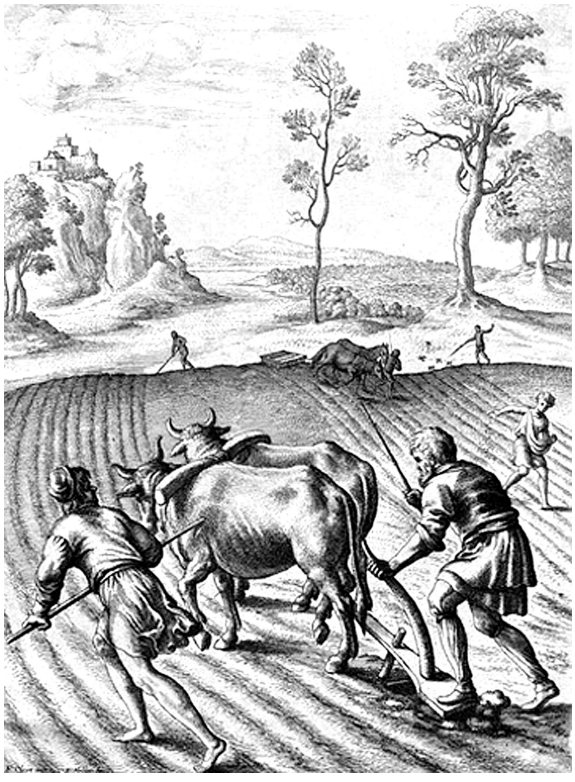
ISSN : 1812-5379 (Print)
ISSN : 1812-5417 (Online)
http://ansijournals.com/ja

JOURNAL OF AGRONOMY



ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Agronomy 1(1): 12-14, 2002 January-March 2002

Effect of Various Levels of N and P on Yield and Yield Components of Maize

Johar Ali, Jehan Bakht, Mohammad Shafi, Sherin Khan and Wajid Ali Shah
Department of Agronomy, NWFP Agricultural University, Peshawar, Pakistan

Abstract: In order to study the effect of various levels of N and P (applied alone or in combinations) on maize, an experiment was conducted at Malakandher Research Farms, NWFP Agricultural University, Peshawar, Pakistan during 1997. Statistical analysis of the data revealed that different levels of nitrogen and phosphorus had a significant effect on plant height, number of rows cob^{-1}, thousand grains weight, shelling percentage, barrenness percentage, number of grains cob^{-1}, number of cobs plant^{-1} and grain yield. Taller plants were attained by those plots, which received nitrogen and phosphorus in 150.60 kg ha^{-1} ratio. Similarly, plots treated with fertilizer combination of 150:90 NP kg ha^{-1} resulted in maximum, number of rows cob^{-1} (16.00), maximum number of cobs plant^{-1} (2.00) and maximum grain yield (3841.35 kg ha^{-1}).

Key words: Nitrogen, phosphorus, maize, yield components

Introduction

Maize is a crop with high yield potential and it occupies an important place in the cropping system of Pakistan. It not only provides food to the country fast growing population but also supplies raw materials to some of her industries. Pakistan though an agricultural country, is deficient in food grain and other food articles. The main cause of food shortage in the country has been failure of increased production of food grain to keep pace with the fast increase in population. To fill the gap between supply and demand, it is necessary to increase the production of food grains in country. Production can be increased by bringing more culturable waste land under cultivation and increasing per unit of crop from the area already under cultivation. Maize crop has got a great potential to fill the gap between supply and demand and hence there is a tremendous scope for increasing yield of maize crop in Pakistan. Keeping in view the importance of the role played by maize in the agricultural system of Pakistan, the present project was designed to study the effect of various levels of N and P on the yield and yield components of maize. Arain *et al.* (1989) reported that plant height and number of grains cob^{-1} increased with 100 kg N and 60 Kg P_2O_5 ha^{-1}; further increase in nitrogen decreased plant height and number of grains cob^{-1}. Dahiya *et al.* (1991) observed increase in dry matter yield with increasing nitrogen. Compared with nitrogen alone, phosphorus increased grain yield of maize by 11.5% (Kostic *et al.*, 1991). Negrila and Negrila (1994) concluded that the best fertilizer dose for maize was 100 Kg N and 80 kg P_2O_5 ha^{-1}. Similarly, Onisie *et al.* (1993) reported that maize grain yield ranged from 5.5 t with no NP to 8.4 t with 30 kg each of N and P_2O_5 ha^{-1}.

