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BIO-EFFICACY OF BOTANICALS AGAINST POWDERY MILDEW OF FENUGREEK

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ABSTRACT

Fenugreek (*Trigonella foenum-graecum* L.) is a valuable leguminous crop widely cultivated for its medicinal, culinary and nutritional properties. However, powdery mildew, caused by the fungus *Erysiphe polygoni* poses a significant threat to fenugreek production leading to considerable yield losses and reduced quality of the harvested product. Application of methanol-based extract of ginger, 5% first at appearance of the disease and second at 10 days after first spray was found effective against powdery mildew of fenugreek.

Key words : Fenugreek, Powdery mildew, Botanicals.

Introduction

Fenugreek (*Trigonella foenum-graceum* L.) is herbaceous annual plant in the family *Fabaceae*. There are two cultivated species of genus *Trigonella* viz. *foenuni-graecum* (common fenugreek) and *corniculata* (Kasuri type fenugreek). The major fenugreek producing countries are India, Argentina, Egypt, Southern France, Morocco, Spain, Turkey and China. Native to the Mediterranean region, southern Europe and western Asia, it has been widely cultivated for its culinary and medicinal applications. This plant is valued for its seeds and leaves, which have been used in traditional medicine and cooking for centuries. Fenugreek seeds are rich in fiber, protein, iron, magnesium and manganese. They contain various beneficial compounds, including saponins, flavonoids, and alkaloids (Mehrafarin *et al*., 2010). Seeds have a bitter taste and a strong aroma, often likened to maple syrup or burnt sugar (Srinivasan, 2006). Leaves are used fresh or dried to flavour curries, stews and soups (Basch *et al*., 2003). The plant possesses anti-inflammatory properties, making it useful in alleviating pain and swelling (Khare, 2007).

Fenugreek can be grown in almost all type of soils having good drainage but grow best on well drained loamy soils. Organic matter rich clay-loam soil may also be used if adequate drainage facilities are available. However, it can be grown on sandy or gravely soils with slightly compromising yield. For rainfed cultivation, black cotton soils are best suited for its successful cultivation. Although the crop is sensitive to salinity except very low yet it can tolerate the pH up to 8.5, but in neutral soils having a pH range from 6.0 to 7.0, it always gives higher yield with better quality of leaves.

Fenugreek can be susceptible to various diseases that can affect yield and quality. Here are some common diseases that affect fenugreek: Damping off (Pythium aphanidermatum) Powdery Mildew (*Leveillula taurica*), Downy Mildew (*Peronospora trigonellae*), Root Rot (*Rhizoctonia solani* and *Fusarium* spp.), Anthracnose (*Colletotrichum* spp.) and Leaf Spot (*Cercospora* spp.) The disease, powdery caused by *Erysiphae polygoni* is serious diseases resulting 15 to 50 percent seed yield losses (Kumawat and Shekhawat, 2015). Fenugreek yield loss of 27 to 33 per cent due to powdery mildew caused (Prakash and Saharan, 2002). The symptoms of powdery mildew appeared in month of February. White floury patches were found on leaves, stems and pods (Prakash and Saharan, 2002). Symptoms start with white powdery growth on leaves which may coalesce and cover the white leaf with the white powdery growth of the fungus (Roba and Simion, 2022). Hence, this experiment was initiated with the objective of determining of the effects botanicals

on powdery mildew on seed yield.

Materials and Methodology

A field trial was conducted during *rabi* 2019-20 and *rabi* 2020-21 at Horticulture Farm, College of Horticulture, Anand Agricultural University, Anand to test the efficacy of three ready mix fungicides efficacy at different doses against powdery mildew of fenugreek. Fenugreek (Gujarat Fenugreek 2) was raised during *rabi* season in Randomized block design with three replications. A spacing of 30 (between rows) was adopted in plots (Gross: 4.0 x 2.4 m Net: 3.8 x 1.8 m).

