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Chemical study on rust of sugarcane (cv. Co 86032)

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ABSTRACT

Sugarcane (*Saccharum officinarum* L.) is one of the important cash crops of the tropical and sub tropical countries, where 60 per cent of total sugar comes from sugarcane. The common rust of sugarcane caused by *Puccinia melanocephala* H. and P. Syd and orange rust caused by *P. kuehnii* are the important diseases of the crop, which cause both qualitative and quantitative loss in the cane yield. Field trail was conducted with three non- systemic and combifungicides and five systemic fungicides were evaluated. All treatments have reduced the disease severity significantly compared to untreated control (52.73%). Minimum severity was recorded at 0.1 per cent (13.83%) of tebuconazole which was at par with captan + hexaconazole (15.38%) at 0.2 per cent. Similar trend was observed after first and second spray of chemicals. Among all chemicals, tebuconazole was effective in controlling the disease and thereby increased the yield and yield parameters with economical B : C ratio.

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INTRODUCTION

Sugarcane is emerging as a multiproduct crop used as a basic raw material for the production of sugar, ethanol, electricity, paper and boards, besides a host of ancillary products. Consequently the overall demand for sugarcane for its varied uses will increase significantly. The crop is also associated with inherent constraints to increase the productivity. Diseases are the one of the major constraints to increase the productivity of the crop. About 100 diseases of sugarcane have been reported from India (Agnihotri, 1983). Out of these red rot, whip smut, pineapple disease, rust, grassy shoot, ratoon stunting, mosaic and wilt cause maximum damage to the crop in terms of yield and quality parameters.

The common rust of sugarcane caused by *Puccinia melanocephala* H. and P. Syd and orange rust caused by *P. kuehnii* are the important diseases of the crop, which cause both qualitative and quantitative loss in the cane yield.

Chemical control by fungicides may have negative environmental effects and limitations but fungicides still constitute the predominate part of the control measures used against rust. Use of chemicals has become more popular in recent times because of their quick results, especially in absence of resistant varieties. Many systemic and non-systemic fungicides are reported to manage the sugarcane rust. The information on the efficacy of different new fungicides against sugarcane rust is insufficient. Hence, there is a need to evaluate new fungicides against rust of sugarcane.

MATERIAL AND METHODS

Field experiment was conducted at Agricultural Research Station, Sankeshwar of Belgaum district to find out the effective systemic fungicides, non systemic and combi-fungicides for management of rust disease in sugarcane. Concentration of chemicals was tested as per the result of laboratory study.

A field experiment was laid-out in Randomised Block Design with eleven treatments, one untreated check and replicated thrice. Co 86032 genotype was used in the present investigations. The plot size of 3.6×6 m was maintained. The variety was grown as per packages of practices for higher yields. Treatments were imposed at six months after planting by spraying fungicides. Observation on severity was recorded at three times. First observation was recorded after first spray other two observations were recorded after second spray and before harvest.

The details of the experiment are given below:

Design : RBD
Replication : 3

Treatment No.	Treatments	Concentration (%)
Non-systemic fungicides		
T_1	Chlorolthalonil 75% WP	0.2
T_2	Mancozeb 75% WP	
T_3	Zineb 75% WP	
Systemic fungicides		
T_4	Difenoconazole 25% EC	0.1
T_5	Hexaconazole 5% EC	
T_6	Propiconazole 25% EC	
T_7	Tebuconazole 25% EC	
T_8	Triadimefon 25% WP	
Combi fungicides		
T_9	Captan 70%+ hexaconazole 5% WP	0.2
T_{10}	Hexaconazole 4%+ zineb 68% WP	
T_{11}	Mancozeb 18%+ tricyclozole 62% WP	
T_{12}	Control	-

Spacing : 90 × 60 cm
Varieties : Co 86032
Treatments : 12

Observation on intensity of disease was recorded using five randomly selected plants from each treatments plot and graded as per 0 to 9 scale given. Further per cent disease index was calculated as described earlier. Average values were taken into consideration for statistical analysis. Yield, yield parameters and quality aspects *viz.*, millable cane length, number of internodes, cane girth, cane and juice weight, brix in juice, sucrose per cent in juice, purity percentage Commercial Cane Sugar per cent (CCS%) were recorded etc and B : C ratio was calculated.

RESULTS AND DISCUSSION

All treatments were effective in reducing the disease severity significantly compared to untreated control (94.68%). Tebuconazole at 0.1 per cent was effective in controlling the disease and was recorded minimum disease severity (24.65%), which was at par with captan + hexaconazole (25.32%) treatment, hexaconazole + zineb (25.73%, chlorothalonil (19.50%) at 0.2 per cent and hexaconazole (25.35%), propiconazole (19.50%) at 0.1 per cent.this was significantly superior to other treatment. Similar trend was observed after first and second spray (Table 1).

