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Bacteria Isolation from Public Cemeteries Soil and Test for Resistance to Antibiotics

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Abstract

Background: A public cemetery, also known as a public burial place (TPU) is an active decomposition of corpses in the soil, which produces soil nutrients and minerals that can support the growth of microorganisms in the ground, including pathogenic bacteria. Pathogenic bacteria have a more severe impact if they are resistant to antibiotics. **Methods:** Soil samples were taken in the Bonoloyo TPU area, Surakarta, Central Java, at 3 points each of 2 depths of 20 and 50 cm. Soil samples were inoculated on Nutrient agar (NA) using the spread plate method. After 48 hours, colony counting and morphology observations were carried out, followed by gram staining. Isolated bacterial isolates were tested for resistance to 3 types of antibiotics. **Results:** The average population of soil bacteria in blocks 12, 17, and 21 at a depth of 20 cm is 4 x 10^6 CFU/g; 8 x 10^6 CFU/g; and 1 x 10^6 CFU/g, while at a depth of 50 cm, it is 2.3 x 10^6 CFU/g; 6 x 10^6 CFU/g; and 4 x 10^6 CFU/g. The morphology of bacterial colonies is irregular (26 isolates), and flat elevation (19 isolates), and the color of isolates is predominantly white. The Gram staining results obtained 23 isolates are Gram-negative, and 22 are Gram-positive with a dominant cell form in cocci. Antibiotic resistance tests showed that the bacterial isolates were resistant to ampicillin (28.9 %), Bacitracin (64.4 %), and Cefepime (57.8 %). **Conclusions:** Burial soil bacterial populations at Bonoloyo TPU at different depths did not differ markedly, with numbers ranging from 1 - 8 x 10^6 CFU/g.

Keywords: Bacteria; antibiotic resistance; public burial places.

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Introduction

A graveyard is an area reserved for the burial of the dead, regulated by the local government (Zanial & Irwansyah, 2016). After being declared dead, the human body undergoes decay, and a decomposition process begins. The decomposition process has five stages: fresh stage, bloated, active rot, dry putrefaction, and skeletonized (Sunniyyah, 2021). Simple compounds enrich soil nutrients and minerals (Laskow, 2018). Soil is one of the habitats of diverse microorganisms. The active decomposition of bodies in the ground varies between individuals and environmental conditions. The results of the disintegration of the corpse include organic and inorganic nitrogen compounds, potassium (K), and sodium (Na) (Sunniyyah, 2021). Various environmental factors can significantly affect the process of decomposition of corpses (Ciaffi et al., 2018). One study reported that the total rhizosphere soil bacteria in the TPU area was 1.0 x 10^7 CFU/g (Putra et al., 2023). The number of rhizosphere bacteria in the TPU area is more significant than outside the TPU area, as in the total rhizosphere bacteria of rubber plants of 1.06 x 10^6 (Wulandari et al., 2020). The abundance of rhizosphere bacteria in the TPU area proves that the process of decomposition of corpses can affect the diversity and function of soil microbes because the bodies release nutrients into the soil in large quantities (Singh et al., 2018).

TPU was also found in pathogenic bacteria and fungi; research in Poland reported that burial grounds contained *Bacillus spp., Escherichia spp., Enterococcus spp., Klebsiella Enterobacter-Serratia., Staphylococcus spp., Penicillium spp*., and *Aspergillus spp*., with the most common pathogens being *Enterococcus spp.* (80.6 %), *Bacillus spp*. (77.4 %), *Penicillium spp.* (51 %), and A*spergillus spp.* (6.4 %) (Całkosiński et al., 2015). From microbiome analysis in South African burial grounds, it is predicted to contain pathogens that cause tuberculosis, Alzheimer's, Huntington's, influenza, vibrio cholera, toxoplasmosis, Parkinson's, amoebiasis, myocarditis, and cancer (Abia et al., 2019). Based on the results of this study, it turns out that TPU can be a severe problem for public health, especially for people living around TPU. One of the largest TPUs in Surakarta is TPU Bonoloyo, with an area of 124,253.80 m^2 (Pradana et al., 2021). Around the Bonoloyo TPU, some residential areas are located very close, even though most use groundwater for consumption. This TPU will be used as a sampling location.

