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Maize Growth as Influenced by Different Manures in Pothwar Tract (Pakistan)

KHALID MEHMOOD[1], ZAMMURAD IQBAL AHMED AND KHALID SAIFULLAH KHAN
Department of Agronomy, University of Arid Agriculture, Rawalpindi, Pakistan
[1]Corresponding author's e-mail: Khalid_meh2003@yahoo.com

ABSTRACT

The objective of this study was to determine separate and combined effects of different manuring treatments on growth and development of two maize varieties. For this purpose, two maize varieties, EV-1098 and EV-3001 were sown at Agronomic Research Area of the University of Arid Agriculture Rawalpindi, Pakistan during Kharif 2003. A basal dose of nitrogen and phosphorous was applied in all plots at the rate of 90 kg ha^{-1} each. Farmyard manure @ 3 t ha^{-1}, wheat straw @ 3 t ha^{-1} and Sulphate of potash (SOP) 60 kg ha^{-1} singly and half and one third of these organic and inorganic fertilizer doses were incorporated in soil 15 days before crop sowing to evaluate their effect on different growth characteristics. Different manuring treatments significantly affected leaf area, plant height, biological and stalk yield at 5% level of probability. Mixed application of different organic and inorganic fertilizer gained maximum plant growth in both the varieties.

Key Words: Maize; Manures; Pothwar; Pakistan

INTRODUCTION

Growth and development of a plant are a wonderful combination of many events at different levels, from biophysical and biochemical to organismal, which result in the production of a whole organism (Hopkins, 1999). Many soil and environment variables affect the plant growth and development differently and it had been concluded that temperature regulates the plant growth and development processes in a favorable photoperiod however, the rate of plant growth and development is mainly temperature driven, but the amount of growth is related to nutrients and moisture availability (Ritchie & Smith, 1991; Gardner *et al.*, 1995).

Potassium is an essential element for all living organisms. It is of utmost importance for water status of plant and is involved in the growth of meristamatic tissues. Potassium is also indispensable for the maintenance of cell turgor pressure which is required for cell expansion. It also plays a significant role in osmoregulation of plant cells and regulates the opening and closing of stomata. Although Potassium is not a constituent of organic structures, but regulates enzyme activities and translocation of photosynthates (Mengel & Kirkby, 1987).

Application of farmyard manure was found useful in increasing the yield of maize and wheat by 27 and 20%, respectively (Mahajan, 1996). There is a need to study the farmyard manure application in combination with crop residues so that all the sources could supplement each other when in short supply. Application of FYM may supply K directly to the crops and also mobilize native soil K and application of N either through FYM or fertilizer N may accelerate the productivity in due course of time (Singh *et al.*, 2000). In present study, efforts have been made to find out optimum combination of organic and inorganic manures which help to produce better maize growth and development.

MATERIALS AND METHODS

The experiment was conducted at Agronomic Research Farm of University of Arid Agriculture Rawalpindi under normal environmental conditions. Two maize varieties namely EV-1098 and EV-3001 were planted in a Randomized Complete Block Design having split plot arrangement at the seed rate of 30 kg ha^{-1}. The row-to-row and plant-to-plant distance was maintained at 75 and 25 cm, respectively. A basal dose of nitrogen and phosphorous was applied in all plots at the rate of 90 kg ha^{-1}. All the organic and inorganic fertilizers were added to the soil 15 days before crop sowing in the following combinations: Control, 3 t FYM ha^{-1}, 3 t wheat straw ha^{-1}, 60 kg Potassium ha^{-1}, 1.5 t FYM + 1.5 t wheat straw ha^{-1}, 1.5 t FYM ha^{-1} + 30 kg Potassium ha^{-1}, 1.5 t wheat straw + 30 kg Potassium ha^{-1}, 1t FYM + 1 t wheat straw + 20 kg Potassium ha^{-1}. Data regarding Number of days to seedling emergence, Number of leaves plant, Leaf area Plant height, stalk and biological yield was taken and subjected to statistical analysis. The LSD test was applied on obtaining significant differences among different parameters to compare the treatment means.

