

Water-logging resistibility of tubers of different potato cultivars

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Abstract

Present study disclosed 24 hours water-logging as physio-damage free water logging and more than 24 hours as physio-damage for the tubers of 4 potato cultivars, namely Kufri Bahar, K. Suttlej, K. Anand and K. Ashoka. A higher percentage (72.51 %) of K. Bahar tubers displaying freedom from water damage showed the tubers of this variety as most water damage resistance among tubers of all cultivars studied. Tubers of K. Suttlej with 64.16 % freedom from water damage were next in order. At various durations of water logging viz. 0, 24, 72, 160 hours, 80.01% freedom of tubers of K. Bahar from water damages showed this cultivar as most water resistant ones among tubers of remaining cultivars and tubers of K. Suttlej with 56.66% water damage freedom were next in overall 72 hours water logging. But tubers of all cultivars lost their water damage resistibility under 160 hours water logging. Tubers of K. Anand and K. Suttlej were found to be most water damage susceptible under water logging for more than 24 hours. The present investigation suggests that the potato growers should first take care of K. Anand and K. Ashoka tubers during water logging for more than 24 hours.

Key words: Potato, water-logging resistability, cultivars, tubers, damage

Introduction

Water or hydro-logging-caused spoilage of tubers in Gangetic agro-climatic zone viz. Meerut, Buland Shahr and Aligarh etc., due to sudden night outburst of winter downpour at near time of harvest *i.e.* Decembers-February particularly in uneven low land is not uncommon. Such problem is also alive under such field conditions in temperate and tropical hilly regions owing to frequent more rainy days there. Such water-logging caused by sudden and continuous raining spoils tubers and mars their qualities in various ways (Ekanayake, 1994; Papathanasiou *et al.*, 1999; Jackson, 1962). Additive contribution of hydro-logging-caused damages to total or partial discard loss of tubers, increased glycoalkaloids in tubers during colder months, poor market acceptability, ethylene-driven damage to plant and tuber (Heerkloss, 1987), lowered storability and nutritional value of tuber owing to the leaching out of nutrients and dormancy imposing hormones multiply direct loss to potato growers, sellers, consumer and even to processors. Such abiotic stress-induced harms to potato growers are beyond their control but they suffer from such strains.

Therefore, studying water-logging stress resistance and injuries to tubers of different potato cultivars in controlled conditions is also absolutely imperative, matter of particular significance, desirability and urgency in order to make potato growers aware of water-logging susceptibility of tubers of various potato cultivars to take care of them on priority basis. Stress of various abiotic factors viz. low or high temperature, drought or low moisture etc., on tuber and plant of potato has been studied as mentioned by Midmore (1992). But information on water-logging driven physio-spoilage of tubers in potato are scanty. Present investigation was, hence, conducted on Indian potato cultivars in this direction at Central Potato Research Institute Campus, Modipuram, Meerut, Uttar Pradesh.

Materials and methods

Harvested equi-size tubers (60g) belonging to four potato cultivars, namely Kufri Anand, K. Ashoka, K. Suttlej and K. Bahar were exposed to water-logging created in plastic boxes of 20cm length x 20cm width x 13cm depth for various periods viz., 0, 24, 72 and 160 hours in order to deduce their water damage sensitivity and insensitivity reaction based on count of number of tubers free or spoiled by physio-damage like maceration and separation of cells leading to watery softness and manifestation of lenticles. Tubers were kept completely under overhead water stagnation or water-logging. There were 6 tubers/treatment and 16 treatments in total. Each treatment was replicated 5 times in completely randomized design. Data on number of tubers sensitive and insensitive to water damage were recorded and statistically analysed.

Results and discussion

Water-logging action: Twenty four hour water-logging caused no damage to tubers of all potato cultivars and hundred percent tubers were free from any physical water-caused damage and were comparable with tubers under no water-logging. But hydraulic logging more than 24 hours weakened water damage resistibility of tubers of all potato cultivars and 160 hours water-logging resulted in significantly higher percentage of water damage tubers (96.66%) than 72 hours water-logging with 60.83% of physio-damaged tubers caused by hydraulic stress. Consequently percentage of water damage insensitivity (39.17) was remarkably more under 72 hours water-logging than that of 160 hours water-logging (3.33%)

Varietal resistibility: There were significant varietal variations in water damage sensitivity/susceptibility and insensitivity/resistance. Significantly higher percentage of water damage insensitive tubers of Kufri Bahar was observed than those of

tubers of remaining cultivars. Kufri Sutlej (64.16%) was next to K. Bahar in the order. There was no considerable variation with respect to water damage insensitivity between tubers of K. Anand and K. Ashoka. Significantly higher percentage of water damaged tuber in K. Anand (47.50%) and K. Ashoka (46.66%) identified both potato cultivars as most water logging damage susceptible ones among the studied potato cultivars.

