



CHEMICAL MANAGEMENT OF BACTERIAL LEAF BLIGHT DISEASE IN RICE

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ABSTRACT

Bacterial leaf blight (BLB) is an economically important disease of rice caused by *Xanthomonas oryzae* pv. *oryzae*. Use of chemicals is an important part of plant disease management. For this purpose, comparative efficacy of three antibiotics, Flare 72 WP (streptomycin sulphate), Cordate 4 WP (kasugamycin) and Castle 50 WP (kasugamycin+ copper oxychloride) along with four fungicides, viz. Copper oxychloride 50 WP (copper oxychloride), Nativo 75 WDG (Tebuconazole+trifloxystrobin), Gem Star Super 325 SC (azoxystrobin+difenconazole) and Bordeaux mixture, was studied as foliar spray applications against *Xanthomonas oryzae* pv. *oryzae*, under natural environmental field conditions at farmer's field at Faisalabad during two years (2012-2013). Super Basmati variety of rice, susceptible to the pathogen, was grown in the fields. Among the tested chemicals, Flare 72 WP performed as the best with 92.23% disease control and increase in rice yield up to 3.55% over the untreated control. Castle 50 WP gave disease control up to 87.97% with an increase in yield by 3.01%, Cordate 4 WP gave 86.31% control with increase in yield of 2.90%. Among fungicides, Copper oxychloride 50 WP gave disease control of 76.48% with 2.67% rice yield increase, Nativo 75 WDG gave disease control of 68.63% with 1.30% increase in yield, Gem Star Super 325 SC showed 63.67% disease control and yielded 0.47% more over untreated control treatment. Bordeaux mixture treatment gave disease control up to 84.08% with 2.78% rice yield increase over untreated control. Mean disease incidence in the untreated control treatment remained as 85.67%. In general, all the treatments significantly reduced incidence of disease and improved rice yield higher than untreated control during the study period.

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INTRODUCTION

Rice (*Oryza sativa* L.) is a leading cereal crop throughout the world as well as main staple diet of people, living in Middle East, Latin America, West Indies and East and South Asia. In Pakistan it ranked 3rd leading crop, grown after wheat and cotton and ranked third as a country in exporting rice throughout the world and earns more than 500 million US \$ yearly. Rice is grown on an area of 2.9 million acres yielding to annual production of 7 million tons with average yield of 1080 kg per acre (Anon., 2013). Pakistani basmati rice is well known for its specific aroma. Basmati rice varieties grown in the are influenced by various diseases. *Xanthomonas oryzae* pv. *oryzae*, the rice bacterial leaf blight (BLB) is the most problematic disease in rice (Ishiyama, 1922; Swing *et al.*, 1990). Mostly pathogen attack rice crop, when temperature falls between 25-34°C with more than 70% relative humidity Bedi and Gill (1960). Reported that bacterial blight disease may deteriorate the seedling and may cause loss in grain yield from 4.5-29.1%. Mew and Jajid (1977) reported the disease first time in 1977 in Pakistan and then its attack was

observed by Ahmad and Majid (1980) on IR 6, Palman, Basmati-198 (O U, 1987). Akhtar and Akram (1987) reported the BLB disease incidence in all provinces of Pakistan. According to Mew (1987); Reddy (1989) and Adhikari *et al.* (1994) it can cause losses in rice yield from 30 to 50 %. Khan *et al.* (2000) specified that BLB disease incidence is rising day by day in Kallar belt, well-known area for quality rice production and indicated that all the basmati varieties are becoming susceptible to the pathogen. According to Rafi *et al.* (2013) BLB disease incidence varied from 35-80% in Khyber Pakhtunkhwa (KPK), 11.67-46.67% in Sindh, 36.8-74.6% in Punjab and 12-21.67% in Balochistan. Tagami and Mizukami (1962) reported that the better control of bacterium growth by application of copper oxychloride and streptomycin solution as spray. Okimoto and Misato (1963) found the inhibited growth of *Xanthomonas oryzae* in liquid medium when added low concentration of dicarbamoylacetylen (collocidin). Srivastava (1972) tested the streptomycin mixture for decontamination of rice seeds and indicated suitable treatment against the pathogen. Hori (1973) inhibited

