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Management of *Alternaria* blight of sunflower through fungicides

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Abstract

The present study was conducted to evaluate the efficacy of fungicides. Crop was sown in Randomized Complete Block Design and fourteen treatments were applied with three replications. Plot size of 4.2m x 3.0 m with spacing of 60cm x 30cm was maintained. All the recommended package of practices was applied to raise the crop except the disease management practices.

Treatments were of non-systemic, systemic and combination fungicides. Minimum disease severity 16.3% was observed in T₁₁ (foliar application of Difenconazole @ 0.1%) and it was significantly lower than all other treatments. T₁₀ (foliar application of Difenconazole @ 0.05%) gave disease severity of 20.4 percent (PDI) which was followed by T₇ (Hexaconazole 5EC @ 0.2%), T₉ (Tebuconazole 25EC @ 0.1%), T₄ (Tebuconazole + Trifloxystrobin @ 0.05%), T₈ (Tebuconazole 25 EC @ 0.05%) and T₅ (Tebuconazole + Trifloxystrobin @ 0.1%). The highest seed yield was observed in T₁₁ (foliar application of Difenconazole @ 0.1%) and T₁₀ (foliar application of Difenconazole @ 0.05%) treatments.

Keywords: Oilseeds, alternaria blight, disease management, seed yield, fungicides

Introduction

Oilseeds form the second largest agricultural commodity after cereals, sharing 14% of country's gross cropped area accounting nearly 5% of Gross National Product (GNP) and 10% of the value of all agricultural products Shankergoud *et al.* (2006) [21]. Sunflower (*Helianthus annuus* L.) is native of Southern USA and Mexico; an important oilseed crop of family Asteraceae ranks third next to groundnut and soybean. It is a rich source of edible oil (40-52%) having anti-cholesterol properties due to the presence of polyunsaturated fatty acids (PUFA, 55-65% linoleic acid & 20-30% oleic acid) which are known to reduce the risk of coronary diseases Joksimovic *et al.* (2006) [9]. The large scale cultivation of sunflower in India was started in 1972 with the introduction of high yielding Russian varieties.

Sunflower is the 4th most important oilseed crop, cultivated throughout India which accounts about 0.43 MT of annual production with a productivity of 736 kg/ha from 0.59 Mha area Anonymous (2015) [3]. It is mostly valued for its high quality edible oil, i.e. extracted from the seed (22-36%) and kernel (45-55%). The expressed oil is of light amber coloured with a mild, pleasant flavour which is high in vitamin E, unsaturated fatty acids; mono-unsaturated fatty acids (30%), polyunsaturated fatty acids (59%) and low in saturated fats; palmitic acid (5%) and stearic acid (6%). It is also a good source of Zn and folate that provide several health benefits. Besides consumption, the oil is also used in cosmetic and paint industries, the seeds are used as seed meal for live stocks and dried plants as fuel. Being a short duration (100-110 days) and photo-thermo insensitive crop, sunflower can fit easily in any cropping pattern and can be cultivated throughout the year.

Sunflower cultivation is largely confined to southern parts of the country comprising the states of Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu. The four states contribute about 90% of the total acreage and 78% of total production. Among these states, Karnataka stands first. Under optimum conditions, sunflower has the yield potential of 2.0 to 2.5 ton/ ha as against its national low productivity level of 736 kg/ha in India. Despite the rapid spread of the crop, the disheartening trend is that, the productivity is going down, in recent years. The potential of the crop is, far from being exploited and the yield levels of the country are the lowest in the world due to several biotic and abiotic stresses. At present, the sunflower productivity in India is 608 kg/ ha as mentioned above and in Karnataka it is 372 kg/ ha less

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than the national average. Among several biotic stresses for successful sunflower production, the susceptibility to the diseases is one of the major constraints. Gulya and Masirevic (1991) [7] have listed 80 pathogens infecting sunflower. In Karnataka, the major diseases on sunflower viz., necrosis virus disease, Alternaria blight, rust, collar rot and downy mildew are among these, Alternaria blight caused by *Alternaria helianthi* (Hansf) Tubaki and Nishihara has been considered as a potentially destructive disease in many parts of the sunflower growing countries Allen *et al.* (1983) [1]; Morris *et al.* (1983) [16] and Lipps and Herr, (1986) [12], and in India, the disease has been reported in all sunflower growing states (Shankergoud *et al.* (2006) [21]. Further this disease is known to cause reduction in flower size, number of seeds per head, seed yield per plant, test weight and also oil content Balasubramanyam and Kolte (1980) [4]. The loss in yield varies from 11.30 to 73.33 per cent depending on the extent of infection Reddy and Gupta, (1977) [20]. Alternaria leaf blight is known to cause more than 80 per cent of yield loss under severe epiphytotic conditions Hiremath *et al.* (1990) [8]. The disease is particularly destructive in tropical and sub-tropical regions wherein a combination of high temperature and extended periods of humid weather cause rapid epidemics Sujatha *et al.* (1997) [22]; Dudienas *et al.* (1998) [6]. Under these conditions, the pathogen causes premature senescence and rapid defoliation Kong *et al.* (1995) [11]. Seed yield is reduced up to 70% together with significant reduction in quantity and quality of oil Kolte (1984) [10]. Disease symptoms appear more predominantly on older leaves than on young and expanding ones. Plants are highly susceptible during anthesis and foliage reduction at this stage results in 80% loss in yield Carson, (1985) [5].

