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INFLUENCED OF CULTURAL PRACTICES ON LEAF BLIGHT DISEASE SEVERITY (*Xanthomonas oryzae* pv. *Oryzae*) AND YIELD OF PSBRC72H

***Juan P. Agudera, Jr.**

Department of Agriculture, Southern Philippines Agribusiness Marine and Aquatic School of Technology- College of Agricultural Sciences (SPAMAST-CAS), Matti, Digos City, Philippines

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ABSTRACT

The study influenced of cultural practices on leaf blight disease (*Xanthomonas oryzae* pv. *oryzae*) severity and yield of PSBRc72H was conducted to identify combinations of different cultural practices that will gave conditions unfavorable to bacterial leaf blight disease and its' influence on the agronomic characteristics and yield of PSBRc72H. The experiment was laid out in strip – split plot arranged in Randomized Complete block Design (RCBD) replicated three times

The analyses showed the following findings:

1. The applications of controlled irrigation practices such as applied once a week, saturated and intermittent, any of the four NPK rates (80-60-120, 100-60-120, 80-80-140 and 100-80-140) and planting at 20 x 30 and 30 x 30 cm gave conditions unfavorable to bacterial leaf blight disease.
2. The applications of controlled irrigation practices such as applied once a week, saturated and intermittent and any of the four NPK rates (80-60-120, 100-60-120, 80-80-140 and 100-80-140) did not affect the following agronomic characteristics: number of tillers at 30 and 60 DAT, unproductive and productive tillers and the number of days to heading. However, plant heights became taller when irrigated continuously. The number of tillers at 30 and 60 DAT and unproductive tillers were lesser, the plant height and number of days to heading were shorter when planted at a closer distance (20 x 20 cm) and more tillers at 30 and 60 DAT and unproductive tillers, taller plant height and longer number of days to heading when planted at a wider distance (20 x 30 and 30 x 30 cm). On the other hand, yield was higher if applied with continuous irrigation and planted at 20 x 20 and 20 x 30 cm than applied with a controlled irrigation such as intermittent, saturated and once a week and planted at wider distance (30 x 30 cm). Applications of any of the four NPK rates (80-60-120, 100-60-120, 80-80-140 and 100-80-140) did not affect the yield.

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INTRODUCTION

Rice production in the Philippines is confronted with tremendous pressures from four fronts: first, the annual population growth of 2.3 percent; second, the reduction of prime agricultural lands due to urbanization, industrialization, and degradation; third, the yield potential of modern rice varieties leveled off during the past two decades, the country's average yield ranged from 2.7 – 3.07 tons per hectare only despite collective and intensified efforts done; and fourth, the rice importation, a practice resorted to in times of deficits, cannot be a sustainable strategy for attaining food security. The world rice market is highly volatile; with only 4 percent of the total production enter the world market (Obien, 1998). A major strategy that can be used to address this enormous challenge is to increase the yield of rice per unit area per unit time.

Corresponding author: Juan P. Agudera, Jr.
Department of Agriculture, Southern Philippines Agribusiness Marine and Aquatic School of Technology- College of Agricultural Sciences (SPAMAST-CAS), Matti, Digos City, Philippines

Amongst currently available technologies, the use of F_1 hybrids in commercial rice production is foreseen to give a major contribution to meet the demands of the society. Recognizing the potential of hybrid rice to increase local rice production and the prospects the technology offers in terms of increasing the profitability of rice farming, the Philippine government launched a comprehensive Hybrid Rice Program in 1998 under the Department of Agriculture (De leon *et al*., 2003). However, susceptibility to leaf diseases is one of the major problems encountered in F_1 cultivation. Based on disease assessment, the most important diseases were bacterial leaf blight (BB) and rice blast (Gaspar *et al.*, 2002). BB is an important bacterial disease (Mew, 1987) as cited by Suryadi *et al*. (2004). Specifically, the study was conducted to identify combinations of different cultural practices that will give conditions unfavorable to bacterial leaf blight and other diseases, determine the effect of the combinations of different cultural practices on the yield and agronomic characteristics and accounts the different cultural practices, agronomic characteristics, yield components and severity of bacterial leaf blight and other diseases in the variation in yield of PSBRc72H.

