

## Mitigating pearl millet blast (*Pyricularia grisea*): Effective Fungicidal treatments

### 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 and 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 fungicides in reducing the incidence and severity of blast disease in pearl millet as well as identify the most effective fungicide formulations and application rates for minimizing blast intensity. On the basis of field and based on the pooled data 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%). The control treatment recorded the highest blast intensity at 54.96%. In context to grain and fodder yield, highest grain yield (2135 kg/ha) and fodder yield (44.38 q/ha) 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), Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.625% (1940 kg/ha) and Tebuconazole 50% + Trifloxystrobin 25% WG, 0.0375% (1851 kg/ha). In summary, Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% was the most effective treatment for controlling blast and maximizing both grain and fodder yield. The performance of Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05% was comparable in terms of blast intensity and yield parameters.

**Keywords:** Pearl millet Blast, *Kharif*, Azoxystrobin, Tebuconazole, 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 productivity (DA&FW, 2024). “The major pearl millet growing states are Rajasthan, Maharashtra, Uttar Pradesh, Gujarat 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) in parts of Gujarat, Rajasthan and Uttar Pradesh; and during the post-rainy (*rabi*) season (November-February) at a small scale in Maharashtra and Gujarat” (Anon., 2024). 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 (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 disease 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 soil/leaf 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 fungicidal compounds against the minimized blast disease intensity at natural condition.

Experiment conducted with randomized block design (RBD), each having three 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 ten fungicide and fungicidal combination (Table 1) including control was used as treatment for management of pearl millet blast disease intensity.

Foliar application of different fungicides was carried out management of pearl millet blast [15]. The first spray was given just after appearance of the disease and subsequent spray given after 15 days of first spray. 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	a. i g/ha	Quantity of formulation kg or l/ha
1.	Iprobenphos (Kitazin) 48 EC	0.075	15.63 ml	375	0.800 l
2.	Iprobenphos 48 EC	0.1	20.83 ml	500	1.000 l
3.	Iprobenphos 48 EC	0.125	26.04 ml	625	1.302 l
4.	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0375	5.0 g	188	0.250 kg
5.	Tebuconazole 50 + Trifloxystrobin 25 WG	0.05	6.67 g	250	0.333 kg
6.	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0625	8.33 g	313	0.417 kg
7.	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0375	12.80 ml	188	0.640 l
8.	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.05	17.06 ml	250	0.853 l
9.	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0625	21.33 ml	313	1.000 l
10.	Untreated (Control)	-	-	-	-

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

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

### 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 diameter 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 number 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

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

## RESULTS AND DISCUSSION

A field experiments was conducted with different ten treatments including control during *kharif* 2021, 2022 and 2023. The three year pooled result of all parameters presented in Table 1 to 5. All the treatment found effective to suppress blast disease intensity significantly.

Based on the three-year pooled observations (2021-2023) for 30 Days After Sowing (DAS) (Table 1), Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% was found to be the most effective treatment, minimizing blast disease intensity to 10.81%. This treatment, Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05% which recorded a blast intensity of 11.85%, Tebuconazole 50% + Trifloxystrobin 25% WG, 0.0375%, with a blast intensity of 12.11%, Iprobenphos 48% EC, 0.075%, with a blast intensity of 13.29% and Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.0625%, with a blast intensity of 13.88% was statistically at par with Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05%.

According to the results for 45 Days After Sowing (DAS) (Table .2), the treatments for managing blast disease in pearl millet showed the following effectiveness. Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% was the most effective treatment, minimizing blast disease intensity to 19.05%.

This treatment was statistically at par with Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05%, which recorded a blast intensity of 20.47%. Iprobenphos 48% EC, 0.075%, which resulted in a blast intensity of 23.07%. Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.0625%, with a blast intensity of 23.31%. These findings suggest that Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% is highly effective at 45 DAS for reducing blast disease intensity, with similar results from the other listed treatments.

