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Performance and economics of different fungicides against Pokkah boeng disease in sugarcane

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Abstract
A field trial was conducted at the Pusa farm to manage the disease through chemicals and to find out the impact on quantitative and qualitative parameters. The disease incidence varied from 1.8 to 14.2 per cent during the course of study. Minimum (1.8%) disease incidence was recorded in the plot when setts treated and sprayed with carbendazim 50 WP which was found significantly superior over all the treatments. Among the treatments, T_5 (setts treated and sprayed with carbendazim) was found significantly superior over all the treatments in respect of quantitative as well as qualitative attributes of the sugarcane in crop being cane height (280 Cm), cane weight (1.20 Kg), cane girth (2.6 Cm), number of internodes (22), number of clumps (124), number of tillers (700), number of milliable canes (510/plot), cane yield (113.30 tones/ha), brix per cent (18.4%), sucrose per cent (15.83) and juice purity (86%). The cost benefit ratio indicated that the setts treated and sprayed with carbendazim achieved higher returns of Rs/ha being 2,23,039/- followed by Rs. 1,61,124 and Rs. 140679 of T_6 (Sett treatment with carbendazim 50 WP @ 0.1% + three spray with propiconazole 25 EC @ 0.1%) and T_7 (Sett treatment with propiconazole 25 EC @ 0.1% + three sprays with carbendazim 50 WP @ 0.05%), respectively.

Keywords: performence, economics, fungicides, pokkah boeng and sugarcane

1. Introduction
Sugarcane is the most important cash-cum-industrial and emerging multiproduct crop with a great demand in the country. Besides sugar production, it has also produced byproducts like Bagasses and Molasses in the world [1]. In India the incidence and severity of Pokkah boeng disease has been reported from major sugarcane growing states like Uttar Pradesh, Uttarakhand, Maharashtra, Karnataka, Andhra Pradesh, Punjab, Haryana, Rajasthan, Assam, Tamil Nadu and Bihar [2]. Presently it is observed in Uttar Pradesh, Haryana, Maharashtra, Bihar and other parts of India wherever sugarcane is cultivated [3]. Pokkah boeng is a re-emerging disease of sugarcane which has been found recently to cause major yield losses in most sugarcane producing regions including South Africa, Malaysia, India and China [4]. Pokkah boeng was favoured by warm, moist condition with typical symptoms develop during the monsoon season which coincides with rapid and vigorous growth phase of the crop, additionally summer showers with cloudy weather also favour disease development. Three to seven months old crops are most susceptible to the disease [5]. Keeping the above facts in consideration the present investigation was therefore, conducted on Performance and economics of different fungicides against Pokkah boeng disease in Sugarcane.

2. Materials and Methods
A field trial was conducted to manage the disease and to see the impact of fungicides on qualitative as well as quantitative characteristics of sugarcane. At the time of harvesting various parameters *viz*., cane height, cane weight, cane girth, number of internodes, number of milliable cane, number of tillers, number of clumps, cane yield, percentage of brix, sucrose and purity were observed.
Three budded treated setts (as per treatment) of variety CoSe 95422 were planted in three replication for each treatment in Randomized Block Design and size of plot was (5.40 × 10.0 m^2) and row to row distance was kept 90 cm. The following treatments were under taken to evaluate the efficacy of the fungicides.

I. Treatment details

T_1- Sett treatment with Carbendazim 50 WP @ 0.1%. (Planting time).
T_2- Sett treatment with Propiconazole 25 EC @ 0.1%. (Planting time).
T_3- Three Sprays with Carbendazim 50 WP @ 0.05%. (Appearance of symptoms).
T_4- Three Spray with Propiconazole 25EC @ 0.1%. (Appearance of symptoms).
T_5- (T_1 + T_3), appearance of symptoms at 15 days interval.
T_6- (T_1 + T_4), appearance of symptoms at 15 days interval.
T_7- (T_2 + T_3), appearance of symptoms at 15 days interval.
T_8- (T_2 + T_4), appearance of symptoms at 15 days interval.
T_9- Control (no treatment)

