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Biofertilizers: A key tool for developing fruit orchards

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Abstract

1.Background:

Fruit orchards represent an important sector in the economics of different countries, therefore, there are more interests in improving the practice management of orchards to sustain fruit production and produce healthy fruits. Various agricultural practices in conventional agriculture aim to improve plant growth and increase productivity, while, continuous use of synthetic fertilizers particularly the main elements fertilizers nitrogen (N), potassium (K), and phosphorus (P), affect negatively on soil characters and microorganisms in the rhizosphere, which reflects on crop productivity (Belay, et al. 2002).

The arid and semi-arid areas are characterized by alkaline soils that are poor content of organic matter and microorganisms. In addition, to continuous use of chemical fertilizers to maintain the high production of fruits, which affects negatively soil characters and increases soil degradation. Furthermore, the accumulation of many elements in the soil, which increases the soil salinity, consequently, affects orchards productivity, limits the growers' profitability, in addition to increasing the leaching of nitrites, and nitrates into the water, which increases the pollution of the environment and increases human diseases.

Under the increasing global demand for fruit consumption, biofertilizers should be an important part of the integrated fertilization practice for orchards with organic and chemical fertilizers. Therefore, using biofertilizers increase the potential of producing healthy fruit with high quality and increasing farmers' profits, and protecting the environment.

There are different disorders of synthetic fertilizers on the environment, such as increasing soil degradation, leaching of nitrate, and increasing chemicals residues, which rising salinity in soil and increase water contamination, in addition to increasing emission of greenhouse gases (Weldeslassie, et al, 2018). Biological fertilizers are considered a type of organic fertilizers, it is consisting of microorganisms with some components of organic fertilizers (Abobatta2020).

Biofertilizers are microorganisms, including bacteria, fungi, and algae, which live in the root or in the rhizosphere, and have a positive interaction with the root system (El-Gioushy, et al, 2018). In addition, biofertilizers play various roles in plant nutrition like atmospheric nitrogen-fixing organisms, phosphate rock solubilizers, phosphorous mobilizers, potassium solvents (Mącik, et al, 2020), also some biofertilizers acting as biocides (Ali, et al, 2015).

2. Types of biofertilizers:

There are various types of biofertilizers used as alternative parts of chemical fertilizers (Table 1), such as Arbuscular Mycorrhiza fungi, Rhizobacteria, Pseudomonas, Bacillus circulance, Candida spp, Trichoderma spp …etc.

Biofertilizers are considered safer alternatives to synthetic fertilizers and pesticides, they have a significant role in protecting the environment. Furthermore, it is a low cost compared to chemical fertilizers and can produce as per orchard requirements, in addition to the possibility of synthesis inside the farms directly (Rabeh, et al, 2020).

No.	Biofertilizer	Crop	Scientific Name	Reference
1	(Arbuscalar mycorrhiza), (Azotobacter choroccocum), (Bacillus pasteurii).	Fagri Kalan Mango	Mangifera indica	EL-Gioushy, et al, (2018)
2	Bacillus circulance , B. poylmyxa , B. megatherium, Candida spp , Trichoderma spp	Valencia orange	Citrus sinensis L. Osbeck	El-Aidy et al. (2018)
3	Azotobacter spp., Arbuscular Mycorrhiza	Lemon	Citrus limon Burm	Ghosh et al. (2017)
4	Bio (bio-mex) E.M.	Banana	Musa sp.	Abdel-Hafiz, et al, (2016)
5	Azotobacter spp.	Sweet Orange	Citrus sinensis L. Osbeck	Jugnake et al. (2017)
6	Spirulina platensis algae	Florida Prince peach	Prunus persica	El-Khawaga, (2011).
7	Arbuscular Mycorrhiza	Sour Orange seedlings	Citrus aurantium	Al-Karak (2013)
8	Bacillus circulans, B.megaterium, Azotobacter chroococcum	Balady Mandarin	citrus reticulata	El-Shazly et al. (2015)
9	Azospirillum spp., Bacillus megatherium	Navel Orange	Citrus sinensis L. Osbeck	Zahgloul, et al. (2015)
10	Azospirillum spp., Arbuscular Mycorrhiza	Rough Lemon seedlings	Citrus jambh iri Lush.)	Singh et al. (2018)
11	Nitrobin (N-fixing bacteria), Phosphoren (P-dissolved bacteria)	Mandarin varieties	Citrus spp.	El Khayat and Abdel Rehiem (2013)
12	Azospirillum Lipoferum	Navel orange	Citrus sinensis L. Osbeck	Abd El-Migeed et al. (2007)
13	Azotobacter spp.	Kinnow Mandarin	Citrus reticulata	Bakshi et al., (2018)
14	Arbuscular Mycorrhiza	Trifoliate Orange seedling	Poncirus trifoliata	Liu, et al. (2016)
15	Azotobacter chrocoocum, Bacillus megatherium var phosphaticum	Bitter Orange Seedlings	Citrus aurantium	Ismail, et al. (2011)
16	Micosat, BF Amin, BF Quality,	Apple	Malus domestica	Rozpara, et al, (2014).

