

## Management of *Fusarium* wilt in *Gladiolus*

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### ABSTRACT

The pooled results over three years revealed that the least disease incidence (3.58, 5.55 and 7.22 PDI) and maximum disease reduction (94.67%, 91.74% and 89.26 %) was recorded in pre storage hot water treatment of corm (50°C for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% followed by corm treatment with *T. harzianum* 10g/l for 30 min., pre storage hot water treatment of corm (50°C for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% and pre storage and pre planting corm treatment with captan 0.3% respectively and were found at par with each other.

However, the pre storage and pre planting corm treatment with captan 0.3% gave maximum benefit cost ratio (1.90) and maximum monetary returns per ha.(Rs. 13.21 lakh) and was found cost effective for better management of *Fusarium* wilt of *gladiolus*. The other two treatments failed to give good benefit cost ratio due to the higher cost of the fungicides.

**Key words:** Bioagents, *Fusarium oxysporium f. sp. gladioli*, Percent disease incidence (PDI)

### INTRODUCTION

*Gladiolus* (*Gladiolus dracociphalus* L.) commonly known as sword lilly stand fourth place in the international market, after rose, carnation and chrysanthemum. It is an important cut flower crop mainly growing for cut flower purpose. It has gained popularity in many part of the world. Owing to its unsurpassed beauty and economic value, in India *gladiolus* has become the most important commercial cut flower crop grown over an area of 500 ha. But due to some biotic stresses the quality and quantity of flower is reduced. The main important biotic stress of *gladiolus* is wilt, caused by *Fusarium oxysporium f. sp.*

*gladioli* and may causes a crop loss up to 60-80%. Hence to find out suitable measures for better management of the disease, the present study was under taken.

### MATERIAL AND METHODS

A field trial was conducted during 2011-12 to 2013-14 at All India Coordinated Floriculture Improvement, Project, Ganeshkhind, Pune-67, Maharashtra, India, to test the effectiveness of different management practices, which includes hot water treatment, fungicides and bio agents. The sansarre a *Fusarium* wilt susceptible variety was raised in randomized block design with three replications.

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A spacing of 60x10 cm. was adopted and 15 corms were planted for each treatment using ridges and furrow method. The inoculum of *Fusarium oxysporium f.sp. gladioli* @ 250 g/m<sup>2</sup> was mixed thoroughly with 5 kg of well pulverized field soil and the mixture was spread evenly in experimental plot prior to planting. Eight treatments were imposed, which includes two bio-control agents namely *T. viride* and *P. flurescans*, two fungicides namely captan 0.2% and carbendazim 0.2% were used as corm dip and corm dip + soil application. The corms were dipped in respective fungicidal/bioagent solution for 30 minutes before planting. The observations regarding sprouting were recorded 4-5 days after planting. The wilt incidence was recorded 60-65 days after planting. The yield of flower stalk was recorded regularly for one year. The data was statistically analyzed to evaluate the effect of different management practices. The percent decrease in disease control was also calculated by using following formula.

$$\text{Percent disease control (PDC)} = \frac{(T - C)}{C} \times 100$$

## RESULTS AND DISCUSSION

The three years pooled results presented in Table 1 to 6 indicated that the treatment differences in wilt incidence, yield and quality parameters of flower stalks, corms and cormels were statistically significant.

### A. *Fusarium* wilt:

The pooled results over three years revealed that the least disease incidence (3.58, 5.55 and 7.22 PDI) and maximum disease reduction (94.67%, 91.74% and 89.26 %) was recorded in pre storage hot water treatment of corm (50°C for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% followed by corm treatment with *T. harzianum* 10g/l for 30 min., pre storage hot water treatment of corm (50°C for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% and pre storage and pre planting corm

treatment with captan 0.3%, respectively and were found at par with each other (Table 1).

The same treatments gave significant results of plant height, spike length and weight of healthy corm and cormels (Table 2 to 5).

Similar results in respect of *T. viride* were also reported by De et al.<sup>1</sup> and Gangwar et al.<sup>2</sup> in case of lentil wilt and chickpea wilt respectively. Rana et al.<sup>3</sup> reported the effectiveness of captan @ 0.3% as corm dip treatment in case of *Fusarium* wilt of gladiolus.

### B. Yield of flower stalk and healthy corms and cormels:

As the pre storage hot water treatment of corm (50°C for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% followed by corm treatment with *T. harzianum* 10g/l for 30 min. and pre storage and pre planting corm treatment with captan 0.3% reduced disease to greater extends, it gave significantly the highest yield of flower stalks (139920 and 130920/ha. respectively) and healthy corms (117660 and 110064/ha. respectively) and found at par with each other (Table 6).

