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Original Research Article

Mungbean Yield and Nutrients Content as Affected By Coal and Plant Based Humic Acid Application

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Abstract

Soil health Index demands organic fertilizer usage may be imperative couple with chemical fertilizers. Mungbean (*Vigna radiata*) yield and nutrients content were studied during kharif 2019 through coal and plant based humic acid (HA) application at NARC. The plots were arranged in randomized complete block design (RCBD). Results indicated that application of HA couple with chemical fertilizers significantly improved mungbean yield and nutrients content. HA at 15 kg ha^{-1} along with 50 kg ha^{-1} DAP recorded the highest grain yield (0.79 t ha^{-1}) that is 14.4% more than the control (0.69 t ha^{-1}) receiving 100% DAP application alone. The highest concentration of P (0.34 %), K (3.7%) and N (3.65%) in whole shoot mungbean were observed in the treatment where HA was applied at 15kg ha^{-1} along with 50 kg ha^{-1}DAP. Residual organic matter improved by 0.06%. Based on findings of this study it can be suggested that HA couple with inorganic fertilizer application have significant effect on grain yield and nutrients content of N and P. It showed that HA mayenhanced NO_3 and P availability through chelation and reduce soil P fixation.

Keywords: Mungbean, Nutrients, Humic Acid.

INTRODUCTION

Soil health is major concern in soil fertility scenario. This imbalance fertilizers use continuously damaging biological and physical properties of soil as well as nutrients and organic matter bioavailability, which result in low crop yield [1].Owing to the ever increasing cost of inorganic chemical fertilizers, the organic fertilizers like humic acid has become imperative for sustained crop production and maintenance of soil health [2]. Commercial Humic acid is a rich source of many essential nutrients including, 6-8% hydrogen, 46-42% oxygen, 44-58% carbon and 4-5%, Nitrogen, as well as many other nutrients which encourage plant growth [3]. Humic acid when applied to field converted into readily available humic substances which directly or indirectly effect the plant growth [3]. It was reported that humic substances promote the activity of PGPR to induce the growth promoting hormones in rhizospheric zone and these hormones increase the efficiency of roots to transport water and nutrients from soil solution to plants El-Hassanin*et al*. [4]. Humic acid also act as natural antioxidant. Its presence in plant tissues affects many biochemical processes by increasing nutrient uptake and maintaining levels of amino acids and certain vitamins [5]. It was also concluded that addition of humic acid mayreduce the requirement of primary macronutrients (N, P and K) at optimal growth [6]. Xi *et al*. [7] also observe the stimulatory effect on plant micro and macronutrient uptake due to humic acid application. Keeping the declining soil fertility, ever increasing fertilizer costs and continuous increasing demand for more food the current study was initiated. The current study aimed at applying HA along with chemical fertilizers to enhance mungbean productivity.

Table-1: Physico chemical soil characteristics

Soil characters	Unit	Values
Textural Class	Clay loam	
pH	----------	7.80
EC (1:1)	(dS m^{-1})	0.34
Organic Matter	(%)	0.51
NO_3-N	(mg kg^{-1})	2.41
K	(mg kg^{-1})	109
P	(mg kg^{-1})	1.31