Foliar application of fungicide was made just after disease initiation in the field and second spray was done after 15 days of first spray. The fungicides were than concentrated and used after proper dilution in water. The spray was given using manually operated knapsack sprayer. The per cent disease severity was recorded after 10 days of first spray and second spray by examining 20 randomly selected plants per plot. Disease intensity was recorded by observing powdery mildew on leaf, stem and pods using 0-4 grade (Sekhavat *et al.*, 2016), where, 0=healthy, 1= whitish small spots on leaves, 2 = whitish growth covering the entire leaf, 3 = growth on leaf and stem and 4 = growth on leaf, stem and pods. Seed yield of fenugreek per plot was recorded and converted in to hectare for each treatment. The data on disease intensity and seed yield were subjected to ANOVA.

Treatment details

Treat. No.	Treatment	Conc. (%)	ml or g/10 litre of water
T_1	Methanol based extract of ginger	5	500
T_2	Methanol based extract of lantana	5	500
T_3	Methanol based extract of kuvadiyo	5	500
T_4	Methanol based extract of garlic	5	500
T_5	n-Hexane based extract ginger	5	500
T_6	n-Hexane based extract lantana	5	500
T_7	n-Hexane based extract kuvadiyo	5	500
T_8	n-Hexane based extract garlic	5	500
T_9	Control	—	—

Observations recorded: 1. Per cent disease intensity
2. Seed yield (kg/ha)

Results and Discussion

First year-2019-20

The data on 10 days after first spray revealed that significanltly minimum percent diseases intensity of powdery mildew was found in treatment T_1 *i.e.* methanol based extract of ginger (23.84%), which was at par with treatment T_5 *i.e.* n-hexane based extract of ginger (24.74%). The next best treatment in order of merit was treamant T_4 *i.e.* methanol based extract of garlic which significantly reduces the intensity of powdery mildew compare to control (30.7%). After 10 days of second spray, the significantly minimum intensity of powdery mildew was found in treatment T_1 *i.e.* methanol based extract of ginger (20.56%). The next best treatment in order of merit was treatment T_5 *i.e.* n-hexane based extract of ginger (23.40%) which was at par with treatment T_4 *i.e.* methanol based extract of garlic (24.10%). The result of pooled over period recorded that, significantly lowest disease intensity of powdery mildew on fenugreek was found in T_1 *i.e.* methanol based extract of ginger (22.20%), which was at par with treatment T_5 *i.e.* n-hexane based extract of ginger (24.17%). The significantly reduces the intensity of disease in all the treatment compare to control (32.33) (Table 1).

Second year-2020-21

The data on 10 days after first spray revealed that significanltly minimum percent diseases intensity of powdery mildew was found in treatment T_1 *i.e.* n-hexane based extract of garlic (26.59%) which was at par with treatment T_1 *i.e.* methanol based extract of ginger (27.07%) and T_5 *i.e.* n-hexane based extract of ginger (27.07%). After 10 days of second spray, the significantly minimum intensity of powdery mildew was found in treatment T_1 *i.e.* methanol based extract of ginger (23.61%). The next best treatment in order of merit was treatment T_8 *i.e.* n-hexane based extract of garlic (25.85%) which was at par with treatment T_5 *i.e.* n-hexane based extract of ginger (26.09%). The result of pooled over period suggested that, significantly lowest disease intensity of powdery mildew on fenugreek was found in T_1 *i.e.* methanol based extract of ginger (25.34%) which was at par with treatment T_8 *i.e.* n-hexane based extract of garlic (26.22%). The significantly reduces the intensity of disease in all the treatment compare to control (36.68%) (Table 2).

Pooled over year

The result of pooled over year suggested that, significantly lowest disease intensity of powdery mildew on fenugreek was found in T_1 *i.e.* methanol based extract of ginger (23.78%). The next best treatment in order of merit was treatment T_5 *i.e.* n-hexane based extract of ginger (25.72%) which was at par with treatment T_4 *i.e.* methanol based extract of garlic (26.69%). The intensity of powdery mildew was significantly reducing in all the treatments compare to untreated control (34.46%) (Table 3).

Table 1 : Efficacy of solvent-based plant extract on powdery mildew of fenugreek (2019-20).

