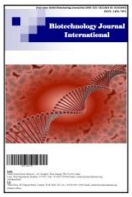

Biotechnology Journal International

24(3): 15-18, 2020; Article no.BJI.53535
ISSN: 2456-7051
(Past name: British Biotechnology Journal, Past ISSN: 2231–2927, NLM ID: 101616695)

Nano-Bio Challenge: New Approaches in Agricultural Production

Kağan Tolga Cinisli[1*], Ela Akin[2] and Neslihan Dikbaş[1]

[1]Department of Enzyme and Microbial Biotechnology, Atatürk University, Erzurum, Turkey.
[2]Department of Agricultural Biotechnology, Atatürk University, Erzurum, Turkey.

Authors' contributions

This work was carried out in collaboration among all authors. Author KTC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EA and ND managed the analyses of the study. Author ND managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJI/2020/v24i330103
Editor(s):
(1) Dr. Tulay Askin Celik, University of Adnan Menderes, Turkey.
(2) Dr. Kazutoshi Okuno, University of Tsukuba, Japan.
(3) Anil Kumar, Devi Ahilya University, India.
(4) Associate Prof. Chung-Jen Chiang, China Medical University, Taiwan.
Reviewers:
(1) Linda Appianimaa Abrokwah, CSIR-Crops Research Institute, Ghana.
(2) Nguyen Thi Hieu Trang, Vietnam.
(3) M. Kiley-Worthington, France.
Complete Peer review History: http://www.sdiarticle4.com/review-history/53535

Opinion Article

Received 25 February 2020
Accepted 01 May 2020
Published 14 May 2020

ABSTRACT

Despite climate change scenarios, new research on improving yield and quality in agricultural production is extremely important. The use of nanomaterials and plant-growth-promoting bacteria (PGPB) has been of interest to researchers in recent years. In the future, the creation of new nano-biotechnological products by using nanomaterials together with bacteria will be more advantageous than conventional methods. Thus, the number of fertilizers applied on farmland will be reduced and maximum efficiency will be achieved with minimum input. The number of chemical inputs applied to agricultural areas will be reduced and effective protection against various plant stress factors will be provided. By producing Nano-bio-active. It is expected to increase mineral availability in farmland according to chemical formulations. The results obtained are certain to provide an effective benefit to the agricultural area and nature. Also, nano-biotechnological methods with new research potential are important for serving scientific researchers.

Keywords: Nanomaterial; plant production PGPB; bacteria.

**Corresponding author: E-mail: kagantolgacinisli2525@gmail.com;*

1. INTRODUCTION

Nanotechnology has a wide range of applications [1]; one of them is nano-agriculture, which used to improve the productivity of plants and bio-controlling [2], fuel production [3], food industry [4,5], environment protection [6] and producing of antimicrobial agents [7,8]. Higher plants are different in the ability of absorption and accumulation of synthetic engineered nanoparticles. The nanoparticles induce changes in several metabolic pathways (by entering the plant through intracellular and extracellular means, it can play a role in stress defense by influencing the mechanism of hormonal signaling against stress conditions) which finally affect plant growth and developments [9]. Plant growth promoting bacteria (PGPB), a kind of beneficial bacteria isolated from the rhizospheric soil, were utilized to combine plants to remove contaminants from soil [10]. Inoculation plants with PGPB enhanced the tolerance of plants to environmental stresses by the synthesis of 1-aminocyclopropane-1-carboxylate (ACC) deaminase [11]. PGPB had the ability to solubilize phosphate and fix nitrogen, which provided plants with more nutrients [12]. Also, Indole-3-Acetic (IAA) and siderophores produced by PGPB directly and indirectly increased plant biomass [13]. PGPB were widely used to remediate heavy metal contaminated soil [14-16]. Weyens et al. [13] also investigated the feasibility of inoculating plants with PGPB to remediate organics. Moreover, few reveal the mechanisms of inoculating plants with PGPB to remediate the PAH-metal co-contaminated (heavy metal impurities, pathogens etc) soil by analyzing the chemical speciations of contaminants.

In case of remediating heavy metals, the key factor in phytoremediation was the bioavailability of heavy metal, which determined the remediation efficiency [13]. Root exudates such as organic acids efficiently increased the bioavailability of heavy metals [12,17]. Biosurfactants produced by some PGPB significantly promoted the mobilization of contaminants [10].

2. METHODOLOGY

To select PGPB bacteria that can have a synergistic effect with iron (Fe), Carbon nanotubes (CNTs), phosphorus (P) nanoparticle doses (e.g. 0, 20, 40 mg/L). In microbiology, the minimum inhibitory concentration (MIC) was defined as the lowest concentration showing 100% growth inhibition [18]. The disk diffusion method was mainly that inhibition produced by the test is compared with that produced by the known concentration of a reference compound. The most extensively used techniques for the characterization of NPs are Scanning electron microscopy (SEM), Dynamic light scattering (DLS), Raman and Fourier transform infrared (FTIR) spectroscopy [19,20].

