



Effect of humic acid on soil properties and crop production– A review

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ABSTRACT

Many studies have been made in recent years to improve the quality and increase the quantity of agricultural yield. Mechanization and novel hybrid seeds are not the only factors contributing to agricultural advancement and progress; soil quality also plays an important role. It is common for soils that lack organic matter to be unfit for plant growth. Humic compounds have begun to be added to soil in different regions of the world to address this issue and boost agricultural yields. Nowadays, humic acid (HA) is available in different forms (powder, granule, liquid & flakes) in the market and can be applied to crops or soil by various techniques, i.e. soil application, foliar application, seed treatment, root dipping, through drip irrigation and along with inorganic fertilizers but soil application is found most effective in numerous studies. To know the optimum dose of the humic acid, various studies were conducted on crops and discovered a positive response in yield attributed to character, yield, and soil properties. This review enlightens the relevance of humic acid on different crops and soil health, and boosts agricultural productivity.

Keywords: Crop production, Extraction, Humic acid – genesis, Soil properties

As the world population continues to grow, it is becoming challenging to maintain agroecosystem productivity sustainably. Increasing crop production per unit area with least or no adverse environmental impact is the only way to achieve this (Vitousek *et al.* 1997). In many developing countries, increasing production has been achieved by converting natural ecosystems to agriculture rather than increasing productivity and yield. Such downward trends in productivity are attributed to a decrease in factor productivity, which can be traced back to the appearance of multi-nutrient deficiencies and an increase in the number of soil pathogens, and weed flora (Singh and Sharma 2001). Carbon loss is immediate and rapid due to anthropogenic activities, which precede this land-use change through a continuous cropping system and excessive pesticides (Tilman *et al.* 2001, 2002). Nowadays, agriculture relies heavily on fossil fuels, fertilizers, pesticides, and farm machinery. Due to these agricultural practices, there is a rise in greenhouse gas (GHG) emissions to the atmosphere (Bhatt *et al.* 2018). The soil's physio-chemical characteristics are mainly affected by extensive agriculture. Better nutrient management practices can enhance productivity (Bhatt *et al.* 2018). The term "integrated nutrient management" (INM) refers to the practice of applying several sources of nutrients to soil and crops intelligently and proportionately to maintain soil and crop productivity (Joshi *et al.* 2018). Soil

organic carbon is frequently cited as a critical determinant of soil quality and the viability of agriculture. It is essential to replenish the soil periodically by elevating the organic matter proportion (Liu *et al.* 2006). The production of humus from organic material is a crucial step in the process. The substance known as humus consists of fulvic acid, humic acid, and humin.

Humic acid is a dark, black-coloured substance made up of plant and animal residues by microbial degradation and resistant to further weathering. It is a complex molecule that is present naturally in soils, peat, ocean, and freshwater. Leonardite is a significant source of humic acid (O'Donnell 1973). Leonardite is a sediment oxidized lignified layer present in lower layers of subsoil and can be found through mining. The structure of humic acid consists of a wide variety of compounds; thus, not described by a single structural formula. Its molecular weight range is 1000–30,000 (Fig 1). Humic acid has a carbon content of 51–57%, a nitrogen content of 4–6%, a phosphorus content of 0.2–1%, and other micronutrients are found in minute quantities (Haworth 1971).

Various researches have been conducted in India to know the effect of humic acid on different crops, but a systematic comparison among them is lacking. The relationships between humic acid, the soil, and the development of plants are also not well recognized. There is a lack of research comparing the effects of varying humic acid concentrations on different crop types. There are many biotic and abiotic factors that affect the growth, development, and yield of plants. This review article has explained

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how humic acid helps to suppress the effect of disease infestation, soil salinity, and soil nutrient status. The yield of any crop is dependent on the nutrient availability status and physical condition of the soil. This review article also explains the impact of humic acid on various parameters of soil by demonstrating the chemical structure and properties of humic acid and how it is helpful to make the soil more fertile. There are various modes of application of humic acid, out of which soil application and seed treatment are the most common. Multiple methods of application have been demonstrated along with the different levels of doses in particular crops which can be seen clearly in Table 1 and Table 2.