Materials and Methods

An experiment was laid out at Malakandher Research Farms, NWFP Agricultural University Peshawar, Pakistan during 1997 to study the response of maize to different levels of N and P. Before sowing, a composite soil sample was taken for various physicochemical properties (Table 1). Different levels of nitrogen (0, 90 and 150 kg ha^{-1}) and phosphorus (0, 60, 90 and 120 kg ha^{-1}) were applied in the form of urea and triple super phosphate respectively. All phosphorus and half nitrogen was applied at the time of sowing while the remaining half dose of nitrogen was applied at second irrigation. Recommended cultural practices were followed throughout the growing season. Data was recorded on emergence m^{-2}, plant height, number of cobs plant^{-1}, barrenness parentage, number of grains cob^{-1}, thousand grains weight, shelling percentage and grain yield.

Emergence m^{-2} was calculated by taking an area of one square meter randomly in each treatment and number of seedlings was counted as plants emerged m^{-2}. Plant height was recorded by measuring the height of ten randomly selected plants from each sub plot at maturity from ground level to tassels. Number of rows cob^{-1} was calculated by taking ten cobs in each treatment and number of rows in each cob was counted and then converted into average. Barren plants in each sub plot were counted and then their percentage was calculated. Number of grains cob^{-1} was obtained from the central rows in each treatment and their mean was then calculated. Thousand grains weight data was recorded by weighing thousand grains randomly selected from each sub plot and was then averaged. Shelling percentage was determined according to the following formula:

Table 1: Physicochemical properties of the soil

Properties	Unit	Value
Clay	%	36.0
Sand	%	18.0
Silt	%	46.0
Texture	Silty clay loam	
Lime	%	23.88
pH		7.0
E.C.	dS m^{-1}	0.54
Organic matter	%	0.72
Total nitrogen (before sowing)	mg kg^{-1}	210
Total nitrogen (after sowing)	mg kg^{-1}	3-5
Available phosphorus	mg kg^{-1}	11

$$\text{Shelling percentage} = \frac{\text{Grain weight cob}^{-1}}{\text{Whole cob weight}} \times 100$$

Grain yield after harvest of three central rows in each sub plot was recorded and then converted into yield ha^{-1} as per formula:

$$\text{Grain yield (Kg ha}^{-1}) = \frac{\text{Grain yield unit area}^{-1}}{\text{Unit area}} \times 100$$

Results and Discussion

Emergence m^{-2}: Data regarding emergence m^{-2} is presented in Table 2. Statistical analysis of the data revealed that nitrogen and phosphorus alone or in different combinations had a non-significant effect on emergence m^{-2}. However, it is clear that the highest emergence m^{-2} (8.85) was recorded from those plots which received 90 kg P_2O_5 ha^{-1} followed by control plots while lowest emergence of 8.48 seedlings m^{-2} was noted at 120 kg P_2O_5 ha^{-1}. When the effect of nitrogen was taken into account, maximum emergence m^{-2} was observed in check plots whereas emergence m^{-2} was minimum when nitrogen was applied at the rate of 90 kg ha^{-1}. In addition, interaction between N and P in the ratio of 150:90 kg ha^{-1} recorded highest emergence m^{-2} while lowest emergence was noted in those plots, which received N and P in a combination of 150:60 kg ha^{-1}. Non-significant effect of N and P alone or in various combinations may be due to the fact that seed reserves were enough at the time of germination and did not need additional nutrients at the time of emergence.