Treatment No.	Disease Intensity (%)			
	Before spray	10 DAFS	10 DASS	Pooled over applications
T_1	26.67(20.15)	23.84e (16.34)	20.56f (12.33)	22.20f (14.28)
T_2	27.37(21.14)	27.38bc (21.15)	26.22cd (19.52)	26.80bcde (20.33)
T_3	25.67 (18.77)	27.34bc (21.09)	28.42bc (22.65)	27.88bcd (21.87)
T_4	28.84(23.27)	25.91cd (19.09)	24.10de (16.67)	25.01de (17.87)
T_5	27.01(20.62)	24.74de (17.65)	23.40e (15.77)	24.17ef (16.76)
T_6	27.86(21.84)	29.06ab (23.59)	28.76b (23.15)	28.91bc (23.37)
T_7	28.37 (22.58)	29.47a (24.2)	29.85b (24.77)	29.66ab (24.49)
T_8	29.52(24.28)	26.57c (20.01)	25.85d (19.01)	26.22cde (19.52)
T_9	26.77 (20.29)	30.7a (26.07)	33.78a (30.91)	32.33a (28.60)
S. Em.± Treatment (T)	0.96	0.55	0.69	0.45
Spray (S)	—	—	—	0.21
T x S	—	—	—	0.63
C.D. at 5% T	NS	Sig.	Sig.	Sig.
C. V. %	6.96	4.85	6.15	4.62

Note : DAFS: Days After First Spray; DASS: Days after Second Spray; NS: Non significantFigures in the parentheses are retransformed values; those outside arc sign transformed valuesTreatments means with the letter(s) in common are not significant by DNMRT at 5% level of significanceSignificant parameters and interactions:SxT.

Table 2 : Efficacy of solvent-based plant extract on powdery mildew of fenugreek (2020-21).

Treatment No.	Disease Intensity (%)			
	Before spray	10 DAFS	10 DASS	Pooled over applications
T_1	23.70(16.16)	27.07d(20.71)	23.61e(16.04)	25.34g(18.32)
T_2	24.75(17.53)	29.97bc(24.95)	28.16c(22.27)	29.06cd(23.59)
T_3	22.99(15.25)	30.73bc(26.11)	29.15bc(23.73)	29.94bc(24.91)
T_4	26.03(19.26)	29.50bc(24.25)	27.26cd(20.98)	28.38de(22.59)
T_5	24.05(16.61)	28.57cd(22.87)	26.09d(19.34)	27.33ef(21.08)
T_6	24.96(17.81)	31.78b(27.74)	30.41b(25.62)	31.09b(26.67)
T_7	25.51(18.55)	31.93b(27.97)	30.92b(26.04)	31.43b(27.19)
T_8	26.77(20.29)	26.59d(20.03)	25.85d(19.01)	26.22fg(19.52)
T_9	26.27(19.59)	34.96a(32.83)	38.40a(38.58)	36.68a(35.68)
S. Em.± Treatment (T)	0.98	0.77	0.58	0.48
Spray (S)	—	—	—	0.22
T x S	—	—	—	0.65
C.D. at 5% T	NS	Sig.	Sig.	Sig.
C. V. %	7.82	5.09	4.20	4.65

Note : DAFS: Days After First Spray; DASS: Days after Second Spray; NS: Non significantFigures in the parentheses are retransformed values; those outside arc sign transformed valuesTreatments means with the letter(s) in common are not significant by DNMRT at 5% level of significance Significant parameters and interactions: S and SxT.

Table 3 : Efficacy of solvent-based plant extract on powdery mildew of fenugreek (Pooled: 2019-20 & 2020-21).

Treatment No.	Disease Intensity (%)			
	Before spray	10 DAFS	10 DASS	Pooled over application and years
T_1	25.19(18.12)	25.45f(18.47)	22.09f(14.14)	23.78f(16.26)
T_2	26.06ab(19.30)	28.67d(23.02)	27.19cd(20.88)	27.93cd(27.94)
T_3	24.32(16.96)	29.03cd(23.55)	28.79bc(23.19)	28.92bc(23.39)
T_4	27.43(21.22)	27.71de(21.62)	25.68de(18.78)	26.69de(20.17)
T_5	25.53(18.57)	26.71ef(20.20)	24.74e(17.51)	25.72e(18.83)
T_6	26.41(19.78)	30.42bc(25.64)	29.58b(24.37)	30.00b(25.00)
T_7	26.94(20.53)	30.70b(26.07)	30.39b(25.59)	30.55b(25.84)
T_8	28.14(22.24)	26.58ef(20.02)	25.85de(19.01)	26.22de(19.52)
T_9	26.52(19.94)	32.84a(29.41)	36.09a(34.70)	34.46a(32.02)
S. Em. ± Treatment (T)	0.65	0.51	0.71	0.63
Spray (S)	0.32	0.22	0.21	0.15
Year (Y)	—	—	—	0.15
SxY	0.96	0.67	0.64	0.22
YxT	—	—	—	0.47
SxT	—	—	—	0.47
YxSxT	—	—	—	0.66
C.D. at 5% T	NS	Sig.	Sig.	Sig.
C. V. %	7.37	4.66	4.58	4.71