Properties of humic acid

Aromatic carboxylic, phenolic, and aliphatic carboxylic acids are among the most important chemical breakdown products of humic compounds. The relative quantities of these chemicals vary depending on the environment in which they are found. Humic compounds are most likely composed of monomers, polymerized to form their basic chemical structure. Soil mineral decomposition is aided by many functional groups of humic compounds, which interact with metal ions, metal oxides, and metal hydroxides. Adsorption, ion exchange, or chelation are all possibilities for this interaction. Aromatic carboxylic, phenolic, and aliphatic carboxylic acids are among the most important chemical breakdown products of humic compounds.

Metal-humic combinations help plants get zinc, copper, and other nutrients, and avoid leaching. Humic compounds adsorb ammonium from urea and prevent leaching. In certain bonding with clay minerals and humus, amino and

amide-nitrogen compounds appear important. This type of interaction may also include carboxyl and phenolic hydroxyl. Because of the large amount of negative charge created by releasing protons, the capacity of the cation exchanger is dependent on the quantity of -COOH and -OH groups that are released.

Consequently, the cation exchange capacity of humic substances is not constant but instead fluctuates (Biswas and Mukherjee 1987). It is made up of chemically complex non-biochemical organic components which improve the soil health and balance the plant nutrition. Thus, it is important for soil and plant productivity (Adani *et al.* 2006).

Extraction and fractionation of humic acid from organic matter

Acidity causes the precipitation of humic acid fraction, which is collected from soil using alkali or neutral salts. Grassland soils have significant ash levels, with some samples having as much as 30% ash by mass. Multiple precipitations with mineral acids and transit through ion exchange resins can significantly reduce the amount of ash in the final product. For the clay removal, a high-speed centrifuge is used after the acid has been redissolved in alkali and the pH has been adjusted to 7.0. It is possible to generate low-ash humic acids by treating them with acid solutions such as Hydrofluoric acid (HF) (Fig 2). Initially, the crude humic acid material is dissolved in a base solution, the ionic strength is fixed to 0.1 M relative to KCl, and the mixture is centrifuged to eliminate clay. Afterward, the solution is acidified to precipitate humic acids, and the sample is treated for many rounds with a dilute acid solution made up of 0.3 N HF and 0.1 N HCl (Rattan *et al.* 2015).