The presence of pathogenic microbes, especially bacteria in TPU, will have a more severe impact if it is resistant to antibiotics. Antibiotic resistance is becoming a global public health problem. Reports on deaths caused by antibiotic resistance are estimated at 10 million per year, projected by 2050 (de Kraker et al., 2016). Indonesia forecasts that there will be the highest increase in antimicrobial consumption in 2030, including Indonesia (WHO Indonesia, 2022). This is due to improper use of antibiotics. A lack of understanding about antibiotics affects their use behavior (Yunita et al., 2021). Some bacteria that are resistant to antibiotics are *Pseudomonas aeruginosa* which is resistant to antibiotics ceftazidime and ciprofloxacin and *Haemophilus influenza* resistant to antibiotics imipenem and ampicillin (Pratiwi, 2017). Reduced sensitivity of antibiotics to a bacterium can lead to increased mortality due to complications and healthcare expenditure (Hayati et al., 2022).

There has been no research on bacterial diversity in TPU and antibiotic resistance tests in Indonesia, so the study was conducted to obtain data on bacterial diversity in TPU and antibiotic resistance tests. Based on reference searches, in several countries, there have been studies on soil bacterial diversity in the TPU area and antibiotic resistance tests such as in South Africa, Australia (Zychowski & Bryndal, 2015), Brazil (Fineza et al., 2014), Latvia (Kazarina et al., 2019), and Poland (Całkosiński et al., 2015). The results presented through these references vary. This may be due to differences in climate in Poland and Australia which have summer, winter, spring, and autumn. The way of burial is also different. In Indonesia, Muslim bodies are buried wrapped in shrouds, and Christian and Catholic bodies are dressed in full clothes and put in coffins like in Australia. This study aimed to analyze the diversity of soil bacteria in TPU and their antibiotic resistance. Research data can be used as a reference to increase awareness of the risk of pathogenic microbial contamination from TPU and set policies for the use of antibiotics.

Method

This research is conducted at the Biology Laboratory of the Biology Education Study Program, Universitas Muhammadiyah Surakarta from January 2023 to February 2023. Soil samples were taken from TPU Bonoloyo, Surakarta, Central Java, in 3 blocks, namely blocks 12, 17, and 21 (Figure 1.). Soil samples were taken using a drill with a depth of 20 cm and 50 cm. Exploratory was used to determine the diversity of soil bacteria in TPU and their resistance to antibiotics. Tools used for media manufacturing, bacterial diversity analysis, and bacterial resistance to antibiotics are Erlenmeyer (Pyrex), sprayer, petri dish, shaker, autoclave (GEA LS-35LJ), oven incubator (Memmert), colony counter (Funke gerber), vortex (DLAB MX-S), digital analytical balance (Durascale DAB-E223), hot plate (Cimarec$^+$), micropipette (Socorex 10-100), blue tip, Laminer Air Flow (LAF), microscope and glass object. And the materials used include nutrient agar (Merck), nutrient broth, burial soil samples, 70 % alcohol, Gram dyes, malachite green, molten paper, spirtus, antibiotic disc ampicillin (Liofilchem), antibiotic disc bacitracin (Oxoid), and antibiotic disc cefepime (Liofilchem).

Figure 1. Sampling Floor Plan

Isolation of soil bacteria

Soil samples were diluted serially from 10^{-1} to 10^{-6} dilutions. Isolation of soil bacteria using the spread plate method at dilutions of 10^{-5} and 10^{-6} on top of NA (Himedia). Incubation at 30°C for 48 hours (Fitriana & Asri, 2021). The bacterial population is calculated based on the number of growing colonies. The isolate is stored in the refrigerator for further analysis in an oblique agar medium. Identification of bacterial isolates obtained by observing colony morphology and gram staining. Observations of colony morphology include colony shape, edge, elevation, and color while from Gram staining to get Gram grouping data, cell shape, and cell arrangement (Ayuti et al., 2023). If the cell is purple or violet, it belongs to the Gram-positive bacteria group, while if the cell is red, it is included in the Gram-negative group (Andayani et al., 2022).