The three-year pooled data for 60 Days After Sowing (DAS) (Table .3, Fig. 1) confirmed the previous observations for managing blast disease in pearl millet. Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% recorded the minimum blast intensity of 30.20%. This treatment was statistically at par with, Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05%, which recorded a blast intensity of 31.65%. The maximum blast intensity of 54.96% was observed in the control treatment, indicating the lack of protection in untreated plots. This data highlights the consistent effectiveness of Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% and Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05% in minimizing blast intensity over the three-year period at 60 DAS. 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 *Pseudomonas fluorescens* and Trifloxystrobin + Tebuconazole as second spray was found superior in managing the blast disease. Gouramanis (2007) reported the fungicide Derosal (Carbendazim) @ 1.5 lb/100 gallons and Beam (Tricyclazole) @ 0.75 kg/ha effectively decreased rice neck blast followed by Fongoren (Pyroquilon) @ 2 kg/ha while, Kitazin (Iprobenfos) @ 750 g/ha and bla-s (Blasticidin) @ 100 µg/ml reduced leaf blast but not neck blast infection. Effectiveness of iprobenfos (kitazin) (3.75 kg a.i./ha) in controlling rice blast and increasing grain yield has also been reported by Sharma and Kumar (1992).

#### **Grain and fodder yield:**

The three-year pooled results for grain yield (Table.4, Fig. 2) demonstrated that the highest grain yield of 2135 kg/ha was recorded in the treatment Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05%. The treatment Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05%, which produced a grain yield of 2054 kg/ha and the treatment Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.625% recorded a grain yield of 1940 kg/ha and the treatment Tebuconazole 50% + Trifloxystrobin 25% WG, 0.0375% recorded a grain yield of 1851 kg/ha found at par in the three-year pooled results. While this yield was lower than other treatments like Azoxystrobin + Tebuconazole (2135 kg/ha) combinations, it still contributed to significant improvement in grain yield compared to untreated controls. Trifloxystrobin + Tebuconazole was found to be effective in managing the blast disease in pearl millet with higher yield (Ajay *et al.*, 2018). 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. Parmesh *et al.*, (2016) reported that rice blast was effectively controlled with Tebuconazole + Trifloxystrobin and resulted in higher yield.

For fodder yield data presented in Table .5 and Fig. 3 revealed that maximum fodder yield (44.38 q/ha) same as grain yield in treatment Azoxystrobin 11 + Tebuconazole 18.30 SC, 0.05% and which was at par with Azoxystrobin 11 + Tebuconazole 18.30 SC, 0.0375% (41.74 q/ha), Tebuconazole 50 + Trifloxystrobin 25 WG, 0.05% (41.25 q/ha) and treatment Azoxystrobin 11 + Tebuconazole 18.30 SC, 0.0625% (39.66 q/ha). Minimum grain yield (1229 kg/ha) and fodder yield (29.58 q/ha) recorded in control.

#### **Economics:**

Based on the economics of different fungicidal treatments presented in Table.6. The highest additional income of ₹25,610/ha was obtained with the treatment Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05%. This treatment also achieved the highest net realization of ₹23,075/ha. The maximum Incremental Benefit-Cost Ratio (ICBR) of 1:10.10 was associated with the same treatment. These economic indicators highlight that Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% is not only the most effective fungicide for controlling blast disease but also provides the best financial return on investment.

**Conclusion:**

From the results, it can be concluded that spraying Azoxystrobin 11% + Tebuconazole 18.30% SC, 0.05% (17.06 ml/10 l of water) or Tebuconazole 50% + Trifloxystrobin 25% WG, 0.05% (6.67 g/10 l of water) in pearl millet effectively manages blast disease. Both treatments were successful in minimizing blast intensity, achieving higher grain and fodder yields and also providing additional income. These treatments offer a practical solution for managing blast disease while also enhancing the overall productivity and profitability of pearl millet cultivation.

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**Table 2 : Efficacy of different fungicides on blast disease intensity at 30 DAS**

