



# African Journal of Biological Sciences



## Effect of integrated disease management modules on sweet basil diseases

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### Abstract

Sweet basil (*Ocimum basilicum* L.) is an important *kharif* crop grown in dry region of India. It is used for Anti-inflammatory properties, antimicrobial activity, digestive aid, antioxidant stress relief, and respiratory health. Basils are suffering from a number of diseases. Downy mildew and leaf blight of basil are wide spread and destructive disease in India. Use of synthetic fungicides has led to several problems like environmental pollution and residual effect. Hence the use of integrated disease management modules is environmentally safe, non pollutant, indigenously available and easily accessible for the management of diseases. Validation of integrated disease management modules for sweet basil was carried out at main experimental station, Department of Medicinal and Aromatic Plants, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the *Kharif* 2020-21-2022-23. The minimum disease incidence was observed in T<sub>4</sub> – (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>3</sub>- (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Neem oil @ 300 ppm) and T<sub>6</sub> (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture@ 5000 ppm at 15 days interval.

**Key words:** Sweet basil, Integrated disease management, Downy mildew and leaf blight

Article History

Volume 6, Issue 13, 2024

Received: 18 June 2024

Accepted: 02 July 2024

doi:10.48047/AFJBS.6.14.2024.554-562

## Introduction

Sweet basil crops are vulnerable to various diseases viz., grey mould (*Botrytis cinerea*), downy mildew (*Peronospora belbahrii*), leaf spot (*Alternaria alternata*), black spot (*Colletotrichum gloeosporioides*), damping-off (*Pythium ultimum*), bacterial leaf spot (*Pseudomonas cichorii*), sweet basil rots (*Rhizoctonia solani Kuhn*) and Fusarium wilt (*Fusarium oxysporum f.sp. sweet basilica*). These diseases imposed significant production constraints on yield and overall oil quality of sweet basil. Intensive cultivation and increasing restriction on the use of fungicide led to severe epidemics. The recent widespread outbreaks of *Fusarium* wilt and black spot on sweet basil impetus to investigate effective control measures against both soil borne and airborne pathogens for maintain economically profitable crops. Use of integrated disease management approach against important diseases was our goal. Several fungal pathogens have been reported on sweet basil. Although some are restricted to certain areas, while others are more widespread. Integrated disease management (IDM) is reducing the health and ecological damages in response to chemicals by adopting certain cultural, mechanical, and biocontrol measures to manage various diseases. However, efficacy of the control measure generally depends upon their effective concentration and time of application at the stage of pathogen multiplication. Cultural control measures such as cover crops, intercropping, trap crops, tillage practices, and planting time were reducing disease severity but are not viable commercially under field conditions. Similarly, only use of the biocontrol agents and plant extracts at large scale is also questionable. However, combination of bio-control agents and cultural methods have increased their efficacy with reduced chemical applications (Wyenandt *et al.*, 2010)

## Materials and Methods

Validation of integrated disease management modules for sweet basil was carried out at main experimental station, Department of Medicinal and Aromatic Plants and analytical works were undertaken in laboratory at Department of Medicinal and Aromatic Plants, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the *Kharif* 2020-21-2022-23 in randomized block design (RBD) with plot size 3×4.5 m<sup>2</sup> and spacing 60 X45cm. Seven treatments viz., T<sub>1</sub>. Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time, T<sub>2</sub>. Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation, T<sub>3</sub>. Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Neem oil @ 300 ppm, T<sub>4</sub>. Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm, T<sub>5</sub>. Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval, T<sub>6</sub>. Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture @ 5000 ppm at 15 days interval, T<sub>7</sub>

Control . The nursery of sweet basil (*Ocimum basilicum*) variety GAB-1 were sown at the rate of 200g/ha in well-prepared, high humid nursery beds (10–15cm height) in 3<sup>rd</sup> week of June, 2022. Transplanting were done 45 days old seedlings with standard agronomical practices.

