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Management of ramularia blight in fennel

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Abstract

Ramularia blight, caused by *Ramularia foeniculi* Sibilla is a highly destructive disease of fennel and it may cause complete failure of crop, if proper and timely precautionary measures are not taken. Consistence use of mancozeb to manage the *Ramularia* blight increases the load of mancozeb residues in fennel seed which reduces the export potential and ultimately reduces the market value of farmer produce. Its necessary to test new fungicides against the management of this disease which have low residual toxicity. However, many of the broad spectrum fungicides readily available in market are widely used by many farmers without any scientific data base/recommendation. Hence to test the efficacy of these fungicides, a trial was conducted on management of *Ramularia* blight of fennel. A set of 10 funcidical molecules were tested in field trials conducted for three consecutive *kharif* seasons (2012-13, 2013-14 & 2014-15). Among them spraying of mancozeb 75WP @ 0.25% first spray at just appearance of the disease and subsequent two spray at 10 days interval (T_{10}) recorded the maximum yield, gross and net realizations , BCR with lower disease intensity and was closely followed by spraying of chlorothalonil 75% WP @ 0.15%. Under the study residues level of chlorothalonil 75% WP @ 0.15% was found below critical limit fixed by various agencies. Thus, use of chlorothalonil instead of mancozeb can be promoted to meet the quality standards of domestic and international market with respect to pesticide residue in fennel.

Key words : Fennel, *ramularia* blight, fungicides, pesticide residue

Introduction

Fennel (*Foeniculum vulgare* Mill; Family: Apiaceae), a seed spice crop is native of Southern Europe and Mediterranean area. It is widely cultivated in the temperate and subtropical regions of the world. France, Germany, Romania, Russia, Italy, India and the US are the major fennel growing countries. In India it is mainly cultivated in Gujarat, Rajasthan, Karnataka, Maharastra, UP, Punjab and Bihar. Gujarat alone accounts for 75 per cent of the fennel production in the country (http://www.indianspices.com) Fennel requires a fairly mild climate and is cultivated during winter season in India. Cool and dry climate is ideal for the cultivation of fennel. Dry and cool weather during the seed setting increases seed yield as well as the quality of the produce. Fennel can be cultivated in all types of soils which are rich in organic matter. Shallow sandy soils are not suitable for fennel cultivation. Best soils for fennel cultivation are black cotton soil and loamy soil containing lime. Prolonged cloudy weather at the time of flowering is conducive to diseases and pests. Appropriate temperature for seed germination is 20-29°C, whereas the crop requires 15-20°C for good vegetative growth. Black cotton soil with sufficient lime is the most suitable for its cultivation. Also, the soil pH ranging from 6.5 to 8.0 is helpful for the growth of fennel. Fennel is rich in vitamin A and contains a fair amount of calcium, phosphorous and potassium (Abubacker, 2011). The odour in fennel is due to anethole which comprises a great medicinal value. It has digestive, stomachic, carminative, stimulant, appetizer properties and is used in diseases like cholera, biliousness, dysentery, diarrhea, cough, cold, constipation and ailment of chest, lungs and kidney. The crop is affected by many diseases which reduce the production (Mukerji and Basin, 1986). *Ramularia* blight is one of the important disease of fennel. Under congenial conditions, it may cause complete failure of crop, if proper measures are not taken timely. There is only single and widely adopted management practice for the control of this blight *i.e.* using fungicide spray mainly mancozeb. Consistent use of mancozeb to manage the *Ramularia* blight may increase the load of fungicide residues in fennel seed which reduces the export potential and ultimately reduces the market value of farmer produce. Recently developed molecules of fungicides have not been tested against this disease. Moreover, its residues levels/load on seed of fennel have not been measured. However, these concentrated fungicides are widely used by many farmers without any scientific data base/recommendation. Hence their evaluation (ten molecules of fungicides) against *Ramularia* blight of fennel, this experiment was planned.