Quantity parameters :

Cane height :

All fungicides evaluated increased the cane height significantly compared to control. Maximum cane height (2.09 cm) was observed in tebuconazole (3.15 cm) which was at par with captan + hexaconazole (1.89 cm), hexaconazole (1.88 cm), hexaconazole + zineb (1.87 cm) and mancozeb + tricyclozole (1.86 cm). However, zineb (1.73 cm) difenconazole (1.64 cm) and mancozeb (1.6 cm), was significantly superior to tebuconazole.

Cane girth :

All fungicides evaluated were effective in controlling the disease and thereby increased the cane girth. Maximum cane girth (3.15 cm) was observed in tebuconazole and was at par with captan + hexaconazole (3.14 cm), hexaconazole (3.12 cm), hexaconazole + zineb (3.09 cm) and mancozeb + tricyclozole (2.91 cm).

Number of internodes:

All the fungicides evaluated for number of internodes were significantly superior to the control (16.22). Maximum number of internodes were observed in tebuconazole (23), which was significantly superior to triadimefon (19.56), chlorothalonil (19.67), zineb (19.44) and mancozeb (16.89). This was followed by captan + hexaconazole (22.67), hexaconazole + zineb (21.33) and mancozeb + tricyclozole (20.67) and they were at par with tebuconazole.

Number of millable canes:

All fungicides evaluated increased the number of millable canes significantly compared to control (138). Maximum number of millable canes were observed in Tebuconazole (190.33) which was significantly superior to all other treatments. This was followed by captan + hexaconazole (188.67), hexaconazole (188), hexaconazole + zineb (187.67) and mancozeb + tricyclozole (185.67).

Single cane weight:

All fungicides evaluated were effective in controlling the disease and thereby increased the single cane weight. Maximum single cane weight (1.47 kg) was observed in tebuconazole and was at par with captan + hexaconazole (1.45 kg), hexaconazole (1.41 kg), hexaconazole + zineb (1.37 kg) and mancozeb + tricyclozole (1.32 kg).

Quality parameters :

Juice weight :

All fungicides evaluated increased the juice weight significantly compared to control (0.48%). Maximum juice weight (0.86%) was observed in tebuconazole which was at par with captan + hexaconazole (0.86%) followed by hexaconazole (0.83%), hexaconazole + zineb and mancozeb + tricyclozole (0.78%).

Brix :

All fungicides evaluated increased the brix significantly compared to control (17.08%). Maximum brix (20.24%) was observed in tebuconazole which was significantly superior to propiconazole (18.87), chlorothalonil (18.78), triadimofon (18.24), zineb (18.24), mancozeb (17.94) and mancozeb + tricyclozole (17.08). which was at par with captan + hexaconazole (19.94%) hexaconazole (19.65%), hexaconazole + zineb (19.40%) and mancozeb + tricyclozole (19.27%).

Sucrose:

All fungicides evaluated were effective in controlling the disease and thereby increased the sucrose per cent. Maximum sucrose per cent (19.38%) was observed in tebuconazole and was at par with captan + hexaconazole (19.29%), hexaconazole (19.08%), hexaconazole + zineb (18.64%) and significantly superior to mancozeb + tricyclozole (18.35%).

Commercial cane sugar :

All the treatments were significant with respect to CCS per cent compared to control. Maximum CCS per cent (19.38%) was observed in tebuconazole and was followed by captan + hexaconazole (14.72%), which was at par with hexaconazole (14.60%), hexaconazole + zineb and mancozeb + tricyclozole (14.51%).

Purity :

All fungicides evaluated increased the juice purity significantly compared to control (84.83%). Maximum juice purity (97.85%) was observed in Tebuconazole. This was followed by captan + hexaconazole (97.34%) which was at par with hexaconazole (97.20%), hexaconazole + zineb (97.08%) and mancozeb + tricyclozole (96.71%) (Table 2).

Yield :

Yield of individual plot was calculated as mentioned in table and converted to per hectare. Cane yield of sugarcane was significantly superior in all the treatments compared to unsprayed control.

All fungicides evaluated increased the cane yield significantly compared to control (71.53 t/ha). Maximum cane yield (172.26 t/ha) was observed in tebuconazole. This was followed by captan + hexaconazole (168.69 t/ha) which was at par with hexaconazole (163.93 t/ha), hexaconazole + zineb (157.33 t/ha) and mancozeb + tricyclozole (153.33 t/ha).

Benefit cost ratio :

In the present investigation highest benefit was obtained from tebuconazole treatment (4.70) followed by hexaconazole treatment (4.62) and captan + hexaconazole (4.52). In untreated control cost-benefit ratio was 2.04.