### Disease intensity

The number of infected plants/ plots was counted from the total number of plants in a plot. Percent disease severity was calculated by using the following formula described by McKinney 1923:

$$\text{Percent Disease severity (PDS)} = \frac{\text{Sum of all numerical rating}}{\text{Total number of plant examined} \times \text{Highest rating}} \times 100$$

### Result and Discussion

Pooled analysis of data 2020-21 to 2022-23 (table-1) on integrated disease management of leaf blight of basil revealed that all treatments are significantly minimized percent disease incidence and percent disease. The minimum disease incidence was observed in T<sub>4</sub> – 63.05% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- 68.91% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>3</sub>- 69.22% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Neem oil @ 300 ppm) and T<sub>6</sub>- 69.25% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture@ 5000 ppm at 15 days interval) whereas percent disease severity was lowest in T<sub>4</sub>- 14.22% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- 19.44% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>6</sub>- 19.77% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture@ 5000 ppm at 15 days interval)and T<sub>2</sub>- 19.91% (Soil application of FYM @1.0 kg/m<sup>2</sup> enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation).

**Table- 1.: Pooled analysis on effect of integrated disease management of leaf blight disease of Basil (2020-21, 2021-22 and 2022-23).**

Sl. No.	Treatment	Per cent Leaf blight Incidence			Pooled mean	Percent Leaf blight severity/ index			Pooled mean
		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23	
1.	T <sub>1</sub>	91.32 (72.84)	72.10 (58.12)	53.03 (46.72)	72.15 (59.23)	17.09 (24.35)	16.46 (23.89)	34.62 (36.03)	22.72 (28.09)
2.	T <sub>2</sub>	90.44 (71.95)	79.60 (63.15)	44.91 (42.07)	71.65 (59.06)	14.44 (22.30)	15.57 (23.19)	29.89 (33.09)	19.96 (26.19)
3.	T <sub>3</sub>	86.97 (68.78)	69.26 (56.29)	51.44 (45.80)	69.22 (56.96)	15.55 (33.19)	18.89 (25.70)	32.88 (34.94)	22.44 (31.28)
4.	T <sub>4</sub>	87.83 (69.56)	69.50 (56.48)	31.83 (34.32)	63.05 (53.45)	15.94 (23.50)	14.88 (22.63)	11.80 (20.09)	14.20 (22.07)
5.	T <sub>5</sub>	86.84 (68.79)	73.70 (59.15)	46.19 (42.76)	68.91 (56.90)	16.63 (24.04)	16.53 (23.90)	25.17 (30.07)	19.44 (26.00)
6.	T <sub>6</sub>	83.78 (66.19)	74.90 (59.93)	49.13 (44.48)	69.25 (56.87)	14.53 (22.38)	17.40 (24.65)	27.39 (31.56)	19.77 (26.20)
7.	T <sub>7</sub>	95.21 (78.76)	88.83 (70.45)	87.89 (69.56)	90.64 (72.92)	35.65 (36.63)	36.14 (36.93)	55.26 (47.98)	42.35 (40.51)
SEm±		<b>2.72</b>	<b>1.36</b>	<b>1.97</b>	<b>1.57</b>	<b>0.95</b>	<b>0.79</b>	<b>0.96</b>	<b>1.93</b>
CD at 5%		<b>8.85</b>	<b>4.18</b>	<b>6.06</b>	<b>4.76</b>	<b>2.88</b>	<b>2.44</b>	<b>2.97</b>	<b>5.94</b>
CV%		<b>7.91</b>	<b>3.88</b>	<b>7.28</b>	<b>6.71</b>	<b>6.22</b>	<b>5.32</b>	<b>5.01</b>	<b>11.66</b>

**Table- 2.: Pooled analysis on effect of integrated disease management of Downy mildew diseases of Basil (2020-21, 2021-22 and 2022-23).**

