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EVALUATION OF BIOAGENTS FOR MANAGEMENT OF THE ONION PURPLE BLOTCH AND BULB YIELD LOSS ASSESSMENT UNDER FIELD CONDITIONS

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ABSTRACT
Among the several diseases, purple blotch diseases of onion (*Allium cepa* L.) caused by *Alternaria porri* (Ellis) Cif. is one of the most destructive disease causing accountable losses of about 80 to 90 per cent. The results obtained on the field efficacy of different bioagents tested, *Pseudomonas fluorescens*--I (0.5%) was found most antifungal against *A. porri* and recorded significantly least mean disease intensity (37.19%) and gave maximum bulb yield (27183 kg/ha). Both the fungal and bacterial antagonists tested were also found effective against *A. porri* and recorded significantly reduced mean disease intensity thereby increased the bulb yield over unsprayed control. Based on incremental cost:benefit ratio (ICBR) of the bioagents spray treatments, *P. fluorescens*--I (ICBR, 1:13.87) was found economical and effective for the management of purple blotch of onion followed by *Bacillus subtilis* (ICBR, 1:12.93).

INTRODUCTION

Onion (*Allium cepa* L.) rightly called as "queen of kitchen" is one of the important vegetable crop grown in India. According to Vavilov (1951) the primary center of origin lies in central Asia. The near East and Mediterranean are the secondary centers of origin and introduced in India from Palestine. It belongs to the family Alliaceae and genus *Allium* is very large comprising of more than 500 spp. usually perennial bulbous plants. Out of these, *Allium cepa* (Onion) is the major cultivated species grown all over the world. Onion crop is attacked by 66 diseases, of which 10 bacterial, 38 fungal, 6 nematodes, 3 viral, 1 phytoplasmal, 1 phanerogamic plant parasite and 7 miscellaneous diseases and disorder. Among these diseases the purple blotch is one of the major constraints in onion cultivation. The pathogen is polyphagus infecting crop like onion, garlic, shallot and other *Allium* spp. High relative humidity (80 to 90%) and optimum temperature (24 ± 1°C) are favour for further development of purple blotch disease and causing considerable yield losses. Shahanaz *et al*. (2007) reported losses about 50 to 100 per cent due to purple blotch disease. Different chemicals including systemic and contact fungicides have been used for management of this disease (Srivastava *et al.,* 1999; Kanzaria *et al.,* 2003 and Rahman *et al.,* 2003). However increase environmental pollution and present day public perception on pesticide contaminants of foods, development of alternate economical and eco-friendly approaches for disease management. The damage due to these chemicals was brought an awareness to find out other alternatives like eco-friendly management with the framework of IDM without affecting our precious eco-system (Mukhopadhyay, 1994). Keeping in view economic importance of the onion and yield losses due to purple blotch in the crop, the present investigations were being planned and conducted experiment on *A. porri* with different bioagents in field condition.

MATERIAL AND METHODS

Field experiment was carried out in *rabi* season during the period 2011-12 and 2012-13 at the College farm, N.M.C.A., Navsari Agril. University, Navsari (Gujarat). The study was undertaken with the objective, management of purple blotch of onion caused by *A. porri* with bioagents *in vitro* condition. Seedlings of cv. Pilipatti were planted in plot (4.0m × 1.8m). The first spray of bioagents (0.50%) was given on initiation of disease, remaining two sprays were carried out at 15 days interval. Control plot was maintained by without spraying any bioagent.

The detail's bioagents treatments applied is given in Table 1. The severity of disease was measured using 0-5 Scale (Sharma, 1986) after second and third spray as the details of scales are as shown below:

0 No disease symptoms
1 A few spots towards tip covering 10 per cent leaf area.
2 Several dark purplish brown patch covering up to 20 per cent leaf area.
3 Several patches with paler outer zone covering up to 40 per cent leaf area.

4 Leaf streaks covering up to 75 per cent leaf area or breaking of the leaves from center.
5 Complete drying of the leaves or breaking of the leaves from center.

