The Pharma Innovation Journal 2022; SP-11(2): 776-781

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(2): 776-781

www.thepharmajournal.com
Received: 01-12-2021
Accepted: 03-01-2022

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Growth and yield performance of paddy under teak (*Tectona grandis)* based rice bund plantation in Chhattisgarh

Manish Kumar Mankur, Pratap Toppo, Lalji Singh, Anil Verma and RR Saxena

Abstract

Teak acceptance in agroforestry is also based on its high timber value; it is suitable for furniture, doors, decorative furniture, boards and any kind of construction work. Investigations of the interactions between trees and crops in traditional agroforestry studies in village Bade Urla, Block Abhanpur, District Raipur, Chhattisgarh, showed that the growth parameters of paddy decreased under the shade of *Tectona grandis*. Plant height found minimum at under the shade of *Tectona grandis* i.e., (33.64 cm, 70.59 cm, 109.40 cm) in 30 DAT, 60 DAT, 90 DAT and the control was maximum (35.14 cm, 73.39 cm and 111.60 cm) in 30 DAT, 60 DAT, 90 DAT. Number of total tillers m^{-2} at harvest was found maximum (146.46) at control and minimum (117.93) at under the shade of *Tectona grandis*. Number of effective tillers m^{-2} at harvest was significantly highest in control (121.85) i.e. control condition and lowest in under shade of *Tectona grandis* (85.08). Dry matter accumulation $hill^{-1}$ at harvest was found maximum (13.54 g) at control and minimum (11.61 g) at under the shade of *Tectona grandis*. Panicle weight $plant^{-1}$ at harvest was found maximum (21.32 g) at control and minimum (18.41 g) at under the shade of *Tectona grandis*. Significantly highest panicle length $plant^{-1}$ at harvest was observed in control (27.74 cm/plant) and lowest in under the shade of *Tectona grandis* (26.56 cm/plant). Number of filled grains $panicle^{-1}$ at harvest was found maximum (193.31) at control and minimum (183.39) at under the shade of *Tectona grandis*. Number of unfilled grains $panicle^{-1}$ at harvest was recorded maximum under the shade of *Tectona grandis* (58.51 grains/panicle) and minimum found when the crop was grown under control (50.54 grains/panicle). With increasing distance from the tree base grain yield 39.11 q ha^{-1} & straw yield 44.54 q ha^{-1} significantly highest at control and lowest grain yield 35.39 q ha^{-1} & straw yield 41.58 q ha^{-1} under the shade of teak because the plant species under the agroforestry system depends on the same supply of growth and development resources, such as light, water, nutrients and thus the performance of the other components as well as the system as a whole will impact one component of the system. It is reasonable to believe that the decline may be related to the reduced availability of light together along with competition.

Keywords: DAT, plant, panicle, tiller, *Tectona grandis*, grain yield, straw yield

Introduction

"Agroforestry is the deliberate integration of trees with agricultural crops and/or livestock on the same plot/unit of land, either simultaneously or sequentially." (Nair, 1993) [17]. While agroforestry systems are thought to increase or at least sustain the amount of organic matter in soil (Young, 1989) [29, 30], intensive cropping reduces humus over time and causes rapid degradation of soil physical properties (Lal, 1989) [13]. Agroforestry has the ability to recover and preserve soil fertility, monitor and prevent soil erosion, control and prevent water harvesting and eutrophication of streams and rivers, increase local biodiversity, minimise the process of soil being acidic (acidification), reduce fuel pressure on natural forests, provide livestock feed, increase productivity, and strengthen and as well as to boost people's living conditions in developed countries (Stadtmüller, 1994) [26].

Rural people are found to have rich indigenous knowledge and have adapted trees with productive systems in areas in which they have been living for a very long time (Evans and Alexander, 2004) [9]. Intercropping agroforestry trees with crop plants involves sequence systems in which trees and crops occur in various times on the same piece of ground and parallel systems in which trees and crops are grown simultaneously on the same piece of ground. The related proportions of trees and plants and their spatial arrangements can vary widely between complex systems (Young, 1989) [29, 30].

