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Research Article

Effect of Humic acid levels on fodder production of maize (*Zea mays*) varieties under agro-climatic conditions of Tandojam-Sindh Pakistan

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Abstract

In Pakistan, maize is the fourth largest grown crop after wheat, cotton, rice and is considered as fodder for livestock as well. There are various reasons for low productivity of this crop which includes low soil organic matter (O.M). Chemical fertilizers indiscriminate utilization disturbs the soil tithe and its chemical composition which caused in reduction plant yield. Hence to overcome the problem of this low fertility, humic acid is strongly recommended throughout the world. Hence and research experiment was conduct as student's Agronomy experimental farm, at Sindh Agriculture University Tandojam, Pakistan during the year 2017 on humic acid levels effect on fodder production of maize *(Zea Mays)*. The experiment was designed by following the randomize complete block design (RCBD) with net plot size 3 by 4 m (12 m.seq). The experiment comprises of the recommended dose of NPK and various levels of humic acid such as HA1 = Untreated, HA2 = 2 kg ha-1, HA3 = 3 kg ha-1 and HA4 = 4 kg ha-1. The results of our study showed that significant effect on different levels of humic acid on the different varieties of maize crop. The results revealed that the application of humic acid @4Kgha-1 gave maximum yield and better growth of maize varieties as compared to lower levels of humic acid application where as in varieties Akbar and Sadaf produced maximum fodder yield than variety Neelum in response to humic acid application.

Keywords: Fodder production; Humic acid levels; Maize (*Zea mays* L.)

Introduction

Maize (*Zea mays* L.) belongs to the family *Poaceae.* The mentioned crop one of the most prevailing cereal crops of the world. Is a chief multi-use and utilised as food, feed, fodder, fuel and an industrial products [1]. Maize is additionally an imperative oat harvest of Pakistan and it is progressively ahead a vital status in product cultivation due to its higher yield potential in short period of time. Maize having 6.4 % of the aggregate grain generation in the nation, and possesses an uncommon status in the economy of nation, as it is great well-spring of nourishment and encourage livestock feeding. Maize has taken considerable value on this earthy planet regarding its grub and grain value importance [2]. Grain lack is viewed as a noteworthy constraining element in the advancement in animal's husbandry industry in Pakistan and this matter remained documented lengthy prior in the food asset report [3]. In this condition, vertical development of maize creation could be accomplished by most extreme expanding grub and seed yield per unit territory [4]. Maize donates 2.2 % to the quality included agribusiness and 0.5 % to gross domestic product (GDP), in Pakistan. The area of maize was 1117 hectares in 2013-14, expanded by 5.4 % over going before 2012-13; while the production among this year was 4527 tons recommending an increment of 7.3 % in the course of the most recent year. The yield ha^{-1} in the year of 2013-14 was 4053 kg ha^{-1} which showed positive development of 1.8 % over going earlier 2012-13 where [5]. Crop creation is the premise of particular additions for humanoid life which relies upon measure in reachable supplement of soil. To augment natural substance in soils for developing harvests, there are a few applications, for example pivot plantation different furrow procedures green manure application and creature compost application. Not with standing these practices, use of natural mineral manures in farming has expanded as of late [6]. Many scientists suggested that the use of organic matter along with chemical fertilizers can give the higher grains yield than obtained with artificial chemical fertilizers alone [7]. Pakistani soils has less than 5 % organic matter which can be mended by the application of composts and organic matters [8]. Natural fixation of soil is demonstrated the yield elevation and its segments in oats and in addition soil air circulation, soil thickness and boosting water holding limit of soil for seed germination and plant root encroachment [9]. Availability of natural matter in soil diminishes the dirt temperature and mitigates saltiness impact and build dampness preservation and as result animates crop enlargement and quality [10]. To oversee enriching so as to farm generation in adverse soil situations their natural matter, different choices found in writing e.g. crop turn green, fertilizers deposit creature excrements consolidation, blood feast, fish dinner, vermin manure and humic corrosive application. Every one of these choices fundamentally plan to enhance soil conditions for development and nature of the yield [11, 12], have reported humic acid valuable impacts on plant development, its mineral composition, germination, root initiation and its development, seedling development, young branch improvement and the uptake of large scale and micro-elements notwithstanding the case that 1 kg humic acid corrosive can substitute for 1-ton excrement [13, 14], the shown that humic substances may balance a biotic anxiety e.g. temperature, pH value, and saltiness improving the uptake of supplements and diminishing the uptake of some noxious components. Humic matter formation is carried out by the natural humification of plant's and animal's matter and the microorganism's regular activities. The humic substances impact on plant's improvement depend upon obsession, and in

addition on the sub-atomic part weight of humus. Lower atomic size division effectively achieves the plasma lemma of plant cells, deciding a constructive outcome on plant development, and also a future impact the level of plasma layer, the supplement uptake, particularly nitrate. The impacts on go-between digestion system are less seen, yet it appears that humic substances may impact both breath and photosynthesis [15]. Humic substances affect the development of plant roots. At the point when humic acids and folic acids are connected to the dirt, improvement of root start and expanded root development may be watched [16]. Therefore keeping in view the economical importance of the maize crop and the potential value of humic acid, its capacity to improve soil fertility and crop yield the present studies were planned to observe the effect of different levels of humic acid on the growth and yield of maize crop.

