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Management of Rose Powdery Mildew Caused by *Podosphaera pannosa* (Wallr.) de Bary

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ABSTRACT

Rose powdery mildew caused by *Podosphaera pannosa* (Wallr.) de Bary is the most occurring disease on roses worldwide cause severe losses both quality and quantity of the produce, hence present investigation was carried out under field studies during 2019-20 for effective management through cultural practices (Spacing and pruning), natural products and fungicides and find out suitable weather parameters for disease development. Wider plant spacing (60 cm × 90 cm) showed minimum powdery mildew intensity while maximum yield was found in closer (60 cm × 30 cm). Minimum disease intensity with maximum flower yield was recorded in 15th December pruning followed by 1st December pruning. Neem oil showed significantly minimum powdery mildew intensity (16.89%), highest disease control (40.77 %), maximum flower yield (12.93 MT ha^{-1}), highest yield increased (40.60%) and highest flower diameter (5.14 cm). Difenoconazole (0.05%) showed significantly minimum powdery mildew intensity (11.21%), highest disease control (51.88%), maximum flower yield (14.54 MT ha^{-1}) highest yield increased (40.60%) and highest flower diameter (5.14 cm). Powdery mildew development was positively correlated with morning relative humidity (0.166), evening relative humidity (0.005) and wind velocity (0.221) and negatively correlated with minimum temperature (–0.767), maximum temperature (–0.635) and effective rainfall (–0.234).

Keywords Rose, Powdery mildew, Spacing, Pruning, Eco friendly management.

INTRODUCTION

Rose, one of the nature's beautiful creations which are usually acclaimed as the 'Queen of Flowers'. Rose occupies a prominent place amongst the flower crops and one of the oldest fragrant flower cultivated by man. Its different types having beautiful flowers of exquisite shapes, varied sizes, be witching colors and delightful fragrance captivate the flower lovers. Rose is grown for various purposes such as garden flowers, aesthetic values as a cut flower for decorative purposes and for making various products from rose petals such as rose oil, rose water, gulkand, pankhuri and gul-roghan. Rose hips are very good source of vitamin-A, B_2, C and K. Rose can be grown throughout the year in India under open and protected cultivation. Infect, the vast Indian sub-continent with its varied climate provides diverse ecological niches, so that roses spread their charm year round almost without a

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pause. Today, the success of cut flower trades, both in domestic and international markets, depends upon the quality. But flower grown in open fields are subjected to various biotic and abiotic stresses due to which their quality deteriorates because of blemishes and losses due to insect pests and diseases. Powdery mildew caused by fungal pathogen Sphaero the capannosa (Wallr.) Lev. is known to cause severe damage to this crop, both in open and protected cultivation. The powdery mildew fungi seldom kill their hosts but utilize their nutrients, reduce photosynthesis, increase respiration and transpiration, impair plant growth and reduce the yield, ranging between 20 to 40% depending upon the congenial environment favorable for their growth and multiplication (Agrios 2005). The losses particularly in roses ranged between 20 to 25% as reported by Kumar (1998). To check the heavy loss caused by powdery mildew it becomes necessary to manage this disease. In order to do this there is a need to evaluate the botanicals and bio-agents for their efficacy against the pathogen. Considering the economic importance of the powdery mildew disease of rose, studies were undertaken with the objective to manage the disease with the help of fungicides, plant products, pruning time, spacing and find out suitable weather parameters for disease development.

MATERIALS AND METHODS

All field trial was conducted at College Farm, College of Horticulture, SD Agricultural University, Jagudan, District Mehsana Gujarat, India during 2019-20 to determine proper spacing, pruning time, natural plant products, fungicides and suitable weather parameters in management of powdery mildew of rose. The dasi rose (Rosa spp.) were used in the field trials. The trials were laid out in a Randomized Block Design (RBD) with four replications for each treatment ten plants were used for every treatment and with a spacing of 60 × 60 cm. The rose were planted on 12th April, 2019 for all experiment. The recommended package of practices were followed to cultivate the rose crop.

