# CONSORTIUM OF BIOFERTILIZING MICROBES

SITI RAMLAH AHMAD ALI; NOR SHALINA AHMAD TAJUDDIN;
SHAMSILAWANI AHAMED BAKERI and MOHD BASRI WAHID

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Biofertilizer is a substance which contains living microorganisms. When applied to seed, plant surfaces or the soil, the microorganisms in biofertilizer colonize the rhizosphere or the interior of the plant, and promote growth by increasing the supply or availability of the primary nutrients to the host plant. Most biofertilizers contain root nodule bacteria, mycorrhizal fungi and other microorganisms that facilitate nutrient uptake by the plant.

## OBJECTIVES

- To reduce the use of chemical fertilizers.
- To improve the yield of crops using nitrogen-fixers, phosphate-solubilizers and potassium-solubilizers for increased availability of plant nutrients from the soil.

## PROCESS DESCRIPTION

Selective media were used to isolate the nitrogen-fixing, phosphorus-solubilizing and potassium-solubilizing microbes. Nitrogen-free agar was used to isolate microbes that can fix atmospheric nitrogen. Pikovskaya agar was used to isolate microbes that can mineralize inorganic phosphorus, while a potassium-solubilizing medium was used to isolate potassium-solubilizing microbes that can mineralize inorganic potassium. Microbial DNA extraction and polymerase chain reaction (PCR) were done prior to sequencing. Sequencing and blasting using the National Centre for Biotechnology Information (NCBI) database and phylogeny analysis were carried out using Mega4 software.

## NITROGEN, PHOSPHORUS AND POTASSIUM MICROBES

Nitrogen-fixers can enhance crop maturation, improve soil quality and fertility, replace 30%-50% of the total nitrogen requirement, and improve the yield of host plants. Some of the nitrogen-fixers detected in the laboratory using nitrogen-deficient medium were species from the genera *Acidovorax, Bacillus, Flavobacterium, Brevibacillus, Phyllobacterium* (*Figure 1*), *Leifsonia, Pseudomonas, Sphingomona, Amycolatopsis* and *Variovorax*.

Phosphate-solubilizing bacteria have the ability to solubilize insoluble inorganic phosphate compounds to make them available to plants (Rosas *et al*., 2006). Among the phosphate-solubilizing strains identified in the laboratory were species from the genera *Burkholderia, Bacillus, Chitinophaga, Pseudomonas, Sphingomonas* (*Figure 2*), *Arthrobacter, Cupriavidus, Curtobacterium, Dyella, Enterobacter, Flexibacter, Janthinobacterium, Leifsonia, Methylobacterium, Rhodanobacter, Streptomyces, Variovorax* and *Williamsia.*

Potassium is another nutrient important to the oil palm. In the soil, potassium exists in the form of silicate minerals such as feldspars. Some of the potassium-solubilizing bacteria isolated in the laboratory were species from the genera *Bacillus, Paenibacillus, Staphylococcus, Methylobacterium, Sphingomonas* (*Figure 3*), *Bordetella, Burkholderia, Enterobacter, Flavobacterium, Ralstonia, Rhizobium, Sinomonas, Arthrobacter, Stenotrophomonas* and *Xanthomonas.*

Some of the microbes play common roles in making nitrogen, phosphorus and potassium available to plants, as listed in *Table 1*.

## BENEFITS

- Increase soil fertility and crop productivity.
- Improve plant growth.
- Reduce the use of chemical fertilizers.
- Unlike chemical fertilizers, biofertilizers are environmental-friendly (RSPO, 2005).

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Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. *Tel*: 03-87694400 *Website*: www.mpob.gov.my *Telefax*: 03-89259446

