International Journal of Bio-resource and Stress Management 2016, 7(4) Special:738-742 DOI: 10.5958/0976-4038.2016.00114.7

Short Research Article

Bioefficacy of Azoxystrobin 23% w/w SC Against Major Diseases of Sugarcane

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Article History

Manuscript No. ARISE 43
Received in 28th April, 2016
Received in revised form 24th July, 2016
Accepted in final form 29th July, 2016

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Keywords

Sugarcane, Azoxystrobin 23% w/w SC, red rot, wilt, smut, rust

Abstract

Sugarcane is severely affected by various diseases like red rot, smut, wilt, rust, leaf scald and yellow leaf that reduced the cane production in India. A field experiment was conducted to study the bio-efficacy of Azoxystrobin 23% w/w SC (Amistar 25 w/v SC) against sugarcane diseases during spring 2013–14 and 2014–15. The results revealed that among the various treatments, Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} showed 6.47 PDI and 6.15 PDI against red rot, 5.65 PDI and 5.12 PDI against rust, 6.25% and 5.66% disease incidence against smut and 4.95 and 4.23 PDI against wilt in 2013–14 and 2014–15 respectively. Treatments Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} and Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} was found significantly at par in controlling red rot, smut, wilt and rust disease of sugarcane. Treatment Azoxystrobin 23% w/w SC @ 1.25 ml lt^{-1} also recorded the significantly higher sugarcane yield of 749.60 q ha^{-1} and 768.95 q ha^{-1} which is significantly at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (741.17 q ha^{-1} and 759.92 q ha^{-1} respectively). It reduced disease significantly and thereby indirectly they reduced stress of pathogen on sugarcane crop. Yield increase in sprays could be attributed to the significant reduction of disease severity and thereby improvement of crop health for better growth and development. Hence, this fungicide at particular dose may also be viable alternatives for the management of sugarcane diseases.

1. Introduction

Sugarcane (*Saccharum officinarum* L.) is a monocotyledonous plant from the family Poaceae of the subfamily Andropogoneae. It is considered as one of the oldest cultivated crop known to man. Sugar along with honey is the oldest natural sweetner of sugarcane is grown in the tropical and subtropical regions of the world and is cultivated in nearly 60 countries as a commercial crop. Due to its wide range of adaptability, it supplies more than 60% of the world sugar demand and basic raw material in many industries which makes it one of the most important cash crop that play an enormous role in the economy. Various biotic as well as abiotic factors are responsible for yield reduction and economics losses. Among these factors, diseases are major cause. According to an estimate, sugarcane production declines upto 19.0% by diseases only. During the last 100 years, the country has witnessed epidemics of various diseases like red rot, smut, wilt, rust, leaf scald (Viswanathan and Rao, 2011).

Sugarcane crop is affected by several pathogens such as fungi, bacteria, viruses and phytoplasmas which are responsible for reducing the yield and quality of the crop (Tiwari et al., 2011). The losses (due to the diseases) vary from place to place, depending upon the crop variety and could not be ignored, neglected and or regretted, because they also cause variable loss time by time to the crop. All parts of plant are subject to disease and one or more diseases can occur on virtually every plant and in every field. Among the various diseases, red rot, smut, wilt and rust are the major diseases of sugarcane cause huge loss in cane yield. Owing to its vegetative mode of propagation, sugarcane is prone to infection by systemic pathogen. Red rot caused by *Colletotrichum falcatum* is the most important disease of sugarcane in India. Adoption of healthy setts which are devoid of reddened cut ends, shrunken nodes, borer holes and damaged buds is mandatory to promote enhanced germination on one hands and lessen the probabilities of red rot spread in the main field (Kalaimani et al., 2012). Sugarcane smut is caused by fungus *Sporisorium scitamineum*. Yield losses

due to smut may be 39–56% in planted crop and 52–73% in ratoon crop of sugarcane (Braithwaite et al., 2008). Wilt is a serious constraints to sugarcane production in India and is important disease causing economic losses. The disease had prevailed to varying intensities for the past 100 years in India (Viswanathan et al., 2012). Sugarcane disease is mainly a disease of the leaf. It is caused by *Puccinia melanocephala* H. & P. Syd., an obligate parasite. Foliar spray of ergosterol biosynthesis inhibiting fungicides can effectively control the rust disease (Nalwar et al., 2014).