Materials and Methods

During the present investigations on management of Alternaria blight (*Alternaria helianthi* (Hansf.) Tubaki and Nishihara) of sunflower (*Helianthus annuus.*), all the experiments were conducted (*in vivo*) at Oilseeds section in the Department of Plant Breeding and Genetic PAU Ludhiana during spring 2018, to fulfill the objectives defined, the details of the materials used and methods adopted for various experiments are described here in the following paragraphs.

Standard chemicals, reagents, fungicides, fertilizers etc. required for the experimentation were obtained from the Oilseed Research Station, Punjab Agriculture University and Department of Plant Pathology College of Agriculture, PAU Ludhiana.

The common glass-ware (Borosil and Coming Make) viz., Petridishes, test tubes, conical flasks, volumetric flasks, measuring cylinder, glass rods, beakers, funnel, pipettes etc. were obtained from the Department of Plant Breeding and Genetics.

Sunflower seeds of hybrid PSH (1962). Were surface sterilized with 0.1 per cent mercuric chloride and sown in earthen pots containing sterilized soil. They were allowed to grow for 30 days. The plants were predisposed to 95 per cent humidity for 24 hours. Thereafter, they were inoculated with spore suspension of (5.4×10^6 spores/ ml) the fungus, by using atomizer. After inoculation the plants were exposed in the same conditions for 24 hours. Suitable control plants were maintained by spraying of sterile distilled water. Symptoms appeared after five days. The organism was re-isolated from these artificially infected leaves and the culture obtained was compared with the original culture for confirmation.

The field experiment was conducted on the research farm of the Oilseed Section, plant Breeding and Genetic during spring, 2018, to evaluate the efficacy of fungicides. The seed PSH 1962 were provided by oil seed section plant breeding and genetic Section Oilseed Research Station, Plant Breeding and Genetic Section PAU, Ludhiana. Fungicides were obtained from the Department of Plant Breeding and Genetic College of Agriculture PAU, Ludhiana.

Research design: Crop was sown in Randomized Complete Block Design and fourteen treatments (such as T1: Mancozeb @ 0.2%, T2: Azoxystrobin 23 SC +Difenoconazole @ 0.05%, T3: Azoxystrobin 23 SC +Difenoconazole @ 0.1%, T4:Tebuconazole +Trifloxystrobin @ 0.05%, T5: Tebuconazole +Trifloxystrobin @ 0.1%, T6: Hexaconazole 5 EC @ 0.1%, T7: Hexaconazole 5 EC @ 0.2%, T8: Tebuconazole 25 EC @ 0.05%, T9: Tebuconazole 25 EC @ 0.1%, T10: Difenconazole @ 0.05%, T11: Difenconazole @ 0.1%, T12: Chlorothalonil @0.15%, T13: Chlorothalonil @0.3% and T14: Control – untreated) were applied with three replications. Plot size of 4.2m x 3.0 m with spacing of 60cm x 30cm was maintained. All the recommended package of practices was applied to raise the crop except the disease management practices. Following treatments were applied at PAU, Ludhiana.

Disease incidence

Observations of disease incidence and disease intensity were recorded at appearance of visible spots of *A. helianthi* to quantify amount of *Altenaria* infection. Disease incidence was calculated from the number of infected plant against the total number of plants existed at the time of observation. Thus formula of per cent incidence was

$$\text{Percent incidence (PI)} = \frac{\text{No. of plants infected}}{\text{Total no. of plants observed}} \times 100$$

Percent disease intensity / severity

Percent intensity (severity) was calculated as per the standard area diagram developed by Mayee and Datar (1986) [14]. For recording the disease intensity at field conditions 0 to 9 disease rating scale developed by Mayee and Datar was used. For this purpose two leaves located at the bottom, two at middle and two top of the plant were chosen and scored as per scale given below.

