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FIELD EVALUATION OF COMBI-FUNGICIDES FOR THE MANAGEMENT OF *ALTERNARIA* LEAF BLIGHT OF SUNFLOWER

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ABSTRACT

A field experiment on management of Alternaria leaf blight of Sunflower by using combi-fungicides was conducted for three years during Kharif season at MARS, Raichur. The experiment was planned with seven treatments (six combi fungicides and one untreated) in three replications for three years i.e., Kharif 2018, 2019 and 2020. The fungicides used were Difenoconazole 25% + Propiconazole 25%, Zineb 68% + Hexaconazole 4% WP, Trifloxystrobin 25% + Tebuconazole 50 %, Pyraclostrobin 5% + Metiram 55% , Tricyclozole 18% + Mancozeb 62% and Mancozeb . For six treatments (T1 to T6) seed treatment was done with Carbendazim 12% + Mancozeb 63% WP and for T7 was maintained without seed treatment. Pooled analysis revealed that the treatment T1 :(Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 ml) recorded the lesser Sunflower Alternaria leaf blight of 21.67 % with higher yield of 1551.3 kg/ha, which is followed by the treatment T4 : (Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l recorded Sunflower Alternaria leaf blight of 28.75 % with yield of 1308.3 kg/ha and both were at par. Both the treatments recorded B:C ratio of 1.74 and 1.36 respectively.
Keywords **:** Sunflower, Alternaria leaf blight, Management, Fungicides

Introduction

Sunflower is major oil seed crop in India next to soyabean and groundnut at the global level (Shilpa, 2015). This crop was introduced into India's vegetable scenario around 1969 and made a significant dent on the country's vegetable oil front. The crop became popular in India due to its adoptability and high yield potential (Indumathi, 2011). Sunflower is an important oilseed of our country. The major constraint in profitable sunflower cultivation is the susceptibility to Alternaria leaf and stem blight caused by *Alternaria helianthi*. The disease appears in Karnataka, Uttar Pradesh, Maharastra, Bihar, Andhra Pradesh, Haryana and Tamil nadu and causes 27 to 80 per cent reduction in seed yield. The disease has considerable effect on plant height, stem girth, head diameter, seed production, seed weight and hull percentage (Mathur *et al.,* 1978) and was reported to reduce the seed yield by 27- 80 % and oil yield by 17 - 33 % (Balasubrahmanyam and Kolte, 1980; Allen *et al.,* 1981; Carson, 1985).It significantly reduces both seed yield and oil content besides leading to germination losses (Reddy and Gupta, 1977; Hiremath *et al.,* 1990). The disease also affects seed germination and seedling vigour and the loss in the germination varies from 23-32 % (Kolte *et al.,* 1979). The disease symptoms are characterized by irregular, necrotic greyish brown lesions surrounded by a chlorotic halo on leaves, stem and even on florets resulting in premature defoliation and stem breakage. High humidity and moderate to warm temperatures favour Altemaria leaf spot. Yield losses of 20 to 80%, with oi11osses of 20 to 30%, have been reported from tropical and subtropical sunflower production regions (Howard and Gent, 2007). In India, the losses due to Alternaria blight range upward to 80% (Shankergoud *et al*., 2006). Use of resistant cultivars is normally the most economical management option against most of the plant diseases. Unfortunately, such resistance against ALB is not

usually expressed in commercially available sunflower hybrids till now (Iacomi-Vasilescu *et al.*, 2004). Thus it has become inevitable to go for fungicidal spray for the management of the disease. The present study was undertaken to evaluate the efficacy of fungicides for the management of Alternaria leaf blight of sunflower.