the bacterium growth by spraying of copper oxychloride and streptomycin solution. Chand *et al.* (1979) stated that use of bleaching powder along with 30% chlorine @ 2kg/hectare, significantly decrease the lesions produced by the bacterium in rice. Rukhsana (2011) described the antibacterial activity of medicinal plants (*Ferula assafoetida*, *Anethum graveolens*, *Azadirachta indica*, *Amomum subulatum*, *Terminalia bellirica*, *Terminalia chebula* & *Thuja orientalis*) against the disease causing bacterium.

Xanthomonas oryzae has emerged as common disease pathogen of the rice crop and generally escaped the consideration of the growers. The farmers mostly control the bacterium by the application of fungicides instead of the use of proper recommended antibiotics or copper-based fungicides, mostly found effective. In a way they neglected the attack of *Xanthomonas oryzae*, thus BLB pathogen attack on rice crop is going up in Pakistan and become basis of heavy yield loss. Realizing the importance of BLB disease of rice, the present study was conducted to find out the most effective chemical control (antibiotic/fungicide) of BLB disease of rice crop.

MATERIALS AND METHODS

The present study was carried out at farmer's field at Faisalabad during 2014 and 2015. For both years' trial,

variety Super Basmati was planted by farmers by using traditional cultural practices. Layout system was RCBD with 3 repeats and treatment area was kept to 72 x 3 m² in each case. The disease data were recorded at weekly intervals.

First, it was desirable to identify and describe the proper symptoms of the disease on rice crop. The infected plants leaves were collected for the observation of disease symptoms. Disease infected plants were collected and treated with sterile water. Infected tissues chopped with sterilized razor blade and placed on slide in dewdrop of sterile water. The specimens observed under Olympus Microscope (Model BX50F-3 with ocular lens of 10 X and objective lens of 100 X, total magnification of 1000 X) for bacterial streaming (Wilson, *et al.* 1967; Di M, *et al.* 1991; Gnanamanickam *et al.* 1994 and Anon, 2007).

Ten plants were tagged randomly in each replication before spraying. Seven different chemical treatments alongwith untreated control treatment were used as curative treatments at their recommended doses against bacterial blight of rice. Treatments and their doses are given in Table 1.

Table 1. Chemicals and treatments applied on rice crop against *Xanthomonas oryzae*

| Treatments | Formulation | Active ingredient | Concentration / 100 l of water | Source |
|----------------|--------------------------|----------------------------------|--------------------------------|---|
| T ₁ | Cordate 4 WP | Kasugamycin | 300 gm | Kanzo Ag. (Evyol Group), Pakistan |
| T ₂ | Copper oxychloride 50 WP | Copper oxychloride | 300 gm | Auriga Chemicals Enterprises, Pakistan |
| T ₃ | Flare 72 WP | Streptomycin sulphate | 200 gm | Kanzo Ag. (Evyol Group), Pakistan |
| T ₄ | Castle 50 WP | Kasugamycin + copper oxychloride | 250 gm | Four Brothers Agri. Services, Pakistan |
| T ₅ | Nativo 75 WDG | Tebuconazole+trifloxystrobin | 65 gm | Bayer Crop Sciences, Pakistan |
| T ₆ | Gem Star Super325 SC | Azoxystrobin + difenconazole | 120 ml | Sun Crop Pesticides, Pvt. Ltd, Pakistan |
| T ₇ | Bordeaux mixture | Copper sulfate: lime: water | 1% solution | - |
| T ₈ | Untreated control | | | |

One percent Bordeaux mixture was prepared freshly every time before spray at the time of its application by mixing and dissolving of one kg of Copper sulphate in 50 liters of water and one kg lime powder dissolved in another 50 liters of water in plastic buckets, slowly added the solution of copper sulphate in the lime solution. Constant stirring was kept during preparation of solutions and poured simultaneously to a third container and mixed well and sprayed. Sprays of all tested chemicals were carried out till the attack of disease with 5 days interval. All sprayings were carried out with hand machine and plants were sprayed till run-off with 2000 kPa pressure. About 5 to 10 liter of spray mix per treatment was sprayed. Tagged plants were evaluated for the incidence of bacterial leaf blight

(percent), a week after the last spray, calculated based on lesion length and total leaf length and rice grains yield were taken after harvest of the crop in kilograms/treatment. The data recorded in various treatments were analyzed by statistical software Statistix 8.1 (Statistix, 2006). Data of both years were pooled and subjected to analysis of variance.

