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Distribution and Integrated Management of Root Rot of Pea in Malakand Division

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Abstract

Aphanomyces euteiches, *Fusarium oxysporium* f.sp. *pisi*, *F. solani* f.sp. *pisi* ans *Rhizoctonia solani* were isolated from 135 infected root specimens collected from eight commerical pea fields at Malakand Division, Pakistan. However, *A. euteiches* was isolated most frequenty, followed by *F. oxysporium* f.sp *pisi* with frequency of 45.92 and 33.33 percent, respectively. For the first time, *A. euteiches* was recorded on pea from Pakistan as an important component of the root complex. All the isolated fungi were tested for pathogenicity on pea seedings of the variety "climax" and found virulent. The fungicides, benlate, ridomil and captan significantly reduced the incidence and severity of pea root when applied at the time of first symptoms appearance to the root zone, followed by a repeat treatment 15 days latter. The effectiveness of these fungicides was increase when used in conjunction with other management practices for two consecutive years on the same field.

Key words: Pea field, root rot, fungi, fungicides, other management practices

Introduction

Root rot of pea (*Pisum sativum*) is a major soil borne disease in pea growing areas worldwide, and it often considered to be the limting factor in pea production (Shehata *et al*., 1983). The disease in complex in nature and various fungi are involved in its causation. Among those the most predominant fungi are *Rhizoctonia solani, Fusarium solani* f.sp. *pisi*, *Fusarium oxysporium* f.sp. *pisi*, *Pythium ultimum*, and *Aphanomyces euteiches* (Flentje and Hagedorn, 1964; Hampton and Ford, 1965; Escobar *et al*., 1967; Kraft and Roberts, 1970; Kaiser *et al*., 1971; Reyes, 1980; King and Parke, 1993). These pathogens may be present and active in the same soil, causing pea root rot disease independently or as a combination, depending on the soil or environment conditions that exist throughout the growing seasons. Shehata *et al*. (1983) worked on the interaction between soil borne plant pathogens and reported severe root rot development on susceptible genotype of pea when inoculated with either combinations of *F. solani* f.sp. *pisi* plus *R. solani* or combination of sequential inoculation of *F. solani* f.sp. *pisi* plus *R. solani* plus *P. ultimum* plus *A. euteiches*.

Fungicides were commonly used for control of root rot complex in pea. Jhooty and Behar (1970) successfully controlled *R. solani* by treating pea seed and soil with benomyl. Powell (1988) used benomyl on poisettia cuttings as drenches and proved it effective against *R. solani*. Moustafa-Mahmoud *et al*. (1993) tested ridomil (metataxyl) against *R. solani* on cotton seedings in the greenhouse and field and found it effective in reducing infection of *R. solani*. Root rot caused by *F. oxysporium* and *F. solani* was effectively controlled with beomyl and derosal (Wahid *et al*., 1995). Similarly, Harper (1968) reported benomyl as the best fungicide for the successful control of pea root rot caused by *R. solani*, *F. solani* and *A. euteiches*.

Root rot is one of the most serious diseases of pea in Malakand Division and causes heavy damage to pea production. So far, no systematic research work has been performed on this economically important disease complex in Pakistan except the occurrence of *R. solani* on pea in Faisalabad, (Shahzad and Ghaffar, 1990). Therefore, the present studies were conducted with the objectives to determine pathogens associated with the root rot complex in Malakand Division, and their possible control measures.

Materials and Methods

Sampling and isolation of pathogens: The collected roots were washed in running tap water to remove the soil particles and blotted dry on paper towel. Three to five centimetre long root pieces were cut, surface sterilized with 1 percent sodium hypochlorite for three minutes, washed twice in sterilized distilled water and again blotted dry on a clean paper towel. The sterilized root pieces were then transferred on the PDA plates containing penicillin (100 ppm) and streptomycin (100 ppm) and incubated at 20°C. Incidence of root infecting fungi viz, *Fusarim oxysporium* f.sp. *pisi*, *F. solani*, f.sp. *pisi*, *Rhizoctonia solani* and *Aphanomyces euteiches* were recorded after seven days.

Pathogenicity test: The methods used by Whalley (1984) was adopted with a slight modification. Surface sterilized pea seeds, of the variety 'climax', were germinated on moist filter paper in a petri plate until 30 mm of the plumule had emerged. Five plants per petri plate were maintained and inoculated with a spore suspension of each fungus, and placed at room temperature. Randomized Complete Block design was followed and each treatment was replicated three times.

