Original research article

Effective Management of Pearl Millet Blast (*Pyricularia grisea*) Through Combined Chemical and Biological Tactics $^{ha-1}$

ABSTRACT

Pearl millet is a staple cereal grown in India. It encounters number of diseases which attack the crop during its growth, cause low yield and economic loss to the peasant ad finally to the nation as a whole. The blast also referred as leaf spot caused by *Pyricularia grisea* has emerged as a serious disease affecting both forage and grain production in pearl millet. in view of this a field experiment was conducted over three consecutive *kharif* seasons (2021, 2022 and 2023) at the Pearl Millet Research Station, JAU, Jamnagar, to assess to evaluate the efficacy of different fungicide and bio agents in for reducing the pearl millet blast disease as well as Identify the most effective fungicide/bio agents and application rates for minimizing blast intensity. On the basis of field and based on the pooled data,

Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 and 35 DAS found minimum blast disease intensity (22.96%), Gighest grain yield (2472 kg ha^{-1}) and fodder yield (46.80 q ha^{-1}) over treatment and sprays of *Pseudomonas fluorescens*, 10g L-1 at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS (26.75%), found statistically at par, with blast intensity (26.75%), grain yield (2377 kg ha^{-1}) and fodder yield 44.28 q ha^{-1}).

Keywords: Pearl millet Blast, *Kharif*, Tebuconazole + Trifloxystrobin, *Pseudomonas fluorescens*, disease intensity, Yield

Introduction

During 2023-24, pearl millet area in India was 7.36 million ha with an average production of 10.67 million tons and 1449 kg ha^{-1} productivity (DA&FW, 2024). The major pearl millet growing states are Rajasthan, Maharashtra, Uttar Pradesh, Gujrat and Haryana contributing to 90% of total production in the country. Rajasthan contributes nearly 45% followed by Uttar Pradesh (19%), Haryana (9%), Gujarat (9%), Maharashtra (6%) and Tamil Nadu (2%). Most of pearl millet in India is grown in rainy (kharif) season (June/July-September/October). Pearl millet is also cultivated during summer season (February-May) I parts of Gujarat, Rajasthan and Uttar Pradesh; and during the post-rainy (rabi) season (November-February) at a small scale in Maharashtra and Gujarat. In Gujarat it is grown in 26 out of 33 districts covering an area of 2.03 lakh ha in *kharif* with an average production 3.04 lakh tonnes and average yield 1787 kg ha^{-1} (DA&FW, 2024). In 2023, Hon'ble prime minister of India rebranded millets as "Shree Anna" for their climate resilience and nutritional superiority and declared ICAR-IIMR, Hyderabad as "Global Centre of Excellence for Millets". In order to mainstream and exploit nutritionally superiority of millets and promote their cultivation, Govt. of India declared Year 2018 as the "Year of Millets" and after declaration of FAO Committee on Agriculture (COAG) forum in 2021, Year 2023 was celebrated as "International Year of Millets" (Anon., 2024). Among the diseases of pearl millet, blast caused by *Pyricularia grisea* (Cooke) Sacc. [Teleomorph: Magnaporthe grisea (Herbert) Barr], a dis- ease of minor importance in past years, has gained status of major constraint to pearl millet production in India (Lukose et al., 2007). Bajra blast also referred as leaf spot caused by *Pyricularia grisea (Cooke) Sacc.* [Teleomorph: *Magnaporthe grisea* (Herbert) Barr.] has emerged as a serious disease affecting both forage and grain production in pearl millet (Kaurav *et al*., 2018), resulting economic loss. Recently intensity of blast increased at alarming rate in commercial hybrids cultivation (Thakur *et al*., 2009) In view of these, chemical control is taken to manage this disease. *Magnaporthe grisea* is externally seed borne and also survives as chlamydospores or as free saprophytic mycelium in the soilL-1eaf debris which serves as a source of primary inoculum (Singh and Pavgi, 1977).

MATERIALS AND METHODS

Three-year field experiments were conducted during *kharif* 2021, *kharif* 2022 and *kharif* 2023 at Pearl Millet Research Station, JAU, Jamnagar to find out the bio efficacy of different fungicide and bio agents against the minimized blast disease intensity at natural condition.

Experiment conducted with randomized block design (RBD), each having four replications. The plot size was 4.2 m × 2.4 m and distance between row to row and plant to plant was 60 cm and 10 cm, respectively. Four row were maintained in each treatment (plot) during all experimental season. Total six chemicals and bio agents (Table 1) including control was used as treatment for management of pearl millet blast disease intensity.

Seed treatments were given initially at the time of sowing. Foliar application of different fungicides and bio agents was carried out management of pearl millet blast. The first spray was given at 20 DAS and second spray given at 35 DAS.

For observation, ten plants were selected randomly and labeled from each plot for scoring the disease intensity. These labeled plants were observed for disease intensity from upper, middle and lower leaves using disease rating scale of 0-9. Observations on disease intensity was recorded at 30, 45 and 60 DAS.

Table 1: Treatments details:

Tr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	a. i g ha^{-1}	Quantity of formulation kg or lha-1
1.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *P.fluorescens*, 10g L^{-1} at 20 & 35 DAS	-	3.75 g kg^{-1}	-	0.015 kg
		1×10^8 cfug-1	100 g	-	5.0 kg
2.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10gL-1 at 20 & 35 DAS	-	3.75 g kg^{-1}	-	0.015 kg
		1×10^8 cfug-1	100 g	-	5.0 kg
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	1×10^8 cfug-1	100 g	-	5.0 kg
		0.04	5.33 g	200	0.267 kg
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS	0.04	5.33 g	200	0.267 kg
		1×10^8	100 g	-	5.0 kg

		cfu g^{-1}			
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	200	0.267 kg
6.	Control	-	-	-	-

Per cent disease intensity (PDI) will be calculated by using the following formula (Wheeler, 1969).

$$\text{Disease intensity (\%)} = \frac{\text{Sum of total rating}}{\text{Total number of leaves observed}} \times \frac{}{\text{Maximum disease rating}} \times 100$$