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

$$\% \text{ disease intensity} = \frac{\text{Sum of numerical ratings}}{\text{Number of observations}} \times \frac{100}{5}$$

RESULTS AND DISCUSSION

During *rabi* 2011-12, the per cent disease intensity was 62.65 observed. Proportionately different bioagents controlled the disease effectively. Among the different bioagents, the per cent intensity was less (36.95) in *Pseudomonas fluorescens*-I sprayed plot which was at par with all the bioagents tested rather than *Trichoderma virens* with high per cent disease intensity (46.96).

It is evident from data presented in Table 1, that all the bioagents were effective in reducing the incidence of purple blotch as compared to control. Maximum disease control (41.03%) was recorded in foliar application of *P. fluorescens*-I followed by *Bacillus subtilis*, *P. aeruginosa* and *T. viride* resulting in 39.97, 37.97 and 34.23 per cent in disease control, respectively. Correspondingly, maximum bulb yield of 27207 kg/ha was also recorded in *P. fluorescens*-I sprayed plot which could reduce 30.87 per cent yield loss over control followed by *B. subtilis* (25349 kg/ha), *P. aeruginosa* (24186 kg/ha) and *T. viride* (23483 kg/ha) sprayed plots which could reduce 25.80, 22.24 and 19.91 per cent yield loss respectively over control.

During *rabi* 2012-13, the per cent disease intensity was increased to 64.35. Similarly different bioagents controlled the disease effectively over control. Among the different bioagents, the per cent intensity was also less (37.43) in *P. fluorescens*-I sprayed plot which was at par with all the bioagents tested rather than *T. virens* with high per cent disease intensity (45.62). Maximum disease control (41.84%) was recorded in foliar application of *P. fluorescens*-I followed by *B. subtilis*, *P. aeruginosa* and *T. viride* resulting in 37.29, 35.99 and 35.09 per cent in disease control, respectively. Correspondingly, maximum bulb yield of 27160 kg/ha was also recorded in *P. fluorescens*-I sprayed plot which could reduce 31.18 per cent yield loss over control followed by *B. subtilis* (25306 kg/ha), *P. aeruginosa* (24139 kg/ha) and *T. viride* (23483 kg/ha) sprayed plots which could reduce 26.14, 22.57 and 20.41 per cent yield loss respectively over control (Table 2).

Pooled analysis of data presented Table 3 and Fig. 1, 2 revealed no significant differences between bioagents treatments with respect to per cent disease intensity during *rabi* 2011-12 and *rabi* 2012-13. The pooled data over the years on the intensity of disease indicated that the bioagents *P. fluorescens*-I was found superior in reducing the purple blotch of onion gives 37.19 per cent disease intensity with maximum disease control (41.44) among bioagents followed by *B. subtilis*as with PDI value of 38.98, *P. aeruginosa* with PDI value of 39.09 and *T. viride* with PDI value of 41.23 with 38.62, 38.45 and 35.08 per cent disease control respectively. Correspondingly, maximum bulb yield of 27183 kg/ha was recorded in *P. fluorescens*-I sprayed plot which could reduce 31.02 per cent yield loss over control followed by followed by *B. subtilis*

Table 1: Evaluation of different bioagents against purple blotch of onion under field conditions during *rabi* 2011-12

Bioagents	*Mean disease intensity (%)	Disease control(%)	Bulb yield (kg/ha)	Avoidable yield loss(%)
Bacillus subtilis (0.5%)	37.61(37.82)	39.97	25349	25.80
Pseudomonas aeruginosa (0.5%)	38.93(38.60)	37.87	24186	22.24
Pseudomonas fluorescens-I (0.5%)	36.95(37.44)	41.03	27207	30.87
Trichoderma harzianum (0.5%)	43.64(41.35)	30.35	23352	19.46
Trichoderma koningii (0.5%)	44.54(41.86)	28.91	23373	19.53
Trichoderma virens (0.5%)	46.96(43.26)	25.05	23153	18.77
Trichoderma viride (0.5%)	41.21(39.93)	34.23	23483	19.91
Control	62.65(52.32)	-	18807	-
SEm ±	2.60	1364		
CD at 5%	7.90	4139		
CV%	10.85	10.01		

