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Evaluation of field pea varieties against mildews (Downy and Powdery) under natural conditions

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Abstract
In India a very narrow genotype based is involved in existing pea varieties and the resistant varieties for mildews could not be expected to be permanently resistant. Numbers of genotypes are still identified to possess desirable degree of resistance in pea. Studies were planned to search out the genotypes against mildews through sick plot technique. Out of 49 genotypes, 5 *viz.*, genotypes FP-16-21,FP-16-27,FP-16-11,FP-16-39,FP-16-38 were found moderately resistant and 5 *viz*., FP-16- genotypes 19,FP-16-22,FP-16-40, FP-16-16,FP-16-45. Whereas tolerant. Twenty nine genotypes namely (FP-16-30,FP-16-4,FP-1634,FP-16-54,FP-16-9,FP-16-13,FP-16-1,FP-16-41,FP-16-8,FP-1649,FP-16-3,FP-16-6,FP-16-10,FP-16-25,FP-16-44,FP-16-32,FP-16-5,FP-16-17,FP-16-7,FP-16-36,FP-16-43,FP-16-29,FP-16 35, FP-16-24,FP-16-33,FP-16-23,FP-16-46,FP-16-18,rachna.) were found moderately susceptible only rest ten genotypes (FP-16-48, FP-16-42, FP-16-31, FP-16-2, FP-16-15, FP-16-47, FP-16-51, FP-16-37, FP-16-14,FP-16-20) as highly susceptible. The same set of 49 germplasms was screened against powdery mildew under natural conditions. Out of 49 germplasms, none was found highly resistant (Immune). However twenty two germplasms *viz*., FP-16-42,FP-16-27,FP-16-11,FP-1631,FP-16-2,FP-16-15,FP-16-39,FP-16-34,FP-16-54,FP-16-22,FP-16-9,FP-16-51,FP-16-37,FP-16-14,FP-16-8,FP-16 16, FP-16-6,FP-16-20,FP-16-29,FO-16-32,FP-16-5,FP-16-18.were found resistant and seven germplasms *viz.* FP-16-48,FP-16-30,FP-16-4,FP-16-47,FP-16-10,FP-16-7 and Rachna moderately resistant. Nineteen genotypes namely (FP-16-21,FP-16-19,FP-16-13,FP-16-38,FP-16-1,FP-16-36,FP-16-40,FP-16-41,FP-16-43,FP-16-49,FP-16-3,FP-16-45,FP-16 25, FP-16-44,FP-16-35,FP-16-24,FP-16-17,FP-16-23,FP-16-46) were found moderately susceptible and rest one germplasms (FP-16-33) as susceptible. None was found highly susceptible.

Keywords: Pea, germplasms, powdery mildew, downey mildew

Introduction
Pea (*Pisum sativum* L.) is the third most widely grown grain legume worldwide, commonly called as matar, in Hindi, belongs to family leguminaceae and cultivated as an important vegetable as well as pulse crop throughout the world. Field pea originated in Europe and Western Asia and is grown throughout the world as a cool season crop. Among various grain legumes, field pea (*Pisum sativum* L.) is one of the ancient domesticated popular pulse crops of India and has versatile uses in both food and feed. The dry seed contains 22.5g proteins and 62.5g carbohydrates 100g and having relatively less is anti- nutritional substances. In India, the maximum cultivation of pea in Uttar Pradesh followed by Bihar and Madhya Pradesh. At national level the total area under pea cultivation is about 0.96 million ha with a production of 0.92 million tonnes and productivity is 960 kg/ha. In U.P., total area under pea is about 357000 ha with production of 354000 tonnes and a productivity is 992 kg/ha. (Anonymous, 2014-15) [2]. According to the Indian Council of Medical Research (ICMR) optimum requirement of pulses for a person to maintain the health is 80 g/day. However, even half of this quantity is not available to the people due to fast growth in population and decrease in the production of pulses. The per capita availability of pulse during the year 1960-61 was 70 g/day but it has been considerably decreased to 35.9 g/day during 2000 (Chaturvedi & Ali, 2002) [3].
Powdery mildew caused by the pathogen *Erysiphe pisi* is a serious disease of pea. The pathogen is obligate parasite act as biotroph. Linnaeus (1753) [9] was the first to name a powdery mildew as an organism by using the binomial *Mucor erysiphe* to a white fungus on the leaves. Powdery mildew first appears on the upper surface of the lower most (oldest) leaves as small (4-5mm diameter), scattered, white, almost circular colonies which eventually coalesce as the colonies grow further covering the entire leaf surface under favourable environmental conditions. Colony colour changes from white to greyish brown, plants become stunted. Mildew appears as fine talcum powder like appearance.