The average per cent disease incidence from 5 plants of powdery mildew was worked out by using following 0–5 given by Sahni (1987) with slight modification. The disease incidence was worked out as below to calculate per cent disease index by using following formula (Mc Kinney 1923).

$$\text{Per cent Disease Intensity (PDI)} = \frac{\text{Sum of the disease ratings}}{\text{Total number of sample observed} \times \text{Maximum disease grade}} \times 100$$

Where,
PDI = Per cent disease incidence,
0 = No infection,
1 = 1–5 % area infected/average extension growth mildewed,
2 = 6–15% area infected/average extension growth mildewed,
3 = 15–35% area infected/average extension growth mildewed,
4 = 35–50% area infected/average extension growth mildewed,
5 = > 50% area infected/average extension growth mildewed.

The per cent disease control was calculated with the help of the following formula (Mathur *et al.* 1971).

$$\text{Per cent Disease Control (\%)} = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in control}} \times 100$$

Total number of flowers per plant were recorded, average number of flowers per plot was worked out from the five tagged plants and then it was converted into yield of flowers per hectare. Flower yield was recorded from December to March on weekly interval picking.

Diameter of flower bud from ten randomly harvested flower shoot was recorded with the help of venire caliper and averaged out.

The disease development was correlated with

Table 1. Effect of spacing on powdery mildew intensity and flower yield of rose. *Figures in parentheses re-transformed values of arc sign. Treatments mean with the common letter(s) are non- significant by DNMRT at 5% level of significance.

Sl. No.	Treatments	Disease intensity (%)	Flower yield (MT ha^{-1})
T_1	60 cm × 30 cm	38.85*^{a} (38.88)	14.15^{a}
T_2	60 cm × 45 cm	36.80^{b} (35.43)	12.37^{b}
T_3	60 cm × 60 cm	35.23^{b} (32.81)	10.01^{c}
T_4	60 cm × 75 cm	32.84^{c} (28.96)	9.02^{c}
T_5	60 cm × 90 cm	30.55^{d} (25.39)	9.12^{c}
SEm±		0.52	0.32
CD at 5 %		1.60	0.98
CV %		2.98	5.81

Table 2. Effect of different pruning time on powdery mildew development in rose under open field during 2019-20. *Figures in parentheses re-transformed values of arc sign. Treatments mean with the common letter (s) are non -significant by DNMRT at 5 % level of significance.

Sl. No.	Treatments	Disease intensity (%)	Flower yield (MT ha^{-1})
T_1	1st September	40.62*^{a} (41.94)	8.24^{g}
T_2	15th September	39.88^{a} (40.64)	8.74^{fg}
T_3	1st October	39.72^{a} (40.38)	9.06^{ef}
T_4	15th October	38.97^{a} (39.09)	9.57^{de}
T_5	1st November	38.59^{ab} (38.46)	10.10^{cd}
T_6	15th November	36.26^{b} (34.52)	10.73^{bc}
T_7	1st December	33.22^{c} (29.55)	11.33^{ab}
T_8	15th December	32.08^{c} (27.74)	11.69^{a}
SEm±		0.80	0.24
CD at 5 %		2.43	0.74
CV %		3.70	4.27

weather parameters viz., maximum and minimum temperature, morning and evening relative humidity rainfall and wind velocity on rose plants under open field condition. Weekly data on weather parameters collected from Meteorological Observatory, Seed Spices Research Station, SD Agricultural University, Jagudan, Gujarat.

RESULTS AND DISCUSSION

Effect of spacing on powdery mildew development in rose

Plant population greatly influenced powdery mildew intensity of rose. Analysis of data presented in Table 1 showed that 60 cm × 30 cm spacing showed highest 38.88% disease intensity which was significantly higher than other treatments. Minimum disease intensity 25.39% was found with 60 cm × 90 cm spacing. However, spacing of 60 cm × 45 cm and 60 cm × 60 cm was found at par.

Data of flower yield indicated that spacing 60 cm × 30 cm was significantly superior to 60 cm × 45 cm spacing. Maximum 14.15 MT ha^{-1} flower yield was recorded in 60 cm × 30 cm spacing followed by 60 cm × 45 cm spacing (12.37 MT ha^{-1}). The spacing of 60 cm × 75 cm resulted in lowest (9.02 MT ha^{-1}) flower yield which were at par with 60 cm × 90 cm spacing (9.12 MT ha^{-1}) and 60 cm × 60 cm spacing (10.01 MT ha^{-1}). Patel *et al.* (2017) studied the effect of spacing on intensity of cumin powdery mildew. Crop sown at 30 cm ×10 cm and 45 cm × 10 cm was found at par and recorded significantly lower powdery mildew intensity as compared to sowing through broadcasting. Kumawat *et al.* (2017) reported that wider spacing of 15 cm × 45 cm, 15 cm × 30 cm and 10 cm × 45 cm between rows and within rows recorded minimum per cent disease intensity (36.11, 39.66 and 45.39), respectively in fenugreek. However, closer spacing 5 cm × 15 cm recorded maximum fenugreek seed yield and per cent powdery mildew intensity. Thus, the results obtained in present investigation corroborate with the findings of earlier research workers.