Table 2: Emergence m^{-2} in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	8.33	8.67	8.78	120.00	8.91
90	8.56	8.55	8.67	8.67	8.44
150	8.89	8.33	9.10	8.44	8.47
Mean	8.59	8.51	8.85	8.48	

Table 3: Plant height (cm) in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	170.00B	171.43B	189.91B	161.21B	173.14B
90	195.23B	280.62A	279.76A	173.25B	257.22A
150	197.31B	289.99A	273.81A	272.27A	258.35A
Mean	187.51B	247.34A	247.83A	235.58A	

LSD value for nitrogen at $p \leq 0.05$ = 20.72
LSD value for phosphorus at $p \leq 0.05$ = 23.92
LSD value for interaction at $p \leq 0.05$ = 41.44
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Table 4: Cobs $plant^{-1}$ in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	0.53 G	0.73 F	0.67 FG	0.93 E	0.72 C
90	1.07 DE	1.47 BC	1.33 C	1.33 C	1.30 B
150	1.33 D	1.60 AB	1.73 A	1.67 A	1.53 A
Mean	0.91 B	1.27 A	1.24 A	1.31 A	

LSD value for nitrogen at $p \leq 0.05$ = 0.096
LSD value for phosphorus at $p \leq 0.05$ = 0.111
LSD value for interaction at $p \leq 0.05$ = 0.193
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Table 5: Barrenness percentage in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	16.22 A	13.89 C	13.56 C	15.00 B	14.66 A
90	6.55 D	5.44 E	6.78 D	4.89 EF	5.91 B
150	7.44 D	3.12 G	4.11 FG	4.56 EF	4.80C
Mean	10.07 A	7.48 C	8.15 B	8.15 B	

LSD value for nitrogen at $p \leq 0.05$ = 0.53
LSD value for phosphorus at $p \leq 0.05$ = 0.62
LSD value for interaction at $p \leq 0.05$ = 1.07
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Table 6: Rows cob^{-1} in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	6.84 F	7.85 E	8.81 DE	9.53 D	8.26 C
90	9.21 D	13.23 B	12.32 BC	11.81 C	11.64 B
150	11.34 C	15.56 A	15.79 A	14.95 A	14.41 A
Mean	9.13 B	12.21 A	12.31 A	12.09 A	

LSD value for nitrogen at $p \leq 0.05$ = 0.4915
LSD value for phosphorus at $p \leq 0.05$ = 0.5675
LSD value for interaction at $p \leq 0.05$ = 0.9830
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Plant height: Table 3 present data concerning plant height. Analysis of the data showed that plant height was significantly ($P \leq 0.05$) affected by N, P and their interaction. Mean values of the data indicated in Table 3 revealed that taller plants (247.83cm) were attained by those plots, which received phosphorus at the rate of 90 kg ha^{-1} and were at par with other levels of phosphorus i.e. 60 and 120 kg ha^{-1}. Similarly, nitrogen when applied at the rate of 150 kg ha^{-1} resulted in taller plants (258.35 cm), which were at par with nitrogen dose of 90 kg ha^{-1} but significantly different when compared with control plots. When interaction between N and P was taken into an account, it was observed that maximum plant height was attained when plots were fertilized with N and P in combination of 150:60 kg ha^{-1}. The probable reason could be the balanced nutrient supply by 150:60 NP kg ha^{-1} combinations. These results are in contrast with those of Arain *et al.* (1989), who concluded that plant height of maize increased with increase in NP up to 100.60 kg ha^{-1}; further increase in nitrogen had adverse effects on plant height.

