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Effect of sowing dates, crop geometry and host range on powdery mildew (*Erysiphe polygoni*) of fenugreek, *Trigonella foenum graecum* L.

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Abstract

In Rajasthan, fenugreek crop is attacked by a number of diseases. Powdery mildew of fenugreek is an important and serious disease caused by *Erysiphe polygoni*. Date of sowing and crop geometry greatly influenced the disease intensity of powdery mildew on fenugreek during the two consecutive years 2012-13 and 2013-14. Early sown crop exhibited more disease development as compared to late sown crop. November 30th sown crop recorded minimum per cent disease intensity, whereas 10th October sown crop recorded maximum per cent disease intensity and minimum seed yield. The crop was sown on 30th October registered maximum seed yield (16.48 q/ha) with 61.10 per cent disease intensity. The wider spacing of 15 x 45 cm, 15 x 30 cm and 10 x 45 cm between rows and within rows recorded minimum per cent disease intensity (36.11, 39.66 and 45.39), respectively. However, closer spacing 5 x 15 cm recorded maximum seed yield and per cent disease intensity. Out of 15 host species powdery mildew symptoms were observed on *Pisum sativum, Cuminum cyminum, Coriandrum sativum, Calendula officinalis, Lathyrus odoratus* and *Foeniculum vulgare* under caged conditions.

Keywords: *Erysiphe polygoni*, fenugreek, host range, powdery mildew, sowing date, spacing

Introduction

Fenugreek (*Trigonella foenum graecum* L.) is an important seed spice crop belongs to family *Fabaceae*, cultivated widely in India. The importance of this crop has increased due to its medicinal values and presence of diosgenin that is used for the synthesis of sex hormone and oral contraceptive. Fenugreek seeds are rich source of protein (Shankaracharya & Natarajan 1972) and leaves are rich in minerals, proteins, vitamin A and C. In industry, seeds are used for dye making and for extraction of alkaloids and steroids. The dried leaves and flowers are used for flavouring vegetable curries (Arya 2000). Fenugreek can be grown in all types of soils provided that they are rich in organic matter with good drainage.

Fenugreek is attacked by number of diseases.

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Powdery mildew of fenugreek is an important and serious disease especially during flowering and pod formation stage of the crop and cause significant losses (33.27%) in grain quality as well as quantity (Prakash & Saharan 2002).

In Rajasthan, powdery mildew disease caused by *Erysiphe polygoni* appears in first week of January and reaches a peak in March (Rathi *et al.* 2000). The disease is characterized by white floury patches appearing on both sides of leaves as well as tendrils, stems, pods etc. As the plant become older, the powdery growth almost covers the entire plant, become more or less greyish brown and the infected part impart dirty appearance. In later stage, powdery growth also covers the pods. The seeds in pods do not either set or remain very small.

Date of sowing and spacing is considered very important and has shown considerable effect on several diseases. The present study was undertaken to know the effect of sowing date, spacing and host range on the fenugreek powdery mildew caused by *Erysiphe polygoni.*

Materials and methods

Effect of sowing dates and spacing

To understand the role of sowing dates and spacing on occurrence and development of powdery mildew on fenugreek, the field experiments were conducted during *rabi* 2012-13 and 2013-14 in randomized blocked design (RBD) on susceptible fenugreek local cultivar (Rmt-1) at Agronomy farm of S.K.N. College of Agriculture, Jobner (Sri Karan Narendra Agriculture University, Jobner). The crop was sown in the last week of October in both the years with plot size of 2 × 2 m^2. To know the effect of sowing dates and spacing, the sowing was done at ten days interval starting from 10th, 20th, 30th October; 10th, 20th and 30th November. The plant spacing treatments were 5 × 15 cm, 5 × 30 cm, 5 × 45 cm, 10 × 15 cm, 10 × 30 cm, 10 × 45 cm, 15 × 15 cm, 15 × 30 cm and 15 × 45 cm in the experimental farm during both seasons. Powdery mildew is known to occur in severe form under natural field conditions in this area. The crop was observed regularly for foliar infections. Disease intensity was recorded by examining 20 leaves from ten randomly selected plants in each plot starting from the initiation of the disease at 10 days intervals. For disease scoring on leaves 0-5 scale (Plate 1) was used as mentioned in Table 1 (Prakash & Saharan 1999). Per cent disease intensity was calculated by using formula given below by Mckinney (1923). At harvesting, seed yield per plot was also recorded and calculated in kg ha^{-1}.

