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Effect of date of sowing on disease incidence of powdery mildew in dill seed and its relation with weather parameters

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Abstract

Powdery mildew of dill seed appears during the month of January and March when the crop attains an age of 2 to 3 months. Among different dates of sowing, the earliest sown crop *i.e.,* 21st October proved to be the most effective in reducing the disease intensity (26.00 %) and increasing the seed yield of dill (1164 kg ha^{-1}). The highest volatile oil per cent (2.40) and 1000-seed weight (6.55 g) was recorded in case of early sown crop *i.e.,* 21st October (D_1), whereas, the least was in late sown crop of 1st December (D_5). The early sown (21st October) dill crop significantly reduced mean powdery mildew disease intensity; as a result there was increase in seed yield, seed weight and oil content as compared to late sown (21st November and 1st December) dill seed crop. The correlation between powdery mildew disease intensity and weather parameter was non-significant in case of early sown crop of 21st October. In the sowing of 11th November maximum and minimum temperature recorded positive and significant correlation with disease intensity. In late sowing of 1st December the maximum and minimum temperature showed negative and significant correlation whereas, wind speed recorded positive and significant correlation with per cent disease intensity of powdery mildew in dill seed. It showed that higher relative humidity is not favourable, but cooler the days coupled with wind multiplying and disseminating the disease fast.

Key words : Dill seed, disease incidence, *erysiphe heraclei*, powdery mildew, correlation.

Introduction

Dill seed (*Anethum graveolens*) is an annual herb in the family *Apiaceae*. It is the sole species of the genus *Anethum*. It is known to be a native of Central Asia, but is also been widely grown in large quantity in Egypt and Mediterranean countries or Eastern Europe. It is also getting popular in North America. It's related species *Anethum* Sowa is grown in India whose fruits are larger, but less fragrant. India and Pakistan have the major dill production areas, while Egypt, Fiji, Mexico, Netherland, United States, England and Hungary are other countries, making small contributions to the world production (http://www.agrocrops.com/dill seed).

Dill seed is fed to animals after calving. Seed of dill yields 2.5 to 3.5 per cent essential oil rich in carvone, which imparts its characteristics flavor. Both seed and oil used in medicine. Preparation of dill water and similar products are used in flatulent, abdominal and colic pain. Dill is a warm-season biennial herb having 2 to 4 feet height. Dill has finely cut feathery blue-green leaves a top hollow stems with green and white stripes. Small greenish-yellow flowers bloom on flat-topped clusters from summer to autumn. Flat, oval, light-brown seeds follow the blossoms. Dill seed or sowa is a small annual plant with smooth and fine leaves.

Change in sowing time lead to significant change in weather parameter and consequently the performance of the crop. In addition to crop management, the physical environment has profound influence on growth, biomass production and oil accumulation. Temperature, sunlight and other meteorological factors may individually or collectively limit the plant growth and production. Date of sowing has an important role in deciding growth and production. Adjustment in sowing time creates favourable environmental conditions for better performance of all physiological processes in plant and for escaping from pest and diseases which provides great opportunity to maximize the production.

Material and methods

The trial was conducted during the years 2016-2017 at Seed Spices Research Station, Jagudan and Department of Plant Pathology, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar. Gujarat Dill seed-3 (GD-3) were sowing in the month of october at a distance 45 cm in a plot size 3.60 m × 4.00 m. The study was laid out in RBD with four replicates of five date of sowing. The crop was sown in natural condition and were regularly observed for the development of the disease till harvest, without adding any inoculum.

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Observations recorded

Per cent Disease Intensity (PDI)

Per cent disease intensity of *Powdery milded* was recorded from 20 tagged plants of a plot at 20 days interval. An observation on per cent disease intensity of powdery mildew of dill seed was recorded from different treatments. Per cent disease intensity was worked out by using formula given by Datar and Mayee, 1981.

$$PDI = \frac{\text{Sum of all numerical ratings}}{\text{Total plants examined} \times \text{Maximum ratings}} \times 100$$

Seed yield

The crop was harvested after 140 days when the seeds matured and dried enough and separated by threshing. The seeds were cleaned and plot-wise yield was recorded. Yield hectare^{-1} was calculated and the data were analyzed statistically.