The average intensity of each plot was worked out by using following formula

$$\text{P.D.I.} = \frac{\text{Summation of all numerical ratings}}{\text{Total no. of plant x Maximum rating scale observed}} \times 100$$

Where,

PDI = Percent disease intensity.

Percent disease control

Per cent disease control (PDC) was worked out by applying the Formula

$$\text{PDC} = \frac{\text{PDI in control plot} - \text{PDI in treatment plot}}{\text{PDI in control plot}} \times 100$$

Results and Discussion

Among the different foliar diseases of sunflower, *Alternaria* blight caused by *Alternaria helianthi* (Hansf.) Tubaki and Nishihara is one of the major diseases, causing a yield loss up to 80 per cent. Hence, the present investigations on epidemiology and management of *Alternaria* blight of sunflower were carried out in the field during spring, 2018, at Oilseeds Section, Department of Plant Breeding & Genetics, College of Agriculture, and Ludhiana. The results thus obtained are presented hereunder.

The disease appeared in the form of small, scattered brown spots on the leaf lamina. Later these spots increased in size and coalesced covering larger leaf area, with dark brown margin and yellow halo. Necrotic lesions appeared even on stem, petioles and sepals. The symptoms observed on different plant parts are depicted in plate 1.

Disease management experiment through fungicides was conducted during spring 2018 at PAU, Ludhiana. The experiment was laid out in RCBD with fourteen treatments and replicated thrice. The seeds of sunflower hybrid PSH 1962 were sown at spacing of 60×30 cm. All the recommended agronomic practices were followed throughout the experiment. The data on per cent disease incidence and seed yield were collected from all the locations and data was pooled.

Results at Ludhiana (Table 1) revealed that the minimum disease severity (16.3%) was observed in T₁₁ (foliar application of Difenconazole @0.1%) and it was significantly lower than all other treatments. T₁₀ (foliar application of Difenconazole @0.05%) gave disease severity of 20.4 percent (PDI) which was followed by T₇ (Hexaconazole 5EC @ 0.2%), T₉ (Tebuconazole 25EC @0.1%), T₄ (Tebuconazole + Trifloxystrobin @ 0.05%), T₈ (Tebuconazole 25 EC @ 0.05%) and T₅ (Tebuconazole + Trifloxystrobin @ 0.1%). The maximum disease severity (46.5%) was observed in T₁ (seed treatment with mancozeb).

At Ludhiana maximum disease control of 69.9 percent was recorded in treatment T₁₁ (foliar application of Difenconazole @0.1%) and next to it was at foliar application of Difenconazole @0.05 percent (62.4%). The conclusion from the results is that T₁₁ (foliar application of Difenconazole @0.1%) and T₁₀ (foliar application of Difenconazole @0.05%) proved best in controlling the *Alternaria* blight disease at PAU, Ludhiana.

Many fungicides were tested against the pathogen *Alternaria* spp. and in sunflower similar fungicide groups were found effective. Chemical management with protective (nonsystemic) fungicides such as iprodione, chlorothalonil,

and mancozeb as well as with therapeutic (systemic) fungicides such as hexaconazole, carbendazim, and propiconazole has been found effective against the disease. But systemic fungicides were more effective than the nonsystemic ones Amaresh *et al.* (2004) [2]. Seed treatment with a mixture of carbendazim + iprodione in a 1:1 ratio at 0.3% followed by foliar spray of systemic fungicide hexaconazole (0.1%) gave best management of the disease with high yield Rao *et al.* (2009) [19]. Combination of carbendazim + mancozeb in the ratio of 1:1 at 0.2% spray used effectively in the management of the disease avoiding the possibility of fungicide-resistant strains of the pathogen (Mathivanan and Prabavathy 2007) [13].