Sl. No.	Treatment	Per cent Downy mildew Incidence			Pooled mean	Percent Downy mildew severity/ index			Pooled mean
		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23	
1.	T <sub>1</sub>	72.33 (58.24)	64.60 (53.49)	53.29 (46.82)	63.40 (52.85)	18.89 (25.70)	16.63 (24.04)	31.70 (34.27)	22.40 (28.00)
2.	T <sub>2</sub>	67.43 (55.18)	70.63 (57.17)	45.86 (42.59)	61.30 (51.65)	17.40 (24.65)	16.92 (24.27)	24.22 (29.47)	19.51 (26.13)
3.	T <sub>3</sub>	62.50 (52.24)	58.36 (49.78)	50.25 (45.11)	57.03 (49.04)	16.55 (23.97)	17.76 (24.80)	28.27 (32.08)	20.86 (26.95)
4.	T <sub>4</sub>	51.90 (46.09)	69.43 (56.42)	43.25 (41.09)	54.86 (47.87)	16.73 (24.12)	14.53 (22.38)	18.74 (25.62)	16.66 (24.04)
5.	T <sub>5</sub>	65.40 (53.97)	62.90 (52.48)	39.35 (38.82)	55.88 (48.42)	16.53 (23.97)	14.44 (22.30)	21.56 (27.63)	17.51 (24.63)
6.	T <sub>6</sub>	75.60	61.53	48.11	61.74	16.46	15.55	26.48	19.49

		(60.40)	(51.65)	(43.91)	(51.99)	(23.89)	(23.19)	(30.92)	(26.00)
7.	T <sub>7</sub>	92.53 (74.11)	81.30 (64.38)	87.05 (68.87)	86.96 (69.12)	46.14 (42.76)	35.65 (36.63)	59.22 (50.30)	47.00 (43.23)
<b>SEm±</b>		<b>3.15</b>	<b>1.60</b>	<b>1.50</b>	<b>2.56</b>	<b>1.67</b>	<b>0.58</b>	<b>1.47</b>	<b>1.15</b>
<b>CD at 5%</b>		<b>9.45</b>	<b>4.94</b>	<b>4.63</b>	<b>7.90</b>	<b>5.13</b>	<b>1.79</b>	<b>4.54</b>	<b>3.56</b>
<b>CV%</b>		<b>9.86</b>	<b>5.04</b>	<b>5.56</b>	<b>8.38</b>	<b>4.06</b>	<b>3.97</b>	<b>7.76</b>	<b>7.04</b>

Three years experimental data 2020-21 to 2022-23 ( table- 2) showed significant effect of integrated disease management on downy mildew disease incidence and severity against control. The percent disease incidence of downy mildew was minimum in T<sub>4</sub>- 54.86% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- 55.88% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>3</sub>- 57.03% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Neem oil @ 300 ppm) and T<sub>2</sub>- 61.30% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation) against control (T<sub>7</sub>- 86.96%). The lowest percent disease severity of downy mildew was in T<sub>4</sub> - 16.66% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- 17.51% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>6</sub>- 19.49% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture @ 5000 ppm at 15 days interval) and T<sub>2</sub>- 19.51% (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation). In control (T<sub>7</sub>) disease severity was recorded 47.00%.

**Table- 3.: Effect of integrated disease management on days of disease appearance in Basil (2020-21 to 2022-23).**

Sl. No.	Treatment	Days of first disease appearance			Pooled mean
		2020-21	2021-22	2022-23	
1.	T <sub>1</sub>	47	52	49	49.33
2.	T <sub>2</sub>	46	56	53	51.67
3.	T <sub>3</sub>	45	57	54	52.00
4.	T <sub>4</sub>	45	49	47	47.00
5.	T <sub>5</sub>	49	59	54	54.00
6.	T <sub>6</sub>	46	56	52	51.33
7.	T <sub>7</sub>	43	49	46	46.00

All treatments of Integrated disease management (Table-3) were delayed the first disease appearance. The delayed days of disease appearance was observed maximum in T<sub>5</sub>- 54.00 days (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval) followed by T<sub>3</sub>- 52.00 days (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Neem oil @ 300 ppm), T<sub>2</sub>- 51.67 days (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation) and control (46.00 days).

