

Bio-efficacy and phytotoxicity of metiram 55% + pyraclostrobin 5% WG against blight and powdery mildew in cumin

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Received: 13 July, 2018

Accepted: 27 December, 2019

ABSTRACT

Blight and powdery mildew are very destructive diseases of cumin and may cause complete failure of crop, if proper and timely precautionary measures are not taken. For the effective and economic management of cumin blight and powdery mildew, field trial was carried out at during Rabi 2010-11 and Rabi 2011-12 to determine the effectiveness of Metiram 55% + Pyraclostrobin 5% WG against blight and powdery mildew on cumin. Different eight treatments with their prefixed concentrations were compared with control. On the basis of the two years data it has been concluded that metiram 55% + pyraclostrobin 5% WG @1050 a.i.g/ha was found effective against *Alternaria blight* (*Alternaria burnsii*) disease of cumin with increase in the yield. Higher dose of 2100 a.i.g/ha (3500 ml/ha) did not produce any phytotoxic symptoms on cumin crop at different crop stages during sprays. This indicated that metiram 55% + pyraclostrobin 5% WG is safe to cumin crop.

Key words: Cumin, *Alternaria blight*, powdery mildew, disease, management

Cumin (*Cuminum cyminum* L.) is grown in India besides several other countries like Bulgaria, Egypt, Argentina, Turkey, Bangladesh, Iran, China, Italy and Pakistan etc. It is an important low volume but high value seed spice crop of Rajasthan and Gujarat which contributes more than 80 per cent national production, Therefore, these both the states tern as Bawl of seed spices During 2016-17, cumin was grown in 7.60 lakh hectares with 4.86 lakh tones production and 0.64 tons per hectare productivity in India, where as, in Gujarat cumin was grown in 2.79 lakh hectares with 2.91 lakh tones production and 1.05 tons per hectare productivity (Anon, 2017). The area under the crop is increased in recent past. It is exported to many countries including Bangladesh, Japan, Malaysia, Nepal, Pakistan, Singapore, USA etc. The value added products, oils and oleoresins are exported to USA, UK, and Germany etc. Cumin seeds contain 2.5-4.0% volatile oil, cuminol which need in pharmaceutical industries. The crop is subjected to many pathogens causing diseases which negatively

influence the yield (Dange, 1995 and Sharma *et al.* 2010). In Rajasthan and Gujarat, the major cumin diseases observed on farmer's field are wilt (*Fusarium oxysporum* f.sp. *cumini*), blight (*Alternaria burnsii*) and powdery mildew (*Erysiphe polygoni*) in moderate to severe form (Sharma *et al.* 2013).

Blight (*Alternaria burnsii*) is the major disease of cumin and reported first in Gujarat by Uppal *et al.* (1938). Small necrotic spots develop on all the aerial parts which enlarge, coalesce and turn brown to black and cause the loss in yield up to 80 per cent in absence of any effective control measures.. The powdery mildew disease caused by *Erysiphe polygoni* DC reduced seed yield up to 50 per cent under favorable weather conditions. Under severe disease condition, the total failure of the crop has been observed (Champawat and Singh, 2008).As there is no resistant variety available against this disease, it has become inevitable to go for the use of fungicides for the management of diseases. Few fungicides were reported earlier for the management of disease by Akbari *et al.*

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(1996), Solanki *et al.* (1973), Dange *et al.* (2012), Patel (2011), Sharma *et al.* (2013), Patel *et al.* (2017) and Wadud *et al.* (2017) but under favorable environmental conditions the disease is still causing severe yield losses as well as posed pesticides residue problem in cumin. To overcome pesticides residue problem, fungicides having less residue effect is very essential. Hence, fungicides were tested under field conditions to find out their efficacy against blight and powdery mildew as well as low fungicidal load.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* 2010–11 and 2011–12 to evaluate the bio-efficacy of metiram 55% + pyraclostrobin 5% WG against *Alternaria* blight (*Alternaria burnsii*) and powdery mildew (*Erysiphe polygoni*) diseases of cumin. The trial was laid out in a randomized block design (RBD) with eight treatments and three replications (Table 1). The size of each plot measured 4.0 m × 3.0 m. Gujarat Cumin 4 was spaced at 30cm. All the recommended agronomic practices were adopted as per package of practices except fungicidal sprays. Three foliar sprays of respective fungicides were given by manually operated knapsack sprayer. First spray was done at initiation of disease symptoms and total three sprays were applied at an interval of 10 days. Observations were recorded from ten randomly selected plants as per the disease scale (0-4 Point scale) (Rathore and Rathore, 1995) and from that percent disease index (PDI) was calculated, analyzed and given in tabular form. The individual plant was kept for sun drying for a day and yield was recorded plot wise and later extrapolated to per hectare basis and statistically analyzed.