3. RESULTS, DISCUSSION AND CONCLUSION

Iron (Fr), copper (Cu) Zinc (Zn), manganese (Mn), phosphorus (P), calcium (Ca) magnesium (Mg), nano zeolite, molybdenum (Mo), titanium (Ti), Carbon Materials (CNT) etc. the application of nano-forms of substances to *Bacillus sp, Rhizobium sp* as PGPB bacteria by immobilizing them is important in the future. Thus, the co-administration of bioagents with nanoparticles in comparison to generalistic formulations will result in an increase in yield quality and a decrease in environmental risk potentials for the plant. Especially in the next 20-30 years, according to the scenarios put forward by climate scientists, it is a very valuable approach to be able to solve these problems against the developments that are going to increase in plant production.

If nanoparticles and PGPB bacteria are used together, increase plant biomass, plant protein, plant, promote plant growth, etc. can be combined to produce beneficial effects (Fig. 1). Microbial fertilizers supported by nanoparticles can be applied to both hydrophonic systems and soil systems. Advantages due to their high specific surfaces they can hold onto soil colloids and facilitate the removal of plant roots. Using the metabolic liquid of microorganisms, nutrients do not form insoluble compounds and become mobile towards the root site.

In this article, two important elements such as nanoparticle and microbial fertilization can form combinations together, biological activity in the soil can work and be used partly as if it were organominerals fertilization. It has been tried to draw attention to the fact that a new formulation (combining microorganisms with different nano-based minerals) can be useful on an academic scale and shed possible light on many innovations both in terms of scientific studies and terms of agriculture. It is important to use bioagens and nanomaterials together in health studies.

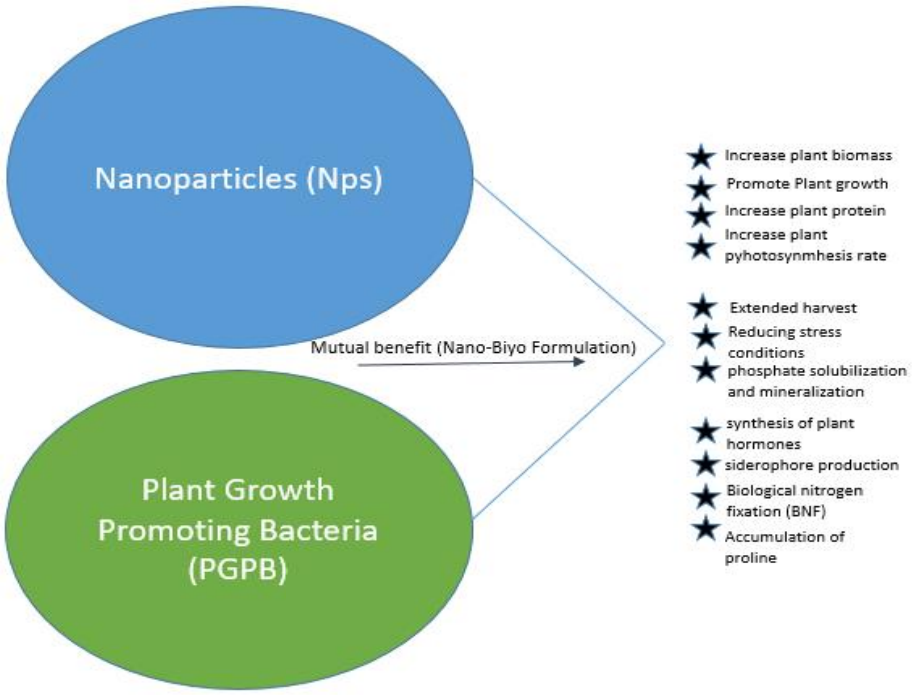

Fig. 1. Demonstration of the common utility of Nano-Bio formulation

The most important issue to be considered is to thoroughly investigate the effects of these formulations on the environment and human. The use of non-pathogenic microorganisms is extremely important. Green nanotechnology should be used in nanoparticle syntheses and application doses should be tested following European commission criteria.

ETHICAL APPROVAL

The doses to be administered should be administered by the ethics committees and after being evaluated by scientists. If these conditions are met, these fertilizers will be less used and more effective than chemical fertilizers on plants and humans.