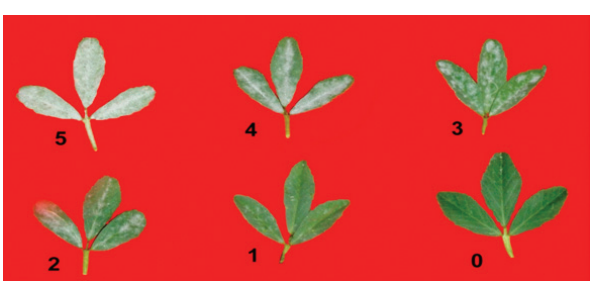

Table 1. Disease score chart for powdery mildew

Disease rating	Description	Host reaction
0	Free from disease	Immune
1	1 to 10% area of leaves $plant^{-1}$ parts infected	Resistant
2	11 to 25% area of leaves $plant^{-1}$ parts infected	Moderately resistant
3	26 to 50% area of leaves $plant^{-1}$ parts infected	Moderately susceptible
4	51 to 75% area of leaves $plant^{-1}$ parts infected	Susceptible
5	More than 75% area of leaves $plant^{-1}$ parts infected	Highly susceptible

Per cent disease intensity =
[(Sum of all numerical rating) / (No. of leaves examined × Maximum disease rating)] × 100

Disease rating, per cent disease intensity (PDI) was calculated as per method suggested by Prakash & Saharan (1999) with slight modifications.

Host range

Fifteen host species, *Beta vulgaris, Ranunculus acutus, Chenopodium album, Chenopodium murale, Pisum sativum, Daucus carota, Cuminum cyminum, Launea asplenifolia, Asphodelus tenuifolius, Coriandrum sativum, Anagalis arvensis, Foeniculum vulgur, Calendula officinalis, Cosmos bipinatus,* and *Lathyrus odoratus* belonging to different families were used in host range studies. Seeds of these species were obtained from local market of Jobner. The seeds were sown in 15 cm earthen pots pre-sterilized with copper sulphate solution and filled with sterilized soil which was autoclaved at 1.045 kg cm^{-2} for 1 hour on 3 consecutive days. Seeds were sown at a depth of about 2 cm and 5 seedlings were kept in each pot. The watering was applied as and when required. After 45 days of sowing, plants were inoculated by dusting the inoculum of *Erysiphe polygoni* (Yarwood 1936) and covered with polythene bags to maintain humidity. Symptoms were observed after 96 hours of incubation. Species showing symptoms were designated as positive (+) host and those not showing any symptoms were designated as negative (-) host.

Results and discussion

Effect of sowing date

The result of pooled data presented in Table 2 indicated that powdery mildew disease intensity showed a decreasing trend with the late sowing, where disease intensity was maximum 72.37% on 10th October sown crop, which was followed by 69.26% o disease recorded for 20th October sown crop. Minimum 40.71% disease intensity was observed in 30th November sown crop followed by 47.56% in 20th November sown crop. 30th October sown crop registered 61.10% disease intensity.

Table 2. Effect of dates of sowing on powdery mildew disease intensity and seed yield of fenugreek

Date of sowing	Per cent disease intensity*			Increase/ decrease in PDI over standard recommended date of sowing** (%)	Yield (q ha^{-1})*			Decrease in yield over standard recommended date of sowing** (%)
	2012–13	2013–14	Pooled		2012–13	2013–14	Pooled	
10 Oct.	73.62 (59.10)	71.12 (57.49)	72.37 (58.13)	18.44	12.70	12.18	12.44	24.51
20 Oct.	70.87 (57.24)	67.64 (55.33)	69.26 (56.32)	13.35	14.01	14.79	14.40	12.62
30 Oct.	62.45 (52.10)	59.75 (50.62)	61.10 (51.40)	-	15.37	17.59	16.48	-
10 Nov.	54.44 (47.55)	50.10 (45.06)	52.02 (46.15)	14.86	14.05	16.30	15.17	7.94
20 Nov.	49.22 (44.56)	45.90 (42.65)	47.56 (43.61)	22.16	14.65	16.25	15.45	6.25
30 Nov.	42.25 (40.54)	39.16 (38.74)	40.71 (39.64)	33.38	13.89	14.66	14.28	13.34
SEm±	1.65	1.62	1.63		0.54	0.53	0.54	
CD (P<0.05)	5.08	4.97	5.03		1.65	1.62	1.65	
CV	8.41	8.48	8.45		9.49	9.40	9.51	

*Average of four replications; **Standard recommended date of sowing 30th October;
Figures in parenthesis are angular transformed values

The pooled analysis of seed yield data (Table 2) indicated that seed yield was lowest (12.44 q ha^{-1}) in case of 10th October sown crop followed by 30th November sown crop (14.28 q ha^{-1}). However, 30th October sown crop recorded maximum (16.48 q ha^{-1}) seed yield but was at par with 10th and 20th November sown crop with 15.45 q ha^{-1} and 15.17 q ha^{-1} seed yield, respectively. The present findings are in contradiction with finding of Singh *et al.* (2002), as they observed severity of powdery mildew disease in pea was more on 10th October sown crop in comparison to early sown crop. The reason is that in early sown crop (10th October), the incidence of disease was more in January as during this period pathogen have more congenial climatic conditions as well as surface area of host plant (including both vegetative and reproductive) for development. Sharma & Sharma (2002) reported that maximum seed yield per hectare of pea was obtained in 30th October sowing crop.