Blast disease rating scale (0-9)

Scale		Description	Scale		Description
0	:	No lesions	5	:	Typical blast lesions infecting 2-10% of the leaf area
1	:	Small brown specks of pinhead size without sporulating center	6	:	Blast lesions infecting 11-25% leaf area
2	:	Small roundish to slightly elongated, necrotic grey spots, about 1-2 mm in 8diameter with a distinct brown margin, lesions are mostly found on the lower leaves	7	:	Blast lesions infecting 26-50% leaf area
3	:	Lesion type is the same as in scale 2, but significant lesions are on the upper leaves	8	:	Blast lesions infecting 51-75% leaf area
4	:	Typical sporulating blast lesions, 3 mm or longer, infecting less than 2% of the leaf area	9	:	More than 75% leaf area affected

Observations recorded:

1. Seedling germination (%) 2. Per cent blast disease intensity at 30, 45 and 60 DAS. 3. Grain yield kgha-1 and fodder yield qha-1.

Grain and fodder yield was recorded from net plot area at harvest and data obtained was analyzed statistically.

RESULTS AND DISCUSSION

A field experiments was conducted with different six treatments including bio agents and chemical during *kharif* 2021, 2022 and 2023. The three year pooled result of all parameters presented in Tables (2 to 7). All the treatment found effective to suppress blast disease intensity significantly.

The three-year pooled data analysis (Table 2) shows that none of the treatments had a statistically significant impact on seed germination (Fig. 1). This result suggests that the treatments applied did not effectively enhance germination rates. Consequently, no treatment was superior, highlighting the need for further investigation to identify potential improvements or alternative approaches to influence seed germination effectively.

Looking to results of blast disease, three year pooled observation on 30 DAS (Table 3 and Fig. 2) stated that the treatment spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 and 35 DAS (9.17%) found significantly superior over treatment and which was at par with remaining all treatment without control, *viz.*, sprays of *Pseudomonas fluorescens*, 10gL-1 at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS (10.98%), spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *Bacillus subtilis*, 10g L^{-1} at 35 DAS (11.63%), seed treatment with Chitosan, 3.75 g kg^{-1} seed

+ two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS (12.18%) and seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS (12.42%).

The pooled data (Table 4 and Fig. 3) at 45 DAS shows that the treatment involving two sprays of Tebuconazole 50 + Trifloxystrobin 25 WG at 0.04% concentration, applied at 20 and 35 DAS, resulted in a blast intensity of 12.85%, which was significantly superior to other treatments. Among the remaining treatments, only the spray of *P. fluorescens* at 10 g L^{-1} at 20 DAS followed by Tebuconazole 50 + Trifloxystrobin 25 WG at 0.04% at 35 DAS (15.48%) was statistically at par with the superior treatment. The control registered highest blast intensity at 25.48%,

The treatment Tebuconazole 50 + Trifloxystrobin 25 WG treatment, particularly when applied at both 20 and 35 DAS, consistently resulted in significantly lower blast intensity compared to other approaches. This suggests it as a highly effective choice for disease control, outperforming other treatments and the untreated control.

More or less similar trend was observed in results of blast intensity on 60 DAS (Table 5 and Fig. 4) pooled results same as 45 DAS data, treatment spray Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 and 35 DAS (22.96%) found superior over treatment and sprays of *P. fluorescens*, 10gL-1 at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS (26.75%), found statistically at par. Maximum blast intensity (47.72%) recorded in control.

Above result supported the previous worked done by Chaudhari *et al.* (2024) showed that Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% recorded the lowest blast intensity at 30.20%, which was statistically at par with Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05% (31.65%). Sharma *et al.* (2018) reported that, the disease can be effectively managed in pearl millet with two to three sprays of propiconazole or tebuconazole + trifloxystrobin at 15 day intervals with the first spray at 20–25 days after sowing. Patro *et al.* (2020) mentioned that initial spray of *P. fluorescens* and Trifloxystrobin + Tebuconazole as second spray was found superior in managing the blast disease.

Grain and fodder yield:

The three-year pooled results (Table 6 and Fig. 5) for grain yield indicate that the highest yield was achieved with the treatment involving two sprays of Tebuconazole 50 + Trifloxystrobin 25 WG at 0.04%, applied at 20 and 35 DAS, resulting in 2472 kg ha^{-1}. This yield was statistically on par with the treatment of *P.fluorescens* spray at 10 g L^{-1} at 20 DAS followed by Tebuconazole 50 + Trifloxystrobin 25 WG at 0.04% at 35 DAS, which produced a yield of 2377 kgha-1. These findings suggest that both treatment regimens effectively enhance grain yield, with Tebuconazole 50 + Trifloxystrobin 25 WG showing a slightly higher yield. Field experiment results of Sharma *et.al*., (2018) revealed that three sprays of Tebuconazole + Trifloxystrobin or propiconazole was superior in reducing blast incidence with higher yields in pearl millet. Pramesh *et al.*, (2016) reported that rice blast was effectively controlled with Tebuconazole + Trifloxystrobin and resulted in higher yield. Chaudhari *et al.* (2024) recorded that highest grain yield (2135 kgha-1) and fodder yield (44.38 q ha-1) recorded in treatment Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% which was at par with Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05% (2054 kg ha^{-1}).

Three year pooled result (Table 7 and Fig. 6) for fodder yield indicated that the highest fodder yield also found in treatment spray Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 and 35 DAS (46.80 q ha^{-1}) and which was at par with treatment sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS (44.28 q ha^{-1}), spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS (43.26 q ha^{-1}) and seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS (42.84 q ha^{-1}). Minimum grain yield (1755 kg ha^{-1}) and fodder yield (36.41 q ha^{-1}) recorded in control. The result supported by Patro (2020) on foliar application of Pseudomonas fluorescens at 20 DAS and

Trifloxystrob in + Tebuconazole at 35 DAS was found effective with least disease intensity of blast (14.1%), highest grain (26.0 q ha^{-1}) and fodder yield (60.9 q ha^{-1}).