MATERIALS AND METHODS

The materials used were certified seeds of PSBRc72H, triple beam balance, planting markers, stakes and field tags. The study was conducted at Agricultural Experiment Station rice area of Central Mindanao University, University Town, Musuan, Bukidnon, Philippines. The experiment was laid out in strip – split plot arranged in Randomized Complete block Design (RCBD) replicated three times. The treatments were:

Horizontal treatments (NPK rate in kg / ha)

F_1 - 80 – 60 – 120 (RR / ha)
F_2 - 100 – 60 – 120
F_3 - 80 – 80 – 140
F_4 - 100 – 80 – 140

Vertical treatments (Irrigation practices)

I_1 – intermittent (intervals of 7 days with 5 cm water depth and 7 days with no water).
I_2 – continuous (maintenance of 5 cm water depth)
I_3 – saturated (maintenance of 1 cm water depth)
I_4 – once a week (intervals of with 5 cm water depth for 2 days and with no water for 5 days)

Subplots (planting distance)

D_1 - 20 cm x 20 cm
D_2 - 20 cm x 30 cm
D_3 - 30 cm x 30 cm

Severity rating was done at hard dough stage on ten flag leaves at random per subplot using the scale (Chaudhary, 1996) below:

Scale	(% lesion area)
1	0 – 3
2	4 – 6
3	7 – 12
4	13 – 25
5	26 – 50
6	51 – 75
7	76 – 87
8	88 – 94
9	95 – 100

Percent severity was computed using the disease index formula below:

$$\text{Disease Index (DI)} = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5 + 6n_6 + 7n_7 + 8n_8 + 9n_9}{9N} \times 100$$

where:

N – number of samples (10 samples)
9 – represents the highest scale
$n_1+n_2+\ldots+n_9$ – number of leaf showing the scale of 1 – 9

The actual grain yield was determined by harvesting the middle rows in the sub-plot excluding one hill at each row ends; number of harvested hills was recorded. Grains was threshed, dried and cleaned before weighing. Corrected plot yield (grams) and yield (kilogram / hectare) were computed as follows:

$$\text{Corrected plot yield (g)} = \frac{\text{wt. of harvest (g)}}{\text{no. of hills harvested}} \times \text{no. of possible hills / subplot}$$

$$\text{Grain yield (kg/ha)} = \frac{\text{corrected plot yield (g)}}{1{,}000 \text{ g / kg}} \times \frac{10{,}000 \text{ m}^2}{\text{harvested plot area (m}^2)} \times \text{MF}$$

where: MF - is the moisture factor so that yield would be based on 14% moisture.

$$\text{MF} = \frac{100 - \text{moisture content at weighing time}}{86}$$

All data gathered from the study were analyzed and interpreted using the analysis of variance (ANOVA) in Strip – Split Plot Design, the Duncan Multiple Range Test (DMRT) was used to determine the significant differences among treatment means.

RESULTS AND DISCUSSION

The severity of bacterial leaf blight disease (Table 1.) was influenced by irrigation practices and planting distances. Plants with continuous irrigation (I_2) significantly had the highest severity of bacterial leaf blight with a mean of 26.08% followed by saturated (I_3), intermittent (I_1) and once a week (I_4) irrigation practices with a comparable means of 17.50, 17.14 and 15.75%, respectively. Plants spaced at 20 x 20 cm (D_1) significantly had the highest severity of bacterial leaf blight disease with mean of 21.04% followed by plots planted at a distance of 20 x 30 (D_2) and 30 x 30 cm (D_3) with comparable means of 18.65 and 17.67%, respectively. On the other hand, the low disease severity obtained in intermittent (I_1), saturated (I_3) and once a week (I_4) irrigation practices and planting at wider distances (20x30 and 30x30 cm) provided conditions unfavorable for the disease. NPK rates did not influence the severity of bacterial leaf blight disease. Variations among means were found non-significant. No interaction effects were noted on different irrigation practices x NPK rates, irrigation practices x planting distances, NPK rates x planting distances and irrigation practices x NPK rates x planting distances. This indicated that the different factors independently influenced the severity of bacterial leaf blight disease