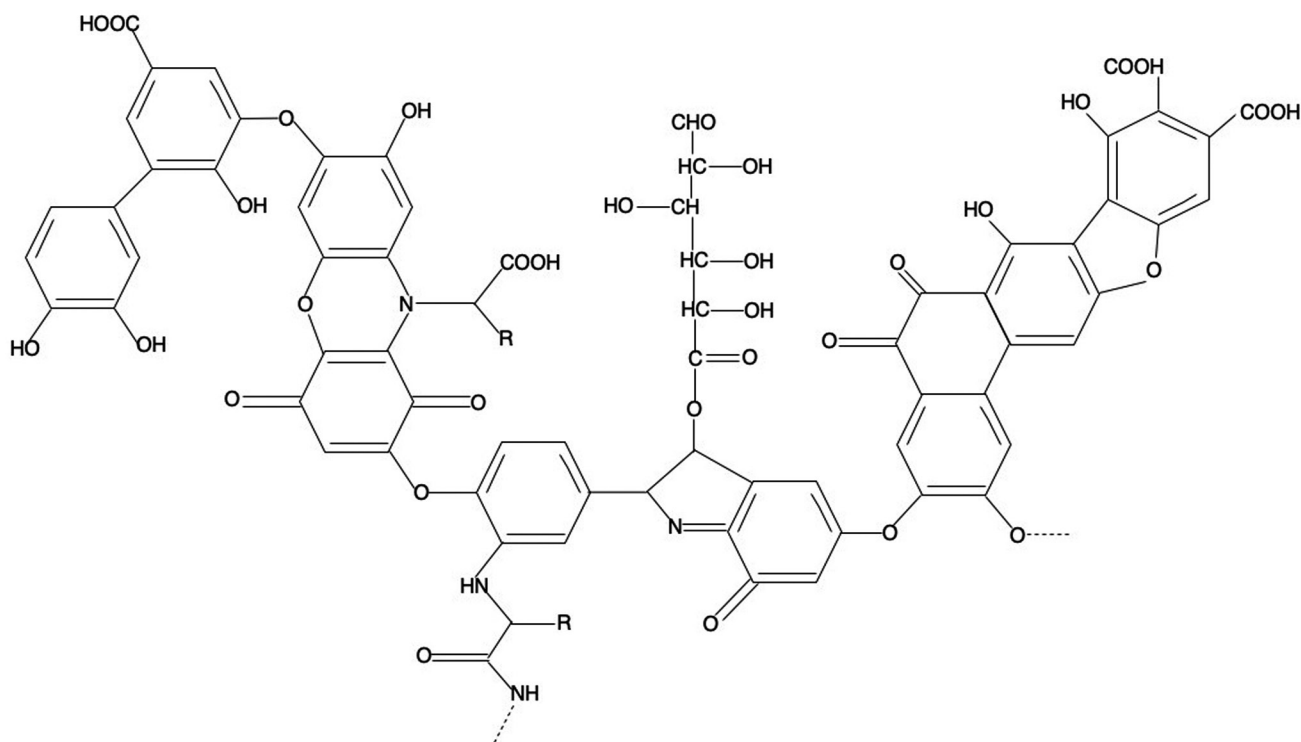


Fig 1 Molecular structure of humic acid (Stevenson 1994).

Uses of humic acid in agriculture

Today, most soils cannot absorb plant nutrients because of many factors, including dryness, water logging, and acidic or alkaline conditions. To combat this, the most significant way to encourage sustainable agriculture is to use humic acid. Fertilizers are a waste of money for farmers, if humic acid is not present in the soil to facilitate nutrient availability to plants. Thus, the addition of humic acid has a significant impact on the intake of nutrients and the yield of crops. Humic acid acts as a soil conditioner; it improves the physio-chemical and biological properties of soil (Table 1).

Effect of humic acid on soil properties

Humic acids are organic compounds that play crucial roles in enhancing the qualities of soil, the growth of plants, and other agronomic factors. In recent years, products based on humic acid have been incorporated into crop production to ensure the agricultural output's continued viability. According to the research that was conducted, HA has the potential to have a beneficial effect on the soil's physical, chemical, and biological properties. These properties include the aggregation and relative proportion of soil particles, the capacity of soil to hold water, cation exchange capacity (CEC), pH, carbon content in the soil, enzymes activity, macronutrients cycling, and availability (Ampong *et al.* 2022). Humic acid contains many compounds, including macromolecule, hydrophobic, hydrophilic, and functional groups. The hydrophilic nature of humic acid attracts the hydrogen ions that lead to increased water holding capacity of the soil. Organic humus contains humic acid (HA), which has the potential to have a significant impact on soil health and plant development. Also, it helps to improve the soil's structure and water storage capacity (Fahramand *et al.* 2014). Addition of humic acid to the soil, whether by addition or

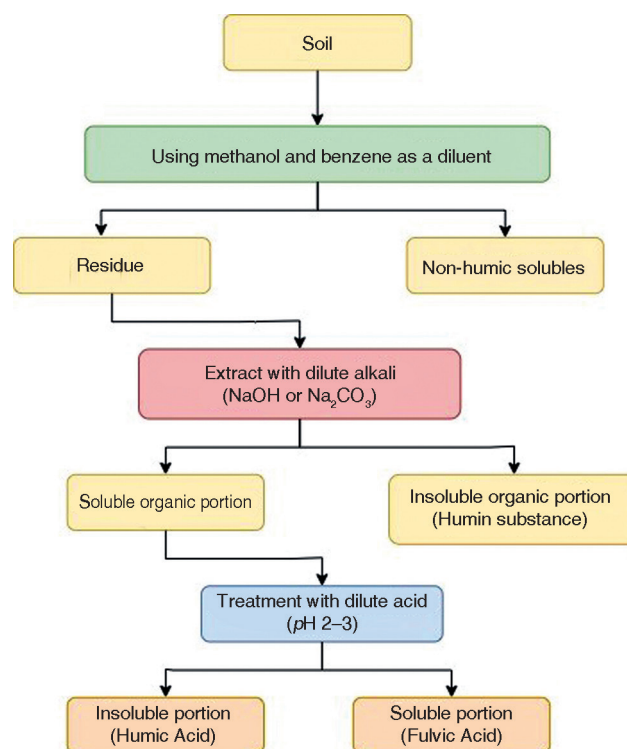


Fig 2 Extraction of humus acid from soil (Biswas and Mukherjee 1987).

adsorption, both help increase aggregate stability, while the adsorption method gives more significant results (Chaney and Swift 1986).

