Response of maize (Zea mays L.) to different levels of humic acid

Muhammad Ijaz khan[1], Mohammad Qadoons[2], Muhammad Suleman[1], Hamayun[1] khan, Muhammad Aqeel[1] and Muhammad Rafiq[1]

[1]Agriculture Research Station, Ahmad Wala, Karak, KPK Province
[2]M.Sc (Hons) Student, the University of Agriculture Peshawar, KPK Province

ABSTRACT

In Pakistan maize is increasingly gaining an important position in crop husbandry because of its higher yield potential and short growth duration. Humic acid (HA) is a natural product that exerts stimulatory, conditioning and growth promoting effect when applied in combination with chemical fertilizers. Keeping in view the beneficial effects of humic acid, high cost and losses associated with use of chemical fertilizers, an experiment was conducted to asses the response of maize (*Zea mays* L.) to different levels of humic acid. The experiment was conducted in randomized complete block design with three replications on farmer field at district karak during summer 2014. The experiment consisted of five humid acid levels (0, 3, 6, 9, 12, 15 kg ha^{-1}) and maize variety Azam was used. Different humic acid levels significantly effected days to tasseling, days to silking, days to maturity, grains cob^{-1}, grain yield and biological yield. Plants treated with 15 kg ha^{-1} humic acid took minimum days to tasseling (58), silking (60) and maturity (99) while maximum days to tasseling (68), silking (71) and maturity (106) were noted in control plots. .Humic acid at 15 kg ha^{-1} significantly increased number of grains cob^{-1} (575), thousand grain weight (358.7 gm), biological yield (15279 kg ha^{-1}) and grain yield (4400 kg ha^{-1}) while minimum number of grains cob^{-1} (456), thousand grain weight (210.3 gm), biological yield (11905 kg ha^{-1}) and grain yield (3095 kg ha^{-1}) was recorded in control plot. From the experiment it is concluded that 15 kg ha^{-1} humic acid have positive effect on yield and yield components of maize. Further more it is suggested to the farmer to use 15 kg ha^{-1} humic acid in combination with chemical fertilizer for sustainable yield.

Key words: Humic acid, Yield, Gwowth

INTRODUCTION

Maize (*Zea mays* L.) is world's third most important cereal crop after wheat and rice both in area and production (Morris, 1998). In Pakistan, maize is grown on an area of 1.05 million hectares with total production of 3.59 million tons having average yield of 3415 kg ha^{-1}. In Khyber Pakhtunkhwa (KP), average yield of maize was 1880 kg ha^{-1} (MINFA, 2012). Grain yield per hectare of maize in Pakistan is low as compared with other leading maize producing countries, although soil and climatic condition of Pakistan are very ideal for maize production.

Low yield of maize in Pakistan in general and Khyber Pakhtunkhwa in particular is due to low soil fertility status, insufficient and imbalance use of fertilizer and inefficient utilization of available moisture or water in addition to the factors of crop production. Our growers are generally resource poor and they cannot afford to purchase expensive chemical fertilizers, the prices of which are increasing day by day. In order to fill this gap in maize productivity, the package of latest production technology involving the use of low cost N fertilizer at appropriate level needs to be find out and used to increase maize production and quality as well as net profit of the farmers.

Chemical fertilizers are used as major source of nutrients for crops to maintain soil fertility and increase crop productivity. Chemical fertilizers are more concentrated in nutrients and show immediate effect on crops as compared to organic manures. Given the high cost of fertilizers, losses due to fixation and adsorption, leaching and volatilization, use of chemical fertilizers in the required quantity is becoming increasingly difficult for obtaining maximum yield on sustainable basis.

Humic acid (HA) is a natural product, which is present in Pakistan's lignitic coal in reasonable concentration and is used in agriculture and industry but on limited scale (Hai and

Mir, 1998). Humic substances are formed through the process of humification of organic materials as by-product of microbial metabolism and are found in soil, coal, sediments water, peat and organic matter (Stevenson,1994).