Values in parenthesis are angular transformed value, * Average of three replications

Table 2: Evaluation of different bioagents against purple blotch of onion under field conditions during *rabi* 2012-13

Bioagents	*Mean disease intensity (%)	Disease control(%)	Bulb yield (kg/ha)	Avoidable yield loss(%)
Bacillus subtilis (0.5%)	40.36(39.44)	37.29	25306	26.14
Pseudomonas aeruginosa (0.5%)	39.26(38.79)	35.99	24139	22.57
Pseudomonas fluorescens-I (0.5%)	37.43(37.72)	41.84	27160	31.18
Trichoderma harzianum (0.5%)	43.83(41.45)	31.89	23334	19.90
Trichoderma koningii (0.5%)	45.28(42.29)	29.64	23319	19.85
Trichoderma virens (0.5%)	45.62(42.48)	29.11	23229	19.54
Trichoderma viride (0.5%)	41.25(39.96)	35.09	23483	20.41
Control	64.35(53.34)	-	18690	-
SEm ±	2.50	1369		
CD at 5%	7.59	4153		
CV %	10.34	10.06		

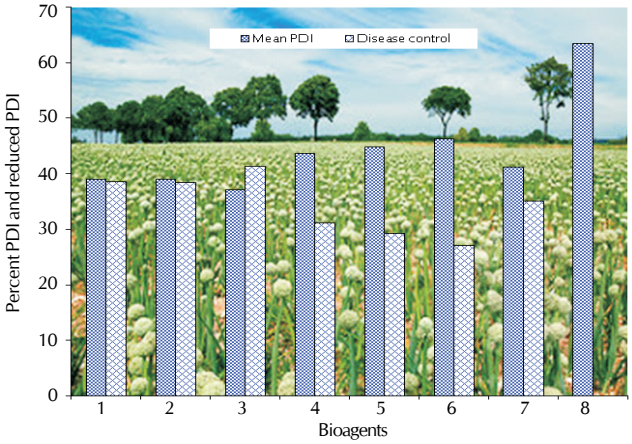
Values in parenthesis are angular transformed value, * Average of three replications

(25327 kg/ha), *P. aeruginosa* (24162 kg/ha) and *T. viride* (23479 kg/ha) sprayed plots which could reduce 25.97, 22.40 and 20.14 per cent yield loss respectively over control.

Trichoderma virens yielded 23191 kg/ha bulb, which was the lowest bulb yield among all the treatments with 19.15 per cent increase yield over control while minimum bulb yield of 18749 kg/ha was recorded in control plot (Table 3 & Fig. 2).

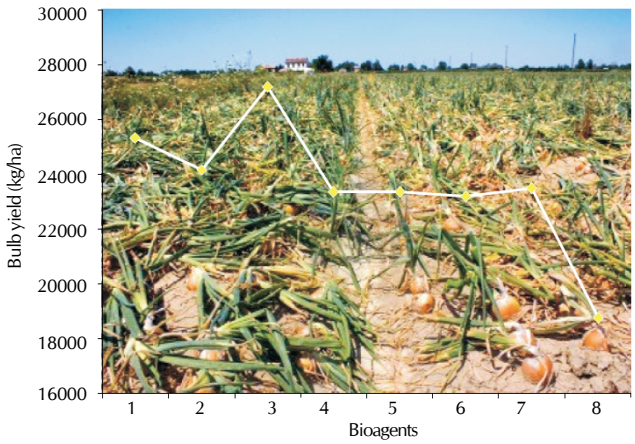
The incremental C:B ratio was also found higher in *P. fluorescens*-I (1:13.87) followed by *B. subtilis* (1:12.93) and *P. aeruginosa* (1:12.33) sprayed plots compared to other bioagents and control plot over two years (Table 4).