Rice (*Oryza sativa*) is grown in over a hundred countries worldwide. It is the primary source of nutrition for 60% of the world's population. Rice (*Oryza sativa* L.) is the state's most important crop, responsible for about 3.7 million hectares (mha), or about 81 percent of agricultural land during the rice season. Around 85 percent of the rice is grown in rain-fed conditions, and about 8-10 percent of the rice is grown in big bunds. In general, modern bunds (with a width and height of 1.5 m) are built around paddy fields for one or two years to cultivate upland crops (Bargalli *et al.*, 2009). Following that, the bunds are left fallow and are inhabited by naturally growing tree species. Naturalized trees on bunds and boundaries in Chhattisgarh's plains form an important traditional agroforestry method, with *Acacia nilotica*, *Butea monosperma*, *Terminalia tomentosa*, and *Albizia procera* dominant.

Tree shadow is considered to be the cause of reduced crop returns in grouped plantations including those who appreciate the shade and are vulnerable to shade. If the tree is not pruned, this condition is more serious. Shade has a major impact on the productivity of rice crops. The height, panicle/hill, and panicle/grain are reduced and the production of grain is reduced. Shade promotes cell development and speedy cell division and increases the length and height of the plant blade (Schoch, 1972) [23]. The shadowing impact of trees may be attributable to less rice yield near the frontier plantation trees.

Study Area

The study was carried out in Village Bade Urla, Block Abhanpur which is located in Raipur District, Chhattisgarh at an elevation of 310 metres above sea level. The research area is located at 2103'50.1"N longitude and 81046'14.5"E latitude. The research region has a dry humid tropical climate with three seasons: rainy, winter, and summer. The rainy season starts from mid-June to the end of October. The winter season starts at the beginning of November and continues until the end of February. The beginning of March represents the start of the summer season. It is very long and continues until the monsoon comes. The soil condition in the study region is Inceptisols, which is also known as Matasi locally. These soils are called immature because they have a poor soil profile, lighter texture, and a shallow to moderate depth. They are deficient in organic matter and usable nutrients, allowing grasslands and degraded forests to grow. These soils are most prevalent in the eastern and southern parts of the country.

Materials and Methods

Paddy fields along with *Tectona grandis* trees plantation on field bunds were selected. The effect of Sagon (*Tectona grandis*) trees on paddy was estimated by studying crop parameters like plant height at 30 DAT, 60 DAT, 90 DAT, number of total tillers m^{-2} at harvest, , number of effective tillers m^{-2} at harvest, dry matter accumulation $hill^{-1}$ (g), panicle weight $plant^{-1}$ at harvest, panicle length $plant^{-1}$ at harvest, number of filled and unfilled grains $panicle^{-1}$ at harvest, grain yield & straw yield (q ha^{-1}). For the measurements of paddy crop, sample plots of 1 m^2 were laid in a line running perpendicular to the tree line according to the shade effect of Teak. In each sampling plot, numbers of hills were counted for the total number of tillers where data analysis has done by T-test.

Result and Discussion

Plant height

The results on plant height (cm) at various growth stages of rice crop (30 days after transplanting, 60 days after transplanting and 90 days after transplanting i.e at harvest) are presented in Table 1 and figure 1 under control and *Tectona grandis* based agroforestry system.

Results showing that, 30 days after transplanting at control (35.14 cm) growth of plant height in paddy crop was maximum and the minimum growth in shade of *Tectona grandis*, i.e. (33.64 cm) and 60 days after transplanting data shows that the average growth in plant height of the Paddy crop was maximum in control (73.39 cm) and minimum in under the shade of *Tectona grandis* i.e., (70.59 cm). At harvest in 90 days after transplanting, the plant height was highest at control (111.6 cm), while the lowest was under the shade of *Tectona grandis* (109.4 cm).