Cane height was measured with the help of scale in centimeter, cane weight is measured by using electric balance, cane girth is measured with the help of slide calipers in centimeter and girth was calculated by the help of formula;

Girth= 2πr

Internodes of cane was taken by counting the area between two nodes.
Clumps – Group of side shoots growing from the base at ground level.
Tillers – Side shoot growing from the base of the stem at ground level.
Cane yield is calculated by;
Cane yield = number of milliable cane × cane weight (kg)

Cane yield (tones/ha) $= \frac{10}{Plot\ area}$ × cane yield (kg/plot)

Brix is the percentage of total solid in sugarcane juice. Its reading was taken by brix hydrometer. Sucrose percentage was measured by polariscope. The purity coefficient was calculated by employing the formula:

$$\text{Purity coefficient} = \frac{Sucrose\ Percentage}{Brix\ Percentage} \times 100$$

II. Cost Benefit Ratio (CBR)
Cost benefit ratio is calculated with respect to performance of treatments for management of the Pokkah boeng disease in sugarcane.

III. Statistical analysis
The data were analyzed by the technique of analysis of variance whenever necessary. The values of the standard error of mean (SEm) and critical difference at one per cent and five per cent level of significance were computed.

3. Results and Discussions
The data presented in Table 1, revealed that the incidence of disease varies from 1.8 to 14.2 per cent during the course of investigation. Minimum (1.8%) disease incidence was recorded in the plot when sett treated and sprayed with carbendazim 50 WP which was found significantly superior over all treatments followed by 2.4 and 2.8 per cent when sett treated with carbendazim along with sprayed of propiconazole and sett treated by propiconazole sprayed of carbendazim, respectively. These treatments were at par with each other. All the treatments were found significantly superior as compared to check which was showed maximum (14.2%) disease incidence under control plots.

A. Quantitative effect
I. Cane height
It is revealed from the data (Table 1 and illustrated in figure 1a) that maximum (280 cm) average height of cane was recorded in case of setts treated + sprayed with carbendazim followed by 274 cm height when sett treated with carbendazim + sprayed with propiconazole and minimum (196 cm) height was recorded in control. However, the remaining treatments were at par with check.

II. Cane girth
Experimental results presented in Table 1 and illustrated in figure 1a revealed that the effect of different treatments on the average cane girth (cm). The maximum (2.60 cm) girth was recorded in case of setts treated + sprayed with carbendazim followed by sett treated with carbendazim + sprayed with propiconazole and setts treated with propiconazole and sprayed with carbendazim being 2.56 cm and 2.52 cm respectively and minimum (1.8 cm) cane girth was recorded in control. Although, other treatments were found superior over control.

III. Cane weight
The effect of different sett treatments on cane weight (kg) presented in Table 1 and illustrated in figure 1a. Maximum (1.20 kg) average cane weight was recorded in case of setts treated + sprayed with carbendazim followed by sett treated + sprayed with carbendazim and propiconazole (1.01 kg) and minimum was recorded at sprayed with carbendazim 50 WP (0.93 kg) as compared to check (0.54 kg). Sett treated + sprayed with carbendazim and sprayed with carbendazim was found significantly superior as compared to propiconazole and other treatments also.

IV. Number of internodes
Effect of different treatments on the average number of internodes presented in Table 1 and illustrated in figure 1 revealed that maximum number of internodes were recorded in case of setts treated + sprayed with carbendazim (22) followed by sett treated + sprayed with carbendazim and propiconazole (21) and minimum (17) was recorded at sprayed with propiconazole as compared to check (15). Setts treated and sprayed with carbendazim was found superior among all treatment at par with control. There was no significant difference among the treatments, except in between propiconazole and carbendazim treated setts.