At the present status of knowledge about disease system, it is not possible to raise a successful crop without use of fungicides. Most of the recommended fungicides often fail to provide adequate control if not applied at appropriate time. Efforts made so far to check destruction effects of pathogen on the growing sugarcane industry have centered on preplant fungicidal dips of planting setts. Planting of disease free seed setts is considered as a key factor. Keeping in view the importance of sett treatment against sugarcane disease, the present experiment was conducted to evaluate the new fungicides against major diseases of sugarcane in order to fetch maximum returns.

2. Materials and Methods

2.1. Experimental layout

Field experiments were conducted during *spring* 2013–14 and *spring* 2014–15 at Sugarcane Research Centre, Kashipur in Randomized Block Design (RBD) with seven treatments and three replications with plot size of 5.5×4.5 m^2 under assured irrigated conditions. The fungicides were applied as sett treatment just before planting. The setts were soaked with different treatments for 15 minutes.

2.2. Treatments

The treatments includes Azoxystrobin 23% w/w SC @ 0.50 ml l^{-1}, Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1}, Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1}, Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1}, Mancozeb 75% WP @ 3.00 g l^{-1}, Carbendazim 50% WP @ 1.00 g l^{-1} along with control. Mancozeb 75 WP and Carbendazim 50 WP were used as standard check. After appearance of disease, disease intensity was recorded. At harvesting, cane yield was recorded as kg $plot^{-1}$ and converted into q ha^{-1}.

2.3. Disease rating scale

Disease was measured by using disease rating scale. Disease rating scale for red rot of sugarcane i.e. 0–2.0: Resistant (R), 2.1–4.0: Moderately Resistant (MR), 4.1–6.0: Moderately Susceptible (MS), 6.1–8.0: Susceptible (S), >8.0: Highly Susceptible (HS) is used.

Rating scale for sugarcane rust i.e. 1: No symptoms, 2: Necrotic flecks, 3: A few sporulating pustules on plants, 4: A few sporulating pustules on upper leaves and abundant pustules on lower side, 5: Numerous pustules on upper leaves, slight necrosis on lower leaves, 6: Abundant pustules on upper leaves, more necrosis on lower leaves, 7: Abundant pustules on lower leaves with lower leaf necrosis, 8: Some necrosis on upper leaves and 9: Leaves necrotic with plant near death is used.

Disease rating scale for sugarcane smut i.e. 0–5.0% infection: Resistant (R), 5.1–15.0% infection: Moderately Resistant (MR), 15.1–30.0% infection: Moderately Susceptible (MS) and >30% infection: Susceptible (S) is used.

Disease rating scale for sugarcane wilt i.e. 0: Healthy cane/ roots, 1: No wilting or drying of leaves, slight pith formation with yellow discoloration of internal tissues, 2: Mild yellowing of the top leaves and drying of lower leaves, mild stunting and shrinking of stalk and rind, slight cavity formation of pith, no fungal growth seen, 3: Mild yellowing of the top leaves and drying of lower leaves, mild stunting and shrinking of stalk and rind. Severe pith and cavity formation with sparse fungal growth, 4: Complete yellowing and death of leaves, large pith cavities with profuse over growth of fungus, necrotic roots is used.

Data were statistically analyzed and Percent Disease Index (PDI) were calculated.

$$\text{PDI}=\frac{\text{Sum of all numerical rating}}{\text{Total number of plants}\times\text{Maximum grade}}\times 100$$

$$\text{PDC}=\frac{\text{Disease in control plot - Disease in treated plot}}{\text{Disease in control plot}}\times 100$$

Percent disease reduction (PDC) over control will calculated by using following formula

3. Results and Discussion

3.1. Efficacy of Azoxystrobin 23% w/w SC against red rot in sugarcane

During 2013–14 cropping season (Table 1) data revealed that all the doses of Azoxystrobin 23% w/w SC were found effective against red rot disease. Among the various treatments, Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the lowest PDI of 6.00 which is significantly at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (6.47 PDI) followed by Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1} (9.00 PDI) as against 27.47 PDI in untreated check at 270 DAP. The standard