The result showed that shade condition affected the plant height of rice which is in agreement of the result found by Vitryakon *et al.* (1993) [28] and Verma *et al.*, (2016) [27].

Table 1: Plant height at different growth stages of rice as influenced by control and *Tectona grandis* based agroforestry system

		Plant height (cm)	
Treatment	30 DAT	60 DAT	90 DAT
Control	35.14	73.39	111.60
Under the shade of Teak	33.64	70.59	109.40
SEm±	0.07	0.09	0.09
t value	2.76	4.77	4.11
Significance	S	S	S

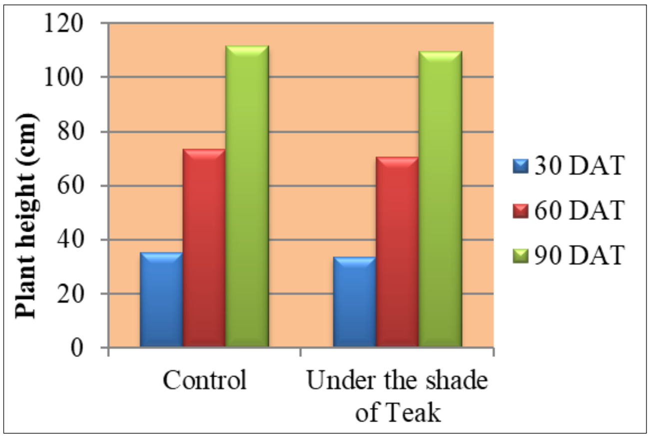

Fig 1: Plant height at different growth stages of rice as influenced by control and *Tectona grandis* based agroforestry system

Yield attributes of rice

Observation on number of total tillers m^{-2} at harvest, number of effective tillers m^{-2} at harvest, dry matter accumulation $hill^{-1}$ at harvest, panicle weight $plant^{-1}$ at harvest, panicle length $plant^{-1}$at harvest, number of filled grains $panicle^{-1}$ at harvest and number of unfilled grains $panicle^{-1}$ at harvest was measured while comparing crop parameters at agroforestry to control farming.

The data on number of total tillers m^{-2} at harvest has been presented in Table 2 & Fig. 2 showed that the average number of tillers m^{-2} at harvest was significantly higher in control (146.46) i.e. light condition and lowest in under shade of *Tectona grandis* (117.93).

As the tree line became more increased, the number of tillers m^{-2} of rice increased, similar with the finding of Chauhan *et al.* (1995) [4], Lalitha *et al.*, (1999) [14], Kemp and Whingwiri (1980) [11] and George *et al.*, (1998) [10].

Table 2: Yield attributes of rice as influenced by control and *Tectona grandis* based agroforestry system

Treatment	Number of total tillers m^{-2} at harvest	Number of effective tillers m^{-2} at harvest	Dry matter accumulation $hill^{-1}$ (g) at harvest	Panicle weight $plant^{-1}$ (g) at harvest	Panicle length $plant^{-1}$ (cm) at harvest	Number of filled grains $panicle^{-1}$ at harvest	Number of unfilled grains $panicle^{-1}$ at harvest
Control	146.46	121.85	13.54	21.32	27.74	193.31	50.54
Under the shade of Teak	117.93	85.08	11.61	18.41	26.56	183.39	58.51
SEm±	1.22	1.34	0.06	0.11	0.04	0.34	0.27
t value	3.15	4.17	4.49	3.88	3.77	4.64	4.65
Significance	S	S	S	S	S	S	S

