

Review Article

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Effect of Application of Humic Acid and Vermiwash on the Growth, Quality and Yield of Plants: A Review

Jatin Hudda^{1*}, Ankush Godara² and Sarvjeet Kukreja¹

¹Department of Agronomy, ²Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

*Corresponding author

ABSTRACT

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Humic acid and vermiwash play a vital role in the improvement of growth and high yield without compromising quality if supplemented with the nutrients. They are of organic origin, thus ensures sustainability and rich in essential nutrients, ensuring proper nutrition availability. The incorporation of humic acid and vermiwash is done by two ways viz. foliar application and soil amendment. The effect of these bio stimulants studied in various crops by using different methods of incorporation at different doses. This review focuses on the research done on the usage of these bio stimulants and evaluates the result of various studies for future reference and research.

Introduction

Bio stimulants are synthetic or natural substances which can be applied to soil, plants and seeds that cause change to structural or vital physiological processes to enhance plant growth by improving resistance to abiotic stresses and enhance seed or grain yield as well as quality of seeds. Bio stimulants such as humic acid and vermiwash have proven to be beneficial organic amendments to be used in the current scenario of increasing trend of organic farming. It has reduced the dependency on inorganic fertilisers in order to achieve sustainability

without compromising the quality and quantity. Humic acid is a natural resource which can be used as an alternative for inorganic fertilisers. Humic acid is a naturally existing polymeric organic compound which is converted due to decay of organic matter and initiated in humus, peat as well as lignite (Sharif *et al.*, 2002). Humic acid consist a combination of organic acids which are aromatic in nature and contain various heterogeneous functional groups that have impervious interaction with different metallic ions such as Mg, Zn, Ca and Cu (Piccolo 2012). Humic acid can be applied in both ways i.e. soil and foliar application. The soil

amendment of humic acid ensures soft, pulverized and well aerated soil with nutrient supplements. On the other hand, the foliar spray of humic acid ensures better nutrient uptake, improved permeability and photosynthetic rate. Another such bio stimulant is vermiwash which is mostly used in the form of foliar application. It contains N 0.29 %, P 0.042 %, K 0.143 %, Ca 0.186 %, Mg 0.11 %, S 0.058 %, Fe 0.466 ppm, Mn 0.406 ppm, Zn 0.11 ppm, Cu 0.18 ppm, (Anonymous, 2007). It is a transparent pale yellow to brown bio fertilizer and a mixture of excretory product and mucous secretion of earth worm (*Lampito mauritii* and *Esenia foetida*) and organic micronutrients of soil, which may be promoted as a potent bio fertilizer for better growth and yield (Shweta *et al.*, 2005). Vermicompost wash is having approximately 1300 ppm humic acid, 116 ppm dissolved oxygen, 50 ppm inorganic phosphate, 168 ppm potassium and 121 ppm sodium (Haripriya and Pookodi, 2005). Due to these diverse constituents vermiwash is mostly suited for every plant for better growth and yield. The main aim of this review is to determine the effects of these bio stimulants individually and with combination with other applications on various crops as researched by various researchers.

Effect on physiological parameters

Physiological parameters such as leaf nutrient, total chlorophyll content, photosynthetic rate, stomatal conductance, transpiration rate determine the inner wellbeing of the plant and proper functioning of the physiological processes of the plant. A comparative study conducted to check the impact of foliar and soil applied humic acid on quality and yield of pepper evaluated the total chlorophyll content and suggested that the maximum value was achieved at soil application of 20ml/litre and 22% HA followed by foliar based application at same

rate (Karakrut *et al.*, 2009). The effect of application of humic acid showed on the pepper fruit as increase in chlorophyll content lead to increase in the green colour. The change in total chlorophyll is caused by the fluctuation in chlorophyll b concentration as no remarkable change was observed in chlorophyll a content under the influence of humic acid (Karakurt *et al.*, 2009).

In another research on soil based application of humic acid and foliar spray vermicompost leachate was used for improving the productivity and quality of mango in North Sanai. It was observed that humic acid (40ml/tree) and vermicomposting leachate (15%) gave the highest total chlorophyll content and leaf mineral nutrition (N, P, K%) and thus this dose is recommended (Sheren A. Abd El-Hamied, 2018).

Humic acid (8%) when applied as soil treatment in drip lines on kinnow mandarin at different stages in different doses showed that maximum photosynthetic rate (97%) when applied in triplicate dose of 13.3ml/plant, maximum stomatal conductance (61%) and transpiration rate (57.23%) when applied in triplicate dose of 26.6ml/plant, and highest total chlorophyll content (53%) when applied in triplicate dose of 20ml/plant were observed (Abbas *et al.*, 2012).