Meanwhile, the means of agronomic characteristics were presented in Table 2. The planting distances significantly influence the number of tillers per hill at 30 and 60 DAT. Plants planted at wider distance (30 x 30 cm) (D_3) had the highest number of tillers counted per hill followed by those planted at closer distance (20 x 30 cm) (D_2) and (20 x 20 cm) (D_1) with highly significant differences on means of 19.17, 16.83 and 15.48 tillers per hill, at 30 DAT and 23.44, 17.35 and 13.33 tillers per hill at 60 DAT, respectively. The result showed that plants planted at a wider distance produced more tillers than those planted at a closer distance. Irrigation practices and NPK rates did not influence the number of tillers per hill at 30 and 60 DAT. Variation among means were found non-significant.

Table 1. Mean percentage severity of bacterial leaf blight (BLB) disease of PSBRc72H as influenced by different cultural practices, Musuan, Bukidnon, Philippines

TREATMENTS	BLB
Vertical Treatments (Irrigation Practices)	
I_1 – Intermittent	17.14 ^{b}
I_2 – Continuous	26.08 ^{a}
I_3 – Saturated	17.50 ^{b}
I_4 – Once a week	15.75 ^{b}
Horizontal Treatments (NPK Rates)	
F_1 – 80-60-120 (RR/ha)	18.53
F_2 – 100-60-120	19.22
F_3 – 80-80-140	20.22
F_4 – 100-80-140	18.44
Subplots (Planting Distance)	
D_1 – 20 cm x 20 cm	21.04 ^{a}
D_2 – 20 cm x 30 cm	18.65 ^{b}
D_3 – 30 cm x 30 cm	17.67 ^{b}

Means within each column having a common letter are not significantly different at 5% level of probability (DMRT).

Interaction effect on the number of tillers per hill at 30 DAT was noted only on irrigation practices x NPK rates. This indicates that irrigation practices responded differently to NPK rates on the number of tillers per hill at 30 DAT. Highest mean number of 20.67 tillers per hill was recorded on plot applied with saturated irrigation (I_3) and 100-80-140 NPK rate (I_4) and the lowest (14.33) on plot applied with saturated irrigation (I_3) and 100-60-120 NPK rate (F_2) which significantly differed across NPK rates and across irrigation practices except on plot applied with saturated irrigation (I_3) and 80-80-140 NPK rate which had comparable effect with means of 15.89 tillers per hill. The mean number of tiller was higher in plants with continuous irrigation across NPK rates and plants with high NPK rate (100-80-140) (F_4) across irrigation practices. Tillering was enhanced in plants with 5 cm continuous water depth irrigation and higher NPK rate (100-80-140). No interaction effects were noted between irrigation practices and NPK rates, irrigation practices and planting distances, NPK rates and planting distances and different irrigation practices x NPK rates x planting distances on the number of tillers per hill at 60 DAT. This implies that each factor is not affected by the other. The number of days to heading on the other hand, was influenced by the irrigation practices and planting distances. Plants with continuous irrigation (I_2) had the lowest number of days to heading with a mean of 79.61 followed, with significant difference, by plants irrigated once a week (I_4), intermittent (I_1) and saturated (I_3) with comparable means of 80.47, 80.42 and 80.22 days, respectively. Plants spaced at a closer distance (20 x 20 cm) (D_1) had the lowest number of

Table 2. Means of agronomic characteristics such as number of tillers per hill at 30 and 60 DAT and days to heading, number of unproductive and productive tillers per hill, and plant height of PSBRc72H as influenced by different cultural practices, Musuan, Bukidnon, Philippines