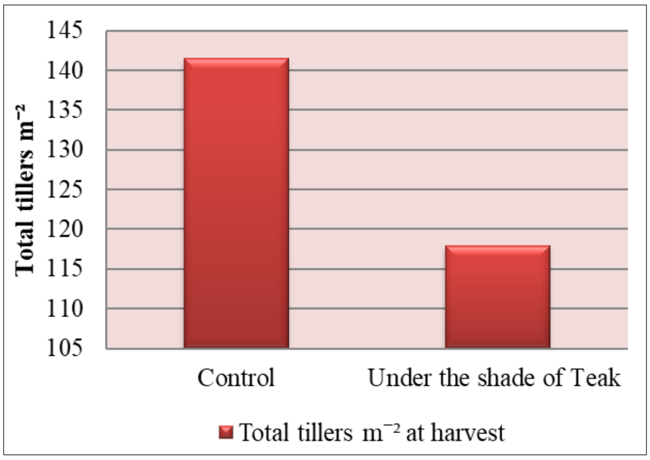

Fig 2: Number of total tillers m^{-2} at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

Result indicates that there is a significance difference in no of effective tillers m^{-2} at harvest in both the condition. The data on effective number of tillers m^{-2} at harvest has been presented in Table 2; Fig. 3 showed that the number of effective tillers m^{-2} at harvest was significantly highest in control (121.85) i.e. light condition and lowest in under shade of *Tectona grandis* (85.08).
This result is supportive to the findings of Nayak and Murty (1980) [18] & Singh *et al.*, (2008) [25] which reported that effective number of tillers per hill of rice was decreased due to low light.

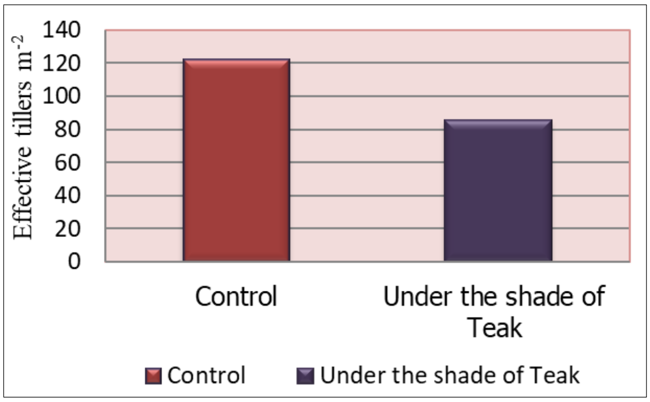

Fig 3: Number of effective tillers m^{-2} at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

The data on dry matter accumulation $hill^{-1}$ has been presented in Table 2 and fig 4. Dry matter accumulation $hill^{-1}$ was observed significantly higher in control (13.54 g $hill^{-1}$) and lowest in under shade of *Tectona grandis* (11.61 g $hill^{-1}$) with the findings of Singh *et al.*, (2008) [25] & Dhillon *et al.*, 1998 [5].

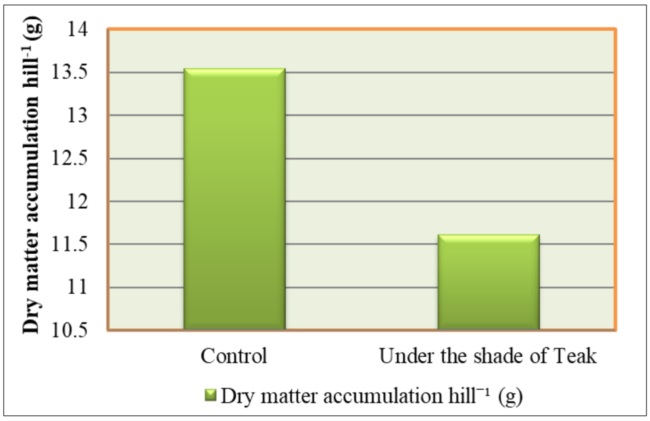

Fig 4: Dry matter accumulation $hill^{-1}$ (g) at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

The data of panicle weight $plant^{-1}$ of paddy (g) and t test values on panicle weight (g) at harvest has been presented in Table 2 and fig. 5. Significantly highest panicle weight at harvest was observed under control condition (21.32 g/plant) and lowest under shade of *Tectona grandis* (18.41 g/plant). These results are in conformity with the studies of Moss *et al.*, (1961) [16] and Dhillon *et al.*, (1979, 1982, and 1984) [6, 7, 8].