Field study fungicides: Among the surveyed areas in Table 1, an infested field near Agricultural Research Station, Mingora, Swat was selected and susceptible pea variety 'climax' was grown on ridge one mater apart. Plant to plant distance was kept to five centimetres. Balance fertilizer and farm yard manure was used before sowing the crop to keep the soil fertile and produce a healthy crop. The field was well grained and thoroughly weeded. The plants were staked to give proper support and to allow good proper air

cirulation and sunshine, which ultimately helps in the reduction of the pathogens. This experiment was conducted during 1995-96 and repeated on the same field during 1996-97.

During 1996 and 1997, three fungicides viz., captan and dithane M-45, and benlate, ridomil and captan respectively were applied at the standard dose against root rot disease to the root zone of the pea plants at the time of the first disease infection (first week of April). Application of fungicides was repeated once after 15 days. Control treatment was left without application of fungicides. Randomized Complete Block design was followed and treatments were replicated three times. The date regarding percent infected plants were recorded after 15 days from the second application, and at the time of last harvest. The infected plants were then collected and the pathogens were isolated in the laboratory of the Plant Pathology at Agricultural Research Station, Mingora, Swat to examine the effectiveness of the tested fungicides against the existing fungi in the field.

Results and Discussion

Approximately eight commercial pea fields were surveyed in the summer of 1995. Results of the survey on the incidence of pea root rot are presented in Table 1. In commercial pea fields, *Aphanomyces euteiches and Fusarium oxysporium* t.sp. *pisi* were isolated most frequently and *F. solani* t.sp. P151 and *Rhizoctonia solani* occasionally. Though *F. solani* f.sp. P151 was reported among the major causal organisms in most parts of the world, its presence in this locality was recorded as the minor one possibly due to difference in the topography, and other edaphic and environmental factors. However, occurrence of *R. solani* was lower and reported only occasionally from various regions of the world (Reyes, 1980; Tu, 1987). Out of 135 diseased root samples, *A. euteiches, F. oxysporium* t.sp. *pisi, F. solani* f.sp. *pisi and R. solani* were isolated with frequency of 45.92, 33.33, 14.81 and 5.52 percent, respectively. Calculation of a disease damage index or frequency for each fungus showed that the root rot caused by *A. euteiches* was the most serious problem, followed by *F. oxysporium t.sp. pisi* this might possibly be due to the prevailing favourable environmental conditions in the area eg. wet and mild warm weather from March to May during the pea growing season. However, *A. euteiches, F. oxysporium* t.sp. *pisi,* increased in the root tissues as the season advanced. Kotova (1979) and Abbo and Irwin (1990) reported *A. euteiches* as a highly pathogenic fungus on pea crop on Russia and Australia respectively and attributed its severity to high soil moisture and moderate temperature $>10^{\circ}$C. Similarly, Maheshwari *et al*. (1981a), and Sharma *et al*. (1989) reported *F. oxysporiun* f.sp. *p151 and F. solani* f.sp. *p151* from India on pea crop with disease incidence ranging from 19.57 to 37.39 percent *R. solani* and *Fusariurn spp.* have been reported as the causal organisms of pea root rot from the Southern part of Pakistan by Shahzad and Ghaffar (1990) and Ehteshamul-Haque and Ghaffar (1994). Although this is the first record of *A. euteiches* on pea from Pakistan, the pathogen had been a common component of the root rot complex but had not been detected previously, might be due to inadequate sampling and isolation techniques of timely approach to the fields. Representative cultures of *A. euteiches, F. oxysporium* f.sp. *pisi, F.solani* f.sp. *pisi and R. solani* were maintained on potato dextrose agar. The one week old culture of each fungus was tested for pathogenicity on climax pea seedlings. All the fungi were found virulent and disease symptoms on all the tested seedlings were recorded. The same fungi were re-isolated from the lesions caused by the inoculated materials. The results coincide with those obtained by Reyes (1980) and Whalley (1984).

In both 1996 and 1997, all the fungicides significantly reduced the incidence and severity fo root rot. There were highly significant percentage differences among the fungicides treatments as compared with the control treatment of infected plants after 15 days from second application of fungicides and at the last harvest (Table 2 and 3).

