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Reaction of pea varieties/genotypes against Root Rot (*Rhizoctonia solani*) of pea under field conditions

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Root rot in peas, caused by *Rhizoctonia solani*, is emerging as significant threats to pea production in India, being the most important and widespread soil-borne diseases affecting peas grown in relatively dry and warm areas. To assess resistance to root rot disease, an experiment was conducted to screen forty-eight pea varieties/genotypes under field conditions at the Instructional Farm of SKN College of Agriculture (SKNAU) in Jobnerfor two consecutive *Rabi* seasons (2022-23 and 2023-24). The results indicated that none of the varieties/genotypes were immune or highly resistant to the disease. However, four varieties/genotypes (Lincoln, 2021/PEPVAR-5, 2021/PEPVAR-2, and 2021/PEPAR-9) showed resistance. Eighteen varieties/ genotypes exhibited moderate resistance, while the remaining varieties/genotypes ranged from susceptible to highly susceptible.

Keywords: Genotypes, pea, root rot**,** *Rhizoctonia solani*

INTRODUCTION

Garden pea (*Pisum sativum* var. *hortense*), also known as table pea, is a vital vegetable crop in the Fabaceae family. The name “pea” derives from the Latin *Pisum*, itself based on the Greek *Pison*, a neutered form of Pisos. Originally cultivated as a winter annual in the Mediterranean region, garden peas are harvested immature for consumption as vegetables or for canning and freezing. It is a top vegetable crop grown in cool regions of the world and used as a vegetable (green pea) and pulse (dried pea). Peas can be classified into four main types i.e. garden pea {*P. sativum* sp. *hortense* (Asch. and Graebn.)}, dry pea {*P. sativum* sp. *arvense* (L.) Poir.}, edible-podded pea (*P. sativum* sp. *macrocarpon*) and early dwarf pea (*P. sativum* var. *humile*).

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Rhizoctonia solani. root rot diseases pose significant threats, often leading to substantial reductions in yield and quality of harvested peas.

In recent years, pathogens such as *Rhizoctonia solani, Pythium ultimum*, and *Fusarium solani* f.sp. *pisi* have emerged as the most prevalent and damaging, primarily responsible for root rot in peas. Root rot disease Is the soil-borne basidiomycete fungus *Rhizoctonia solani* Kuhn (Dube, 2013) (teleomorph-*Thanatephorus-scucumeris*) causes disease on many economically important crop plants worldwide. Teleomorph-*Thanatephorus cucumeris* (Frank) Donk; anamorph- *Rhizoctonia solani* Kuhn are traditionally classified into genetically isolated anastomosis groups (AGs) based primarily on hyphal anastomosis reactions. *Rhizoctonia solani* causing seedling mortality and root rot is one of the major diseases. The fungus most often infects the hypocotyl, epicotyl and seed of pea (Acharya

et al. 2014). Management of root rot is largely ineffective, as these pathogens have broad host ranges and can persist in the soil for extended periods in the form of sclerotia and conidia, surviving for several months even without host plants and under dry conditions. Thus, the present investigation aimed to develop promising integrated disease management strategies by screening pea varieties/genotypes for their resistance to root rot disease under field conditions. This approach seeks to identify resistant varieties that can be utilized in breeding programs to enhance the resilience of pea crops against these damaging diseases.

MATERIALS AND METHODS

Experimental site

The investigation was conducted at the Instructional Farm of S.K.N. College of Agriculture, (SKNAU) Jobner, Rajasthan, during the *Rabi* seasons of 2022-23 and 2023-24. Jobner is situated at latitude 26°5' N, longitude of 75°20' E and altitude of 427 meters above MSL (mean sea level) and also part of the semi-arid eastern plain (Agro Climatic Zone-III A) of Rajasthan.

Screening of different genotypes of pea against the disease

To identify resistant pea cultivars against the root rot pathogen *Rhizoctonia solani*, 48 varieties were screened under artificial inoculation conditions at Instructional Farm, S.K.N. College of Agriculture (Sri Karan Narendra Agriculture University), Jobner, Jaipur, during two consecutive crop sessions (*Rabi* 2022-23 and 2023-24). This method is recognized as the most effective, economical, and environmentally friendly approach for disease control.