Table 1 Details of the treatment evaluated against alternaria blight and powdery mildew diseases of cumin

Sr.No.	Treatment	Dose (g a.i./ha)	Formulation (g or ml/ha)
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750
4	Metiram 70% WG	1400	2000
5	Pyraclostrobin 20% WG	100	500
6	Chlorothalonil 75% WP	600	800
7	Mancozeb 75% WP	1500	2000
8	Untreated Control	-	-

Disease scale employed for observations on alternaria blight and powdery mildew

<i>Alternaria</i> blight		Powdery mildew	
0	0-1% (No disease),	0	No Symptoms
1	1-6% (Slight),	1	1 - 10%
2	6-9% (Moderate),	2	11-25%,
3	10-49% (severe)	3	25 - 50%,
4	>49% (Very severe)	4	>51% inflorescence coverage by powdery mildew.

Phytotoxicity symptoms were recorded using scale (0-10) at 1, 3, 5, 7 and 10 days after first spray. Ten plants were selected at random from each plot and the total number of leaves and those showing phytotoxicity symptoms such as leaf tip and surface injury, wilting, vein clearing, necrosis, epinasty and hyponasty were rated and converted into percentage and given in tabular form.

Table 2 Scores used for effect on crop health.

Score	Percent crop affected	Score	Percent crop affected
0	No adverse effect	6	51-60
1	1-10	7	61-70
2	11-20	8	71-80
3	21-30	9	81-90
4	31-40	10	91-100
5	41-50		

RESULTS AND DISCUSSION

Percent disease intensity of blight:

The results presented in Table 3 revealed that all the treatments were effective to reduce blight and disease and to improve the yield of cumin as compared to control. The minimum blight disease

intensity that is 27.06, 27.39, 27.41 and 27.67 per cent was observed in the treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha at 7 days after 1st spray, 2nd spray, 3rd spray and at harvest of crop, respectively followed by metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha where 28.40, 28.54, 28.79 and 29.71 per cent disease was registered, respectively. They were at par at 7 days after 2nd and 3rd spray. while during 2011-12 (Table 5) minimum blight disease intensity 26.91, 27.15, 27.29 and 27.43 per cent was observed in the treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha at 7 days after 1st spray, 2nd spray, 3rd spray and at harvest of crop, respectively followed by metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha where 27.32, 27.55, 28.37 and 28.99 per cent disease was registered, respectively. They were at par at 7 days after in all sprays and harvest.

In pooled data, all the treatments were found effective to reduce blight disease and to improve the yield of cumin as compared to control (Table 7). The minimum blight disease intensity of 26.99, 27.27, 27.35 and 27.55 per cent was observed in the treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha at 7 days after 1st spray, 2nd spray, 3rd spray and at harvest of crop, respectively followed by metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha where 27.86, 28.05, 28.58 and 29.35 per cent disease were registered, respectively. They were at par at 7 days after in all sprays and at harvest. The results obtained in the present study can be corroborated with the findings of wadud *et al.* 2017.

Percent disease intensity of powdery mildew:

The minimum powdery mildew disease intensity that is 17.84, 20.61, 22.30 and 19.45 per cent was observed in the treatment of metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha at 7 days after 1st spray, 2nd spray, 3rd spray and at harvest of crop, respectively followed by metiram

55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha where 18.25, 22.38, 22.70 and 19.45 per cent disease were registered, respectively. They were at par at 7 days after 1st, 2nd, 3rd spray and at harvest of crop during 2010-11 (Table 4) while during 2011-12 minimum powdery mildew disease intensity of 23.96, 24.09, 24.09 and 24.14 per cent was observed in the treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha at 7 days after 1st spray, 2nd spray, 3rd spray and at harvest of crop, respectively followed by metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha where 23.89, 24.14, 24.14 and 24.51 per cent disease were registered, respectively. They were at par at 7 days after 1st, 2nd, 3rd spray and at harvest of crop (Table 6).