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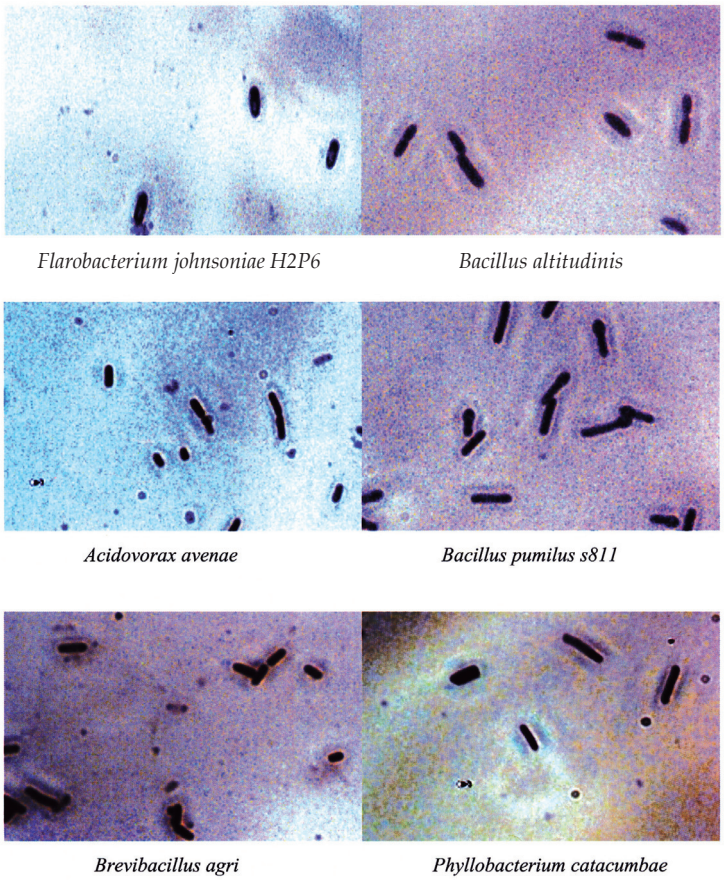