Effect of pruning time on powdery mildew development in rose

The rose plants under experimentation were pruned with secateur at 15 days interval from September to December. The observations on severity of powdery mildew were recorded at weekly interval on a 0–5 scale as described earlier. Treatment-wise disease intensity and flower yield data are given in Table 2.

The data revealed significant differences in mean per cent disease intensity of powdery mildew in rose amongst dates of pruning. The minimum disease intensity was recorded with the pruning on December

Table 3. Effect of different eco-friendly products against powdery mildew of rose caused by *P. pannosa.* *Figures in parentheses re-transformed values. Figures indicating common alphabets in superscript do not differ significantly at 5% level of significance according to DNMRT.

Sl. No.	Natural products	Conc. (%)	Disease intensity (%)		Disease control (%)	Flower diameter (cm)	Fruit yield (MT/ha)	Yield increased (%)
1	Sodium bicarbonate	1	28.09*^{fg}	(21.72)	32.42	4.40^{c}	12.00^{bc}	36.00
2	Full creamed milk	10	33.54^{cd}	(30.06)	19.31	4.15^{cde}	10.60^{ef}	27.54
3	Neem oil	5	24.62^{h}	(16.89)	40.77	5.14^{a}	12.93^{a}	40.60
4	Neem leaf extract	10	30.43^{ef}	(25.24)	26.79	4.33^{cd}	11.59^{cd}	33.73
5	Pilodi extract	10	35.16^{c}	(32.70)	15.41	4.09^{de}	10.12^{f}	24.11
6	Fermented cow- urine	10	31.79^{de}	(27.30)	23.52	4.23^{cd}	10.94^{de}	29.79
7	Kaoline	1	26.90^{gh}	(20.03)	35.28	4.83^{b}	12.57^{ab}	38.90
8	Water spray	–	38.67^{b}	(38.59)	6.97	3.96^{ef}	9.32^{g}	17.59
9	Control (No spray)	–	41.57^{a}	(43.56)	–	3.82^{f}	7.68^{h}	–
SEm±		–	0.82	–	0.08	0.08	–	–
CD at 5%		–	2.47	–	0.24	0.24	–	–
CV%		–	4.41	–	3.22	3.22	–	–

15th (27.74 %), followed by December 1st (29.55%), November 15th (34.52%), November 1st (38.46%), October 15th (39.09%), October 1st (40.38%), September 15th (40.64%) and September 1st (41.94%), respectively. Pruning at 15th December was at par with 1st December pruning, pruning on 1st September were at par with 15th September, 1st October and 15th October and pruning on 15th November was at par with 1st November. As the pruning time of rose was delayed with different intervals from 1st September to 15th December resulted in decreasing powdery mildew severity. Thus, it can be revealed that the late pruned crop exhibited less powdery mildew intensity because of decrease in crop canopy.

Flower yield of rose was influenced by pruning time. The flower yield obtained from 15th December pruning (11.69 MT ha^{-1}) and 1st December pruning (11.33 MT ha^{-1}) was higher compared to early pruning. It ranged from 8.24 to 11.69 MT ha^{-1}. The lowest flower yield was obtained from 1st September pruning (8.24 MT ha^{-1}). More or less all the treatments were at par with each other.

Similar results have also been presented by Jamadar and Jahagirdar (2004) and they investigated on the effect of pruning periods on powdery mildew incidence in ber. The results clearly indicated that, early pruning in mid-April is not generally suitable from the point of view of disease incidence and its subsequent severity resulting in low yields. Hence it is advisable to go for late pruning periods ; preferably in April-end to early May for the effective and economic management of powdery mildew disease. Sharma *et al.* (2019) studied on the effect of foliage trimming once or twice on powdery mildew disease (PDI) intensity, canopy microclimate and seed as well as foliage yield of fenugreek crop. Foliage trimming reduced the powdery mildew intensity (PDI). Temperature and RH data from crop canopy showed that trimming treatment reduced the RH% and slightly increased the temperature. Thus, the results obtained in present investigation corroborate with the findings of earlier research workers.