In pooled data the minimum powdery mildew disease intensity of 20.86, 22.37, 23.22 and 21.78 per cent was observed in the treatment of metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha at 7 days after 1st spray, 2nd spray, 3rd spray and at harvest of crop, respectively followed by metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha where 21.11, 23.24, 23.40 and 21.80 per cent disease were registered, respectively. They were at par at 7 days after 1st, 2nd, 3rd spray and at harvest of crop (Table 8). The results obtained in the present study can be corroborated with the findings of wadud *et al.* 2017).

Phytotoxicity of metiram 55% + pyraclostrobin 5% WG on cumin crop:

The data on different aspects of phytotoxicity are presented in Table -10.1 to 10.6 such as chlorosis, necrosis, wilting, scorching, epinasty and hyponasty on cumin crop sprayed with metiram 55% + pyraclostrobin 5% WG @ 1050 g a.i./ha and 2100 g a.i./ha. From the present study it can be concluded that metiram 55% + pyraclostrobin 5% WG @ 1050 g a.i./ha and 2100 g a.i./ha did not exhibit any phytotoxicity symptoms in cumin crop during 2011-12.

Seed yield:

The results presented in table 9 revealed that during 2010-11 maximum seed yield (333 kg/ha) was recorded in treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha. It was at par with other treatment viz., metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha and mancozeb 75% WP @ 1500 a.i.g/ha. The metiram 55% + pyraclostrobin 5% WG @ 750 a.i.g/ha was found next effective fungicide to improve yield 305 kg/ha was recorded, respectively. Chlorothalonil 75% WP was found moderately effective in improving yield. Whereas maximum seed yield (426 kg/ha) was recorded in treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha. followed by treatments viz., metiram 55% + Pyraclostrobin 5% WG @ 900 a.i.g/ha, mancozeb 75% WP @ 1500 a.i.g/ha and metiram 55% + pyraclostrobin 5% WG @ 750 a.i.g/ha. Although, the yield differences among various treatments was found to be non-significant during 2011-12.

It is revealed from the pooled data that

Table 3 Efficacy of metiram 55% + pyraclostrobin 5%WG against blight disease in cumin (2010-11)

No	Treatment	Dose (ga.i./ha)	Formula tion (product g or ml/ha)	PDI before 1 st spray	PDI 1 st spray	PDI 2 nd spray	PDI 3 rd spray	PDI at harvest
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	29.79 (24.70)	30.08 (25.13)	30.43 (25.33)	30.38 (25.60)	31.18 (26.83)
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	28.25 (22.40)	28.40 (22.63)	28.54 (22.83)	28.79 (23.20)	29.71 (24.57)
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	26.92 (20.50)	27.06 (20.70)	27.39 (21.17)	27.41 (21.20)	27.67 (21.23)
4	Metiram 70% WG	1400	2000	29.04 (23.57)	30.44 (25.67)	31.73 (27.67)	32.37 (28.67)	38.55 (38.83)
5	Pyraclostrobin 20% WG	100	500	29.15 (23.73)	33.04 (29.73)	35.51 (33.73)	38.69 (39.07)	44.24 (48.67)
6	Chlorothalonil 75% WP	600	800	28.28 (22.47)	31.13 (26.73)	32.41 (28.73)	34.89 (32.73)	37.76 (37.50)
7	Mancozeb 75% WP	1500	2000	29.55 (24.33)	29.69 (24.53)	29.82 (24.73)	30.37 (25.57)	31.26 (26.93)
8	Untreated Control	-	-	29.79 (24.70)	33.64 (30.70)	38.13 (38.03)	44.52 (43.37)	49.86 (58.43)
	S.E.m. ±			0.56	0.40	0.41	1.06	0.57
	C.D. (at 5%)			1.68	1.21	1.23	3.18	1.72
	C.V. %			3.37	2.29	2.24	5.49	2.74

Figures in parenthesis are re transformed values

maximum seed yield (380 kg/ha) was recorded in treatment of metiram 55% + pyraclostrobin 5% WG @ 1050 a.i.g/ha. followed by treatments viz., metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha mancozeb 75% WP @ 1500 a.i.g/ha and metiram 55% + pyraclostrobin 5% WG @ 750 a.i.g/ha. Although, the yield differences among various treatments was found to be non-significant. Similar results were also reported earlier by Wadud *et al.* (2017).