RESULTS AND DISCUSSION

Xanthomonas oryzae pv. *oryzae* was clearly distinguished by symptoms. The signs of the infection include blighting, wilting (kresek) and yellowing of leaves. Leaf symptoms were categorized by curvy elongated spots alongside the leaf margins. Bacterial ooze was also observed from these type of infected

leaves. Infected plants leaves became curled, wilted, turned to grey green in color ultimately resulted in plant death. Grey to light brown colored lesions were observed on panicles/glumes of the infected plants that may be cause of sterility and inferior quality grains. Diseased plants remained undersized and had yellowish color. Yellow/pale yellow leaves are due to the systemic infection, occurred during tillering phase. Yellow colored stripes were observed in young leaves. Same type of symptoms description were noted by earlier workers Ou (1985) Reddy (1989) and Goto,

(1992). Yellow color colonies were observed from the infected leaves exudates, which were resembled with colonies of the bacterium. Rafi *et al.* (1989) reported the observation of mucoid, doomed, yellow colored colonies of *Xanthomonas oryzae* on Yeast Dextrose Calcium Carbonate (YDC) plates.

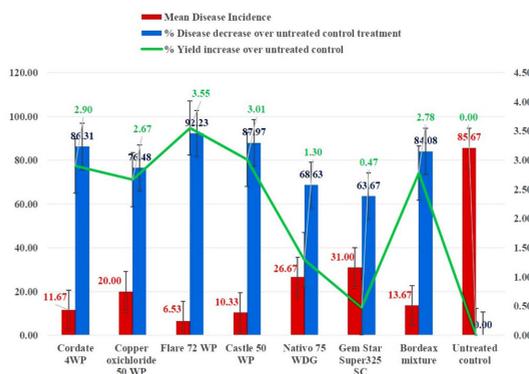
All antibiotic / fungicidal treatments resulted in significantly better disease control with varying degree of success as compared to untreated control treatment. (Table 2 and Fig.1).

Table 2. Effect of various antibiotics and fungicides on *Xanthomonas oryzae* and rice yield

| Treatments | Formulation | Active ingredient | Mean disease incidence | Disease controlover untreated control (%) | Mean yield (Kg/ treatment) | Yield increase over untreated control (%) | Yield increase over untreated control |
|----------------|--------------------------|----------------------------------|------------------------|---|----------------------------|---|---------------------------------------|
| T ₁ | Cordate 4WP | kasugamycin | 11.67de | 86.31 | 89.10ab | 2.51 | 2.90 |
| T ₂ | Copper oxychloride 50 WP | copper oxychloride | 20.00cd | 76.48 | 88.90ab | 2.31 | 2.67 |
| T ₃ | Flare 72 WP | streptomycin sulphate | 6.53e | 92.23 | 89.66a | 3.07 | 3.55 |
| T ₄ | Castle 50 WP | kasugamycin + copper oxychloride | 10.33de | 87.97 | 89.20ab | 2.61 | 3.01 |
| T ₅ | Nativo 75 WDG | Tebuconazole + trifloxystrobin | 26.67bc | 68.63 | 87.72bc | 1.13 | 1.30 |
| T ₆ | Gem Star Super325 SC | azoxystrobin + difenconazole | 31.00b | 63.67 | 87.00c | 0.41 | 0.47 |
| T ₇ | Bordeaux mixture | copper sulfate: lime: water | 13.67de | 84.08 | 89.00ab | 2.41 | 2.78 |
| T ₈ | Untreated control | | 85.67a | 0.00 | 86.59c | 0.00 | 0.00 |
| LSD: 0.05 | | | CV: 6.17 | | CV: 1.62 | | |

Means are not significantly different from one another.