TREATMENTS	Tiller no. (30DAT)	Tiller no. (60DAT)	Days to Heading	Unproductive Tiller	Productive Tiller	Plant Height (cm)
Vertical Treatments (Irrigation Practices)						
I_1 – Intermittent	17.28	17.94	80.42 ^{b}	0.92	15.31	103.17 ^{b}
I_2 – Continuous	17.89	18.17	79.61 ^{a}	1.14	16.11	106.81^a
I_3 – Saturated	16.86	18.31	80.22 ^{b}	1.07	15.67	101.28 ^{b}
I_4 – Once a week	16.61	17.75	80.47 ^{b}	1.04	15.50	102.53 ^{b}
Horizontal Treatments (NPK Rates)						
F_1 – 80-60-120 (RR/ha)	17.22	17.56	79.58	1.01	15.42	102.64
F_2 – 100-60-120	16.11	17.47	80.78	1.06	15.22	102.94
F_3 – 80-80-140	16.92	17.75	80.39	0.96	15.42	104.00
F_4 – 100-80-140	18.39	19.39	79.97	1.14	16.53	104.19
Subplots (Planting Distance)						
D_1 – 20 cm x 20 cm	15.48 ^{c}	13.33 ^{c}	79.15 ^{c}	0.96 ^{b}	11.88 ^{c}	100.88 ^{c}
D_2 – 20 cm x 30 cm	16.83 ^{b}	17.35 ^{b}	80.23 ^{b}	0.99 ^{b}	15.33 ^{b}	103.13 ^{b}
D_3 – 30 cm x 30 cm	19.17 ^{a}	23.44 ^{a}	81.17 ^{a}	1.17 ^{a}	19.73 ^{a}	106.33 ^{a}

days to heading followed, with significant difference, by plants at a wider distance (20 x 30 and 30 x 30 cm) with means of 79.15, 80.23 and 81.17, respectively. The results showed that plants with continuous irrigation and closer planting distance had shorter days to heading than plants with intermittent, saturated and once a week irrigation and wider planting distance. NPK rates did not influence the number of days to heading. Variations among means were non-significant. No interaction effects were noted on irrigation practices x NPK rates, irrigation practices x planting distances, NPK rates x planting distances and irrigation practices x NPK rates x planting distances on the number of days to heading. This indicates that each factor is not influenced by the other on the number of days to heading. The number of unproductive tillers per hill was influenced by the planting distances. Plants spaced at a wider distance 30 x 30 cm (D_3) significantly had the highest number of unproductive tillers followed by plants with a closer distance; 20 x 30 (D_2) and 20 x 20 cm (D_1) with means of 1.17, 0.99, and 0.96 tillers per hill, respectively. Results indicated that plants with wider planting distance had more unproductive tillers per hill than plants planted at closer distance, although wider planting distance enhanced the production of tillers at early stage but not all the tillers produced panicles.

Irrigation practices and NPK rates did not influence the number of unproductive tillers per hill. Variations among means were found non-significant. Interaction effect on the number of unproductive tillers per hill was noted only on irrigation practices x NPK rates. This indicates that irrigation practices responded differently to NPK rates on the number of unproductive tillers per hill. Significantly, highest mean (1.36) and the lowest (0.79) were recorded on plants applied with continuous (I_2) and once a week irrigation (I_4), respectively and both applied with the recommended rate (80-60-120). It was further observed that plants with continuous irrigation (I_2) had higher unproductive tiller across NPK rates and lower in plants with intermittent (I_1), saturated (I_3) and once a week irrigation (I_4); higher also in plants applied with high rate of NPK (100-80-140) across irrigation practices. On the other hand, the number of productive tillers per hill was not influenced by the irrigation practices and NPK rates. Variations among means were found non-significant. Planting distances influenced the number of productive tillers per hill. Plants planted at 30 x 30 cm significantly had the highest (19.73) number of tillers per hill.