Tr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water	Blast intensity (30 DAS)			
				2021	2022	2023	Pooled
T <sub>1</sub>	Iprobenphos (Kitazin) 48 EC	0.075	15.63 ml	22.33 <sup>bc</sup> (14.43)	23.81 <sup>bcd</sup> (16.29)	18.00 <sup>e</sup> (9.55)	21.38 <sup>bcd</sup> (13.29)
T <sub>2</sub>	Iprobenphos 48 EC	0.1	20.83 ml	23.52 <sup>b</sup> (15.92)	24.07 <sup>bc</sup> (16.64)	18.42 <sup>de</sup> (9.98)	22.00 <sup>bcd</sup> (14.04)
T <sub>3</sub>	Iprobenphos 48 EC	0.125	26.04 ml	21.60 <sup>bcd</sup> (13.55)	26.30 <sup>ab</sup> (19.63)	22.33 <sup>ab</sup> (14.44)	23.41 <sup>b</sup> (15.78)
T <sub>4</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0375	5.0 g	19.60 <sup>cd</sup> (11.25)	21.41 <sup>de</sup> (13.32)	20.10 <sup>c</sup> (11.81)	20.37 <sup>bcd</sup> (12.11)
T <sub>5</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.05	6.67 g	18.44 <sup>d</sup> (10.00)	24.31 <sup>bc</sup> (16.94)	17.67 <sup>e</sup> (9.21)	20.14 <sup>cd</sup> (11.85)
T <sub>6</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0625	8.33 g	20.78 <sup>bcd</sup> (12.59)	25.20 <sup>bc</sup> (18.13)	20.71 <sup>c</sup> (12.50)	22.23 <sup>bcd</sup> (14.31)
T <sub>7</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0375	12.80 ml	21.68 <sup>bcd</sup> (13.65)	25.21 <sup>bc</sup> (18.14)	21.05 <sup>bc</sup> (12.91)	22.65 <sup>bc</sup> (14.83)
T <sub>8</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.05	17.06 ml	19.09 <sup>cd</sup> (10.70)	20.41 <sup>e</sup> (12.16)	18.07 <sup>e</sup> (9.62)	19.19 <sup>d</sup> (10.81)
T <sub>9</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0625	21.33 ml	23.22 <sup>b</sup> (15.54)	22.63 <sup>cde</sup> (14.81)	19.77 <sup>cd</sup> (11.44)	21.88 <sup>bcd</sup> (13.88)
T <sub>10</sub>	Untreated (Control)	-	-	29.87 <sup>a</sup> (24.80)	28.36 <sup>a</sup> (22.56)	23.20 <sup>a</sup> (15.51)	27.14 <sup>a</sup> (20.81)
	<b>S. Em. ±</b>			<b>1.06</b>	<b>0.82</b>	<b>0.51</b>	<b>0.92</b>
	<b>C. D. at 5%</b>			<b>3.16</b>	<b>2.44</b>	<b>1.50</b>	<b>2.74</b>
	<b>C. V. %</b>			<b>8.36</b>	<b>5.88</b>	<b>4.39</b>	<b>6.51</b>
	<b>Y</b>						
	<b>S. Em. ±</b>						<b>0.26</b>
	<b>C. D. at 5%</b>						<b>0.74</b>
	<b>Y×T</b>						
	<b>S. Em. ±</b>						<b>0.83</b>
	<b>C. D. at 5%</b>						<b>2.35</b>

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 DMRT at 5% level of significance.