In the arid region, the application of HA provides resistance to plants against heat stress by producing heat tolerance enzymes and increasing the permeability of the plant membrane. HA improves the soil structure, thus

Table 1 Crop growth and soil properties enhanced by various doses of humic acid

Crop	HA dose	Result	Reference
Soil aggregates	100–200 kg/ha	Increased the stable soil aggregates range from 40–120% than control.	Piccolo <i>et al.</i> 1996
Soil moisture content	0.05 g/kg	Significantly increased the field capacity (25.9%), permanent wilting point (21.7%), and available water content (29.9%) in Acireale soil than control.	Piccolo <i>et al.</i> 1996
Chickpea (<i>Cicer arietinum</i> L.)	9 kg/ha	Increased the number of branches and pods per plant and seed yield.	Kahraman 2017
Sugarcane (<i>Saccharum officinarum</i> L.)	20 kg/ha 30 kg/ha	Catalase and alkaline phosphate activity Dehydrogenase activity	Sellamuthu and Govinda Swamy 2003
Mustard (<i>Brassica campestris</i> L.)	6.35 kg/acre	Increased growth and yield	Rajpar <i>et al.</i> 2011
Fodder maize (<i>Zea mays</i> L.)	25 kg/ha	Improved growth and quality of fodder maize	Daur and Bakhshwain 2013
Wheat (<i>Triticum aestivum</i> L.)	150 mg/kg	Increased shoot length 18%, root length 29%, and yield 19–55% as compared to control.	Arjumend <i>et al.</i> 2015
Tobacco (<i>Nicotiana tabacum</i> L.)	14.8 kg/ha	Decreased the concentration of Pb, Cd, Zn and Cu by 39, 37%, 29%, and 18%, respectively, as compared to control.	Rong <i>et al.</i> 2020

reducing soil erosion by increasing aggregation capacity among the soil particles. HA positively impacts cell division and root development (Khaled and Fawy 2011). As a part of humus, humic acid's large surface area leads to more cation exchange capacity. Thus, HA exchanges the nutrients from organic fertilizer and store in its molecule, then slowly releases as per the requirement of plants. Humic acid is the product of the decomposition of plant residue. It has many binding sites for macro-nutrients such as Ca, P, and K, and Zn micronutrient. Foliar spray of humic acid at the rate of 400 ppm along with NAA (Naphthalene acetic acid) and vermicompost waste gave significantly superior yield attributing character, plant growth indices, and yield of chickpea (Kapase *et al.* 2014). An experiment was conducted at BHU, Varanasi. The study evaluated the effect of INM on soil characteristics. They employed 50, 75, and 100% RDF, PGPR, and HA. *P. fluorescens* and humic acid both affected cabbage yield and soil physicochemical parameters. One hundred per cent RDF + *P. fluorescens* and humic acid recorded higher organic carbon (5.2 g/kg), available P (37.9 kg/ha), and available K (332 kg/ha) than control. The same treatment found a maximum N (319 kg/ha) (Verma *et al.* 2017). A field study showed that soil's pH, salt content, organic matter, phosphorus, magnesium, iron, and manganese were all elevated by humic acid. The best amount of soil organic matter was 40 kg/ha of HA treatment, which dropped the pH from 7.51–7.39. The HA group had the highest P, Mg, Fe, and Mn levels as 0, 20 and 40 kg/ha of humic acid were applied (Dinçsoy and Sönmez 2019).

An adequate dose of HA is necessary concerning yield and economic point of view. Among various doses of HA from 5–30 kg/ha in maize, the highest value of mineral content was found at 25 kg/ha. It also indicates the quadratic relation between yield and HA doses as results show a decline in the uptake of nutrients by plants at 30 kg/ha of HA (Daur and Bakhshwain 2013). In an experiment in Rome, Italy, durum wheat was investigated. It was found that humic compounds had a stimulating impact, which was connected to better absorption of macronutrients. It has been demonstrated that applying HA to the soil or the leaves of plants will increase the levels of macronutrients such as nitrogen, phosphorus, potassium, and magnesium, while among the micronutrients iron, copper, zinc, and manganese were increased. Four distinct approaches to the fertilization process were used (control, foliar application of humic acid, foliar application of N and mineral N on soil (Delfine *et al.* 2005).

