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Potato leaf Roll virus (PLRV) on Solanum Tuberosum L. in Eastern Zone of Nepal and Adjoining Area of India

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ABSTRACT

Potato is cultivated in plain and hilly area of eastern zone of Nepal and adjoining area of India. It is an important ingredient of vegetables- boiled, fried and spicy used in daily diet. Potato is grown a little in eastern zone against the demand and mostly imported from India. Potato requires a wide range of soil- sandy loams, slit loams, loams and peat. The tuber is rich in starch. The varieties of potato such as Kufri Red, Kufri Sinduri have been developed in Central Potato Research Institute, Simla. The survey of potato cultivation was completed on Date 15/03/2022 at Devanganj, Sunsari district of Province no 1. Some branches of potato were suffering from leaf roll disease by the pathogen Potato leaf roll virus (PLRV). Polero Virus transmitted by green peach aphid *Myzus persicae*. Severity of the disease was 4-8%. Identification of the potato leaf roll virus was according to Mehrotra (1980)[21], Gibbs (1969)[9], Gibbs & Harison (1976)[12], Gibbs, et al. (1966)[10], Nagaich, et al. (1972)[22] Lowff & Tournier (1966)[19], Smith (1929)[32], Smith (1957)[33], Widely (1971)[36], Pandey (2018)[25], Rangaswami (1994)[28] & Singh (1968)[31].

1. Introduction

Host

Potato Solanum tuberosum L. (n= 24)

Potato is an important ingredient either alone or mixed with other vegetables. The different form of potato- boiled, fried and spicy is used in our diet. Now a day potato chips are very popular in different forms and loved and liked by children and adults. Potato cultivation is very common in China, Russia, Poland, USA, Ukraine, India, Germany, Netherlands, UK, France & Turkey. The potato homeland south America is distant seventh producing only about 11.8 million tones. In Asia the major producers are China, India, Turkey, Japan and Korea. Potato is also cultivated in Nepal in hilly area. Potato is grown as summer crop while in the plain it is a winter crop. It is an annual plant having stout, erect, branched stems 1-2 ft long. The stolon, which is 2-4 inches long, enlarge at the outer end to develop a tuber. The tuber is a modified stem with lateral branches forming which are known as potato eye. Each eye contains at least three buds enclosed by scales. The interior of the tuber shows pithy central region with branches leading to each of the eyes. The pith is surrounded by the parenchyma in which most of the starch is deposited. Towards the outer part of the tuber is the vascular ring that contains the cambium, as well as an outer cortex that contains pink, red or purple pigment of colored-skinned varieties. It requires a wide range of soil types- Sandy loams, Silt loams, lamas and peat. The tuber is rich in starch and used in the manufacture of alcohol and starch. The varieties of potato such as Kurfi red, Kurfi sinduri have been developed in the central potato research Institute, Simla. According to Gopalan (2007) 100g of potato contains following substances:

Moisture-74.7 g, Protein-1.6g, Fat-0.1g, Minerals-0.6g, crude fibre-0.4g, Carbohydrate-22.6, Energy-97 kcal, Calcium-10mg, Phosphorous- 40mg, Iron- 0.48mg, Carotene-24mg, Thiamine-0.10mg, Riboflavin- 0.01mg, Niacin- 1.2mg, Free folic acid- 3mg, Total folic acid- 7mg, Vitamin C-17mg, Choline- 100mg, Mg- 30mg, Sod- 11mg, potassium-2.47 mg, Cu.- 0.16, Mn- 0.13, Mo- 0.070mg, Zn- 0.53mg, Cr-0.007mg, S.- 37mg, Cl- 16mg, Approximate total N\100 gm, Arginine–330, Histidine- 100, lysine- 320, Tryptophane- 100, Phenyl alanie-270, Tryosine-170, Methionine-90,Cystine-50, Threonine-220, Lencine-380, Isolencine-270, Valine-310 mg/gN, Oxalic acid-20mg, Phytin P-14 mg, Phytin P as perfect of total P-35, Total dietary fibre-1.7g, Insoluble dietary fibre-1.1g, soluble dietary fibre- 0.6g

