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Management of Alternaria Leaf Spot using Available Fungicides (Combi Products) in Sunflower

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ABSTRACT

Background: Alternariaster leaf spot/blight caused by *Alternariaster helianthi* is an important disease of sunflower, caused yield losses upto 80%. It is seed and air borne. Management of this disease is very important to avoid yield losses, hence, this experiment was planned with available fungicides (combi products) in the market.

Methods: A field experiment was carried out on management of Alternariaster leaf spot disease for three years *i.e*., *kharif* 2018, 2019 and 2020 at RARS, Nandyal under AICRP on Sunflower scheme. Seven treatments were imposed in three replications with different fungicides by using the hybrid KBSH-44 in RBD design.

Result: Pooled analysis results indicated that among different treatments, the treatment T_3: (Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with Trifloxystrobin 25%+ tebuconazole 50% (Nativo 75WG)@ 0.25 g/l) has recorded low severity (PDI) of 37% with higher yield of 1382 kg/ha, which was followed by the treatment T_1 (Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75 WP) @ 2 g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% (TASPA 500EC) @ 0.3 ml/l) which has recorded disease severity (PDI) of 40.95% and yield of 1363 kg/ha, where as control recorded high PDI of 53.38% and lower yield of 1200 kg/ha. Regarding B:C ratio, the treatment T_1 recorded high B:C ratio *i.e*., 1.65, followed by T_4 and T_3 which recorded 1.59 and 1.57, respectively. Hence, it was concluded that the above three treatments were recommended for disease management as they are *at par* with each other and recorded more B:C ratio than others.

Key words: Alternariaster leaf spot/blight, Fungicides, *Kharif*, Management, Sunflower.

INTRODUCTION

Sunflower is one of the major oilseed crop cultivated in India and in the year 2021-22, it occupied an area of 2.25 lakh ha with a production of 2.28 lakh tons and productivity of 1011 kg/ha (Directorate of Economics and Statistics, 2022) in India. Leaf spot/blight caused by *Alternariaster helianthi* (Hansf) Tubaki and Nishihara is one of the economically important diseases, responsible for yield losses of 20 to 80%, with oi1 losses of 20 to 30%, reported from tropical and subtropical sunflower production regions (Howard and Gent, 2007).

In India, the disease was first reported by Narain and Saksena (1973), Kolte and Mukhopadhyay (1973) from Uttar Pradesh. The pathogen reduces seed germination and seedling survival (Udayashankar *et al*., 2011). The major symptoms are brown spots on the leaves, stem, petals and sepals resulted in premature defoliation and leads to death of the plant under severe infection (Anilkumar *et al*., 1974). It also affects the formation of number of seeds per head, seed filling, kernel weight and oil content. Cloudy weather, high humidity and drizzling rains can result in severe outbreak and spread of the disease. As there is no resistant variety available for this disease, it is essential to use the fungicides to manage this disease. Many commonly used fungicides such as vitavax, captan, dithane Z-78, fytolan, thiride and benlate failed to provide satisfactory control of severe incidence of leaf blight under field conditions, especially during the rainy season (Mukewar and Gera, 1980). Hence, this experiment was taken up with combi fungicides to find out new effective and cheaper fungicides for management of this disease.

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MATERIALS AND METHODS

The experiment was carried out at the farm of Regional Agricultural Research Station, Nandyal (15 27N and 78 28E) of Andhra Pradesh for three years from *kharif*, 2018 to 2020

under All India Coordinated Research Project on Sunflower Scheme (Anonymous, 2018a). The soil of the experimental field was black cotton, with pH 8.3 and EC 0.26 dS/m. The experiment was laid out in Randomized block design with susceptible check KBSH-44, with six different fungicides (combi products) and one untreated control was maintained in three replications. Susceptible check seed was obtained from IIOR, Hyderabad. The fungicide SAAF (carbendazim 12% +mancozeb 63%) was used for all the treatments except untreated plots as it is a seed borne pathogen. Plot size of 4.2×3 m^2 and spacing of 60×30 cm were maintained for all the treatments. Regular agronomic practices were followed as per the technical programme of work. All the treatments were imposed for two times as per the schedule given *i.e.*, first spray was done at the time of disease initiation and second spray was done at 15 days after first spray. Disease scoring was done randomly on ten selected plants from each plot at 15 days interval based on 0-9 scale (Anonymous, 2018b), which was commonly followed for Alternariaster leaf spot.