The effect of HA depends on the level of doses; a higher amount of H₅ (200 mg/kg of soil) gave maximum value in all parameters of soil nutrient status such as organic matter, total nitrogen, available phosphorus, and potassium. In comparison, H₄ (150 mg/kg) was found non-significant with H₅. The reaction of soil phosphorus to HA was much greater than the responses of organic matter, nitrogen, and potassium among the several nutrients investigated (Arjumend *et al.* 2015). Incorporating humic compounds as chelating agents can help break down the iron, aluminum,

or calcium bindings between organic matter and phosphate, allowing P to be released into the soil solution (Turgay *et al.* 2011). The presence of a microbial population in the soil is an indication of a good soil fertility index. Microorganisms facilitate the availability of nutrients in the soil by decomposing the organic residue and also prevent the residual effect of fertilizer in the soil. As HA improves the structure of the soil, it increases the porosity/aeration in the soil.

Thus, HA stimulates plant enzymes and acts as an organic catalyst in various biological processes. The application of 100% NPK along with 20 or 30 kg HA/ha recorded sugarcane's maximum activity of catalase, dehydrogenase, and phosphatase. It might be due to the higher efficiency of nitrogen fertilizer in the presence of HA (Sellamuthu and Govindaswamy 2003). In another study, the application of HA changed the microbial population in the soil. It was found that HA increased the fungus population but decreased the bacterial numbers under the continuous cropping of peanuts. The acidic nature of HA reduces the pH of the soil, and generally, bacteria grow in the range of pH 6–7; thus, it might be the reason for the lower number of bacteria (Li *et al.* 2019). Treatment with HA has been demonstrated to be beneficial for plant growth, and researchers in China as observed that after applying HA to sweet potatoes, populations of *Firmicutes* bacteria, *Basidiomycota* fungi, and *Mortierellomycota* fungi all increased. Five treatments were employed in this analysis namely, control (C), humic acid urea, HA activator, nitrogen fertilizer weathered coal and urea (Chen *et al.* 2017).

Effect of humic acid on crop production

A form of organic material known as humic acid can be used to improve the quality of soil and enable plants to take in more water and minerals. As a consequence of this, there is a possibility that the severity of the condition will decrease as a consequence of this improvement. It's possible that the compounds could directly influence soil-borne plant diseases in humic substances. *In vitro* studies showed that the humic substance prevented the growth of *Fusarium oxysporum* species melons and lycopersici, in addition to *Alternaria alternata* and *Fusarium culmorum*. There is a possibility that the potential of humic acid to reduce the severity of diseases that affect strawberry plants is associated with the roots of the plant growing more quickly and, as a result, absorbing a greater quantity of nutrients and water (Khafagi *et al.* 2018). HA is a stable portion of carbon, which regulates and releases nutrients such as nitrogen and phosphorus, which could cause increased growth and yield metrics. This would lower the need for inorganic fertilizer for plant growth. HA stimulates the uptake of major and minor nutrients, the activation and inhibition of enzymes, enhance the activity of micro-organism in rhizosphere, improve membrane permeability and protein synthesis, and increase the biomass production. All of these processes are necessary for HA to be effective at promoting plant development (El-Ghamry *et al.* 2009).

Table 2 depicts the impact of humic acid on different crop yield. Humic acid had a substantial impact on the grain yield of black cumin (*Nigella sativa* L.) at all levels, with the maximum rate (531.24 kg/ha) obtained with humic acid treatment (3 kg/ha) and the lowest rate (398.72 kg/ha) obtained with control. The grain production improved by 33.24% when 3 kg/ha of humic acid was added to the soil (Aiyafar *et al.* 2015).

In medicinal plants *Borago officinalis* and *Cichorium intybus*, HA has positively influenced germination. Three-level of humic acid were 0, 15, and 30 g/L. The results indicated that humic acid (30 g/L) significantly influenced the plant's germination qualities, namely radical fresh weight, seedlings, and pedicle length, except for the germination % and mean germination time (Ebrahimi and Miri 2016). In chickpea, humic acid and potassium treatments significantly improved grain yield and yield attributed components. The doses of potassium (0, 10, and 20 kg/ha) and humic acid (0, 30, and 60 kg/ha) were applied. This investigation obtained the maximum seed yield (286.9 kg/ha) with a 20 kg P₂O₅ + 60 kg humic acid (Donder and Togay 2021). After being treated with HA, it was discovered that the biomass of the mung bean root increased, which may contribute to increased mineral uptake, particularly potassium. The study's findings also revealed that humic acid helps to mitigate the adverse effects of mild salt stress (50 mM NaCl) on the growth of mung bean plants as it increased the plants resistance to salinity by decreasing their sodium content. However, administration of HA in salt stress (100 mM NaCl) exhibited inconsistent results in the intake of the investigated several nutrients. It did not appear to have any prominent role in reducing the detrimental effect of salt or increasing the uptake of those nutrients. Because HA did not substantially impact Ca, Mg, Mn, or Zn, it is clear that additional research is required to fully comprehend the part that HA plays in determining the permeability of membranes (Kalyoncu *et al.* 2017). The application of 60 kg/ha of humic acid resulted in the most significant chickpea plant height of 51.7 cm.