MATERIALS AND METHODS

A field experiment was conducted during 2019 at pulses program, National Agricultural Research Institute (NARC) Islamabad.The latitude and longitude of Islamabad is 33° 42' N, 73° 10 E'. Treatments were assigned according to RCBD design to see the effect of humic acid application. Humic substances derived from coal have characteristics of pH 7.8, EC 0.94 and OM 68% N, P and K were 3.40, 0.15 and 3.42% respectively. Humic substances derived from plant have characteristics of pH 7.8, EC 0.78 and OM 3.2% P and K were 0.20 and 0.5% respectively The treatments were: Recommended Dose DAP (50 kg ha^{-1} HA1: Control (No humic acid) HA2: plant derived HA @7.5 mg Kg^{-1} HA3: plant derived HA @ 15 mg Kg^{-1}HA4: coal derived HA @ 15 Kg ha^{-1} HA5: coal derived HA @ 30 Kg ha^{-1}. The composite soil samples were collected before experiment; air dried; sieved (2 mm). Plant samples were analyzed for NO3, availableP andsoluble K adopting standard analytical methods. The data thus obtained were subjected for statistical analysis using Statistic 8.1 package. The basic physical and chemical characteristics of soil under investigation were analyzed as described by ICARDA [8] standard methods and presented in table1. Soil texture class was determined according to hydrometer method as described by Bouyoucos [9]. Soil pH and ECe (1:1 soil to water ratio) were measured using digital pH/EC meter. Plant samples collected for N, and P concentration in plant tissues were dried in oven at 60ºC till constant weight. Ground plant samples were digested in perchloric-nitric acid (2:1 1N) mixture [10]. Total nitrogen in mung bean was determined by the Kjeldahl procedure as described by Bremner and Mulvaney [11]. Soil samples were determined by AB-DTPA method as described by Soltanpour and workman [12]. The data thus obtained were statistically analyzedaccording to Gomez and Gomez [13].

RESULTS AND DISCUSSIONS

Humic acid application on grain yield (Figure 1) showed that coal based HA at 30 kg ha^{-1} along with 50 kg ha^{-1} DAP recorded the highest grain yield 0.79 t ha^{-1} that is 14.4% more than the treatment receiving 50 kg ha^{-1} DAP application alone. It was followed 0.75 t ha^{-1} the treatment receiving plant based HA at 15 mg kg^{-1}. Maximum yield statistically same with HA application 15 kg ha^{-1} Similar findings have been reported by [14]. Gao *et al.* [15] and Akhtar *et al.* [16] that humic acid significantly enhance root and shoot elongation and yield mung by activating the hormonal activity It is concluded that HA have significant effect on grain yield on mungbean by enhancing nutrients availability and reducing the P fixation and increases its availability through chelation effect. Therefore, increased availability of nutrients and its uptake confirmed the soil fertility improvement by humic acid addition at 15 kg ha^{-1}

Humic acid application on bio mass (Figure 2) showed that HA at 15 kg ha^{-1} along with 50 kg ha^{-1} DAP recorded the highest bio mass 1.7 t ha^{-1} that is 20% more than the treatment receiving 50 kg ha^{-1} DAP application alone. Similar findings have been reported by [14]. Gao *et al.* [15] and Akhtar *et al.* [16] that humic acid significantly enhance root and shoot elongation and yield mung by activating the hormonal activity It is concluded that HA have significant effect on grain yield on mungbean by enhancing nutrients availability and reducing the P fixation and increases its availability through chelation effect. Therefore, increased availability of nutrients and its uptake confirmed the soil fertility improvement by humic acid addition at 15 kg ha^{-1}.

Nitrate content in the soil were affected with the interaction of HA, and DAP application. The highest concentration (3.1 mg kg^{-1}) was found with the application of HA at 30kg ha^{-1}along with 50 kg ha^{-1}DAP. It was statistically at par with HA 15 kg ha^{-1} application. An increase of 40% higher than In comparison to 100% DAP application alone (Figure 3). It was followed by the treatment at HA at 15 mg kg^{-1}. It shows that HA application significantly reduces the unease activity led to reduce the losses of N volatilization as described by Vaughan and Ord [17]. Similar findings have been reported by Xi *et al.* [7] and [8].

Phosphorus content in the soil was positively affected with the interaction of HA, and DAP application. The highest concentration of soil P (1.37 mg kg^{-1}) was recorded with the application of HA at 30kg ha^{-1}along with 50kg ha^{-1}DAP (Figure 4). However, it was statistically at par with the applicationof HA at 15kg ha^{-1}along with 50kg ha^{-1}DAPapplication. It shows that HA and application significantly reduces the phosphorus fixation and increases its availability through chelation effect. This is in consonance with the findings of David *et al.* [19] who reported slow and continuous dissolution of phosphate minerals in soil by HA increased P availability. The soil phosphates activity improved by humic acid might have resulted in increased P availability as phosphatase hydrolyses the phosphate esters into inorganic phosphorus Malcolm and Vaughan [17]. Heng [20] reported that HA reduces P soil fixation and hence increased P availability.