In another study to check the accumulative effect of humic acid and multi nutrient fertiliser it was observed that treatment containing 80ml of 10% humic acid and multi nutrient fertiliser when applied in three split doses showed maximum leaf nutrient content (N-24.1%, P-31.8%, K-60.1%), highest total chlorophyll content (26.9%), highest photosynthetic rate (46%), highest stomatal conductance (44.2%), and highest transpiration rate (32.3%) (Hameed *et al.*, 2018).

Total chlorophyll content and leaf nutrients (NPK) were estimated to be highest in case of foliar application of vermicompost wash (400ppm) to check the effectively in vermicompost wash treated groundnut (Hiradeve *et al.*, 2011).

Further in another experiment, total chlorophyll content and nitrogen content in soybean leaves were found maximum in treatment containing 200 ppm vermivash in a comparative study of vermivash and cow dung foliar sprays on biochemical and yield parameters of soybean (Lende *et al.*, 2007). These various studies showed the significant positive effects of humic acid and vermivash on different crops in context to improvement of physiological parameters.

Effect on nutrient uptake

The uptake of nutrients is essential for the utilisation of nutrients for growth of the plant and therefore there is a need to study the variation in nutrient uptake when bio stimulants such as humic acid are applied with the nutrients. One such study focused on the behaviour of nutrient uptake in maize under calcareous soils and studied the uptake of various nutrient viz. Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Iron, Copper, Zinc, Manganese, Sodium and observed that highest copper and sodium uptake was at 0.1% concentration of humic acid, while for other nutrients the uptake was highest at 0.2% concentration of humic acid except manganese which had negative impact of humic acid (Celik *et al.*, 2010).

In another study carried on Gerbera, Nutrient uptake was studied at varied concentration of humic acid applied along with nutrient solutions and results revealed that nitrogen uptake can increase by 40%, P content by 32% at 1000mg/litre humic acid, and Mg, Ca, Fe, Zn content by 157%, 585%, 49%, 10%,

respectively, at 500mg/litre concentration of humic acid (Nikbakht *et al.*, 2008).

Effect on vegetative parameters

Vegetative parameters such as plant height, leaf area, stem girth, number of leaves per branch etc. decide the growth of the plant which ultimately has a direct effect on the yield and quality of the produce. In a research conducted to check the effects of humic acid through vermivash and NAA on various parameters of chick pea, it was observed that 50 ppm NAA + 400 ppm humic acid through vermivash showed maximum leaf area per plant at 45, 65, 85 days (Kapase *et al.*, 2014). The study showed the concentrations at which the vermivash combined with NAA resulted in maximum leaf area per plant. In another study on soil based application of humic acid and foliar spray of vermicompost leachate for improving the productivity and quality of mango, it was evaluated that humic acid (40ml/tree) and vermicompost leachate (15%) gave the highest leaf area (Sheren A. Abd El-Hamied, 2018). Evaluation of leaf area has significant importance as more leaves will directly account for the increased photosynthetic rate of the plant.

A study was conducted to check the accumulative effect of humic acid applied to the soil with irrigation with multi nutrient fertiliser sprayed at kinnow plant in different concentrations and intervals. It suggested that vegetative attributes like plant height, stem girth, leaves per branch and canopy volume increased with the increased concentration and found the increase of plant height (32.2%), stem girth (77.2%), canopy volume (15%) was maximum at 80ml of 10% humic acid and multi nutrient fertiliser when applied in three split doses (Hameed *et al.*, 2018). In the above study the effect of humic acid was supplemented with the application of the multi nutrient fertilizer and less effective

individually, thus suggesting the role of humic acid as a synergist and stimulant. Another such example of cumulative effect of humic acid with other supplements is based on the research conducted in strawberry to study the effect of compost, amino acids and humic acids on yield and growth which suggested that plant length of strawberry was maximum (12.53cm) at treatment containing ½ dose of mineral fertiliser (control) + ½ compost (2ton/fed) + humic acid spray (1g/litre) + amino acid foliar spray (2ml/litre) and number of leaves varied insignificantly (Shehta *et al.*, 2011).