Humic acid contains organic C (51-57%), N (4-6%), and p (0,02%). It is believed that these humic acid elements improve crop yeld due to its capability of supplying N and P to the plant. The beneficial effect of HA addition to soil is associated with the improvement in the physiochemical and biological environment of soils (Brannon and Sommers, 1985). It is also believed that HA although contains small amount of N, it is in a very stable form which serves as slow releasing N fertilizer (Nisar and Mir, 1989). It is also reported that HA reduces phosphate adsorption at low pH values (Sibanda and Young, 1986).

The present study was therefore conducted to investigate the effect of levels of humic acid on yield and yield component of maize crop and to find out the optimum level of humic acid for potential yield.

MATERIALS AND METHODS

A field experiment entitled "Response of maize to different levels of humic acid" was conducted on farmer field at tehsil takht-e-nasrati district karak during summer 2014.

The experiment was laid out in RCB design having three replications. Each plot consisted of 6 rows, 4 m long and row to row distance of 75 cm. Maize variety Jalal was used. A basal dose of 100 and 60 kg ha^{-1} of nitrogen and phosphorus was applied respectively. All phosphorus was applied at time of sowing while nitrogen was applied in two split, half at sowing time and remaining half at time of silking. The following treatments were investigated during the study.

Humic acid levels (Kg ha^{-1})

H_0 = 0

H_1 = 3

H_2 = 6

H_3 = 9

H_4 = 12

H_5 = 15

Data was recorded on the following parameters.

1. Days to tasseling
2. Days to silking
3. Days to maturity
4. Number of grains per ear
5. 1000 grain weight
6. Biological yield
7. Grain yield

Days to tasseling was recorded by counting number of days from sowing to the date on which 50% plants developed tassels. Days to silking was counted from the date of sowing to the date on which 50% ears of plants developed silks. Days to maturity was counted from the date of sowing to the date on which 50% plants matured completely and loss green color. The ears harvested for grain yield was used for the determination of number of grains per ear by randomly selecting five ears from each plot, dried and shelled for counting the grains ear^{-1}. Data regarding 1000 grains weight was recorded by counting randomly selected1000 grains from seed lot of each plot. Biological yield was recorded by weighing all the plants harvested from 4 central rows and then will convert into kg ha^{-1}. Grains yield was recorded after shelling of ears harvested from 4 central rows. The data was converted into kg ha^{-1}.

Data was statistically analyzed and means were compared using LSD test.

RESULTS AND DISCUSSION

Days to tasseling

Data regarding days to tasselling is presented in table 1. Statistical analysis of the data revealed that humic acid effected days to tasselling significantly. Higher days to tasseling (68) were recorded in control plots while minimum (53) days were recorded in plots treated with 9 kg ha^{-1} of humic acid. Plants received 9 kg ha^{-1} humic acid levels took less days to tasseling. Its might be due to the availability of all nutrients in proper amount required for faster growth.

Days to silking

Data regarding days to silking is given in the table 1. Statistical analysis of the data showed that humic acid significantly effected days to silking. Maximum days to silking (71) were taken by control treatment while minimum (57) days were recorded in plots treated with 9 kg ha^{-1} humic acid. 9 kg ha^{-1} gave good result and took fewer days to silking. Its may be that all required condition were favorable for plant growth at this level.

Days to maturity

Data in table 1 reveals that days to maturity influenced by humic acid significantly. Maximum days (106) were taken by plot in which 15 kg ha^{-1} was applied while minimum days (99) were taken by plot which 9 kg ha^{-1} of humic acid was applied. From the result it is clear that 9 kg ha^{-1} gave best result and took fewer days to maturity. It may be due to that 15 kg ha^{-1} humic acid decomposed and provide nutrients early, results in quick vegetative growth and ultimately early maturity of the crops.

Table 1. Days to tasseling, silking and maturity as affected by different humic acid levels.