In 1996, the percentage of infected plants after 15 days from the second application of fungicide, ridomil, captan and dithane M-45, averaged 1.59, 3.82, and 12.18 percent, respectively. As the season progressed, the fugicides reduced their effectiveness and root rot causing fungi started increasing in population. At the last harvest, the percentage of the infected plants increased to 8.32, 14 and 21.87 percent in the plots treated with ridomil, captan and dithane M-45, respectively. Among the fungicides, ridomil gave the most effective control followed by captan. Dithane M-45, reduced the percent infection as compared to the control one, did not prove to be effective fungicide for the control of root rot complex in pea, and was therefore dropped from the experiment. In 1997 , this experiment was repeated on the same field with some minor alteration. Instead of dithane M-45, benlate was applied to the pea plot. Benlate and ridomil effectively controlled the disease up to the last harvest, and only 0.5 and of 0.6 percent respectively infected plants were recorded. Captan also did well and at the last harvest only 2.3 percent infected plants were observed. Maheshwari *et al*. 1981a), Maheshwari and Jhooty (1987), Fahim *et al*. (1987), Raut and Somani (1987), Moustafa-Mahmoud *et al*. (1983) and Olaya *et al*. (1994) studied on benlate, captan, and dithane M-45 against *R. solafli, F. oxysporium, F. solani* and obtained similar results. In both the years, only *A. euteiches* was detected from the infected plants in the treated plots. Vincelli (1992) and Harper (1968) tested ridomil and benlate respectively against *A. euteiches* and reported that ridomil and benlate did not eliminate the fungus, but reduced its incidence and improved the vigor of the plants.

When the data of 1996 and 1997 were compared, an imminent drop was noted in the percentage of the infected plants. The percentage of infected plants was drastically decreased in 1997. Such changes may be attributed to the timely application of fungicides, the cultural practices natural changes in the environment, or a combination of both fungicides and cultural practices adopted for the two consecutive years. Srihuttagum and Sivasithamparam (1991) worked on the influence of fertilizers on root rot of pea and reported that nitrogen + phosphorous + potassium are effective in reducing the severity of *R. solani* and *F. oxysporium* in the soil. Similarly, Maheshwari *et al*. (1981b) studied the effect of various cultural practices and reported that the incidence of root rot complex of pea can be reduced with proper sowing time and method, irrigation

Table 1: Pathongens detected from disease samples collected from different pea growing areas

Pea growing areas	Samples collected	Fungi isolated (%)			
		F. oxysporium	*F. solani*	*R. solani*	*A. euteiches*
Charbagh	10	40.00	0.00	0.00	60.00
Gulibagh	15	33.33	13.33	6.67	46.67
Salanda	17	41.17	29.41	11.76	17.64
Alamganj	20	20.00	10.00	15.00	55.00
Khawazkela	15	40.00	20.00	6.66	33.33
Asala	30	36.66	6.66	0.00	56.66
Yusaf abad	8	25.00	12.50	0.00	62.50
Mingora	20	30.00	25.00	5.00	40.00
Total	135	33.33	14.81	5.92	45.92

Table 2: Percent infected plants of root in pea plot after treatment with different fungicides during 1996

Fungicide	Percent infected plants after treatment	
	After 15 days	At least harvest
Ridomil	1.59d	5.32d
Captan	3.82c	14.00c
Dithane M-45	12.18b	21.87b
Control	13.12a	24.99a

Table 3: Percent infected plants or root/stem rot in pea plot after treatment with different fungicides during 1997

Fungicide	Percent infected plants after treatment	
	After 15 days	At least harvest
Benlate	0.2c	0.5c
Ridomil	0.4c	0.6c
Captan	1.3b	2.3b
Control	8.7a	20.6a

LSD value at 5% level: 0.2189 and 0.2825 respectively. Mean followed by different letters are significantly different from one another at 5% level

and balanced fertilizer application, particularly phosphorous. Maheshwari *et al*. (1980) reported that wet weather, air temperature >10°C and light soil (95% sand) favoured disease development, and recommended proper soil drainage for reducing the infection and development of the disease complex. Therefore, the present results coincide with the previous studies conducted in different parts of world. Further investigations are needed to examine the influence of cultural practices only, and fungicides without cultural practices, and the interaction among the soil borne pathogens for the control of root rot complex in pea and their effects on yield potential.

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