Effect of Tree-Rice Associations and Orientations on the Incidence of Major Diseases of Rice

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Abstract: This experiment was conducted to determine the effect of tree species associations with different orientations grown as intercrop with rice on the incidence of major rice diseases (Bacterial leaf blight, Blast, Sheath blight and Brown spot). Jhau-rice association developed least incidence of four major diseases and the highest disease severity was recorded in Sissoo-rice association. The highest and lowest severity were recorded in O_3 and O_0, respectively. Out of five tree-rice associations highest yield (4.345 t ha^{-1}) was obtained in case of Jhau-rice (T_2) association and lowest yield (2.550 t ha^{-1}) was recorded in Sissoo-rice (T_5) association. Regarding different orientations, The highest yield (5.486 t ha^{-1}) was obtained from open field (O_0-orientation) and the lowest yield (1.522 t ha^{-1}) was recorded in North-1.5 meter from the tree base (O_3).

Key words: Rice, tree, association, orientation, rice diseases

Introduction

In Agroforestry systems, interaction between trees and crops (or animals) is the heart because sharing of the common resources by different species is the common phenomenon. However, these interactions should take place with respect of how the component of agroforestry utilize and share the resources of the environment and how the growth and development of any of the components will influence the others (Torquebiau, 1994). Farmers in Bangladesh practice monoculture of rice. As a result, the incidence of various types of disease occurs causing yield loss greatly as well as decreasing the fertility and productivity of land. In this context, if farmer adopted the simultaneous cultivation of rice along with inter-cropping of suitable tree-species practiced, the overall production may be increased. Under such production system, the incidence of major rice diseases and their effects on yield is necessary to determine. Keeping this view in mind, this experiment has been undertaken to determine the effect of tree species association with different orientations grown as intercrop with rice on the incidence of major rice diseases-Bacterial leaf blight (BLB), Blast, Sheath blight and Brown spot.

Materials and Methods

The experiment was conducted at the Field Laboratory, Department of Agroforestry, Bangladesh Agricultural University (BAU), Mymensingh during June to November, 1999. The experiment was carried out by randomize complete block design (RCBD). Following five tree species (T) and eight orientations (O) were used:

Tree-rice species
T_1 = Albida (*Acacia albida*)
    O_0 = Out side of the tree canopy (control)
T_2 = Jhau (*Casuarina equisetifolia*)
    O_1 = South–1.5 meter from tree base
T_3 = Eucalyptus (*Eucalyptus camaldulensis*)
    O_2 = South–3.0 meter from tree base
T_4 = Akashmoni (*Acacia auriculiformis*)
    O_3 = North–1.5 meter from tree base
T_5 = Sisso (*Dalbergia sissoo*)
    O_4 = North–3.0 meter from tree base
    O_5 = East–1.5 meter from tree base
    O_6 = East–3.0 meter from tree base
    O_7 = West–1.5 meter from tree base
    O_8 = West–3.0 meter from tree base

These tree species and orientations were used in rice var. BR 11 field. Thirty two days seedlings of rice var. BR 11 were collected and two or three seedlings/hill were transplanted in the prepared main field. The data were recorded on severity of Bacterial leaf blight (BLB), Blast, Sheath blight and Brown spot following IRRI recommended grading scale (Standard Evaluation System for Rice, 1988) and on yield. The collected data analyzed following the appropriate design of the experiment. Duncan's multiple range test (DMRT) were done in order to show the significant differences between the treatments means (Zaman et al., 1982).

Results and Discussion

Four diseases viz. Bacterial leaf blight, Blast, Sheath blight and Brown spot were observed at flag leaf stage. The severity of Bacterial leaf blight, Blast, Sheath blight and Brown spot varied significantly under different associations. Out of five tree-rice associations, Jhau-rice (T_2) combination yielded lowest infection of all the four major diseases followed by Albida-rice (T_1) and Eucalyptus-rice (T_3) combinations (Table 1). On the contrary, Sissoo-rice association developed highest incidence of all the diseases. The severity grade of Bacterial leaf blight ranged from 3.085 to 4.833, where the highest severity was observed in case of Sissoo-rice association (T_5) and the lowest severity was found in T_2. In case of Blast, the severity grade ranged from 1.496 to 2.670, where the highest severity was in T_5 and the lowest severity were recorded in association of T_2 and in association of T_1. The severity grade of Sheath blight ranged from 2.081 to 3.363. The plants of T_5 and T_2 resulted maximum and minimum Sheath blight severity, respectively. The severity grade of Brown spot ranged from 3.185 to 4.533, where the higher severity was observed in T_5; while the lower severity of the disease was recorded in T_2 and T_1, respectively. In general, total yield gradually decreased with the increase of disease incidence in all cases. Out of five tree-rice associations highest yield (4.345 t ha^{-1}) was obtained in case of T_2 association, when all the four major diseases were recorded at lowest severity. The lowest yield (2.540 t ha^{-1}) was recorded in case of T_5 where all the four major diseases were obtained at highest severity.

