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INTEGRATED MANAGEMENT OF POWDERY MILDEW OF GERBERA UNDER POLYHOUSE CONDITION IN ARUNACHAL PRADESH

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ABSTRACT: Powdery mildew caused by the fungus *Erysiphe cichoracearum* DC. is a common disease of gerbera grown in Indian conditions. Fungicidal and varietal trial was conducted at Instructional farm, Department of Floriculture, College of Horticulture and Forestry, Central Agricultural University, Pasighat, during April 2011 to March 2012. In fungicidal disease management, least disease severity (5.23%) was observed in spray of wettable sulphur @ 2.5g/l of water followed by Carbendazim @ 2g/ l of water foliar spray (7.23 %). Whereas, the unprotected treatment showed highest disease severity (65.30 %). The highest number of flowers m^{-2} / year (195.00) and number of suckers / plant / year (6.60) were also recorded in wettable sulphur @ 2.5g/l of water foliar spray. Powdery mildew symptoms were first observed on the leaves of the varieties viz. Pia, Rionegro and Tecala on 30th day after planting. In Manizales, Teresa and Galileo powdery mildew incidence was started only after 38 days of planting. On the other varieties Figaro, Marinila and Palmira powdery mildew incidence was started only after 68 days of planting. Palmira variety showed resistance to powdery mildew with per cent disease index of 9.27% at the end of 160 days after planting followed by Figaro and Marinila with PDI of 9.73% and 10.23%, respectively. Variety Teresa showed moderately resistant reaction (24.57 %) against powdery mildew infection. Varieties Pia and Tecala were highly susceptible to powdery mildew throughout the experiment which showed per cent disease index of 65.30% and 54.27%, respectively. Other varieties like as Galileo (34.73%), Manizales (46.93%) and Rionegro (49.67%) showed susceptible reaction to powdery mildew infection.

Keywords: *Disease, gerbera, fungicides, powdery mildew, screening, variety.*

Gerbera (*Gerbera jamesonii* Bolus ex. Hooker F.), belongs to the family Asteraceae, is a popular flower throughout the world. Many people enjoy by growing this flower in gardens or large containers (Tjia *et al.,* 14). It has demand as cut flower and also as an ornamental potted plant gaining importance in the world market and has a very good export potential because of its graceful appearance, hardiness and ability to withstand during transportation and long shelf life (Latha and Suresh, 9). The tremendous variability in gerbera with reference to flower colour, shape and size makes it more useful for cut flowers, bouquet and decoration in marriage and landscaping in gardening (Aswath and Survay, 2). Apart from domestic consumption it has got export potential also. Claims have been made that from 30-70 % of the potential lasting quality of cut flowers is determined at harvest (Halevy and Mayak, 5). In India, gerbera is mainly grown in North Eastern States, Karnataka and Maharashtra (Aswath and Rao, 1). Gerbera is susceptible to a variety of pests and diseases. Powdery mildew is one of the most destructive fungal diseases of gerbera causing significant economic losses under poly house conditions. It is caused by two fungal species viz. *Erysiphe cichoracearum* DC and *Podosphaera fusca* (Fr.) S. Blumer. They are the obligate parasite (they live always living matter) and can affect all parts of the plants. Powdery mildew is easy to identify since to noticeable white spots or powder like appearance or white patches appear on the upper and lower surfaces of the leaves or flowers. These spots are enlarge to form a white, powder like mat, which can spread to stems and flowers also (Moyer and Peres, 11). This disease reduced plant growth and lesser flower quality which contribute to economic losses. Severely infected leaves turn pale yellow or brown and the plants eventually die. Some environmental conditions like high relative humidity (80-95%), moderate

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temperature (20-28 °C) and low light intensities or shade are most congenial for powdery mildew development. Unfortunately poly house usually provide all these conditions the varieties will react specifically (Daughtrey *et al.,* 3). However, information on the effectiveness of these products in managing powdery mildew in ornamentals, and more specifically on gerbera, is limited. Consequently, the objective of this study was to evaluate the efficacy of fungicides and varietal response for the management of powdery mildew in gerbera grown under polyhouse conditions in Pasighat, Arunachal Pradesh.