In the experiments, inoculum was prepared using sterilized sorghum grains, which were then applied in furrows at a rate of 20 grams per meter of row length. Each genotype/variety was replicated three times. Observations on disease incidence were recorded up to 90 days of sowing. On the basis of disease incidence, the genotype/ varieties were categorized as per criterion followed by Nene *et al.* (1981) and Farooq *et al.* (2019) (Table1).

RESULTS AND DISCUSSION

Forty-eight genotypes/varieties of pea were screened infield under artificial inoculation conditions against root rot disease. It is evident from the data that all the tested genotypes/ varieties had showed variable reaction to the *R. solani* during both the years (*Rabi* 2022-23 and 2023-24) as well as on pooled basis (Table2).The average of two years revealed that root rot incidence was ranged from 12.98 per cent (Lincoln) to 57.66 per cent (Arkel) among evaluated forty-eight genotypes/varieties and it was lowest (12.98%) in the variety Lincoln while it was maximum in Arkel (57.66%).

Based on disease reaction, pea genotypes/ varieties were grouped (Table3) into five categories *i.e.* highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S) and highly susceptible (HS). None of the genotypes/ varieties was found immune and highly resistant. However, four varieties were found resistant (Lincoln, 2021/PEPVAR-5, 2021/PEPVAR-2 and 2021/PEPAR-9), while eighteen varieties were moderately resistant (Kashi Ageti, Kashi Nandini, Mithi Phalli, IP-83, Hisar Harit, Kashi Udai, Pusa Shree, 2021/PEPVAR-1, 2021/PEPVAR-3, 2021/ PEPVAR-6, 2021/PEVAR-4, 2021/PEVAR-5, 2021/PEVAR-6, 2021/PEVAR-7, 2019/PEMPMR-14, 2019/PEMPMR-13,2019/PEMPMR-20 and 2019/PEMPMR-19), fifteen varieties were susceptible (Kashi Shakti, Kashi Samrath, PC-531, NDVP-1, Azad pea-1, NDVP-12, KS-205, Pant Uphar, VL-72, 2019/PEMPMR-18, 2019/ PEMPMR-17, 2019/PEMPMR-16, 2019/ PEMPMR-15, 2021/PEVAR-8 and 2021/PEVAR-1) whereas eleven varieties were highly susceptible (Arkel, VRP-7, Pusa-Pragati, Pusa Prabal, VL-7, Ajad Pea-3, Arka Kartik, 2021/ PEPVAR-4, IC-208-366, PRS-86 and No.-17) to the *R. solani*.

Testing of resistance is a continuous process due to the evolution of new biotypes of the pathogen or breakdown of resistance in host genotypes. Combating plant disease through host resistance is an economic, ecologically safe and a viable proposition for disease management. Monoculture/lack of diversity, pre-disposes a crop to disease and the situation is more alarming in

Table1: Categorization of pea genotypes/varieties as per disease incidence

Category	Per cent disease incidence
Immune	0
Resistant	1-10
Moderately Resistant	10.1-20
Moderately Susceptible	20.1-30
Susceptible	30.1-50
Highly Susceptible	>50
Category	Per cent disease incidence
Immune	0
Resistant	1-10
Moderately Resistant	10.1-20
Moderately Susceptible	20.1-30
Susceptible	30.1-50
Highly Susceptible	>50

As per Nene *et al*., 1981 and Farooq *et al*., 2019).

