Environment & Ecology 35 (1) : 113—121, January—March 2017
Website: environmentandecology.com ISSN 0970-0420

Assessment of Fungicides, Botanicals and Biocontrol Agents for Integrated Management of *Alternariaster* Leaf Blight of Sunflower

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Received 4 March 2016 ; Accepted 8 April 2016 ; Published online 27 April 2016

Abstract Leaf blight of sunflower caused by *Alternariaster helianthi* is one of the economically important disease. Efficacy of different control methods was evaluated for integrated disease management of sunflower leaf blight caused by *A. helianthi* under field conditions. Preliminary evaluation of different botanicals, biocontrol agents and fungicides were done separately against *Alternariaster* leaf blight in *in vitro* and pot culture conditions. Among biocontrol agents *Trichoderma harzianum* (Th10) recorded low leaf blight severity, out of ten botanicals, low disease severity was above selected effective fungicides, botanicals and biocontrol agents are used alone and combination treatments for controlling *Alternariaster* leaf blight in sunflower. In the field conditions, among the observed with extracts of garlic and among fungicides tested, seed treatment with the iprodione + carbendazim (2g / kg seed) combination followed by spraying of propiconazole (0.1%) showed low leaf blight intensity. Under field conditions, various combinations seed treatment with the iprodione + carbendazim (2g / kg seed) followed by spraying of propiconazole, garlic extract (0.5%) and *T. harzianum* (0.2%) recorded 43.6% and 64.8% reduction when compared to the pathogen checks in the year 2010-11 and 2011-12 *kharif* season field trials respectively. This suggests that integration of botanicals, biocontrol agents and fungicides may be an efficient way to reduce the number of chemical fungicide sprays for controlling *Alternariaster* leaf blight in sunflower.

Keywords Sunflower, Leaf blight, *Alternariaster helianthi*, Botanicals, Biocontrol agents.

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Introduction

India is considered to be a Paradise of oilseeds crops having 19% of total world's oilseeds area and 10.0% of the total world's oilseeds production. Sunflower is cultivated in an area of 0.73 m. ha with a total production of 0.52 m.t and productivity of 712 kg/ha during 2012-13. In India, sunflower seed production in 2013-14 was 4.22 lakh ha. The major sunflower growing states are Karnataka, Maharashtra Andhra Pradesh and Telangana. Several diseases are known to cause yield loss in sunflower and some of them are *Alternariaster* leaf blight, necrosis disease, powdery mildew, downy mildew, charcoal rot and head rot [1]. *Alternariaster* leaf blight caused by *Alternariaster helianthi* is an important fungal disease of sunflower and causes yield losses ranging from 27 to 80%. This fungus was reported to affect the quality and germination of seeds.

At present, chemical fungicides are the first choice for the farmers to combat diseases because of their easy adaptability and immediate control. The overzealous and indiscriminate use of most of the fungicides has created different types of environmental, toxicological problems and development of resistance in the pathogen. Fungicide application kills important beneficial fungi and also weakens the natural antagonistic activity. Recently, in different parts of the world, attention has been paid towards the exploitation of organic products as novel step in plant protection [2]. More emphasis has been given on the use of bioagents and plant extracts, either alone or in combination in recent years. Despite of well-known side effect of pesticides on environment, bioagents / plant products are continuously used to control pathogens, to reduce the use of pesticides, biological control method has been considered as more natural and environmentally acceptable approach [3]. In integrated disease management package, incorporation of natural products provides viable solution to the environmental problems caused by synthetic pesticides. Identification of these compounds is an effective approach to minimize the use of hazardous chemicals to develop an effective disease management program. Combination of chemicals, botanicals and biocontrol agents in an integrated disease management strategy may enhance the effectiveness towards disease control and provide better and sustainable management of the plant diseases. The combination of biological control agents, botanicals and fungicides would provide similar disease suppression as achieved with more use of fungicide. Combine use of antagonists with synthetic and non-synthetic chemicals eliminates the chance of resistance development and reduces the fungicide application. In recent year, use of T*richoderma* as bioagent has attracted the attention of the researchers for the sustainable management of the soil borne as well as foliar diseases [4]. Rao [5] found *Pseudomonas fluorescens* and *Trichoderma harzianum* as effective bioagents in reducing the mycelia growth of *A. helianthi*. Rajput et al. [6] observed strong antagonistic effect of *T. harzianum* (Junagadh isolate) inhibiting the mycelia growth of *Alternaria alternata*. Roopa et al. [7] reported that *Trichoderma harzianum* found effective in inhibiting the mycelial growth *Alternaria solani*. Mesta et al. [8] reported propiconazole (0.1%) as effective fungicide against *Alternariaster* blight of sunflower.

