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Research Article

USE OF CHEMICAL FUNGICIDES FOR THE MANAGEMENT OF RICE BLAST (*PYRICULARIA GRISEA*) DISEASE AT JYOTINAGAR, CHITWAN, NEPAL

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Abstract

Rice blast caused by *Pyricularia grisea* Sacc. is the important disease of rice and different fungicides against this disease were evaluated in summer 2014 at Karma Research and Development Center, Jyotinagar, Chitwan, Nepal. A susceptible rice cultivar 'Mansuli' was planted in randomized complete block design and fungicides viz. Tricyclazole 22% + Hexaconazole 3% SC (0.2%), Streptomycin 5% + Thiophanate Methyl 50% WP (0.15%), Prochloraz 25% EC (0.3%), Kasugamycin 2% WP (0.2%), Hexaconazole 4% + Zineb 68 % WP (0.2%) and Udaan (Hexaconazole 3% SC) (0.2%) were sprayed thrice at weekly interval starting from the booting stage. All these fungicides were found to be effective in controlling leaf and neck blast disease as compare to control one. Among them, Tricyclazole 22% + Hexaconazole 3% SC was found to be the most effective with least leaf blast severity (6.23%), neck blast incidence (8.97%), and highest percentage disease control (87.08% and 79.62% in leaf blast and neck blast respectively) and grain yield (4.23 t/ha) followed by Prochloraz 25% EC (0.3%) and Udaan (Hexaconazole 3% SC) (0.2%). It is therefore concluded that Tricyclazole 22% + Hexaconazole 3% SC fungicide could be used to control rice blast at weekly interval starting from the booting stage for three times.

Keywords: rice blast; *Pyricularia grisea*; fungicides; severity; incidence

Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop of the world and is consumed by 50% population worldwide (Luo *et al.*, 1998). It had been affected by many serious diseases, including blast which was caused by ascomycete fungus *Pyricularia grisea* Sacc., (Telemorph: *Magnaporthe grisea*) (Correll *et al.*, 2000). The fungus can infects most parts of the plant, but the most damaging phase of the disease is the nodal or panicle infection (Ou, 1985). The disease either kills the host plant or prevents seed development when pathogen infects on neck or panicle. In Nepal, it has been a continuous threat to rice production (Manandhar, 1987; Manandhar *et al.,* 1992; Chaudhary, 1999) and epidemics result in a complete loss of seedlings in the seedbed (Manandhar, 1984; Thapa and Manandhar, 1985; Adhikari and Shrestha, 1986; Pradhanang, 1988; Sah, 1989; Chaudhary *et al.,* 1994; Chaudhary and Sah, 1997; Chaudhary and Sah, 1998).

Rice blast is one of the most destructive diseases in rice fields. Depending on cultivar susceptibility, environmental conditions and management system, it causes yield losses up to 100%. The disease was recorded in 1966 in Nepal for the first time and it is more devastating in valleys, river basins, foot-hills and hills of Nepal, although it is prevalent throughout the rice growing areas in the country. The disease causes 10-20% yield reduction in Nepal in susceptible varieties, but in severe case it went up to 80% (Manandhar *et al.*, 1992). In 'Sankharika', a reduction in grain yield had been estimated between 21 to 51 kg/ha when there is 1% increase in neck blast (Manandhar *et al.*, 1985). Similarly, due to 1% increase in neck blast, a grain yield loss of 38.5 and 76.0 kg/ha was reported in the rice cultivars: 'Masuli' and 'Radha-17', respectively (Chaudhary, 1999). In Japan, the disease affects approximately 865,000 hectares of rice fields each year and more than 50% yield losses each year caused by rice blast in the Philippines (IRRI, 2003).

Planting of resistant cultivars, application of fungicides, and manipulation of planting times, fertilizers and irrigations are the most usual approaches for the management of rice blast disease (Georgopoulos and Ziogas, 1992; Moletti *et al.*, 1988; Mbodi *et al.*, 1987; Naidu and Reddy, 1989). Among several methods developed for the control of the disease (Mariappan *et al.*, 1995), chemical control has been widely practiced in many countries. Seed treatments with systemic fungicides and foliar sprays with those fungicides had been demonstrated to be effective in minimizing blast disease (Manandhar, 1984; Manandhar *et al.*, 1985, Sah and Karki, 1988; Chaudhary and Sah, 1998; Chaudhary, 1999). Keeping this view, efforts have been made to find out the efficacy of various fungicides on the management of rice blast disease and their impact on grain yield.