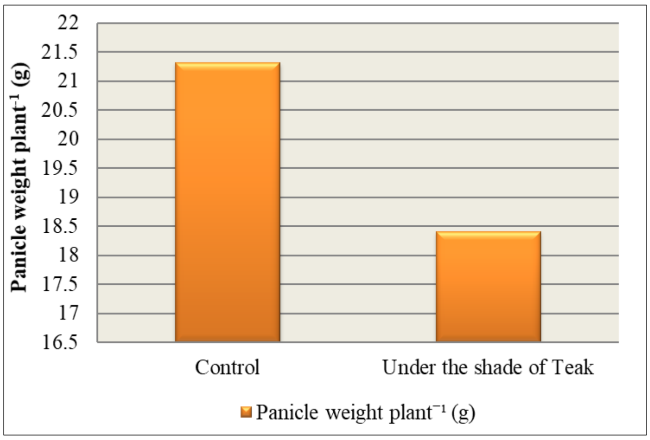

Fig 5: Panicle weight $plant^{-1}$ (g) at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

The data on panicle length of paddy in cm and t test values on panicle length $plant^{-1}$ (cm) at harvest has been presented in Table 2 and fig 6. Significantly highest panicle length $plant^{-1}$ at harvest was observed under control condition (27.74 cm/plant) than under shade of *Tectona grandis* (26.56 cm/plant). This finding is supported of Park and Kwon (1975) [21], where they stated that generating shading gradually reduced the panicle length and decreased rice yields during the growth and ear formation phase.

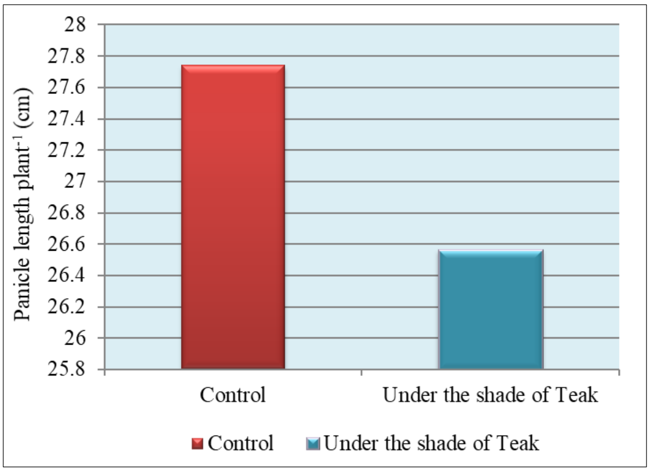

Fig 6: Panicle length plant^{-1} (cm) at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

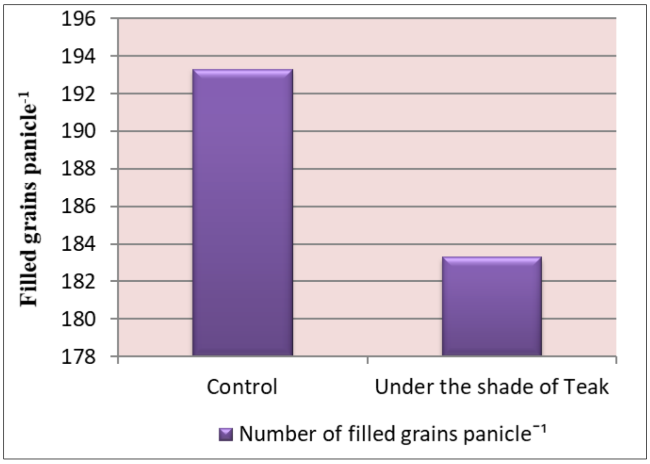

Fig 7: Number of filled grains panicle^{-1} at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

The data on number of filled grains per panicle are presented in Table 2 and fig. 7. Shows the result revealed that average maximum number of filled grains panicle^{-1} at harvest was recorded in control (193.31 grain/panicle) and minimum was found when the crop was grown under shade of Teak (183.39 grain/panicle). Similar result also found by Chaturvedi and Ingram (1989) [3], who observed that pre-flowering shade, resulted in reduced grain panicle^{-1} in rice.