In this study, we are aiming to investigate antifungal activity of botanicals, biocontrol agents and fungicides *in vitro* and in greenhouse conditions for the integrated disease control of *Alterna riaster* leaf blight in sunflower under field conditions.

Materials and Methods

Isolation of pathogen, biocontrol agents and preparation of botanical extracts

From naturally diseased sunflower plant, leaves infected with *Alternariaster* leaf spot were collected from sunflower field at Research farm of Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad and thoroughly washed with tap water. Infected leaf spots were excised, surface sterilized with 0.2% sodium hypocholorite solution, then rinsed three times in sterilized distilled water and dried. The surface sterilized samples were plated onto sunflower leaf extract medium and incubated at 25 ±2°C for one week. *A. helianthi* isolate was identified morphologicallly by bright field microscopy [9] and pure culture was maintained on SLEM medium and stored in refrigerator for further studies.

Isolation and identification of fungal and bacterial antagonists biocontrol agents listed in Table 1 from rhizosphere soil was done.

Botanical extracts were prepared with the help of soxhlet assembly and methanol was used as a solvent. Different concentrations of botanicals were prepared by dissolving specified amount of plant extracts in 100 ml of sterilized distilled water (Table 2).

In vitro antifungal activity of botanicals, fungicides and biocontrol agents

In vitro screening of different botanicals (Table 2) against *A. helianthi* was carried out by spore germination technique [10]. Botanical concentrations of 0.5, 1.0, 2.0 and 5.0% were prepared by dissolving 0.5 g, 1.0 g, 2.0 g and 5.0 g of plant extracts in 100 ml of

Table 1. Biocontrol agents used for evaluation against *Alternariaster* leaf blight.

Sl. No.	Biocontrol agent	Isolate
1	*Trichoderma viride* 3	Tv 3
2	*T. viride* 4	Tv 4
3	*T. hamatum* 3	Th 3
4	*T. harzianum* 10	Th 10
5	*T. songyi* 4	Ts 4
6	*T. songyi* 7	Ts 7
7	*T. songyi* 9	Ts 9
8	*T. songyi* 3	Ts 3
9	*T. songyi* 12	Ts 12
10	*Trichoderma* spp 6	T 6
11	*T. harzianum* 7	Th 7
12	*T. viride* 7	Tv 7
13	*Trichoderma* spp 12	T 12
14	*T. atroviride* 5	Ta 5
15	*Trichoderma* spp 3	T 3
16	*T. viride* 22	Tv 22
17	*T. viride* 11	Tv 11
18	*T. viride* 2	Tv 2
19	*T. viride* 12	Tv 12
20	*T. viride* 8	Tv 8
21	*Trichoderma* spp 4	T 4
22	*Trichoderma* spp 8	T 8
23	*Bacillus megaterium*	*B. megaterium*
24	*B. circulans*	*B. circulans*
25	*Pseudomonas fluorescens*	*P. fluorescens*

sterilized distilled water. One drop each of pathogen spore suspension and different concentrations (0.5, 1.0, 2.0 and 5.0%) of above mentioned plant extracts were put separately into cavity slides under aseptic conditions. Each plant extract and its, respective concentrations were replicated thrice. The slides were placed in petriplates, lined with moist blotter paper to serve as moist chambers. For check the spores were added to sterile distilled water. Germination of spores was recorded after 6, 12 and 24 h of incubation at 24 ±2°C. Percent germination and percent inhibition of spore germination over control were calculated.