Economics:

Looking to the economics of different bio agents and fungicidal treatments (Table 8), the highest additional income ₹17129 ha^{-1}, highest net realization of ₹13393 ha^{-1} and maximum ICBR 1: 4.58 was obtained in the treatment, spray of *P. fluorescens* (100 g/10 l of water) at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% (5.33 g/10 l of water) at 35 DAS.

Conclusion:

It can be concluded from the above results that the spraying of *P. fluorescens* (100 g/10 l of water) at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% (5.33 g/10 l of water) at 35 DAS or spray Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 and 35 DAS (5.33 g /10 l of water) in pearl millet against blast disease were found effective to minimize blast intensity, higher grain and fodder yield and additional income also.

List of abbreviations

@???	:	At a rate of
a.i.	:	Active Ingredient
DAS	:	Days After Sowing
DMRT	:	Duncan's Multiple Range Test
lb	:	Pound
ICBR	:	Incremental Cost Venefit Ratio
JAU	:	Junagadh Agricultural University
kgha-1	:	Kilogram Per Hectare
PDI	:	Per cent Disease Intensity
qha-1	:	Quintal Per Hectare
WG	:	Water dispersible Granules

Table 2: Effect of chemical and bio-agents treatments on seedling emergence (%)

Sr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	Seedling emergence (%)			
				2021	2022	2023	Pooled
1.	Seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L-1 at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	44.81^{ab}	57.93^{ab}	82.42^{a}	61.72^{a}
2.	Seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	44.81^{ab}	56.93^{ab}	77.25^{a}	59.66^{a}
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	- 0.04	100 g 5.33 g	43.68^{b}	57.05^{ab}	79.41^{a}	60.04^{a}
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS	0.04 -	5.33 g 100 g	46.13^{a}	60.48^{a}	80.24^{a}	62.28^{a}
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	44.43^{ab}	56.13^{b}	83.58^{a}	61.38^{a}
6.	Control	-	-	43.02^{b}	57.74^{ab}	80.59^{a}	60.45^{a}
	S. Em. ±			**0.66**	**1.09**	**1.98**	**0.78**
	C. D. at 5%			**NS**	**NS**	**NS**	**NS**
	C. V. %			**2.96**	**3.79**	**4.91**	**4.46**
	Y						
	S. Em. ±						**0.55**
	C. D. at 5%						**1.58**
	Y×T						
	S. Em. ±						**1.36**
	C. D. at 5%						**NS**

Data were transformed (angular transformed) before analysis. Treatment means with letters(s) in common are at par as per DNMRT at 5% level of significance.

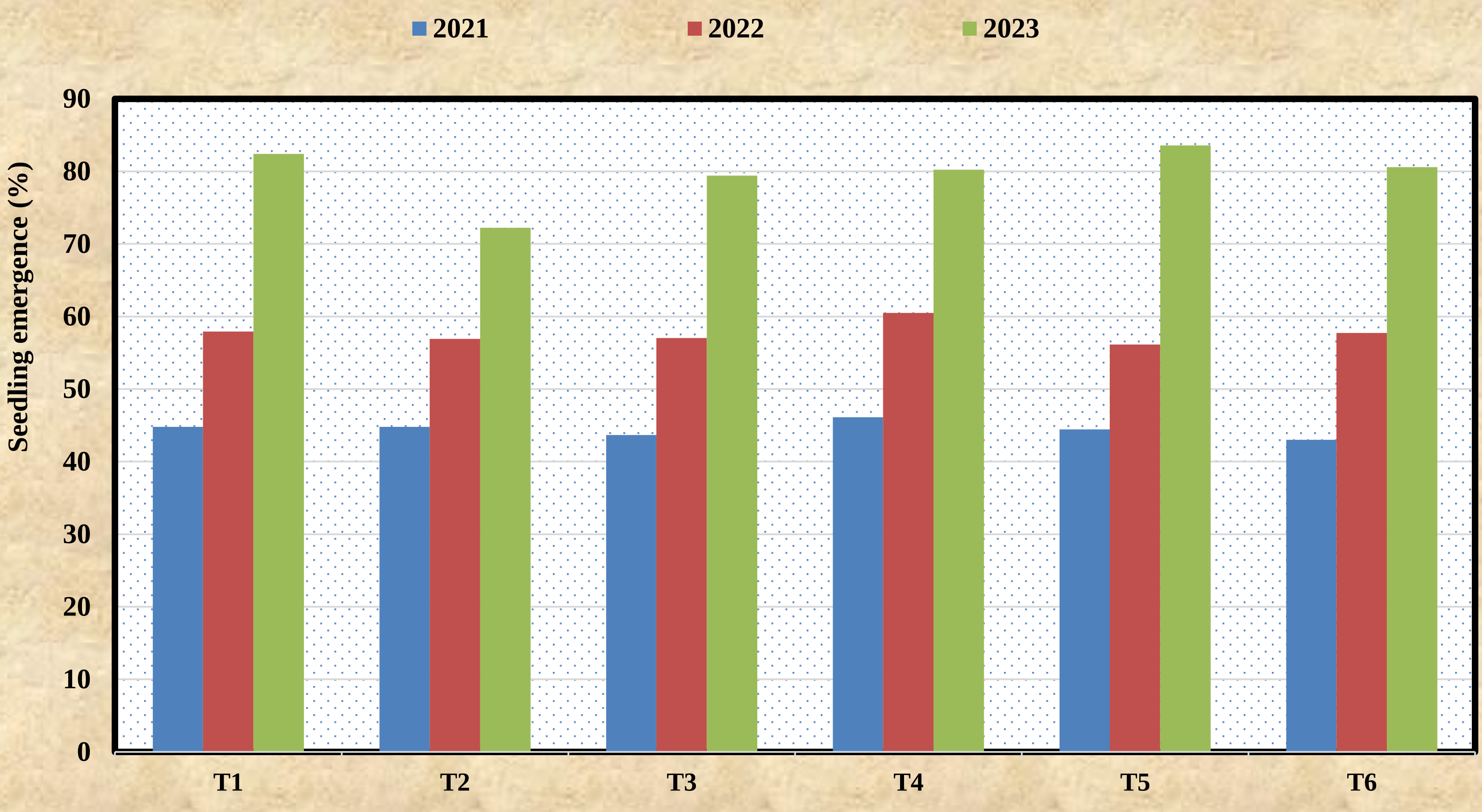

Fig. 1. Effect of chemical and bio-agents treatments on seedling emergence (%).