Table 1. Influence of water-logging on physical health of tubers of different potato cultivars

Water-logging/ duration/ cultivars/ Interactions	Physio-damaged tubers (%)	Physio-damage free tubers (%)
Water-logging duration		
0.00 hours	0.00	100.00
24.00 hours	0.00	100.00
72.00 hours	60.83	39.17
160.00 hours	96.66	3.33
CD ($P=0.05$)	4.56	4.63
Cultivars		
Kufri Anand	47.50	52.49
Kufri Ashoka	46.66	53.33
Kufri Sutlej	35.83	64.16
Kufri Bahar	27.49	72.51
CD ($P=0.05$)	4.56	4.63
Cultivars x Water-logging		
0.00 hours x Kufri Anand	0.00	100.00
0.00 hours x Kufri Ashoka	0.00	100.00
0.00 hours x Kufri Sutlej	0.00	100.00
0.00 hours x Kufri Bhar	0.00	100.00
24.00 hours x Kufri Anand	0.00	100.00
24.00 hours x Kufri Ashoka	0.00	100.00
24.00 hours x Kufri Sutlej	0.00	100.00
24.00 hours x Kufri Bhar	0.00	100.00
72.00 hours x Kufri Anand	93.33	6.66
72.00 hours x Kufri Ashoka	86.66	13.33
72.00 hours x Kufri Sutlej	43.33	56.66
72.00 hours x Kufri Bahar	19.99	80.01
160.00 hours x Kufri Anand	96.66	3.33
160.00 hours x Kufri Ashoka	100.00	0.00
160.00 hours x Kufri Sutlej	100.00	0.00
160.00 hours x Kufri Bahar	89.99	9.99
CD ($P=0.05$)	9.31	9.27

Interaction between cultivars and water-logging: Although not at all levels of duration of water-logging but there were significant varietal variations in water damage sensitivity/susceptibility and insensitivity/resistance among studied potato cultivars at some duration of water-logging *i.e.* 72 hours. Significantly higher percentage of water damage insensitive tubers of K. Bahar (80.01%) and of K. Sutlej (56.66%) next in order indicated the tubers of these both varieties to be most water damage resistant at 72 hours water-logging among remaining cultivars with the consequence of considerably lesser percentage of water damaged tuber among tubers of these cultivars (19.99-43.33%) at this level of duration of overhead water stagnation. K. Ashoka with 86.66% water damaged tubers showed poorest water damage resistance, exhibiting poorest percentage of water damage insensitive tuber (6.6-13.33%) at 72 hours water-logging.

Twenty four hours water-logging did not had interaction with water damage of tubers of potato cultivars but at 160 hours water-logging interaction were severely harmful to water damage resistance of tubers of all potato cultivars. Tubers of all studied potato cultivars lost their water damage resistance under 160 hours overhead water stagnation. Tubers of none of the cultivars showed considerable resistance on their exposure to 160 hours water-logging. However, percentage of water-damaged tubers (89.99%) was slightly lesser in tubers of K. Bahar than that in tubers of K. Ashoka and K. Sutlej (100%) even on their exposure to 160 hours water logging which meant slight water logging resistance in tubers of this variety at this duration of water logging too.

Water damage appeared in the form of maceration and separation of cells and tissues leading to watery softness of tubers and manifestations of lenticles upon them with intolerable odour but without development of any pathogen/disease. Manifestation of lenticles returned to their normal state in tubers free from watery softness on their exposure to oxygen out of water-logging after 2-3 days. Water softness caused by cell maceration and separation rendered the tubers unfit to all uses.

Full, partial and no damaging actions by various durations of water-logging may be attributed to complete failure, partial or full water damage resistibility of tubers. Mode of water damaging action may be ranging from creation of acute oxygen deficiency, washing out water resistant substance coating, diluting cells cementing substance/force, ethylene and CO₂ production to cell separation, watery softness and loss of tuber shape into porridge. Water damage insensitivity/resistibility variations among tubers of various cultivars may be associated to the differences in strength or water damage resistant substance coating, cell cementing substance and respiration of tubers with limited oxygen in water.

Tubers of Indian potato cultivars contain genes with capacity to resist water damage to some degree of water-logging for developing water damage resistant potato cultivars for uneven low land areas. Farmers should take care of K. Anand and K. Ashoka under water- logging conditions for more than 24 hours. Neither 24 hours nor 160 hours water-logging is adequate period of screening of water resistance in tubers but is somewhere between 72 and 160 hours.

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