CONCLUSION

The foliar application of metiram 55% + pyraclostrobin 5% WG @ 900 a.i.g/ha (1500 ml/ha) was found effective for the management of blight and powdery mildew diseases and increasing seed yield of cumin.

No adverse effect or any deformities was observed with application of metiram 55% + pyraclostrobin 5% WG on cumin crop even at higher dose of 2100 a.i.g/ha (3500 ml/ha) during the period of experimentation.

Authors are grateful to Manager, BASF., Mumbai for the supply of Metiram 55% + Pyraclostrobin 5% WG with protocol.

Table 4 Efficacy of metiram 55% + pyraclostrobin 5%WG against powdery mildew disease in cumin (2010-11)

No	Treatment	Dose (g. a. i. /ha)	Formulation (g or ml/ha)	PDI before 1 st spray	PDI 7 DA 1 st spray	PDI 7 DA 2 nd spray	PDI 7 DA 3 rd spray	PDI at harvest
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	22.50 (14.70)	22.85 (15.10)	24.67 (17.43)	24.67 (17.43)	24.67 (17.43)
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	15.77 (7.40)	17.84 (9.40)	20.61 (12.40)	22.30 (14.40)	19.45 (15.00)
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	15.45 (7.17)	18.25 (9.83)	22.38 (14.50)	22.70 (14.90)	19.45 (15.00)
4	Metiram 70% WG	1400	2000	21.60 (13.57)	22.40 (14.57)	23.99 (16.57)	25.26 (18.23)	25.71 (18.83)
5	Pyraclostrobin 20% WG	100	500	21.74 (13.73)	25.64 (18.73)	27.32 (21.07)	29.59 (24.40)	30.03 (25.07)
6	Chlorothalonil 75% WP	600	800	20.65 (12.47)	24.01 (16.57)	25.49 (18.57)	25.51 (18.57)	27.15 (20.83)
7	Mancozeb 75% WP	1500	2000	23.56 (16.00)	26.07 (19.33)	29.55 (24.33)	29.55 (24.33)	30.32 (25.50)
8	Untreated Control	-	-	22.50 (14.7)	29.83 (24.77)	36.22 (34.93)	36.22 (34.93)	42.00 (44.77)
	S.Em. ±			0.87	0.75	0.64	0.62	1.44
	C.D. @ 5%			2.63	2.27	1.94	1.88	4.37
	C.V. %			7.34	5.55	4.22	3.99	9.13

Figures in parenthesis are re transformed values

Table 5 Efficacy of metiram 55% + pyraclostrobin 5%WG against blight disease in cumin (2011-12)

No	Treatment	Dose (g a. i. /ha)	Formula tion (g or ml/ha)	PDI before 1 st spray	PDI 7 DA 1 st spray	PDI 7 DA 2 nd spray	PDI 7 DA 3 rd spray	PDI at harvest
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	28.43 (22.70)	29.79 (24.70)	30.24 (25.37)	30.32 (25.50)	30.32 (25.50)
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	26.85 (20.40)	27.32 (21.07)	27.55 (21.40)	28.37 (22.60)	28.99 (22.83)
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	26.20 (19.50)	26.91 (20.50)	27.15 (20.83)	27.29 (21.03)	27.43 (21.23)
4	Metiram 70% WG	1400	2000	31.67 (27.57)	37.40 (36.90)	39.56 (40.57)	39.60 (40.63)	39.62 (40.67)
5	Pyraclostrobin 20% WG	100	500	30.33 (30.73)	39.66 (40.73)	42.55 (45.73)	43.32 (47.07)	44.56 (49.90)
6	Chlorothalonil 75% WP	600	800	32.03 (28.13)	35.14 (33.13)	35.75 (34.13)	35.79 (34.20)	35.83 (34.27)
7	Mancozeb 75% WP	1500	2000	27.74 (21.67)	28.20 (22.33)	28.31 (22.50)	28.31 (22.50)	28.31 (22.50)
8	Untreated Control	-	-	31.10 (26.7)	37.28 (36.7)	43.64 (42.03)	43.30 (47.03)	47.70 (54.67)
	S.Em. ±			1.25	0.56	1.14	0.56	0.61
	C.D. @ 5%			3.79	1.70	3.45	1.70	1.85
	C.V. %			7.39	2.97	5.74	2.81	2.99