Table 3: Effect of chemical and bio-agents treatments on per cent disease intensity at 30 DAS

Sr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	Per cent disease intensity (30 DAS)			
				2021	2022	2023	Pooled
1.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg-1 100 g	22.02^{b} (14.06)	23.42^{b} (15.80)	16.46^{a} (8.06)	20.64^{b} (12.42)
2.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	21.15^{bc} (13.02)	23.66^{b} (16.10)	16.46^{a} (8.06)	20.42^{b} (12.18)
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	- 0.04	100 g 5.33 g	21.38^{b} (13.33)	21.15^{c} (13.01)	15.53^{a} (7.22)	19.35^{b} (10.98)
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS	0.04 -	5.33 g 100 g	22.66^{b} (15.00)	20.68^{cd} (12.48)	16.48^{a} (8.06)	19.94^{b} (11.63)
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	18.68^{c} (10.28)	18.67^{d} (10.25)	15.53^{a} (7.22)	17.63^{b} (9.17)
6.	Control	-	-	27.91^{a} (21.94)	27.53^{a} (21.37)	16.46^{a} (8.06)	23.97^{a} (16.50)
	S. Em. ±			**0.75**	**0.61**	**0.67**	**1.00**
	C. D. at 5%			**2.2506**	**1.829**	**NS**	**3.16**
	C. V. %			**6.70**	**5.39**	**8.25**	**6.65**
	Y						
	S. Em. ±						**0.28**
	C. D. at 5%						**0.79**
	Y×T						
	S. Em. ±						**0.68**
	C. D. at 5%						**1.93**

Figures in parenthesis are retransformed arc sine values.

Data were transformed (angular transformed) before analysis. Treatment means with letters(s) in common are at par as per DNMRT at 5% level of significance.

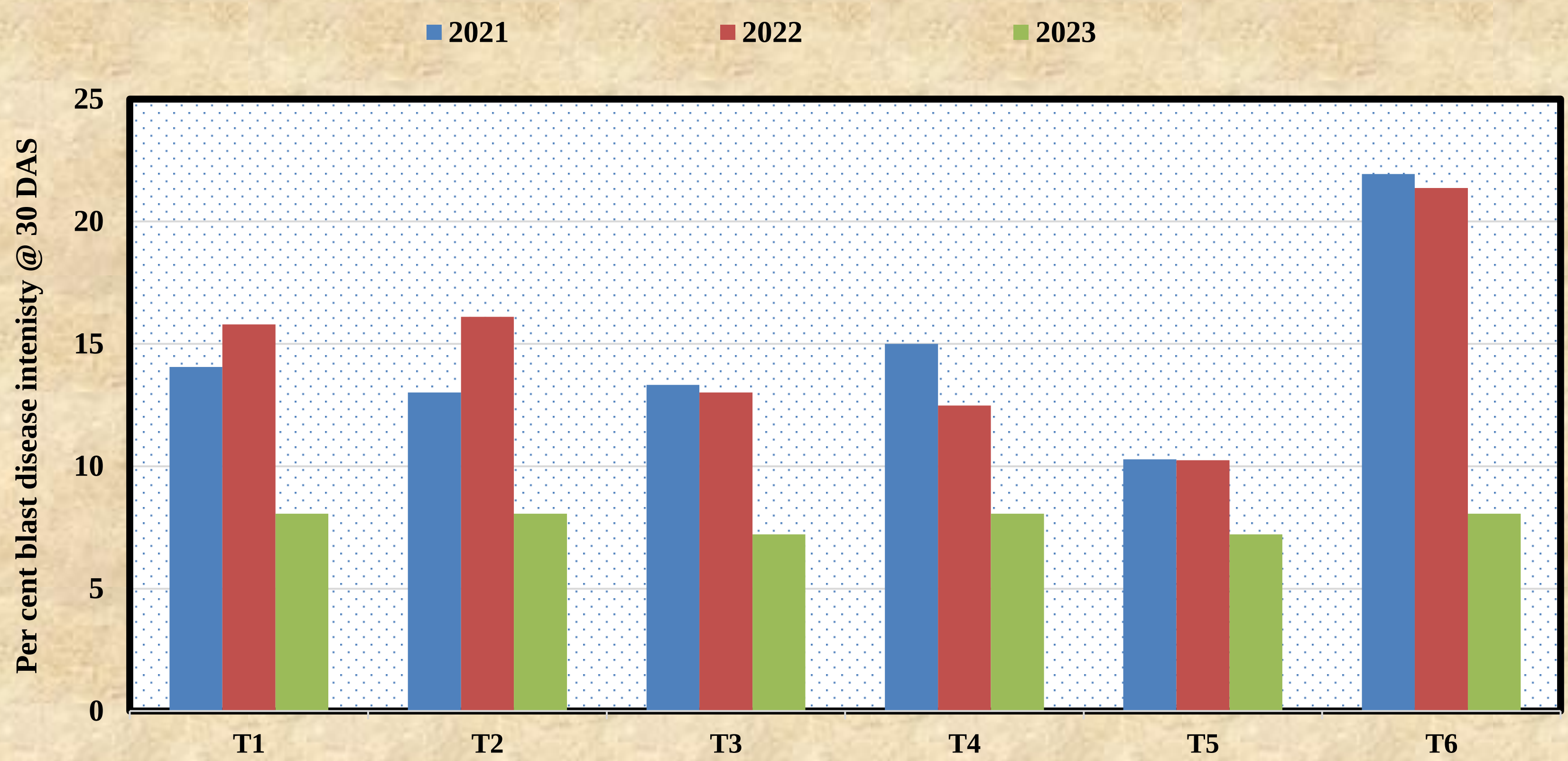

Fig. 2. Effect of chemical and bio-agents treatments on per cent disease intensity at 30 DAS.