The treatments varied significantly regarding the severity of Bacterial leaf blight, Blast, Sheath blight and Brown spot. From the orientations effect it appeared that, plants of O_2-orientation (South-3 meter from the tree base) suffered least by all the major diseases followed by O_8 (West-3 meter from the tree base). The severity grade of bacterial leaf blight (BLB) ranged from 1.747 to 6.273 among the treatments, where the highest severity was observed in case of North-1.5 meter from tree base (O_3) and lowest severity was found in O_0 (control plot) (Table 2). In case of Blast, the highest severity grade (3.927) was

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Table 1: Effect of different tree-rice associations on the incidence of major diseases of rice

Tree-rice associations	Average disease severity grade				
	*BLB	Blast	Sheath blight	Brown spot	Yield (t ha^{-1})
T$_1$ = Albida-BR11	3.333d	1.496d	2.411d	3.252d	3.794b
T$_2$ = Jhau-BR11	3.085e	1.496d	2.081e	3.185d	4.345a
T$_3$ = Eucalyptus-BR11	3.922c	2.070c	3.067c	3.648c	3.151c
T$_4$ = Akashmoni-BR11	4.378b	2.263b	3.233b	3.989b	2.919d
T$_5$ = Sisso-BR11	4.833a	2.670a	3.363a	4.533a	2.540e
LSD (P = 0.1)	0.0848	0.1711	0.0988	0.1199	0.1975

*BLB: Bacterial Leaf Blight

Table 2: Development of major rice diseases at different orientations of the tree-rice associations

Orientations	Average disease severity grade				
	*BLB	Blast	Sheath blight	Brown spot	Yield (t ha^{-1})
O$_0$ = Out side of the tree canopy (control)	1.747i	0.773f	0.866h	2.037h	5.486a
O$_1$ = South−1.5 m from tree base	3.193f	1.760d	2.320e	3.433e	3.264d
O$_2$ = South−3.0 m from tree base	2.307h	0.966ef	1.433g	2.780g	4.838b
O$_3$ = North−1.5 m from tree base	6.273a	3.927a	5.067a	5.260a	1.522f
O$_4$ = North−3.0 m from tree base	4.940c	2.787b	3.840c	4.380c	2.545e
O$_5$ = East−1.5 m from tree base	5.573b	2.740b	4.047b	4.653b	2.288e
O$_6$ = East−3.0 m from tree base	4.073e	1.767d	2.940d	3.940d	3.068d
O$_7$ = West−1.5 m from tree base	4.200d	2.080c	2.867b	3.940d	3.113d
O$_8$ = West−3.0 m from tree base	2.867g	1.193e	2.100f	3.080f	4.041c
LSD (P = 0.1)	0.113	0.229	0.1325	0.1609	0.2650

*BLB: Bacterial Leaf Blight

recorded in O$_3$ and the lowest severity (0.773) was found in O$_0$. The severity grade of Sheath blight ranged from 0.866 to 5.067, where the highest severity (5.067) was observed in O$_3$ and the lowest severity (0.866) was found in O$_0$-orientation, Brown spot severity ranged from 2.03 to 5.26, while the highest and lowest severity were recorded in O$_3$ and O$_0$, respectively. North orientation produced significantly the lowest yield and the highest yield was recorded in South orientation followed by West orientation. On the other hand, the total yield increased as the distances from the tree base increases. The highest yield (5.486 t ha^{-1}) was obtained from open field (O$_0$). The lowest yield (1.522 t ha^{-1}) was recorded in O$_3$, where, all the four major diseases were observed at highest severity.

In these investigations, Jhau-rice association developed least incidence of four major diseases viz. Bacterial leaf blight, blast, sheath blight and brown spot, where light intensity in all the orientation was higher compared to that of other four associations. On the other hand, the highest disease was recorded in Sissoo-rice association, where mean season light intensity was lowest. From the result, it appeared that light interception in different orientations of Jhau was higher although Jhau possesses the largest canopy volume. The rice plants grown under Jhau tree developed least incidence of all the disease. On the contrary Sissoo have the smallest canopy volume but light penetration through it was minimum and disease development was higher. From the above results, it revealed that light has direct relationship with the disease development of rice. Development of higher incidence of diseases in the rice plants grown under Sissoo tree was probably due to the poor penetration of light through the canopy area of Sissoo. As there was no research report on tree-rice joint production system, these findings can not be compared with other. Although, there was no direct report on tree-rice agroforestry system, influence of light on disease development in monocropping system showed that light intensity is directly correlated with disease development of rice (Abe, 1931; Endo, 1935; Naito, 1937). Shading resulted good disease incidence and is supported by Imura (1938, 1940), Suzuki and Yoshimura (1963).

It has been recorded that out of five tree-rice associations, the highest yield was obtained in case of Jhau-rice (T$_2$) association and lowest yield was recorded in Sissoo-rice (T$_5$) association. Regarding different orientations, the highest yield was obtained from open field (O$_0$-orientation) and the lowest yield was recorded in North-1.5 meter from the tree base (O$_3$-orientation). Similar results have been reported by Jadhav (1987) and Chaturvedi and Ingram (1989).

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