Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(4): 384-387
Received: 15-05-2017
Accepted: 16-06-2017

Hilal A Bhat
Division of Biotechnology, ICAR-CITH, Rangreth Srinagar J&K, India

Khurshid Ahmad
Plant pathology, SKUAST-K, Shalimar, Srinagar, J&K, India

Rayees A Ahanger
Plant pathology, SKUAST-K, Shalimar, Srinagar, J&K, India

Sajad H Wani
Division of Biotechnology, ICAR-CITH, Rangreth Srinagar J&K, India

Arif H Bhat
Plant pathology, SKUAST-K, Shalimar, Srinagar, J&K, India

Showket A Dar
Entomology, SKUAST-K, Shalimar, Srinagar, J&K, India

Correspondence
Hilal A Bhat
Division of Biotechnology, ICAR-CITH, Rangreth Srinagar J&K, India

Fungicidal management of leaf blight of gerbera (*Gerbera jamesonii* Hook) in Kashmir valley

Hilal A Bhat, Khurshid Ahmad, Rayees A Ahanger, Sajad H Wani, Arif H Bhat and Showket A Dar

Abstract
Alternaria leaf blight is an important diseases of gerbera (*Gerbera jamisonii*) world over. The present investigation was carried out in various locations of Kashmir valley to evolve an effective management strategy of Alternaria blight disease. Among the eight fungicides tested *in vitro*, chlorothalonil 75 WP, mancozeb 75 WP, fulusilazole 40 EC and fenarimol 12 EC proved significantly superior in inhibiting the mycelial growth of test fungi. Under natural epiphytotic conditions, all the four fungicides tested proved significantly superior over check in controlling the blight. Fulusilazole 40 EC @ 200 ppm with 88.28 per cent disease control was the most efficacious fungicides followed by chlorothalonil 75 WP @ 3000 ppm with 82.64 per cent disease control. The fungicides tested have not only managed the disease but also enhanced number and weight of flowers.

Keywords: management, disease intensity, disease incidence, yield

Introduction
Gerbera (*Gerbera jamisonii*) also known as Transvaal daisy, Barberton or African daisy, is the most popular florists flower with increasing commercial significance. It is cultivated under wide range of climatic conditions, mostly inhabit temperate and mountainous regions. Gerbera, a perennial herb, is native of South Africa and Asia [1]. It has a wide applicability in the floral industry as cut flower and potted plant [2]. It is one of the top cut flowers in Europe in demand and major portion of it produced in various countries including India and exported to Europe and Japan [3]. The production of gerbera was approximately US$ 220 million in 2001 representing 70 million stems sold in US alone [4]. The production of gerbera is hindered by many factors, and among all disease is the main problem. Alternaria leaf blight is of serious nature reducing the plant vigor, flower quality and market value [5]. Therefore, in this article we investigate the management of Alternaria leaf blight using different fungicides and their combinations.

Materials and Methods
The present investigations were conducted in the Division of Plant Pathology, SKUAST-K, Shalimar Campus. The field trails were laid out in the Farm of Tulip Garden, Cheshmashahi, Srinagar.

In vitro evaluation of fungicides
Eight fungicides including both systemic and non-systemic at four different concentrations were evaluated *in vitro* for their efficacy in inhibiting the mycelial growth of *Alternaria alternata* using poisoned food technique [6]. The % mycelial growth inhibition of fungi over control was calculated by using the formula of Vincent [7].

% growth inhibition=

$$\frac{C-T}{C} \times 100$$

Where,
C = Mycelial growth in check
T = Mycelial growth in treatment triglyceride content, thus enhancing insulin sensitivity in the liver and skeletal muscle, and plays a key role in slowing down the progression of NAFLD [21, 22].

In vivo evaluation of fungicides
Among the eight fungicides evaluated *in vitro*, the four most efficacious were selected and also

evaluated *in vivo* under natural conditions of disease development at recommended concentrations. The evaluation of fungicides was carried out on susceptible cv. "Cango" of gerbera. The experiment was laid in Randomized Block Design (RBD) with four replications in each treatment, five plants represented one replication. Recommended package of practices were also followed in all the treatments except plant protection measures. Four sprays were given with the help of baby sprayer first one at the time of appearance of disease, followed by three sprays at an interval of 15 days. Observations regarding per cent disease incidence and intensity were recorded 20 days after fourth spray.

Per cent disease incidence was calculated by counting the total number of leaves and the number of leaves infected on randomly selected plants using the formula:

$$\%\text{ disease incidence} = \frac{\text{Number of infected leaves}}{\text{Total number of leaves examined}} \times 100$$

The flower yield per plant in terms of weight and number was recorded in each treatment at the time of harvesting of crop. The data was subjected to appropriate transformation wherever needed, as suggested by Gomez and Gomez **[8]**.