Table 4: Effect of chemical and bio-agents treatments on per cent disease intensity at 45 DAS

Sr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	Per cent disease intensity (45 DAS)			
				2021	2022	2023	Pooled
1.	Seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	27.66^{bc} (21.55)	26.14^{bc} (19.41)	21.65^{b} (13.61)	25.15^{bc} (18.06)
2.	Seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10gL-1 at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	28.68^{b} (23.03)	27.91^{b} (21.91)	21.86^{b} (13.87)	26.15^{b} (19.42)
3.	Sprays of *P.fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	- 0.04	100 g 5.33 g	25.73^{cd} (18.84)	24.08^{cd} (16.64)	19.70^{c} (11.36)	23.17^{cd} (15.48)
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS	0.04 -	5.33 g 100 g	30.15^{b} (25.23)	27.89^{b} (21.89)	20.92^{bc} (12.75)	26.32^{b} (19.66)
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	23.00^{d} (15.27)	21.86^{d} (13.87)	18.15^{d} (9.70)	21.00^{d} (12.85)
6.	Control	-	-	35.07^{a} (33.02)	31.79^{a} (27.75)	24.08^{a} (16.64)	30.31^{a} (25.48)
	S. Em. ±			**0.86**	**0.84**	**0.44**	**0.70**
	C. D. at 5%			**2.58**	**2.52**	**1.34**	**2.20**
	C. V. %			**6.04**	**6.28**	**4.22**	**5.81**
	Y						
	S. Em. ±						**0.30**
	C. D. at 5%						**0.56**
	Y×T						
	S. Em. ±						**0.74**
	C. D. at 5%						**NS**

Figures in parenthesis are retransformed arc sine values. Data were transformed (angular transformed) before analysis. Treatment means with letters(s) in common are at par as per DNMRT at 5% level of significance.

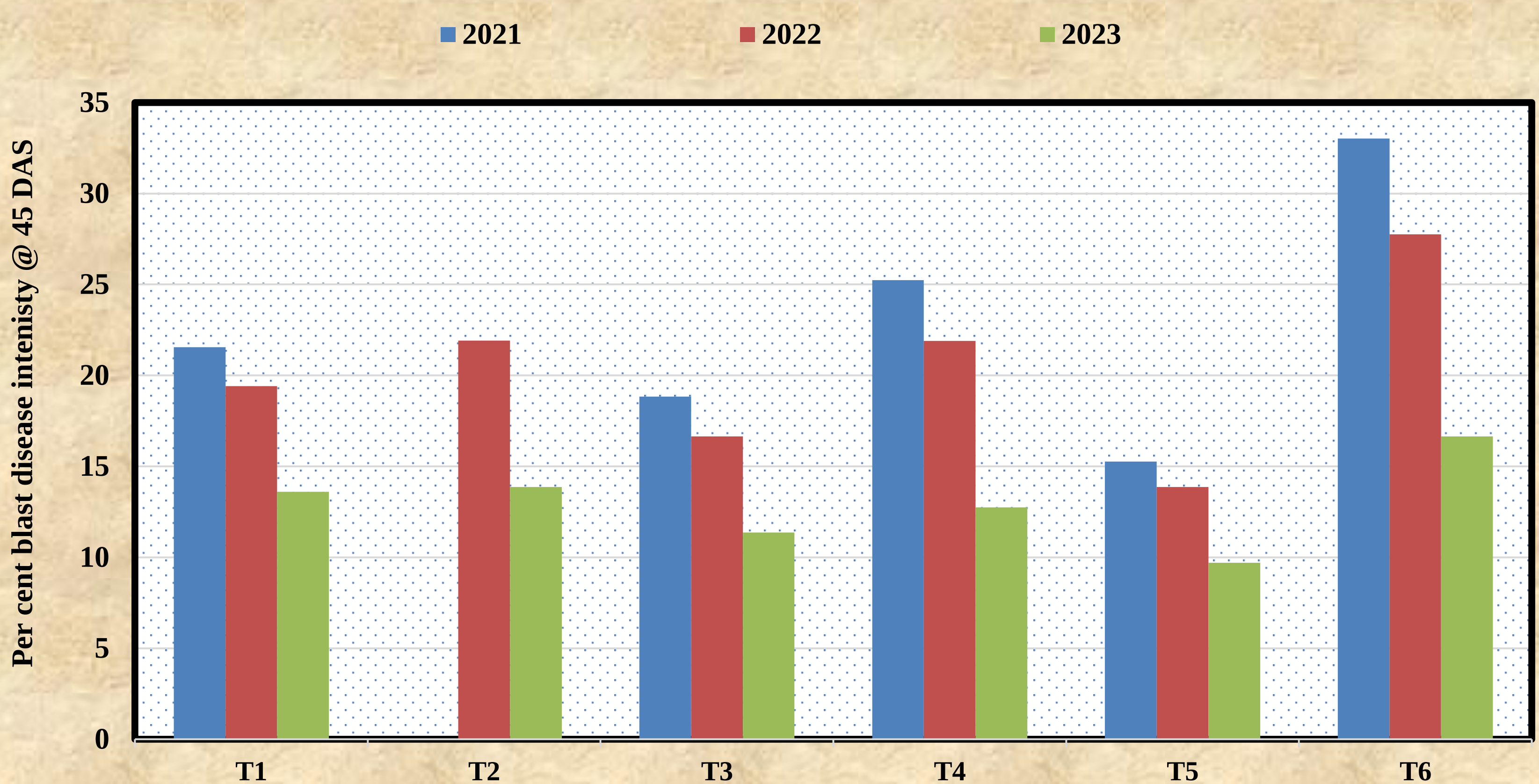

Fig. 3. Effect of chemical and bio-agents treatments on per cent disease intensity at 45 DAS.