Note: DAFS: Days After First Spray; DASS: Days after Second Spray; NS: Non significant. Figures in the parentheses are retransformed values; those outside arc sign transformed valuesTreatments means with the letter(s) in common are not significant by DNMRT at 5% level of significance Significant parameters and interactions: Y, S, YxT and SxT.

Plate 1 : T_1- Methanol based extract of ginger (5%).

Plate 2 : T_{11} Control.

Seed yield

First year (2019-20)

The seed yield of fenugreek recorded significant differentiation in treated plot than the control. The highest yield of fenugreek seed was found in tretmant T_1 *i.e.* methanol based extract of ginger (1395.8 kg/ha) which was at par with treatment T_5 *i.e.* n-hexane based extract of ginger (1359.4 kg/ha).

Second year (2020-21)

The fenugreek Seed yield of second year shows significant different in treated plot than the control. The highest yield of fenugreek seed was found in tretmant T_1 *i.e.* methanol based extract of ginger (1567 kg/ha), which was at par with treatment T_5 *i.e.* n-hexane based extract of ginger (1473.95 kg/ha).

Table 4 : Efficacy of solvent-based plant extract on yield of fenugreek.

Tr. no.	Treatment details	Seed Yield(kg/ha)		
		2019-20	2020-21	Pooled
T_1	Methanol based extract of ginger	1395^{a}	1567^{a}	1481^{a}
T_2	Methanol based extract of lantana	1190^{abc}	1346^{ab}	1268^{bc}
T_3	Methanol based extract of kuvadiyo	1054^{cd}	1080^{bcd}	1067de
T_4	Methanol based extract of garlic	1273^{abc}	1351^{ab}	1312^{abc}
T_5	n-Hexane based extract ginger	1359^{ab}	1473^{a}	1416^{ab}
T_6	n-Hexane based extract lantana	718^{ef}	885^{cd}	802^{fg}
T_7	n-Hexane based extract kuvadiyo	921de	921^{cd}	921^{ef}
T_8	n-Hexane based extract garlic	1145^{bcd}	1145^{bc}	1145^{cd}
T_9	Control	588^{f}	843^{d}	716^{g}
	S. Em.± Treatment (T)	70	89	55
	Years (Y)	—	—	27
	YxT	—	—	81
	C.D. at 5% T	Sig.	Sig.	Sig.
	C. V. %	13.14	15.24	14.34

Treatments means with the letter(s) in common are not significant by DNMRT at 5% level of significance.

Pooled (2019-20 & 2021-22)

The pooled result of Seed yield found that significantly highest yield found in treatment T_1 *i.e.* methanol based extract of ginger (1481 kg/ha) which was at par with treatment T_5 *i.e.* n-hexane based extract of ginger (1416 kg/ha) as compare to control (716 kg/ha) (Table 4).

Conclusion

Considering the efficacy of different extract of botanicals extracted based by methanol and n-hexane against powdery mildew of fenugreek, methanol-based extract of ginger @ 5% found most effective while, n-hexane based extract of ginger @ 5% and methanol based extract of garlic @ 5% were found next in order of their effectiveness than the rest of treatments. These treatments also reflected on seed yield of fenugreek. Sneha *et al*. (2020) also confirmed that methanol-based extract of ginger and garlic at 3% concentration effective against powdery mildew in capsicum. Marakna and Kapadiya (2021) observed highest spore germination inhibition (81.82%) was recorded at 20 per cent concentration of garlic on 72 hrs after the treatment against powdery mildew of fenugreek.

Recommendations

Application of methanol based extract of ginger, 5% first at appearance of the disease and second at 10 days after first spray was found effective against powdery mildew of fenugreek.

Competing interests

Authors have declared that no competing interests exist.

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