocephala* at all five sampling dates.

2.*Spike length*

Effect of tree species

Spike length of wheat did not vary significantly by the mean effect of *Gliricidiasepium*and *Leucaenaleucocephala*. In general, the highest spike length of wheat grown in alley cropping was recorded (15.14 cm) under *G. sepium* (Table 2) followed by *L. leucocephala*(13.09 cm) and the lowest length of spike

(12.88 cm) was obtained in control plot. The length of spike of wheat was not affected by tree species where *G. sepium* produced relatively the highest length of spike, which was followed by *L. leucocephala*.

Response of nitrogen level

Spike length of wheat did not differ significantly by the mean effect of *Gliricidiasepium*and *Leucaenaleucocephala* tree species. In general, the highest spike length of wheat grown in alley cropping was recorded (16.91 cm) in N_{100}+PM and the lowest length of spike (12.76 cm) was obtained in N_0+PM.

Interaction effect of tree species and nitrogen

Interaction effect of tree species and nitrogen doseson length of spike was found significant (Table 2). Significantly the highest length of spike of wheat (14.14 cm) was found in N_{100}×GS combination). And the lowest length of spike of wheat (11.76 cm) was found in N_0×C (11.76 cm) combination which were statistically similar to those of N_0×GS to N_{75}×GS , N_0×LL to N_{100}×LL and N_{25}×C to N_{100}×C combinations. The result revealed that *G. sepium* always showed the highest length of spike over other *L.lecocephala*, and control treatment condition.

4.*Number of spike per square meter*

Effect of tree species

Number of grain per spike of wheat did not differ significantly by the mean effect of *Gliricidiasepium*and *Leucaenaleucocephala* tree species. In general, the highest number of grain per spike of wheat grown in alley cropping was recorded (47.53) under *G. sepium* (Table 2) followed by *L. leucocephala*(46.57) and the lowest number of spike (44.77) were obtained in control plot.

Response of nitrogen level

Number of grain per spike of wheat did not vary significantly by *Gliricidiasepium*and *Leucaenaleucocephala* tree species. In general, the highest number of grain per spike of wheat grown in alley cropping was recorded (47.02) in N_{100}+PM and the lowest number of spike (43.51) was obtained in N_0+PM. Nitrogen application at 120 kg/ha for wheat has been recommended by various research workers (Lathwal*et al*., 1992; Das *et al*., 1993). Geleto*et al.* (1995) reported that spike numbers were increased with high level of nitrogen. The number of grain per spike of wheat was not affected by tree species where *G. sepium* produced relatively the highest number of grain per spike, which was followed by *L. leucocephala*.

Interaction effect of tree species and nitrogen

Interaction effect of tree species and nitrogen doseson number of grain per spike did not differ significantly (Table 2). In general, the highest number of grain per spike of wheat (51.60) was found in N_{100}×GS combination and the lowest number of grain per spike of wheat (42.80) was found in N_0×C combination. The number of grain per spike of wheat was found 51.53 and 46.87 in N_{100}×LL and N_{100}×C combinations respectively. Similar trend was found by Ayoub*et al.* (1993). Such response can be attributed to the adequate organic matter and nitrogen availability which might facilitate the tillering ability of the plants, resulting in a greater spike population.

The result revealed that *G. sepium* always showed the highest number of grain per spike over *L.lecocephala*, and control showed that the poorest performance of number of grain per spike under each treatment.

5. *Thousand grain weight*

Effect of tree species

Thousand grain weight of wheat grown in alley cropping was not influenced by the tree species. In general, the highest 1000 grain weight of wheat (52.00 g) was recorded under *G. sepium* (Table 2) followed by *L. leucocephala*(50.69 g) and the lowest 1000 grain weight of wheat (49.05 g) were obtained in control plot. The 1000 grain weight of wheat was not affected by tree species where *G. sepium* produced relatively the highest 1000 grain weight of wheat, which was followed by *L. leucocephala*.

Response of nitrogen level

Thousand grain weight of wheat did not significantly vary due to the effect of nitrogen levels. In general, the highest 1000 grain weight of wheat was found in N_{100} + PM (52.75 g) and the lowest 1000 grain weight of wheat (51.57 g) was in N_0 +PM. 1000 grain weight of wheat was found 52.42g in N_{50} +PM. The highest value of 1000-grain weight(40.54g) was achieved in case of higher N dose where N was applied at the rate of 180 kg N ha-1 .The 1000-grain weight value (39.69g) for N_0 was significantly low than the higher dose of N dose. These findings are in conformity with those of Yang *et al*. (2001) and Halepyati (2001).

Interaction effect of tree species and nitrogen

Interaction effect of tree species and nitrogen doseson 1000 grain weight of wheat was found significant (Table 3). Significantly the highest 1000 grain weight of wheat (53.21 g) wa s found in N_{100}×GS combination which were statistically similar to N_0×GS to N_{75}×GS, N_0×LL to N_{100}×LL and N_{25}×C to N_{100}×C combinations . The lowest 1000 grain weight of wheat (48.63 g) was found in N_0×C combination which were statisticallly similar to those of to N_0×GS to N_{75}×GS, N_0×LL to N_{100}×LL and N_{25}×C to N_{100}×C combinations. The result revealed that *G. sepium* always showed the highest 1000 grain weight of wheat over *L.lecocephala*, and control treatment.