Table 5: Effect of chemical and bio-agents treatments on per cent disease intensity at 60 DAS

Sr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	Per cent disease intensity (60 DAS) 2021	2022	2023	Pooled
1.	Seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	39.23^{c} (40.00)	41.48^{b} (43.88)	25.92^{bc} (19.11)	35.54^{b} (33.80)
2.	Seed treatment with Chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	40.52^{c} (42.22)	41.15^{b} (43.30)	26.16^{bc} (19.43)	35.94^{b} (34.46)
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	- 0.04	100 g 5.33 g	36.07^{d} (34.67)	33.71^{c} (30.80)	23.65^{cd} (16.09)	31.14^{c} (26.75)
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L-*1* at 35 DAS	0.04 -	5.33 g 100 g	43.57^{b} (47.50)	40.30^{b} (41.83)	27.14^{b} (20.81)	37.00^{b} (36.22)
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	33.03^{e} (29.71)	31.06^{c} (26.62)	21.81d (13.81)	28.63^{c} (22.96)
6.	Control	-	-	49.48^{a} (57.79)	49.64^{a} (58.07)	31.95^{a} (28.01)	43.69^{a} (47.72)
	S. Em. ±			**0.71**	**1.36**	**0.90**	**1.08**
	C. D. at 5%			**2.14**	**4.10**	**2.70**	**3.40**
	C. V. %			**3.53**	**6.88**	**6.86**	**5.81**
	Y						
	S. Em. ±						**0.42**
	C. D. at 5%						**1.19**
	Y×T						
	S. Em. ±						**0.02**
	C. D. at 5%						**NS**

Figures in parenthesis are retransformed arc sine values. Data were transformed (angular transformed) before analysis. Treatment means with letters(s) in common are at par as per DNMRT at 5% level of significance

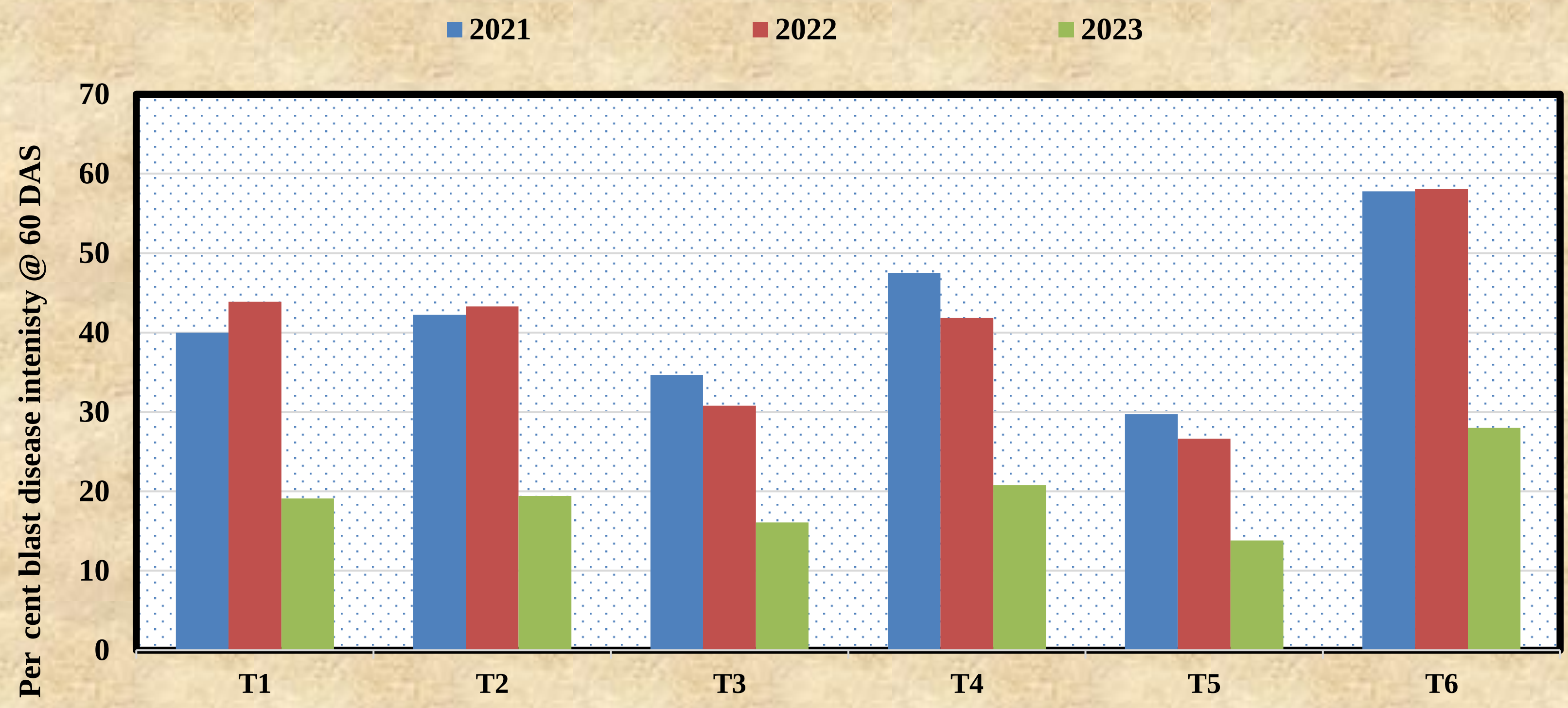

Fig. 4. Effect of chemical and bio-agents treatments on per cent disease intensity at 60 DAS.