Table 1: application of biofertilizers in fruit orchards
*Modified from Abobatta (2020)

3. Beneficially effects of biofertilizers:

Using biofertilizers as a partial alternative to synthetic fertilizers in fruit orchards achieves many benefits (figure 1), both from the growth of trees, increasing their yield, and improving fruit quality, increase plant tolerance for different stress, as well as improving soil properties and stimulation biological activity in the root zone (Abobatt, 2019; El-Gioushy, et al, 2018).

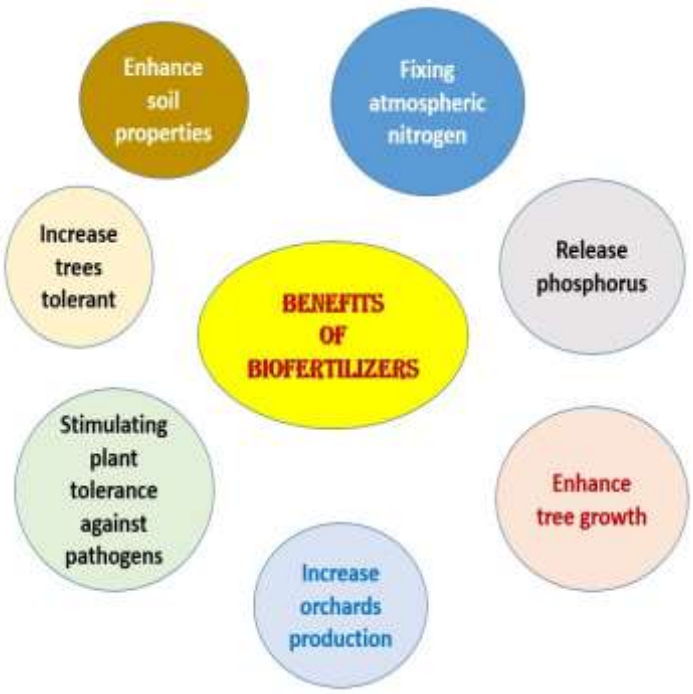

Figure 1: Benefits of biofertilizers in fruit orchards.

The main benefits of biofertilizers:

1.Enhance tree growth.
2.Increase orchards production.
3.Stimulating plant tolerance against pathogens.
4.Increase tree tolerance against abiotic stress.
5.Fixing atmospheric nitrogen.
6.Release phosphorus from complex forms in the soil.
7.Enhance soil properties (Physically and chemically).

4. Biofertilizers and sustaining fruit production:

Under fluctuation in climatic conditions like rising temperature, heatwaves, and increased soil salinity, biofertilizers could play significant roles in sustaining the growth and productivity of various fruit orchards worldwide.
There are the different roles of biofertilizers that include among the others:
1. Enhancing growth and productivity of different fruit trees.
2. Reduce input costs and increase farmers' profits.
3. Produce safe food products.
4. Improve release of nutrients (particularly microelements) from complex forms in the soil.
5. Reduce soil and water pollution.
6. Recover soil vitality and enhance soil properties.

5. Conclusion:

Biofertilizers have a significant role in sustaining fruit orchards, particularly under climate change conditions, there are different types of biofertilizers used in the agricultural sector include bacteria, fungi, and algae. Therefore, partially using biofertilizers as an alternative to chemical fertilizers in fruit orchards achieves numerous advantages for orchards productivity and improving soil characters.

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