Humic Acid-A Critical Review

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A B S T R A C T

Soil organic material is needed up to a satisfactory level for sustainable crop production and high productivity of crops over long periods. Humic Acid (HA), an organic matter, might help to overcome the production constraints of crops with its growth stimulating property. Humic acid is the major component of most of the organic fertilizers and the most active components of soil and compost. Humic acid mainly arises from chemical and biological degradation of plant and animal residues and by the synthetic activities of different micro-organisms. After enriches into the soil it facilitates fertilizer nutrients to reach their maximum potential in improving plant growth.

Keywords
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Introduction

One of the most disruptive human activities is high-external input agriculture which has been justified by the current economic paradigm due to high productivity and the need to feed a growing population and we are dangerously close to the edge of the planet resources and both hunger and food insecurity has increased (Olivares et al., 2017). Excessive use of non-renewable chemical fertilizers and pesticides risks agricultural sustainability through the deterioration of soil and water resources, environmental quality (Ekin et al., 2019). Humic acid is an important soil component that can improve nutrient availability and impact on other important chemical, biological, and physical properties of soils (Meganind et al., 2015). The ecological benefits of humic acids are diverse and represent profitable and effective solutions for environmental problems and preservation of the environment (Manal et al., 2016). HA particularly K-Humate has potential to be used as an effective conversation and management tool for sustainability of the soil environment (Gumus et al., 2015). In agricultural production system the widespread use of unsustainable and unsustainable production techniques has resulted in extensive deterioration of soil
quality, reductions in soil organic matter content (Martinez-Blanco et al., 2011). With increase in human population the soil quality is threatened by intensive management of cultivable land and by urbanisation and soil degradation. Humic acid is an effective agent to use as a complement to synthetic or organic fertilizers and regular humic acid use will reduce the need for fertilization due to the soil’s and plant's ability to make better use of it or fertilization can be eliminated entirely if sufficient organic material is present and the soil can become self-sustaining through microbial processes and humus production (Khaled et al., 2011). Even in small quantities humic acid affect growth of living organism by inhibiting or stimulating the growth and they are also capable of protecting living cells against the toxic action of natural and anthropogenic compounds (Tikhonov et al., 2010).

**Definition of humic acid**

Humic acid is known to be among the most bio-chemically active materials found in soil and are considered to be the most abundant naturally occurring organic molecules on earth and also described as being the “most important component of a healthy fertile soil” (Calvo, 2014). Humic acid term is used for the brown-black, polymeric, alkali-soluble acids found in soils, plants, sea-grasses, fungi, sediments, and terrestrial and marine waters (Susic et al., 2016). Humic acid is the main fraction of humic substances (HS) and it is the most active components of soil and compost organic matter (Ferrara et al., 2008). Humic acid is also a naturally-available substance in the soil and a bio product of organic matter decomposition, which is successfully used in cultivation of various crops (Ekin et al., 2019). Generally, humic acid is high in molecular weight, dark brown in colour and soluble in an alkali solution. Humic acids are comprising a large family of organic compounds with identical characteristics that are products of organic matter transformations by soil microorganisms (Roy et al., 2017). Humic Acids are an effective agent to use as a complement to synthetic or organic fertilisers (Khaled et al., 2011).

**Sources of humic acid**

Humic acids are generally formed in senescent plant matter so it is important that plant trash from harvested crops is returned to the soil (Susic et al., 2016). Low rank coal can be successfully used as a rich source of humic acids in agriculture (Huculak-Maczka et al., 2018). Some developing countries used huge amount of lignite coals in agriculture as a rich source of humic acids (Susic et al., 2016). Composition of humic acid are contains 51% to 57% C, 4% to 6% N and 0.2% to 1% P and other micronutrients in minute amounts (Waqas et al., 2014).

**Benefits of humic acid**

Some beneficial effects of humic acid are:1) Addition of organic matter to organically-deficient soils 2) Improved nutrient uptake 3) Increased chlorophyll synthesis 3) Increase root vitality 5) Better seed germination 6) Increased fertilizer retention capacity 7) Stimulate beneficial microbial activity 8) Healthier plants and improved yields.