The vertical column correct /ha to ha^{-1}

Table 6 : Effect of chemical and bio-agents treatments on grain yield (kg ha-1)

Sr. No.	Treatment	Conc. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	Grain yield (kg ha^{-1}) 2021	2022	2023	Pooled
1.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	1750^{b}	2035^{ab}	2375^{bc}	2053^{bc}
2.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	1595^{b}	1912^{bc}	2348^{bc}	1952^{cd}
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	- 0.04	100 g 5.33 g	2193^{a}	2206^{ab}	2732^{a}	2377^{a}
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS	0.04 -	5.33 g 100 g	1866^{b}	2111^{ab}	2511^{ab}	2163^{b}
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	2361^{a}	2309^{a}	2746^{a}	2472^{a}
6.	Control	-	-	1547^{b}	1627^{c}	2092^{c}	1755^{d}
	S. Em. ±			**98.46**	**103.91**	**112.38**	**60.66**
	C. D. at 5%			**296.72**	**313.16**	**338.67**	**172.93**
	C. V. %			**10.44**	**10.22**	**9.11**	**9.87**
	Y						
	S. Em. ±						**43.90**
	C. D. at 5%						**122.28**
	Y×T						
	S. Em. ±						**105.07**

	C. D. at 5%						**NS**

Treatment means with letters(s) in common are at par as per DNMRT at 5% level of significance.

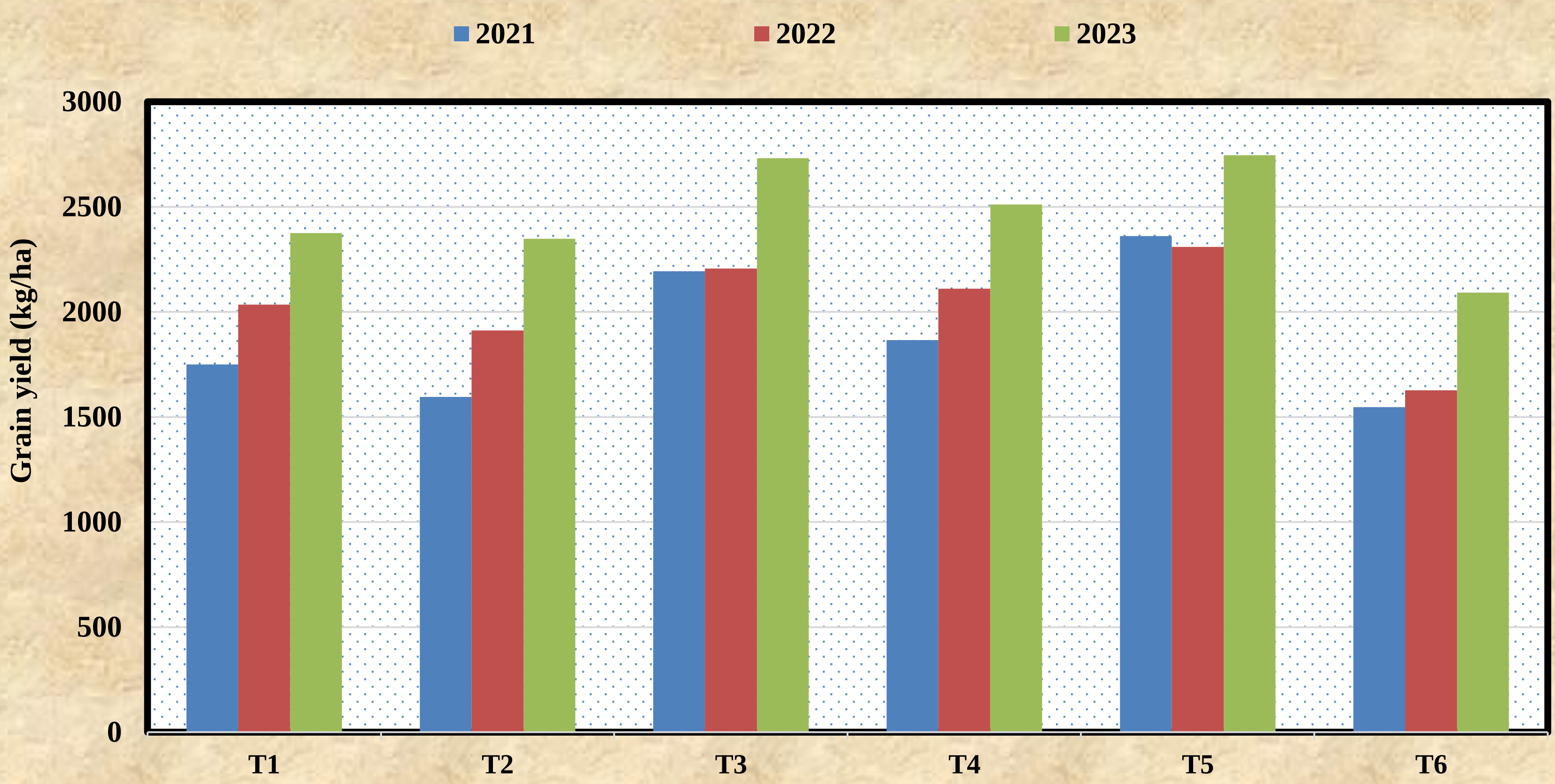

Fig. 5. Effect of chemical and bio-agents treatments on grain yield (kg ha^{-1}).

The vertical column correct /ha to ha^{-1}

Table 7: Effect of chemical and bio-agents treatments on fodder yield (q ha^{-1})

Sr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water or 1 kg seed	Fodder yield (q ha^{-1}) 2021	2022	2023	Pooled
1.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	40.61^{a}	50.34^{abc}	37.58^{a}	42.84^{ab}
2.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS	- -	3.75 g kg^{-1} 100 g	37.08^{a}	47.47^{bc}	36.22^{ab}	40.26^{bc}
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	- 0.04	100 g 5.33 g	40.11^{a}	54.9^{ab}	37.84^{a}	44.28^{ab}
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *B. subtilis*, 10g L^{-1} at 35 DAS	0.04 -	5.33 g 100 g	42.71^{a}	48.62^{abc}	38.44^{a}	43.26^{ab}
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	0.04	5.33 g	42.62^{a}	57.5^{a}	40.29^{a}	46.80^{a}
6.	Control	-	-	35.84^{a}	42.37^{c}	31.02^{b}	36.41^{c}
	S. Em. ±			**2.52**	**2.88**	**1.71**	**1.40**
	C. D. at 5%			**NS**	**8.69**	**5.15**	**3.98**
	C. V. %			**12.65**	**11.49**	**9.26**	**11.44**
	Y						
	S. Em. ±						**0.99**
	C. D. at 5%						**2.82**
	Y×T						
	S. Em. ±						**2.42**
	C. D. at 5%						**NS**

Treatment means with letters(s) in common are at par as per DNMRT at 5% level of significance.