RESULTS AND DISCUSSION

Days to seedling emergence. Data regarding days to seedling emergence are shown in Table I. Statistical analysis of data showed non significant difference among manuring treatments. The varieties and interaction between varieties and manuring treatments were also non significant. When manuring treatments were singly applied, the plots fertilized with 60 kg SOP ha^{-1} showed rapid seedling emergence than wheat straw and FYM, respectively. Seedling emergence in case of wheat straw alone was slower than FYM and SOP, respectively. The combination of half dose of FYM + half dose wheat straw took less days for seedling emergence than FYM + SOP. SOP in combination with FYM caused early emergence than in combination with wheat straw. The

early seedling emergence in plots treated with FYM and wheat straw might be due to adequate supply of moisture to germinating seed for its fast growth.

All the manuring treatments were unable to show significant differences however, the plots fertilized with 3 t wheat straw took maximum (9.66) days for seedling emergence; whereas, minimum (8.83) days were taken by the plots treated with 1.5 t FYM + 1.5 t wheat ha^{-1}. Among varieties, variety EV-3001 took relatively more days for seedling emergence than EV-1098.

Number of leaves plant^{-1}. Data on number of leaves plant^{-1} is shown in Table II. Mean values of data indicated that there was a non significant difference among the different manuring treatments. The varieties and the interaction between varieties and manuring treatments were also non significant.

When FYM, wheat straw and SOP were singly used, FYM produced higher number of leave plant^{-1} than SOP and wheat straw. FYM in combination with SOP produced higher number of plant^{-1} than in combination with wheat straw. SOP + wheat straw produced higher number of leaves plant^{-1} compared with SOP + FYM. So the plots with potash and FYM alone and in combination found to be helpful in increasing number of leaves plant^{-1}. The results are in line with Lonhard and Nemeth (1989) who reported an increase in number of leaves plant^{-1} with an increase in potassium supply.

Highest (12.50) leaves plant^{-1} were produced by 3 t FYM followed by treatment 60 kg SOP ha^{-1}; whereas, lowest (11.23) leaves plant^{-1} were produced by 1.5 t FYM + 1.5 t wheat straw ha^{-1}. Both the varieties showed non significant results for production of leaves; however, variety EV-1098 produced more number of leaves than variety EV-3001.

Leaf area plant^{-1}. The development of the leaf area plant^{-1} against different manuring treatment and varieties is shown in Table III. Mean values of data showed that there was a significant difference among the different manuring treatments whereas varieties have shown non significant results. The interaction between varieties and manuring treatments was also non significant.

The mean values of the data indicated that all the treatments except 3 t FYM ha^{-1} and 1.5 t FYM + 1.5 t wheat straw ha^{-1} increased leaf area plant^{-1} than control. When the treatments were applied singly, 3 t wheat straw ha^{-1}, produced higher leaf area than application of SOP and 3 t FYM ha^{-1}. Application of SOP + FYM was better than SOP + wheat straw when used in combination. The best combination which gave maximum leaf area was application of 1.5 t FYM + 30 kg SOP ha^{-1}.

Maximum leaf area (2751.16 cm^2) was produced by 1.5 t FYM + 30 kg SOP ha^{-1} and minimum (2308.66 cm^2) by the treatment 1.5 t FYM + 1.5 t wheat straw ha^{-1}. Leaf area within both the varieties was not significantly different; however, variety EV-1098 produced higher leaf area plant^{-1} than variety EV-3001.

Table I. Days to seedling emergence as affected by different manures and varieties in maize

Treatments	EV-1098	EV-3001	Means
To(control)	9.00	9.33	9.16
3 t FYM ha^{-1}	9.00	10.0	9.50
3 t wheat straw ha^{-1}	10.0	9.33	9.66
60 kg SOP ha^{-1}	9.33	8.66	9.00
1.5 t FYM + 1.5 t wheat straw ha-1	8.66	9.00	8.83
1.5 t FYM + 30 kg SOP ha^{-1}	9.00	9.66	9.33
1.5 t wheat straw + 30 kg SOP ha^{-1}	9.33	9.66	9.50
1 t FYM + 1 t wheat straw + 20 kg SOP ha-1	9.33	9.33	9.33
Means	9.20	9.37	

Any two means in a column not sharing a letter differ significantly at 5% level of probability