For *in vitro* evaluation of fungicides poisoned food technique was followed and fungicides evaluated (Table 3), 100 ml of SLEM (sunflower leaf extract medium broth) was poured in 250 ml conical flasks, plugged with non-absorbent cotton and autoclaved at 15 lbs pressure for 15 min. After cooling the medium, 50 ppm quantity of each fungicide was incorporated into each separate flask, except control. Three replications were maintained for each fungicide. The flasks were then inoculated with mycelial discs (7

Table 2. Plants used for evaluation against *Alternariaster helianthi*.

Sl. No.	Common name	Taxonomic name	Family
1	Garlic	*Allium sativum*	Liliaceae
2	Arandi	*Jatropha curcas*	Euphorbiaceae
3	*Devadaru*	*Polyalthialongifolia*	Annonaceae
4	Vincarosea	*Catharanthusroseus*	Apocynaceae
5	Neem	*Azadirachtaindica*	Meliaceae
6	*Eucalyptus*	*Eucalyptus citriodora*	Myrataceae
7	Tridax daisy/ coat buttons	*Tridaxprocumbens*	Asteraceae
8	Giant milk weed	*Calotropis gigentia*	Ascelepiadaceae
9	Algarroba	*Prosopisjuliflora*	Fabaceae
10	Indian beech	*Pongamia pinnata*	Fabaceae

Table 3. Fungicides used for evaluation against *Alternariaster helianthi*.

Sl. No.	Trade name	Concentration	Chemical composition
1	Tilt	0.1%	Propiconazole
2	Score	0.1%	Difenoconazole
3	Indofil M–45	0.25%	Mancozeb
4	Bavistin	0.1%	Carbendazim
5	Rovral	0.1%	Iprodione
6	Contaf	0.1%	Hexaconazole
7	Saaf	0.1%	Carbendazim + mancozeb
8	Taquat	0.1%	Captan + hexaconazole
9	Quintal	0.2%	Iprodione + carbendazim

Table 4. Integrated disease management of *Alterna riaster* leaf blight under field conditions during 2010-11 and 2011-12. a. $STFS_1$= ST with (iprodine + carbendazim) 2g/kg seed + propiconazole 0.1% (FS) ; FS_1=Garlic 0.5% (FS) ; FS_2 = *Trichoderma harzianum* 0.2% (FS) ; FS_3 = *Pseudomonas fluorescens* 0.2% (FS) ; FS_4 = Salicylic acid 0.0004% (FS) ; FS_5 = Garlic 0.5% + *T. harzianum* 0.2% (FS) ; STFS2 = ST with (iprodine + carbendazim) 2g / kg seed + propiconazole 0.1% + Garlic 0.5% + *T. harzianum* 0.2% (FS) ; FS_6 = Mancozeb 0.25% ; FS: Foliar Spray ; ST: Seed Treatment. b. PDI: Percent disease index ; Values in parenthesis represent arcsine transformed values. C. RDI: Reduction over control ; Values in parenthesis represent arcsine transformed values.

	2010–11				2011–12				Pooled data	
Treatment[a]	PDI (%)[b]		RDI (%)[c]	Yield kg/ha	PDI (%)		RDI (%)	Yield kg/ha	PDI (%)	Yield kg/ha
$STFS_1$	33.4	(35.3)	40	661	32.5	(34.7)	53.2	2074	35.04	1367.6
FS_1	42.8	(40.8)	23.2	525	38.4	(38.2)	44.7	1814	39.59	1169.6
FS_2	38.2	(38.1)	31.4	608	36.6	(37.2)	47.3	2022	37.71	1315.0
FS_3	45.1	(42.1)	35.1	518	39.9	(39.1)	42.5	1804	40.68	1144.7
FS_4	40.5	(39.5)	27.3	545	37.7	(37.8)	45.7	1944	38.70	1244.4
FS_5	35.2	(36.3)	36.8	652	36.1	(36.9)	48.0	2048	36.85	1299.8
$STFS_2$	31.4	(34.0)	43.6	682	24.4	(29.6)	64.8	5185	31.83	2933.6
FS_6	49.1	(44.4)	11.8	511	45.1	(42.1)	35.1	1556	43.33	1033.4
Pathogen check	55.7	(48.2)	0.0	368	69.5	(56.4)	0.0	1413	51.69	890.3
Control	53.1	(46.7)	4.7	386	58.6	(49.9)	15.6	1413	49.13	899.4
CD (0.05)	2.8			39.3	5.7			271.7	1.85	128.9
CV (%)	3.8			4.3	8.0			7.4	3.9	8.3
SEd	1.3			18.7	2.7			129.3	0.6	45.0

mm) cut from 9 days old actively growing *A. helianthi* culture and incubated at 25±2°C for seven days. After incubation period, the medium containing the mycelial growth of the *A. helianthi* fungus was filtered through previously weighed whatman filter paper.