Materials and methods

The field experiment was conducted during year of 2017 with three replicated randomized complete block design (Factorial) having net plot size of 3 by 4 m (12 m.seq) Hence an research experiment was conduct as student's Agronomy experimental farm. Sindh Agriculture University Tandojam, Pakistan during the year 2017. Three maize varieties (Akbar, Sadaf, Neelum) were sown. The three different types of fertilizers i.e single super phosphate (SSP), urea and muriate of potash (MOP) was used according to their respective recommended doses. When seedbed was prepared then humic acid, Phosphorus, Potassium and half of the Nitrogen was applied at the time of sowing. The remaining half of nitrogen was divided into two splits and applied at second and third irrigation, respectively. All other cultural practices were performed in all the plots uniformly and the observations on the following parameters were recorded on the basis of five randomly selected plants in each treatment. The seed of three maize varieties (Akbar, Sadaf, Neelum) were sown by means of single coulter hand drill.

Statistical analysis

The data was recorded on the regular intervals the collected data was statistically analyzed. All yield parameters was examined during the research study were significantly ($P<0.5$) as affected by the application of different levels of humic acid.

Results and discussion

Plant population (m^2)

The results for plant population (m^2) of Maize varieties as affected by various levels of humic acid presented in table 1. The application of different levels of humic acid showed the significant effect on the growth of plant population of maize crop.[17], results showed that the maximum plant population (19.4 m^2) was recorded humic acid @ 4kg ha^{-1} however the minimum plant population (12.6 m^2) was noted in control plots. In case of varieties the maximum plant population (17.5 m^2) was recorded in variety Sadaf, the minimum plant population (15.2 m^2) was recorded in variety Akbar. [18]. In case of interaction the maximum plant population (22.6 m^2) was recorded at 4kg ha^{-1} humic acid x variety Sadaf and the minimum plant population (12.2 m^2) was recorded under the interaction of control x variety Sadaf respectively.

Plant height (cm)

The results of plant height (cm) of Maize varieties as affected by various humic acid levels presented in table 2. The application of different levels of humic acid showed the significant effect on the growth of plant height of maize crop. The results showed that the maximum plant height (127.1 cm) was recorded with the application of humic acid @ 4kg ha^{-1} however the minimum plant height (63.9 cm) was noted in control plots [19]. In case of varieties the maximum plant height (108.6 cm) was recorded in variety Akbar and the minimum plant height was

recorded (93.4 cm) in variety Akbar. In case of interaction the maximum plant height (133.4 cm) was recorded at 4kg ha^{1} humic acid x variety Akbar and the minimum plant height (19.2 cm) was recorded under the interaction of control x variety Sadaf respectively.

Table 1. Plant population m^2 of Maize varieties as influenced by different humic acid levels

Humic acid levels	Varieties			Mean
	Akbar	Sadaf	Neelum	
Control (Untreated)	13.2	12.2	12.2	12.6 B
Recommended NPK+ HA 2Kg ha^{-1}	14.3	16.2	15.3	15.7 AB
Recommended NPK+ HA 3Kg ha^{-1}	15.6	19.3	18.2	18.3 A
Recommended NPK+ HA 4Kg ha^{-1}	17.7	22.6	21.3	19.4 A
Mean	15.2 C	17.5 A	16.7 B	

SE 1.4175
LSD 0.05; 3.9369

Table 2. Plant height (cm) of Maize varieties as influenced by different humic acid levels

Humic acid levels	Varieties			Mean
	Akbar	Sadaf	Neelum	
Control(Untreated)	83.5	19.2	89.2	63.9 D
Recommended NPK+ HA 2kg ha-1	104.2	106.2	101.6	104.0 C
Recommended NPK+ HA 3kg ha-1	113.3	117.6	115.3	115.4 B
Recommended NPK+ HA 4kg ha-1	133.4	130.6	117.4	127.1A
Mean	108.6 A	93.4 C	105.8 B	

SE 0.0972
LSD 0.05; 0.2700

Leaves plant^{-1}

The results for leaves plant^{-1} of Maize varieties as affected by various levels of humic acid presented in table 3. The application of different levels of humic acid showed the non-significant effect on the growth of plant height of maize crop. The results showed that the maximum leaves plant^{-1} (15.5) was recorded with the humic acid @ 4kg ha^{-1} however the minimum leaves plant^{-1} (7.5) was noted in control plots. In case of varieties the maximum leaves plant^{-1} (11.7) was recorded in variety Neelum and the minimum leaves plant^{-1} (11.4) was recorded in variety Akbar. In case of interaction the maximum leaves plant^{-1} (16.5) was recorded at 4kg ha^{-1} humic acid x variety Sadaf and the minimum leaves plant^{-1} (7.1) was recorded under the interaction of control x variety Akbar respectively [20].