V. Number of clumps
Results presented in Table 1 and illustrated in figure 1a showed the effect of different treatments on the number of clumps. Significantly higher number (124) of clumps were recorded in the plot when sett treated + sprayed with carbendazim which was significantly superior over (121) sett treated and sprayed with carbendazim and propiconazole. The minimum (110) clumps were recorded at sprayed by propiconazole treated setts. Although, all treatments were superior from check (90). However, carbendazim showed significant increase in number of clumps as compared to propiconazole and check.

VI. Number of tillers
As per the results depicted in Table 1 and illustrated in figure 1a showed the effect of different treatments on the number of tillers. Significantly higher number (700) of tillers were

recorded in the plots sett treated+ sprayed with carbendazim followed by sett treated and sprayed with carbendazim + propiconazole and minimum treated with propiconazole and sprayed by carbendazim being 690 and 682, respectively. However, remaining treatments were superior over control (550).

VII. Number of milliable canes

The effect of different treatments on the average number of milliable canes presented in Table 1 and illustrated in figure 1a. Maximum (510) number of milliable canes were recorded in the plots where sett treated + sprayed with carbendazim followed by 495 sett treated and sprayed with carbendazim + propiconazole and 470 with propiconazole + carbendazim. The minimum (410) milliable canes were recorded when sprayed with propiconazole as compared to check (400). Sett treated and sprayed with carbendazim gave significantly increase in number of milliable canes as compared to other treatment. However, all the treatments were found to be superior over check.

VIII. Cane yield

The data on effect of different treatments on cane yield presented in Table 1 and illustrated in figure 1b showed that maximum (113.34 tones) cane yield was obtained when setts were treated and sprayed with carbendazim followed by 92.59 tones setts treated and sprayed with carbendazim + propiconazole and minimum (54.67 tones) was in spraying with propiconazole. Setts treated with carbendazim and propiconazole gave significant increase in cane yield, as compared to other treatment. Although, all treatments were found superior over control (40.0 tones).

B. Qualitative effect

I. Brix per cent

Experimental Results presented in Table 2 and illustrated in figure 2 showed the effect of different treatments on the brix value. Maximum (18.4%) brix value recorded in plot when sett treated and sprayed with carbendazim 50 WP followed by 17.8 per cent brix value sett treated and sprayed with carbendazim and propiconazole and 17.6 per cent with sett treated and sprayed with propiconazole. The minimum (14.5%) brix value was obtained in check where no treatment was followed.

II. Sucrose per cent

Results presented in Table 2 and illustrated in figure 2 also showed the effect of different treatments on the sucrose per cent of the canes. Maximum sucrose per cent was recorded when setts were treated + sprayed with carbendazim (15.8%) followed by sett treatment and spray with carbendazim and propiconazole (15.0%) and minimum sucrose content was observed in case of setts sprayed with propiconazole (12.8%). The lowest (10.4%) sucrose content was found in control plots where no treatment was applied. Although, remaining treatments were found significantly superior over control.

III. Juice purity per cent

As per the data presented in Table 2 and illustrated in figure 2. Maximum (86.0%) juice purity was observed in setts treated + sprayed with carbendazim followed by sett treatment + sprayed with carbendazim and propiconazole (84.4%) and minimum was recorded in sprayed with propiconazole (76.5%). The lowest (72.1%) juice purity was found in control plots where no chemical was applied.

4. Economics

The data on cost benefit ratio (CBR) presented in Table 3 and illustrated in figure 3 revealed that the net profit over control (Rs/ha) showed considerable difference within the various treatments which were applied to manage the Pokkah boeng disease. Treatment (T_5) setts treated with carbendazim 50 WP @ 0.1% + sprayed with carbendazim 50 WP @ 0.05% followed by sett treated with carbendazim + sprayed with propiconazole and setts treated with propiconazole + sprayed with carbendazim achieved higher returns of Rs/ha being 2,23,039/-, 1,61,124/- and 1,40,679/-, respectively, as compared to rest of the treatment. The minimum net profit of Rs 11,703 per hectare was obtained from control plot where no chemical was applied.