Eco-friendly management of rose powdery mildew under field condition

The perusal of the data (Table 3) revealed that all the eco-friendly products were effective in lowering the disease intensity with per cent disease control. Minimum per cent disease intensity (16.89%) of powdery mildew with highest disease control (40.77%) was observed in 5% neem oil spray which was at par with spray of 1% kaoline spray (20.03%) with 35.28% disease control. Maximum per cent disease intensity (32.70) was observed with spray of 10%

Table 4. Effect of fungicides against powdery mildew of rose caused by *P. pannosa.* *Figures in parentheses re-transformed values. Figures indicating common alphabets in superscript do not differ significantly at 5% level of significance according to DNMRT.

Sl. No.	Natural products	Conc. (%)	Disease intensity (%)		Disease control (%)	Flower diameter (cm)	Fruit yield (MT/ha)	Yield increased (%)
T_1	Wettable sulfur 80% WP	0.20	25.08^{de}	(17.49)*	39.66	4.43^{d}	12.02^{cd}	33.36
T_2	Dinocap 48% EC	0.05	25.45^{d}	(18.00)	38.77	4.34^{de}	11.66^{cde}	31.30
T_3	Propiconazole 25% EC	0.05	24.43^{de}	(16.63)	41.23	4.63^{c}	12.38^{c}	35.29
T_4	Azoxystrobin 25% EC	0.05	29.70^{c}	(24.09)	28.55	4.17^{f}	11.06^{e}	27.57
T_5	Pyroclostrobin 20% WG	0.05	26.30^{d}	(19.17)	36.73	4.21^{ef}	11.35^{de}	29.42
T_6	Difenoconazole 25% EC	0.05	20.00^{f}	(11.21)	51.88	5.10^{a}	14.54^{a}	44.91
T_7	Tebuconazole 25.9% EC	0.05	21.27^{f}	(12.70)	48.83	4.90^{b}	13.91^{ab}	42.41
T_8	Hexaconazole 5% EC	0.01	22.49^{ef}	(14.22)	45.89	4.81^{b}	13.32^{b}	39.86
T_9	Water spray	-	37.48^{b}	(36.59)	9.83	3.86^{g}	9.20^{f}	12.93
T_{10}	Control (No spray)	-	41.57^{a}	(43.56)	-	3.72^{g}	8.01^{g}	-
SEm±				0.82	-	0.05	0.22	
CD at 5%				2.45	-	0.16	0.64	
CV%				5.21	-	2.14	3.19	

pilodi extract with lowest disease control (15.41%) which was at par with 10% full creamed milk spray (30.06%) with 19.31% disease control.

All eco-friendly product significantly increased the rose flower yield as compared to control. It ranged from 17.59 to 40.60% increase in yield. The highest rose flower yield (12.93 MT ha^{-1}) was obtained with spray of neem oil 5% which was at par with kaoline 1% spray (12.57 MT ha^{-1}). The other treatments viz., sodium bicarbonate (12.57 MT ha^{-1}), neem leaf extract (11.59 MT ha^{-1}), fermented cow urine (10.94 MT ha^{-1}), full creamed milk (10.60 MT ha^{-1}), pilodi extract (10.12 MT ha^{-1}) and water (9.32 MT ha^{-1}) gave significantly higher yield as compared to control.

Maximum per cent yield increase was observed in the treatment neem oil (40.60%) followed by kaoline (38.90%). The other treatments like sodium bicarbonate, neem leaf extract, fermented cow urine, full creamed milk, pilodi extract and water spray gave 36, 33.73, 29.79, 27.54, 24.11 and 17.59% yield increased respectively, over the control.

Results revealed that there were significant differences in diameter of flower bud due to different eco-friendly treatments. Significantly highest 5.14 cm and the lowest 3.96 cm diameter of flower bud were recorded in the treatment neem oil and water spray respectively, followed by kaoline 4.83 cm and neem leaf extract 4.33 cm as against control 3.22 cm. All the eco-friendly product treatments showed increased diameter of flower bud than the control. These indicate that the eco-friendly product sprays could improve the quality of flowers.