Material and Methods

A field experiment was conducted at Main Agriculture Research Station, Raichur, University of Agricultural Sciences, Raichur (16°12' N 77° 19'3 E, 407 m elevation) of Karnataka for a period of three seasons from Kharif 2018 to Kharif 2020 under All India Coordinated Research Project on Sunflower scheme. The climate of the region is semi-arid and subtropical. The soil of the area was medium to deep black, low in organic carbon (0.36 %), high in available P_2O_5 (45 kg ha^{-1}) and available K_2O (536 kg ha^{-1}). Randomized Block Design with seven different treatments in three replications. Plot size was maintained as 4.2 x 3 m^2 (60 plants per plot), spacing of 60x30 cm and fertilizer schedule of 75- 90-30 NPK kg/ha was followed. Three irrigations were given at different stages i.e., star bud stage, flowering and seed setting in the crop period. Seeds of susceptible check (KBSH-44) were obtained from IIOR, Hyderabad. Ten plants were randomly selected from each plot and scored for the disease reaction at 15 days interval using 1-9 scale (Anonymous, 2006, DOR technical program). The data on seed yield were also recorded after harvesting. The per cent disease index (PDI) was calculated using the formula suggested by Mayee and Datar (1986). 'The percent disease control by different fungicidal treatments over water sprayed control was computed and the economics of different fungicidal treatments was worked out. Percent index was calculated by using the following formula:

Percent Disease Index:

The per cent disease index (PDI) was calculated by using the formula given by Wheeler (1969).

$$PDI\,(\%) = \frac{\text{Summation of all numerical ratings}}{\text{Total number of plants x maximum rating scale observed}} \times 100$$

Results and Discussion

The present investigation was carried out using fungicides to manage Alternaria leaf blight disease of sunflower. The results indicated that during kharif 2018, (Table 1) Among the imposed treatments lowest PDI of Alternaria leaf blight of (22.67%) was observed in T_1 (Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 ml/l First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray) followed by T_4 (Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray) recorded (31.74%). Higher yield of 1595.6 kg/ha and highest B:C ration of 1.60 was recorded in T1 followed by T4 which recorded seed yield of 1417.5 kg/ha and B:C ration of 1.35 however, all these treatments were at par with each other and significantly differed with untreated plot. Less yield of 973.1kg/ha was observed in untreated plot among all the treatments and it was non-significant with treatments T1 and T4.

During kharif 2019 (Table 2) also, similar trend was observed *i.e.*, the treatment T_1 (Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 ml/l First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray recorded lowest PDI of (13.70%) followed by T4 (Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray) recorded PDI of (20.02%). Higher yield of 1510.6 kg/ha and B:C ration of 1.67 was recorded in T1 followed by T4 which recorded seed yield of 1421.2 kg/ha and B:C ration of 1.56 however, all these treatments were at par with each other and significantly differed with untreated plot. Less yield of 907.3 kg/ha was observed in untreated plot among all the treatments and it was non-significant with treatments T1 and T4. During 2020 (Table 3) also the same treatment T1 performed better in disease reduction compared to other treatments. Similarly other treatments i.e., T3, T2, T5 and T4 recorded less disease severity respectively and non significant with each other. Control has recorded more Alternariaster leaf spot (PDI) of 60.00%.

Pooled analysis

Disease severity

Pooled analysis results (Table 4) indicated that among the seven treatments, the treatment T1: (Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC) @ 0.25 ml/l First spray at the onset of incidence or 45

days after sowing and second spray 15 days after 1st spray) was recorded low severity of Alternariaster leaf spot i.e., 21.67 %. It is followed by T4, T2 and T3 which recorded disease severity of 28.75%, 28.44% and 30.45% respectively and all these treatments were at par with each other. Control or untreated plot (T7) recorded more disease severity of 49.03%.

Yield and B: C ratio

The treatment T1 recorded highest yield of 1551.3 kg/ha and B:C ration of 1.74 it was significant with other treatments such as T 4 and T3 and less yield was recorded in T7 which recorded low yield of 937.1 kg/ha and lowest B:C ratio of 0.83.

Seed treatment with fungicides protect the seeds from seed borne infections as it is a seed borne pathogen and it also helps in seed germination. Present experimental results are in conformity with Venkataramanamma *et al.* (2014) conducted an experiment on management of *Alternaria* leaf spot disease of sunflower with five different fungicides and found that the treatment T3 (seed treatment with SAAF @ 2 g/kg of seed followed by two foliar sprays of propiconazole @ 1 ml/litre at 15 days interval starting from the appearance of disease) has recorded least per cent disease intensity of 12.23% with higher yield 918 kg/ha when compared to control, which recorded more disease severity (PDI) of 60.2% with low yield of 542 kg/ha and they used SAAF as the seed treatment chemical. Waghe *et al.* (2015) has conducted a management trial on *Alternaria* leaf spot disease under in vivo conditions and among eight treatments imposed, the treatment i.e., seed treatment with fungicide (carbendazim 12% + mancozeb 63%) @3 g/kg seed + two sprays of (carbendazim 12% + mancozeb 63%) @ 0.2% at 30 and 45 DAS recorded higher disease control (82.82%) with good seed yield (16.86 q/ha). The effectiveness of propiconazole and other triazoles on Alternariaster leaf spot of sunflower was reported by Mane *et al.* (2019) and Mesta *et al.* (2011)