Antibiotic Resistance Test

Antibiotic resistance test using three types of antibiotics, namely Ampicillin (Liofilchem), Bacitracin (Oxoid), and Cefepime (Liofilchem) with agar diffusion method (Khusuma et al., 2019). This test is carried out by inoculating a liquid culture of bacteria that has been incubated for 16 hours on the surface of NA with a swab method. Petridisk inoculated with bacteria is then placed on an antibiotic disk. Incubation at 37°C for 24 hours and antibiotic activity is shown by forming a clear zone (Mulyani et al., 2023). According to Amri & Wulandari (2022), antibiotic resistance is determined based on the Clinical and Laboratory Standard Institute (CLSI) with sensitive, intermediate, and resistant categories.

Result

Soil bacteria population

The mean burial soil bacteria population sequentially from block 12, block 17, and block 21 was 4 x 10^6 CFU/g; 2.3 x 10^6 CFU/g; 8 x 10^6 CFU/g; 6 x 10^6 CFU/g, 1 x 10^6 CFU/g, and 4 x 10^6 CFU/g at depths of 20 cm and 50 cm respectively (Table 1.). The soil bacteria population at TPU Bonoloyo, Surakarta, did not show significant differences among the blocks tested at different depths.

Table 1. Population Soil Bacteria

Burial Block	Dept (Cm)	Average Bacterial Population (Cfu/G)	Altitude of the Premises (Mdpl)
12	20	4 x 10^6	128,7
12	50	2,3 x 10^6	
17	20	8 x 10^6	126,2

17	50	6×10^6	
21	20	1×10^6	129,2
21	50	4×10^6	

Identification of colony morphology and Gram staining results

A total of 45 isolates were isolated based on differences in colony morphology. Furthermore, the isolates observed colony morphology and Gram staining results, as seen in Table 2.

Table 2. Colony morphology and gram staining results of soil bacterial isolate from TPU Bonoloyo, Surakarta