2. Review of Literature

Beck (1970)[2], Bose, et al. (1993)[4,] Burton (1989)5, Chauhan (1968)[6], Cox (1967)[7], Harris (1978)[14], Hawkes (1978)[15,] Hawkes (1990)[16], IPC (1984)[17], Nath (1976)[23], Pushkar Nath (1969)[27], Salaman29 (1949) have mentioned about the vegetable potato, while Smith (1977)[34] described the production, storing and processing of potato. Swaminath and Howard (1953)[35] reported the cytology and genetics of potato (Solanum tuberosum) and related species. Kochhar (1998)[18], Prakash & Sharma (1975)[26] and Pandey (1998)24 wrote the book of economic Botany about potato. Gopalan, et al. (2007)[13] described the constituent of potato. Dubey & Maheswari (2016)[8] and Biswas & Biswas (1993)[3] mentioned potato leaf roll virus (PLRV). Gibbs, et al. (1966)[10], Gibbs, et al. (1969)[9] properties and inter- relationship of virus and nomenclature of virus. Gibbs (1969)9 gave classification of plant virus. Gibbs & Harrison (1976)[12]mentioned the principle of plant virology. Lwoff & Turner (1966 & 1971)[19] gave the classification of plant virus and remarks on the classification. Nagaich (1972)[22] reported the transmission of potato virus X and S by Epilachna and Cocanella beetles.

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Smith (1929)[32] studied insect transmission of potato leaf roll virus. Smith (1957)[34] wrote a text book of plant virus diseases. Widely (1971)[36] described classification and nomenclature of viruses. Pandey (2018)24, Rangaswami (1994)[28], Maharotra (1980)[21], Singh (1968)[31] and Anonymous (1984)[1] have given the basic concept of plant pathology. Singh, et al. (2014)[30] reported degeneration of potato cultivars in North Gujrat (INDIA).

3. Lab Work

Anatomical study

1) The host cells become thicker.
2) Distributed particles in phloem were present.
3) Tyloses in vascular region was a peculiar phenomenon.
4) No any sign except necrosis in the stem.
5) Chlorophyll containing cells become dead in primary infection.
6) In secondary infection stage, all the leaves became dead.

4. Identification

According to Mehrotra (1980)[21], Pandey (2018)[25], Gibbs (1966)[11], Gibbs & Harrison (1976)[12], Gibbs, et al. (1966)[10], Nagaich, et al. (1972)[22], Lwoff & Tournier (1966)[19], Singh (1968)[31], Smith (1929)[32], Smith (1957)[33], Widely (1971)[36] the virus is known as potato virus X and Leaf roll virus- Y, X or Solanum Virus 14 (Apple & Quanjer).

5. Structure of potato leaf roll virus

1. PLRV particles are isometric, isohedral, non-enveloped virion (T=3 particles) of 25-30 nm diameter with 180 copies of capsid protein (CP).
2. It contains 30% of the stranded positive- sense RNA with a molecular weight of 5.9 kb.
3. The viral genome is covalently linked to a 7.2 kDa (VPg) at its 5′ Stand and not polyadenylated at the 3′ end.

6. Varietal response

i. Phulwa and ArranComrade are responded the rolling leaves especially in lower leaves of the potato plant.

ii. Agra red does not show any symptom by visual observation.

iii. Arran Victory, craigs Defiance and Kerr's pink show marked symptom of leaf rolling.

iv. In Arran chief and Kerr's pink, the severe necrosis takes place and therefore synthesized food material in leaves (glucose) is not translocated to the underground tuber.

v. Therefore, the formation of aerial tuber in the axil of the leaves.

vi. Net necrosis of tubers

Sometimes the whole tubers show necrosis i.e., entire productivity.

vii. Early maturity of potato plants

In plains, the potato plants infected by Potato leaf roll virus (PLRV) mature early.

viii. Short stolon

Infected plants exhibit not larger stolon and therefore, the tubers lie around the plant (not underground)

ix. Yield

As low yield or small tubers in shape and size or in weight because of necrosis or the death of phloem element concerned in the translocation of the substance from the leaf of tubers.

7. Nature and reoccurrence of the disease

The leaf roll disease of potato is seed borne (tuber-borne). Tubers infected with the virus, when planted gives rise to shoots, in which leaf roll symptoms are seen. And the produces new progeny which are also capable of causing the diseases.

8. Control

1. Use of resistant varieties.
2. Seed crops should be away from peach trees (because the vector *Myzus persical* survives on Peach).
3. Spraying of Ekatox (0.02%) and Regor (0.05%) at 10 days interval reduce the infection.
4. Burning of infected plants after getting the tuber crop.
5. Making organic fertilizer by the infected plants.

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