Materials and Methods

A field experiment was done at Karma Research and Development Center (KRDC), Jyotinagar, Chitwan, Nepal in summer (June to November, 2014). The site lies in the sub-tropical zone with an altitude of 250 masl, between 27°36’ N latitude and 84°16’ E longitude. Rice nursery of susceptible cultivar ‘Mansuli’ was sown in the month of June, 2014. The experiment was laid out in randomized complete randomized complete block design with three replications. Each replication was separated by 1 m and there were seven blocks in each replication which were separated by 0.5 m. 26 days old seedlings were transplanted to the main field. The whole field was surrounded by one row of highly susceptible cultivar ‘Sankharika’ and also there is a row between two replications to provide the uniform source of inocolum. The plot size for each treatment was 9 m^2 (3 m × 3m) with 15 rows in each plot and plant to plant and row to row distance was 20 cm. Fertilizer was applied @ 140:60:40 kg NPK/ha through urea (46% N), DAP (18% N and 46% P_2O_5) and MOP (60% K_2O). One third dose of Nitrogen, full dose of Phosphorus and Potash were applied before final land preparation as basal dose. Remaining dose of N was applied in two split doses at active tillering stage and panicle initiation. Zinc Sulphate (commercial product) was applied @ 20 kg/ha at final land preparation. Herbicide pyrazosulfuron ethyl 10% WP @ 0.5 g/l of water was sprayed two days after transplanting for controlling weeds. Twice spraying of Kingstar (emamactin benzoate 5% SG) @ 5 g/16 l of water + Kingvan (dichlorovos 80% EC) @ 2 ml/l of water was done before milking stage to control rice gundhi bug and stem borer. There were seven treatments including six fungicides and one control (no spray). The fungicides viz. Tricyclazole 22% + Hexaconazole 3% SC (0.2%), Streptomycin 5% + Thiophanate Methyl 50% WP (0.15%), Prochloraz 25% EC (0.3%), Kasugamycin 2% WP (0.2%), Hexaconazole 4% + Zineb 68 % WP (0.2%) and Udaan (Hexaconazole 3% SC) (0.2%) were sprayed thrice at weekly interval starting from the booting stage.

The data on leaf blast severity were collected from randomly selected 25 plants from each plot, one week after the last application of fungicides by using 0 – 9 disease rating scale given by International Rice Research Institute (IRRI, 1996) as shown in Table 1 and then converting into percent disease by using the following formula.

$$Disease\ \% = \frac{Sum\ of\ the\ scores\ \times 100}{Number\ of\ observation\ \times highest\ number\ in\ rating\ scale}$$

The neck blast incidence was recorded one week before harvesting by examining all the tillers in 25 randomly selected hills per plot. By counting the infected and healthy panicles in each hill, percentage neck blast incidence was determined. The grain yield was recorded from individual plots. The percent disease control was calculated using the formula given by Abbotts (1925), percentage reduction = C – T/C × 100, where, C is the population of control and T is the population of treated plots. The data on yield was recorded at maturity by manual harvesting with the help of sickle from whole plot and that was adjusted at 12% moisture level using the formula.

$$Gain\ yield\ \left({}^{t}/_{ha}\right) at\ 12\%\ moisture\ = \frac{(100 - MC)\ \times Plot\ yield\ (kg)\ x\ 10}{(100 - 12) \times net\ plot\ area\ (m^2)}$$

Where, MC is the moisture content of grain in percentage.

Data entry was done by using MS-excel 2007 program and they were processed to fit into MSTAT-C (Freed and Scott, 1986) software for analysis. DMRT was done at 5% level of significance for mean comparison from the reference of Gomez and Gomez (1984).

Table 1: Rice leaf blast disease rating scale

Scale	Description	Host Behavior
0	No lesion observed	Highly Resistant
1	Small brown specks of pin point size	Resistant
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves	Moderately Resistant
3	Lesion type same as in 2, but significant number of lesions on the upper leaves	Moderately Resistant
4	Typical susceptible blast lesions, 3 mm or longer infecting less than 4% of leaf area	Moderately Susceptible
5	Typical susceptible blast lesions of 3mm or longer infecting 4-10% of the leaf area	Moderately Susceptible
6	Typical susceptible blast lesions of 3 mm or longer infecting 11-25% of the leaf area	Susceptible
7	Typical susceptible blast lesions of 3 mm or longer infecting 26-50% of the leaf area	Susceptible
8	Typical susceptible blast lesions of 3 mm or longer infecting 51-75% of the leaf area many leaves are dead	Highly Susceptible
9	Typical susceptible blast lesions of 3 mm or longer infecting more than 75% leaf area affected	Highly Susceptible

(IRRI System, 1996)