The result showed that the effect of sett treatment as well as spraying not only reduced the Pokkah boeng disease incidence but also enhance the quantitative as well as qualitative parameters in cane. [6, 7, 4, 8] also reported more or less similar observations.

Table 1: Quantitative effect of different treatments

Treatment	Disease Incidence (%)	Av. Cane Height (cm)	Av. Cane Girth (cm)	Av. Cane Weight (Kg)	Av. No. of Internodes	No. of clumps /plot	No. of tillers /plot	No. of milliable canes/plot	Cane Yield (tone/ha)
T_1 (Sett treatment with carbendazim)	3.8	260	2.48	0.88	19	118	598	435	70.87
T_2 (Sett treatment with propiconazole)	4.2	254	2.4	0.84	18	114	591	430	66.89
T_3 (3 spray with carbendazim)	5.4	246	2.22	0.82	18	111	578	420	63.78
T_4 (3 spray with propiconazole)	6	232	2.1	0.72	17	110	564	410	54.67
T_5 (T_1+T_3)	1.8	280	2.6	1.20	22	124	700	510	113.34
T_6 (T_1+T_4)	2.4	274	2.56	1.01	21	121	690	495	92.59
T_7 (T_2+T_3)	2.8	271	2.52	0.96	20	120	682	480	85.34
T_8 (T_2+T_4)	3.2	266	2.5	0.93	20	118	678	470	80.95
T_9 (control)	14.2	196	1.83	0.54	15	90	550	400	40
SEm±	0.25	8.82	0.14	0.03	0.87	4.67	26.91	18.46	4.52
CD (0.05)	0.76	26.80	0.41	0.10	2.60	14.14	80.67	55.36	13.60
CV (%)	9.06	6.11	10.07	6.66	7.97	7.11	7.45	7.11	10.58