Results and Discussion

In vitro evaluation of fungicides

In vitro evaluation of fungicides revealed that at each concentration, all fungicides significantly inhibited mycelia growth of test fungi compared to check. The inhibitory effect of fungi-toxicants increased significantly with increase in test concentration (Table 1). Non-systemic fungicides provided mean inhibition in mycelia growth ranging from 43.79 per cent at 100 ppm to 71.38 per cent at 400 ppm concentration. The corresponding inhibition in systemic ranged from 38.31 at 10 ppm to 59.90 per cent at 75 ppm. Irrespective of concentration, all the test fungicides which worked as fungi-toxicants differed significantly from one another in their inhibitory effect. Non-systemic fungicide, chlorothalonil 75 WP proved to be significantly superior at each respective concentration by exhibiting maximum mean inhibition of 71.79 per cent. It was followed by mancozeb 75 WP (62.74%), copper oxychloride 50 WP (51.01%) and least effective captan 50 WP (44.08%). Furthermore, chlorothalonil @ 400 ppm proved significantly most effective, exhibiting 82.36 per cent inhibition in mycelia growth of the test fungi. It was followed by chlorothalonil @ 300 ppm (78.18%), mancozeb @ 400 ppm (75.51%), chlorothalonil @ 200 ppm (67.64%), mancozeb @ 300 ppm (67.19%) and copper oxychloride @ 400 ppm (66.07%). The results are supported by the findings of Kamble *et al.* [9], Ghosh *et al.* [10], and Tetarwal and Rai [11],. Among systemic fungi-toxicants, fulusilazole 40 EC proved significantly superior at each respective concentration and provided maximum mean inhibition of 67.64 per cent in mycelia growth (Table 2). It was followed by fenarimol 12 EC (57.05%) and hexaconazole 5 EC (52.15%), while as carbendazim 50 WP proved to be least effective (18.62%). It was also observed that fulusilazole @ 75 and 50 ppm were highly effective by providing maximum inhibition of 79.06 and 72.12 per cent in mycelial growth of test fungi, respectively. Langoo [12], has recorded significant *in vitro* efficacy of hexaconazole and fenarimol against *A. alternata*, causing leaf spot of brinjal. Murthy and Shenoi [13], observed significant inhibition in mycelia growth of *A. alternata*with fulusilazole. Least effectiveness of carbendazim against *Alternaria* spp. has also been reported by Dubey *et al* [14], Amresh and Nargund [15], and Shahzad [16],

Table 1: Efficacy of various non-systemic fungi-toxicants in inhibiting mycelia growth of *Alternaira alternate* (*In vitro*)

Concentration (ppm) Fungicides	Growth inhibition				
	100	**200**	**300**	**400**	**Mean**
Chlorothalonil 75WP	58.99 (51.91)	67.64 (57.24)	78.18 (64.30)	82.36 (67.41)	71.79 (60.22)
Mancozeb 75 WP	49.10 (46.02)	59.18 (52.03)	67.19 (56.96)	75.51 (62.42)	62.74 (54.36)
Copper oxychloride 50WP	38.43 (39.63)	45.84 (44.08)	53.71 (48.75)	66.07 (56.25)	51.01 (47.80)
Captan 50WP	28.65 (33.47)	38.99 (39.97)	50.00 (46.55)	61.57 (53.47)	44.08 (43.37)
Mean	43.79 (42.76)	52.91 (48.33)	62.27 (54.14)	71.38 (59.89)	-
$CD_{(p=0.05)}$ Fungicides (Fungi-toxicant) : (3.12) Concentration : (2.08) Fungi-toxicant x Concentration : (5.03)					

* Average of 3 replications; Figures in parenthesis are arc sine transformed values

Table 2: Efficacy of various systemic fungi-toxicants in inhibiting mycelia growth of *Alternaria alternata (In vitro)*

Concentration (ppm) Fungicides	Growth inhibition				
	10	**25**	**50**	**75**	**Mean**
Hexaconazole 5 EC	39.77 (40.45)	46.47 (44.64)	54.94 (49.49)	67.41 (57.09)	52.15 (47.92)
Fenarimol 12 EC	44.41 (43.23)	53.77 (48.79)	60.59 (52.88)	69.95 (58.71)	57.05 (50.91)
Carbendazim 50 WP	13.77 (22.53)	17.29 (25.42)	20.24 (27.66)	23.18 (29.77)	18.62 (26.34)
Fulusilazole 40 EC	55.29 (49.69)	64.12 (55.04)	72.12 (60.13)	79.06 (64.94)	67.64 (57.45)
Mean	38.31 (38.97)	45.41 (43.43)	51.97 (47.54)	59.90 (52.63)	
$CD_{(p=0.05)}$ Fungi-toxicant : (3.03) Concentration : (2.13) Fungi-toxicant x Concentration : (4.73)					