Code	Colony Morphology				Gram Staining			
	Shape	**Edge**	**Elevation**	**Color**	**Color**	**Cell Shape**	**Cell Arrangement**	**Gram**
BN1	*Circular*	*Entire*	*Convex*	Yellow	Yellow	*Coccus*	*Diplococcus*	Negative
BN2	*Circular*	*Entire*	*Convex*	White	White	*Coccus*	*Diplococcus*	Negative
BN3	*Irregular*	*Lobate*	*Flat*	White	White	*Coccus*	*Monococcus*	Negative
BN4	*Circular*	*Entire*	*Convex*	Pink	Pink	*Basil*	*Monobasil*	Negative
BN5	*Irregular*	*Undulate*	*Flat*	White	White	*Coccus*	*Diplococcus*	Negative
BN6	*Irregular*	*Undulate*	*Convex*	White	White	*Coccus*	*Streptococcus*	Negative
BN7	*Rhizoid*	*Filamentous*	*Flat*	White	White	*Coccus*	*Diplococcus*	Negative
BN8	*Irregular*	*Undulate*	*Flat*	White	White	*Coccus*	*Monococcus*	Negative
BN9	*Irregular*	*Entire*	*Convex*	White	White	*Coccus*	*Monococcus*	Negative
BN10	*Punctiform*	*Entire*	*Flat*	Yellow	Yellow	*Coccus*	*Monococcus*	Negative
BN11	*Irregular*	*Entire*	*Convex*	White	White	*Coccus*	*Monococcus*	Negative
BN12	*Circular*	*Entire*	*Flat*	Yellow	Yellow	*Coccus*	*Staphylococcus*	Negative
BN13	*Irregular*	*Lobate*	*Flat*	White	White	*Coccus*	*Streptococcus*	Negative
BN14	*Circular*	*Entire*	*Raised*	Yellow	Yellow	*Coccus*	*Staphylococcus*	Positive
BN15	*Circular*	*Entire*	*Flat*	Pink	Pink	*Coccus*	*Diplococcus*	Positive
BN16	*Filamentous*	*Lobate*	*Raised*	White	White	*Coccus*	*Diplococcus*	Positive
BN17	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Diplococcus*	Positive
BN18	*Circular*	*Entire*	*Convex*	White	White	*Coccus*	*Staphylococcus*	Positive
BN19	*Circular*	*Entire*	*Flat*	White	White	*Coccus*	*Diplococcus*	Positive
BN20	*Circular*	*Entire*	*Flat*	White	White	*Coccus*	*Monococcus*	Positive
BN21	*Irregular*	*Entire*	*Umbonate*	White	White	*Coccus*	*Diplococcus*	Positive
BN22	*Filamentous*	*Filamentous*	*Raised*	White	White	*Coccus*	*Streptococcus*	Positive
BN23	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Diplococcus*	Positive
BN24	*Irregular*	*Undulate*	*Flat*	White	White	*Coccus*	*Streptococcus*	Negative
BN25	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Streptococcus*	Negative
BN26	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Streptococcus*	Positive
BN27	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Staphylococcus*	Negative
BN28	*Irregular*	*Lobate*	*Flat*	White	White	*Coccus*	*Staphylococcus*	Positive
BN29	*Irregular*	*Undulate*	*Unbonate*	White	White	*Coccus*	*Staphylococcus*	Positive
BN30	*Circular*	*Entire*	*Convex*	White	White	*Basil*	*Diplobacilli*	Positive
BN31	*Irregular*	*Entire*	*Umbonate*	Yellow	Yellow	*Basil*	*Diplobacilli*	Positive
BN32	*Irregular*	*Filamentous*	*Flat*	White	White	*Coccus*	*Diplococcus*	Positive
BN33	*Irregular*	*Undulate*	*Flat*	White	White	*Coccus*	*Diplococcus*	Negative
BN34	*Punctiform*	*Entire*	*Umbonate*	White	White	*Coccus*	*Staphylococcus*	Negative
BN35	*Circular*	*Entire*	*Raised*	Yellow	Yellow	*Coccus*	*Staphylococcus*	Negative
BN36	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Diplococcus*	Negative
BN37	*Irregular*	*Undulate*	*Umbonate*	White	White	*Coccus*	*Monococcus*	Positive
BN38	*Filamentous*	*Filamentous*	*Flat*	White	White	*Basil*	*Streptobaciili*	Positive
BN39	*Irregular*	*Entire*	*Flat*	White	White	*Coccus*	*Diplococcus*	Negative
BN40	*Irregular*	*Entire*	*Convex*	White	White	*Coccus*	*Monococcus*	Positive
BN41	*Irregular*	*Filamentous*	*Flat*	White	White	*Coccus*	*Monococcus*	Negative
BN42	*Circular*	*Entire*	*Flat*	Pink	Pink	*Coccus*	*Staphylococcus*	Negative
BN43	*Irregular*	*Entire*	*Flat*	White	White	*Coccus*	*Monococcus*	Positive
BN44	*Irregular*	*Entire*	*Convex*	White	White	*Coccus*	*Diplococcus*	Positive
BN45	*Circular*	*Entire*	*Convex*	White	White	*Coccus*	*Staphylococcus*	Positive

Based on observations, isolates of burial grounds at TPU Bonoloyo have different results. The colony's morphological form found as many as 26 irregular, 13 circular, three filamentous, two punctiform, and one rhizoid. The edges of the settlement are dominated by entire (23 isolates), undulate (13 isolates), filamentous (5 isolates), and lobate (4 isolates). The elevation was 19 flats, 11 convex, 11 umbonate, and four raised. The color that often appears in macroscopic observations is white, and there are other colors, namely yellow and pink. In the Gram staining results, as many as 51% of isolates are included in Gram-negative, and 49 % are gram-positive. Cell forms of 45 isolates, found 91.1 % of coccus-shaped isolates and 8.9 % of bacilli-shaped isolates with diplooccal cell arrangement (33.3 %), monococci (22.2 %), streptococci (13.3 %), staphylococci (22.2 %), diplobacilli (4.4 %), monobacilli (2.2 %), and streptobacilli (2.2 %) (Table 2).

Antibiotic Resistance Test

Antibiotic resistance tests were carried out on three types of antibiotics, namely ampicillin, bacitracin, and cefepime. Antibiotic resistance test results are determined by measuring the clear zone formed around the antibiotic disc (Figure 2.).