Stem girth (cm)

The results for stem girth (cm) of Maize varieties as affected by various levels of humic acid presented in table 4. The application of different levels of humic acid showed the significant effect on the growth of stem girth of maize crop [21]. The results showed that the maximum stem girth (10.2 cm) was recorded with the humic acid @ 4kg ha^{-1} however the minimum stem girth (6.5 cm) was noted in control plots. In case of varieties the maximum stem girth (8.9 cm)

was recorded in variety Sadaf and the minimum stem girth (7.7 cm) was recorded in variety Akbar. In case of interaction the maximum stem girth (10.2 cm) was recorded at 4kg ha^{-1} humic acid x variety Neelum and the minimum stem girth (5.4 cm) was recorded under the interaction of control x variety Akbar respectively [22].

Table 3. Leaves plant^{-1} of Maize varieties as influenced by different humic acid levels

Level of humic acid	Varieties			Mean
	Akbar	Sadaf	Neelum	
Control (Untreated)	7.1	7.3	8.3	7.5 D
Recommended NPK+ HA 2kg ha^{-1}	11.4	10.4	10.2	10.7 C
Recommended NPK+ HA 3kg ha^{-1}	12.2	12.2	13.2	13.2 B
Recommended NPK+ HA 4kg ha^{-1}	15.0	16.5	15.2	15.5 A
Mean	11.4 A	11.6 B	11.7 C	

SE 0.1310
LSD 0.05; 0.3637

Table 4. Stem girth (cm) of Maize varieties as influenced by different humic acid levels

Level of humic acid	Varieties			Mean
	Akbar	Sadaf	Neelum	
Control (Untreated)	5.4	8.8	5.4	6.5 C
Recommended NPK+ HA 2kg ha^{-1}	7.2	7.3	7.4	7.3 BC
Recommended NPK+ HA 3kg ha^{-1}	8.2	9.3	9.1	8.9 AB
Recommended NPK+ HA 4kg ha^{-1}	10.1	10.3	10.2	10.2 A
Mean	7.7 B	8.9 A	8.7 A	

SE 0.7878
LSD 0.05; 2.1880

Fodder yield (kg ha$^{-1)}$

The results for fodder yield (kg ha^{-1}) of Maize varieties as affected by various levels of humic acid presented in table 5. The application of different levels of humic acid showed the significant effect on the growth of fodder yield (kg ha^{-1}) of maize crop. The results showed that the maximum fodder yield (27960kg ha^{-1}) was recorded with the humic acid @ 4kg ha^{-1} however the minimum fodder yield (17669kg ha^{-1}) was noted in control plots [23]. In case of varieties the maximum fodder yield (24506kg ha^{-1}) was recorded in variety Sadaf and the minimum fodder yield (20437kg ha^{-1}) was recorded in variety Neelum. In case of interaction the maximum fodder yield (30862kg ha^{-1}) was recorded at 4kg ha^{-1} humic acid x variety Akbar and the minimum fodder yield (16762kg ha^{-1}) was recorded under the interaction of control x variety Akbar respectively.

Table 5. Fodder yield (kg ha^{-1}) of Maize varieties as influenced by different humic acid levels

Humic acid levels	Varieties			Mean
	Akbar	Sadaf	Neelum	
Control (Untreated)	16762	18575	17668	17669 D
Recommended NPK+ HA 2kg ha^{-1}	20994	20132	19625	20250 C
Recommended NPK+ HA 3kg ha^{-1}	27212	28837	21918	25989 B
Recommended NPK+ HA 4kg ha^{-1}	30862	30479	22537	27960 A
Mean	23958 A	24506 A	20437 B	

SE 396.05
LSD 0.05; 995.17

Conclusion

It is concluded that the application of 4 kg humic acid provided maximum yield and better growth of maize varieties as compared to lower levels of humic acid application where as in varieties Akbar and Sadaf produced maximum fodder yield kg ha^{1} than variety Neelum in response to humic acid application.

Author's contributions

Design & idea the experiments: T Aziz & AQ Gola, Performed the experiments: MA Mahesar & MS Mastoi, implement the experiments: AN Domki, B Ali, M Kashif, M Khan & T Aziz, contributed reagents/ materials/ analysis tools: AQ Gola & T Aziz, MA Korejo, wrote the paper: AQ Gola.

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