**Table 3: Efficacy of different fungicides on blast disease intensity at 45 DAS**

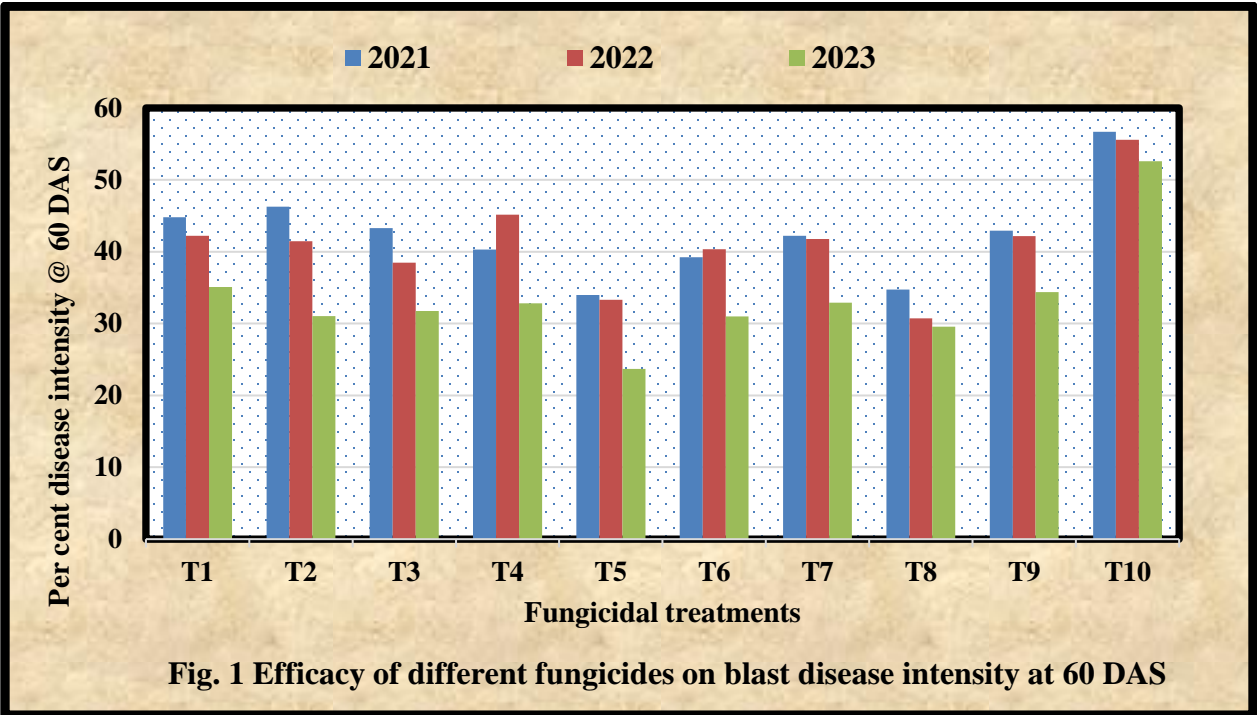
Tr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water	Blast intensity (45 DAS)			
				2021	2022	2023	Pooled
T <sub>1</sub>	Iprobenphos (Kitazin) 48 EC	0.075	15.63 ml	32.03 <sup>b</sup> (28.13)	28.63 <sup>cs</sup> (22.96)	25.45 <sup>def</sup> (18.52)	28.70 <sup>bc</sup> (23.07)
T <sub>2</sub>	Iprobenphos 48 EC	0.1	20.83 ml	32.46 <sup>b</sup> (28.80)	29.36 <sup>bcd</sup> (24.04)	26.56 <sup>bcdde</sup> (20.00)	29.46 <sup>b</sup> (24.19)
T <sub>3</sub>	Iprobenphos 48 EC	0.125	26.04 ml	31.79 <sup>b</sup> (27.74)	33.18 <sup>ab</sup> (29.95)	25.20 <sup>def</sup> (18.15)	30.05 <sup>b</sup> (25.08)
T <sub>4</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0375	5.0 g	29.62 <sup>bcd</sup> (24.43)	30.58 <sup>bc</sup> (25.88)	27.34 <sup>bcd</sup> (21.11)	29.18 <sup>bc</sup> (23.77)
T <sub>5</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.05	6.67 g	26.82 <sup>d</sup> (20.36)	31.00 <sup>bc</sup> (26.52)	22.88 <sup>f</sup> (15.19)	26.90 <sup>bc</sup> (20.47)
T <sub>6</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0625	8.33 g	29.85 <sup>bc</sup> (24.78)	32.00 <sup>abc</sup> (28.09)	28.29 <sup>bc</sup> (22.59)	30.05 <sup>b</sup> (25.08)
T <sub>7</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0375	12.80 ml	31.80 <sup>b</sup> (27.76)	30.59 <sup>bc</sup> (25.90)	28.58 <sup>ab</sup> (22.96)	30.32 <sup>b</sup> (25.49)
T <sub>8</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.05	17.06 ml	28.12 <sup>cd</sup> (22.22)	25.47 <sup>d</sup> (18.50)	24.04 <sup>ef</sup> (16.67)	25.88 <sup>c</sup> (19.05)
T <sub>9</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0625	21.33 ml	32.03 <sup>b</sup> (28.13)	28.83 <sup>cd</sup> (23.25)	25.74 <sup>cdef</sup> (18.89)	28.87 <sup>bc</sup> (23.31)
T <sub>10</sub>	Untreated (Control)	-	-	39.87 <sup>a</sup> (41.10)	35.69 <sup>a</sup> (34.04)	31.07 <sup>a</sup> (26.67)	35.54 <sup>a</sup> (33.80)
	<b>S. Em. ±</b>			<b>0.85</b>	<b>1.19</b>	<b>0.84</b>	<b>1.02</b>
	<b>C. D. at 5%</b>			<b>2.52</b>	<b>3.52</b>	<b>2.50</b>	<b>3.02</b>
	<b>C. V. %</b>			<b>4.68</b>	<b>6.73</b>	<b>5.49</b>	<b>5.71</b>
	<b>Y</b>						
	<b>S. Em. ±</b>						<b>0.31</b>
	<b>C. D. at 5%</b>						<b>0.87</b>
	<b>Y×T</b>						
	<b>S. Em. ±</b>						<b>0.97</b>
	<b>C. D. at 5%</b>						<b>NS</b>

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 DMRT at 5% level of significance.