It has been previously reported that foliar spray of Carbendazim (Chattopadhyay, 1999), Hexaconazole @ 0.1% (Amaresh and Nargund, 2002), difenoconazole @ 0.05% (Karuna *et al.,* 2012), SAAF (Mancozeb + Carbendazim) (Waghe *et al.,* 2015) and Propiconazole@ 0.1% (Pathare *et al.,* 2019) significantly reduce the severity of Alternaria blight resulting in the lowest disease severity of ALB on the sunflower.

Conclusion

Hence, from this experiment it can be concluded that, among the seven treatments, the treatment T1 (Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% @ 0.25 ml/l) and T4 (Seed treatment with Carbendazim 12% + Mancozeb 63% WP (SAAF 75WP) @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% (Cabriotop 60WG) @ 0.25g/l.

Table 1: Effect of fungicides for management of *Alternaria* leaf blight (*kharif* -2018)

Treatment details		***Alternaria* leaf blight (%)**	**Yield kg/ha**	**B:C Ratio**
T1	Seed treatment with Carbendazim 12% + Mancozeb 63% WP (SAAF 75WP) @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 Ml/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	22.67 (28.40)	1595.6	1.60
T2	T2. Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Zineb 68% + Hexaconazole 4% WP @ 2.5g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	33.03 (34.98)	1329.5	1.05
T3	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Trifloxystrobin 25% + Tebuconazole 50 % WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	36.70 (37.27)	1277.6	1.01
T4	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	31.74 (34.28)	1417.5	1.35
T5	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Tricyclozole 18% + Mancozeb 62% WP@ 1 g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	35.70 (36.66)	1259.7	1.04

T6	Seed treatment with Mancozeb 75WP @ 2.5gm followed by two sprays. (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	38.62 (38.35)	1234.8	1.08
T7	Control	46.56 (43.02)	973.1	0.75
SEM±		2.09	103.8	102.8
CD (P=0.05)		6.44	317.92	

Table 2: Effect of fungicides for management of *Alternaria* leaf blight (*kharif* -2019)

Treatment details		***Alternaria* leaf blight (%)**	**Yield kg/ha**	**B:C Ratio**
T1	Seed treatment with Carbendazim 12% + Mancozeb 63% WP (SAAF 75WP) @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 Ml/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	13.70 (21.66)	1510.6	1:67
T2	T2. Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Zineb 68% + Hexaconazole 4% WP @ 2.5g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	22.14 (27.99)	1344.9	1:25
T3	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Trifloxystrobin 25% + Tebuconazole 50 % WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	22.66 (28.31)	1280.27	1:19
T4	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	20.02 (26.57)	1421.27	1:56
T5	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Tricyclozole 18% + Mancozeb 62% WP@ 1 g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	26.89 (31.19)	1196.3	1:10
T6	Seed treatment with Mancozeb 75WP @ 2.5gm followed by two sprays. (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	24.73 (29.81)	1101.5	1:02
T7	Control	34.20 (35.73)	907.30	0:77
SEM±		**1.70**	**72.84**	
CD (P=0.05)		**5.22**	**224.45**	
CV		**10.21**	**10.46**	

Table 3: Effect of fungicides for management of *Alternariaster* leaf blight (*kharif* -2020)

Treatment details		***Alternariaster* leaf blight (%)**	**Yield kg/ha**	**B:C Ratio**
T1	Seed treatment with Carbendazim 12% + Mancozeb 63% WP (SAAF 75WP) @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 Ml/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	25.92 (30.49)	1547.9	1.74
T2	T2. Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Zineb 68% + Hexaconazole 4% WP @ 2.5g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	31.11 (33.89)	1180.5	0.97
T3	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Trifloxystrobin 25% + Tebuconazole 50 % WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	32.59 (34.71)	1239.9	1.12