In contrast, the application with no humic acid resulted in the least considerable chickpea plant height of 47.3 cm (Shaaban *et al.* 2009, Kahraman 2017). A two-year study compared the solid and liquid forms of humic acid on mung

beans. The result indicated that the maximal dose (60 kg/ha) increased physiological indicators such as photosynthesis, transpiration rate, total chlorophyll, stomatal conductance, and carotenoids in both years besides HA considerably increased the P and K content in mungbean (Alghabari 2020). A pot study conducted in Turkey demonstrated that among the different doses of humic acid, the range of humic acid was 1.50–0.25 mg/L. Results indicated that higher doses of HA increased, improved the root branching, root number, and root length of *Pinus mugo* and *Pinus sylvestris* (Nardi 2000).

Under an experiment on mung bean, HA were applied by three methods, i.e. seed priming (0.5, 1, 1.5 and 2%), foliar spray (0.01, 0.05 and 0.1%), and soil application (1, 2 and 3 kg/ha). Results showed that among three methods of HA application, the soil application method gave the superior value in all yield attributing characters and yield (Waqas *et al.* 2014). Treatments with the investigated amino and humic acids had an immediate and significant impact on the total yield of faba beans. When faba bean plants were sprayed with a mixture of HA (2000 ppm), there was a significant increase in the number of pods per plant as well as the weight of 100 seeds (192.94 and 25.94%) respectively. It was discovered that exposure to AA at concentrations of 3000 and 2000 ppm resulted in an increase of 21.51 and 20.24%, respectively, in the weight of 100 seeds. After treatment with amino and humic acids, as well as any of the fungicides, there is not a discernible change in the number of seeds produced by faba bean plants (El-Ghamry *et al.* 2009). Another study in Egypt demonstrated that humic acid at a high rate of 2.0 g/L generated the tallest plants and the most branches per plant in the two growing seasons of pea (El-Hak and Ahmed 2012). The incorporation of humic acid improved plant population by increasing the number of branches, which is a good indicator of correct rectangularity in plants. The adaptation of the appropriate planting geometry to a given genotype will go a long way towards making optimal use of limited growth resources and, as a result, stabilizing yields (Arya *et al.* 2020).

In comparison studies, the effects of HA were to increase the 1000-grain weight by 9–17%, the biological yield by 18–36%, the dry matter yield by 15–25%, the grain yield

Table 2 Impact of humic acid on crop yield

Crop	Humic acid dose	Grain yield	Reference
Mungbean (<i>Vigna radiata</i> L.)	3 kg/ha	72% increase in the grain yield over the control	Waqas <i>et al.</i> 2014
Rice (<i>Oryza sativa</i> L.)	6 L/ha	71.7% increase in grain yield over the control	Saha <i>et al.</i> 2013
Wheat (<i>Triticum aestivum</i> L.)	2 g/L	159.5% increase in grain yield as compared to control	Abou-Aly and Mady 2009
Chickpea (<i>Cicer arietinum</i> L.)	9 kg/ha	34% increase in seed yield over the control	Kahraman 2017
Lentil (<i>Lens culinaris</i> L.)	300 kg/ha	24.15% increase in seed yield per plant over control	Dogan <i>et al.</i> 2014
Sunflower (<i>Helianthus annuus</i> L.)	4 L/ha	6.1% increase in seed yield over control	Hatami 2017
Barley (<i>Hordeum vulgare</i> L.)	500 mg/L	54.2% increase in seed yield over control	Dulaimy and El-Fahdawi 2020

by 19–58%, and the harvest index by 3–14% (Arjumend *et al.* 2015). Foliar application of humic acid enhances the growth parameters and nutrient status in soil. Parameters include plant growth improvement, nutrient absorption by plants, also improves the yield and quality of the output of some crops. Since, humic acid enhanced the nutrient status thus, it may lead to a reduction in the amount of nitrogen, phosphorus, and potassium fertilizer used, which will, in turn, lead to a decrease in soil pollution and costs (El-Desuki 2004). Researchers in the Iranian city of Firouzkouh found that applying 3 kg of humic acid per hectare led to the highest percentage of protein production (20.48%). In contrast, the control group only produced 11.41% (using no humic acid). A total of 4.5 kg of humic acid was broadcast throughout chickpea fields at one of four distinct rates: 0, 1.5, 3 or 4.5 kg/ha (Saadati and Baghi 2014).