**Table- 4.: Effect of integrated disease management on leaf yield and C:B ratio of Basil (2020-21 to 2022-23).**

Sl. No.	Treatment	Leaf yield (Kg/plot)			Pooled mean	Leaf yield (t/ha)			Pooled mean	C:B ratio
		2020-21	2021-22	2022-23		2020-21	2021-22	2022-23		
1.	T <sub>1</sub>	16.29	16.02	14.55	15.62	27.20	26.75	24.29	26.08	1.10
2.	T <sub>2</sub>	17.43	14.88	18.46	16.92	29.10	24.84	30.82	28.25	1.22
3.	T <sub>3</sub>	21.24	15.82	12.60	16.55	35.47	26.41	21.04	27.64	1.16
4.	T <sub>4</sub>	20.13	20.26	26.45	22.28	33.61	33.83	44.17	37.20	1.90
5.	T <sub>5</sub>	19.95	20.24	25.22	21.80	33.31	33.80	42.11	36.40	1.70
6.	T <sub>6</sub>	17.80	18.64	16.72	17.72	29.72	31.12	27.92	29.58	1.35
7.	T <sub>7</sub>	10.20	13.82	9.65	11.22	17.03	23.07	16.11	18.73	0.61
SEm±		<b>1.63</b>	<b>0.36</b>	<b>2.74</b>	<b>1.68</b>	<b>2.73</b>	<b>2.50</b>	<b>4.57</b>	-	-
CD at 5%		<b>5.04</b>	<b>1.08</b>	<b>8.43</b>	<b>5.17</b>	<b>8.41</b>	<b>7.69</b>	<b>14.08</b>	-	-
CV%		<b>16.11</b>	<b>3.59</b>	<b>16.83</b>	<b>16.64</b>	<b>16.11</b>	<b>3.60</b>	<b>16.84</b>	-	-

Three years experimental data 2020-21 to 2022-23, (Table- 4) showed that leaf yield varied significantly against control. The highest leaf yield was obtained from T<sub>4</sub> – 22.28 Kg/plot, 37.20 t/ha (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- 21.80 Kg/plot, 36.40 t/ha (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>6</sub>- 17.72 Kg/plot, 29.58 t/ha (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture@ 5000 ppm at 15 days interval) and T<sub>2</sub>- 16.92 Kg/plot, 28.25 t/ha (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation). In control (T<sub>7</sub>) leaf yield was recorded 11.22 Kg/plot, 18.73 t/ha.

The highest C:B ratio was noted with T<sub>4</sub> – 1.90 (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation and Neem oil @ 300 ppm) followed by T<sub>5</sub>- 1.70 (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Tebuconazole + Trifloxystrobin @ 0.10% with 15 days interval), T<sub>6</sub>- 1.35 (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of Bordeaux mixture@ 5000 ppm at 15 days interval) and T<sub>2</sub>- 1.22 (Soil application of FYM (1.0 kg/m<sup>2</sup>) enriched with *Trichoderma* + *Pseudomonas* talc based formulation each @ 2.0% at planting time. On the onset of disease symptoms three spray of *P. fluorescence* @ 2.0% of talc based formulation). In control (T<sub>7</sub>) C:B ratio was recorded 0.61. Haveri *et al.*, (2019) was evaluated several region specific integrated disease management (IDM) modules against downy mildew of cucumber in field condition. It revealed that M<sub>3</sub> modules i.e, application of bio-gent enriched Farm yard manure (*Trichoderma harzianum* @1kg/100 kg FYM), Seed treatment with Metalaxyl (2kg seed) and prophylactic spray with Mancozeb@0.25% before onset of disease and foliar spray of Dimethomorph @0.1%+Mancozeb @0.2% at weekly interval was done at onset of disease has resulted significant least downy mildew disease severity ( 11.09%). Machenahall *et al.*, (2012) has evaluated thirteen treatments against downy mildew of gherkins caused by *Pseudoperonospora cubensis* and found minimum PDI 30.27% in T<sub>5</sub> ( Ridomil MZ-Section –Acrobat) followed by 30.42% in T<sub>1</sub>(Ridomil MZ) and 30.55% in T<sub>2</sub> (Sectin). Patel *et al.* , ( 2020) found three foliar spray of Ridomil MZ resulted in minimum disease intensity (10.12%) of downy mildew of Opium poppy. Similar result of percent disease control was obtained by Pandya *et al.*,(2000). They reported that seed treatment with Apron 35 WS @ 2g a.i./kg followed by one spray of