Results and Discussions

Different fungicides were evaluated to control leaf and neck blast disease under field conditions and their ultimate effect on grain yield was given in the Table 2. The table shows the leaf blast severity, neck blast incidence, percentage disease control and grain yield from various fungicidal treatments. During the experiment leaf blast severity was found to be significantly less in all treated plots over control one. The result shows that after the application of various fungicides as foliar spray, Tricyclazole 22% + Hexaconazole 3% SC was found most effective treatment showing significantly less leaf blast disease severity (6.23%) as compare to others. A range of 59.98 to 87.08% disease control was noticed from various fungicides. Maximum percent disease control was recorded from Tricyclazole 22% + Hexaconazole 3% SC followed by Prochloraz 25% EC whereas, Kasugamycin 2% WP showing least effect on disease control. Similarly, Tricyclazole 22% + Hexaconazole 3% SC was also found to be effective in controlling neck blast (8.97% disease incidence) and a range of 43.18 to 79.62% disease control was recorded from various treatments.

The leaf blast severity and neck blast incidence covered significant reduction in yield (control 2.71 t/ha). Grain yield from various treatments shows that yield was significantly higher in Tricyclazole 22% + Hexaconazole 3% SC (4.23 t/ha) and it increases up to 56.09% grain yield over the control one. Our results are in conformity with those of Sood and Kapoor, (1997), Tirmali *et al.*, (2001), Prabhu *et al.*, (2003) and Usman Ghazanfar *et al.*, (2009) as they reported fungicides application increases the rice yield. Researchers from around the world also found similar results while testing the various fungicides, like Varier *et al.*, 1993 used eight fungicide for rice blast management and treated the seeds with tricyclazole @ 4 g/kg seed proved effective after 40 days of sowing. Gouramanis, 1995 found that leaf blast disease was reduced by fungicides carbendazim, pyroquilon, thiophanate methyl and chlobenthiazone, on the other hand tricyclazole was effective in controlling neck blast. Two systemic fungicides benomyl and tricylazole were evaluated by Enyinnia, 1996 on Faro/29, a rice cultivar, at full booting stage and reported good control of natural infection of rice leaf blast. Also, Sood and Kapoor, 1997 evaluated 7 fungicides against leaf and neck blast of rice at recommended rates at booting and heading stage and found that tricyclazole was the most effective. It reduces leaf and neck blast by 89.2% and 97.5% respectively and increases the yield by 43.3% as compared with control (No spray).

Table 2: Effect of different fungicides for the control of blast and grain yield of rice

S.N.	Treatments	Leaf blast severity (%)	% disease control	Neck blast incidence (%)	% disease control	Grain yield (t/ha)	% increase yield over control
1	Tricyclazole 22% + Hexaconazole 3% SC (0.2%)	6.23^{e}	87.08	8.97^{d}	79.62	4.23^{a}	56.09
2	Streptomycin 5% + Thiophanate Methyl 50% WP (0.15%)	18.17^{bc}	62.33	22.00^{bc}	50	3.22^{cd}	18.82
3	Prochloraz 25% EC (0.3%)	12.23^{d}	74.64	16.33^{c}	62.88	3.71^{b}	36.90
4	Kasugamycin 2% WP (0.2%)	19.30^{b}	59.98	25.00^{b}	43.18	3.02^{de}	11.44
5	Hexaconazole 4% + Zineb 68 % WP (0.2%)	17.10^{bc}	64.54	21.33^{bc}	51.52	3.40^{bc}	25.46
6	Udaan (Hexaconazole 3% SC) (0.2%)	15.20^{cd}	68.48	18.33^{bc}	58.34	3.50^{bc}	29.15
7	Control	48.23^{a}		44.00^{a}		2.71^{e}	
	$LSD_{0.05}$ value	3.489		7.249		0.3558	
	CV (%)	10.06		18.48		5.89	

means in a column followed by the same letters are not significantly different according to LSD at 5% probability level, CV: Coefficient of variance and $LSD_{0.05}$: Least Significant Difference at 5 % level of significance.

Conclusion

The trial on management of rice blast disease by the use of different chemical fungicides at Jyotinagar, Chitwan revealed that fungicides can effectively control the rice blast disease and among them Tricyclazole 22% + Hexaconazole 3% SC was found to be the most effective one with least leaf blast disease severity (6.23%) and neck blast incidence (8.97%). Also, maximum disease control (87.08% and 79.62%) and highest grain yield (4.23 t/ha) were recorded from Tricyclazole 22% + Hexaconazole 3% SC. So, it is recommended to use this fungicide against rice leaf and neck blast disease, thrice at weekly interval starting from the booting stage to have effective control and higher grain yield under field condition.

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