T4	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	27.10 (31.17)	1086.2	0.96
T5	Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Tricyclozole 18% + Mancozeb 62% WP@ 1 g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	34.81 (36.14)	1212.8	1.13
T6	Seed treatment with Mancozeb 75WP @ 2.5gm followed by two sprays. (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	42.22 (40.54)	1273.3	1.33
T7	Control	60.00 (50.94)	931.2	0.81
SEM±		**2.35**	**107.08**	
CD (P=0.05)		**7.25**	**329.95**	
CV		**11.07**	**15.32**	

Table 4 : Management of Alternaria leaf blight disease of sunflower using combi-fungicides

Treatments	**Alternaria leaf blight**			
	2018	**2019**	**2020**	**Pooled**
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 Ml/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	22.67 (28.40)	13.70 (21.66)	25.92 (30.49)	21.67 (27.72)
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Zineb 68% + Hexaconazole 4% WP @ 2.5g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	33.03 (34.98)	22.14 (27.99)	31.11 (33.89)	28.44 (32.21)
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Trifloxystrobin 25% + Tebuconazole 50 % WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	36.70 (37.27)	22.66 (28.31)	32.59 (34.71)	30.45 (33.49)
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	31.74 (34.28)	20.02 (26.57)	27.10 (31.17)	28.75 (32.42)
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Tricyclozole 18% + Mancozeb 62% WP 1 g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	35.70 (36.66)	26.89 (31.19)	34.81 (36.14)	30.65 (33.60)
Seed treatment with Mancozeb 75WP @ 2.5gm followed by two sprays. (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	38.62 (38.35)	24.73 (29.81)	42.22 (40.54)	34.99 (36.26)
Control	46.56 (43.02)	34.20 (35.73)	60.00 (50.94)	49.03 (44.47)
S. Em.±1	**2.09**	**1.70**	**2.35**	**1.99**
C. D. at 5%	**6.44**	**5.22**	**7.25**	**6.12**

Table 5 : Seed yield (Kg/ha) and B: C Ratio under various treatments

Treatments	Yield (Kg/ha)				B:C Ratio
	2018	2019	2020	Pooled	
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Difenoconazole 25% + Propiconazole 25% EC @ 0.25 Ml/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	1595.6	1510.6	1547.9	1551.3	1.74
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Zineb 68% + Hexaconazole 4% WP @ 2.5g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	1329.5	1344.9	1180.5	1284.9	1.15
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Trifloxystrobin 25% + Tebuconazole 50 % WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	1277.6	1280.27	1239.9	1265.9	1.16
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Pyraclostrobin 5% + Metiram 55% WG @ 0.25g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray)	1417.5	1421.27	1086.2	1308.3	1.36
Seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2g/kg seed followed by two foliar sprays with Tricyclozole 18% + Mancozeb 62% WP 1 g/l (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	1259.7	1196.3	1212.8	1222.9	1.15
Seed treatment with Mancozeb 75WP @ 2.5gm followed by two sprays. (First spray at the onset of incidence or 45 days after sowing and second spray 15 days after 1st spray).	1234.8	1101.5	1273.3	1169.9	1.14
Control	973.1	907.30	931.2	937.1	0.83
S. Em.±1	102.8	72.84	107.08	74.12	
C. D. at 5%	316.75	224.45	329.95	228.39	

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References

Allen, S.J., Kochman, J.K. and Brown, J. (1981). Losses in sunflower yield caused by *Alternara helianthi* in southern Queensland. *Australian Journal of Experimental Agriculture and Animal Husbandry,* **21** , 98.

Amaresh, V.S. and Nargund, V.B. (2002). Field evaluation of fungicides in the management of Alternaria leaf blight of sunflower. *Annals of Plant Protection Sciences*, **10**, 331-36.

Balasubrahmanyam, N., Kolte, S.J. (1980). Effect of Alternaria blight on yield. Components, oil content and seed quality of sunflower. Indian J Agric Sci., **50**(9),701

Carson, M.L. (1985). Epidemiology and yield losses associated with Alternaria blight of sunflower. *Phytopathology,* **75**, 1151-1156.