cases where pathogen evaluation frequently takes place. Forty-eight genotypes/varieties of pea were screened in the field under artificial inoculation conditions against root rot disease. It is evident from the data that all the tested genotypes/varieties had showed variable reactions to the *R. solani* during both years (*Rabi* 2022-23 and 2023-24). The average of two years revealed that root rot incidence ranged from 12.98 per cent to 61.85 per cent among evaluated forty-eight genotypes/varieties and it was lowest (12.98%) in the variety Lincoln while it was maximum in Arkel (61.85%). None of the genotypes/varieties was found immune and highly resistant. However, four varieties were found resistant (Lincoln, 2021/PEPVAR-5, 2021/ PEPVAR-2 and 2021/PEPAR-9), while eighteen varieties were moderately resistant. Gaur and Katariya (2007) reported that out of 23 varieties screened against dry root rot of chickpea, two varieties *viz.,* BG-203 and BG-209, which recorded incidence below 10 per cent were termed as resistant, while BG-377, BG-416, GMS-469, GMS-1292, GNG-469 and RSG-887 having incidence between 11-30 per cent and categorized as moderately resistant. Benagi *et al*. (2008) tested 12 genotypes and one susceptible check JG-62 of chickpea against *Rhizoctonia bataticola*. Out of these, four were found resistant, two were moderately susceptible, three were susceptible and three were highly susceptible to the disease. Nigam *et. al.* (2015) found that out of thirty-six lines screened for their reaction only two lines viz., DMR-7 and PUDP-2 remained completely free from the incidence of wilt and root rot disease. Similarly, Sharma and Ratnoo (2016) also screened varieties like Kashi Samrath, VRP-22, VRP-6, VRP-7, VRP-5, Pea IP-3, Azad P1, Pea KS-210, Pea KS- 205, Pea VP-433 and Local cultivar in the field against *F. solani* f. sp. *pisi*. Among these, VRP-7 was found moderately resistant, four cultivars namely VRP-6, VRP-5, VRP22 and Pea IP-3 were found moderately susceptible whereas six cultivars were found susceptible. Thus, among the eleven cultivars tested none of the cultivars was found free to the disease. Nain *et al*. (2023) tested the twenty-nine varieties/genotypes of peas under field conditions with artificial inoculation against root rot disease. Among all tested varieties/

Table 2: Evaluation of different genotypes/varieties of pea against root rot disease under field conditions.

Genotypes/varieties	PDI*		Pooled*	Disease Reaction
	2022-23	2023-24		
2021/PEPVAR-1	28.04 (31.97)	27.66 (31.73)	27.85 (31.85)	MR
2021/PEPVAR-3	22.06 (28.01)	23.04 (28.69)	22.55 (28.35)	MR
2021/PEPVAR-4	48.99 (44.42)	52.93 (46.68)	50.96 (45.55)	HS
2021/PEPVAR-5	14.36 (22.27)	11.93 (20.21)	13.15 (21.26)	R
2021/PEPVAR-6	26.22 (30.80)	27.09 (31.36)	26.66 (31.08)	MR
2021/PEV AR-1	46.78 (43.15)	49.66 (44.81)	48.22 (43.98)	S
2021/PEV AR-2	16.38 (23.87)	19.04 (25.87)	17.71 (24.89)	R
2021/PEV AR-4	23.78 (29.19)	27.46 (31.60)	25.62 (30.41)	MR
2021/PEV AR-5	24.66 (29.77)	29.68 (33.01)	27.17 (31.42)	MR
2021/PEV AR-6	25.52 (30.34)	21.18 (27.40)	23.35 (28.90)	MR
2021/PEV AR-7	25.42 (30.28)	26.02 (30.67)	25.72 (30.47)	MR
2021/PEV AR-8	33.28 (35.23)	37.25 (37.61)	35.27 (36.43)	S
2021/PEV AR-9	14.63 (22.49)	14.03 (22.00)	14.33 (22.24)	R
2019/PEMPMR-13	23.87 (29.25)	25.07 (30.05)	24.47 (29.65)	MR
2019/PEMPMR-14	25.43 (30.28)	27.29 (31.49)	26.36 (30.89)	MR
	31.89	34.48	33.19	

2019/PEMPMR-15	(34.38)	(35.96)	(35.17)	S
2019/PEMPMR-16	31.01 (33.84)	32.06 (34.49)	31.54 (34.16)	S
	40.98	37.26	39.12	
2019/PEMPMR-17	40.98 (39.80)	37.26 (37.62)	39.12 (38.72)	S
2019/PEMPMR-18	34.66 (36.07)	37.78 (37.93)	36.22 (37.00)	S
2019/PEMPMR-19	25.39 (30.26)	28.05 (31.98)	26.72 (31.13)	MR
2019/PEMPMR-20	26.88 (31.23)	27.41 (31.57)	27.15 (31.40)	MR
Kashi Ageti	28.44 (32.23)	29.84 (33.11)	29.14 (32.67)	MR
Kashi Nandini	26.80 (31.18)	25.89 (30.59)	26.35 (30.88)	MR
Kashi Shakti	38.89 (38.58)	42.40 (40.63)	40.65 (39.61)	S
Kashi Samrath	40.77 (39.68)	36.36 (37.08)	38.57 (38.39)	S
Ajad Pea-3	56.56 (48.77)	54.42 (47.54)	55.49 (48.15)	HS
PC-531	46.56 (43.03)	48.07 (43.89)	47.32 (43.46)	S
Lincoln	11.88 (20.16)	14.07 (22.03)	12.98 (21.11)	R
IC-208-366	56.04 (48.47)	52.38 (46.36)	54.21 (47.42)	HS
Mithi Phali	26.89 (31.24)	24.88 (29.92)	25.89 (30.58)	MR
IP-83	28.39 (32.20)	28.90 (32.52)	28.65 (32.36)	MR
PRS-86	51.11 (45.64)	49.83 (44.90)	50.47 (45.27)	HS
NDVP-1	36.46 (37.14)	39.23 (38.78)	37.85 (37.97)	S
	23.53	26.81	25.17	