The data on number of unfilled grains panicle^{-1} at harvest are presented in Table 2 and fig. 8. Shows the result revealed that maximum number of unfilled grains panicle^{-1} was recorded in under the shade of *Tectona grandis* (58.51 grains/panicle) and minimum were found when the crop was grown under control (50.54 grains/panicle). Similar result also found by Chaturvedi and Ingram (1989) [3].

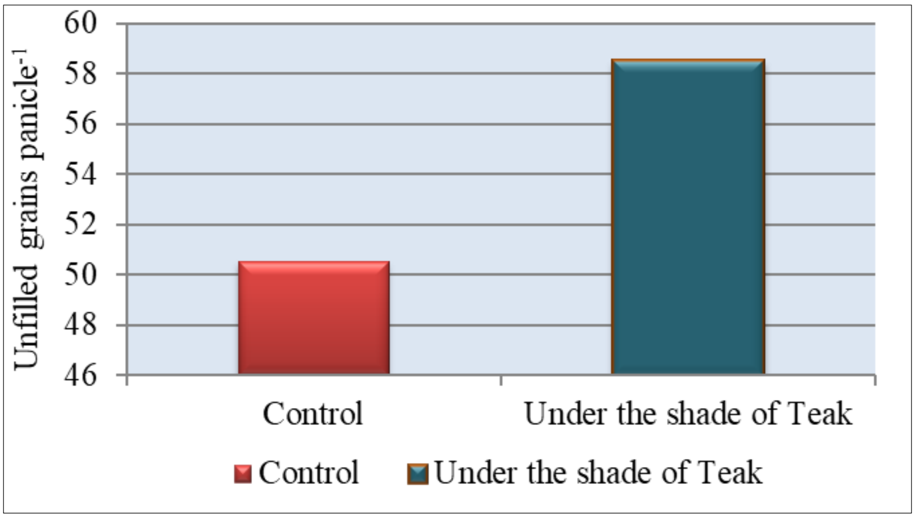

Fig 8: Number of unfilled grains panicle^{-1} at harvest of rice as influenced by control and *Tectona grandis* based agroforestry system

Grain & Straw Yield

Table 3: Grain and straw yield (q ha^{-1}) of rice as influenced by control and *Tectona grandis* based agroforestry system

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Control	39.11	44.54
Under the shade of Teak	35.39	41.58
SEm±	0.13	0.11
t value	4.41	3.71
Significance	**S**	**S**

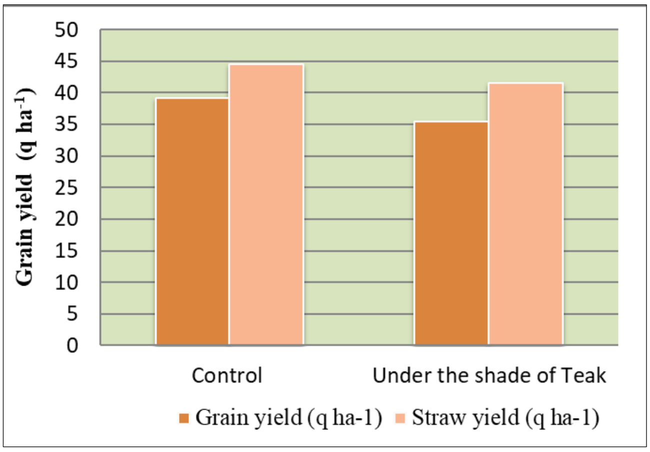

Fig 9: Grain and straw yield (q ha^{-1}) of rice as influenced by control and *Tectona grandis* based agroforestry system