The fresh mycelial weight was calculated by subtracting weight of previously weighed filter paper from weight of filter paper with mycelial mat. Percent inhibition of mycelia growth was calculated using the formula

$$\text{Percent inhibition} = \frac{C - T}{C} \times 100$$

Where, C = Weight of fungal colony in control (mg), and T = Weight of fungal colony in treatment (mg).

To test potentiality of biocontrol agents (Table 1) dual plate technique was followed, but *A. helianthi* is a slow growing fungal pathogen, so it is difficult to evaluate biocontrol agents in *in vitro* conditions as all tested biocontrol agents were over grown on *A. helianthi*, hence all biocontrol agents were directly screened under pot culture conditions.

Antifungal activity of botanicals, fungicides and biocontrol agents in pot culture experiment

Individually antifungal activity of different fungicides, biocontrol agents and botanicals were tested under pot culture experiment. For this purpose, five seeds of sunflower variety Morden which is susceptible to leaf blight were sown in each pot containing red soil, sand, FYM in the ratio of 3 : 2 : 1 with three replications and 15 plants in each treatment. 20 ml of botanical extracts were sprayed evently with trigger garden sprayer on the pot with 20 days old sunflower plants before artificial inoculation of pathogen, after five days the same volume of the pathogen spore suspension (1×10^6 spores / ml) of *A. helianthi* was also sprayed on to the pots. The pathogen spore suspension was prepared from 9 days old *A. helianthi* culture grown on SLEM which flooded with water and concentration was adjusted to 1×10^6 spores / ml. The check was maintained by spraying water only and tween - 20 was added which acts as sticker to all liquids before spray (pathogen, botanicals, biocontrol

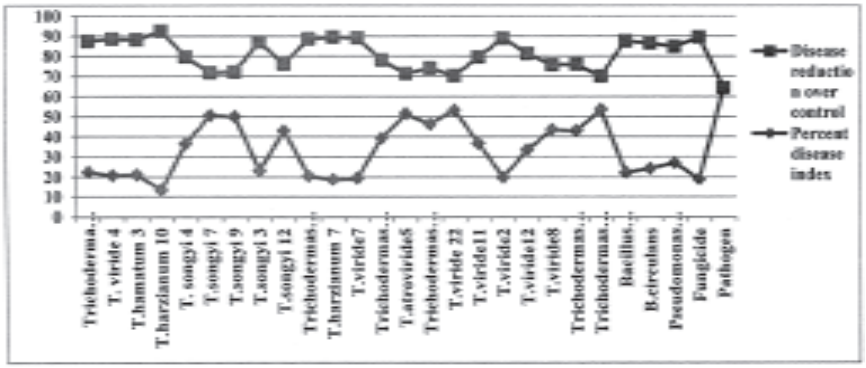

Fig. 1. Antifungal activity of biocontrol agents against *Alternariaster* leaf blight in pot culture experiment.

agents). Treated and control plants were covered with polyethylene cover to maintain humidity for disease development for two days. After 5 days of inoculation, when disease symptoms were initiated on the inoculated plants, data on leaf blight was recorded. The spray of plant extracts was repeated twice with one week interval and three replications were kept for each botanical. Observation on disease intensity was recorded at different intervals after last spray of botanicals. The experiment was repeated twice.