Humic acid levels (kg ha^{-1})	Days to tassling	Days to silking	Days to maturity
0	68 a	71 a	105 a
3	60 cd	61 c	103 b
6	59 de	63 c	102 b
9	58 e	60 d	99 c
12	59 bc	64 bc	102 b
15	64 ab	66 ab	106 a
LSD at 0.05 alpha level	3.499	3.316	0.359

Grains Cob^{-1}

The data regarding grains cob^{-1} as affected by humic acid levels is given in table 2. Statistical analysis of the data revealed that humic acid level significantly effected grains cob^{-1}. Highest number of grains cob^{-1} (575) were obtained from the plot treated with 9 kg ha^{-1}, while the lowest number of grains cob^{-1} (456) were taken from control plots. Number of grains cob^{-1}

contributes to the economic yield as well as represents the reproductive efficiency of any cereal crop. The plots which receive 9 kg ha^{-1} gave good grains cob^{-1}. May be 9 kg ha^{-1} provide an excellent environment for the plants to grow and develop properly and express their maximum genetic potential for grain formation.

Thousand grains weight

Data regarding 1000 grain weight is shown in table 2. Statistical analysis of the data showed that humic acid significantly affected 1000 grains weight. The highest 1000 grain weight (358.7gm) was recorded from the plot treated with 9 kg ha^{-1}, while the lowest 1000 grains weight (210.3gm) was noted in control plots.

Grain weight is an important trait that contributes to overall yield of maize. Grains become dominant sink at maturity and all the photo assimilates deposited in the grains give them weight. The plot treated with 9 kg ha^{-1} of humic acid gave higher 1000 grains weight. It may be that humic acid work with the combination of hemical fertilizer and produced heavier grains weight.

Table 2. Grain cob^{-1}, 1000 grain weight (g) as affected by different humic acid levels.

Humic acid levels (kg ha^{-1})	Grain cob^{-1}	1000 grain weight (g)
0	456 b	210.3 d
3	497 b	221.0 c
6	512 b	261.3 b
9	575 a	358.7 a
12	524 b	325.7 c
15	516 b	321.7 c
LSD at 0.05 alpha level	34.668	18.427

Biological yield

Statistical analysis of the data showed that humic acid had significant effect on biological yield which is presented in table 3. The highest biological yield (15279 kg ha^{-1}) was obtained from the plot treated with 9 kg ha^{-1}, while the lowest biological yield (11361 kg ha^{-1}) was noted in control plots.

Higher biological yield is noted in plots that received 9 kg ha^{-1} humic acid. It may be due to reason that humic acid improved endurance to high stands allowed intercept and use solar radiation more effectively, contributing increase in crop growth and yield. Increasing in crop growth rate thus resulting in higher biological yield.

Grain yield

The data grain yield as affected by humic levels is given in table 3 Statistical analysis of the data showed that humic acid had significant effect on grain yield. The highest grain yield (4400 kg ha^{-1}) was obtained from the plot treated with 9 kg ha^{-1}, while the lowest grain yield (3095 kg ha^{-1}) were taken from the plot treated with 5 kg ha^{-1}.

Grain yield is one the most important goal and ultimate objective of any cereal. Humic acid at the rate of 15 kg ha^{-1} in combination with chemical fertilizer improved physiochemical and biological environment of soil, regulated supply of nutrients needed for maximum plants growth and development.

Table 3. Biological yield and grain yield as affected by different humic acid levels.

Humic acid levels (kg ha^{-1})	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})
0	11905 c	3435 c
3	13741 b	3095 c
6	14422 b	3163 c

9	15279 a	4400 a
12	14320 b	4626 a
15	11361 c	4048 b
LSD at 0.05 alpha level	1383.7	374.5

CONCLUSION AND RECOMENDATIONS

Improper fertilizer management particularly with continued soil nutrient mining is a major factor contributing to low maize yield in Khyber Pakhtunkhwa. Application of humic acid in combination with chemical fertilizers increases yield and yield component of maize crop.

From the experiment it is concluded that humic acid at the rate of 9 kg ha^{-1} positively effected days to tasseling, days to silking, days to maturity, grains cob^{-1}, thousand grain weight, biological yield and grain yield.

Humic acid at the rate of 9 kg ha^{-1} is recommended for higher yield. It is suggested to the farmer to use humic acid in combination with chemical fertilizers for improved yield. Furthermore government should provide humic acid at low prices to the farmer.

More precise studies of this nature however recommended to be carried out for further confirmations.

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