**Table 4: Efficacy of different fungicides on blast disease intensity at 60 DAS**

Tr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water	Blast intensity (60 DAS)			
				2021	2022	2023	Pooled
T <sub>1</sub>	Iprobenphos (Kitazin) 48 EC	0.075	15.63 ml	42.02 <sup>b</sup> (44.81)	40.51 <sup>b</sup> (42.20)	36.32 <sup>b</sup> (35.09)	39.62 <sup>b</sup> (40.66)
T <sub>2</sub>	Iprobenphos 48 EC	0.1	20.83 ml	42.87 <sup>b</sup> (46.29)	40.09 <sup>b</sup> (41.47)	33.85 <sup>bc</sup> (31.03)	38.94 <sup>b</sup> (39.50)
T <sub>3</sub>	Iprobenphos 48 EC	0.125	26.04 ml	41.14 <sup>bc</sup> (43.29)	38.34 <sup>bcd</sup> (38.48)	34.30 <sup>b</sup> (31.76)	37.93 <sup>b</sup> (37.78)
T <sub>4</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0375	5.0 g	39.40 <sup>c</sup> (40.28)	42.22 <sup>b</sup> (45.16)	34.94 <sup>b</sup> (32.80)	38.85 <sup>b</sup> (39.35)
T <sub>5</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.05	6.67 g	35.65 <sup>d</sup> (33.96)	35.24 <sup>cd</sup> (33.29)	29.12 <sup>c</sup> (23.68)	34.23 <sup>c</sup> (31.65)
T <sub>6</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0625	8.33 g	38.79 <sup>c</sup> (39.24)	39.44 <sup>bc</sup> (40.35)	33.83 <sup>bc</sup> (30.99)	37.35 <sup>b</sup> (36.81)
T <sub>7</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0375	12.80 ml	40.51 <sup>bc</sup> (42.20)	40.25 <sup>b</sup> (41.76)	35.01 <sup>b</sup> (32.92)	38.59 <sup>b</sup> (38.91)
T <sub>8</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.05	17.06 ml	36.12 <sup>d</sup> (34.75)	33.66 <sup>d</sup> (30.72)	32.93 <sup>bc</sup> (29.55)	33.33 <sup>c</sup> (30.20)
T <sub>9</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0625	21.33 ml	40.93 <sup>bc</sup> (42.92)	40.50 <sup>b</sup> (42.18)	35.90 <sup>b</sup> (34.39)	39.11 <sup>b</sup> (39.80)
T <sub>10</sub>	Untreated (Control)	-	-	48.85 <sup>a</sup> (56.70)	48.19 <sup>a</sup> (55.56)	46.49 <sup>a</sup> (52.60)	47.85 <sup>a</sup> (54.96)
	<b>S. Em. ±</b>			<b>0.75</b>	<b>1.48</b>	<b>1.52</b>	<b>0.75</b>
	<b>C. D. at 5%</b>			<b>2.22</b>	<b>4.40</b>	<b>4.51</b>	<b>2.13</b>
	<b>C. V. %</b>			<b>3.19</b>	<b>6.44</b>	<b>7.46</b>	<b>5.83</b>
	<b>Y</b>						
	<b>S. Em. ±</b>						<b>0.41</b>
	<b>C. D. at 5%</b>						<b>1.17</b>
	<b>Y×T</b>						
	<b>S. Em. ±</b>						<b>1.30</b>
	<b>C. D. at 5%</b>						<b>NS</b>