Table 2. Spike length, number of spike per square meter, number of grain per spike and 1000 grain weight of wheat grown in alleys consisting of two different tree species as affected by different nitrogen levels along with pruned materials

Treatment	Spike length (cm)	Number of grain per spike	1000 grain weight (gm)
Tree species			
Gliricidiasepium	15.14	47.53	52.00
Leucaenaleucocephala	13.09	46.57	50.69
Control	12.88	44.77	49.05
Nitrogen dose (%) + PM			
N_0 +PM	12.76	43.51	51.57
N_{25} +PM	12.92	44.80	51.81
N_{50} +PM	12.82	48.67	52.42
N_{75} +PM	13.11	47.46	51.60
N_{100} +PM	16.91	47.02	52.75
SE			
Nitrogen dose x Tree species			
N_0 x GS	11.87 b	46.47	51.79ab
N_{25} x GS	12.83 b	45.00	52.87ab
N_{50} x GS	13.25 b	48.47	51.91ab
N_{75} x GS	13.15 b	51.40	51.80ab
N_{100} x GS	14.18 a	51.60	53.21 a
N_0 x LL	12.68 b	42.67	51.25ab
N_{25} x LL	13.07 b	44.93	51.15ab
N_{50} x LL	13.44 b	45.13	52.22ab
N_{75} x LL	12.78 b	48.00	52.56ab
N_{100} x LL	13.47 b	51.53	51.13ab
N_0 x C	11.76 b	42.80	48.63 b
N_{25} x C	12.38 b	45.77	50.51ab
N_{50} x C	13.28 b	46.13	49.68ab
N_{75} x C	12.82 b	47.60	50.52ab
N_{100} x C	12.57 b	46.87	50.23ab

In a column, means followed by a common small letter are not significantly different at 5% level by DMRT.
GS= *Gliricidiasepium*, LL= *Leucaenaleucocephala*
N_0 = 0% Nitrogen, N_{25} = 25% Nitrogen, N_{50} = 50% Nitrogen, N_{75} = 75% Nitrogen & N_{100} = 100% Nitrogen

6. *Grain yield*

Effect of tree species

Grain yield of wheat grown in alley cropping was influenced significantly by the tree species The highest grain yield of wheat (3.63 t ha^{-1}) was recorded under *G. sepium* (Table 3) followed by *L. leucocephala*(3.31 t ha^{-1}) and the lowest grain yield of wheat (2.56 t ha^{-1}) were obtained in control plot.

Response of nitrogen level

Grain yield of wheat did not significantly vary due to the effect of nitrogen levels. In general, the highest grain yield of wheat was found in N_{100} + PM (3.49 t ha^{-1}) and significantly the lowest grain yield of wheat (2.98 t ha^{-1}) was in N_{25} +PM and (3.00 t ha^{-1}) in N_0+PM. Nitrogen application at 120 kg/ha for wheat has been recommended by various research workers (Lathwal*et al.*, 1992; Das *et al.*, 1993). Singh and Uttam (1995) recorded increased grain yield with increase in nitrogen level.

Interaction effect of tree species and nitrogen

Interaction effect of tree species and nitrogen doseson grain yield of wheat was found significant (Table 4). The highest grain yield of wheat (3.93 t ha^{-1}) was found in N_{100}×GS combination which was identical to those of N_{25}×GS to N_{75}×GS and N_{25}×LL to N_{25}×LL combinations. The lowest grain yield of wheat (2.27 t ha^{-1}) was found in N_{25}×C combination which was statistically similar to that of N_0×LL, N_0×GS and N_0×C to N_{100}×C combinations. The result revealed that *G. sepium* always showed the highest grain yield of wheat over *L.lecocephala*, while control showed that the shy performance of grain yield of wheat under each treatment. The grain yield of wheat was not affected by tree species where *G. sepium* produced relatively the highest grain weight of wheat, which was followed by *L. leucocephala*.

A substantial improvement in crop yield in agroforestry systems was reported where tree prunings were used as mulch or green manure (Soriano, 1991, Onim*et al.,* 1990 and Getahum and Jama, 1986). The increased wheat yield with the increased N levels was reported by several authors (Islam *et al.* 1989, Sarkar 1995 and Rahman 1996). The higher yield with higher N levels was mainly due to higher spikes per m^2 and also due to combined contribution of other yield components. Sharma and Kumar (1972) also found the higher grain yield with higher N dose was due to higher spike per m^2. Among the two tree species, grain yield produced in the treatment where only pruned materials were applied was statistically identical regardless of tree species. But in the other N levels (except 50 and 75% N) plus PM treatment, *G. sepium* and *L. leucocephala*produced statistically similar grain yield. In these N levels, grain yield produced in *G. sepium*alley was statistically higher than that in *L. leucocephala*alley. In the treatment with 75 and 50% N plus PM, grain yield produced in *G. sepium*was significantly higher than those were in *L. leucocephala.*

7. *Straw yield*

Effect of tree species

Straw yield of wheat grown in alley cropping was influenced by the tree species. Significantly the highest straw yield of wheat (4.52 t ha^{-1}) was recorded under *G. sepium* (Table 3) followed by *L. leucocephala*(4.01 t ha^{-1}) and the lowest straw yield of wheat (3.99 t ha^{-1}) were obtained in control plot.