Leaf, stem, floral parts and pods get affected. The downy mildew, caused by *Peronospora pisi* (*P.viciae* f. sp. *pisi*) and powdery mildew caused by *Erysiphe polygonyi* D.C. De Bary are the major constraints in the production of pea crop and in the realization of genetic potential of several available high yielding varieties. In eastern plane zone of U.P., downy mildew and powdery mildew are major constraints for low productivity as they occur in light to severe form on the same crop during season under favourable environmental conditions and cause considerably losses in yield.

Materials and methods

The experiment on pea was conducted during the course of investigation in 2016-2017 at A.N.D.U.A. & T. Kumarganj, Ayodhya (U.P.). The seed material of genotypes obtained from different sources like IIPR, Kanpur and other, planted by the pulse breeder was used for screening against mildews of field pea. For disease rating (powdery mildew) the scale suggested by Singh (1988) [13] was used and the percentage of disease severity index was calculated as suggested by Singh (1988) [13]. While the emergence and mortality due to downy mildew was reported in percentage. The varietal evaluation of field pea genotypes against mildew (downy/powdery). Forty nine germplasms of pea were obtained from the Vegetable form. The Percent disease intensity (PDI) was calculated by formula as given below and Per cent disease intensity and per cent disease control were calculated by using the following formula (Vincent, 1947) [16].

$$\text{Percent disease intensity (PDI)} = \frac{\text{Sum of total numerical}}{\text{Total No.of leaves examined} \times \text{highest rating}} \times 100$$

Table 1: Disease rating scale for downy mildew (1-9) (Anonymous 2003) [1]

Rating	Disease reaction	Description
1	Immune	Free from disease
3	Moderately resistant	Less than 10% of total leaf area infected
5	Tolerant (average infection)	11-20% of leaf area infected
7	Moderately susceptible	21-40% of leaf area infected
9	Highly susceptible	More than 40% of leaf area infected

Table 2: Disease rating scale for powdery mildew (0-5) (Anonymous 2003) [1]

Rating	Disease reaction	Description
0	Highly Resistance	Plant free from infection
1	Resistance	Plant showing trace to 10% infection on leaves, stem free from infection
2	Moderately Resistance	Slight infection with thin coating of powdery growth on leaves covering 11-25% leaf area, stem and pods usually free
3	Moderately Susceptible	Dense powdery coating covering 26-50% leaf area. Slight to moderate infection on stem and slight infection on pods
4	Susceptible	Dense powdery coating 51-75% leaf area, stems heavily and pods moderately infected. Infected portion turns greyish
5	Highly Susceptible	Severe infection with dense powdery growth covering more than 75% area of the whole plant including pods, plant resulting in premature defoliation and drying