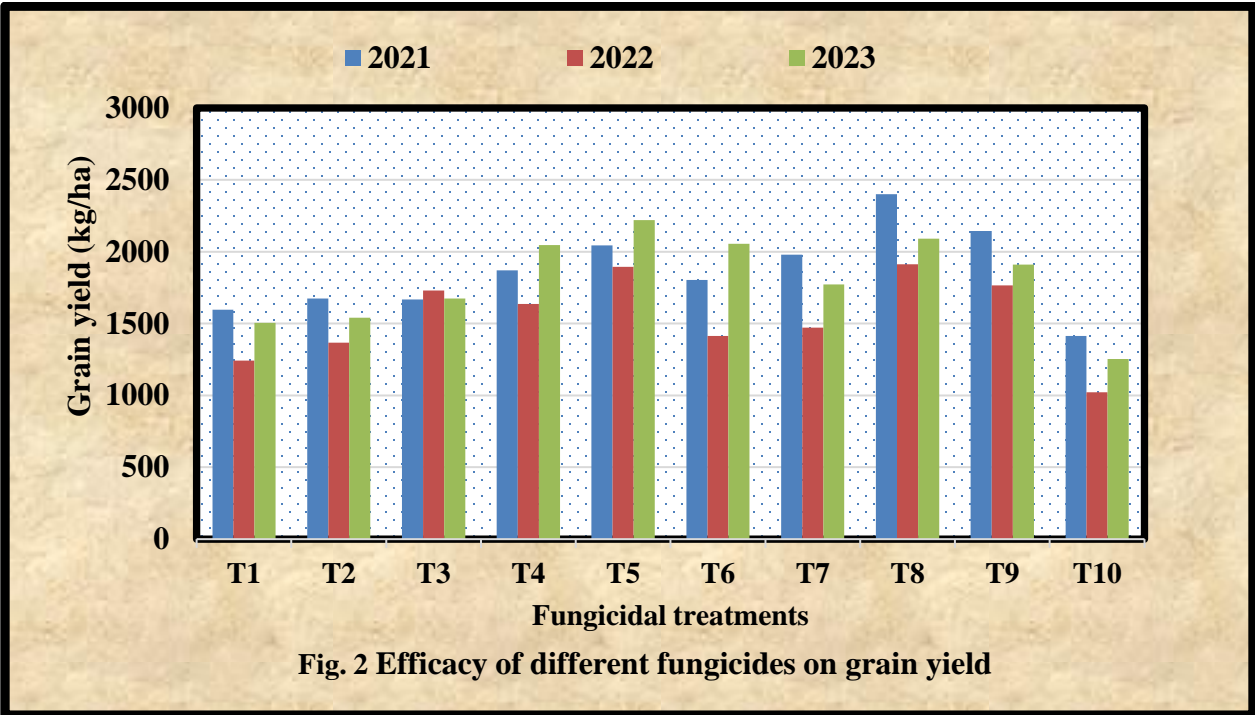
Figures in parenthesis are retransformed arc sine values. Data were transformed (angular transformed) before analysis. Treatment means with letters(s) in common are at par as per DMRT at 5% level of significance.



**Table 5: Efficacy of different fungicides on grain yield**

Tr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water	Grain yield (kg/ha)			
				2021	2022	2023	Pooled
T <sub>1</sub>	Iprobenphos (Kitazin) 48 EC	0.075	15.63 ml	1596 <sup>de</sup>	1242 <sup>de</sup>	1505 <sup>cd</sup>	1448 <sup>de</sup>
T <sub>2</sub>	Iprobenphos 48 EC	0.1	20.83 ml	1674 <sup>cde</sup>	1367 <sup>cd</sup>	1540 <sup>cd</sup>	1527 <sup>cde</sup>
T <sub>3</sub>	Iprobenphos 48 EC	0.125	26.04 ml	1667 <sup>cde</sup>	1729 <sup>ab</sup>	1675 <sup>bcd</sup>	1690 <sup>bcd</sup>
T <sub>4</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0375	5.0 g	1871 <sup>bcd</sup>	1637 <sup>abc</sup>	2046 <sup>ab</sup>	1851 <sup>abc</sup>
T <sub>5</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.05	6.67 g	2045 <sup>abc</sup>	1895 <sup>a</sup>	2221 <sup>a</sup>	2054 <sup>ab</sup>
T <sub>6</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0625	8.33 g	1804 <sup>bcde</sup>	1415 <sup>cd</sup>	2055 <sup>ab</sup>	1758 <sup>bcd</sup>
T <sub>7</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0375	12.80 ml	1980 <sup>bc</sup>	1471 <sup>bcd</sup>	1773 <sup>abc</sup>	1742 <sup>bcd</sup>
T <sub>8</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.05	17.06 ml	2401 <sup>a</sup>	1913 <sup>a</sup>	2090 <sup>ab</sup>	2135 <sup>a</sup>
T <sub>9</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0625	21.33 ml	2144 <sup>ab</sup>	1766 <sup>ab</sup>	1911 <sup>abc</sup>	1940 <sup>ab</sup>
T <sub>10</sub>	Untreated (Control)	-	-	1413 <sup>e</sup>	1021 <sup>e</sup>	1254 <sup>d</sup>	1229 <sup>e</sup>
	<b>S. Em. ±</b>			<b>114.95</b>	<b>93.03</b>	<b>137.87</b>	<b>114.74</b>
	<b>C. D. at 5%</b>			<b>341.51</b>	<b>276.41</b>	<b>409.64</b>	<b>340.92</b>
	<b>C. V. %</b>			<b>10.71</b>	<b>10.42</b>	<b>13.21</b>	<b>11.64</b>
	<b>Y</b>						
	<b>S. Em. ±</b>						<b>36.91</b>
	<b>C. D. at 5%</b>						<b>104.72</b>
	<b>Y×T</b>						
	<b>S. Em. ±</b>						<b>116.73</b>
	<b>C. D. at 5%</b>						<b>NS</b>