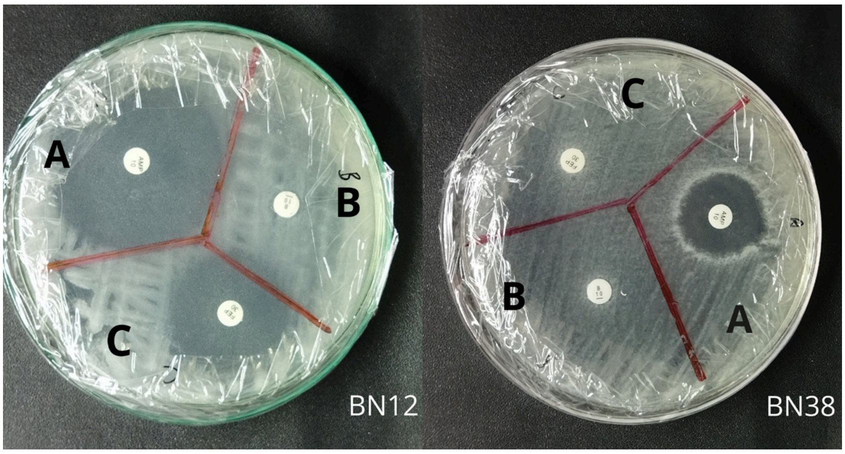

Figure 2. Test Results of Isolate Resistance with BN12 (Left) and BN38 (Right) Codes Against Ampicillin (A), Bacitracin (B), and Cefepime (C) Antibiotics

Based on the results of antibiotic resistance tests on burial soil bacteria, results were obtained that showed antibiotic multi-resistant properties. The percentage of antibiotic resistance tested, namely Ampicillin, Bacitracin, and Cefepime, respectively 28.9 %, 64.4 %, and 57.8 % (Table 3.).

Table 3. Percentage of bacterial isolates from TPU Bonoloyo that are already antibiotic-resistant.

Antibiotic	**Percentage of Isolates by Category (%)**		
	Susceptible	*Intermediate*	*Resistance*
Ampicillin	66,7	4,4	28,9
Bacitracin	35,6	0	64,4
Cefepime	24,4	20	57,8

Discussion

The lowest population of soil bacteria from TPU Bonoloyo was found in block 21 at a depth of 20 cm, namely 1 x 10^6 CFU/g, while the highest population in block 17 at a depth of 20 cm was 8 x 10^6 CFU/g. This may be due to the location of block 21 in a higher position than other blocks (Table 1.). In addition, the content of several elements such as P_2O_2, C-organic, and N-total required to support bacterial growth is lower than blocks 17 and 12 (Table 4 Supplement). With the highest soil position, the leachate water resulting from the corpse's decomposition process will flow to lower places (Block 12 and Block 17) to enrich soil minerals in blocks in a lower position. This is evident from the higher electrical conductivity (DHL) parameters in Block 17 (126.2 masl) (Table 4 Supplement). DHL shows the ability of an electrolyte solution to conduct electricity (Sofiah et al., 2016). More bacterial populations were detected at depths of 50 cm except block 21.

Soil bacteria in the TPU area are much higher when compared to soil bacteria populations outside the TPU, such as in land-use soils of annuals and secondary forests have the highest number of soil bacteria populations of 1.5 x 10^5 CFU/g with a depth of 0 - 30 cm (Zainudin & Kesumaningwati, 2021), mountain soils of 7.36 x 10^5 CFU/g (Sahara et al., 2019), land in oil palm plantations of 1.16 x 10^5 CFU/g with a depth of 0 cm (Irfan, 2014), and waste burnt land of 5.5 x 10^5 CFU/g (Situmorang et al., 2022). The study's results (Putra et al., 2023) showed data on the population of rhizosphere bacteria in burial grounds of 1.0 x 10^7 CFU/g. The bacterial population at TPU Bonoloyo Surakarta at a depth of 10 cm is around 3.4 x 106 CFU/gram (Rahmawati et al., 2023). At a depth of 10 cm, the soil bacteria population is still strongly influenced by cover plant factors (Sriwulan et al., 2022). It may not have been affected by soil elements resulting from the corpse's decomposition because the body was buried at a depth of about 1.5 m. The growth rate and activity of bacteria can be influenced by several factors, namely pH, osmosis pressure, and so on (Fitria & Zulaika, 2019). In addition, climatic conditions, including temperature, humidity, rainfall, and wind speed, can affect the life and breeding of microorganisms (Utami & Windraswara, 2019). This corroborates the notion that many factors affect the bacterial population of burial soils.