Results and Discussion

Downey mildew

In India a very narrow genotype based is involved in existing pea varieties and the resistant varieties for mildews could not be expected to be permanently resistant. Numbers of genotypes are still identified to possess desirable degree of resistance in pea. Therefore, the search for source of donors with a high degree of resistance for use as parental material in breeding programme for mildews has always been desirable. There is no doubt about the fact that the use of resistant variety is one of the best methods of disease management. Therefore, studies were planned to search out the genotypes against mildews through sick plot technique. In table no. 3 out of 49 genotypes, 5 *viz.*, genotypes FP-16-21,FP-16-27,FP-16-11,FP-16-39,FP-16-38 were found moderately resistant and 5 *viz*., FP-16- genotypes 19, FP-16-22, FP-16-40, FP-16-16,FP-16-45. Whereas tolerant. Twenty nine genotypes namely (FP-16-30,FP-16-4,FP-1634,FP-16-54,FP-16-9,FP-16-13,FP-16-1,FP-16-41,FP-16-8,FP-1649,FP-16-3,FP-16-6,FP-16-10,FP-16-25,FP-16-44,FP-16-32,FP-16-5,FP-16-17,FP-16-7, FP-16-36,FP-16-43,FP-16-29,FP-16-35,FP-16-24,FP-16-33,FP-16-23,FP-16-46,FP-16-18, rachna.) were found moderately susceptible only rest ten genotypes (FP-16-48, FP-16-42, FP-16-31, FP-16-2, FP-16-15, FP-16-47, FP-16-51, FP-16-37, FP-16-14,FP-16-20) as highly susceptible. The similar results found by Stegmark (1990) [14] reported that the cultivars Puget, Cobri, Gasto, Starcovert and Starnin possess specific resistance to downy mildew. Davidson *et al.*, (2004) [4] Jan, (1999) [6] Jan *et al.*, (2007) [7] Shahid *et al.*, (2010) [11] reported the resistant and susceptible cultivars against mildews. Davidson *et al*., (2004) [4] inoculated the apical buds of plants with conidia suspension and recorded the spore of mildew out of 88 lines tested 25 had useful downy mildew resistance.

Powdery mildew

The same set of 49 germplasms was screened against powdery mildew under natural conditions. In table no. 4 out of 49 germplasms, none was found highly resistant (Immune). However twenty two germplasms *viz*., FP-16-42,FP-16-27,FP-16-11,FP-1631,FP-16-2,FP-16-15,FP-16-39,FP-16-34,FP-16-54,FP-16-22,FP-16-9,FP-16-51,FP-16-37,FP-16-14,FP-16-8,FP-16 16, FP-16-6,FP-16-20,FP-16-29,FO-16-32,FP-16-5,FP-16-18.were found resistant and seven germplasms *viz.* FP-16-48,FP-16-30,FP-16-4,FP-16-47,FP-16-10,FP-16-7 and Rachna moderately resistant. Nineteen genotypes namely (FP-16-21,FP-16-19,FP-16-13,FP-16-38,FP-16-1,FP-16-36,FP-16-40,FP-16-41,FP-16-43,FP-16-49,FP-16-3,FP-16-45,FP-16 25, FP-16-44,FP-16-35,FP-16-24,FP-16-17,FP-16-23, FP-16-46) were found moderately susceptible and rest one germplasms (FP-16-33) as susceptible. None was found highly susceptible. Thakur *et al*., (1996) [15] reported that sugar giant, plant P-8, DPP-26, DPP-54, P MR-3, JP-71 and HPPC-95 were resistant to powdery mildew. Khare and Lakpale (1997) [8] studied that among 25 tall cultivar tested, Rachana, Pant P-5 Pant P-9 and DMR-9 showed resistant to moderately resistant reaction of *Erysiphe pisi* , but Rahhi and Tripathi (1994) [10] have recorded as Rachna as moderately susceptible against powdery mildew. Ghafranul *et al*., (2000) Screened 11 pea varieties against powdery mildew under natural field condition in Pakistan and found three (3) varieties Kalam-1, Kalam-2 and Kalam-3 as resistant due to containment of disease symptoms to small necrotic leaf spots with no symptoms on stem and pods.

Singh *et al.*, (2003) [12] studied 234 field pea germplasms against powdery mildew (*Erysiphe pisi*) during 3three consecutive *Rabi* seasons, 1993-96 under epiphytic conditions. Out these, five genotypes *viz.* DPFPD-8, DPFPD-12, HFP-4, HFP-8711, HFP-8909 and 11 genotypes *viz.* DMR-7, DMR-20, HUP-13, KFP-103, KFP-125, KFP-132, KPMR-186, KPMR-241, Pant P-5, Pant P-5, Pant-8 and Pant P-9 exhibited stable resistance to the powdery mildew in all the three years of testing.