* Average of 3 replications; Figures in parenthesis are arc sine transformed values

In vivo evaluation of fungicides

During the course of the present investigations four fungicides as toxicants which proved most effective *in vitro* were further evaluated *in vivo* at recommended concentrations for their efficacy in controlling the Alternaria leaf blight. All test fungicides viz., fenarimol 12 EC @ 400 ppm, fulusilazole 40 EC @ 200 ppm, chlorothalonil 75 WP @ 3000 ppm and mancozeb75 WP @ 3000 ppm significantly reduced the incidence and intensity of the disease compared to control. Although test fungicide toxicants differed significantly from one another in term of their efficacy (Table 3), fulusilazole was found to be significantly superior by exhibiting 16.31 and 5.03 per cent of incidence and intensity compared to 79.15 and 42.93 per cent recorded in check respectively, and provided 88.28 per cent control in disease intensity over check. It was followed by chlorothalonil (21.54 & 7.53%) and fenarimol (28.62 & 10. 54%) which exhibited 82.46 and 75.45 per cent disease control, respectively. Mancozeb (38.67 & 15.86%) proved to be significantly inferior by providing minimum disease control of 61.64 per cent. Although very little information is available on use of chemical control in gerbera yet more or less similar findings have been reported in other crops by Chaudhary *et al.* [17],, Singh *et al.* [18],, Tetarwal and Rai [11], and Shahzad [16],. The *in vivo* effect of test fungicides on yield (flower number and weight) of gerbera was also assessed during 2010. All the four test fungi-toxicants significantly increased both flower number and their weight compared to check. It was observed that fulusilazole proved to be significantly superior in producing maximum mean number of 3.75 flowers compared to 3.57, 3.05 and 2.80 flowers per plant recorded in chlorothalonil, fenarimol and mancozeb treatments, respectively, while as 1.70 flowers per plant were recorded in the control.

Table 3: Efficacy of various fungi-toxicants on incidence and intensity of Alternaria leaf blight (*Alternaria alaternata*) on gerbera cv. "Cango" under natural epiphytotic conditions (In vivo)

Fungi-toxicant/ Concentration (ppm)	Disease incidence (%)*	Disease intensity (%)*	Control over check (%)
Fenarimol 12EC (400)	28.62 (33.46)	10.54 (19.60)	75.45
Fulusilazole 40EC (200)	16.31 (24.64)	5.03 (13.41)	88.28
Chlorothalonil 75WP (3000)	21.54 (28.61)	7.53 (16.46)	82.46
Mancozeb 75WP (3000)	38.67 (39.78)	15.86 (24.28)	61.64
Check (water spray)	79.15 (65.00)	42.93 (40.73)	-
CD (p = 0.05)	3.80	2.34	

* Mean of four replications: Figures in parenthesis are arc sine transformed values and those superscripted with same letter(s) do not differ significantly

Effect of fungicides on number and weight of flowers
The test fungicides exhibited 120.59, 108.82, 97.41 and 64.71 per cent increase in flower number in that order. The corresponding average weight of flowers in fungi-toxicants treatments was recorded to be 19.43, 18.79, 16.46 and 15.54 g as against 8.71 g noticed in check (Table 4). The increase in yield in terms of weight over check was observed to be 122.95, 115.57, 88.93 and 78.28 per cent, respectively (Table 5). More or less similar effects on yield of other crops have been reported by Amaresh [15], Singh *et al.* [18], and Kamanna *et al.* [19].

Table 4: Effect of various fungi-toxicants on number of flowers of gerbera under natural epiphytotic conditions (in vitro)

Fungicide toxicants/ concentration (ppm)	Disease intensity (%)	Average No. of flowers/plant*	Increase in yield over check (%)
Fenarimol 12EC (400)	10.54 (19.60)	3.05	97.41
Fulusilazole 40EC (200)	5.03 (13.41)	3.75	120.59
Chlorothaloni 75WP (3000)	7.53 (16.46)	3.57	108.82
Mancozeb 75WP (3000)	15.86 (24.28)	2.80	64.71
Check (water spray)	42.93 (40.73)	1.70	-
CD (p = 0.05)	2.34	0.27	

* Average of four replications: Figures in parenthesis are arc sine transformed values

Table 5: Effectof various fungi-toxicants on weight of flowers of gerbera under natural epiphytotic conditions.