### C. Economics of treatments (ha.<sup>1</sup>):

The data presented in Table 6 revealed that the different treatments gave monetary returns ranging from Rs. 9.7 lakh to Rs. 14.15 lakh as against 6.31 lakh in control. The highest benefit cost ratio 1.90 and maximum monetary returns of Rs. 13.21 lakh/ha. were obtained in pre storage and pre planting treatment of corm with captan 0.3 %.

Though the pre storage hot water treatment of corm (50° for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% followed by corm treatment with *T. harzianum* 10g/l for 30 min. and pre storage hot water treatment of corm (50° for 30 min.) followed by pre planting corm treatment with captan 0.2% + carbendazim 0.2% were effective in managing the disease and increase in yield and monetary returns, it failed to give good benefit cost ratio due to the higher cost of fungicides.

Table 1: Management of *Fusarium* wilt of gladiolus cv. Sancerre (Pooled results 2011-12 to 2013-14)

S. No	Treatments	Per Sprouting				Percent Disease Incidence				
		2011-12	2012-13	2013-14	Pooled Mean	2011-12	2012-13	2013-14	Pooled Mean	PDR
1	Pre storage hot water treatment of corms (50° c for 30 min.)	86.67 (68.64)	85.00 (67.38)	80.00 (63.90)	83.89 (66.36)	13.33 (21.14)	16.67 (24.04)	23.33 (28.76)	17.77 (24.78)	73.56
2	T1 + captan 0.2% + carbendazim 0.2%	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.0)	3.33 (6.14)	6.67 (14.75)	6.67 (12.28)	5.55 (13.47)	91.74
3	T1 + Pre planting treatment of corms with <i>T. harzianum</i> 10g/l for 30 min.	90.00 (71.93)	86.67 (68.64)	83.33 (66.11)	86.66 (68.66)	6.67 (12.29)	10.00 (18.43)	13.33 (21.14)	10.00 (18.27)	85.12
4	T1 + Pre planting treatment of corms with <i>P. flurescence</i> 10g/l for 30 min.	88.33 (70.09)	88.33 (70.09)	86.66 (68.82)	87.77 (69.51)	10.00 (18.43)	13.33 (21.33)	16.67 (23.84)	13.33 (21.30)	80.17
5	Combination of treatment 2 and 3	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	0.00 (0.00)	5.00 (12.91)	5.75 (13.80)	3.58 (11.10)	94.67
6	Pre storage+ Pre planting bulb dip in captan 0.3%	100.00 (90.00)	98.33 (85.68)	100.00 (90.00)	99.44 (87.51)	3.33 (6.14)	8.33 (16.59)	10.00 (18.42)	7.22 (15.23)	89.26
7	Pre storage treatment of corm with captan 0.2%	88.33 (70.09)	91.67 (73.37)	96.66 (83.84)	92.22 (74.23)	13.33 (21.14)	15.00 (22.78)	16.67 (23.85)	15.00 (22.16)	77.68
8	Control	68.33 (55.75)	75.00 (60.05)	63.33 (52.75)	68.88 (56.13)	73.33 (58.98)	68.33 (55.75)	60.0 (50.83)	67.22 (55.12)	-
	<b>S.E. ±</b>	<b>1.44</b>	<b>2.17</b>	<b>3.21</b>	<b>1.81</b>	<b>3.2</b>	<b>1.26</b>	<b>3.14</b>	<b>2.12</b>	-
	<b>C.D. at 5%</b>	<b>4.42</b>	<b>6.64</b>	<b>9.84</b>	<b>5.55</b>	<b>9.6</b>	<b>3.85</b>	<b>9.62</b>	<b>6.49</b>	-

Note: Figures in parenthesis are arc sin values. PDI= Percent disease incidence  
PDR= Percent Disease Control

Table 2: Management of *Fusarium* wilt of gladiolus cv. Sancerre (Pooled results 2011-12 to 13-14)