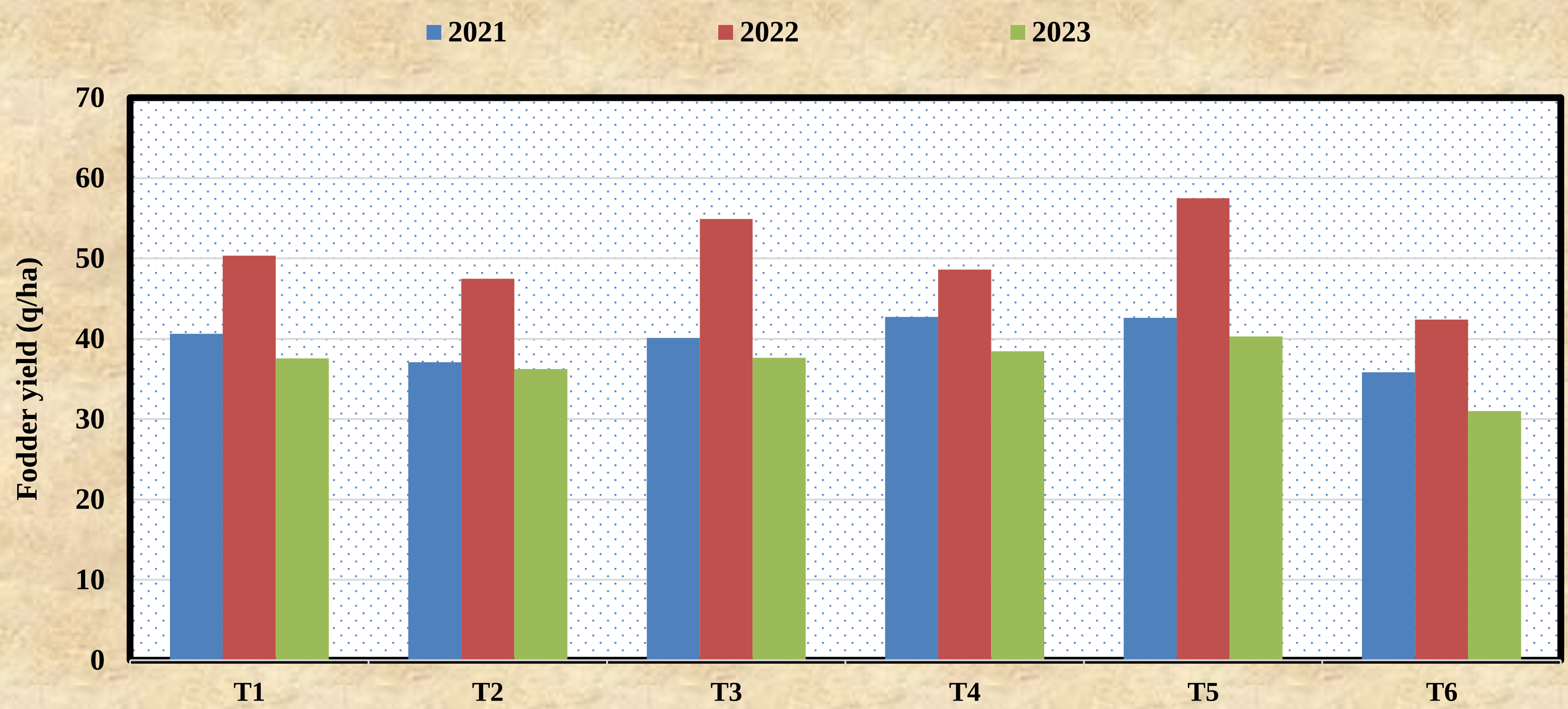

Fig. 6. Effect of chemical and bio-agents treatments on fodder yield (q ha^{-1}).

Table 8: Economics of various treatments for the management pearl millet blast

Tr. No.	Treatment	Yield (kg ha^{-1}) Pooled		Yield increase over control (kg ha^{-1})		Income (₹)		Additional income (₹)	Cost of treatment (fungicides/bio agents, labour charge, etc.) (₹ha^{-1})	Net realization (₹)	ICBR
		Grain	Fodder	Grain	Fodder	Grain*	Fodder**				
1	2	3	4	5	6	7	8	9	10	11 (9-10)	12 (9/10)
1.	Seed treatment with chitosan, 3.75 gkg-1 seed + two sprays of *P. fluorescens*, 10g L^{-1} at 20 & 35 DAS	2053	4284	298	643	7455	1286	8741	2117	6625	1:4.13
2.	Seed treatment with chitosan, 3.75 g kg^{-1} seed + two sprays of *B. subtilis*, 10g L^{-1} at 20 & 35 DAS	1952	4026	197	385	4913	770	5683	2117	3566	1:2.68
3.	Sprays of *P. fluorescens*, 10g L^{-1} at 20 DAS and Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 35 DAS	2377	4428	622	787	15555	1574	17129	3736	13393	1:4.58
4.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 DAS and *Bacillus subtilis*, 10g L^{-1} at 35 DAS	2163	4326	408	685	10192	1370	11562	3736	7826	1:3.09
5.	Spray of Tebuconazole 50 + Trifloxystrobin 25 WG, 0.04% at 20 & 35 DAS	2472	4680	717	1039	17924	2078	20002	3136	16866	1:6.38
6.	Control	1755	3641	0	0	0	0	0	0	0	0

* Price of bajra grain: ₹25kg-1, ** Price of bajra fodder: ₹2kg-1

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Please write references according to the journal's system, then check them with those on the manuscript.

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