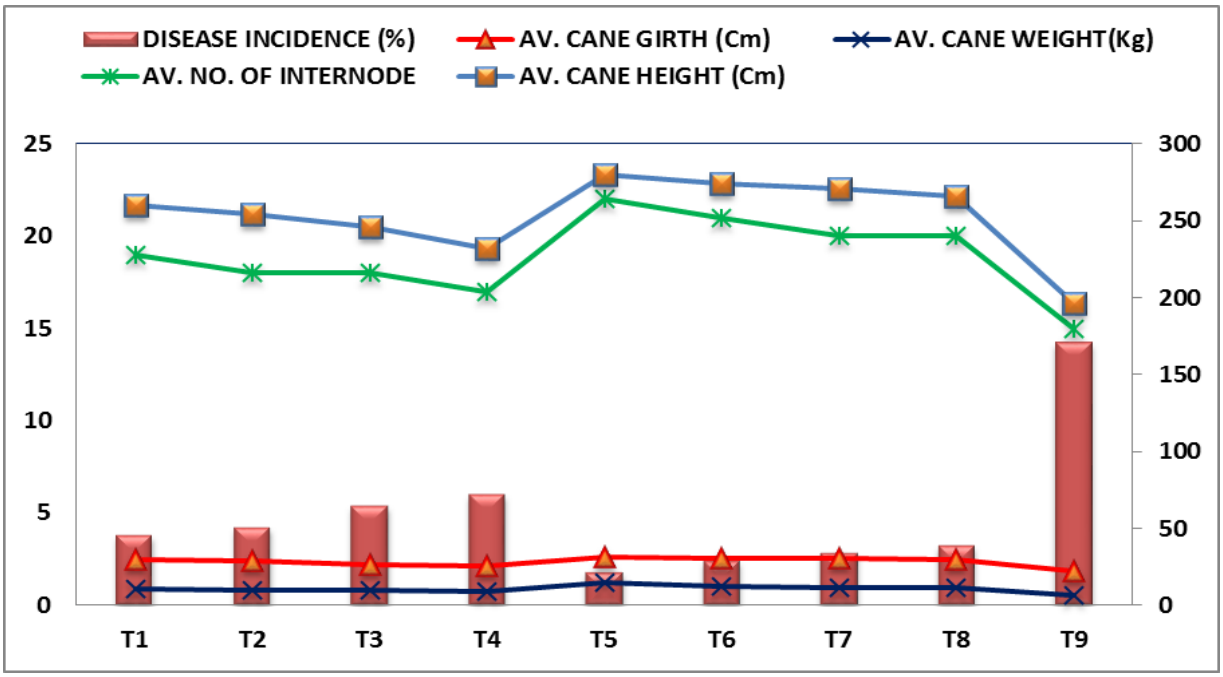

Fig 1: Effect of different treatments on quantitative parameters

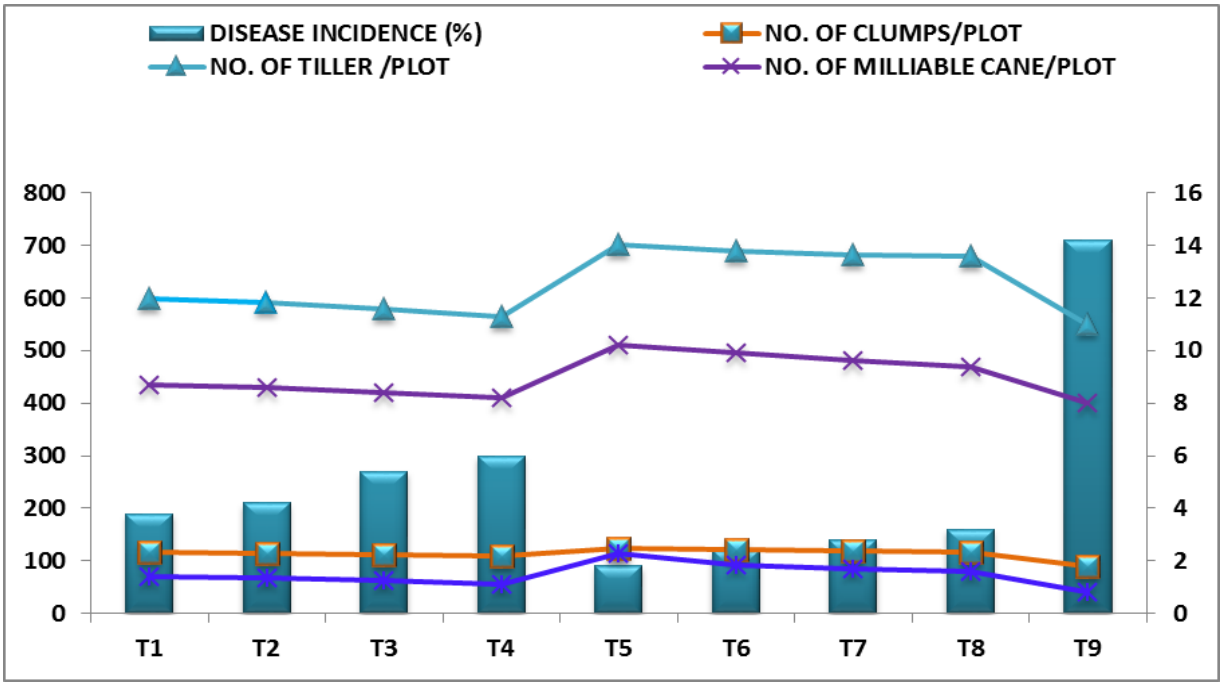

Fig 1a: Effect of different treatment on quantitative parameters

Table 2: Effect of different treatments on juice quality

Treatment	Disease Incidence (%)	Brix (%)	Sucrose (%)	Purity (%)
T_1 (Sett treatment with carbendazim)	3.8	17.4	14.0	80.5
T_2 (Sett treatment with propiconazole)	4.2	17.4	13.8	79.3
T_3 (3 spray with carbendazim)	5.4	17.0	13.25	77.9
T_4 (3 spray with propiconazole)	6.0	16.8	12.86	76.5
T_5 (T_1+T_3)	1.8	18.4	15.83	86.0
T_6 (T_1+T_4)	2.4	17.8	15.02	84.4
T_7 (T_2+T_3)	2.8	17.6	14.7	83.5
T_8 (T_2+T_4)	3.2	17.5	14.36	82.1
T_9 (control)	14.2	14.5	10.45	72.1
SEm±	0.25	0.18	0.18	1.6
CD (0.05)	0.76	0.54	0.54	4.8
CV%	9.06	1.79	2.26	3.45