S. No	Treatments	Flowers/plot				Pl. ht (cm)			
		2011-12	2012-13	2013-14	Pooled Mean	2011-12	2012-13	2013-14	Pooled Mean
1	Pre storage hot water treatment of corms (50° c for 30 min.)	7.0	7.67	8.41	7.69	117.67	118.67	119.00	118.44
2	T1 + captan 0.2% + carbendazim 0.2%	10.0	10.67	10.83	10.50	120.67	121.33	123.33	121.77
3	T1 + Pre planting treatment of corms with <i>T. harzianum</i> 10g/l for 30 min.	8.0	9.67	10.33	9.33	119.00	119.00	124.00	120.66
4	T1 + Pre planting treatment of corms with <i>P. flurescence</i> 10g/l for 30 min.	7.33	8.00	9.33	8.22	117.67	118.33	119.67	118.55
5	Combination of treatment 2 and 3	11.33	11.67	12.00	11.66	125.50	126.33	132.33	128.05
6	Pre storage + Pre planting bulb dip in captan 0.3%	10.33	11.00	11.42	10.91	124.33	125.00	128.67	126.00
7	Pre storage treatment of corm with captan 0.2%	7.67	8.67	8.50	8.28	116.33	118.33	120.00	118.22
8	Control	5.33	4.67	4.83	4.94	106.33	108.33	111.00	108.55
	<b>S.E. ±</b>	<b>0.45</b>	<b>0.54</b>	<b>0.23</b>	<b>0.28</b>	<b>0.67</b>	<b>0.60</b>	<b>1.61</b>	<b>0.64</b>
	<b>C.D. at 5%</b>	<b>1.36</b>	<b>1.65</b>	<b>0.70</b>	<b>0.85</b>	<b>2.06</b>	<b>1.83</b>	<b>4.94</b>	<b>1.96</b>

Table 3: Management of *Fusarium* wilt of gladiolus cv. Sancerre (Pooled results 2011-12 to 2013-14)

S. No	Treatments	Length of spike (cm)				No. of corms/pl			
		2011-12	2012-13	2013-14	Pooled Mean	2011-12	2012-13	2013-14	Pooled Mean
1	Pre storage hot water treatment of corms (50° c for 30 min.)	99.33	95.00	96.33	97.05	1.75	1.76	1.50	1.67
2	T1 + captan 0.2% + carbendazim 0.2%	103.67	104.67	107.67	105.33	1.90	1.93	1.75	1.86
3	T1 + Pre planting treatment of corms with <i>T. harzianum</i> 10g/l for 30 min.	102.67	103.00	103.33	103.00	1.75	1.78	1.95	1.82
4	T1 + Pre planting treatment of corms with <i>P. flurescence</i> 10g/l for 30 min.	98.67	97.67	99.00	98.44	1.75	1.78	1.98	1.837
5	Combination of treatment 2 and 3	109.00	110.33	113.00	110.77	2.5	2.15	2.33	2.32
6	Pre storage + Pre planting bulb dip in captan 0.3%	106.00	109.00	111.00	108.66	1.90	1.95	1.82	1.89
7	Pre storage treatment of corm with captan 0.2%	97.67	98.67	98.67	98.33	1.65	1.67	1.71	1.68
8	Control	90.00	91.00	92.67	91.22	0.70	0.72	0.67	0.69
	<b>S.E. ±</b>	<b>1.05</b>	<b>1.22</b>	<b>0.99</b>	<b>0.81</b>	<b>0.28</b>	<b>0.015</b>	<b>0.18</b>	<b>0.067</b>
	<b>C.D. at 5%</b>	<b>3.22</b>	<b>3.73</b>	<b>3.06</b>	<b>2.49</b>	<b>0.82</b>	<b>0.046</b>	<b>0.55</b>	<b>0.20</b>

**Table 4: Management of *Fusarium* wilt of gladiolus cv. Sancerre (Pooled results 2011-12 to 2013-14)**

S. No	Treatments	Healthy corm wt. (gm)				% Healthy corms			
		2011-12	2012-13	2013-14	Pooled Mean	2011-12	2012-13	2013-14	Pooled Mean
1	Pre storage hot water treatment of corms (50° c for 30 min.)	32.00	33.00	34.33	33.11	71.00	77.19	77.50	75.23
2	T1 + captan 0.2% + carbendazim 0.2%	37.00	35.00	37.33	36.44	90.20	91.00	91.67	90.95
3	T1 + Pre planting treatment of corms with <i>T. harzianum</i> 10g/l for 30 min.	31.00	30.67	33.00	31.55	86.25	87.00	83.33	85.52
4	T1 + Pre planting treatment of corms with <i>P. flurescence</i> 10g/l for 30 min.	31.00	31.33	35.00	32.44	74.00	79.00	76.00	75.33
5	Combination of treatment 2 and 3	41.00	40.00	38.33	39.77	98.50	99.00	96.67	98.05
6	Pre storage+ Pre planting bulb dip in captan 0.3%	37.50	36.33	36.00	36.61	92.50	91.00	90.67	91.72
7	Pre storage treatment of corm with captan 0.2%	28.50	29.00	28.33	28.61	80.50	79.00	81.67	80.39
8	Control	15.25	17.67	18.33	17.08	39.50	39.33	16.67	31.83
	<b>S.E. ±</b>	<b>0.75</b>	<b>0.83</b>	<b>1.70</b>	<b>0.766</b>	<b>0.95</b>	<b>0.58</b>	<b>6.11</b>	<b>2.79</b>
	<b>C.D. at 5%</b>	<b>1.95</b>	<b>2.54</b>	<b>5.19</b>	<b>2.34</b>	<b>2.85</b>	<b>1.79</b>	<b>18.71</b>	<b>8.55</b>