The results of present study are in line with Mohan *et al.* (2001) who found lowest disease percentage was observed in *B. subtilis* and *T. viride* in controlling leaf blight in onion caused by *A. porri*.



1 *Bacillus subtilis* 2 *Pseudomonas aeruginosa*
3 *Pseudomonas fluorescens*-I 4 *Trichoderma harzianum*
5 *Trichoderma koningii* 6 *Trichoderma virens*
7 *Trichoderma viride* 8 Control

Figure 1: Evaluation of different bioagent against purple blotch of onion under field conditions (pooled data of *rabi* 2011-12 and 2012-13)



1 *Bacillus subtilis* 2 *Pseudomonas aeruginosa*
3 *Pseudomonas fluorescens*-I 4 *Trichoderma harzianum*
5 *Trichoderma koningii* 6 *Trichoderma virens*
7 *Trichoderma viride* 8 Control

Figure 2: Efficacy of the different bioagent on onion bulb yield (pooled data of *rabi* 2011-12 & 2012-13)

Table 3: Evaluation of different bioagents against purple blotch of onion under field conditions (Pooled data of *rabi* 2011-12 and 2012-13)

Bioagents	*Mean disease intensity (%)	Disease control(%)	Bulb yield (kg/ha)	Avoidable yield loss(%)
Bacillus subtilis (0.5%)	38.98(38.63)	38.62	25327	25.97
Pseudomonas aeruginosa (0.5%)	39.09(38.70)	38.45	24162	22.40
Pseudomonas fluorescens-I (0.5%)	37.19(38.58)	41.44	27183	31.02
Trichoderma harzianum (0.5%)	43.74(41.40)	31.12	23343	19.68
Trichoderma koningii (0.5%)	44.91(42.08)	29.28	23346	19.69
Trichoderma virens (0.5%)	46.29(42.87)	27.11	23191	19.15
Trichoderma viride (0.5%)	41.23(39.95)	35.08	23479	20.14
Control	63.50(52.83)	-	18749	-
SEm ±	2.55	1366		
CD at 5%	NS	NS		
CV %	10.59	10.03		

Values in parenthesis are angular transformed value, * Average of three replications

Table 4: Economics of bioagents sprayings for the management of purple blotch in onion cv. Pilipatti

Treatments	Qty. required/ ha	Total cost of bioagent/ ha (Rs)**	Mean PDI	Yield (q/ha)	Gross income ***(Rs)	Additional income/ha over control (Rs)	Total cost of cultivation (Rs)	Net profit (Rs)	ICBR
Bacillus subtilis (0.5%)	2500 lit	1350	38.98(38.63)	253.27	177289	46046	13710	32336	1:12.93
Pseudomonas aeruginosa (0.5%)	2500 lit	1350	39.09(38.70)	241.62	169134	37891	13710	24181	1:12.33
Pseudomonas fluorescens-I (0.5%)	2500 lit	1350	37.19(38.58)	271.83	190281	59038	13710	45328	1:13.87
Trichoderma harzianum (0.5%)	2500 lit	1500	43.74(41.40)	233.43	163403	32160	13860	18300	1:11.78
Trichoderma koningii (0.5%)	2500 lit	1500	44.91(42.08)	233.46	163422	32179	13860	18319	1:11.79
Trichoderma virens (0.5%)	2500 lit	1500	46.29(42.87)	231.91	162337	31094	13860	17234	1:11.71
Trichoderma viride (0.5%)	2500 lit	1500	41.23(39.95)	234.79	164353	33110	13860	19250	1:11.85
Control (water spray)	-	-	63.50(52.83)	187.49	131243	-	-	-	-

ICBR : Incrimental cost:benefit ratio, *Figures in parenthesis are angular transformed values, **Include cost of three spray, *** Selling rate of onion @ Rs.700/ qt., Avg. of March-2012 & 13.

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