Table II. Number of leaves plant^{-1} as affected by different manures and varieties in maize

Treatments	EV-1098	EV-3001	Means
To(control)	11.33	12.20	11.96
3 t FYM ha^{-1}	12.60	12.40	12.50
3 t wheat straw ha^{-1}	12.33	11.00	11.66
60 kg SOP ha^{-1}	12.06	12.20	12.13
1.5 t FYM + 1.5 t wheat straw ha-1	11.66	10.80	11.23
1.5 t FYM + 30 kg SOP ha^{-1}	11.53	12.00	11.76
1.5 t wheat straw + 30 kg SOP ha^{-1}	12.00	11.66	11.86
1 t FYM + 1 t wheat straw + 20 kg SOP ha-1	11.86	11.73	11.80
Means	11.98	11.75	

Any two means in a column not sharing a letter differ significantly at 5% level of probability

Table III. Leaf area plant^{-1} as affected by different manures and varieties in maize

Treatments	EV-1098	EV-3001	Means
To(control)	2434.66	2460.37	2447.50b
3 t FYM ha-1	2660.66	2229.66	2445.16b
3 t wheat straw ha-1	2763.33	2635.00	2699.16a
60 kg SOP ha-1	2546.00	2702.00	2624.00ab
1.5 t FYM + 1.5 t wheat straw ha-1	2523.66	2308.66	2416.16b
1.5 t FYM + 30 kg SOP ha-1	2678.00	2824.33	2751.16a
1.5 t wheat straw + 30 kg SOP ha-1	2571.33	2683.00	2627.16ab
1 t FYM + 1 t wheat straw + 20 kg SOP ha-1	2657.66	2771.66	2714.16a
Means	2604.41	2576.66	

Any two means in a column not sharing a letter differ significantly at 5% level of probability; LSD Value : 230.8

Plant height. Data pertaining to plant height is shown in Table IV. Analysis of the data showed that plant height was significantly affected by manuring treatments whereas both varieties have shown non significant difference. The interaction between varieties and manuring treatments was also non significant. It was observed from the data that plant height increased with the increase in FYM doses as maximum plant height was attained by the treatment 1.5 t FYM + 30 kg SOP ha^{-1} followed by 1 t FYM + 1 t wheat straw + 20 kg SOP ha^{-1}.

So the treatments with FYM in combination with other fertilizers gave tallest plants. The shortest plants were observed in the control plot which was at par with the treatment 3 t wheat straw ha^{-1}. The lowest height may be due to delayed seed germination and seedling emergence owing to poor soil conditions. The results are in conformity with Khan *et al.* (2000) who observed maximum height in the plot having higher doses of FYM mixed with other fertilizers. The results are in agreement with those of Iqbal *et al.* (1999). Both the varieties failed to bring about significant difference however, variety EV-1098 gained

higher plant height than variety EV-3001.

Biological yield. Analysis of the data (Table V) revealed that biological yield was significantly affected by different manuring treatments whereas varieties and the interaction between varieties and manuring treatments was also non significant.

When different fertilizers were used singly FYM gave significantly higher biological yield than use of wheat straw and SOP alone. The combination of 1.5 t FYM + 30 kg SOP ha^{-1} produced higher biological yield than 1.5 t FYM + 1.5 t wheat straw ha^{-1} and 1.5 t wheat straw + 30 kg SOP ha^{-1}. The highest biological yield in treatment 1.5 t FYM + 30 kg SOP ha^{-1} might be due to supply of balanced nutrition which produced and portioned maximum photosynthates for increased biological yield.

Maximum biological yield (7185.10 kg ha^{-1}) was obtained by the plot receiving 1.5 t FYM + 30 kg SOP ha^{-1} which was at par with 3 t FYM ha^{-1} whereas minimum (5827.88) kg ha^{-1} was obtained by the control plots which was at par with 60 kg SOP ha^{-1}. Both varieties were non significant for biological yield however variety EV-3001 produced slightly higher biological yield than variety EV-1098.