Table 1: Red rot disease of sugarcane as influenced by sett treatment with various doses of fungicide

Treatments	Red rot (percent disease index) 2013–14				Red rot (percent disease index) 2014–15			
	150 DAP	180 DAP	270 DAP	DROC# (%)	150 DAP	180 DAP	270 DAP	DROC# (%)
Untreated check	13.57	20.53	27.47	-	11.45	14.67	24.90	-
Azoxystrobin 23% w/w SC @ 0.50 ml l^{-1}	5.00	7.77	10.33	62.40	4.13	7.07	9.30	62.65
Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1}	4.80	7.00	9.00	67.24	3.67	6.07	8.45	66.06
Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1}	3.60	5.10	6.47	76.45	2.98	4.25	6.15	75.30
Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1}	2.83	4.80	6.00	78.16	2.37	4.10	5.80	76.71
Carbendazim 50 WP @ 1.00 g l^{-1}	7.98	11.73	15.07	45.14	6.42	10.90	13.43	46.06
Mancozeb 75 WP @ 3.00 g l^{-1}	10.57	14.23	17.43	36.55	8.00	12.90	15.77	36.67
CD (p=0.05)	1.09	1.37	1.25	-	1.07	1.15	1.23	-

#DROC: Disease reduction over control

checks i.e. Carbendazim recorded 15.07 PDI while Mancozeb recorded 17.43 PDI at 270 DAP. Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the highest percent disease reduction of 78.16% which is at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (76.45% disease reduction over control).

During 2014–15 cropping season, similar trends of checking the red rot infection by various treatments were observed at different days interval. Results revealed that Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} found very effective against red rot disease which recorded 76.71% disease reduction over untreated check which is significantly at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (75.30% disease reduction over control). Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the lowest PDI of 5.80 at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (6.15 PDI) followed by Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1} (8.45 PDI), Azoxystrobin 23% w/w SC @ 0.50 ml l^{-1} (9.30 PDI), Carbendazim (13.43 PDI) and Mancozeb (15.77 PDI) as against 24.90 PDI in untreated check at 270 DAP.

Malathi et al. (2004) reported that soaking of sugarcane setts in a 0.25% suspension of Thiophanate Methyl found effective against red rot disease. Subhani et al. (2008) reported that fungicides Benomyl, Folicur, Ridomil gave the best results against red rot of sugarcane. Sabhir Hussain Khan et al. (2009) also studied the control of red rot disease through fungicides. Bharadwaj and Sahu (2014) also evaluated fungicides, botanicals and essential oils against red rot fungus. Bharti et al. (2014) observed that the maximum inhibition (98%) were found by Bavistin followed by Vitavax i.e. 91.0% inhibition.

3.2. Efficacy of Azoxystrobin 23% w/w SC against rust disease

During 2013–14 cropping season (Table 2), Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the lowest PDI of 4.90 which is significantly at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (5.65 PDI) followed by Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1} (9.72 PDI), Azoxystrobin 23% w/w

Table 2: Disease severity of rust disease as influenced by sett treatment with various doses of fungicide

Treatments	Rust (percent disease index) 2013–14				Rust (percent disease index) 2014–15			
	90 DAP	120 DAP	150 DAP	DROC# (%)	90 DAP	120 DAP	150 DAP	DROC# (%)
Untreated check	10.36	15.17	26.52	-	9.15	12.58	23.57	-
Azoxystrobin 2% w/w SC @ 0.50 ml l^{-1}	7.08	9.22	11.33	57.28	6.28	8.10	10.18	56.81
Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1}	6.30	7.85	9.72	63.35	5.15	6.78	8.36	64.53
Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1}	3.05	4.55	5.65	78.70	3.13	4.62	5.12	78.28
Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1}	2.65	3.85	4.90	81.52	2.17	3.45	4.25	81.97
Carbendazim 50 WP @ 1.00 g l^{-1}	6.73	8.63	11.50	56.64	5.63	7.98	10.37	56.00
Mancozeb 75 WP @ 3.00 g l^{-1}	7.98	9.25	11.65	56.07	7.05	8.55	10.87	53.88
CD (p=0.05)	1.41	1.09	1.10	-	1.50	1.06	1.07	-

#DROC: Disease reduction over control

SC @ 0.50 ml l^{-1} (11.33 PDI), Carbendazim (11.50 PDI) and Mancozeb (11.65 PDI) as against 26.52 PDI in untreated check at 150 DAP. Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded 81.52% disease reduction over control while treatment Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} recorded 78.70% disease reduction over control.