*Figure 1. Microbial nitrogen-fixing candidates. Magnification at 4000X.*

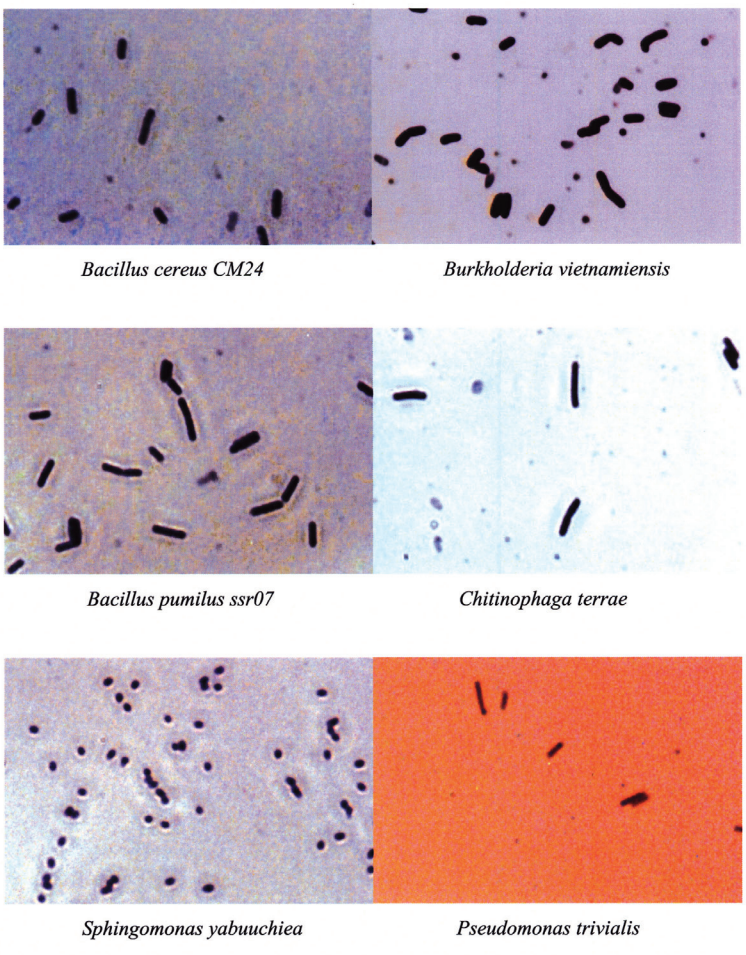


*Figure 2. Microbial phosphate-solubilizing candidates. Magnification at 4000X.*

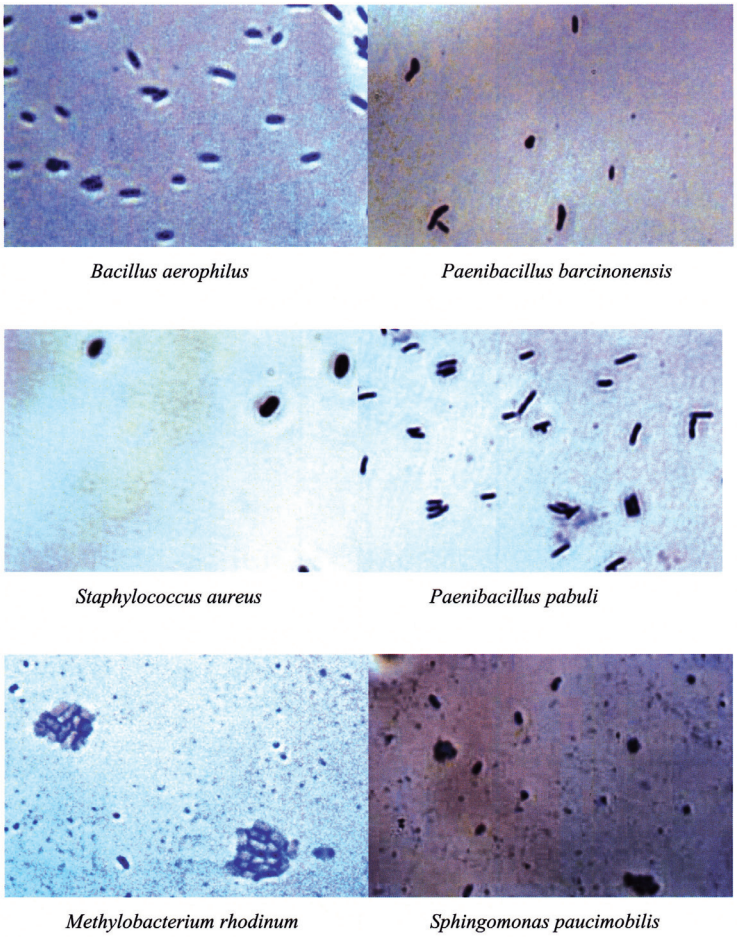


*Figure 3. Microbial potassium-solubilizing candidates. Magnification at 4000X.*

**TABLE 1. NUTRIENT-RELATED MICROBES DETECTED USING NITROGEN-FREE MEDIUM, PIKOVSKAYA MEDIUM AND POTASSIUM-SOLUBILIZING MEDIUM**

| Nutrients | Organisms |
|---|---|
| Nitrogen | *Actinobacterium, Brevibacillus.* |
| Phosphorus | *Actinomycetales, Curtobacterium, Eubacterium, Flexibacter, Janthinobacterium, Mycobacterium, Ochrobactrum, Pantoea, Paracoccus, Providencia, Rahnella, Williamsia* |
| Potassium | *Bacterium, Bordetella, Delftia, Rhizobium, Sinomonas, Staphylococcus, Xanthomonas* |
| Nitrogen and potassium | *Flavobacterium* |
| Phosphorus and potassium | *Arthrobacter, Cupriavidus, Enterobacter, Microbacterium, Micrococaceae, Micrococcus, Myroides, Paenibacillus, Proteus, Ralstonia, Rhodanobacter, Stenotrophomonas, Streptomyces* |
| Nitrogen, phosphorus and potassium | *Acidovorax, Amycolatopsis, Bacillus, Beta proteobacterium, Burkholderia, Chitinophaga, Dyella, Leifsonia, Methylobacterium, Pandoraea, Phyllobacterium, Pseudomonas, Sphingomonas, Variovorax* |

## CONCLUSION

Biofertilizers can reduce the use of chemical fertilizers and increase crop production. Hypothetically, biofertilizers are less expensive and are more environmental-friendly than chemical fertilizers.

## REFERENCES

ROSAS, S B; ANDRES, J A; ROVERA, M and CORREA, N S (2006). Phosphate-solubilizing *Pseudomonas putida* can influence the rhizobia-legume symbiosis. *Soil Biology and Biochemistry, 38(12)*: 3502-3505.

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For more information, kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
*Tel*: 03-8769 4400
*Fax*: 03-8925 9446
www.mpob.gov.my