Volatile oil per cent

The analysis of volatile oil content from dill seed seeds was carried out using steam distillation method (AOAC, 1984). For carrying out analysis of volatile oil content, plot-wise harvested seeds were collected and 25 g sample from each plot subjected for analysis.

1000-seed weight (g)

The 1000-seeds of dill seed were randomly selected from the yield lot of each plot and weighed on digital analytical balance. The data recorded for each sample and subjected to statistical analysis.

Weather parameters

During the period of investigation, the standard week-wise weather parameters *viz.,* maximum temperature, minimum temperature, mean temperature, relative humidity (morning and afternoon), bright sunshine hours and wind speed were recorded at meteorological observatory, Seed Spices Research Station, S. D. Agricultural University, Jagudan, and the data were used for correlating with the severity of powdery mildew disease

Results and discussion

Per cent Disease Intensity (PDI)

The data revealed significant differences in mean per cent disease intensity of powdery mildew in dill seed with different dates of sowing. Minimum disease intensity was recorded with the sowing date of October 21st (26.00 %), followed by November 1st (33.00 %), November 11th (52.75 %), November 21st (46.75 %) and December 1st (62.00 %), respectively. As the sowing time of dill seed crop was delayed with different intervals from 21st November to 1st December resulted in increasing powdery mildew severity. Thus, it can be revealed that the late sown crop exhibited more powdery mildew intensity because of readily availability of inoculum. The inoculum in early sown crop was carried to late sown crop which resulted in heavy build-up of inoculum which increasing powdery mildew disease severity.

Seed yield (kg ha^{-1})

The differences in seed yield of dill seed were found significant among different dates of sowing. The highest mean seed yield (1164 kg ha^{-1}) was recorded with sowing date of 21st October followed by 1st November (1109 kg ha^{-1}), 21st November (1092 kg ha^{-1}), 11th November (995 kg ha^{-1}) and 1st December (485 kg ha^{-1}). The delayed sowing of dill seed crop from 21st November to 1st December resulted in decreasing seed yield. The higher seed yield in early sown crop might be due to the lower powdery mildew disease intensity. Similarly, decreased in seed yield was accordance to increasing powdery mildew severity in late sown crop.

Seed weight (g)

Mean of 1000-seed weight of dill seed was recorded from different sowing dates where maximum seed weight of 6.55 g was recorded with 21st October and 6.45 g with 1st November date of sowing which stood at par statistically. The least seed weight of 1000 dill seed (6.00 g) was

Table 1. Effect of different dates of sowing on per cent disease intensity of powdery mildew and seed yield of dill seed

Treatments	Disease intensity (%)	Seed yield (kg ha^{-1})
D_1 : 21st October	30.81 (26.00)*	1164
D_2 : 1st November	35.25 (33.00)	1109
D_3 : 11th November	46.85 (52.75)	995
D_4 : 21st November	43.40 (46.75)	1092
D_5 : 1st December	52.24 (62.00)	485
S.Em. ±	1.44	37.66
C.D. at 5 %	4.45	116.06
C.V. %	6.93	7.77

* Figures in parentheses retransformed values.

recorded with 1st December as due to the high disease severity at late sowing of the crop.

Volatile oil content (%)

The mean oil content at different dates of sowing of dill seed crop was varied significantly. The maximum mean oil content (2.40 %) was recorded with 21st October sown crop which was at par with 1st November (2.30 %). The succeeding dates of sowing progressively decreased the oil content might be due to the high severity of the powdery mildew diseases which deteriorates the quality of grains. Sharma (1999) reported that powdery mildew intensity of fenugreek was comparatively less in early sown crop of October month than the late sown crop of November month, as a result reduced seed yield in late sown crop. It is noted that with the subsequent delayed in sowing time, progressively increased powdery mildew intensity in mungbean (Thakur *et al.,* 2004 and Wadje *et al.,* 2008). It can be revealed in the present study that as delayed the sowing time of dill seed crop progressively increase powdery mildew intensity, which resulted decreasing in seed yield, seed weight and oil content significantly. Similarly, protected dill seed crop against powdery mildew disease by the application of fungicide, increased seed yield, thousand seed weight and oil content positively as compared to untreated crop.