During 2014–15 cropping season data revealed that all the doses of Azoxystrobin 23% w/w SC were found effective against rust disease. Among the various treatments, Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the lowest PDI of 4.25 at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (5.12 PDI). The standard checks i.e. Carbendazim recorded 10.37 PDI while Mancozeb recorded 10.87 PDI at 150 DAP. Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the highest per cent disease reduction of 81.97% which is at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (78.23% disease reduction over control). Sumangala et al. (2014) reported that fungicide Tebuconazole was found the most effective in controlling the disease and thereby increased the cane yield. Zvoutete (2006) have also reported that use of Triazole fungicides reduced the rust infection and there was no significant difference among Triazoles fungicides.

3.3. Efficacy of Azoxystrobin 23 % w/w SC against smut in sugarcane

During 2013–14 cropping season (Table 3), Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded 5.93% disease incidence which is significantly at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (6.25% disease incidence) followed by Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1} (7.70% disease incidence), Azoxystrobin 23% w/w SC @ 0.50 ml l^{-1} (8.12% disease incidence), Carbendazim (15.50% disease incidence) and Mancozeb (18.43% disease incidence) as against 25.60% disease incidence in untreated check at 210 DAP. Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} found very effective which recorded 76.84% disease reduction over untreated check and Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} recorded 75.59% disease reduction over check.

Table 3: Disease incidence of smut disease as influenced by sett treatment with various doses of fungicide

Treatments	Smut (% disease incidence) 2013–14			Smut (% disease incidence) 2014–15		
	180 DAP	210 DAP	DROC# (%)	180 DAP	210 DAP	DROC# (%)
Untreated check	17.67	25.60	-	15.06	22.50	-
Azoxystrobin 23% w/w SC @ 0.50 ml l^{-1}	6.40	8.12	68.28	4.97	7.10	68.44
Azoxystrobin 23% w/w SC @ 0.75 ml l^{-1}	5.90	7.70	69.92	4.80	6.90	69.33
Azoxystrobin 2% w/w SC @ 1.00 ml l^{-1}	4.33	6.25	75.59	3.35	5.66	74.84
Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1}	3.80	5.93	76.84	2.70	5.00	77.78
Carbendazim 50 WP @ 1.00 g l^{-1}	11.17	15.50	39.45	7.63	13.43	40.31
Mancozeb 75 WP @ 3.00 g l^{-1}	13.37	18.43	28.01	11.27	16.47	26.80
CD (p=0.05)	1.19	1.20	-	1.38	1.19	-

#DROC: Disease reduction over control

During 2014–15 cropping season data revealed that all the doses of Azoxystrobin 23% w/w SC were found effective against smut disease. Among the various treatments, Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the lowest percent disease incidence of 5.00 at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (5.66% disease incidence). The standard checks i.e. Carbendazim recorded 13.43% disease incidence while Mancozeb recorded 16.47% disease incidence at 210 DAP. Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} recorded the highest per cent disease reduction of 77.78% which is at par with Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} (74.84% disease reduction over control). Bharathi, (2009–10) also reported sett treatment with Tridemifon @ 0.1% or Propiconazole @ 0.1% for 2 hr and 4 hr had shown reduction in smut incidence and can be recommended for an effective management of sugarcane smut. Triademifon, Propiconazole significantly reduced the smut incidence and improve the cane yield (Sundravadana et al., 2011). Meena and Ramyabharthi (2012) observed that the lowest smut infection i.e. 4.4% infection was recorded in the sett treatment and foliar spray of Triadimefon @ 0.1%.

4. Conclusion

Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} and Azoxystrobin 23% w/w SC @ 1.25 ml l^{-1} was found significantly at par. Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} was found superior to other doses of Bavistin and Mancozeb against red rot, smut, wilt, rust and cane yield of sugarcane. So, Azoxystrobin 23% w/w SC @ 1.00 ml l^{-1} may be recommended for control of red rot, smut, wilt and rust diseases.

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