Neem oil proved to be best eco-friendly product for control of rose powdery mildew in the present investigation followed by kaoline, sodium bicarbonate, neem leaf extract, fermented cow urine, full creamed milk and pilodi extract. Earlier researchers also noted that neem base natural products were effective for control of powdery mildew of rose plant. Ragupathi *et al.* (1994) reported that neem oil and neem seed kernel extracts reduced incidence of Powdery mildew of *Abelmoschus esculentus* caused by *E. cichoracearum*. Pawar and Chavan (2010) reported neem leaf extract (15%), *Parthenium* leaf (10%), *Ocimum* leaf (20%), citrus leaf (20%), *Annona s quamosa* leaf (10%), *Ipomoea* (15 %) and Jowar leaf (20%), cow urine (15 %), butter milk (20%) and ash spray (20%) found effective against powdery mildew disease of cucurbits. Dinesh *et al.* (2015) observed that *Azadirachta indica* and NSKE at 5% concentration showed highest disease reduction (81.94 and 78.33%) and (69.07 and 66.93%) *in vitro* and *in vivo*, respectively. Mishra *et al.* (2017) studied application of five natural products for the control of powdery mildew of pea plants, among them, neem

Table 5. Role of meteorological parameters on development of powdery mildew of rose during 2019-20. *Week No. 9 have 8 days during leap year; ** Week No. 52 always have 8 days.

Month and year	Standard week No.	Date of observation	PDI	Temperature (°C) Minimum	Temperature (°C) Maximum	Morning RH (%)	Evening RH (%)	Rainfall (mm)	Wind velocity (km/hr)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
November-2019	46	17	0.00	22.86	31.71	74.42	47.85	0.00	3.18
	47	24	0.00	21.43	31.07	67	43.42	0.00	2.23
	48	1 Dec	2.25	21.07	29.86	77.57	55.28	0.00	3.17
December-2019	49	8	4.50	21.06	28.19	68.14	46.28	0.00	3.87
	50	15	7.56	19.27	26.77	74.85	55	4.00	2.95
	51	22	15.25	18.13	25.14	80.57	54.57	0.00	3.27
	52**	31	25.30	19.78	25.92	78.88	46.55	0.00	3.53
January-2020	01	7	30.45	16.93	23.79	81.71	60.57	0.00	3.09
	02	14	38.40	13.36	23.21	74.71	62	0.00	4.94
	03	21	45.76	12.19	23.07	83	53.57	0.00	3.43
	04	28	42.28	15.80	26.71	73.42	44.14	0.00	3.15
	05	4 Feb	40.73	14.34	25.04	70.71	39.71	0.00	3.5
February-2020	06	11	36.54	15.93	25.91	61.85	43.14	0.00	4.77
	07	18	30.42	20.36	30.37	65.14	43.42	0.00	3.4
	08	25	26.67	20.96	31.06	67.42	40.43	0.00	2.98
	09*	4 Mar	20.84	23.33	32.87	80.57	46.71	0.00	2.90
March-2020	10	11	15.78	23.43	30.07	71.42	49.28	1.70	4.60
	11	18	10.89	23.41	30.21	59.28	45.14	0.00	4.15
	12	25	7.67	28.21	34.71	67	44.85	0.00	4.50

oil was found most effective organic amendment. The minimum per cent disease incidence was found in neem oil (31.80%) followed by eucalyptus leaf extract (34.33%) and neem leaf extract (37.20%). Thus, the results of the present investigations are also in agreement with the results of earlier researchers.

Evaluation of fungicides against rose powdery mildew under field condition

Table 4 revealed that all the fungicides tested reduced the disease significantly as compared to the control. Difenoconazole (0.05%) was the most effective fungicide with 11.21% least mean disease intensity which was at par with by tebuconazole (0.05 %) with 12.70% mean disease intensity. Hexaconazole, propiconazole, wettable sulfur, dinocap, pyroclostrobin, azoxystrobin and water were found moderately effective with 14.22, 16.63, 17.49, 18.00, 19.17, 24.09 and 36.59% disease intensity, respectively. Per cent disease control ranged from 9.83 to 51.88. Maximum disease control of 51.88 % was observed in the treatment of difenoconazole followed by tebuconazole by 48.83 % as compared to control.