0- No symptoms on the leaf.
1- Small, circular, scattered brown spots covering 1% or less of the leaf area.
3- Spots enlarging, dark brown in colour covering 1-10% of leaf area.
5- Spots enlarging, dark brown in colour, target like appearance covering 11-25% of leaf area.
7- Spots dark brown, coalescing with target like appearance covering 26-50% of leaf area.
9- Spots uniformly dark brown, coalescing covering 51% or above of leaf area.

From the collected data, per cent disease index (PDI) was calculated by using the below formula (Mayee and Datar (1986).

$$PDI = \frac{\text{Sum of individual rating}}{\text{No. of leaves examined} \times \text{Maximum disease grade}} \times 100$$

After harvesting data pertaining to seed yield was recorded. Data was analysed statistically by ANOVA. The B:C ratio was calculated by deducting the cost of cultivation from gross returns and the result was divided by gross returns for the data in pooled analysis.

RESULTS AND DISCUSSION

During *kharif* 2018 the treatment T_3: (Seed treatment with carbendazim 12% + mancozeb 63% WP @ 2 g/kg seed followed by two foliar sprays with Trifloxystrobin 25%+ tebuconazole 50% (Nativo 75 WG) @ 0.25 g/l) has given less PDI of Alternaria leaf spot *i.e.*, 24.68% and also recorded higher yields of 1743 kg/ha (Table 1). It was followed by T_1 (Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75 WP) @ 2 g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% (TASPA 500EC) @ 0.3 ml/l), T_4 (Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with pyraclostrobin 5% +

Table 1: Per cent disease index (PDI) and yield (kg/ha) in management trial on alternariaster leaf spot.

Treatments	2018		2019		2020	
	PDI (%)	Yield (kg/ha)	PDI (%)	Yield (kg/ha)	PDI (%)	Yield (kg/ha)
T_1: Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75 WP) @ 2 g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% (TASPA 500EC) @ 0.3 ml/l	28.82 (32.49)	1680	43.79 (41.43)	1550	50.84 (45.50)	888
T_2: Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with zineb 68% + Hexaconazole 4% WP (Avatar) @ 2.5g/l.	31.17 (33.96)	1588	40.57 (39.54)	1560	56.18 (48.57)	853
T_3: Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with Trifloxystrobin 25%+ tebuconazole 50% (Nativo 75WG)@ 0.25 g/l.	24.68 (29.80)	1743	36.71 (37.28)	1567	51.34 (45.79)	879
T_4: Seed treatment with carbendazim 12% + mancozeb 63% wp @2 g/kg seed followed by two foliar sprays with pyraclostrobin 5% + metiram 55% (Cabriotop 60WG) @ 0.3 g/l.	30.1 (33.29)	1570	45.58 (42.46)	1443	61.00 (51.38)	829
T_5: Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with tricyclazole 18% + mancozeb 62% (Merger 80 WP) 1 g/l.	30.29 (33.41)	1550	47.00 (43.30)	1380	57.78 (49.50)	838
T_6: Seed treatment with carbendazim 12% + mancozeb 63% wp@ 2 g/kg seed followed by two sprays of mancozeb@ 2.5 g/litre of water.	33.05 (35.11)	1530	49.84 (44.93)	1303	65.30 (53.94)	773
T_7: Control or Untreated plot	35.95 (36.86)	1516	66.71 (54.81)	1294	67.02 (54.95)	747
Sem±	1.6	68	2.32	82.46	2.32	40.7
CD at 5%	4.94	210	7.14	254.10	7.14	125.4
CV (%)	9.7	10.2	9.6	11.05	9.6	9.5

metiram 55% (Cabriotop 60WG) @ 0.3 g/l), T_5(Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with tricyclazole 18%+mancozeb 62% (Merger 80 WP) 1 g/l) and T_2 (Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with zineb 68% + Hexaconazole 4% WP @ 2.5 g/l) treatments recorded the disease severity of 28.82%, 30.1%, 30.29% and 31.17%, respectively and which were *at par* with T_3. Control or untreated plot recorded highest disease severity (PDI) of 35.95% and it was non significant with disease severity in T_6 (Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with mancozeb 75 WP @ 2.5 g/l followed by two sprays 2 g/kg seed followed by two foliar sprays) treatment. During *kharif* 2019, the treatment T_3 has given less PDI of Alternariaster leaf spot *i.e*., 36.71% and also recorded higher yields of 1567 kg/ha. It was followed by the treatments T_2, T_1, T_4 and T_5 that recorded the disease severity of 40.57%, 43.79%, 45.58% and 47%, respectively which were non significant with each other and significant over control and T_6. The highest severity of disease (66.71%) was observed in control plot. During 2020 also the same treatment T_1 performed better in disease reduction compared to other treatments. Similarly other treatments *i.e*., T_3, T_2, T_5 and T_4 recorded less disease severity respectively and non significant with each other. Control has recorded more Alternariaster leaf spot (PDI) of 67.02%.