Similar pot culture experiment was followed for evaluating the 25 strains of biocontrol agents and some new fungicides against *Alternariaster* leaf blight. Instead of botanicals spray, biocontrol agents or fungicides were sprayed three times i.e., one spray before pathogen artificial inoculation and two sprays after artificial inoculation at one week interval. Out of

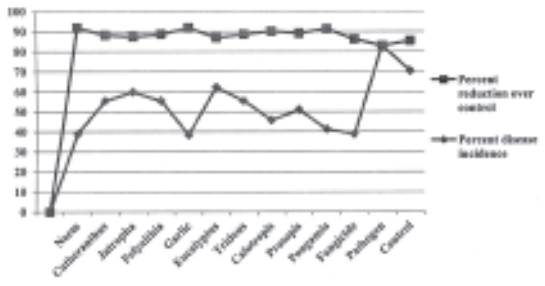

Fig. 2. Antifungal activity of botanicals against *Alternariaster* leaf blight in pot culture experiment.

nine fungicides, some of the new fungicides were evaluated against *Alternariaster* leaf blight under pot culture experiment and some of them with different combinations tested under field conditions in a separate trial [11]. From this, percent disease index was computed.

From the above screening, selected effective botanical, biocontrol agents and fungicides were used for the integrated management of *Alterna riaster* leaf blight under field conditions by alone and combination treatments. From the mean percent disease index (PDI), percent reduction over control (RDI) was calculated using standard formula. Plants sprayed with water served as control and the experiment was repeated twice to confirm the results (Table 4).

Evaluation of selected effective biocontrol agents, botanical and fungicides against *Alternariaster* leaf blight under field conditions

Field trials were carried out to evaluate selected effective biocontrol agents, botanical and fungicides alone and in different combinations as seed treatment and foliar spray against *Alterna riaster* leaf blight of sunflower under field conditions. Experiments were carried out in plots of 3.6 × 3 m size replicated thrice in randomized block design with 10 treatments at Indian Institute of Oilseeds Research, Hyderabad, India during two *kharif* seasons of 2010-11 and 2011-12.

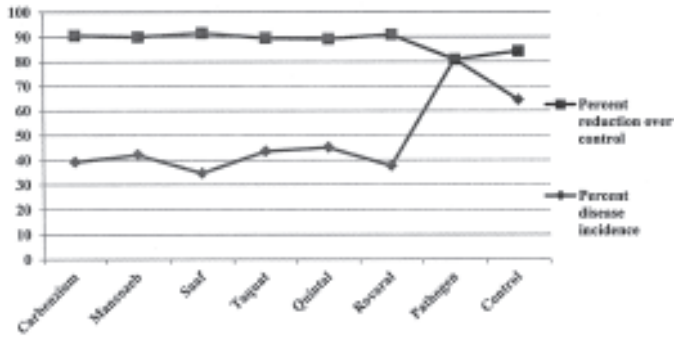

Fig. 3. Antifungal activity of new fungicides against *Alternariaster* leaf blight in pot culture experiments.

Sowing was done in 1st week of July using sunflower hybrid DRSH–1. Five rows of Morden were sown as infector rows at 15 days in advance on four sides of the field. The treatments consist of : seed treatment with combination fungicide iprodione + carbendazim 2g / kg seed followed by foliar spray of propiconazole 0.1% ; garlic 0.5% foliar spray; *Trichoderma harzianum* 0.2% foliar spray ; *Pseudomonas fluorescens* 0.2% foliar spray ; salicylic acid 0.0004% foliar spray ; *Trichoderma harzianum* 0.2% and garlic 0.5% foliar spray ; seed treatment with combination fungicide iprodione + carbendazim 2g/kg seed followed by foliar spray of propiconazole 0.1%, *T. harzianum* 0.2% and garlic 0.5% ; mancozeb 0.25% foliar spray ; pathogen check and control (Table 4).

In absence of natural disease occurrence in the year 2010-2011, spore suspension of *A. helianthi* was sprayed on 25—30 days old infector row Morden plants. Pathogen suspension was collected from infected plants in green house and stored at 4°C for maximum period of 30 days. Pathogen inoculation was done at evening hours and prior to inoculation the field irrigated thoroughly. During the subsequent 10 days, the field was irrigated for 30 min before sunset to maintain humidity in micro-environment. Weeds and insects were controlled according to standard recommended practices.

