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THE EFFECT OF SALINITY TO ACTIVITY AND EFFECTIVITY PHOSPHATE SOLUBILIZING BACTERIA ON GROWTH AND PRODUCTION OF PADDY

Sri Widawati

Research Center for Biology, Indonesian Institute of Sciences
Jl.Raya jakarta-Bogor km 46 Cibinong Science Center
E-mail : widadomon@yahoo.com

ABSTRACT

This study aimed to determine the extent of phosphate solubilizing bacteria resistant to salinity and still be able to provide P for paddy plant. Research using completely randomized design with fertilizer treatments: (A) Bakteri *Aerobacter aerogenes + Azotobacter indicus* (B) Bakteri *Bacillus thuringiensis* + *B. megaterium* + *Pseudomonas fluorescens*, (C) Bakteri *Nocardia mesentrica* + *Spirillum lipoferum*, (D) Mix bakteri *Pseudomonas fluorescens*, *Bacillus thuringiensis*, *B. megaterium*, *Nocardia mesentrica*, *Aerobacter aerogenes*, *Spirillum lipoferum*, dan *Azotobacter indicus*, and (E) control (whitout inoculant), and salinity (NaCl): (1) 0% (0 grams / 7 kg soil), (2) 0.1% (7 grams / 7 kg soil), (3) 0.2% (14 g / 7 kg soil), (4) 0.3% (21 g / 7 kg soil), and (5) 0 , 4% (28 g / 7 kg soil). Thirty and one hundred days after transplanting (DAT), and then measured plant height, number of tillers, number and dry weight of whole grain paddy. The results showed that 0,1 % (7 gram/7 kg tanah) salinity is very good for the growth, activity and effectiveness of phosphate solubilizing bacteria and production of paddy, but 0.4% salinity (28 gr/7kg land) is still safe on the growth, activity and effectiveness of phosphate solubilizing bacteria (*Pseudomonas fluorescens, Bacillus thuringiensis, B. megaterium, Nocardia mesentrica, Aerobacter aerogenes, spirillum lipoferum* and *Azotobacter indicus*) as biofertilizer or growth promoting rhizobacteria on growth and production of paddy.

Key words: Salinity, Phosphate solubilizing bacteria, Paddy

INTRODUCTION

Salinity is the dissolved salt content which has units of milligrams per liter (mg / L) or decisiemens per meter (dS/m), with salinity values around 30 dS / m for sea water and 0.3 dS / m for ordinary water (Water, 2007). High salinity is the cause of death of bacteria and plants, especially paddy (Widawati, 2012). As an attempt for the survival of paddy plants, then had to isolate phosphate solubilizing bacteria from saline environments (coastal eco-systems). Bacteria are expected to help provide an element of P for growth and production of paddy in the high saline levels, especially the breeding and the beginning vegetative growth. Phosphor element is the main element (essential) needed in the metabolic processes of plants and plants just absorb it in the orthophosphate ions (H_2PO_4- and HPO_4-) (Kustiyaningsih, 2003). Phosphate solubilizing bacteria is one of biofertilizer (growth pro-moting rhizobacteria), that can live in coastal tidal, offshore, coastal, marine and mangrove ecosystem (Seshadri *et al.,* 2002). The bacteria produce are vitamins and phytohormones which can improve the growth of plant roots and increases nutrient uptake (Glick, 1995), and can produce the enzyme ACC deaminase (1-aminocyclopropane-1-carboxylate deaminase EC4.1.99.4) in the cytoplasm, especially *Pseudomonas* sp. strain ACP (Honma and Shimomura, 1978). The bacteria has been helping plants grow in saline environments (Husen, 2011). So, phosphate solubilizing bacteria it can be used to supply the soil organic matter (Husen et al., 2007) and stimulate plant growth.

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MATERIALS AND METHODS

Pseudomonas fluorescens, Bacillus thuringiensis, B. megaterium, Nocardia mesentrica, Aerobacter aerogenes, spirillum lipoferum and *Azotobacter indicus* are the pure isolates were isolated from the coastal areas. The bacteria have the ability to dissolve P analyzed quantitatively and qualitatively, and survival of bacteria in solid and liquid media of pikovskaya that have different levels of salinity (NaCl 0% / 0 g; 0.1% / 1 g / L, 0.2 g / 2 g / L, 0.3% / 3 g / L, 0.4% / 4 g / L). Then made of solid inoculant and inoculated into paddy plants. Planting paddy in the pot (50 pots) containing 7 kg of paddy soil / pot (soil pH = 7). Each pot planted 4 seed paddy, then given same of base fertilizer, and given the different inoculants and percentage of different salinity. Research using completely randomized design, repeated 3 times with fertilizer treatments: (A) *Aerobacter aerogenes* + *Azotobacter indicus* (B) *Bacillus thuringiensis* + *B. megaterium* + *Pseudomonas fluorescens,* (C) *Nocardia mesentrica* + *Spirillum lipoferum*, (D) Mix : *Pseudomonas fluorescens, Bacillus thuringiensis, B. megaterium, Nocardia mesentrica, Aerobacter aerogenes, Spirillum lipoferum*, dan *Azotobacter indicus*, and (E) control (whitout inoculant), and salinity (NaCl): (1) 0% (0 grams / 7 kg soil), (2) 0.1% (7 grams / 7 kg soil), (3) 0.2% (14 g / 7 kg soil), (4) 0.3% (21 g / 7 kg soil), and (5) 0 , 4% (28 g / 7 kg soil). Thirty and one hundred days after transplanting (DAT), and then measured plant height, number of tillers, number and dry weight of whole grain paddy, available P and PME-ase soil before and after harvest, soil salinity and bacterial populations in the soil (pot) after harvest