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Materials and methods

A field experiment was conducted in a randomized block design with four replications during *kharif* 2012-13, 2013-14 and 2014-15 at Seed Spices Research Station, Jagudan (GUJARAT). The seedlings of cv. Gujarat Fennel-2 (GF-2) were transplanted in the month of August at a distance of 90 cm x 60 cm with a plot size of 5.4 m x 6.0 m. Ten fungicides at different concentrations (Table-1) were utilized for spray application. The efficacy of these fungicides were compared with untreated control. Three sprays of different fungicides at their respective concentration at an interval of 10 days starting from the appearance of disease were applied. The observation on the disease intensity was recorded after 10 days of last spray from 20 randomly selected plants from each plots using 0-5 scale as: 0 = No incidence/Healthy; 1 = Symptoms on leaf tip and leaves only; 2 = Symptoms on leaves and petiole; 3 = Symptoms on leaves, petiole and stem; 4 = Symptoms on leaves, stem and inflorescence; 5 = Symptoms on leaves, stem, inflorescence including seeds. Based on these observations, per cent disease intensity (PDI) of the disease was worked out using formula (Datar and Mayee, 1981). The seed yield from individual plots was also recorded and converted in hectare basis.

Results and discussion

Pooled and individual years data from three years (2012-13, 2013-14 ,2014-15) trials revealed a significant difference in different treatments for the control of *Ramularia* blight in fennel (Table :1).The minimum PDI of Ramularia blight was observed in T_6 *i.e* spraying of mancozeb 35 SC @ 0.25 % which was at par with treatments T_{10} *i.e* spraying of mancozeb 75 WP @ 0.25% and T_8 *i.e* spraying of propiconazole 25 EC @ 0.1% but these were significantly inferior over rest of the treatments during the year 2012-13. In the year 2013-14, the disease was minimum with treatment T_7 *i.e* spraying of chlorothalonil 75% WP @ 0.15 % and did not differed significantly with treatments T_2 *i.e* spraying of metiram 55% + pyraclostrobin 5% WG @ 0.3%, T_{10} *i.e* spraying of mancozeb 75 WP @ 0.25%, T_6 *i.e* spraying of mancozeb 35 SC @ 0.25 % and T_9 i.e spraying of carbendazim 12 % + mancozeb 63 % @ 0.2 %. Whereas, significantly minimum PDI was recorded in case of treatment T_7 during 2014-15. In pooled data analysis, all the chemical control treatments were at par and showed significantly lower PDI of Ramularia blight than control. Thus, application of chlorothalonil 75 WP @ 0.15 % found better for management of blight in fennel (Table-1). These finding are in agreement with Patel and Patel (2008) and Chaudhari and Patel (1987) who have reported the effect of mancozeb @ 0.2 % followed carbendazim + mancozeb in reduction of *Ramularia* blight of fennel. Jaiman and Patel (2013) reported that mancozeb 63%+ carbendazim 12% @ 0.2 % was effective for the management of *Ramularia* blight followed by mancozeb @ 0.2 %.

Effect of different treatments on fennel seed yield was found significantly effective except during the year 2013-14. During the year 2012-13, spraying of various fungicides were at par and recorded significantly higher yield than control. Spraying of chlorothalonil 75 WP @ 0.15 % recorded significantly the maximum seed yield during 2014-15. Whereas in pooled data, spraying of mancozeb 75 WP @ 0.25 % recorded the maximum yield and showed at par response with treatments T_7, T_6, T_9, T_1, T_8, T_2 and T_5 but significantly superior over rest of the treatments. Higher yield under this treatments might be due to better control of blight by the selected fungicide formulations (Table 2). Spraying of chlorothalonil 75 WP @ 0.15 % found effective fungicide not only in terms of control of blight, yield and quality aspects but also reduced the load of fungicide on seed.

Higher volatile oil percentage was recorded in treatment T_7 while higher test weight was recorded in T_6. Reduction in PDI might be helpful for growing and development consequently seed size and weight (Table 3).