Effect on yield and yield contributing parameters

Yield is the end requirement from any crop and yield is determined in terms of various parameters like for fruits it is number of fruits / tree, and for grains or pulses it is determined in terms of number of pods / plant, 100 seed weight and seed yield / ha, and for some crops it is in terms of dry matter. The yield component is important to consider as it is the component which finally decides the profitability of cultivation of a crop. Maximum number of pods /plant, 100 seed weight and seed yield/ha were observed in treatment of 50ppm NAA+400ppm humic acid through vermiwash in a study on the effect of foliar spray of vermiwash and NAA on chickpea (Kapase *et al.*, 2014). Another research carried on forage turnip for the study of effect of humic acid applied at different time in different concentration on dry matter yield suggested that maximum root and leaf dry matter yields were obtained at 1200ml/ha humic acid concentration applied after 1 month of sowing onto the leaves (Albayrak *et al.*, 2005). In another study on soil based application of humic acid and foliar spray of vermicompost leachate for improving the productivity and quality of mango, it was evaluated that humic acid (40ml/tree) and

vermicompost leachate (15%) gave the highest fruit set, fruit retention and overall yield of mango (Sheren A. Abd El-Hamied, 2018). In other study carried on kinnow mandarin to know the effects of humic acid at different stages with different doses, results revealed that application of humic acid in three split doses of 26.6ml/tree resulted in highest number of fruits/tree and reduced the fruit drop percentage by 19% (Abbas *et al.*, 2013). This finding suggests that application in split doses seems to be more beneficial rather than single dose. Another similar study conducted to check the accumulative effect of humic acid applied to the soil with irrigation in addition with multi nutrient fertiliser sprayed at kinnow plant with different concentrations and intervals suggested that on application of 80ml of 10% humic acid and multi nutrient fertiliser when applied in three split doses viz. Feb, March and August resulted in 38.7% increase in fruits/plant, 22.2% increase in fruit set/branch and 5.2% reduction in fruit drop (Hameed *et al.*, 2018).

Vermiwash spray when applied at the rate of 400ppm in groundnut proved to increase shelling percentage and increase kernel recovery from 85.33% in control to 95.33% (Hiradeve *et al.*, 2011). Similar results were reported in soybean where 200ppm vermiwash spray was found to result in increase in dry pod weight/plant and yield/ha (Lende *et al.*, 2007). In another study with tomato plants were subjected to soil application and foliar spray of 10 and 20ml/litre 23% humic acid. It was observed that foliar sprayed humic acid @ 20ml/litre gave the highest yield in both the seasons (Ertan Yildirim, 2007).

Effect on biochemical parameters

Biochemical parameters like total soluble salts, titratable acidity, total sugars, anthocyanin content, protein content, oil

content etc. determine the quality of the produce. In case of fruits, the biochemical parameters are of the utmost importance as they determine the inner quality of fruits. Humic acid and vermiwash applications have showed significant positive changes in these attributes. The TSS and reducing sugars in pepper were highest in soil applied humic acid @20ml/litre concentration in a comparative research of soil and foliar application of humic acid in case of pepper (Karakurt *et al.*, 2009). Humic acid (8%) when applied as soil treatment in drip lines on kinnow mandarin at different stages in different doses showed that plants treated with 20ml/plant humic acid in three stages reported maximum increase in TSS(17.84%) and maximum decline in acidity (21.91%), while ascorbic acid increased (22.96%) by 13.3ml/plant HA and total sugar increased by 21.34% by 26.6ml/plant humic acid in three split doses (Abbas *et al.*, 2012). This showed that a minor variation in the dosage of humic acid can have positive or negative effects on various biochemical parameters.

In another study cumulative effect of humic acid applied to the soil with irrigation in addition to multi nutrient fertiliser sprayed at kinnow plant in different concentrations and intervals suggested that 80ml of 10% humic acid and multi nutrient fertiliser when applied in three split doses resulted in 41% decrease in total titratable acidity as compared to control, 27.6% increase in vitamin – C content, 20.8% increase in TSS and 20.3% increase in total sugars (Hameed *et al.*, 2018). This suggested major improvement in quality of fruits when application of nutrients is supplemented with humic acid. The oil content in groundnut increased from 45.05% in control to 48.80% in 400ppm vermiwash foliar spray (Hiravede *et al.*, 2011). Similarly, protein and oil content in soybean increased significantly by the application of 200ppm vermiwash foliar spray (Lende *et al.*, 2007).

Thus, the case studies suggested that the humic acid and vermiwash supplementation play an important role in improving the quality of the produce by influencing the biochemical factors.

In conclusion it is clear from the literature cited that humic acid and vermiwash play positive role in enhancing the growth and yield of different crops by influencing various biochemical and physiological attributes either alone or in synergism. The difference between the effect of soil and foliar application is minimal and mostly foliar application gives the best results. The use of these bio stimulants is limited to some crops and need to be widely adapted to other crops mostly in fruits to increase productivity and quality.

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