Hisar Harit	(29.02)	(31.18)	(30.11)	MR
NDVP-12	48.33 (44.04)	46.28 (42.87)	47.31 (43.46)	S
No. 17	55.12 (47.94)	51.08 (45.62)	53.10 (46.78)	HS
Ajad Pea-1	34.75 (36.12)	38.76 (38.50)	36.76 (37.32)	S
KS-205	28.38 (32.19)	32.42 (34.71)	30.40 (33.46)	S
Arka Kartik	52.12 (46.22)	49.06 (44.46)	50.59 (45.34)	HS
Pant Uphar	43.53 (41.28)	41.78 (40.27)	42.66 (40.78)	S
Kashi Udai	26.47 (30.96)	29.44 (32.86)	27.96 (31.92)	MR
Pusa Prabal	54.17 (47.39)	56.28 (48.61)	55.23 (48.00)	HS
VL-7	49.33 (44.62)	53.08 (46.77)	51.21 (45.69)	HS
Pusa Shree	28.44 (32.23)	27.56 (31.67)	28.00 (31.95)	MR
Pusa Pragati	56.46 (48.71)	51.56 (45.89)	54.01 (47.30)	HS
VRP 7	53.77 (47.16)	54.69 (47.69)	54.23 (47.43)	HS
VL-72	46.46 (42.97)	49.07 (44.47)	47.77 (43.72)	S
Arkel	56.81 (48.91)	58.50 (49.89)	57.66 (49.40)	HS
SEm±	1.29	1.64	0.69	-
CD (P=0.05)	3.72	4.74	1.95	-

Average of three replications.Values in parentheses are angular transformed values

genotypes none was categorized under immune categories, only three varieties *i.e.*2021/PEPVAR-5, 2021/PEPVAR-2 and 2021/PEV AR-9 found resistance against root rot of pea disease. Arkel (check) was found highly susceptible to root rot of pea with 67.34 per cent disease incidence.

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Table 3 : Reaction different genotypes/varieties of pea against root rot under field conditions

Disease reaction	Disease incidence (%)	Genotypes/varieties	Total
HR- Highly Resistant	0-10%	Nil	0
R- Resistant	11-20 %	Lincoln, 2021/PEPVAR-5, 2021/PEPVAR-2, 2021/PEPAR-9	4
MR – Moderately Resistant	21-30%	Kashi Ageti, Kashi Nandini, Mithi Phalli, IP-83, Hisar Harit, Kashi Udai, Pusa Shree, 2021/PEPVAR-1, 2021/PEPVAR-3, 2021/PEPVAR-6, 2021/PEVAR-4, 2021/PEVAR-5, 2021/PEVAR-6, 2021/PEVAR-7, 2019/PEMPMR-14, 2019/PEMPMR-13,2019/PEMPMR-20, 2019/PEMPMR-19	18
S- Susceptible	31-50%	Kashi Shakti, Kashi Samrath, PC-531, NDVP-1, Azad Pea-1,NDVP-12,KS-205,Pant Uphar, VL-72, 2019/PEMPMR-18, 2019/PEMPMR-17, 2019/PEMPMR-16, 2019/PEMPMR-15, 2021/PEV AR-8, 2021/PEV AR-1	15
HS- Highly susceptible	(>50%)	Arkel, VRP-7, Pusa-Pragati, Pusa Prabal, VL-7, Ajad Pea -3, Arka Kartik, 2021/PEPVAR-4, IC-208-366, PRS-86, No.-17	11

guidance, support, and facilities to conduct this research experiment successfully.

DECLARATION

Conflict of Interest: Authors declare no conflict of interest.

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