Considering the yield and cost of different treatments, spraying of mancozeb 75 WP @ 0.25% first at just appearance of the disease and subsequent two spray at 10 days interval after 1st spray (T_{10}) was recorded the maximum yield, gross and net realizations, BCR with lower disease intensity and which was closely followed by spraying of chlorothalonil 75 WP @ 0.15 % (T_7) (Table: 4) Samples collected from different farmer fields and APMC markets revealed the residues of mancozeb beyond critical limit. Under this study residues level of chlorothalonil 75 WP @ 0.15 % was found below critical limit (Table 5) fixed by various agencies.

Conclusion

The use of chlorothalonil instead of mancozeb can promotes the export of fennel without affecting yield and quality. Thus, three foliar sprays of chlorothalonil 75WP @ 0.15% (20 g/ 10 lit. water) are advocated for the management of Ramularia blight disease in fennel. First foliar spray at appearance of disease and subsequent two sprays at an interval of 10 days.

Table 1: Effect of different fungicides on Ramularia blight of fennel

S. No	Treatments	Ramularia blight (PDI)			
		2012-13	2013-14	2014-15	Pooled
T_1	Spraying of zineb 68 % + hexaconazole 4 % @ 0.2%	49.46* (53.25)	37.91 (38.99)	45.90 (51.57)	44.43 (49.00)
T_2	Spraying of metiram 55% + pyraclostrobin 5% WG @ 0.3%	50.65 (59.69)	34.13 (34.07)	45.09 (50.16)	43.29 (47.01)
T_3	Spraying of azoxystrobin 250 SC @ 0.1%	52.36 (62.63)	40.63 (42.35)	47.01 (53.49)	46.67 (52.91)
T_4	Spraying of kresoxim-methyl 44.3 SC @ .1%	57.00 (70.31)	40.24 (41.71)	46.35 (52.35)	47.86 (54.99)
T_5	Spraying of captan 70 % + hexaconazole 6 % @ 0.25%	45.35 (50.63)	43.24 (46.67)	48.90 (56.80)	45.83 (51.45)
T_6	Spraying of mancozeb 35 SC @ 0.25 %	39.70 (40.81)	34.99 (32.64)	46.44 (52.50)	40.37 (41.95)
T_7	Spraying of chlorothalonil 75% WP @ 0.15 %	53.92 (65.31)	32.19 (28.42)	38.40 (38.60)	41.50 (42.19)
T_8	Spraying of propiconazole 25 EC @ 0.1%	43.52 (45.31)	40.90 (42.68)	48.24 (55.63)	44.22 (48.64)
T_9	Spraying of carbendazim 12 % + mancozeb 63 % @ 0.2 %	55.85 (68.44)	35.03 (32.98)	45.49 (50.94)	45.45 (50.79)
T_{10}	Spraying of mancozeb 75WP @ 0.25%	43.11 (46.69)	34.90 (32.93)	45.48 (50.84)	41.16 (43.31)
T_{11}	Untreated Control	72.30 (90.44)	56.05 (68.56)	60.19 (75.18)	62.85 (79.18)
	S.Em	1.60	1.10	0.94	2.50
	C.D at 5%	4.61	3.17	2.71	7.38
	C.V%	6.23	5.61	3.99	5.43
	Y × T	--	--	--	3.62

* Figures in the parenthesis are transformed values (Arcsin values)