The botanical, biocontrol agents and fungicides were sprayed after the appearance of the disease and two sprays at 15 days interval. Spraying was done with a carbonic anhydride pressurized backpack sprayer capacity 16L with a constant boom pressure.

Results and Discussion

Inhibition of conidial germination and mycelia growth by botanicals and fungicides

Different botanicals were suppressed spore germination of *A. helianthi* fungus at different time intervals and various concentrations. In sterile distilled water, conidia of the pathogen were readily germinated, especially almost 100% after 24 h of incubation. On the other hand, pathogen spore germination was less in extracts of garlic and neem at all concentrations, but the reduction of spore germination was observed more over check at 12 h interval and 0.5% concentration of botanicals.

Out of nine fungicides used for leaf blight diseases, propiconazole showed the most discriminatory activity on the fungal growth. The *A. helianthi* showed poor or less mycelia growth. The other fungicides, expect mancozeb that inhibited mycelia growth of fungi, also had medium or weak discriminatory fungicidal activity against the pathogen. Because of their fungicidal discrepancy, those fungicides were further screened under pot culture conditions.

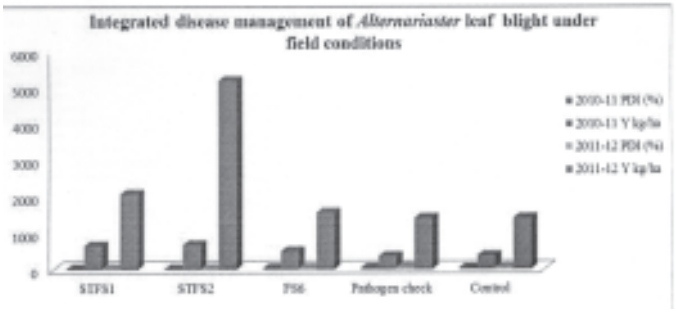

Fig. 4. *Alternariaster* leaf blight disease severity and yield under field conditions during 2010-11 and 2011-12. $STFS_1$ = ST with (iprodine + carbendazim) 2g / kg seed + propiconazole 0.1% (FS) ; $STFS_2$ = ST with (iprodine + carbendazim) 2g / kg seed + propiconazole 0.1% + Garlic 0.5% + *T. harzianum* 0.2% (FS) ; FS_6 = Mancozeb 0.25%. PDI = Percent disease index ; FS: Foliar Spray ; ST: Seed Treatment.

Efficacies of botanicals, biocontrol agents and fungicides individually in disease suppression (under pot culture experiment)

Sunflower *Alternariaster* leaf blight was controlled in pots by all of the botanicals used (Figure 2). From results of *in vitro* screening, effective concentration of botanicals (0.5%) was further evaluated in pot culture experiment. However, less disease incidence was recorded in plants sprayed with extracts of garlic and neem, while 83% disease was observed in pathogen check. Out of ten botanicals, garlic extracts showed low disease severity.

Twenty five strains of three bio-control agents i.e., *T. harzianum*, *P. fluorescens*, *B. megaterium* and *B. circulans* were evaluated under greenhouse conditions and out of them, *Tv*3, *Tv* 4, *Ts*3, *Th*10, *T*6, *Th*7, *Tv*7, *Tv*2, *B. megaterium*, *B. circulans* and *P. fluorescens* recorded low leaf blight severity, while in pathogen check the disease incidence was 72.8%. Among twenty five biocontrol agents, *Th*10 recorded low leaf blight severity (Fig. 1).

Out of 9 fungicides used for *Alternariaster* leaf blight disease, new fungicides were evaluated against *Alternariaster* leaf blight under pot culture conditions, saaf recorded low leaf blight intensity (Fig. 2) and other fungicides screened in field conditions. Seed treatment with combination fungicide (iprodione + carbendazim–2g/kg seed) followed by foliar sprays of propiconazole 0.1% were selected as effective fungicides from field trials (three years) made by Santha Lakshmi et al. [11].