Hiremath P.C., Kulkarni M.S., Lokesh M.S. (1990). An epiphytotic of Alternaria blight of sunflower in Karnataka. *Karnataka Journal of Agricultural Sciences.* **3**,277-278.

Howard F.S., Gent D.H. (2007). Sunflower Alternaria leaf spot. High plains IPM Guide, a cooperative effort of the University of Wyoming, University of Nebraska, Colorado State University and Montana State University.

Iacomi-Vasilescu, B., Avenot, H., Bataillé-Simoneau, N., Laurent, E., Guénard, M. and Simoneau, P. (2004). *In vitro* fungicide sensitivity of Alternaria species pathogenic to crucifers and identification of *Alternaria brassicicola* field isolates highly resistant to both dicarboximides and phenylpyrroles. Crop Protection, **23**, 481-488.

Indumathi, S. (2011). Integrated Disease Management of Alternaria Leaf Spot of Sunflower Caused by *Alternaria helianthi* (Hans f.) Tubaki and Nishihara, Acharya N.G. Ranga Agril. Uni., Rajendranagar, Hyderabad. M.Sc thesis, 1-123.

Karuna, K., Jagadish, K.S., Geetha, K.N. and Shadakshari, Y.G. (2012). Evaluation of efficacy of chemical fungicides and a plant product for the management of Alternaria blight of sunflower. *Indian Phytopathology*, **65**, 305-06.

Kolte, S.J., Balasubramanyam, N., Tewari, A.N. and Awasthi, R.P. (1979). Field performance of fungicides in the control of Alternaria blight on sunflower. *Indian Journal of Agricultural Sciences,* **49** , 555.

Mane, P.N., Manjusha, S.G., Prerna, B.C., Makar and Shinde, P. (2019). Integrated management of alternaria leaf blight and necrosis of sunflower. *International Journal of Current Microbiology and Applied Sciences*, **8**(3), 2536-2544.

Mathur S. J., Prasad N., Agrawat J. M. and Chippa H.P. (1978). Estimation of losses due to Alternaria blight of sunflower. *Indian Journal of Mycology and Plant Pathology,* **8** , 15.

Mayee, C.D., Datar V.V. (1986). Phytopathometry. Tech. Bull.1.Univ. Press. Marathwada Agriculture University, Parbhani (M.S.), 186.

Mesta, R.K., Benagi, V.I., Srikant, K. and Basavarajappa, M.P. (2011). Management of Alternariablight of sunflower through fungicides. *Karnataka Journal of Agricultural Sciences*, **24**, 149-152.

Pathare, I., Akash, S., Ingle, T. and Choudhary, R.J. (2019). Efficacy of fungicides and Trichoderma viride mutants against *Alternaria helianthi* causing leaf blight of sunflower. *Journal of Pharmacognosy and Phytochemistry*, **8**, 1041-44.

Reddy P.C., Gupta B.M. (1977). Disease loss appraisal due to leaf blight of sunflower incited by *Alternaria helianthi*. *Indian Phytopath*., **30**, 569-570.

Shankergoud I, Shadakshari Y.G., Parameshwarappa K.G., Chandranath H.T., Katti P., Mesta R.K. (2006). Sunflower and Castor Research in Karnataka - An overview, University of Agricultural Sciences, Dharwad, India 1-41.

Shilpa, M.E., Vikas, H.M., Sowmya, P., Srikantaiah, M., Dorajeerao, A.V.D. (2015). *In vitro* and *in vivo* evaluation of antagonistic microorganisms on the incidence of leaf blight of sunflower caused by *Alternaria helianthi*, *Plant Archives*, **15**(1),411-416.

Venkataramanamma, K., Madhusudhan, P., Neelima, S. and Narasimhudu, Y. (2014). Field evaluation of fungicides for the management of Alternaria leaf blight of sunflower. *Indian Journal of Plant Protection*. **42**(2), 165-168.

Waghe, K., Wagh, S., Kuldhar, D. and Pawar, D. (2015). Evaluation of different fungicides, bioagents and botanicals against Alternaria blight caused by *Alternaria helianthi* (Hansf) of sunflower. *African Journal of Agricultural Research*, **10**, 351-58.

Wheeler, B.E.J. (1969). An Introduction to Plant Diseases. John Wiley and Sons. Ltd. London, , pp. 301