MATERIALS AND METHODS

Field experiments (under polyhouse condition) were conducted at Instructional farm, Department of Floriculture, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh during April 2011 to March 2012 season following recommended as per package and practices of gerbera gardening. Fungicidal experiment was conducted in a completely randomized design with eight treatments. Variety Pia (highly susceptible) was planted in the raised beds with a spacing of 30 x 30 cm under polyhouse condition. Among the 1-8 treatments, first treatment was used as foliar spray of wettable sulphur @ 1.0g/l of water of beginning of disease initiation, each, wettable sulphur @ 1.5g/l, 2.0g/l and 2.5g/l of water, carbendazim @ 0.5g/l, 0.1g/l, 1.5g/l and carbendazim @ 2.0g/l of water at fortnightly intervals. Treatment nine was unprotected control (alone water spray). The effectiveness of the treatments was worked out by comparing their effect on disease severity. Disease severity ratings were analyzed fortnightly by analysis of variance (ANOVA) with mean separation by Fisher's Protected LSD (P=0.01), (P = 0.05) and (CV %). Disease ratings were used to calculate the severity as mention scale in varietal evaluation. For resistance evaluation, nine varieties of tissue culture derived gerbera viz. Figaro, Galileo, Manizales, Marinila, Palmira, Pia, Rionegro, Tecala and Teresa were planted in the raised beds with a spacing of 30 x 30 cm under polyhouse condition. The plants were provided with all the inputs as per package and practices for gerbera cultivation. This experiment was laid out in completely randomized design and replicated thrice with 20 plants for each replication. Powdery mildew was developed from the natural inoculums. In an earlier study for the evaluation of bio-fungicides for the management of powdery mildew of gerbera, the experiment was conducted using natural epiphytotic condition (Moyer and Peres, 11). Observations of powdery mildew were recorded at 40 days interval upto 5 months (Approximate160 days) of planting and 10 plants per replication were selected randomly for disease assessment. Disease severity was recorded on the upper leaf surfaces at the earlier growth stages and at the later stages on the lower leaves also and rated on a 0 to 6 scale (Standard disease severity scale) as 0 = No powdery growth, 1= 1-20% of the leaf area with powdery growth, 2 = 21- 40% of the leaf area with powdery growth, 3 = 41- 60% of the leaf area with powdery growth, 4 = 61- 80% of the leaf area with powdery growth, 5 = 81- 99% of the leaf area with powdery growth and 6 = 100 % of the leaf area with powdery growth (Moyer and Peres, 11). Using the standard disease score chart, the per cent disease index (PDI) was worked out according to the FAO (4) formula.

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of total numerical rating}}{\text{Total number of observations} \quad \text{Maxi. grade}} \; 100$$

From the PDI calculated, the reaction of the varieties were categorized as 0% PDI = Immune to powdery mildew, 5% PDI = Highly Resistant (HR), 5-10% = Resistant (R), 11-25% = Moderately Resistant (MR), 25-50% = Susceptible (S) and 51-100% = Highly Susceptible (HS).

RESULTS AND DISCUSSION

The results obtained during the course of experimentation (Table 1) clearly showed that all