Yield

In 2018, the treatment T_3 has recorded significantly higher yield of 1743 kg/ha over control and the treatment T_6 and it was non significant with other treatments (Table 1). The next higher yield was obtained in the treatment T_1 *i.e*., 1680 kg/ha, whereas control has recorded low yield of 1516 kg/ha. During 2019 also, higher yield was obtained in the treatment T_3 which recorded significantly higher yield over control *i.e*., 1567 kg/ha and non significant with other treatments *i.e*., T_2, T_1, T_4 and T_5. But during 2020, the treatment T_1 recorded higher yields of 888 kg/ha than T_3 and it was significant over control *i.e*., 747 kg/ha, however, it was non significant with all other treatments.

In the experimental period of three years, low disease pressure was observed in the year 2018 compared to other two years *i.e*., 2019, 2020 and slightly higher disease pressure was observed in 2020 than 2019. This might be due to weather conditions prevailed in the respective years. During the crop season of 2018, a total rainfall of 150.4 mm (From July II FN to October II FN), the minimum and maximum temperature recorded more or less of 25°C and 35°C, respectively. The RH-I was not more than 80% (71.4 to 81%) and RH-II (41.1 to 48.1%) was also <50% in majority of meteorological weeks (weather data enclosed). For the same period during 2019, total rainfall of 778.4 mm, minimum temperature in the range of 23.9 to 25.5°C, maximum temperature in the range 29.4 to 34.7°C and RH-I (80.7 to 91.6%), RH-II (52.6 to 74%) for same meteorological weeks were recorded during 2020, a total rainfall of 896.8 mm received, minimum temperature of 24.1 to 25.8°C, maximum temperature of 29.4 to 34.3°C and RH-I (77-92%), RH-II (64 to 82%) of meteorological weeks. According to Venkataramana *et al*. (1995) temperature in the range of 25°C-27°C with at least 12 hours of wet foliage helps to spread rapidly during the rainy season. The rainfall along with heavy dew deposition provided wetness on leaves for about 14-15 h day. Borkar and Patil (1995), observed that temperature of 25.9°C to 33.7°C, relative humidity of 89-95% favoured Alternariaster leaf spot disease development. Rainfall had significantly positive effect on disease development. Hiremath *et al.* (1990) reported that, higher rainfall had positive influence on Alternariaster blight of sunflower. The species of A.*helianthi* was reported to be at its peak in growth and sporulation under high relative humidity of 89-95 per cent (Patil, 1989). More or less the same weather conditions prevailed in the experimental years of 2019 and 2020 *i.e*., high rainfall, high RH-I and RH-II, moderate temperatures compared to 2018, hence the disease appeared in severe form. When compared to 2019, the climate was more congenial for development of Alternariaster leaf spot in 2020, hence more disease was recorded.

Regarding yield, more was found in 2018 and 2019 compared to 2020. In 2018, though less rainfall was received higher yield was obtained. Because two life saving irrigations were given at times in need and also less disease was recorded. Whereas in 2020, for the period of six weeks (from 37 to 42 MW), heavy rainfall of 574.6 mm rainfall was received and the crop was in flowering to seed setting stage and the crop was suffered from heavy moisture stress. Because of heavy moisture in soil, the roots were unable to absorb nutrients from soil, hence low yields resulted. This was in conformity with Orchard *et al*. (1986) who suggested that water logging during vegetative and flower initiation stages inhibited expansion of leaf and at anthesis stage reduced yields were noticed by Orchard and Jessop (1984). Grassini *et al.* (2007) reported decreased grain yields and adverse physiological responses were due to the effect of water logging conditions in sunflower crop. Hence, in the present experiment, in the experimental year, 2020 yields were reduced drastically.

