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

Tariq Aziz¹, Abdul Qadir Gola²*, Muhammad Ali Mahesar³, Abdul Nabi Domki⁴, Barkat Ali⁵, Muhammad Kashif⁶, Mohammad Saleem Mastoi³, Mitha Khan⁷ and Manthar Ali Korejo⁸

¹. Pakistan Tobacco Board Government of Pakistan-Pakistan
². Department of Horticulture Sindh Agriculture University Tandojam, 70060-Pakistan
³. Department of Agronomy Sindh Agriculture University Tandojam, 70060-Pakistan
⁴. Research Institute (A.R.I), Sariab, Quetta, Balochistan-Pakistan
⁵. Department of Agronomy Agriculture College, Quetta Balochistan-Pakistan
⁶. Directorate of Vegetable Seed Production Agriculture Research Institute ARI Sariab Road Quetta-Pakistan
⁷. Entomologist ARI (DAR) Fodder Quetta-Pakistan
⁸. Assistant Chemist Pakistan Tobacco Board Government of Pakistan-Pakistan

*Corresponding author’s email: abdulqadiragr@gmail.com

Citation
Tariq Aziz, Abdul Qadir Gola, Muhammad Ali Mahesar, Abdul Nabi Domki, Barkat Ali, Muhammad Kashif, Mohammad Saleem Mastoi, Mitha Khan and Manthar Ali Korejo. Effect of humic acid levels on fodder production of maize (*Zea mays*) varieties under agro-climatic conditions of Tandojam-Sindh Pakistan. Pure and Applied Biology. Vol. 8, Issue 2, pp. 1661-1667. http://dx.doi.org/10.19045/bspab.2019.80108

Received: 12/03/2019 Revised: 12/06/2019 Accepted: 20/06/2019 Online First: 24/06/2019

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 (m²)
The results for plant population (m²) 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 m²) was recorded humic acid @ 4kg ha⁻¹ however the minimum plant population (12.6 m²) was noted in control plots. In case of varieties the maximum plant population (17.5 m²) was recorded in variety Sadaf, the minimum plant population (15.2 m²) was recorded in variety Akbar. [18]. In case of interaction the maximum plant population (22.6 m²) was recorded at 4kg ha⁻¹ humic acid x variety Sadaf and the minimum plant population (12.2 m²) 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 levels of 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  |
|---------------------------|-----------------|-------|
| Control (Untreated)       | Akbar           | 13.2  |
|                           | Sadaf           | 12.2  |
|                           | Neelum          | 12.2  |
|                           | Mean            | 12.6  |
| Recommended NPK+ HA 2Kg ha\(^{-1}\) | Akbar           | 14.3  |
|                           | Sadaf           | 16.2  |
|                           | Neelum          | 15.3  |
|                           | Mean            | 15.7  |
| Recommended NPK+ HA 3Kg ha\(^{-1}\) | Akbar           | 15.6  |
|                           | Sadaf           | 19.3  |
|                           | Neelum          | 18.2  |
|                           | Mean            | 18.3  |
| Recommended NPK+ HA 4Kg ha\(^{-1}\) | Akbar           | 17.7  |
|                           | Sadaf           | 22.6  |
|                           | Neelum          | 21.3  |
|                           | Mean            | 19.4  |
| Mean                      | Akbar           | 15.2  |
|                           | Sadaf           | 17.5  |
|                           | Neelum          | 16.7  |

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  |
|---------------------------|-----------------|-------|
| Control (Untreated)       | Akbar           | 83.5  |
|                           | Sadaf           | 19.2  |
|                           | Neelum          | 89.2  |
|                           | Mean            | 63.9  |
| Recommended NPK+ HA 2Kg ha\(^{-1}\) | Akbar           | 104.2 |
|                           | Sadaf           | 106.2 |
|                           | Neelum          | 101.6 |
|                           | Mean            | 104.0 |
| Recommended NPK+ HA 3Kg ha\(^{-1}\) | Akbar           | 113.3 |
|                           | Sadaf           | 117.6 |
|                           | Neelum          | 115.3 |
|                           | Mean            | 115.4 |
| Recommended NPK+ HA 4Kg ha\(^{-1}\) | Akbar           | 133.4 |
|                           | Sadaf           | 130.6 |
|                           | Neelum          | 117.4 |
|                           | Mean            | 127.1 |
| Mean                      | Akbar           | 108.6 |
|                           | Sadaf           | 93.4  |
|                           | Neelum          | 105.8 |

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 4 kg 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      | Sada  | Neelum |       |
| Control (Untreated) | 7.1        | 7.3   | 8.3    | 7.5 D |
| Recommended NPK+ HA 2 kg ha\(^{-1}\) | 11.4       | 10.4  | 10.2   | 10.7 C |
| Recommended NPK+ HA 3 kg ha\(^{-1}\) | 12.2       | 12.2  | 13.2   | 13.2 B |
| Recommended NPK+ HA 4 kg 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      | Sada  | Neelum |       |
| Control (Untreated) | 5.4        | 8.8   | 5.4    | 6.5 C |
| Recommended NPK+ HA 2 kg ha\(^{-1}\) | 7.2        | 7.3   | 7.4    | 7.3 BC |
| Recommended NPK+ HA 3 kg ha\(^{-1}\) | 8.2        | 9.3   | 9.1    | 8.9 AB |
| Recommended NPK+ HA 4 kg 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 (27960 kg ha\(^{-1}\)) was recorded with the humic acid @ 4 kg ha\(^{-1}\) however the minimum fodder yield (17669 kg ha\(^{-1}\)) was noted in control plots [23]. In case of varieties the maximum fodder yield (24506 kg ha\(^{-1}\)) was recorded in variety Sadaf and the minimum fodder yield (20437 kg ha\(^{-1}\)) was recorded in variety Neelum. In case of interaction the maximum fodder yield (30862 kg ha\(^{-1}\)) was recorded at 4 kg ha\(^{-1}\) humic acid x variety Akbar and the minimum fodder yield (16762 kg 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          | Akbar | Sadaf | Neelum | Mean     |
|----------------------------|-------|-------|--------|----------|
| 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 | 24506 | 20437  | A        |

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.

