MedCrave
Step into the World of Research
Journal of Applied Biotechnology & Bioengineering

Research Article

Open Access
CrossMark

Pathogenic potentiality of the bacterium of *Klebsiella pneumoniae* strain Borkar on different plants

Abstract

Klebsiella pneumoniae causes a fatal disease in human being. The pathogen is associated with respiratory tract and lung infection responsible for respiratory mechanism. *K. pneumoniae* strain Borkar was also found to affect the respiratory mechanism of plant root system in Solanaceous plants. The bacterium blocks the root respiration, producing anaerobic condition and alcohol emitting foul smell in the root surrounding, which results in wilting and death of the plants (plant mortality).

The symptoms of plant mortality include the wilting of affected plant seedlings and foul smell of the root system. The association of the bacterium was observed on all over the root surface but not in the root tissues. There were no changes in the root morphology or its discolouration occurred.

The bacterium *K.pneumoniae* in human being as well as in plant seems to affect the respiratory mechanism. The wilting/death of seedlings or plants caused due to hindrance in root respiration are termed as plan mortality.

The seedlings grown n soil infested with *K.pneumoniae* dies within a week period. In host range studies of the bacterium, out of 32 crop plants tested, only 6 were found to be susceptible to get plant mortality symptoms. These were tomato, chilli and eggplant seedlings, which showed wilting in 8 days, whereas ladies finger, green gram and horse gram showed wilting in 21, 22 and 31 days, respectively.

Keywords: *klebsiella pneumoniae*, plant mortality, root respiration, wilting

Special Issue - 2018

Ajayasree TS, Borkar SG
Department of plant pathology and agricultural microbiology, Mahatma Phule Agricultural University, India

Correspondence: Ajayasree TS, Department of plant pathology and agricultural microbiology, Mahatma Phule Agricultural University, Rahuri-413722, Dist- Ahmednagar (MS), India, Fax 091-02446-245141, Email ajayasree128@gmail.com

Received: June 08, 2018 | **Published:** August 02, 2018

Introduction

Bacterial disease causes substantial losses in crop plant.[1] Occurrence of new disease poses a serious threat to crop plant and ecosystem. Recently a new bacterial disease known as root bark necrosis and wilt of pomegranate was observed in pomegranate orchard of Mahatma Phule Agric. Univ., India[2] and the causal bacterium was identified as *Klebsiella pneumoniae* strain Borkar. Whether this bacterium is specific to its host pomegranate or it can infect the other hosts also is not yet known. Therefore, the studies on host range of this bacterium were carried out with the types of symptoms it incite in other plant crop.

Materials and methods

The bacterium *Klebsiella pneumoniae*

The bacterium *K.pneumoniae* used in present study was isolated from the root bark necrosis of the wilted plants of pomegranate. The bacterium was isolated by following the routine method of plant pathogenic bacterial isolation then identified.[3]

Preparation of soil infested with *Klebsiella pneumoniae*

The well mixed soil (comprising of soil 50%+ sand 25%+ compost 25%) was sterilized in autoclave under steam for 30 minutes for 3 consecutive days. The plastic pots were sterilized by methylated spirit and were filled with sterile soil (2kg in each pot).

The bacterial growth of *K. pneumoniae* strain Borkar grown in nutrient broth (3g beef extract, 5g peptone, 20g sucrose, water 1L) for 4-5 days on rotary shaker in 2 litre flasks was added to soil at the rate of 1 litre per pot (1010CFU/L of water) and mix thoroughly and left for incubation for 8-10 days and the soil was mixed well before sowing and/ or transplanting.

Testing of different plants for their reaction to the causal bacterium:

The seeds of various crop plants were sown in soil infested with *K. pneumoniae* in three replications. Similarly the seedlings of vegetables viz. tomato, chilli, eggplant and onion (30days old) were transplanted in pots infested with the causal bacterium in three replications. The plants of betel vine, banana, pomegranate and grapevine were also planted in pots infested with the causal bacterium. Proper control was maintained by growing all the plants in pots contained uninfested soil.

The pots were kept in environmentally controlled polyhouse (temperature 29±2°C, relative humidity 93 with misting of water for 1minute at an interval of 30minutes) to assess the plants for their reaction to *K. pneumoniae*.

The observations were recorded up to 45 days.

Results

Out of 32 crop plants tested for their reaction to *Klebsiella pneumoniae* strain Borkar, 6 plants were observed to succumb to the bacterial association. The seedlings of 3 Solanaceous vegetable crops viz. tomato, eggplant and chilli wilted (Figure 1) within 8days due to *K.pneumoniae*. Ladies finger, green gram and horse gram showed wilting in 21, 22 and 31days, respectively (Table 1).

Table 1 Susceptibility of various crop plants to the soil-borne *K. pneumoniae* strain Borkar