Ridomil MZ 72 WP @ 4g/l at 20 DAS, resulted minimum disease incidence 4.63% and 41.59% of downy mildew in bajra caused by *Sclerospora graminicola* at 30 and 60 DAS respectively. Efficacy of several phytoextracts, bioagents and fungicides were evaluated against *Peronospora destructor* causing downy mildew in onion and resulted minimum disease severity 7.02% and maximum percent disease control 80.99% in Mancozeb 64% + Metalaxyl 4% (Scholten *et al.*, 2007). Mishra (2021) also reported that second and third spray with streptomycin sulphate @ 0.030% (300ppm) and Metalaxyl @ 0.25% at 15 days interval significantly reduced disease intensity of downy mildew. Metalaxyl inhibits growth of mycelium and sporangial formation by inhibiting nucleic acid synthesis (Fuller *et al.*, 1985). Asalkar *et al.*, (2023) were found most effective alternative use of Metalaxyl 4%+ Mancozeb 64%WP, GI Chitosan @ 1 ml/lit and Potassium salt of active phosphorus @ 4 g/lit against downy mildew disease in bitter melon. Gupta and Jared (2014) tested several fungicides and found the lowest disease intensity 16.11 % and maximum percent disease control 73.75% in Metalaxyl + Mancozeb WP. Ali *et al.*,(2011) reported that PDI of cercospora leaf spot at 30 day was lowest 12.56% in Bavistin 50 WP followed by propiconazole 250 EC (15.56%). Naik and Jayalakshmi (2017) were evaluated eight fungicides against cercospora leaf spot. The Propiconazole 25 EC@0.1% was found significantly superior in controlling the percent disease intensity (11.79) followed by carbendazim 12 % +Mancozeb 63 %WP (16.31). Devappav and Jhejakumar (2016) was found lowest percent disease intensity in combination of foliar spray of propiconazole 25 % EC @ 0.05%+Eucalyptus spp @ 10% + *Pseudomonas fluorescens* @ 5 g/ lt. Mishra (2020) also reported that application of propiconazole 25 % EC @0.20% was minimized 20.44 percent disease intensity and 64.04 percent disease control. Two foliar spray of carbendazim @0.1% was effective against Cercospora leaf spot. The minimum disease intensity was 14.45% followed by 17.85 % propiconazole (Yadav *et al* 2022). Ali *et al.*, (2011) reported maximum seed yield of chilli 1324.00 kg ha<sup>-1</sup> in foliar spray of Tilt 250 EC (Propiconazole). Another study revealed that Foliar spray of Tilt 25% EC @0.05% + Eucalyptus spp .@ 10% + *P fluorescens* @ 5g/lit was found most effective in control of cercospora leaf spot of Chilli and induced plant height, number of branches, fruit length and fruit yield (Devappa and Jhejakumar 2016). Maheshwarii *et al*; (2023) showed promising result in sweet basil with significantly highest plant height, no branches, no of leaves, plant spread and fresh yield in integrated nutrient management practices with 75 % RDF dose +Vermicompost(5t/ h<sup>-1</sup>) + AMC is applied followed by INM treatment 75%RDF+FYM(10t<sup>-1</sup>)+AMC.

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