Table IV. Plant height as affected by different manures and varieties in maize

Treatments	EV-1098	EV-3001	Means
To(control)	161.59	162.22	161.91cd
3 t FYM ha-1	146.13	162.15	154.14d
3 t wheat straw ha-1	166.10	159.58	162.84cd
60 kg SOP ha-1	172.08	160.94	166.84bcd
1.5 t FYM + 1.5 t wheat straw ha-1	182.96	180.60	181.78ab
1.5 t FYM + 30 kg SOP ha-1	194.73	193.86	194.29a
1.5 t wheat straw + 30 kg SOP ha-1	182.58	165.52	174.05bc
1 t FYM + 1 t wheat straw + 20 kg SOP ha-1	193.08	190.15	191.61a
Means	174.91	171.88	

Any two means in a column not sharing a letter differ significantly at 5% level of probability; LSD Value : 10.77

Table V. Biological yield as affected by different manures and varieties in maize

Treatments	EV-1098	EV-3001	Means
To(control)	5873.73	5782.03	5827.88d
3 t FYM ha-1	6913.26	7102.10	7007.68a
3 t wheat straw ha-1	6059.36	6127.16	6093.76cd
60 kg SOP ha-1	6267.30	5859.96	6063.63cd
1.5 t FYM + 1.5 t wheat straw ha-1	6198.20	6596.56	6397.38bc
1.5 t FYM + 30 kg SOP ha-1	7082.53	7287.66	7185.10a
1.5 t wheat straw + 30 kg SOP ha-1	6056.50	6208.66	6132.58cd
1 t FYM + 1 t wheat straw + 20 kg SOP ha-1	6862.5	6910.80	6886.65ab
Means	6414.17	6484.80	

Any two means in a column not sharing a letter differ significantly at 5% level of probability; LSD Value : 490.7

Table VI. Stalk yield as affected by different manures and varieties in maize

Treatments	EV-1098	EV-3001	Means
To(control)	3751.40	3677.03	3714.21 c
3 t FYM ha-1	4065.80	4233.33	4149.56 a
3 t wheat straw ha-1	3780.23	3821.26	3800.75 bc
60 kg SOP ha-1	3963.23	3699.86	3831.55 abc
1.5 t FYM + 1.5 t wheat straw ha-1	4015.20	4118.73	4066.96 ab
1.5 t FYM + 30 kg SOP ha-1	4164.73	4183.60	4174.16 a
1.5 t wheat straw + 30 kg SOP ha-1	3858.03	3850.06	3854.05 abc
1 t FYM + 1 t wheat straw + 20 kg SOP ha-1	4142.20	4210.63	4176.41 a
Means	3967.60	3974.31	

Any two means in a column not sharing a letter differ significantly at 5% level of probability; LSD Value: 345.5

Stalk yield. Analysis of the data (Tale VI) revealed that stalk yield was significantly affected by different manuring treatments whereas varieties have shown non significant results. The interaction between varieties and manuring treatments was also non significant.

Mean values of the data indicated that all the combinations of organic and inorganic fertilizers significantly increased stalk yield. FYM alone gave higher stalk yield than wheat straw and SOP alone. FYM in combination with SOP produced higher stalk yield than in combination with wheat straw. SOP in combination with FYM produced higher stalk yield compared with SOP and wheat straw. The reason for higher stalk yield in plots fertilized with FYM and SOP may be due to better supply of all the nutrients which gave higher growth and ultimately the yield.

Maximum stalk yield (4176.41 kg ha^{-1}) was obtained by the plot receiving 1 t FYM + 1 t wheat straw + 20 kg SOP ha^{-1} which was at par with 1.5 t wheat straw + 30 kg SOP ha^{-1}. Minimum stalk yield (2109.1 kg ha^{-1}) was obtained by the control plot which was at par with 60 kg SOP ha^{-1}. Among varieties variety EV-3001 produced higher stalk yield than EV-1098.

CONCLUSION

The results of the experiment demonstrated that growth and development were significantly influenced by organic and inorganic manures supply. Growth parameters as leaf area $plant^{-1}$, plant height, biological and stalk yield were significantly affected by different manuring treatments whereas days to seedling emergence, number of cobs and leaves $plant^{-1}$ showed non significant results. The plots treated with high doses of SOP attained highest plant growth. So potassium supply in combination with organic manures supplement must be incorporated for better plant growth.

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