Nitrogen in mungbean plant was positively affected by HA Data showed that mungbean plant N content was increased both with HA application (Figure 5). The highest N concentration (3.65%) was observed with the HA application at 30kg ha^{-1}along with 50 kg ha^{-1} DAP and statistically at par withHA application at 15kg ha^{-1} along with 50 kg ha^{-1}DAP Similar findings have been reported Samson and Visser [21] that the increased N uptake was supposed to be due to the better use efficiency of applied N fertilizers in the presence of humic acid coupled with retarded nitrification process enabling the slow availability. It was reported that humic substances promote the activity of PGPR to induce the growth promoting hormones in rhizospheric zone and these hormones increase the efficiency of roots to transport water and nutrients from soil solution to plants [4].

Treatments significantly improved the P content in whole shoot mungbean plant at flowering stage. Results show that the highest concentration of P in mungbean (0.34%) was observed in with HA application at 30kg ha^{-1} along with 50kg ha^{-1}DAP (Figure 6). However it was statistically at par with the treatment and it is at par with the applicationof HA at 15kg ha^{-1}along with 50kg ha-1 DAP. The increase in P uptake ascribed to low soil P fixation and or formation of humophospho complexes, which are easily assimilable by the plants [22]. The HA application with P fertilizer significantly increased the amount of water-soluble phosphate and strongly retard the formation of occluded phosphate, and increased P uptake by plants Wang *et al.* [23]. Xi *et al.* [7] also observe the stimulatory effect on plant micro and macronutrient uptake due to humic acid application. HA fertilizers enhanced the uptake and utilization of N, P and K by plants compared to inorganic fertilizers [8, 24].