Sr. No.	English name	Scientific name	Family	Reaction to infection (in days)
1	Wheat	Triticum aestivum	Gramineae	–
2	Sorghum	Sorghum bicolor	Poaceae	–
3	Maize	Zea mays	Gramineae	–
4	Pearl millet	Pennisetum glaucum	Poaceae	–
5	Finger millet	Eleusine coracana	Poaceae	–
6	Soybean	Glycine max	Fabaceae	–
7	Linseed	Linum usitatissimum	Linaceae	–
8	Sesame	Sesamum indicum	Pedaliaceae	–
9	Green gram	Vigna radiate	Fabaceae	22
10	Horse Gram	Macrotyloma uniflorum	Fabaceae	31
11	Black gram	Vigna mungo	Fabaceae	–
12	Pigeon pea	Cajanus cajan	Fabaceae	–
13	Kabuli gram	Cicer arietinum	Fabaceae	–
14	Cowpea	Vigna unguiculata	Fabaceae	–
15	Rajma bean	Phaseolus vulgaris	Fabaceae	–
16	Moth bean	Vigna aconitifolia	Fabaceae	–
17	Snake gourd	Trichosanthes cucumerina	cucurbitaceae	–
18	French bean	Phaseolus vulgaris	Fabaceae	–
19	Ladies finger	Abelmoschus esculentus	Malvaceae	21
20	Dolichus bean	Lablab purpureus	Fabaceae	–
21	Bottle gourd	Lagenaria siceraria	Cucurbitaceae	–
22	Bitter gourd	Momordica charantia	Cucurbitaceae	–
23	Tomato	Solanum lycopersicum	Solanaceae	8
24	Cucumber	Cucumis sativus	Cucurbitaceae	–
25	Eggplant	Solanum melongena	Solanaceae	8
26	Onion	Allium cepa	Amaryllidaceae	–
27	Chilli	Capsicum annum	Solanaceae	8
28	Rice	Oryza sativa	Poaceae	–
29	Betel vine	Piper betel	Piperaceae	–
30	Pomegranate	Punica granatum	Punicaceae	–
31	Banana	Musa acuminate	Musaceae	–
32	Grapevine	Vitis vinifera	Vitaceae	–

+= Wilted plants, – = No reaction, i.e. healthy plants.

Citation: Ajayasree TS, Borkar SG. Pathogenic potentiality of the bacterium of *Klebsiella pneumoniae* strain Borkar on different plants. *J Appl Biotechnol Bioeng.* 2018;5(4):233–235. DOI: 10.15406/jabb.2018.05.00143

Figure 1 Pneumonia wilted seedlings of tomato and eggplant crop due to *K. pneumoniae* strain Borkar.

The symptoms of plant mortality include the wilting of the affected plant seedlings and /or plants and foul smell of the root system. The association of the bacterium was observed on all over the root surface but not in the root tissues under microscopic examination. There was no change in root morphology or its discolouration.

Discussion

The bacterium *K. pneumoniae* in human being affect the respiratory mechanism and in plant also possibly the same mechanism might be playing a role for root respiration. The roots of the plant take the oxygen required for respiration from the air present in between the soil particles by the process of diffusion. The extension of the epidermal cells of the root, known as root hair are in contact with the air in the soil. Oxygen (from air between the soil particles) diffuses into the root hair and reaches all the other cells of the root for respiration.CO_2 produced in the cells of root during respiration moves out through the same process of diffusion. Thus, the respiration in roots occurs by the diffusion of respiratory gases (oxygen and carbon dioxide) through the root hair.[4,5] Whenever the oxygen is not available to the root for aerobic respiration, the roots anaerobically respire by producing alcohol and this concentration of alcohol kills the plant.

The causal bacterium was found to cover all the root surface area thereby binding the site of respiration and hindering the diffusion of gases into the root hair cells and thereby the respiration. Due to blockage of passage of respiration, the seedlings respire anaerobically producing alcohol and giving foul smell to the root system. This produced alcohol was probably responsible for the wilting of crop seedlings of tomato, chilli and brinjal.[6,7] Also, the bacterium was found to affect the respiratory mechanism of root system and thus without the invasion of pathogen into the host root tissues the wilting was caused. The wilting, death of seedlings and plants may be caused due to hindrance in root respiration due to weak the roots and cause plant mortality.

K. pneumoniae causes fatal disease to the human called pneumonia.[8] The pathogen is associated with respiratory tract and lung infection[9] responsible for respiratory mechanism. The plant pathogenic *K.pneumoniae* strain Borkar was also found to affect the respiratory mechanism of plant root system, which was susceptible and succumb to it. The bacterium block the root respiration, producing anaerobic condition and alcohol in root surrounding, which causes wilt and death of the seedlings and plants.[10] This is the first report of this bacterium as a causal of plant mortality.

Acknowledgement

None.

Conflict of interest

The author declares that there is no conflict of interest.

References

1. Borkar SG. Laboratory techniques in plant bacteriology. USA: CRC Press; 2018. p. 256.
2. Ajayasree TS, Borkar SG, Yumlembam RA. Root bark necrosis and wilt of pomegranate. *A disease of new etiology. National Symposium on Diagnosis and Management of Plant Diseases: Integrated Approaches and Recent Trends.* January 9-11. India: Indian Phytopathological Society held at ICAR Research Complex for NEH region; 2017. p. 98.
3. Borkar SG, Yumlembam RA. Bacterial diseases of crop plants. USA: CRC Press; 2016. p. 594.
4. Jensen CR, Stolzy LH, Letey J. Tracer studies of oxygen diffusion through roots of Barley, corn and rice. *Soil Sci.* 1967;103:23–29.
5. Letey J, Stolzy LH. Measurement of oxygen diffusion rates with the platinum microelectrode. *Hilgardia.* 1974;35:545–576.
6. Jackson MB, Herman B, Goodenough A. An examination of the importance of ethanol in causing injury to flooded plant. *Cell and Environ.* 1982;5:163–172.
7. Alpi A, Perata P, Beevers H. Physiological responses of cereal seedlings to ethanol. *J of plant Physiol.* 1985;119(1):77–85.
8. Sugiyama H, Ono Y. *Klebsiella pneumoniae* pneumonia. *Ryoikibetsu Shokogun Shirizu*. 1999;23:366–68.
9. Podschun R, Ullman U. *Klebsiella* spp. as nosocomial pathogens: Epidemiology, Taxonomy, Typing Methods and Pathogenicity Factor. *Clin Microbiol Rev.* 1998;11:589–603.
10. Agular EA, Turner DW, Gibbs DJ, et al. Response of banana roots to oxygen deficiency and its implication for Fusarial wilt. *ISHS Acta Horticulturae.* 1998;490:223–228.