Effect of spacing

Plant population greatly influenced powdery mildew disease intensity of fenugreek during both the years of study. Analysis of pooled data presented in Table 3 showed that spacing 5 × 15 cm showed highest 77.88% disease intensity which was significantly higher than other treatments of spacing. However, spacing of 5 × 45 cm and 10 × 30 cm was found at par. Minimum 36.11% disease intensity was recorded when crop was sown in 15 × 45 cm spacing with 43.68% decreased in disease intensity followed by 15 × 30 cm (39.66%) and 10 × 45 cm (45.39%) spacing with 38.13% and 29.20% decrease in disease intensity.

Table 3. Effect of spacing on powdery mildew disease intensity and seed yield of fenugreek

Spacing (cm) (P x R)	Per cent disease intensity*			Increase/ decrease in PDI over standard recommended spacing** (%)	Yield (q ha)*			Increase/ decrease in yield over standard recommended spacing** (%)
	2012–13	2013–14	Pooled		2012–13	2013–14	Pooled	
5 × 15	78.21 (62.17)	77.54 (61.71)	77.88 (61.94)	21.48	16.93	18.86	17.90	11.80
5 × 30	67.32 (55.13)	65.88 (54.26)	66.60 (54.70)	3.88	17.04	17.18	17.11	6.87
5 × 45	62.22 (52.07)	59.99 (50.76)	61.11 (51.42)	4.68	14.69	15.00	14.84	7.30
10 × 15	71.99 (58.04)	68.33 (55.75)	70.16 (56.89)	9.43	15.90	16.25	16.08	0.43
10 × 30	65.44 (53.99)	62.77 (55.39)	64.11 (53.19)	-	15.23	16.80	16.01	-
10 × 45	46.11 (42.76)	44.66 (41.93)	45.39 (42.35)	29.20	14.97	15.20	15.09	5.75
15 × 15	60.55 (51.09)	58.10 (49.66)	59.33 (50.37)	7.45	15.75	16.10	15.90	0.68
15 × 30	40.22 (39.36)	39.10 (38.70)	39.66 (39.03)	38.13	14.07	14.70	14.39	10.11
15 × 45	36.44 (37.13)	35.77 (36.73)	36.11 (36.93)	43.68	13.54	13.90	13.72	14.30
SEm±	1.72	1.69	1.61		0.66	0.64	0.65	
CD (P<0.05)	5.28	5.19	4.96		2.02	1.97	2.00	
CV	3.32	3.28	3.12		4.08	4.01	4.05	

*Average of three replications; **Standard recommended spacing 10 x 30 cm; Figures in parentheses are angular transformed values

Seed yield data indicated that spacing 5 × 15 cm, 5 × 30 cm, 10 × 15 cm and 10 × 30 cm were significantly superior to 15 × 45 cm spacing. Maximum 17.90 q ha^{-1} seed yield was recorded in 5 × 15 cm spacing with increasing 11.80% higher seed yield over standard recommended spacing. Spacing 10 × 15 cm and 10 × 30 cm statistically at par with 5 × 15 cm and recorded 16.08 and 16.01 q ha^{-1} seed yield, respectively.

The spacing of 15 × 45 cm resulted in lowest (13.72 q ha^{-1}) seed yield with less disease intensity but showed significant yield loss than other higher spacing. Sharma & Sharma (2002) showed that maximum seed yield of pea was obtained in 30th October sown crop at 20 cm spacing along with moderate disease severity followed by 30th October sown crop at 40 cm spacing. Baswana & Pandita (1989) reported that fenugreek crop grown in rows 20 cm apart gave higher seed yield than crop grown at 30 and 40 cm apart rows.

Host range study

Fifteen host species were tested under cage house conditions for infection of *Erysiphe polygoni* as per method described earlier. Observation recorded after 96 hours of incubation showed (Table 4) that *Chenopodium album* L., *C. murale*, *Beta vulgaris* L., *Ranunculus acutus*, *Daucus carota*, *Launea asplenifolia*, *Asphodelus tenuifolius*, *Anagalis arvensis* and *Cosmos bipinatus* were found resistant. Plant species which showed powdery mildew symptoms were *Pisum sativum*, *Cuminum cyminum*, *Coriandrum sativum*, *Foeniculum vulgur*, *Calendula officinalis* and *Lathyrus odoratus*. Munshi & Jhooty (1980) found that *Erysiphe polygoni* of pea was infecting various species of plant which included both weeds and cultivated crops.

Table 4. Infection of *Erysiphe polygoni* on different hosts

Host	Symptoms observed
Anagalis arvensis	-
Asphodelus tenuifolius	-
Beta vulgaris	-
Calendula officinalis	+
Chenopodium album	-
Chenopodium murale	-
Coriandrum sativum	+
Cosmos bipinatus	-
Cuminum cyminum	+
Daucus carota	-
Foeniculum vulgur	+
Lathyrus odoratus	+
Launea asplenifolia	-
Pisam sativum	+
Ranunculus acutus	-

-No symptoms observed; +Symptoms observed

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