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

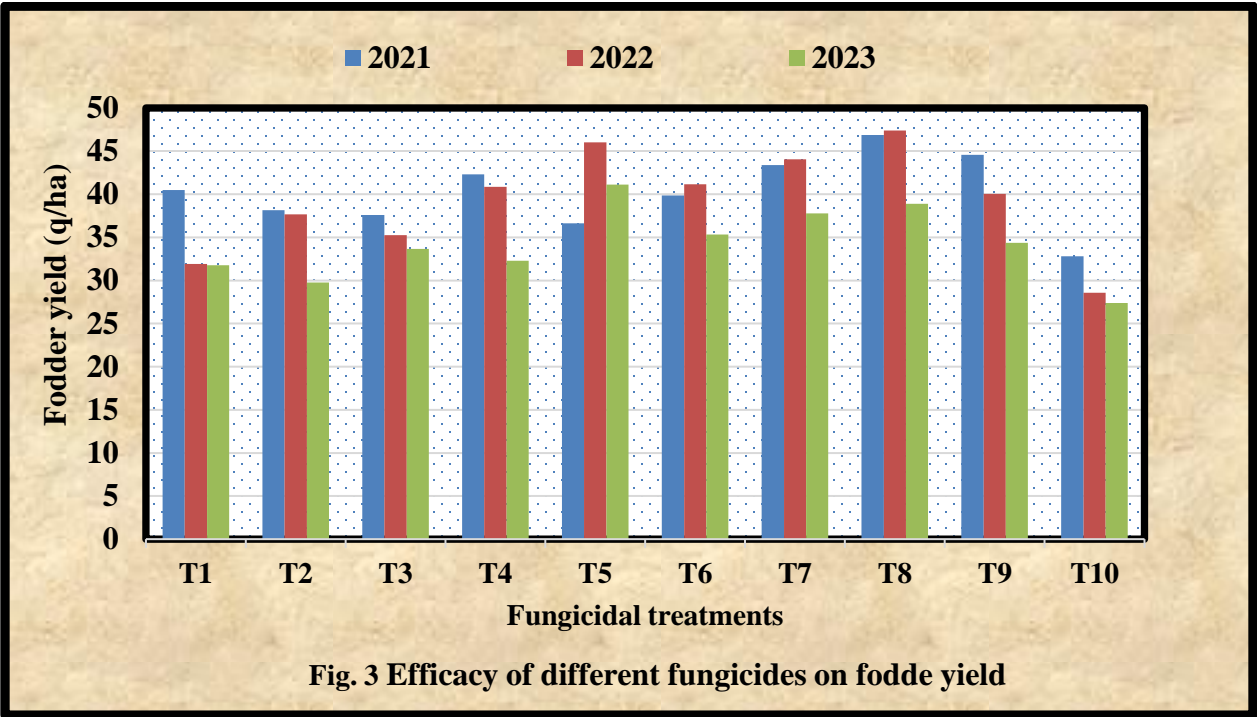


**Fig. 2 Efficacy of different fungicides on grain yield**

**Table 6: Efficacy of different fungicides on fodder yield**

Tr. No.	Treatment	Con. (a. i.)	Quantity in g or ml in 10 liter of water	Fodder yield (q/ha)			
				2021	2022	2023	Pooled
T <sub>1</sub>	Iprobenphos (Kitazin) 48 EC	0.075	15.63 ml	40.50 <sup>ab</sup>	31.90 <sup>de</sup>	31.75 <sup>bcd</sup>	34.72 <sup>cd</sup>
T <sub>2</sub>	Iprobenphos 48 EC	0.1	20.83 ml	38.15 <sup>ab</sup>	37.65 <sup>bcde</sup>	29.76 <sup>cd</sup>	35.19 <sup>cd</sup>
T <sub>3</sub>	Iprobenphos 48 EC	0.125	26.04 ml	37.60 <sup>ab</sup>	35.27 <sup>cde</sup>	33.65 <sup>abcd</sup>	35.51 <sup>c</sup>
T <sub>4</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0375	5.0 g	42.30 <sup>ab</sup>	40.85 <sup>abcd</sup>	32.30 <sup>bcd</sup>	38.49 <sup>bc</sup>
T <sub>5</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.05	6.67 g	36.61 <sup>ab</sup>	46.03 <sup>ab</sup>	41.11 <sup>a</sup>	41.25 <sup>ab</sup>
T <sub>6</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	0.0625	8.33 g	39.86 <sup>ab</sup>	41.14 <sup>abcd</sup>	35.32 <sup>abcd</sup>	38.77 <sup>bc</sup>
T <sub>7</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0375	12.80 ml	43.39 <sup>ab</sup>	44.06 <sup>abc</sup>	37.78 <sup>abc</sup>	41.74 <sup>ab</sup>
T <sub>8</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.05	17.06 ml	46.88 <sup>a</sup>	47.38 <sup>a</sup>	38.89 <sup>ab</sup>	44.38 <sup>a</sup>
T <sub>9</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	0.0625	21.33 ml	44.57 <sup>a</sup>	40.06 <sup>abcd</sup>	34.36 <sup>abcd</sup>	39.66 <sup>abc</sup>
T <sub>10</sub>	Untreated (Control)	-	-	32.79 <sup>b</sup>	28.57 <sup>e</sup>	27.381 <sup>d</sup>	29.58 <sup>d</sup>
	<b>S. Em. ±</b>			<b>3.17</b>	<b>2.90</b>	<b>2.61</b>	<b>1.68</b>
	<b>C. D. at 5%</b>			<b>NS</b>	<b>8.62</b>	<b>7.77</b>	<b>4.76</b>
	<b>C. V. %</b>			<b>13.64</b>	<b>12.80</b>	<b>13.22</b>	<b>13.26</b>
	<b>Y</b>						