The result on grain yield (q ha^{-1}) of paddy crop are presented in Table 3 and Fig. 9. At control (without trees) produced significantly higher grain comparison to *Tectona grandis* based agroforestry system. The maximum number of grain yield was found at control (39.11 q ha^{-1}) and minimum was found in under shade of *Tectona grandis* (35.39 q ha^{-1}). The grain yield was significantly influenced by light and shade of tree. The grain production of rice was severely influenced by the boundary planting of *Tectona grandis*. Dhillon *et al.* (1984) [8], Sharma (1992) [24] have also found similar findings.
The result on straw yield (q ha^{-1}) of paddy is presented in Table 3 and Fig. 9. Maximum straw yield was found in control (44.54 q ha^{-1}) when the crop was grown at open condition and minimum was found in under shade of Teak (41.58 q ha^{-1}) when the crop was grown under shade of Teak. The straw production was significantly influenced by light and tree shadow. The same results were obtained by Newaj *et al*. (2007) [19].

Conclusion

The result shows that the boundary plantation of Teak (*Tectona grandis*) had an adverse effect on growth and yield of rice due to the shade effect of tree. The impact on growth resources of Teak boundary plantation differs with the different dbh and crown width of the tree row and distance from the tree line. Thus, the adverse impact of the tree line on maximum growth and yield of rice under the shade of *Tectona grandis*. The yield and yield characteristics of rice increases as the distance from the tree line increases. The width of the crown has an important effect, as the trees significantly reduce the yield and yield attributes of rice to the maximum width of the crown and has less impact on the minimum width of the crown. In the competition between trees and crops, light is the main factor. In various ways, the strength of light was decreased by the tree canopy to variable distances from the tree line. Thus it can be concluded that minimum crown width and increasing distance from the tree line of *Tectona grandis* has a lesser effect on the growth and yield of rice as compared to the trees growing in a maximum crown width and near the tree line.

References

1. Bargali SS, Bargali K, Singh L, Ghosh L, Lakhera ML. *Acacia nilotica* based traditional agroforestry system: effect on paddy crop and management. Current science. 2009;96(4):25.
2. Binchy A, Morgan JV. Influence of light intensity and photoperiod on inflorescence initiation in tomatoes. Irish Journal of Agriculture Research. 1970;9:261-269.
3. Chaturvedi GS, Ingram KT. Growth and yield of lowland rice in response to shade and drainage. Crop Science. 1989;14:61-67.
4. Chauhan VK, Sood SK, Bhargava JN, Mishra VK. Effect of different trees on the yield of wheat crop. Annals of Forestry. 1995;3:147-151.
5. Dhillon GPS, Dhanda RS, Dhillon MS. Performance of wheat under scattered trees of kikar (*Acacia nilotica*) under rainfed condition in Punjab (India). Indian Forester. 1998, 48-53.
6. Dhillon GS, Grewal SS, Atwal AS. Developing agri silviculture practices. Effect of farm trees (Eucalyptus) on adjoining crops. Indian Journal of Ecology. 1979;6(11):88-96.
7. Dhillon GS, Singh S, Dhillon MS, Atwal AS. Developing agri-silvicultural practices. Studies on the shading effect of Eucalyptus on the yield of adjoining crop. Indian Journal of Ecology. 1982;9(2):228-236.
8. Dhillon MS, Singh Atwal S, Dhillon GS, Singh S. Developing agrisilvicultural practices Effects of *Dalbergia sissoo* and *Acacia nilotica* on the yield of adjoining crops. Indian Journal of Ecology. 1984;11(2):249-253.
9. Evans A, Alexander I. Organic Farming Supports Biodiversity in Farming with Nature, Low external Input and Sustainable agriculture. Amersfoort, the Netherlands, 2004, 36.
10. George EB, Sreedevi P, Nair VR. Effect of shade on plant characteristics and net assimilation rate of ginger cultivars. Journal of Tropical Agriculture. 1998;36:65-68.
11. Kemp DR, Whingwiri EE. Effect of tiller removal and shading on spikelet development and yield components of the main shoot of wheat and on the sugar concentration of the ear and flag leaf. Australian Journal of Plant Physiology. 1980;7:501-510.
12. Kudrjavacev VA. The effect and light intensity on accumulation and dry matter and carbohydrate metabolism in tomatoes. Fiziol. Rast. 1964;11:406-416.
13. Lal R. Agroforestry systems and soil surface management of tropical alfisol. Water runoff, soil erosion and nutrient loss. Agroforestry systems. 1989;8:97-111.
14. Lalitha K, Reddy RD, Rao NSBS. Influence of temperature and sunshine hours on tiller production in lowland rice. Journal of Agrometeorology. 1999;1(1):187-190.
15. Miah MG, Rahman MA, Haque MM. Performance of onion under different reduced light levels for agroforestry and intercropping systems. Tropical Agriculture. 1999;22:31-38.
16. Moss DN, Musgrave RB, Lemon ER. Photosynthesis under field conditions. Some effects of light, carbon dioxide, temperature, and soil moisture on photosynthesis, respiration and transpiration of corn. Crop Science. 1961;1:83-87.
17. Nair PKR. Introduction to Agroforestry. Kluwer, Dordrecht, The Netherlands, 1993, 499.
18. Nayak KS, Murty KS. Effect of varying light intensities on yield and growth parameters in rice. Indian Journal of Plant Physiology. 1980;23:309-316.
19. Newaj R, Dar SA, Bhargava MK, Yadav RS, Ajit. Effect of management practies on growth of white siris (*Albizia*