the treatments reduced disease severity of powdery mildew of gerbera were significantly superior over control. Among fungicidal disease management, least disease severity (5.23 %), was observed in wettable sulphur @ 2.5g/l of water foliar spray at fortnightly intervals (all treatments) against powdery mildew disease severity, it was found significantly superior over all the tested treatments against powdery mildew of gerbera followed by Carbendazim @ 2g/ l of water foliar spray (7.23 %), whereas, the unprotected treatment showed highest disease severity (65.30 %), during course of the investigation. The highest number of flowers m^{-2} / year (195.00) and number of suckers / plant / year (6.60) were also recorded in wettable sulphur @ 2.5g/l of water foliar spray. The result was found significantly superior over all the tested treatments followed by Carbendazim @ 2g/l of water foliar spray and wettable sulphur @ 2.0g/l of water foliar spray number of flowers m^{-2}/year (190.60 and 178.00) and number of suckers / plant / year (6.40 and 4.60), respectively. However, rest of the treatments were also recorded least amount of powdery mildew disease severity and greatest number of flowers m^{-2} / year and number of suckers / plant / year as compared to untreated control (alone water spray). Among the fungicides evaluated for gerbera powdery mildew, wettable sulphur @ 2.5g/l of water foliar spray was the most effective. Nine varieties of gerbera were screened against powdery mildew under polyhouse condition. Powdery mildew symptoms were first observed on the leaves of the varieties viz. Pia, Rionegro and Tecala on 30 days after planting. In varieties Manizales, Teresa and Galileo powdery mildew incidence started only after 38 days of planting. On the other varieties Figaro, Marinila and Palmira powdery mildew incidence started only after 68 days of planting. Palmira variety showed resistance to powdery mildew with per cent disease index of 9.27% at the end of 160 days after planting followed by Figaro and Marinila with PDI of 9.73% and 10.23%, respectively. Variety Teresa showed moderately resistant reaction (24.57%) against powdery mildew infection. Varieties Pia and Tecala were highly susceptible to powdery mildew throughout the experiment which showed per cent disease index of 65.30% and 54.27%, respectively. Other varieties like Galileo (34.73%), Manizales (46.93%) and Rionegro (49.67%) were susceptible reaction to powdery mildew infection. These findings showed closely supported by earlier workers in screening for disease resistance in grapevine genotypes to powdery mildew infection (Jamadar *et al.,* 6) and in gerbera to powdery mildew (Kumar *et al.,* 8). The overcome economic losses due to disease and avoid repeated application of fungicides, development of resistant variety is the best method for disease management. Evaluation procedure in the green house could be used as a rapid assay to screen plants for resistance (Scholten *et al.,* 13). Screening could be important in the development and evaluation of new resistant cultivar if incorporated into breeding programmes (Kozik, 7). Though, the study to powdery mildew resistant screening methodology for gerbera under polyhouse condition has been established and few resistant varieties of gerbera against powdery mildew were indentified. Those varieties may be utilized for future breeding programme to evolve powdery mildew disease resistant gerbera varieties. All varieties performed as expected, Palmira, Figaro and Marinila were the resistant, Galileo, Manizales and Rionegro susceptible, and Pia and Tecala were highly susceptible. Disease symptoms appeared almost a month after transplanting and the powdery mildew epidemic developed slowly thereafter. During the first six weeks of the experiment, the relative humidity was below 80% and since powdery mildew develops best at a high humidity (80% to 90%) (Daughtrey *et al.*, 3), the low relative humidity was probably a constraint to a faster epidemic development. This adverse microclimatic condition (low humidity) was probably useful for the plant cells that were already infected by the powdery mildew fungi in that they reduced the speed of infection process giving the plant more time to transport material to the infection site and stop penetration by formation of papillae (Menzies *et al.,* 10). Our study is the first

Table1: Effect of fungicides against powdery mildew disease of gerbera during April 2011 to March 2012.

Treatments	Disease Severity	Number of flowers m^{-2} / year	Number of suckers /plant / year
Wettable sulphur (1.0g/l water)	22.00 *(27.97)	123.20	3.20
Wettable sulphur (1.5g /l water)	14.33 (22.22)	156.00	3.80
Wettable sulphur (2.0g/l water)	10.67 (19.09)	178.60	4.60
Wettable sulphur (2.5g/l water)	5.23 (13.18)	195.00	6.60
Carbendazim (0.5g/l water)	20.00 (26.56)	125.20	3.00
Carbendazim (1.0g/l water)	15.33 (23.03)	153.00	3.60
Carbendazim (1.5g/l water)	12.67 (20.88)	172.00	4.40
Carbendazim (2.0g/l water)	7.23 (15.56)	190.60	6.40
Control (alone water spray)	65.30 (53.91)	102.00	2.60
CD (P=0.01)	**0.91**	**4.62**	**0.74**
CD (P=0.05)	**0.67**	**3.35**	**0.54**
CV (%)	**1.99**	**1.25**	**7.33**

*Figures in parentheses are arc sine transformed value.

Table 2: Varietal response of gerbera against powdery mildew disease during April 2011 to March 2012.