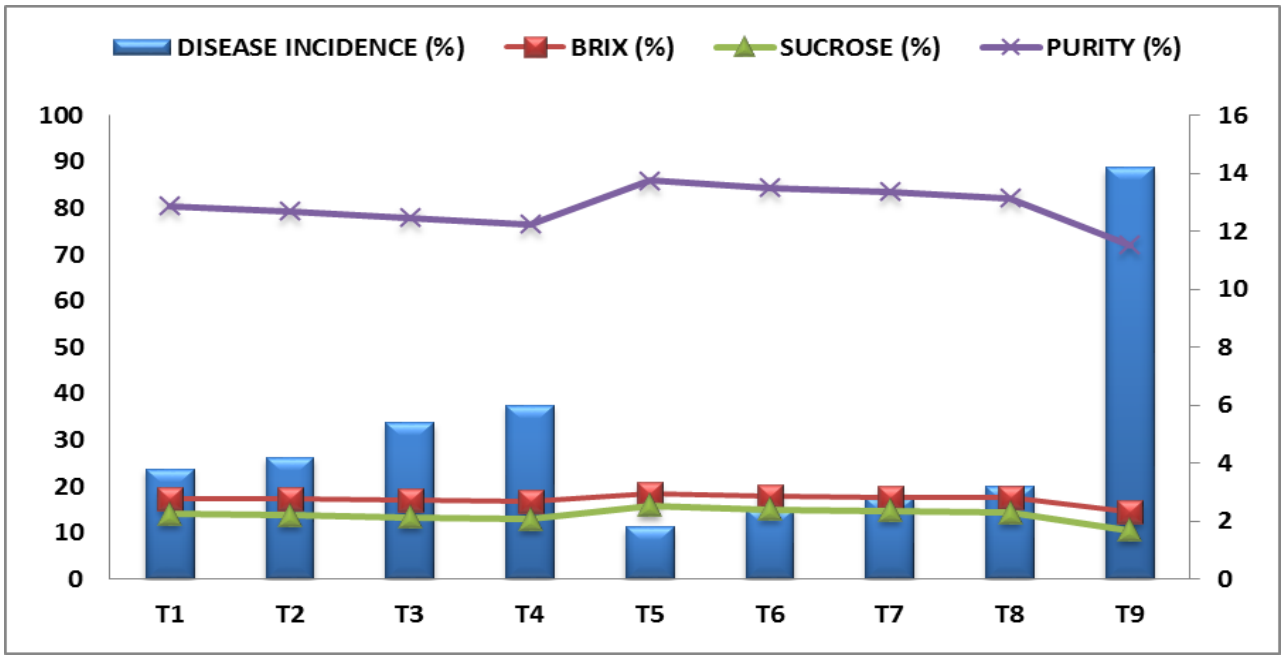

Fig 2: Effect of different treatments on qualitative parameters

Table 3: Cost benefit ratio (CBR) of different treatment

Treatment	Yield (tones/ha)	Total income (`/ha)	Cost of treatment (`/ha)	Net profit (`/ha)	CBR
T_1 (Sett treatment with carbendazim)	70.87	205522	104837	100685	1 : 0.96
T_2 (Sett treatment with propiconazole)	66.89	193981	105997	87984	1 : 0.83
T_3 (3 spray with carbendazim)	63.78	184962	105107	79855	1 : 0.76