21st October (D_1)

The simple correlation co-efficient analysis (Table 3) of weather parameters and disease severity revealed non-significant correlation of disease intensity with minimum temperature, maximum temperature, mean temperature, relative humidity and wind speed. It is indicative that the conditions are not favourable for the disease development and crop is getting matured with less the attack of the disease.

1st November (D_2)

The simple correlation co-efficient analysis of weather parameters and disease severity revealed non-significant correlation of disease intensity with maximum temperature, mean temperature, relative humidity and wind speed. A positive and significant correlation was observed with minimum temperature (1.00). It revealed that minimum night time temperature is important for the multiplication of the spore of pathogen.

11th November (D_3)

The simple correlation co-efficient analysis of weather parameters and disease severity revealed non-significant correlation of disease intensity with mean temperature, relative humidity and wind speed. A positive and significant correlation was observed with minimum temperature (0.95) and maximum temperature (1.00). It showed that cool and dry weather plays important roll for disease development.

21st November (D_4)

The simple correlation co-efficient analysis of weather parameters and disease severity revealed a negative and non-significant correlation of disease intensity with

Table 2. Effect of different dates of sowing on 1000-seed weight and volatile oil of dill seed.

Treatments	1000-seed weight (g)	Volatile oil (%)
D_1 : 21st October	6.55	2.40
D_2 : 1st November	6.45	2.30
D_3 : 11th November	6.12	2.00
D_4 : 21st November	6.25	2.10
D_5 : 1st December	6.00	1.80
S.Em. ±	0.09	0.06
C.D. at 5 %	0.27	0.18
C.V. %	2.84	5.45

Table 3. Sowing date-wise relationship of meteorological variables with per cent disease intensity.

Variables	Correlation co-efficient "r"				
	21st October (D_1)	1st November (D_2)	11th November (D_3)	21st November (D_4)	1st December (D_5)
Minimum temperature °C)	NS	1.00	0.95	-0.90	-0.43
Maximum temperature °C)	NS	NS	1.00	-0.32	-0.98
Mean temperature	NS	NS	NS	NS	NS
Relative humidity (%)	NS	NS	NS	1.00	-0.90
Wind speed (km/hr)	NS	NS	NS	NS	0.62
Critical value (0.05) ±	0.82	0.82	0.82	0.82	0.82

maximum temperature (-0.32). A positive and significant correlation was observed with relative humidity (1.00), whereas, negative and significant correlation of disease intensity with minimum temperature. It indicates that as temperature in November goes down with increase in humidity play vital role and congenial for the disease development.

1st December (D_5)

The simple correlation co-efficient analysis of weather parameters and disease severity revealed a negative correlation of disease intensity with minimum temperature (-0.43) and maximum temperature (-0.98). A positive and non-significant correlation was observed with wind speed (0.62) whereas, a negative and non-significant correlation of disease intensity with relative humidity (-0.90). It shows that high relative humidity is not favourable but cooler the days coupled with wind disseminating the diseases very fast. Sharma (1999) conducted a field trial at Baval, Haryana to study the effect of sowing dates on powdery mildew (Erysiphe polygoni) of fenugreek (Trigonella foenum-graecum). The sowings were done on 5 dates between October 20 to November 30 at an interval of 10 days.

He reported that in early sowings (October 20 and October 30), the disease appeared in the last week of January (*i.e.,* 100 to 105 days after sowing), but it was unable to spread until the first week in March because of the low temperature and low relative humidity. In contrast, the late sown crops (November 20 and November 30), the crop was still at the flowering or pod formation stage when the environmental conditions were more congenial for disease spread. The powdery mildew disease intensity at the two early sowing dates (20th October and 30th October) was comparatively less than the late sowing dates (10th November, 20th November and 30th November). The maximum yield (16.6 q ha^{-1}) was obtained from the October 30th sown crop followed by October 20 crop (15.4 q ha^{-1}) and November 10 crop (14.5 q ha^{-1}). The results indicated that a suitable sowing time would be around October 30 to avoid losses from powdery mildew in fenugreek.

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