Effect of individual and combined treatments of selected effective biocontrol agents, fungicides and botanical on *Alternariaster* leaf blight under field conditions

The results of integrated management of disease under field conditions are shown in Table 4. Table shows that in the year 2010-11, all the treatments significantly reduced the disease compared to control (Fig. 3). However, the magnitude of reduction varied from treatment to treatment. The range of disease intensity in treatments varied from 31.4–49.1% in comparison with 55.7% recorded in control. Minimum disease intensity (31.4%) and maximum seed yield (682 kg/ha) were observed in plants treated with iprodione + carbendazim combination followed by spraying of propiconazole, garlic and *T. harzianum* at 15 days interval. This was followed by treatment consists of seed treatment with the combination of fungicide iprodione + carbendazim followed by spraying of propiconazole with disease intensity of 33.4% and yield 661 kg/ha. Among the various combinations, disease reduction was more (43.6%) in seed treatment with iprodione + carbendazim combination followed by spraying of propiconazole, garlic and *T. harzianum* at 15 days interval when compared to the pathogen check followed by 40% reduction showed by seed treatment with the iprodione + carbendazim followed by spraying of propiconazole (Table 4).

The results obtained during the year 2011-12 revealed that all the treatments proved effective in reducing the disease intensity and were significantly superior over check. Least disease intensity of 24.4% with high yield of 5185 kg/ha was observed in seed treatment with combination iprodione + carbendazim followed by spraying of propiconazole, garlic and *T. harzianum* at 15 days interval, next best was seed treatment with fungicide combination iprodione +carbendazim followed by spraying of propiconazole (32.5% and 2074 kg/ha). Out of various combinations seed treatment with iprodione + carbendazim followed by spraying of propiconazole, garlic and *T. harzianum* resulted 64.8% reduction over pathogen check and the next best was seed treatment with iprodione + carbendazim followed by spraying of propiconazole recorded 53.2% reduction (Table 4).

The seed yield was comparatively more during 2011-12 as compared to 2010-11 as crop was in full potential with big flower heads. The treatments with maximum and minimum disease intensity along with seed yields in both years were graphically represented in Figure 4.

Pooled data of two years clearly revealed significant differences between treatments with respect to disease incidence and seed yield (Table 4). Seed treatment with iprodione + carbendazim followed by spraying of propiconazole, garlic and *T. harzianum* (31.8%) recorded lowest PDI and highest yield (2933.6 kg/ha), which was on par with seed treatment with iprodione +carbendazim followed by spraying of propiconazole (35.0% and 1367.6 kg/ha) and was significantly least than all other treatments. Pathogen check recorded high disease intensity (51.69%) and least yield (890.3 kg/ha).

In this investigation, assessment of biocontrol agents, botanical and fungicides were done in *in vitro* and pot culture experiment, selected effective biocontrol agents (*T. harzianum* and *Pseudomonas fluroscence*), botanical (neem) and fungicides (combination fungicide (iprodione + carbendazim and propiconazole) were used integratedly for managing *Alternariaster* blight of sunflower seeks to minimize the number of fungicidal applications. Regardless of year, seed treatment with combination fungicide (iprodione + carbendazim) followed by spraying of propiconazole, garlic and *T. harzianum* at 15 days interval recorded minimum disease severity under field conditions. The results are in conformity with findings of several workers like Waghe et al. [1] they demonstrated that seed treatment and two foliar sprays of mancozeb+ carbendazim at 30 and 45 DAS recorded highest *Alternariaster* leaf blight disease control of sunflower and highest seed yield. Ganie et al. [12] results revealed that seed treatment with mancozeb 75 WP (0.3%) + foliar spray with hexaconazole 5 EC (0.1%) + foliar spray with Datura (50%) + foliar spray with *T. harzianum* (1×10^7 spore / ml) were highly effective in controlling the early blight disease severity of potato as compared to control. Rathi and Singh [13] tested efficacy of different bioagents and fungicides with different combinations as seed treatment with *Trichoderma harzianum* followed by foliar spray of ridomil and carbendazim reduced *Alternaria* blight intensity in mustard. The present findings were similar with Jagtap et al. [14] reported that propiconazole (0.05%) was found to be significantly superior among all the treatments in managing leaf spot of turmeric under green house conditions. Findings of Laxman Prasad et al. [15] revealed that combination of mancozeb with *Trichoderma viride* was found to be most effective in reducing the *Alternaria* blight in pigeon pea.

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