**Table 5: Management of *Fusarium* wilt of gladiolus cv. Sancerre (Pooled results 2011-12 to 2013-14)**

S. No	Treatments	No. of cormels				Healthy cormels wt. (gm)			
		2011-12	2012-13	2013-14	Pooled Mean	2011-12	2012-13	2013-14	Pooled Mean
1	Pre storage hot water treatment of corms (50° c for 30 min.)	51.00	50.67	56.66	52.78	14.50	15.67	19.33	16.50
2	T1 + captan 0.2% + carbendazim 0.2%	70.00	71.00	77.67	72.89	20.15	21.00	23.33	21.49
3	T1 + Pre planting treatment of corms with <i>T. harzianum</i> 10g/l for 30 min.	61.00	60.67	65.00	62.22	18.50	18.67	18.67	18.61
4	T1 + Pre planting treatment of corms with <i>P. flurescence</i> 10g/l for 30 min.	52.00	50.33	68.33	56.88	14.25	13.67	14.00	13.97
5	Combination of treatment 2 and 3	73.50	72.00	76.67	74.05	21.50	20.33	23.33	21.72
6	Pre storage + Pre planting bulb dip in captan 0.3%	71.50	70.67	70.67	70.94	18.75	20.33	21.67	20.25
7	Pre storage treatment of corm with captan 0.2%	48.75	49.33	64.00	54.02	12.25	14.00	18.67	14.97
8	Control	31.00	31.00	30.00	30.66	9.75	10.00	13.33	11.02
	<b>S.E. ±</b>	<b>1.00</b>	<b>0.53</b>	<b>1.67</b>	<b>2.21</b>	<b>0.65</b>	<b>0.86</b>	<b>1.37</b>	<b>0.70</b>
	<b>C.D. at 5%</b>	<b>3.00</b>	<b>1.62</b>	<b>5.11</b>	<b>6.76</b>	<b>1.78</b>	<b>2.64</b>	<b>4.18</b>	<b>2.14</b>

**Table 6: Comparative assessment over three years of different treatments on monetary returns of gladiolus (2011-12to 2013-14)**

S. No	Treatments	Yield/ha.			Total monetary returns (Rs. Lakh/ha.)	Cost of production (Rs. Lakh/ha.)	Net profit (Rs. Lakh/ha.)	B:C ratio
		No. of spikes	No. of healthy corms	Weight of cormels (kg)				
1	Pre storage hot water treatment of corms (50° c for 30 min.)	92280	90280	1980	10.49	6.65	3.84	1.58
2	T1 + captan 0.2% + carbendazim 0.2%	126000	109140	2579	13.53	7.25	6.28	1.86
3	T1 + Pre planting treatment of corms with <i>T. harzianum</i> 10g/l for 30 min.	111960	102624	2233	12.02	6.96	5.06	1.73
4	T1 + Pre planting treatment of corms with <i>P. flurescence</i> 10g/l for 30 min.	98640	90396	1676	9.71	6.96	2.75	1.40
5	Combination of treatment 2 and 3	139920	117660	2606	14.15	7.61	6.54	1.86
6	Pre storage + Pre planting bulb dip in captan 0.3%	130920	110064	2430	13.21	6.97	6.24	1.90
7	Pre storage treatment of corm with captan 0.2%	99360	96468	1796	10.27	6.85	3.42	1.50
8	Control	59280	38196	1322	6.31	6.60	- 0.29	0.96

### CONCLUSION

The pre storage and pre planting corm treatment with captan 0.3% was found cost effective for better management of *Fusarium* wilt of gladiolus and increasing yield and monetary returns in gladiolus.

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