Relationship between seasons and severity of bacterial wilt of potato under field conditions

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Bacterial wilt disease of potato caused by Pseudomonas solanacearum. Smith is endemic in Kumaon hills of Uttar Pradesh. The disease is widespread on potatoes throughout the region, particularly in mid and low hills (8, 11). There are two potato growing seasons, viz., summer (March-July) and autumn (August/September-December). When potatoes are grown in hot humid summer season, the outbreak of bacterial wilt often occurs and it becomes a limiting factor in growing potatoes while in autumn season, wilt symptoms rarely appear but latent infections in apparently healthy potatoes become a limiting factor in using them as seed for next crop (4, 12). Therefore, the purpose of the present study was to examine the effect of potato planting seasons on severity of bacterial wilt and maintenance of pathogen population in an infested soil.

The study was initiated during 1988-89 in an infested field at Bhowali (1400 m asl) in mid hill of Nainital district, Kumaon region of Uttar Pradesh. The average minimum and maximum air temperature in summer potato crop (March-July months) range between 11.7 and 27.6°C with total rainfall of 76.7 cm while in September-December months, the autumn potato season, the average air temperatures range between 7.9 and 20.7°C with total rainfall of 16.7 cm.

Soils for estimation of P. solanacearum population were sampled at monthly intervals during summer and autumn potato crop seasons using method described by McCarter et al., (10). A dilution series was prepared and 0.1 ml of each dilution was spread over the selective medium plates of Granada and Sequeira (2). Plates were incubated for 48 h at 28°C and then examined for presence of P. solanacearum colonies (7). Pathogen population in colony forming units (CFU) per gram soil was calculated and transformed using log_{10} transformations.

Four plots, 6 x 2 m² having 100 tubers each, were used for planting clean seed of potato variety, Kufri Jyoti during each season. Potatoes were grown during 1988-89 in the same field which was used for collection of soil samples in both the seasons, i.e., summer (March-July) and autumn (September-December). Observations on incidence of wilt were made from emergence till maturity of potato crop and from this average percentage wilt (APW) was calculated (5). Disease grading was done using Martin and French scale (9).

The bacterium was detected in all the soil samples by the selective medium. The number of P. solanacearum colonies/g soil was much greater in samples collected during summer season than the autumn season. There was continuous reduction in population of bacterium in monthly soil samples of autumn season. The mean population of pathogen was 5.9 x 10^6 (6.77 log_{10}) CFU/g soil in September, the month of potato planting but with further fall in mean minimum and maximum monthly temperature, and scanty rainfall, the pathogen population showed an exponential decrease in October and November. In December 1988, the mean bacterial population reached the lowest of 3.1 x 10^4 (4.49 log_{10}) CFU/g soil. There was positive correlations between bacterial population and average minimum and maximum temperatures. The variation in bacterial population did not show any correlation with change in monthly rainfall.

There was substantial increase in population of bacterium in April relative to the bacterial population in March, the month of potato planting in summer...
Table 1. Incidence of bacterial wilt in potato field

<table>
<thead>
<tr>
<th>Potato season</th>
<th>Average percentage wilt (APW) and severity index (SI)* after</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 Weeks</td>
</tr>
<tr>
<td></td>
<td>APW</td>
</tr>
<tr>
<td>(September to December, 1988)</td>
<td>0.0</td>
</tr>
<tr>
<td>Autumn season</td>
<td>0.0</td>
</tr>
<tr>
<td>Summer season</td>
<td>0.0</td>
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</tbody>
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*Severity index was based on scale of 1-5; 1 = no wilt, 2 = one leaf wilting, 3 = one third plant wilting, 4 = two third plant wilting, 5 = plant dead.

season. In further months, the population of pathogen increased exponentially from $7.6 \times 10^6$ CFU (5.88 log$_{10}$) CFU/g soil in April to $2.4 \times 10^6$ (6.33 log$_{10}$) CFU/g soil in May when mean minimum and maximum temperature were 11.9 and 28.7°C respectively. High monthly rainfall and further rise in mean minimum monthly temperature in June and July resulted in further exponential increase in bacterial population from $2.4 \times 10^6$ (6.38 log$_{10}$) CFU/g soil in May to 2.0 (7.46 log$_{10}$) and $3.7 \times 10^7$ (7.56 log$_{10}$) CFU/g soil in June and July months respectively. Increase in bacterial population was positively correlated with average minimum temperature and rainfall but not with the maximum temperature in summer season.

The appearance of first wilt symptoms in standing potato crop in field was associated with bacterial population of $2.4 \times 10^6$ (6.38 log$_{10}$)/g soil. The maximum APW of 18.4 with severity index of 1.7 was recorded in July month with corresponding bacterial population of $3.7 \times 10^7$ CFU (7.56 log$_{10}$)/g soil. No wilted potato plants were observed in autumn season even though high bacterial population of $5.9 \times 10^6$ (6.77 log$_{10}$) CFU/g soil was recorded in September, the month of potato planting (Table 1).

Results obtained in the present study indicate that in summer season (March-July), the bacterial incidence was high, presumably the high temperature and rainfall during these months promote bacterial wilt development. In autumn season (September-December), no wilted plants were observed, perhaps due to low temperature and scanty rainfall which reduce the aggressiveness and multiplication of *P. solanacearum* inpite of the presence of susceptible host. Normally under such whether conditions the pathogen population never reaches to the level of causing wilt symptoms even though bacterial infection does take place (1, 11).

The population and APW were maximum in July, the hottest and wettest month in summer and autumn season with mean minimum and maximum air temperature ranging between 20.5 and 28°C (average 24.6°C). It is possible that under high air temperature and soil moisture roots are invaded easily leading to more rapid bacterial infection and disease development which is in confirmation with previous findings (3, 5, 13) that the rate of multiplication and symptom development are influenced by environmental factors, particularly air temperature and rainfall.

REFERENCES


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