Interaction effect on the number of productive tillers per hill was noted only on irrigation practices x planting distances. This indicates that irrigation practices responding differently to planting distances on the number of productive tillers per hill. Highest mean (21.33 tillers per hill) was recorded in plants with continuous irrigation (I_2) which significantly differed with the other practices; once a week (I_4), saturated (I_3) and intermittent (I_1) irrigation practices had comparable means of 19.5, 19.08 and 19.0 productive tillers, respectively. It was further observed that the number of productive tillers per hill was higher in plants with higher N rate and planted at a wider distance than in plants applied with recommended N rate and planted at a closer distance. The plant height was influenced by irrigation practices and planting distance. Plants with continuous irrigation (I_2) significantly had the highest mean plant height of 106.81 cm followed by plants irrigated intermittently (I_1), once a week (I_4) and saturated (I_3) with comparable means of 103.17, 102.53 and 101.28 cm, respectively. Plants spaced at a wider distance of 30 x 30 cm (D_3) had the highest (106.33 cm) plant height followed with significant difference, by plants spaced at a closer distance of 20 x 30 cm (D_2) and 20 x 20 cm (D_1) with means of 103.13 and 100.88 cm, respectively. The results showed that plants with continuous irrigation and wider planting distance had taller plant height than plants with controlled irrigation and closer planting distance. NPK rates did not influence the plant height. Variations among means were found not-significant.
Interaction effect on the plant height was noted only on irrigation practices x NPK rates. This indicates that irrigation practices responded differently to NPK rates on the plant height. Significant differences on the means were observed. Highest plant height (107.56 cm) was recorded on plots with continuous irrigation and higher NPK rates (100-80-140) while shortest height (98.33 cm) was recorded in plants with saturated irrigation and recommended NPK rates (80-60-120).

The result showed that plant height was taller in plots with continuous irrigation and shorter in plants with intermittent, saturated and once a week irrigation across NPK rates. On the other hand, means of the yield components were presented in Table 3. The length of panicle and number of spikelets per panicle was influenced by the planting distances. Plants spaced at a wider distance of 30 x 30 cm (D_3) had the highest panicle length and number of spikelets per panicle followed by plants spaced at a closer distance of 20 x 30 (D_2) and 20 x 20 cm (D_1) with means of 269.00, 265.58 and 264.90 mm and 154.77, 146.48 and 140.97 spikelets per panicle, respectively. Highly significant differences on the means were observed. The result showed that the length of panicle was longer and more spikelets per panicle in plants with wider planting distance than in plants with closer planting distance. Irrigation practices and NPK rates did not influence the panicle length and number of spikelets per panicle. Variations among means were found non-significant. No interaction effects were noted on irrigation x NPK rates, irrigation practices x planting distances, NPK rates x planting distances and irrigation practices x NPK rates x planting distances for these two parameters. This indicates that each factor is not influenced by the other.

On the other hand, the number of unfilled grains per panicle was influenced by the irrigation practices, NPK rates and planting distances. Plants with continuous irrigation (I_2) significantly had the highest mean number of unfilled grain, followed by plants with once a week (I_4), intermittent (I_1) and saturated (I_3) irrigation with mean values of 41.14, 38.64, 38.27 and 34.52 unfilled grains per panicle, respectively. Plants applied with 80-80-140 (F_3) significantly had the highest number of unfilled grains followed by plants applied with 100-80-140 (F_4) and 100-60-120 (F_2) with comparable means of 39.46, 38.64, and 37.95, respectively. Plants applied with the recommended rate 80-60-120 (F_1) had the lowest mean of 35.61 unfilled grains per panicle. Plants spaced at 30 x 30 cm (D_3) significantly had the highest number of unfilled grains, with a mean of 40.65 followed by 20 x 30 (D_2) and 20 x 20 cm (D_1) with comparable means of 37.44 and 35.66,

Table 3. Means of the yield components such as panicle length, spikelets per panicle, number of unfilled and filled grains per panicle, 1,000 seed weight and yield (kg/ha) of PSBRc72H as influenced by different cultural practices, Musuan, Bukidnon, Philippines

