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Studies on the foliar application of Silicon based nutrients against brown spot of rice

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ABSTRACT

Pot culture study was conducted to test the efficacy of silicon based nutrients for assessing their influence on the incidence of brown spot of rice. Three silicon based nutrients viz., calcium silicate (CS), sodium Silicate (SS) and potassium silicate (PS) at 1.0, 2.0 and 3.0 per cent concentration were sprayed individually at disease initiation and repeated once at fifteen days interval. The experiments were conducted in a randomized block design with three replications for each treatment and a suitable control. The fungicide carbendazim 50 WP @ 0.1 per cent was used for comparison and the standard agronomic practices as recommended by the State Agricultural Department were followed. Among them, potassium silicate at three per cent level was the most effective over the other nutrients followed by potassium silicate at two per cent in reducing disease incidence as compared to control and also Potassium silicate at 3 per cent level recorded maximum grain and straw yield, followed by potassium silicate @ 2 per cent level. It was followed by Calcium silicate @ 3 per cent while the lowest grain and straw yield was recorded in control.

1. Introduction

Rice (*Oryza sativa* L.) is the second most cultivated crop worldwide and it has been estimated that half the world's population survives wholly or partially on this crop (Van Nguyen and Ferrero, 2006) and rice provides more calories per ha than any other cereal food grains. Rice crop is widely affected by a number of diseases caused by fungi, bacteria, viruses and mycoplasma which results in considerable yield losses. Among the various fungal diseases of rice, brown spot or sesame leaf spot incited by *Helminthosporium oryzae* (Breda de Haan) Subram. and Jain (Syn: *Bipolaris oryzae* (Breda de Haan) Shoemaker) is found to occur in most rice growing areas. Normally fungicides are primary means of controlling plant diseases. But the use of chemical fungicides is under special scrutiny for posing potential environmental threat as the indiscriminate use of chemical fungicides resulted in environmental pollution and ill-health to biotic community as a whole. Even if acceptable fungicides are applied the pathogen often develops resistance and produce new biotypes.

Besides, a promising alternative for the control for many rice diseases, including brown spot, is the application of silicon (Si) to soils deficient in this element (Datnoff *et al*., 2007). In recent years, silicon (Si) is being used for the control of fungal diseases with promising results (Yanar *et al.,* 2011) and silicon accumulation has been reported to be one of the main factors responsible for enhanced resistance against various pathogens of rice (Junior *et al*., 2009). In this context balanced nutrition seems to be a promising alternative for the control of brown spot (Carvalho *et al.,* 2010). Therefore, the present work deals about the effect of silicon based nutrients against brown spot of rice.

2. Materials and Methods

Pot culture study

Pot culture study was conducted to test the efficacy of silicon based nutrients for assessing their influence on the incidence of brown spot of rice. The brown spot susceptible variety ADT 36 grown in rectangular pots of size, 30x45 cm was used for the study. The plants were given artificial inoculation by spraying the spore suspensions with adequate spore load (50,000 spores/ml) at 15 DAT in the evening hours. The crop was maintained in a poly house with frequent spraying of water to provide adequate moisture and relative humidity to enable successful infection by the pathogen. The experiments were conducted in a randomized block design with three replications for each treatment and a suitable control. The fungicide carbendazim 50 WP @ 0.1 per cent was used for comparison and the standard agronomic practices as recommended by the State Agricultural Department were followed.

Evaluation of silicon based macro-micro nutrients against H.oryzae

Three silicon based nutrients viz., calcium silicate (CS), sodium Silicate (SS) and potassium silicate (PS) at 1.0, 2.0 and 3.0 per cent conc. were sprayed individually at disease initiation and repeated once at fifteen days interval.

Disease assessment

In all the studies observations on disease incidence, grain and straw yield were recorded at the time of harvest. The disease incidence was observed from a randomly selected set of three hills per pot.

Grain yield

After the harvest, the grains were separated, winnowed, dried in the sun and dry weight was recorded and expressed as g/pot.

Straw yield

After thrashing and separation of grains, the straw was dried pot wise in sun for two days. Later the straw weight was recorded and expressed as g/pot.

The disease incidence was assessed by adopting 0-9 scale according to "Phytopathometry" by Mayee and Datar (1986) and the per cent disease incidence /index was calculated based on the formula suggested by Vidhyasekaran et al. (1989).

DISEASE SEVERITY	DESCRIPTION OF DISEASE INDEX
0	No lesions
1	Affected leaf area less than 1 %
3	1-10 % affected leaf area
5	11-25 % affected leaf area
7	26 -50 % affected leaf area
9	> 50 % leaf area affected

$$\textbf{Per cent Disease Index} = \frac{\textbf{Total ratings}}{\textbf{Total number of leaves graded} \times \textbf{Maximum grade in the score chart}} \times 100$$

3. Results and Discussion

The results of pot culture experiments showed that all the silicon based nutrients reduced the disease incidence over control. Among them, potassium silicate at three per cent level was the most effective (24.5 %) over the other nutrients followed by potassium silicate at two per cent in reducing disease incidence (26.8 %) as compared to 64.10 per cent observed in control. Sodium silicate at one per cent was the least effective (Table 1). In general, yield was significantly higher in silicon nutrient treated plots when compared to Carbendazim treated and control plots. Potassium silicate at 3 per cent level recorded maximum grain and straw yield (33.45 & 75.72 g/pot), followed by potassium silicate @ 2 per cent level (33.20 & 74.56 g/pot). It was followed by Calcium silicate @ 3 per cent while the lowest grain and straw yield was recorded in control (25.94 & 65.42 g/pot).

Rice is a best silicon accumulator and its uptake is about twice that of nitrogen. Wagner (1940) first reported that Si application effectively reduced powdery mildew in cucumber. Foliar application of soluble Si reduced the powdery mildew severity in cucumber, common beans and soybeans. Potassium silicate applications have resulted in reduced severities of powdery mildew on grape and strawberry (Kanto *et al.,* 2006). Foliar application of potassium silicate, as a source of soluble silicon, decreased angular leaf spot severity on beans. Calcium silicate was effective in the reduction of Frog eye spot, downy mildew and Asian rust in soybean (Nolla *et al.,* 2006) and anthracnose in beans (Moraes *et al.,* 2009). Silicates act as a bioactive element and are associated with beneficial effects on the mechanical and physiological properties of plants. Si application might not yield a direct measurable effect on crop growth, but its positive role on disease suppression may lead to better plant productivity (Guevel *et al.,* 2007). Thus, increased plant resistance to diseases through Si treatment is associated with active and/or passive mechanisms (Datnoff *et al.,* 2007).

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Table 1. Evaluation of Silicon based nutrients against brown spot of rice (Pot culture experiment)

Macro-Micro nutrients		Disease incidence (%)	Yield (g/pot)	Straw yield (g/pot)
Potassium silicate	1 %	29.3	33.04	74.37
	2 %	26.8	33.20	74.56
	3 %	24.5	33.45	75.72
Calcium silicate	1 %	36.5	32.36	73.29
	2 %	34.9	32.68	73.61
	3 %	28.9	33.10	74.82
Sodium silicate	1 %	37.4	31.64	72.24
	2 %	35.8	32.02	72.86
	3 %	34.7	33.08	74.08
Carbendazim	0.1 %	14.2	29.80	71.72
Control		64.1	25.94	65.42
C.D. (p=0.05)		4.16	0.61	0.48