T_4 (3 spray with propiconazole)	54.67	158543	106847	51696	1 : 0.48
T_5 (T_1+T_3)	113.34	328686	105647	223039	1 : 2.11
T_6 (T_1+T_4)	92.59	268511	107387	161124	1 : 1.50
T_7 (T_2+T_3)	85.34	247486	106807	140679	1 : 1.32
T_8 (T_2+T_4)	80.95	234755	108547	126208	1 : 1.16
T_9 (control)	40.00	116000	104297	11703	1 : 0.11

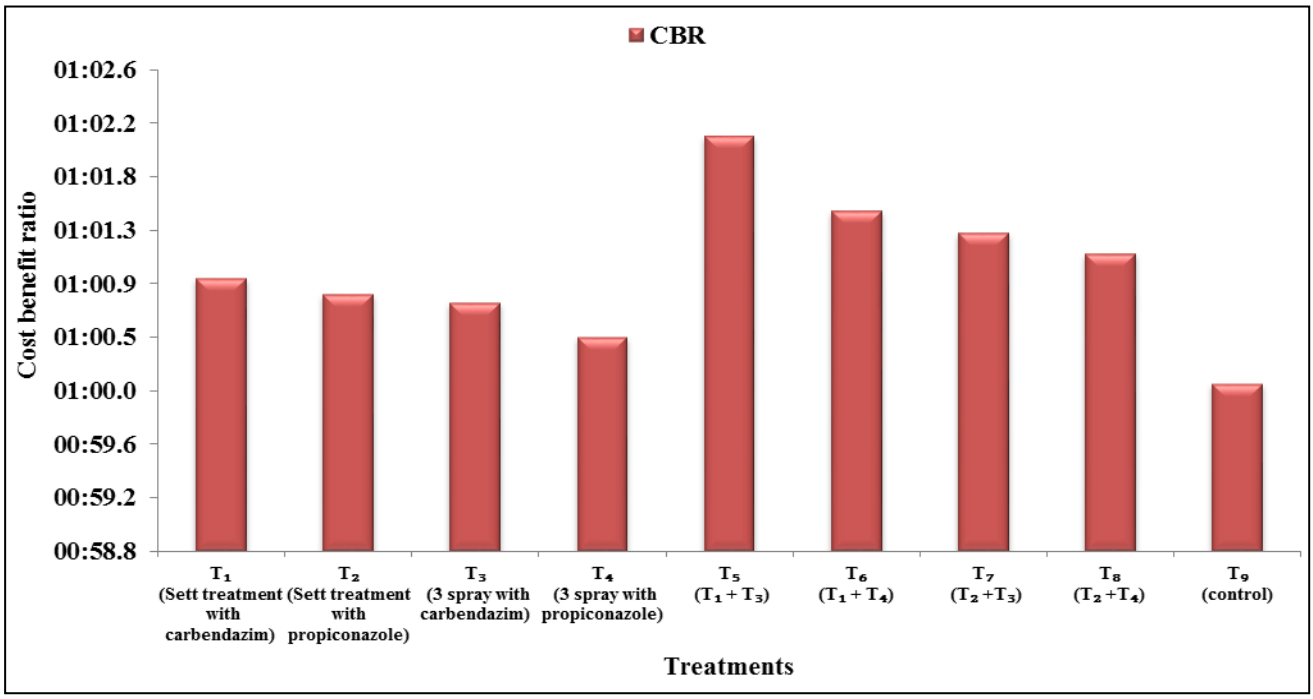

Fig 3: Cost benefit ratio of different treatment

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