Table 3: Performance of pea germplasms against downy mildew during 2016-2017

Disease score	Reaction	Entries	Varieties/germplasms
1	Free from disease(Immune)	-	Nil
3	Less than 10% (Moderately resistant)	5	FP-16-21,FP-16-27,FP-16-11,FP-16-39,FP-16-38
5	11-20% of leaf area infected (Tolerant)	5	FP-16-19, FP-16-22, FP-16-40, FP-16-16, FP-16-45.
7	21-40% of leaf area infected (Moderately susceptible)	29	FP-16-30,FP-16-4,FP-1634,FP-16-54,FP-16-9,FP-16-13,FP-16-1,FP-16-41,FP-16-8,FP-16-49,FP-16-3,FP-16-6,FP-16-10,FP-16-25,FP-16-44,FP-16-32,FP-16-5,FP-16-17,FP-16-7,FP-16-36,FP-16-43,FP-16-29,FP-16-35,FP-16-24,FP-16-33,FP-16-23,FP-16-46,FP-16-18,rachna.
9	More than 40% of leaf area infected (Highly susceptible)	10	FP-16-48, FP-16-42,FP-16-31,FP-16-2,FP-16-15,FP-16-47,FP-16-51,FP-16-37, FP-16-14,FP-16-20.

Table 4: Performance of pea germplasms against powdery mildew during 2016-2017

Disease score	Reaction	Entries	Varieties/germplasms
0	Plant free from infection (highly resistance)	-	-
1	trace to 10% infection on leaves, stem free from infection (Resistance)	22	FP-16-42,FP-16-27,FP-16-11,FP-1631,FP-16-2,FP-16-15,FP-16-39,FP-16-34,FP-16-54,FP-16-22,FP-16-9,FP-16-51,FP-16-37,FP-16,14,FP-16-8,FP-16-16,FP-16-6,FP-16-20,FP-16-29,FO-16-32,FP-16-5,FP-16-18.
2	11-25% (Moderately resistance)	7	FP-16-48, FP-16-30, FP-16-4, FP-16-47, FP-16-10, FP-16-7, Rachna.
3	26-50% (Moderately Susceptible)	19	FP-16-21,FP-16-19,FP-16-13,FP-16-38,FP-16-1,FP-16-36,FP-16-40,FP-16-41,FP-16-43,FP-16-49,FP-16-3,FP-16-45,FP-16-25,FP-16-44,FP-16-35,FP-16-24,FP-16-17,FP-16-23,FP-16-46.
4	51-75% (Susceptible)	1	FP-16-33.
5	more than 75% (Highly susceptible)	_	

Conclusion

In India a very narrow genotype based is involved in existing pea varieties and the resistant varieties for mildews could not be expected to be permanently resistant. Numbers of genotypes are still identified to possess desirable degree of resistance in pea. Therefore, the search for source of donors with a high degree of resistance for use as parental material in breeding programme for mildews has always been desirable. There is no doubt about the fact that the use of resistant variety is one of the best methods of disease management. Therefore, studies were planned to search out the genotypes against mildews through sick plot technique. The same set of 49 germplasms was screened against powdery mildew under natural conditions. Out of 49 germplasms, none was found highly resistant (Immune). However twenty two germplasms *viz.*, FP-16-42,FP-16-27,FP-16-11,FP-1631,FP-16-2,FP-16-15,FP-16-39,FP-16-34,FP-16-54,FP-16-22,FP-16-9,FP-16-51,FP-16-37,FP-16-14,FP-16-8,FP-16 16, FP-16-6,FP-16-20,FP-16-29,FO-16-32,FP-16-5,FP-16-18.were found resistant and seven germplasms *viz.* FP-16-48,FP-16-30,FP-16-4,FP-16-47,FP-16-10,FP-16-7 and Rachna moderately resistant.

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