Figures in parenthesis are re transformed values

Table 6 Efficacy of metiram 55% + pyraclostrobin 5% WG against powdery mildew disease in cumin (2011-12)

No	Treatment	Dose (g. a. i. /ha)	Formula tion (g or ml/ha)	PDI before 1 st spray	PDI 7 DA 1 st spray	PDI 7 DA 2 nd spray	PDI 7 DA 3 rd spray	PDI at harvest
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	22.50 (14.70)	24.86 (17.70)	25.87 (19.07)	25.87 (19.07)	26.17 (19.50)
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	22.30 (14.40)	23.89 (16.40)	24.14 (16.73)	24.14 (16.73)	24.51 (17.23)
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	23.18 (15.50)	23.96 (16.50)	24.09 (16.67)	24.09 (16.67)	24.14 (16.73)
4	Metiram 70% WG	1400	2000	24.74 (17.57)	26.29 (19.57)	27.67 (21.57)	27.67 (21.57)	28.31 (22.50)
5	Pyraclostrobin 20% WG	100	500	23.36 (15.73)	27.31 (21.07)	30.91 (26.40)	30.91 (26.40)	31.66 (27.57)
6	Chlorothalonil 75% WP	600	800	22.33 (14.47)	26.41 (19.80)	30.20 (25.30)	30.20 (25.30)	31.58 (27.43)
7	Mancozeb 75% WP	1500	2000	24.33 (17.00)	27.96 (22.00)	31.08 (26.67)	31.08 (26.67)	32.82 (29.40)
8	Untreated Control	-	-	24.86 (17.7)	31.75 (27.7)	37.91 (37.77)	37.91 (37.77)	40.04 (41.40)
	S.Em. ±			0.87	0.61	0.67	0.65	0.83
	C.D. @ 5%			2.60	1.80	2.00	1.90	2.2
	C.V. %			7.74	3.97	4.03	5.15	4.11

Figures in parenthesis are re transformed values

Table 7 Efficacy of metiram 55% + pyraclostrobin 5% WG against blight disease in cumin (Pooled)

No	Treatment	Dose (g. a. i. /ha)	Formula tion (g or ml/ha)	PDI before 1 st spray	PDI 7 DA 1 st spray	PDI 7 DA 2 nd spray	PDI 7 DA 3 rd spray	PDI at harvest
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	29.11 (23.70)	29.93 (24.92)	30.33 (25.35)	30.35 (25.55)	30.75 (26.17)
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	27.55 (21.40)	27.86 (21.85)	28.05 (22.12)	28.58 (22.90)	29.35 (23.70)
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	26.56 (20.00)	26.99 (20.60)	27.27 (21.00)	27.35 (21.12)	27.55 (21.23)
4	Metiram 70% WG	1400	2000	30.35 (25.57)	33.92 (31.28)	35.65 (34.12)	35.98 (34.65)	39.08 (39.75)
5	Pyraclostrobin 20% WG	100	500	29.74 (27.23)	36.35 (35.23)	39.03 (39.73)	41.00 (43.07)	44.40 (49.28)
6	Chlorothalonil 75% WP	600	800	30.16 (25.30)	33.14 (29.93)	34.08 (31.43)	35.34 (33.47)	36.79 (35.88)
7	Mancozeb 75% WP	1500	2000	28.65 (23.00)	28.94 (23.43)	29.07 (23.62)	29.34 (24.03)	29.79 (24.72)
8	Untreated Control	-	-	30.44 (25.70)	35.46 (33.70)	40.89 (40.03)	43.91 (45.20)	48.78 (56.55)
	S.Em. ±			0.69	0.35	0.61	0.60	0.42
	C.D. @ 5%			1.98	1.00	1.75	1.74	1.21
	C.V. %			5.77	2.68	4.49	4.32	2.86