**References**

1. Stephen P, Zhu X G, Naidu S & Donald R (2006). Can improvement in photosynthesis increase crop yield. *J of Plant Cell & Envi* 29(12): 315-330.
2. Ahsan M & Mehdi S (2000). Selection of S maize (*Zea mays* L.) Families to develop high green fodder yielding population. *Pak J Biol Sci* 3(76): 1870-1872.
3. Sial A & Alam (1998). Live Stock resources scenario of Pakistan. Paper presented at National seminar on Dairy Production, Potential and Challenges held on 29-30, May, 1988. Uni Agric, Faisalabad, Pakistan.
4. Bhatti M (1996). Key note address. In Fodder Production in Pakistan (Eds.) PARC/FAO. *Pak. Agril. Resh.Coun. Islamabad*, pp 5-8.
5. GOP (2014). Area and Production of Other Major Kharif and Rabi Crops and Economic Survey of Pakistan 2013-14, Ministry of Food and Agriculture; Federal Bureau of Statistics, Government of Pakistan, Islamabad, pp 22.
6. Doran I, Akinci C & Yildirim (2003). Effects of delta humate applied with different doses and methods on yield and yield components of Diyarbakir-81 wheat cultivar. 5th Field Crops Congress, Diyarbakir Turk 86(2): 530-534.
7. Sarwar G, Hussain N Schmeisky H, Muhammad S Ibrahim & Safdar E (2008). Improvement of soil physical and chemical properties with compost application in rice wheat cropping system. *Pak J of Bot* 40(65): 275-282.
8. Sarwar G (2005). Use of compost for crop production in Pakistan. University of Faisalabad. *Pak J of Sci* 65(47): 945-735
9. Zia M, Baig B & Tahir B (1998). Soil environment issues and their impact on agricultural productivity of high potential areas of Pakistan. *Pak J of Sci* 4(49): 563-619.
10. Hamayun M, Khan A Khan L, Shinwari K Ahmad N, Kim A & Lee In-J (2011). Effect of foliar and soil application of nitrogen, phosphorus and potassium on yield components of lentil. *Pak J Bot* 43(1): 391-396.

11. Johnson HJ, Colquhoun JB & Bussan AJ (2012). The feasibility of organic nutrient management in large-scale sweet corn production for processing. *Horttech* 22(1): 25-36.

12. Humintech .2012. Is it possible to replace Humus with organic manure. *Inter J of Phy & Bio* 23(6): 954-743

13. Masciandaro G, Ceccanti B, Ronchi V, Benedicto S & Howard L (2002). Humic substances to reduce salt effect on plant germination and growth. *Comm Soi Sci Plant Anal* 33: 365-378.

14. Anonymous (2010). Humic and fulvic acids: The black gold of agriculture. *Inter J of Afri* 35(96): 724-135

15. Ihsanullah D, Ahmed A & Bakhashwain (2013). Effect of humic acid on growth and quality of maize fodder production. *Pak J Bot* 45(S1): 21-25.

16. Pourkhaneghah AM, Shahryari R, Alaei Y & Shahmoradmoghanlou B (2012). Comparison of the effect of liquid humic fertilizers on yield of maize genotypes in Ardabil region. *Afri J of Biotech* 11(21): 4810-4814.

17. Waqas M, Ahmad B, Arif M, Munsif F, Khan AL, Amin M, Kang SM, Kim Y & Lee IJ (2014). Evaluation of Humic Acid Application Methods for Yield and Yield Components of Mungbean Ameri. *J of P Sci* 5(15).

18. Samavat S & Malakoti M (2010). Necessity of produce and utilization of organic acids for increase of quality and quantity of agricultural products. *J of Agroeco* 2(1): 111-118.

19. Nardi S, Pizzeghello D, Muscolo A & Vianello A (2002). Physiological Effects of humic substances in plant growth. *Soi Bio Biochem* 34(11): 1527-1536.

20. Pettit RE (2004). Organic matter, humus, humate, humic acid, fulvic acid and humin: their importance in soil fertility and plant health Sciences. *Inter J of Phy & Bio* 47(36): 375-867

21. Delfinen J, Sepetoglu H & Sindel B (2005). Effect of foliar application of N and humic acid on growth and yield of durum wheat. *Agro Sustain Dev* 25(2): 183-191.

22. Salim E, Mosa A & Ghamry M (2009). Evalulation of humic substances fortigation through surface and subsurface drip irrigation on potato. *Agri Water Manage* 96(22): 121-1222

23. Turan M, Sik A, Katkat A & Lelik (2011). The effect of soil applied humic substance to the dry weight and mineral uptake to maize plant. *Biotech J of Sci* 39(1): 171-177.