Pooled analysis results (Table 2) indicated that among the seven treatments, the treatment T_3: (Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75 WP) @ 2 g/kg seed followed by two foliar sprays with Trifloxystrobin 25%+ tebuconazole 50% (Nativo 75 WG)@ 0.25 g/l) was recorded low severity of Alternariaster leaf spot *i.e*., 37.0% with 30.68% of disease reduction over control. It is followed by T_1, T_2, T_4, T_5 which recorded disease severity of 40.95%, 42.47%, 45.38% and 45.76% respectively and all these treatments were *at par* with each other. Control or untreated plot (T_7) recorded more disease severity of 53.38% and T_6 recorded disease severity of 49.37% and both were non significant with each other.

In terms of yield also the same treatment T_3 has recorded higher yield of 1382 kg/ha and it was *at par* with

Table 2: PDI and seed yield in Pooled analysis data of management trial on alternariaster leaf spot.

Treatments	PDI (%)	% Disease reduction over control	Seed yield (kg/ha)	Cost of cultivation (Rs.)	Gross returns (Rs.)	B:C ratio
T_1: Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75 WP) @ 2g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% (TASPA 500EC) @ 0.3 ml/l	40.95 (39.81)	23.28	1363	29000	47705	1.65
T_2: Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with zineb 68% + Hexaconazole 4% WP (Avatar) @ 2.5 g/l.	42.47 (40.69)	20.43	1327	30600	46445	1.52
T_3: Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with Trifloxystrobin 25%+ tebuconazole 50% (Nativo 75WG)@ 0.25g/l.	37.00 (37.78)	30.68	1382	30920	48370	1.57
T_4: Seed treatment with carbendazim 12% + mancozeb 63% wp @2 g/kg seed followed by two foliar sprays with pyraclostrobin 5% + metiram 55% (Cabriotop 60WG) @ 0.3g/l.	45.38 (42.37)	14.98	1318	28950	46130	1.59
T_5: Seed treatment with carbendazim 12% + mancozeb 63% wp @ 2 g/kg seed followed by two foliar sprays with tricyclazole 18%+mancozeb 62% (Merger 80 WP) 1 g/l.	45.76 (42.59)	14.27	1273	29466	44555	1.51
T_6: Seed treatment with carbendazim 12% + mancozeb 63% wp@ 2 g/kg seed followed by two sprays of mancozeb@ 2.5 g/litre of water.	49.37 (44.68)	7.5	1224	29180	42840	1.47
T_7: Control	53.38 (46.96)	-	1200	27700	42000	1.51
Sem±	2.22		50.69			
CD at 5%	6.83		156.2			
CV (%)	9.11		6.83			

Cost of fungicides and others: 1.TASPA 500EC - 250 g-Rs. 600/-, 2. Avatar - 250 g - Rs.220/-, 3.Nativo 75 WG - 50 g - Rs. 420/-, 4.Cabriotop - 300 g -Rs. 650/-, 5. Merger- 1 kg-Rs. 1000/-, 6. Mancozeb - Rs. 315/-. Labour charges per head: Rs. 350/-. Seed sale price - Rs. 35/-kg.

all other treatments except T_6 and control. Control or untreated plot recorded lower yield of 1200 kg/ha. Regarding B:C ratio, the treatment T_1 has recorded higher B:C ratio of 1.65, compared to T_3 (1.57), as the chemical (trifloxystrobin 25%+ tebuconazole 50%) was costlier than others. Treatment T_1 recorded B:C ratio of 1.65 followed by T_4 recorded *i.e*., 1.59,where as check recorded B:C ratio of 1.55, respectively.

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 the same experiment conducted at AICRP on Sunflower scheme at Ludhiana cnetre also, where the same treatment *i.e*., T_3 recorded low disease severity (PDI) of 11.8% with higher yield of 2454 kg/ha followed by T_1 which recorded PDI of 15.9%, with yield of 2292 kg/ha, whereas control recorded 37.5% with low yield of 1627 kg/ha. At Bengaluru centre also, the treatment T_1 recorded low disease severity (PDI) of 14.8% with higher yield of 2032 kg/ha, followed by T_3 and recorded disease severity of 18%, higher yield of 2033 kg/ha compared to control, which recorded PDI of 41.8% with low yield of 1584 kg/ha (Anonymous, 2021-22). 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 T_3 (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. Similarly, Waghe *et al*. (2015) has conducted a management trial on Alternariaster 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). Similarly in the present experiment also, the treatments *i.e*., T_3 and T_1 performed better when compared to others. However,T_4 recorded higher B:C ratio than T_3 because of its low cost.