Figures in parenthesis are re transformed values

Table 8 Efficacy of metiram 55% + pyraclostrobin 5% WG against powdery mildew disease in cumint (Pooled)

No	Treatment	Dose (g. a. i. /ha)	Formula tion (g or ml/ha)	PDI before 1 st spray	PDI 7 DA 1 st spray	PDI 7 DA 2 nd spray	PDI 7 DA 3 rd spray	PDI at harvest
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	22.50 (14.70)	23.86 (16.40)	25.27 (18.25)	25.27 (18.25)	25.42 (18.47)
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	19.03 (10.90)	20.86 (12.90)	22.37 (14.57)	23.22 (15.57)	21.78 (16.12)
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	19.32 (11.33)	21.11 (13.17)	23.24 (15.58)	23.40 (15.78)	21.80 (15.87)
4	Metiram 70% WG	1400	2000	23.17 (15.57)	24.34 (17.07)	25.83 (19.07)	26.47 (19.90)	27.01 (20.67)
5	Pyraclostrobin 20% WG	100	500	22.55 (14.73)	26.48 (19.90)	29.11 (23.73)	30.25 (25.40)	30.85 (26.32)
6	Chlorothalonil 75% WP	600	800	21.49 (13.47)	25.21 (18.18)	27.84 (21.93)	27.86 (21.93)	29.37 (24.13)
7	Mancozeb 75% WP	1500	2000	23.95 (16.50)	27.02 (20.67)	30.31 (25.50)	30.31 (25.50)	31.57 (27.45)
8	Untreated Control	-	-	23.68 (16.20)	30.79 (26.23)	37.07 (36.35)	37.07 (36.35)	41.02 (43.08)
	S.Em. $\pm$			0.55	0.48	0.47	0.45	0.80
	C.D. @ 5%			1.60	1.4	1.38	1.32	2.33
	C.V. %			6.17	4.74	4.12	4.01	6.88

Figures in parenthesis are re transformed values

Table 9 Effect of metiram 55% + pyraclostrobin 5% WG on seed yield of cumin (2010-11, 2011-12 and Pooled)

No	Treatment	Dose (g. a. i. /ha)	Formulation (product g or ml/ha)	Seed yield (Kg/ha)		
				2010-11	2011-12	Pooled
1	Metiram 55% + Pyraclostrobin 5% WG	750	1250	305	353	329
2	Metiram 55% + Pyraclostrobin 5% WG	900	1500	315	392	353
3	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	333	426	380
4	Metiram 70% WG	1400	2000	250	336	293
5	Pyraclostrobin 20% WG	100	500	247	348	298
6	Chlorothalonil 75% WP	600	800	291	315	303
7	Mancozeb 75% WP	1500	2000	318	359	338
8	Untreated Control	-	-	191	280	236
	S.Em. $\pm$			8.79	59.00	30.00
	C.D. @ 5%			26.67	NS	NS
	C.V. %			5.41	29.00	23.00

Table 10.1 Evaluation of the phytotoxicity of metiram 55% + pyraclostrobin 5% WG Observation on chlorosis, necrosis and wilting

No	Treatment	Dose / ha		Cholorosis					Necrosis					Wilting				
				Days after 1 st spray														
		a.i.(g)	Formu- lation (g/ml)	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
1	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Metiram 55% + Pyraclostrobin 5% WG	2100	3500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.2 Evaluation of the phytotoxicity of metiram 55% + pyraclostrobin 5% WG Observation on scorching, hyponasty and epinasty

No	Treatment	Dose / ha		Scorching					Hyponasty					Epinasty				
									Days after 1 st spray									
		a.i.(g)	Formu- lation (g/ml)	1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
1	Metiram 55% + Pyraclostrobin 5% WG	1050	1750	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Metiram 55% + Pyraclostrobin 5% WG	2100	3500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Untreated control	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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