Response of nitrogen level

Straw yield of wheat did not significantly vary due to the effect of nitrogen levels. In general, the highest straw yield of wheat was found in N_{100} + PM (4.54 t ha^{-1}) and the lowest straw yield of wheat (3.83t ha^{-1}) was found in N_0 +PM followed by 3.98, 4.13 & 4.39 t ha^{-1} in N_{50} + PM, N_{25} + PM & N_{75} + PM respectively.

Interaction effect of tree species and nitrogen

Interaction effect of tree species and nitrogen doseson straw yield of wheat was found significant (Table 4). Significantly the highest straw yield of wheat (5.25 t ha^{-1}) was found in N_{50}×GS combination which was identical to that of N_{75}×GS (4.65 t ha^{-1}), N_0×GS (4.25 t ha^{-1}), N_{100}×GS (4.65 t ha^{-1}),N_{100}×LL (4.35 t ha^{-1})and N_{75}×LL (4.93 t ha^1). Significantly the lowest straw yield of wheat (2.93 t ha^{-1}) was found in both N_0×C combinations which were statistical similar to that of N_{25}×GS (4.00 t ha^{-1}),N_0×LL(3.90 t ha^{-1}) and N_{25}×C to N_{100}×C combinations . The result revealed that *G. sepium* always showed the highest straw yield of wheat over other *L. lecocephala*, while control showed that the poorest performance of straw yield of wheat under each treatment condition. The straw yield of wheat was not affected by tree species where *G. sepium* produced relatively the highest straw weight of wheat, which was followed by *L. leucocephala*.

Table 3. Grain and straw weight of wheat grown in alleys consisting of two different tree species as affected by different nitrogen levels along with pruned materials

Treatment	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Boilogical yield (t ha^{-1})	Harvest index (%)
Tree species				
Gliricidiasepium	3.63 a	4.52 a	8.15	44.54
Leucaenaleucocephala	3.31 a	4.01 a	7.32	45.22
Control	2.56 b	3.99 b	6.55	39.08
Nitrogen dose (%) + PM				
N_0 +PM	3.00	3.83	6.83	43.92
N_{25} +PM	2.98	4.13	7.11	41.91
N_{50} +PM	3.23	3.98	7.21	44.80
N_{75} +PM	3.14	4.39	7.53	41.70
N_{100} +PM	3.49	4.54	8.03	43.46
Nitrogen dose x Tree species				
N_0 x GS	2.72 cde	4.25 abcd	7.97	46.68

N_{25} x GS	3.37 abcd	4.00 bcde	7.37	45.73
N_{50} x GS	3.53 abc	5.25 a	8.78	40.21
N_{75} x GS	3.59 a	4.40 abcd	7.99	44.93
N_{100} x GS	3.93 a	4.65 ab	8.33	47.18
N_0 x LL	2.73 cde	3.90bcde	5.66	48.23
N_{25} x LL	3.31 abcd	4.54 abc	7.85	42.17
N_{50} x LL	3.39 abc	4.30 abcd	7.29	46.50
N_{75} x LL	3.36 abc	4.93 ab	8.29	40.53
N_{100} x LL	3.69 a	4.35 abcd	8.04	45.89
N_0 x C	2.56 de	2.93 e	6.86	37.32
N_{25} x C	2.27 e	3.85 bcde	6.12	37.09
N_{50} x C	2.67 de	3.39 cde	6.06	44.06
N_{75} x C	2.47 e	3.82 bcde	6.29	39.27
N_{100} x C	2.84 bcde	4.01bcde	6.85	41.45

In a column, means followed by a common small letter are not significantly different at 5% level by DMRT.
GS= *Gliricidiasepium*, LL= *Leucaenaleucocephala*
N_0 = 0% Nitrogen, N_{25} = 25% Nitrogen, N_{50} = 50% Nitrogen, N_{75} = 75% Nitrogen & N_{100} = 100% Nitrogen

IV. Conclusion

Accomplishing the present investigation, it may be concluded that:

The crops grown in *Gliricidiasepium*alleys showed superior performance in more or less all aspects. Yield contributing characters of wheat in regards to spike length, 1000 grain weight were found the highest at 100 % N level. Wheat can be grown successfully up to 75% reduction of N level if pruned materials are added to the soil, though 100% N plus PM treatment performed relatively better over control. With the addition of pruned material application of nitrogen fertilizer can be reduced up to seventy five percent without significant yield loss of wheat**.**

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