Fig.1: Effect of various antibiotics and fungicides on *Xanthomonas oryzae* and rice yield



Among the tested chemicals, Flare 72 WP (streptomycin sulphate) performed best by giving 92.23% disease control with increase in rice yield upto 3.55% over the untreated plant as control whereas Castle 50 WP (kasugamycin + copper oxychloride) gave disease control upto 87.97% with an increase of

3.01% in rice yield and Cordate 4 WP (kasugamycin) gave 86.31% control with increase in yield to 2.90%. Many researchers have reported the usefulness of some copper-based fungicides and antibiotics against BLB disease. Sing *et al.* (1980) stated the encouraging effect of antibiotics in suppression of causal pathogen of

rice bacterial blight i.e. Agrimycin 500, Brestanol, Agric. Teramycin 17 and mixture of Cytoxon + Agrimycin 100. Likewise, Khan *et al.* (2012) achieved the suppression of *Xanthomonas oryzae* pv *oryzae* colonies during in-vitro studies by using the antibiotics (Benzylpenicillin, Ampicillin, Kanamycin, Streptomycin, Chloramphenicol and Sinobionic). Azher *et al.* (2013) succeeded in rice BLB control by the use of Castle 50 WP up to 81.04% with yield of 3.537 t/ha. This study revealed that Copper oxychloride 50 WP (copper oxychloride) gave control 76.48% with 2.67% increase in rice yield increase, which had close conformity with Khan *et al.* (2005) who stated that Copper oxychloride, and Vigran blue controlled the BLB disease in rice when used as foliar spray applications and improved the rice yield. Nativo 75 WDG (tebuconazole + trifloxystrobin) gave control 68.63% with an increase in yield (1.30%). Gem Star Super 325 SC (azoxystrobin + difenconazole) showed control up to 63.67% and yield increase was 0.47% over untreated control treatment. According to Azher *et al.*, (2013). Nativo 65WG gave 87.19% control with increase in yield of 4.707 t/ha and Gem Star Super 325 SC application gave control of the malady up to 82.34% with increase of yield (3,903 t/ha). In case of Bordeaux mixture treatment, it gave disease decrease up to 84.08% with 2.78% rice yield increase. Bordeaux mixture proved to be most effective in reducing bacterial blight pathogen (*Xanthomonas campestris* pv *malvacearum*) infection in cotton (58.86%), followed by Flare 72 WP (40.31%), Cordate 4 WP (24.94%) as compared to Copper oxychloride 50 WP (17.49%). (Anon, 2015 a, b) reported that Bordeaux mixture gave maximum control (78.11%), followed by Flare 72 WP (65.77%), Cordate 4 WP (63.64%) as compared to Copper oxychloride 50 WP (50.32%) in controlling *Xanthomonas axanopodis* pv *citri* pathogen of citrus canker. Chaudhary *et al.* (2011). Concluded that Bordeaux mixture is not only effective against BLB disease of rice but also have wide-range of disease controlling spectrum and economical than other copper based chemicals & antibiotics.

CONCLUSION

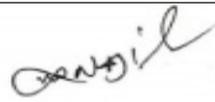
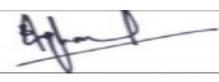
Foliar spray applications of antibiotic Flare 72 WP (Streptomycin sulphate) achieved a most effective control of rice BLB disease caused by a bacterium "*Xanthomonas oryzae* pv *oryzae*" and improved rice yield as compared to fungicides (Nativo 75 WDG, Gem Star Super 325 SC etc.) So the antibiotic Flare 72 WP may be the better option to control BLB in rice.

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CONTRIBUTION OF AUTHORS

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| 2. | Babar Iqbal | Helped in conducting research and reviewed the paper |  |
| 3. | Muhammad Hussain | Helped in data recording and analysis |  |
| 4. | Azher Mustafa | Helped in data recording and analysis |  |
| 5. | Muhammad Ayub | Perceived the idea and proof read the paper |  |