Table 1: Effect of different treatments on quantity parameters on Co 86032 at ARS, Sankeshwar during 2012

Treatments	Concentration (%)	PDI at harvest	Quantity parameters						
			CH (cm)	Girth (cm)	No. of inter nodes	No. of millable canes	SCW (kg)	Yield kg/plot	Yield t/ha
Non- systemic fungicides									
Chlorothalonil 75% WP	0.2	19.50 (26.21)	1.85	2.89	19.67	184.33	1.26	232.30	143.33
Mancozeb 75% WP	0.2	28.10 (32.00)	1.61	2.63	16.89	177.33	1.03	182.65	112.70
Zineb 75% WP	0.2	23.28 (28.85)	1.73	2.74	19.44	181.67	1.24	225.87	139.36
Systemic fungicides									
Difenconazole 25% EC	0.1	24.23 (29.48)	1.64	2.63	17.44	179.33	1.20	215.20	132.78
Hexaconazole 5% EC	0.1	15.88 (23.45)	1.88	3.12	22.67	188.00	1.41	265.69	163.93
Propiconazole 25% EC	0.1	19.50 (26.21)	1.85	2.91	20.11	185.33	1.28	235.94	145.58
Tebuconazole 25% EC	0.1	13.83 (21.75)	2.09	3.15	23	190.33	1.47	279.19	172.26
Triadimefon 25% WP	0.1	21.92 (27.91)	1.81	2.89	19.56	183.33	1.25	231.61	142.90
Combi fungicides									
Captan 70% + hexaconazole 5% WP	0.2	15.38 (23.09)	1.89	3.14	22.67	188.67	1.45	273.40	168.69
Hexaconazole 4% + zineb 68% WP	0.2	16.67 (24.09)	1.87	3.09	21.33	187.67	1.37	254.99	157.33
Mancozeb 18%+ tricyclazole 62% WP	0.2	18.36 (25.37)	1.86	2.91	20.67	185.67	1.32	248.38	153.33
Control	-	52.73 (46.57)	1.48	2.36	16.22	138.00	0.84	115.93	71.53
S.E.±		0.45	0.08	0.11	0.85	0.43	0.04	8.25	5.09
C.D. (P=0.05)		1.62	0.25	0.31	2.50	1.26	0.13	24.19	14.92

Table 2: Effect of different treatments on yield parameters on Co 86032 at ARS, Sankeshwar during 2012

Treatments	Concentration (%)	Quality parameters					B:C ratio
		Juice weight (kg)	Brix	Sucrose %	CCS %	Purity %	
Non- systemic fungicides							
Chlorothalonil 75% WP	0.2	0.76	18.78	18.40	13.81	96.04	3.86
Mancozeb 75% WP	0.2	0.58	17.94	16.62	13.31	94.82	3.14
Zineb 75% WP	0.2	0.69	18.24	17.23	13.52	95.41	3.89
Systemic fungicides							
Difenconazole 25% EC	0.1	0.68	18.06	17.23	13.43	95.31	3.47
Hexaconazole 5% EC	0.1	0.83	19.65	19.08	14.60	97.20	4.62
Propiconazole 25% EC	0.1	0.77	18.87	17.56	14.25	96.26	4.03
Tebuconazole 25% EC	0.1	0.86	20.24	19.38	15.05	97.85	4.70
Triadimefon 25% WP	0.1	0.68	18.24	17.52	13.53	96.04	3.80
Combi fungicides							
Captan 70% + hexaconazole 5% WP	0.2	0.86	19.94	19.29	14.72	97.34	4.52
Hexaconazole 4% + zineb 68% WP	0.2	0.78	19.40	18.64	14.51	97.08	4.32
Mancozeb 18% + tricyclazole 62% WP	0.2	0.78	19.27	18.35	14.45	96.71	4.29
Control	-	0.48	17.08	16.03	12.60	84.83	2.04
S.E.±		0.04	0.22	0.39	0.17	1.25	-
C.D. (P=0.05)		0.13	0.64	0.94	0.49	3.67	-

CCS: Commercial cane sugar

Present study supported by Jeffrey *et al.* (2007) who reported that sugarcane rust can be effectively managed by tebuconazole and metconazole in combination with pyraclostrobin. Frequent applications of the fungicide were however needed and this, coupled with the low net profit obtained after control of the pathogen, limited the use of fungicides in Taiwan (Jiang, 1985). The effectiveness of fungicides against sugarcane rust pathogen was reported by several researchers Comstock *et al.* (1992) and Liu (1980). Zvoutete (2006) reported that use of triazole fungicides like cyproconazole, propiconazole, triadimefon and triadimenol reduced brown rust infections and there was no significant difference among triazole fungicides.

Difenconazole, propiconazole, hexaconazole, triadimefon and myclobutanil belongs to triazoles group. These fungicides interfere with the biosynthesis of fungal sterols and inhibit ergosterol biosynthesis (Rawal, 1993). Ergosterol is essential to the structure of cell wall and its absence causes irreparable damage to the cell wall and fungus dies. These change the sterol content and saturation of the polar fatty acids leading to alterations in membrane fluidity and behaviour of membrane bound enzymes (Nene and Thapliyal, 1993).

Trials in South Africa involved the use of mancozeb and propiconazole and revealed that reduction in rust severity was noted with an application of a combination of these fungicides every four weeks when compared to the untreated control but a slight increase in yield was seen. Further cost benefit analyses revealed that it was uneconomical to spray fungicides (McFarlane *et al.*, 2006). Similar work related to the present investigation was also done by Jat *et al.* (2013) on aonla, Barhate *et al.* (2015) on chrysanthemum and Kanade *et al*. (2015) on groundnut and the reseults found were more of less similar to the results found in the present investigation.

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