Table 2. Effect of different fungicides on seed yield of fennel

S. No.	Treatments	Seed Yield (Kg ha^{-1})			
		2012-13	2013-14	2014-15	Pooled
T_1	Spraying of zineb 68 % + hexaconazole 4 % @ 0.2%	1897	1866	1874	1879
T_2	Spraying of metiram 55% + pyraclostrobin 5% WG @ 0.3%	1773	1933	1822	1843
T_3	Spraying of azoxystrobin 250 SC @ 0.1%	1769	1834	1793	1799
T_4	Spraying of kresoxim-methyl 44.3 SC @ .1%	1738	1844	1839	1807
T_5	Spraying of captan 70 % + hexaconazole 6 % @ 0.25%	1982	1780	1765	1843
T_6	Spraying of mancozeb 35 SC @ 0.25 %	2069	1916	1858	1948
T_7	Spraying of chlorothalonil 75% WP @ 0.15 %	1736	2049	2179	1988
T_8	Spraying of propiconazole 25 EC @ 0.1%	1898	1840	1837	1858
T_9	Spraying of carbendazim 12 % + mancozeb 63 % @ 0.2 %	1737	2036	1871	1881
T_{10}	Spraying of mancozeb 75WP @ 0.25%	2055	2120	1874	2016
T_{11}	Untreated Control	1279	1384	1229	1297
	S.Em	118.52	155.32	95.95	72.55
	C.D at 5%	342.25	NS	277.08	204.19
	C.V%	13.08	16.58	10.59	13.71
	Y × T				NS

Table 3. Effect of different fungicides on 1000 seed weight and volatile oil per cent

S. No.	Treatments	Three years average	
		1000 seed weight (g)	Volatile oil content (%)
T_1	Spraying of zineb 68 % + hexaconazole 4 % @ 0.2%	6.9	1.7
T_2	Spraying of metiram 55% + pyraclostrobin 5% WG @ 0.3%	6.7	1.8
T_3	Spraying of azoxystrobin 250 SC @ 0.1%	6.5	1.6
T_4	Spraying of kresoxim-methyl 44.3 SC @ .1%	7.1	1.6
T_5	Spraying of captan 70 % + hexaconazole 6 % @ 0.25%	6.8	2.0
T_6	Spraying of mancozeb 35 SC @ 0.25 %	7.3	1.6
T_7	Spraying of chlorothalonil 75% WP @ 0.15 %	6.9	2.3
T_8	Spraying of propiconazole 25 EC @ 0.1%	6.9	2.0
T_9	Spraying of carbendazim 12 % + mancozeb 63 % @ 0.2 %	6.9	2.0
T_{10}	Spraying of mancozeb 75WP @ 0.25%	6.9	1.7
T_{11}	Untreated Control	6.1	1.8

Table 4. Economics of different treatments

S. No	Treatments	Yield Kg ha^{-1}	Gross Realization (Rs.)	Cost of Inputs	Net Realization (Rs.)	BCR
1	Spraying of zineb 68 % + hexaconazole 4 % @ 0.2%	1879	178505	46020	132485	2.88
2	Spraying of metiram 55% + pyraclostrobin 5% WG @ 0.3%	1843	175085	47450	127635	2.69
3	Spraying of azoxystrobin 250 SC @ 0.1%	1799	170905	44033	126872	2.88
4	Spraying of kresoxim-methyl 44.3 SC @ .1%	1807	171665	49050	122615	2.50
5	Spraying of captan 70 % + hexaconazole 6 % @ 0.25%	1843	175085	44450	130635	2.94
6	Spraying of mancozeb 35 SC @ 0.25 %	1948	185060	44385	140675	3.17
7	Spraying of chlorothalonil 75% WP @ 0.15 %	1988	188860	43396	145464	3.35
8	Spraying of propiconazole 25 EC @ 0.1%	1858	176510	44250	132260	2.99
9	Spraying of carbendazim 12 % + mancozeb 63 % @ 0.2 %	1881	178695	43090	135605	3.15
10	Spraying of mancozeb 75WP @ 0.25%	2016	191520	43150	148370	3.44
11	Untreated Control	1297	123215	42000	81215	1.93

Table 5. Residue analysis of best treatment

Treatments	Results (ppm)	LoD (ppm)	LoQ (ppm)	Maximum Residue Limit (ppm)		
				EU	CODEX	Japan
Chlorothalonil 75 WP	0.26	0.020	0.050	0.1	20 (celery)	5
Untreated Control	BDL	0.020	0.050	0.1	20 (celery)	5

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