The identification results of bacterial isolates showed the dominance of white to yellow colony color in irregular shapes with flat edges. Gram staining results were identified as 51% Gram-negative bacteria with a dominant diplococcal and staphylococcal cell arrangement (Table 2.). Most Gram-negative are pathogenic because they have endotoxins on the outer membrane (Prastio et al., 2022). This is corroborated by several morphological studies on soil bacteria, including research in Kampung Melayu, three out of four test soil samples obtained the results of coccus-shaped bacteria (Abna et al., 2020), at TPU Pracimoloyo, the majority of coccus cell forms were acquired and had gram-negative (Putra et al., 2023). In the soil at TPU Bonoloyo, it is possible to find coccus-shaped genus bacteria with Gram-negative, such as the genus Streptococcus, genus Streptomyces and genus Klebsiella (Sayuti et al., 2016). The morphology of soil bacteria in TPU is different from soil bacteria other than in the TPU area from the results of research on endophytic bacteria and rhizobacteria from clove plants, bacilli-shaped bacteria with Gram-positive (Dwimartina et al., 2021), in endophytic bacteria of mangrove plants in the form of bacilli with Gram-positive (Suryani & A'yun, 2022), and in soil endogenous bacteria used oil spills in the form of bacilli with Gram-positive (Welan et al., 2019).

The results of antibiotic resistance tests on bacterial isolates in burial grounds showed that the isolates were already resistant to the three antibiotics tested. In this study, the most significant percentage of bacterial resistance was found in bacitracin, while ampicillin resistance was smaller than the percentage of other antibiotic resistance (Table 3.) (Table 2 Supplement). Antibiotic resistance occurs due to various factors, one of which is the use of inappropriate antibiotics without a doctor's prescription (Simamora et al., 2021). The sensitivity chart shows ampicillin is used to cure Gram-positive and Gram-negative bacterial infections but is more effective against Gram-positive bacteria. Bacitracin is effective for curing infectious diseases by Gram-positive bacteria and cefepime for diseases caused by Gram-positive and negative bacteria. Denpasar Hospital in the period 2019-2020 uses ampicillin to cure pneumonia (Sukertiasih et al., 2021). 41.67% of ampicillin antibiotics were also prescribed to hospitalized patients affected by bacterial infections (Nugraheni et al., 2021). The large percentage of resistance to bacitracin antibiotics is possible because bacitracin has a complex chemical structure and high molecular weight and cannot pass through the outer membrane of Gram-negative bacteria, so bacitracin is intrinsically resistant to Gram-negative bacteria (Hong et al., 2020). Bacitracin is a polypeptide antibiotic applied to animals and humans. If used for a long time, it can increase resistance genes in microorganisms (Ma et al., 2019). Resistance to bacitracin is supported by the potential spread of resistance genes in Gram-positive bacteria, especially pathogenic bacteria derived from humans and animals, such as enterococci, staphylococci, and streptococci (Huang et al., 2019). Bacterial resistance to antibiotics will cause problems in the treatment of disease, although many potent Streptomyces genera produce antibiotics (Ambarwati et al., 2019). Based on the results of antibiotic resistance tests on burial grounds, the community needs to maintain cleanliness when making pilgrimages to cemeteries.

Conclusions

The population of soil bacteria at TPU Bonoloyo, Surakarta, Central Java, in several blocks with depths of 20 cm and 50 cm ranged from 1 x 106 - 8 x 106 CFU/g but showed no noticeable difference. The bacterial isolates were dominated by irregular colonies, flat colony edges, flat elevation, convex, umbonate, and raised. In contrast, cocci-shaped gram-negative groups dominated the gram-staining results; the results of the antibiotic resistance test obtained data that the isolate was multi-resistant to antibiotics.

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Declaration statement

The authors reported no potential conflict of interest.