Varieties	Per cent disease index*				Disease reaction	Number of flowers m^{2} / year	Number of suckers / plant/year
	40 DAP	80 DAP	120 DAP	160 DAP			
Figaro	0.0	3.93	6.53	9.73	R	143.00	3.80
Galileo	16.67	24.90	28.57	34.73	S	189.00	5.80
Manizales	12.50	16.90	31.33	46.93	S	137.20	3.20
Marinila	0.0	2.93	7.23	10.27	R	106.60	4.00
Palmira	0.0	1.57	6.50	9.27	R	190.00	5.40
Pia	23.77	33.27	55.00	65.30	HS	102.00	4.20
Rionegro	21.33	29.30	36.70	49.67	S	180.00	5.30
Tecala	19.33	31.00	44.93	54.27	HS	178.00	5.00
Teresa	10.33	15.67	20.77	24.57	MR	125.00	4.00

*Mean of three replications; DAP = Days after Planting

evaluation of two fungicides at different concentration for the management of powdery mildew of gerbera under polyhouse conditions. In addition, it significantly reduced powdery mildew severity in gerbera. Alternative products such as Cease, Milstop, Kaligreen, Biophos and electrolyzed oxidizing water were previously reported for control of powdery mildew of gerberas in other states including Georgia, Hawaii, and Michigan (Mueller *et al.,* 12; Uchida and Kadooka, 15). In conclusion, the fungicides tested at different concentration when applied prior to disease infection may reduce powdery mildew significantly compared to no treatment. As a consequence, these fungicides can be used as part of an integrated approach for disease management programme of powdery mildew in gerbera.

REFERENCES

1. Aswath, C. and Manjunath, T. Rao (2006). Breeding of gerbera (*Gerbera jamesonii* Bolus ex.

Hooker F.) lines suitable for open field cultivation. *J. Orna. Hort.,* **9**(4): 243-247.

2. Aswath, C. and Survay, Nazneen (2004). An improved method for *in vitro* propagation of gerbera. *J. Orna. Hort.,* **7**(2): 141-146.
3. Daughtrey, M., Wick R.L. and Peterson, J.L. (1995). *Compendium of flowering potted plant diseases.* APS Press, St. Paul, MN.
4. FAO (1967). *Crop losses due to diseases and pest.* Rome: Food and Agricultural Organization.
5. Halevy, A.H. and Mayak, S. (1981). Sensecense and post harvest physiology of cut flowers-Part II. *Horti. Revi.*, **3**: 59-143.
6. Jamadar, M.M., Jawadagi, R.S. and Patil, D.R. (2007). Nursery screening of grapevine genotypes to powdery mildew infection. *J. Asian Hort.,* **4:** 69-70.
7. Kozik, E.V. (1999). Evaluation of two techniques for screening tomatoes for resistance to *Fusarium* crown and root rot. *Vege. Crop Res. Bull.*, **50:** 5-12.
8. Kumar, S., Tomar, K.S. and Shakywar, R.C. (2012). Response of gerbera varieties against powdery mildew disease under polyhouse condition. *HortFlora Res. Spectrum,* **1**(3) : 286-288.
9. Latha, T.K.S. and Suresh, J. (2010). Varietal screening of gerbera for their response to powdery mildew disease. *J. Orna. Hort.,* **13** (2): 157-159.
10. Menzies, J., Bowen, P., Ehret D., and Glass, D.M. (1992). Foliar application of potassium silicate reduces severity of powdery mildew on cucumber, muskmelon, and zucchini squash. *J. Amer. Soc. Hort. Sci.*, **117**(6):902–905.
11. Moyer, C. and Peres, N.A. (2008). Evaluation of bio-fungicides for control of powdery mildew of gerbera daisy. *Proc. of Florida State Hortic. Soc.*, **121:** 389-394.
12. Mueller, D.S., Hung, Y.C., Oetting, R.D., Van Iersel, M.W. and Buck, J.W. (2003). Evaluation of electrolyzed oxidizing water for management of powdery mildew on gerbera daisy. *Plant Dis.,* **87**:965–969.
13. Scholten, O.E., Panella, L.W., Bock, T.S.M., and De Lange, W. (2001). A green house test for screening sugarbeet (*Beta vulgaris*) for resistance to *Rhizoctonia solani. European J. Plant Pathol.,* **107:** 161-166.
14. Tjia, B., Black, R.J. and Park-Brown, S. (2008). *Gerberas for Florida.* CIR527. Gainesville: University of Florida Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu / mg 034.
15. Uchida, J.Y and Kadooka, C.Y. (2001). Control of powdery mildew on gerbera in Hawaii. Joint Mtg. of *Amer. Phytopathol. Soc.,* Mycol. Soc. of Amer., and Soc. of Nematologists, Salt Lake City, Utah, 25–29 Aug. 2001.