In Iran, Karimi *et al.* (2020) found that the combination of biochar (40 g/kg) and humic acid (500 mg/L) increased the leaf area, chlorophyll content, stem diameter, and dry shoot biomass of calendula (*Calendula officinalis* L.). Humic acid and biochar were applied at the rate of 0, 250, and 500 mg/L and 0, 20, and 40 mg/kg, respectively. The most successful treatment combination was biochar (40 mg/kg) and humic acid (500 mg/L). Humic acid concentration (9 and 12 kg/ha) increased the number of pods per plant, plant height, and yield. The pod yield per plant ranged from 29.56 (12 kg/ha) to 41.44 (9 kg/ha). Fertile pods per plant ranged from 82.09% (control) to 89.66% (12 kg/ha) in chickpeas (Kahraman 2017). The protein content of chickpea seeds ranged from roughly 17–20%, making them an essential component of a vegetarian diet (Upadhyay *et al.* 2019). Pulses are a valuable source of protein and are often referred to as “little factories” for the production of nitrogen because of their capacity to incorporate nodules, which fix atmospheric nitrogen, into their root systems. The ratio of the total number of nodules on a plant to the total amount of nitrogen present in the soil is directly proportional. The results of an experiment conducted at GBPUAT revealed that the addition of humic acid to the recommended quantity of fertilizer produced chickpeas with a much greater nodule count and a significantly higher dry weight of nodules as compared to the control (Bhatt *et al.* 2022).

Way forward

The use of humic acid might represent a step forward in the direction of sustainable agriculture. In today's agriculture, the application of fertilizer has evolved into an essential practice. Even while humic acid is not a substitute for fertilizer, it does have the ability to cut down on the quantity of the substance that is needed, which in turn helps the soil become more fertile over the course of time. Since humic acid is a naturally occurring substance, there is no trace it may leave behind in the soil or the environment. However, it will demonstrate a complementing influence on the succeeding crop. This review article will assist in determining the proper technique along with the optimal amounts of humic acid that should be applied to a certain

crop in a specific location. The production is dependent on the meteorological condition as well as the rhizospheric environment of the plants. Although we have no control over the climatic conditions, we do have control over the rhizosphere environment and may influence it by using the proper methods. In this manner, there would be a reduced risk of a low yield, and we would be able to meet the targeted yield and also help to boost the economy of the agriculture sector.

Conclusion

This review has shown that the application of HA could significantly affect crops agronomic performance in different crops, viz. plant's height, plant spread, dry matter accumulation, crop growth rate, relative growth rate, nodule count, nodule dry weight, nutrient content, yield components, yield, and quality. The effect of humic acid on soil quality parameters are also reviewed in this article, viz. soil structure, water holding capacity, bulk density, particle density, porosity, microbial activity, soil pH, electrical conductivity, NPK content, organic matter content, and cation exchange capacity. As humic acid is the organic substance that humus produces and the primary component of humus. It has a variety of qualities that contribute to the fertility of the soil. It is essential to maintain soil fertility by improving the physicochemical and biological qualities of the soil. It was discovered that using humic acid has a beneficial impact not only on the production of cereals and pulses but also on the production of fruits and vegetables. When it is applied to a variety of crops at varying levels and dosages, humic acid results in an increase in production as well as an enhancement in the quality of the soil. Its use was discovered to be useful in agricultural output, whether it was implemented in the soil or the plant itself, and via a variety of application methods, including seed treatment, soil application, and foliar application. The majority of research on humic acid is carried out in either greenhouses or pots across the world. It is essential to conduct field trials in order to determine the true potential of humic acid. The application of humic acid has delivered a quick response, in contrast to the different organic manures that are available in the market, which all act in a sluggish manner. As a result, humic acid might potentially make a substantial contribution to the practice of sustainable agriculture by lowering the amount of fertilizer that is required. Additional study in the area is necessary in order to determine the most effective strategy and the appropriate quantity of humic acid.

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