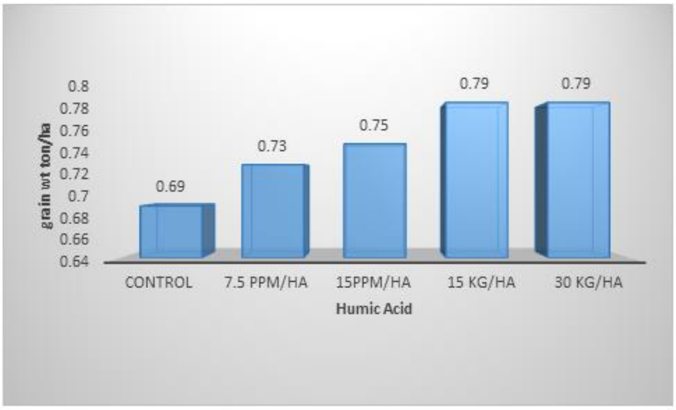

Fig-1: Mungbean yield as affected by coal and plant based HA

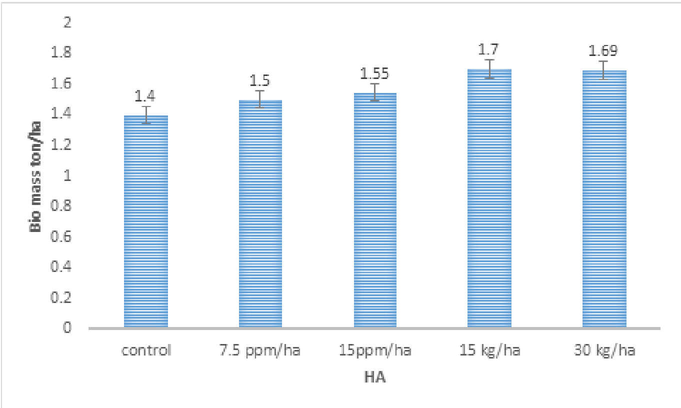

Fig-2: Mungbean bio mass as affected by coal and plant based HA

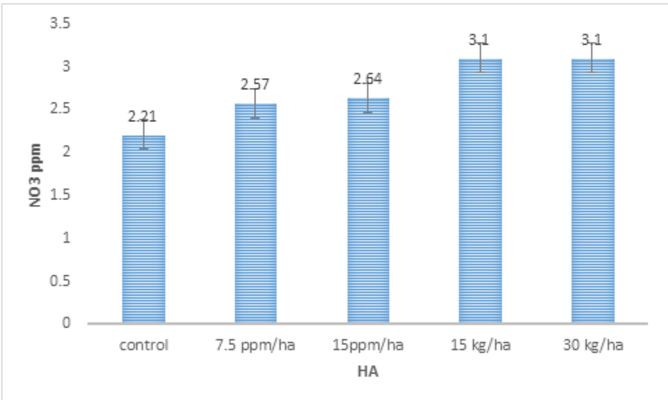

Fig-3: Residual soil NO_3 as affected by coal and plant based HA

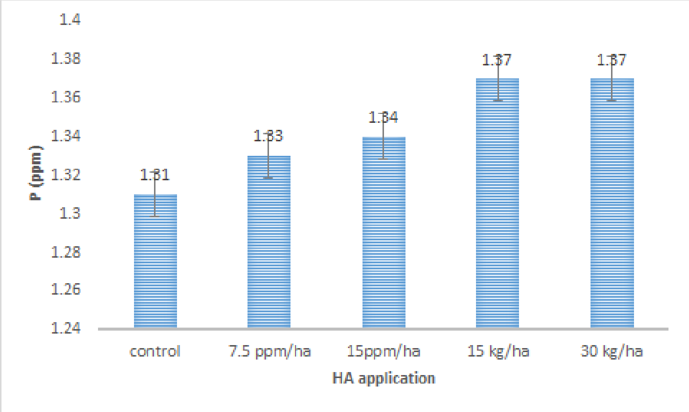

Fig-4: Residual soil available P as affected by coal and plant based HA

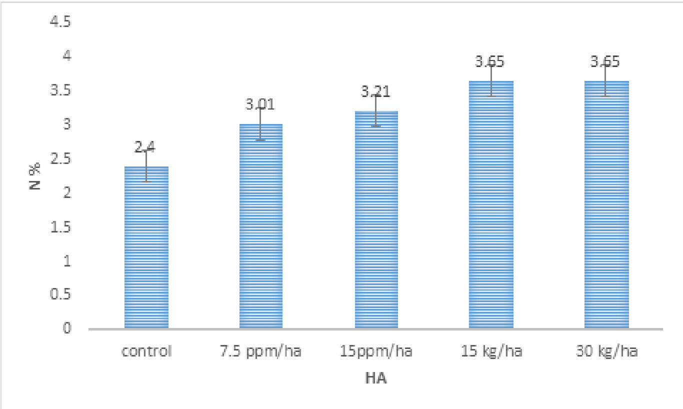

Fig-5: Plant N % as affected by coal and plant based HA

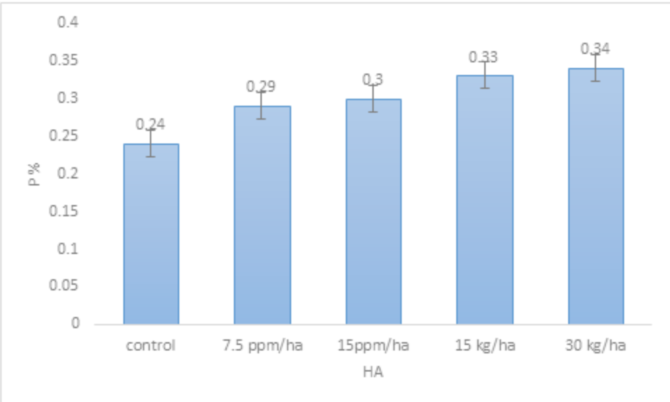

Fig-6: Plant P % as affected by coal and plant based HA

CONCLUSION

The combined effect of coal based HA at 15 Kg ha^{-1}along with 50 Kg ha^{-1} DAP has registered not only the maximum mungbean yield (0.79 ton ha^{-1}) and also maximum uptake of N and P nutrients. It may be concluded that humic acid couple with inorganic fertilizer can help to improve mungbean productivity. It is also recommended more field studies may be conducted to further assess HA application for dissemination and adaptation in future.

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