TREATMENTS	Panicle length (mm)	Spikelets /panicle	Unfilled Grains	Filled Grain	1,000 seed wt. (g)	Yield (kg/ha)
Vertical Treatments (Irrigation Practices)						
I_1 – Intermittent	264.56	142.74	38.27 ab	104.47	31.09	6621.03 b
I_2 – Continuous	267.39	146.46	41.14 a	105.32	31.10	7142.31 a
I_3 – Saturated	267.50	148.80	34.52 b	114.29	30.84	6682.56 b
I_4 – Once a week	266.53	151.62	38.64 ab	113.88	30.74	6824.81 b
Horizontal Treatments (NPK Rates)						
F_1 – 80-60-120 (RR/ha)	266.72	147.90	35.61 b	112.29	30.69	6824.31
F_2 – 100-60-120	265.92	143.62	37.95 a	105.67	31.03	6764.81
F_3 – 80-80-140	263.94	145.91	39.46 a	106.46	31.39	6728.42
F_4 – 100-80-140	269.39	152.19	38.64 a	113.55	30.65	6953.17
Subplots (Planting Distance)						
D_1 – 20 cm x 20 cm	264.90 b	140.97 c	35.66 b	105.31 b	31.05	6853.88 a
D_2 – 20 cm x 30 cm	265.58 b	146.48 b	37.44 b	109.04 b	30.98	985.33 a
D_3 – 30 cm x 30 cm	269.00 a	154.77 a	40.65 a	114.13 a	30.80	6613.81 b

respectively. Interaction effect on the number of unfilled grains per panicle was noted only on irrigation practices x planting distances. This indicates that different irrigation practices responded differently to planting distances on the number of unfilled grains per panicle. Highest mean (39.49) was recorded on plants with continuous irrigation and planted at 30 x 30 cm while plants with intermittent irrigation and planted closer at 20 x 20 cm recorded the lowest mean. Significant differences on the means were observed. Number of unfilled grains was higher in plants with a wider planting distance across irrigation practices. Meanwhile, only planting distances influenced the number of filled grains per panicle. Plants spaced at a wider distance (30 x 30 cm) had the highest number of filled grains with a mean of 114.13 per panicle followed by plants spaced at a closer distance (20 x 30 and 20 x 20 cm) with comparable means of 109.04 and 105.31, respectively. Highly significant differences on their means were observed.

Irrigation practices and NPK rates did not influence the number of filled grains per panicle. Variations among means were found non-significant. No interaction effects were noted on irrigation practices x NPK rates, irrigation practices x planting distances, NPK rates x planting distances and irrigation practices x NPK rates x planting distances on the number of filled grains. This suggests that each factor is not influenced by the other on the number of filled grains per panicle. While irrigation practices, NPK rates and planting distances did not influence the weight of 1,000 seeds. Variations among means were found non-significant. No interaction effects were noted on irrigation practices x NPK rates, irrigation practices x planting distances, NPK rates x planting distances and irrigation practices x NPK rates x planting distances on the weight of 1,000 seeds. This indicates that each factor is not influenced by the other on the weight of 1,000 seeds. On the other hand, the grain yield was influenced by irrigation practices and planting distance.

Plants applied with continuous irrigation (I_2) had the highest mean yield of 7,142.31 kilos per hectare which significantly differed with the other practices. This was followed by plants applied with intermittent (I_1), saturated (I_3) and once a week (I_4) irrigation with a comparable mean yield of 6,824.81, 6,682.56 and 6,621.03 kilos per hectare, respectively. Highly significant differences among mean yields were observed on the three planting distances tested. Plants spaced at 20 x 30 cm (D_2) had the highest mean yield of 6,985.33 followed by 20 x 20 cm (D_1) with a comparable mean yield of 6,853.88 kilos per hectare, respectively. Lowest yield was on 30 x 30 cm (D_3) spacing with a mean yield of 6,613.81 kilos. NPK rates did not influence the yield. Variations among means were found non-significant. No interaction effects were noted on irrigation practices x NPK rates, irrigation practices x planting distances, NPK rates x planting distances and irrigation practices x NPK rates x planting distances on the yield, indicating that each factor is not influenced by the other on the yield.

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