RESULTS AND DISCUSSION

Phosphate solubilizing bacteria that have been tested in the study were able to survive (population mean = 10^9 down to 10^6 cells / g soil) in saline soil with NaCl content of 0% - 0.4%. As in the Seshadri's research, showed genus of *Pseudomonas* and *Bacillus* can survive in saline environments (Seshadri *et al*, 2002).The higher levels of salt given the growing media (0.4%), apparently the lower impact of growth and production results. It is seen in Table 1, which is the average yield of plant height, fresh weight, panicle, number of trees of paddy, grain wet weight, dry weight and grain after harvest. The pots of A1, B1, C1, D1, and E1 with 0.1% salinity has an average yield of the highest harvest than plants growing in the pots with 0.2% saline (A2, B2, C2, D2, E2) , 0.3% (A3, B3, C3, D3, E3), 0.4% (A4, B4, C4, D4, E4), and without salt (A0, B0; C0; D0, and E0). Bacteria in the inoculants (A, B, C, D, E) are still a good effect on crop yield of paddy in saline concentration of 4%, when compared to plants that were not given inoculant but given saline (E1-E4) and plants not given salt and inoculant (E0). The best or highest influence is shown by the crop (plant height, number of tillers, number and dry weight of whole grain paddy) on the pot are A1, B1, C1, D1, and E1 code were given 0.1% saline. While the lowest result is shown by the control plants (without inoculant = E4). Average number of grains of paddy as the final product was still good, especially on pot group C (C1, C2, C3, C4), and D (D1, D2, D3, D4).

Table 1. Average yield of plant height, fresh weight panicle, number of tillers, fresh weight of grains, and dry weight of grains

Inoculant code	Level of NaCl (%)	Plant height (cm)	Fresh weight panicle (gram)	Number of tillers per pot	Fresh weight of grains (gram)	Dry weight of grains(gram)
A0	0	90.5h	19.55n	13g	6.39d	3.58b
A1	0,1	97.5i	26.86p	28q	26.86o	12.96ij
A2	0,2	88.5fgh	17.8m	18m	19.57n	11.03h
A3	0,3	84cdef	13.63i	15ij	17.79m	10.03gh
A4	0,4	83.5cdef	6.39d	9d	13.63j	7.14f
B0	0	87.5efgh	4.81b	11.5e	4.81b	2.44a
B1	0,1	91.5h	34.95s	20.5n	30.45q	16.84k
B2	0,2	85defg	14.23j	14.5hi	14.23k	9.93gh
B3	0,3	82.5cde	10.24h	14h	11.64i	5.57e
B4	0,4	81cd	9.98h	12.5f	10.23h	4.81d
C0	0	87.5efgh	6.64d	7c	9.98g	3.87bc
C1	0,1	91.5h	36.77u	22o	36.77t	21.28m
C2	0,2	87efgh	30.88q	15.5jk	30.87q	21.02m
C3	0,3	82cd	33.37r	17l	33.3r	18.15l
C4	0,4	79.5bc	15.42k	16k	15.42l	7.49f
D0	0	90.5h	5.55s	6b	5.55c	2.76a
D1	0,1	89.5gh	35.61t	28.5q	35.61s	18.96l
D2	0,2	87.5efgh	31.11q	26.5p	28.11p	13.53j
D3	0,3	84cdefg	25.3o	22o	25.3n	12.43i
D4	0,4	74.5b	17.77m	18m	17.77m	11.59h
E0	0	82cd	3.91a	5a	4.16a	2.4a
E1	0,1	89.5gh	15.97l	20.5n	15.97l	9.66g
E2	0,2	80.5cd	9.33g	11.5e	9.33g	4bc
E3	0,3	80.5cd	8.69f	12.5f	8.69f	3.92bc
E4	0,4	64.5a	7.62e	7c	7.03e	4.34cd

Note: The number followed by the same letter in the same column are not significantly different by DMRT at 5% level.

This is all due to the survival of bacteria and bacterial activity and effectiveness in generating enzyme PME-ase, so as to provide P available that can be absorbed by the roots of plants in saline soil. This showed that the salt levels of 0% to 0.4% are still safe for bacterial life activities that effectiveness to produce the enzyme of phosphatase, so that P elements will always be freely available to the paddy crop. This is shown by the analysis of available P in the soil and soil PME-ase during flowering and after harvest, the result is good (data not listed). As stated by Kholer *et al* (2009) and Husen (2011) in his research, that there is an imbalance of nutrients and increased uptake of Na^+ and decreased uptake of K^+ and Ca_2^+ in plants, thereby disrupting the growth during the nursery and early vegetative growth impact on the results. So in general which gripped salinity plant hormone ethylene will menghasilkan in high concentrations due to accumulation of the compound ACC / ethylene precursor hormone (Husen, 2011). The results of this study can be concluded, that salt content of 0.1% is very good for growth, activity and effectiveness of phosphate solubilizing bacteria contained in fertilizer A, B, C, and D on paddy production, but the salt content 0.4% is still safe for the growth, activity and effectiveness of bacteria the solvent phosphate as biofertilizer or growth promoting rhizobacteria.

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