Humic acids are beneficial in freeing up nutrients in the soil so that they are become available to the plant as needed (Khaled et al., 2011). As the humic acid molecules are small, which “allows them to reach the plant plasma membrane, where they effectively influence the assimilation of nutrients” (Quilty, 2011). Humic acid also accumulates toxic heavy metals very efficiently (Sinha et al., 2011). HA can enhance nutrient availability and improve chemical, biological, and physical soil properties (Meganind et al., 2015).
direct and indirect beneficial effects of HA on plant growth and development are their effect on cell membranes which lead to the enhanced transport of minerals, improved protein synthesis, plant hormone-like activity, promoted photosynthesis, modified enzyme activities, solubility of micro-elements and macro-elements, reduction of active levels of toxic minerals and increased microbial populations (Hamideh et al., 2013).

**Effect of HA on crop production**

Foliar application of humic acid improve the plant growth, accumulated photosynthetic matters and biological yield of red bean (Mohajerani et al., 2016). Application of zinc and boron in accompanied with humic acid and compost can be an effective nutritional manipulation by fixing the recommended dose of NPK to successfully reduce the pest and disease incidence in rice-mustard cropping system (Roy et al., 2017). Waqas et al., (2014) concluded that humic acid application in all the three methods i.e., soil fertilization, foliar sprays and seed treatment significantly enhances grain yield and yield components of mungbean. Olk et al., (2013) observed that humic products results significant increases in grain yield of maize (Zea mays L.) and soybean (Glycine max (L.) Merr.). Soil application of humus increased the N uptake of wheat and foliar application of humic acid increased the uptake of P, K, Mg, Na, Cu and Zn (Asik et al., 2009).

Highest values of spike length, number of grains/spike, grains weight/spike and thousand grains weight as well as grain yield of wheat were obtained by foliar spraying with 2 litres of humic acid (Manal et al., 2016). Humic fertilizer not only increases the yield of wheat, but also wheat quality reflected by high content of carbohydrate and protein content of grain wheat (Manal et al., 2016). Nardi et al., (2002) reported the beneficial effect of humic acid on plant growth to the increasing cell membrane, oxygen uptake, respiration and photosynthesis, nutrients uptake, root and cell elongation and ion transport. Treatments receiving HA in both soil or foliar application caused pronounced increases in plant height, number of branches and dry weight of shoot of soybean compared to the untreated ones(Mahmoud et al., 2011).

**Drawbacks of humic acid application**

The application of the very high dose of humic acid is less effective (Lee and Bartlett, 1976). The beneficial effects of humic acids have been cleared but excessive use of these chemicals might lead to the environmental pollution (Yigit et al., 2008). No effect from application of humic acid (Turan et al., 2011; Aydin et al., 2012; Liu et al., 2002) or even growth reduction (Van et al., 2010) also observed. Several studies have reported all outcomes in experiments: positive, negative and nil effects (Lodhi et al., 2013).

**Table.1** Effect of humic acid on Fusarium root rot diseases

| Humic acid treatments (mg a.i. plant$^{-1}$) | Disease incidence (%) |
|-------------------------------------------|-----------------------|
| 0                                         | 30.4                  |
| 80                                        | 29.6                  |
| 160                                       | 30.8                  |
| 240                                       | 34.4                  |

(Source: Yigit et al., 2008)
In conclusion, humic acid (HA) is a vital constituent and an intimate part of soil organic structure. Many scientists, agronomists and farmers used humic acid for improving soil conditions and plant growth. Humic acid can ameliorate negative soil properties, improve the plant growth and uptake of nutrients. The application doses of humic acid are important for taking benefit from it. It is best to apply humic acid or humic acid in little amount throughout the crop period than at a huge amount or at a time. It is very important that plant trash from harvested crops is returned to the soil.

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