Wadibhasme *et al.* (1991) [24] conducted field trial for three years and found mancozeb most superior amongst all the fungicides followed by triademefon, chlorothalonil and ziram, which were at par with each other. Rao and Nageshwar Rao (1997) [18] reported that three sprays of mancozeb on sunflower at 30, 45 and 60 days after sowing were found to be effective in controlling *Alternaria* and increased the yield significantly in Morden variety. Rao *et al.* (2009) [19] treated seeds with carbendazim+iprodione at 0.3% in poly ethylene glycol along with foliar spray of hexaconazole, this treatment recorded least percent disease indexes of 19.24, 28.86 and 37.74% at 45, 60 and 75 DAS, respectively, seed treatment with carbendazim+iprodione at 0.3% in water along with foliar spray of hexaconazole was found most effective in managing *Alternaria* blight with maximum benefit-cost ratio. Mesta *et al.* (2003) [15] found significant differences between treatments with respect to PDI, seed yield, oil content and oil yield. At 75 DAS, hexaconazole (0.1%) recorded lowest PDI (35.63), which was on par with propiconazole (37.80) and was significantly lesser than all other treatments. Iprodione +carbendazim (44.16) was next in order followed by penconazole (48.16), difenconazole (53.44) and mancozeb (54.41). Prasad *et al.* (2015) [17] observed that seed treatment with iprodione + carbendazim 2g/kg along with foliar application of propiconazole (0.1%) twice at 15 days interval showed more reduction in leaf blight during 2008 (21.7%), 2009 (31.8%) and 2010 (30.4%). Vijayalakshmi *et al.* (2018) [23] evaluated three fungicides for management of *Alternaria* blight disease spraying and found Propiconazole (0.1%) with highest yield of 2181.71kg/ha and a least disease severity of 9.85 per cent followed by 13.91 percent with seed treatment and spraying with Mancozeb and 18.11 percent disease severity in seed treatment and spraying with Iprodione+Carbendazim. The highest disease severity (46.03 per cent) was recorded in control.

Table 1: Effect of different fungicide treatments on disease index and seed yield of sunflower (Ludhiana)

Treatments	Percent Disease Index	Percent Disease control	Seed yield (q/ ha)	Percent yield increase
T1: Mancozeb @ 0.2%	46.5 (43.0)	14.2	20.23	4.1
T2: Azoxystrobin 23 SC + Difenconazole @ 0.05%	36.7 (37.2)	32.3	22.46	15.5
T3: Azoxystrobin 23 SC + Difenconazole @ 0.1%	33.0 (34.9)	39.1	23.01	18.4
T4: Tebuconazole + Trifloxystrobin @ 0.05%	26.3 (28.3)	51.5	24.60	26.5
T5: Tebuconazole + Trifloxystrobin @ 0.1%	22.6 (28.4)	58.3	25.13	29.3
T6: Hexaconazole 5 EC @ 0.1%	25.9 (30.5)	52.2	25.60	31.7
T7: Hexaconazole 5 EC @ 0.2%	22.0 (27.6)	59.4	26.17	34.6
T8: Tebuconazole 25 EC @ 0.05%	24.3 (28.3)	55.2	24.89	28.0
T9: Tebuconazole 25 EC @ 0.1%	21.3 (27.8)	60.7	25.99	33.7
T10: Difenconazole @ 0.05%	20.4 (26.3)	62.4	26.40	35.8
T11: Difenconazole @ 0.1%	16.3 (23.4)	69.9	27.14	39.6
T12: Chlorothalonil @0.15%	38.0 (38.3)	29.9	20.12	3.5
T13: Chlorothalonil @0.3%	34.8 (36.2)	35.8	21.32	9.8
T14: Control - untreated	54.2 (48.3)		19.44	
CD	4.1		3.26	

CV	9.3		11.5	
SEM	1.3		1.5	

Seed yield (q/ha)

The highest seed yield at Ludhiana was recorded in T₁₁ (Difencanazole @0.1%) (27.14 q/ ha) and it was followed by T₁₀ (Difencanazole @0.05%) (26.4 q/ h), T₇ (Hexaconazole 5EC@ 0.2%) (26.17 q/ ha), T₉ (Tebuconazole 25 EC @0.1%) (25.99 q/ ha), T₈ (Tebuconazole 25 EC @0.05%) (24.89 q/ ha), T₆ (Hexaconazole 5EC@ 0.1%) (25.60 q/ ha), T₅ (Tebuconazole + Trifloxystrobin @ 0.1%) (25.13 q/ ha), T₄ (Tebuconazole + Trifloxystrobin @ 0.05%) (24.60 q/ ha). The lowest seed yield was observed in T₁₂ (Chlorothalonil @0.15%) (20.12 q/ ha) which differ non-significantly with T₁ (Mancozeb@0.2%) (20.23 q/ ha) and T₁₃ (Chlorothalonil @0.3%) (21.32 q/ ha) as shown in Table 1.

The present study results revealed that T₁₁ (Difencanazole @0.05%) and T₁₀ (Difencanazole @0.1%) proved best treatments with highest seed yield among other treatments for the Ludhiana. On the contrary, the minimum seed yield was observed in T₁₂ (Chlorothalonil @0.15%) as show in Table 1.

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