Fungicides/ conc. (ppm)	Disease intensity (%)	Average weight of flower (g)	Increase in yield over check (%)
Fenarimol 12EC (400)	10.54 (19.60)	16.46	88.93
Fulusilazole 40EC (200)	5.03 (13.41)	19.43	122.95
Chlorothalonil 75WP (3000)	7.53 (16.46)	18.79	115.57
Mancozeb 75WP (3000)	15.86 (24.28)	15.54	78.28
Check (water spray)	42.93 (40.73)	8.71	-
CD (p = 0.05)	2.34	2.20	

Figures in parenthesis are arc sine transformed values

Conclusion
In the present investigations, it is concluded that Alternaria leaf blight is an economically important disease. Four foliar sprays with fulusilazole 40 EC @ 200 ppm and/or chlorothalonil 75 WP @ 3000 ppm at 15 days interval manages Alternaria leaf blight and restrict resultant yield losses.

Acknowledgement
We highly acknowledge SKUAST-K, Shalimar for providing all facilities to conduct this research.

References
1. Kanwar JK, Kumar S. *In vitro* propagation of gerbera. *Horticultural Sciences.* 2008; 35:35-44.
2. Anuradha S, Gowda JVN. Sane A. Characterization of gerbera (*Gerbera jamesonii*) genotypes using morphological characters. *Plant Genetic Resources Newsletter.* 2001; 128:64-67.
3. Anonymous. Production manual: Gerbera. Global Agritech (I) Pvt. Ltd., Mumbai. 2006, 21.
4. Broek VDL, Haydu JJ, Hodges AW, Neves EM. Production, marketing and distribution of cut flowers in the United States and Brazil. In: Annual Report of Florida Agricultural Experiment Station, University of Florida. 2004, 10-19 [cf: Kanwar and Kumar, 2008. *Horticultural Sciences* 35: 35-44].
5. Kulibaba IUF. Disease of gerbera grown under cover. *Glaviny Botanicheskii Sadim* Byul. 1972; 83:115-119. [cf: Mirkova and Konstantinova, 2003. *Journal of Phytopathology* 151: 323-328].
6. Nene YL, Thapliyal PN. *Fungicides in plant disease control*. 3rd edition. Oxford and IBH Publication, New Delhi, India. 1982, 691.
7. Incent JM. Distribution of fungal hyphae in the presence of certain inhibitors. *Nature.* 1947; 15:850.
8. Gomez AK, Gomez AA. Analysis of multi-observation data. In: *Statistical Procedures for Agricultural Research*. John Willey and Sons Inc. New York, USA. 1984, 241-272.
9. Kamble PU, Ramiah M, Patil DV. Efficacy of fungicides in controlling leaf spot diseases of tomato caused by *Alternariaalternata* (Fr.) Kessiler. Journal of Soils and Crops. 2000; 10:36-38.
10. Ghosh C, Pawar NB, Kshirsagar CR, Jadhav AC. Studies on management of leaf spot caused by *Alternariaalternata* on gerbera. Journal of Maharashtra Agricultural Universities. 2002; 27:165-167.
11. Tetarwal ML, Rai PK. Management of *Alternaria*blight of senna (*Cassia angustifolia*) through fungicides and plant extracts. *Annals of Plant Protection Sciences.* 2007; 15:165-169.
12. Langoo GH. Studies on Alternaria leaf spot of brinjal in Kashmir. M.Sc thesis submitted to Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Srinagar. 2000; 43.
13. Murthy KK, Shenoi MM. Evaluation of various chemical fungicides against brown spot disease of FCV tobacco. *Tobacco Research.* 2001; 27:1-6.
14. Dubey SC, Patel B, Jha DK. Chemical management of Alternaria blight of broad beans. *Indian Phytopathology.* 2000; 53:87-94.
15. Amaresh YS. *Studies on foliar diseases of sunflower (Helianthus annuus L.) with special reference to Alternaria leaf blight caused by Alternariahelianthi*

(Hansf.) Tubaki and Nishihara. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad, India, 1997, 86.
16. Shahzad A, 2009. Not available
17. Chaudhary SM, Patel RN, Patel RL, Patel NH. Management of early blight of potato through chemicals. Indian Journal of Plant Protection. 2002; 30:184-186.
18. Singh PJ, Singh P, Dhindsa GS, Kumar R. Efficacy of systemic and non-systemic fungicides against leaf spot (*Alternaria tagetica*) of marigold. *Indian Phytopathology*. 2006; 59:118-119.
19. Kamanna BC, Shankarappa TH, Kumar AGS. Evaluation of fungicides for the management of chrysanthemum leaf blight caused by *Alternariaalternata* (Fr.) Keisser. University of Agricultural Sciences, Dharwad, Karnatka, India. *Plant Archives.* 2010; 10:595-597.