CONCLUSION

Hence, from this experiment it can be concluded that, among the seven treatments, the treatment T_3 (Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75 WP) @ 2g/kg seed followed by two foliar sprays with (Nativo 75WG)@ 0.25g/l) and T_1(Seed treatment with carbendazim 12% + mancozeb 63% wp (SAAF 75 WP) @ 2 g/kg seed followed by two foliar sprays with difenconazole 25% + propiconazole 25% (TASPA 500EC) @ 0.3 ml/l) may be recommended. Though the treatment T_4 (Seed treatment with carbendazim 12% + mancozeb 63% WP @2 g/kg seed followed by two foliar sprays with pyraclostrobin 5% + metiram 55% (Cabriotop 60WG) @ 0.3 g/l) recorded higher PDI than T_1, T_3 and T_2 it may also be recommended as it recorded more B: C ratio compared to T_2 and T_3.

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Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

Anonymous, (2021-22). Annual Report of AICRP on Oilseeds-Sunflower. ICAR-IIOR. pp. 162-164.

Anonymous. (2018-19a). Technical Programme and Guidelines for Implementation. All India Coordinated Research Project on Sunflower. ICAR-IIOR. pp. 21.

Anonymous. (2018-19b). Technical programme and guidelines for implementation. All India Coordinated Research Project on Sunflower. ICAR-IIOR. pp. 17.

Anil Kumar, T.B., Urs, S.D., Seshadri, V.S. and Hegde, R.K. (1974). Alternaria leaf spot of sunflower. Current Science. 43(3): 93-94.

Borkar, S.G. and Patil B.S. (1995). Epidemiology of Alternaria leaf blight of Sunflower. Indian Phytopathology. 48(1): 84-85.

Directorate of Economics and Statistics, (2022). (https://eands.dacnet.nic.in).

Grassini, P., Indaco, G.V., Pereira, M.L., Hall, A.J. and Trapani, N. (2007). Response to short-term waterlogging during grain filling in sunflower. Field Crops Research. 101: 352-363.

Hiremath, B.R., Biradar, D.P. and Hunshal, C.S. (1990). Response of sunflower genotypes to levels of N and P fertilization. Karnataka Journal of Agricultural Sciences. 3: 116-119. https://doi.org/10.53730/ijhs.v6nS2.6866.

Howard, F.S. and 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.

Kolte, S.J. and Mukhopadhyay, A.N. (1973). Occurrence of some new sunflower disease in India. Pesticides.19(3): 392-396.

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.

Mayee and C.D., Datar, V.V. (1986). Diseases of Safflower. Phytopathometry, Marathwada Agriculture University, Maharashtra. pp. 100-104.

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.

Mukewar, P.M. and Gera, S.D. (1980). Comparative efficacy of different fungicides against Alternaria blight of sunflower. Indian Phytopathology. 33: 122-123.

Narain, U. and Saksena, S.W. (1973). Occurence of Alternaria leaf spot on sunflower in India. Journal of Mycology and Plant Pathology. 3: 115-116.

Orchard, P.W. and Jessop, R.S. (1984). The response of sorghum and sunflower to short-term waterlogging. Effects of stage of development and duration of waterlogging on growth and yield. Plant and Soil. 81: 119-132.

Orchard, P.W., Jessop, R.S. and So, H.B. (1986). The response of sorghum and sunflower to short-term waterlogging. IV. Water and nutrient uptake effects. Plant and Soil. 91: 87-100.

Patil, M.K. (1989). Studies on Leaf Spot of Safflower (*Carthamus tinctorius* L.) Caused by Alternaria Helianthi (Hansf.) Tubaki and Nishihara. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka (India).

Udayashankar, A.C., Nayaka, S.C., Niranjana, S.R. and Prakash, H.S. (2011). Comparative efficacy of strobilur in fungicides against leaf spot and blight disease of sunflower. Journal of Mycology and Plant Pathology. 41: 11-19.

Venkataramana, N., Jagadessh, G.V. and Gowda, J. (1995). Severity of rust and Alternaria leaf spot in relation to in different sowing dates in parental lines of sunflower hybrids. Journal of Oilseeds Research. 12: 146-148.

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.P., Wagh, S.S., Kuldhar, D.P. and Pawar, D.V. (2015). Evaluation of different fungicides, bioagents and botanicals against *Alternaria* blight caused by *Alternaria helianthi* (Hansf) of sunflower. Afrcian Journal of Agricultural Research. 10: 351-358. doi: 10.5897/AJAR2014.8919.