ACKNOWLEDGEMENT

We would like to thank Emre Canca, a graduate student in the Department of Agricultural Biotechnology, Faculty of Agriculture, Atatürk University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Archana Singh, Smita Dubey, Harish K. Dubey. Nanotechnology: The future engineering. International Journal of Advance and Innovative Research. 2019;6(2(III)):230–233.
2. Elshahawy HM, Abouelnasr SM, Lashin OM, Darwesh. First report of *Pythium aphanidermatum* infecting tomato in Egypt and controlling it using biogenic silver nanoparticles. J. Plant Prot. Res. 2018;58(2):137-151.
3. Darwesh OM, Matter MF, Eida H, Moawad Y. On influence of nitrogen source and growth phase on extracellular biosynthesis of silver nanoparticles using cultural filtrates of Scenedesmus obliquus. Appl. Sci. 2019;9:1-13.
   DOI: 10.3390/app9071465 1465
4. Darwesh OM, Sultan YY, Seif MM, Marrez DA. Bio-evaluation of crustacean and fungal nano-chitosan for applying as food ingredient. Tox. Rep. 2018;5:348-356.
5. Marrez DA, Abdelhamid AE, Darwesh OM. Eco-friendly cellulose acetate green synthesized silver nano-composite as antibacterial packaging system for food

safety. Food Packag. Shelf Life. 2019;20. Article 100302.
6. Hasanin MS, Mostafa AM, Mwafy EA, Darwesh OM. Eco-friendly cellulose nano fibers via first reported Egyptian *Humicola fuscoatra* Egyptia X4: Isolation and characterization. Environ. Nanotechnol. Monit. Manag. 2018;10:409-418.
7. Emam HE, Darwesh OM, Abdelhameed RM. In-growth metal organic framework/ synthetic hybrids as antimicrobial fabrics and its toxicity. Colloids Surf. B, Biointerface. 2018;165:219-228.
8. Abdelhameed RM, Rocha J. IRMOF-3 biological activity enhancement by post-synthetic modification. Eur. J. Inorg. Chem. 2019;1243-1249.
9. Ma Y, Oliveira RS, Nai FJ, Rajkumar M, Luo YM, Rocha H. Freitas. The hyperaccumulator sedum plumbizincicola harbors metal-resistant endophytic bacteria that improve its phytoextraction capacity in multi-metal contaminated soil. J. Plant Nutr. 2016;37.
10. Rathi MS, Paul S, Thakur JK. Response of wheat to inoculation with mycorrhizae alone and combined with selected rhizobacteria including flavobacterium sp as a potential bioinoculant. J. Plant Nutr. 2014;37:76-86.
11. Zahid MK, Abbasi S. Isolation and identification of indigenous plant growth promoting rhizobacteria from Himalayan region of Kashmir and their effect on improving growth and nutrient contents of maize (*Zea mays* L.). Front. Microbiol. 2015;72-76.
12. Ma Y, Rajkumar C, Zhang H. Freitas. Inoculation of *Brassica oxyrrhina* with plant growth promoting bacteria for the improvement of heavy metal phyto-remediation under drought conditions. J. Hazard. Mater. 2016;320:36-44.
13. Weyens N, Van der D, Lelie S, Taghavi J. Vangronsveld. Phytoremediation: Plant-endophyte partnerships take the challenge. Curr. Opin. Biotech. 2009;20:248-254.
14. Wijayawardena MAA, Naidu R, Megharaj M, Lamb D, Thavamani Kuchel PT. Using soil properties to predict *in vivo* bio-availability of lead in soils. Chemosphere. 2015;138:422-428.
15. Hou YY, Liu XY, Zhang XY, Chen X, Tao KY, Chen X, Liang X. Held identification of *Scirpus triqueter* root exudates and the effects of organic acids on desorption and bioavailability of pyrene and lead in co-contaminated wetland soils. Environ. Sci. Pollut. Res. 2015;22:17780-17788.
16. Juwarkar AA, Nair A, Dubey KV, Singh SK, Devotta S. Biosurfactant technology for remediation of cadmium and lead contaminated soils. Chemosphere. 2007;68:1996-2002.
17. Montiel-Rozas MM, Madejón E, Madejón P. Effect of heavy metals and organic matter on root exudates (low molecular weight organic acids) of herbaceous species: An assessment in sand and soil conditions under different levels of contamination. Environmental Pollution. 2016;216:273-281.
18. Compant S, Samad A, Faist H, Sessitsch A. A review on the plant microbiome: Ecology, functions and emerging trends in microbial application. Journal of Advanced Research; 2019.
19. Radhapriya P, Ramachandran A, Palani P. Indigenous plant growth-promoting bacteria enhance plant growth, biomass, and nutrient uptake in degraded forest plants. 3 Biotech. 2018;8(3):154.
20. Ren X, Guo S, Tian W, Chen Y, Han H, Chen E, Chen Z. Effects of plant growth-promoting bacteria (PGPB) inoculation on the growth, antioxidant activity, Cu uptake, and bacterial community structure of rape (*Brassica napus* L.) grown in Cu-contaminated agricultural soil. Frontiers in Microbiology. 2019;10:1455.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/53535