procera), grain yield of intercrops, weed population and soil fertility changes in agrisilviculture system in semi-arid India. Indian Journal of Agricultural Sciences. 2007;77(7):403-407.
20. Pandey CB, Pandya KS, Pandey D, Sharma RB. Growth and productivity of rice (*Oryza sativa*) as affected by *Acacia nilotica* in a traditional Agroforestry system. Tropi. Ecol. 1999;40:109-117.
21. Park H, Kwon HG. Effect of shading and air temperature on the productivity of Jinheung and IR667 rice. Korean Journal of Soil Science and Fertilizer. 1975;8:183-188.
22. Puri S, Bangarwa KS. Effects of trees on the yield of irrigated wheat crop in semi-arid regions. Agroforestry System. 1993;20:229-241.
23. Schoch PG. Effects of shading on structural characteristics of the leaf and yield of fruit in Capsicum annum. J. Amer. Soc. Hort. Sci. 1972;97(4):461-464.
24. Sharma KK. Wheat cultivation in association with *Acacia nilotica* (L.) Wild. Ex DeI. field bund plantation. Agroforestry Systems. 1992;17:43-57.
25. Singh L, Ghosh L, Bargali SS, Saxena RR. Influence of naturally occurring trees on bunds and their impacts on yield parameters of Paddy Crops. Range Management and Agroforestry. 2008;29(2):134-137.
26. Stadtmüller T. Impacto hidrológico del Manejo Forestal en bosques naturales tropicales: medidas para mitigarlo. Turrialba, C.R., CATIE, 1994. 62p.
27. Verma S, Singh V, Verma DK, Giri SP. Agroforestry practices and concepts in sustainable land use systems in India. International Journal of Forestry and Crop Improvement. 2016;(7):126-131.
28. Vityakon P, Sae-Lee S, Seripong S. Effects of tree leaf litter and shading on growth and yield of paddy rice in Northeast Thailand. Kasetsart J. (Nat. Sci.). 1993;27:219-222.
29. Young A. Agroforestry for Soil conservation and Erosion Control, CAB International, Wallingford, UK, 1989a, 102-115.
30. Young A. Agroforestry for Soil Conservation. CAB International, Wallingford, and International Council for Research in Agroforestry, Narobi, 1989, 276.