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Supplements Attachment

Table 4. Soil Sample Analysis Results

Test parameters	Unit	Block and Depth (cm)			Method
		12 – 20 cm	17 – 20 cm	21 – 20 cm	
pH (H_2O)		7.16	7.29	7.84	pH meter 1:5 IK. 5.4.c
pH (KCl)		6.21	6.69	6.54	pH meter 1:5 IK. 5.4.c
DHL	(µs/cm)	28	87	13	Konduktometer 1 : 5
C-organik	%	2.23	1.23	1.13	Walkly & Black IK 5.4.d
N-total	%	0.12	0.08	0.04	Kjeldahl IK 5.4.e
K tersedia	Ppm	132	106	129	Morgan-Wolf
P_2O_5	ppm	7	2	ttd	Olsen IK.5.4.h

Table 5. Antibiotic Test Data

Isolat Name	Types of Antibiotics								
	Ampicillin			Bacitracin			Cefepime		
	S	I	R	S	I	R	S	I	R
BN1	40 mm	-	-	27 mm	-	-	-	20 mm	-
BN2	24 mm	-	-	21 mm	-	-	-	20 mm	-
BN3	-	-	7 mm	-	-	7 mm	-	-	0 mm
BN4	18 mm	-	-	-	-	9 mm	-	-	8 mm
BN5	-	-	0 mm	-	-	9 mm	-	-	0 mm
BN6	-	-	0 mm	-	-	8 mm	-	-	0 mm
BN7	20 mm	-	-	-	-	0 mm	-	-	8 mm
BN8	-	-	0 mm	-	-	0 mm	-	-	0 mm
BN9	25 mm	-	-	44 mm	-	-	-	20 mm	-
BN10	-	-	0 mm	-	-	0 mm	-	-	0 mm
BN11	-	16 mm	-	-	-	8 mm	-	20 mm	-
BN12	43 mm	-	-	-	-	0 mm	30 mm	-	-
BN13	-	-	0 mm	-	-	0 mm	-	-	0 mm
BN14	43 mm	-	-	-	-	0 mm	30 mm	-	-
BN15	40 mm	-	-	26 mm	-	-	-	-	16 mm
BN16	25 mm	-	-	-	-	8 mm	-	22 mm	-
BN17	20 mm	-	-	32 mm	-	-	-	-	17 mm
BN18	19 mm	-	-	25 mm	-	-	-	24 mm	-
BN19	25 mm	-	-	36 mm	-	-	-	-	0 mm
BN20	18 mm	-	-	-	-	0 mm	30 mm	-	-
BN21	30 mm	-	-	17 mm	-	-	-	20 mm	-
BN22	32 mm	-	-	-	-	0 mm	-	-	0 mm
BN23	-	-	0 mm	-	-	8 mm	-	-	0 mm
BN24	23 mm	-	-	-	-	7 mm	-	-	15 mm
BN25	20 mm	-	-	-	-	10 mm	35 mm	-	-
BN26	25 mm	-	-	-	-	0 mm	25 mm	-	-
BN27	27 mm	-	-	-	-	0 mm	25 mm	-	-
BN28	25 mm	-	-	-	-	0 mm	25 mm	-	-
BN29	-	15 mm	-	20 mm	-	-	-	20 mm	-
BN30	17 mm	-	-	23 mm	-	-	28 mm	-	-
BN31	35 mm	-	-	40 mm	-	-	35 mm	-	-
BN32	32 mm	-	-	-	-	12 mm	-	-	10 mm
BN33	30 mm	-	-	-	-	11 mm	-	-	0 mm
BN34	-	-	11 mm	-	-	11 mm	-	-	0 mm
BN35	-	-	13 mm	20 mm	-	-	-	-	15 mm
BN36	-	-	0 mm	-	-	7 mm	-	-	0 mm
BN37	30 mm	-	-	15 mm	-	-	30 mm	-	-
BN38	20 mm	-	-	-	-	0 mm	-	-	0 mm
BN39	-	-	9 mm	13 mm	-	-	-	-	0 mm
BN40	-	-	8 mm	15 mm	-	-	-	-	0 mm
BN41	32 mm	-	-	-	-	10 mm	-	-	10 mm
BN42	33 mm	-	-	-	-	11 mm	-	-	8 mm
BN43	-	-	0 mm	-	-	0 mm	-	-	0 mm
BN44	40 mm	-	-	-	-	10 mm	-	20 mm	-
BN45	35 mm	-	-	25 mm	-	-	25 mm	-	-

Information:
S = Sensitive
I = Intermediate
R = Resistance