All the fungicide treatments significantly increased the flower yield as compared to control. It ranged from 12.93 to 44.91% increase in yield. The highest rose flower yield of 14.54 MT ha^{-1} was obtained in the treatment of difenoconazole followed by tebuconazole with 13.91 MT ha^{-1}. The other treatments viz., Hexaconazole, propiconazole, wettable sulfur, dinocap, pyroclostrobin and azoxystrobin gave significantly higher yield as compared to control. Maximum per cent yield increment was found in the treatment difenoconazole (44.91%) followed by tebuconazole (42.41%). The other treatments viz., hexaconazole, propiconazole, wettable sulfur, dinocap, pyroclostrobin, azoxystrobin and water spray gave 39.86, 35.29, 33.36, 31.30, 29.42, 27.57 and 12.93% yield increased, respectively over the control.

The data revealed that there were significant differences in diameter of flower bud due to differ-

Table 6. Correlation between meteorological parameter and powdery mildew intensity in rose during 2019-20. *Correlation is significant at the 0.05 level. Critical value- 0.49, n- 26.

Sl. No.	Meteorological parameter	Correlation coefficient (r)
1	Minimum temperature (°C)	–0.767
2	Maximum temperature (°C)	–0.635
3	Morning relative humidity (%)	0.166
4	Evening relative humidity (%)	0.005
5	Effective rainfall (mm)	–0.234
6	Wind velocity (km/hr)	0.221

ent treatments. Significantly highest 5.10 cm and the lowest 4.17 cm diameter of flower bud were recorded in the treatment difenoconazole and azoxystrobin, respectively followed by tebuconazole 4.90 cm which was at par with hexaconazole 4.81 cm as against control 3.72 cm. All the fungicidal treatments showed increased diameter of flower bud than the control. These observations indicate that the fungicidal sprays could improve the quality of flowers. Difenoconazole proved best fungicide for control of powdery mildew in the present investigation followed by tebuconazole. Earlier researchers also noted that triazole fungicides were effective for control of powdery mildew of rose plant. Difenoconazole found the most effective in controlling powdery mildew in various crop viz., rose (Kakade *et al*. 2006, Chaudhary *et al.* 2009, Wei *et al.* 2014, Kumar and Chandel 2018a) and sunflower (Dinesh *et al.* 2011) has been reported. Thus, the results of the present investigations are also in agreement with the results of earlier research workers.

Role of meteorological parameters on development of rose powdery mildew

The data presented in the Table 5 revealed that the powdery mildew intensity was initiated in the field from 48th SMW of 2019 and was continued up to 12th SMW of 2020 of the crop. The data further revealed that the disease initiate with very low intensity of 2.25% progressed to as high as 45.76% intensity during 3rd SMW. Correlation coefficient between meteorological parameters and disease intensity were presented in Table 6. The positive and significant relationships of rose powdery mildew intensity were registered with morning relative humidity (0.166), evening relative humidity (0.005) and wind velocity (0.221). However, meteorological factors viz., minimum temperature (–0.767), maximum temperature (–0.635) and effective rainfall (–0.234) exhibited significant negative relationship with per cent disease intensity of powdery mildew disease at 0.05% level. Gupta *et al.* (2004) also reported that the simple correlation coefficient between the per cent disease index (PDI) of rose powdery mildew and average relative humidity was highly significant (0.873) and positive thereby showing consistent effect of relative humidity on disease development. However, correlation coefficients between disease severity and temperature (–0.737) and light (–0.623) were found significant and negative. Thind and Kaur (2005) reported that correlation coefficient analysis of weather parameters and disease severity revealed a negative correlation of ber powdery mildew with minimum temp. (–0.518), maximum temp. (–0.287), average (–0.012) relative humidity, rainfall (–0.262) and a positive correlation with morning (0.453) relative humidity. They also observed that ber powdery mildew prevailed from September to February. Kumar and Chandel (2018b) studied the effect of epidemiological factors on severity of rose powdery mildew. Simple correlation between per cent disease index with temperature was (0.910), cumulative rainfall (–0.545), average relative humidity (0.616) and total sunshine hours (–0.760). However, multiple regression equation indicated powdery mildew severity was dependent upon meteorological factors about 97.2% for the disease development during years 2015 and 2016.

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