	<b>S. Em. ±</b>						<b>0.92</b>
	<b>C. D. at 5%</b>						<b>2.61</b>
	<b>Y×T</b>						
	<b>S. Em. ±</b>						<b>2.90</b>
	<b>C. D. at 5%</b>						<b>NS</b>

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



**Table-7: Economics of various treatments for the management pearl millet blast**

Tr. No.	Treatment	Yield (kg/ha) Pooled		Yield increase over control (kg/ha)		Income (₹)		Additional income (₹)	Cost of treatment (fungicides, labour charge, etc.) (₹/ha)	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)
T <sub>1</sub>	Iprobenphos (Kitazin) 48 EC	1448	3472	219	514	5475	1028	6503	1800	4703	1: 3.61
T <sub>2</sub>	Iprobenphos 48 EC	1527	3519	298	561	7450	1122	8572	2000	6572	1 :4.29
T <sub>3</sub>	Iprobenphos 48 EC	1690	3551	461	593	11525	1186	12711	2302	10409	1 :5.52
T <sub>4</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	1851	3849	622	891	15550	1782	17332	3000	14332	1 :5.78
T <sub>5</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	2054	4125	825	1167	20625	2334	22959	3664	19295	1 :6.27
T <sub>6</sub>	Tebuconazole 50 + Trifloxystrobin 25 WG	1758	3877	529	919	13225	1838	15063	4336	10727	1 :3.47
T <sub>7</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	1742	4174	513	1216	12825	2432	15257	2152	13105	1 :7.09
T <sub>8</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	2135	4438	906	1480	22650	2960	25610	2535	23075	1 :10.10
T <sub>9</sub>	Azoxystrobin 11 + Tebuconazole 18.30 SC	1940	3966	711	1008	17775	2016	19791	2800	16991	1 :7.07
T <sub>10</sub>	Untreated (Control)	1229	2958	-	-	-	-	-	-	-	-

\* Price of bajra grain: ₹25/kg, \*\* Price of bajra fodder: ₹2/kg

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## List of abbreviations

@	:	At a rate of
a.i.	:	Active Ingredient
DAS	:	Days After Sowing
DMRT	:	Duncan's Multiple Range Test
EC	:	Emulsifiable Concentrate
ICBR	:	Incremental Cost Venefit Ratio
JAU	:	Junagadh Agricultural University
kg/ha	:	Kilogram Per Hectare
PDI	:	Per cent Disease Intensity
q/ha	:	Quintal Per Hectare
SC	:	Suspension Concentrates
WG	:	Water dispersible Granules