Table 7: Grains cob^{-1} in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	185.67	217.44	223.00	246.33	218.11C
90	253.33	301.00	296.55	288.00	284.72B
150	286.00	340.00	344.00	223.89	298.05A
Mean	241.67B	286.15A	287.85A	286.07A	

LSD value for nitrogen at $p \leq 0.05$ = 13.97
LSD value for phosphorus at $p \leq 0.05$ = 16.13
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Table 8: Thousand grains weight (g) in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	208.13	219.58	224.09	227.96	219.94C
90	231.38	272.59	261.58	252.06	254.40B
150	251.04	314.21	320.91	287.73	293.47A
Mean	230.18B	268.79A	268.86A	255.91AB	

LSD value for nitrogen at $p \leq 0.05$ = 23.69
LSD value for phosphorus at $p \leq 0.05$ = 27.36
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Table 9: Shelling percentage in maize as affected by various levels of nitrogen and phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	60.62F	61.51EF	61.28F	62.28DEF	61.42C
90	61.91DEF	64.29D	64.45D	69.42BC	65.02B
150	64.01DE	67.27C	70.57B	73.34A	68.80A
Mean	62.18C	64.35B	65.43B	68.34A	

LSD value for nitrogen at $p \leq 0.05$ = 1.297
LSD value for phosphorus at $p \leq 0.05$ = 1.497
LSD value for interaction at $p \leq 0.05$ = 2.593
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Table 10: Grain yield (kg ha^{-1}) in maize as affected by various levels of nitrogen phosphorus

Nitrogen levels (kg ha^{-1})	Phosphorus (kg ha^{-1}) 0	60	90	120	Mean
0	1615.12H	2022.80G	1963.28G	2025.01G	1906.55C
90	2132.34F	3237.75C	2591.38EF	2847.20D	2702.17B
150	2654.01E	3839.13A	3841.35A	3365.39B	3424.95A
Mean	2133.82C	3033.23A	2798.67B	2745.83B	

LSD value for nitrogen at $p \leq 0.05$ = 52.36
LSD value for phosphorus at $p \leq 0.05$ = 60.46
LSD value for interaction at $p \leq 0.05$ = 104.70
Means of the same category followed by different letters are significantly different from one another at p = 0.05 using LSD test.

Number of cobs plant: Data regarding number of cobs $plant^{-1}$ is indicated in Table 4. Various levels of N, P and their interaction had significant ($P \leq 0.05$) effect on number of cobs $plant^{-1}$. It can be seen from the mean values of the data that highest number of 1.31 cobs $plant^{-1}$ was produced by those plots which received phosphorus at the rate of 120 kg ha^{-1} which was at par with other levels of phosphorus but was significantly higher when compared with control plots. Similarly, when he effect of nitrogen on cobs $plant^{-1}$ was studied, it was observed that

maximum cobs plant^{-1} (1.53) were reported in plots which received nitrogen at the rate of 150 kg ha^{-1} and thus a positive correlation between various levels of nitrogen and number of cobs plant^{-1} was noted. It can be inferred from the data that interaction between N and P at the ratio of 150:90 kg ha^{-1} resulted in maximum number of cobs plant^{-1} when compared with other combinations. The probable reason could be that 150:90 NP kg ha^{-1} combinations may have provided the desired amount of nutrients for the production of more cobs plant^{-1}. Similar results are also reported by Gunarto (1992) and Zada *et al.* (1992).

Barrenness percentage: Statistical analysis revealed that N and P applied alone or in various combinations had significantly ($P \leq 0.05$) affected the barrenness percentage (Table 5). It is clear from mean values of the data that barrenness was maximum (10.07%) in those plots that received no phosphorus (control) followed by plots treated with phosphorus at the rate of 120 kg ha^{-1}. Mean values of the data presented in Table 5 also indicated negative correlation between various levels of nitrogen and barrenness percentage. It can be seen from the data (Table 5) that maximum barrenness percentage was observed in plots , which received no nitrogen while minimum barrenness was noted when plots received nitrogen at the rate of 150 kg ha^{-1}. Analysis of the data also revealed that the highest barrenness percentage was recorded in plots, which received neither nitrogen nor phosphorus while lowest barrenness percentage was noted in plots where NP was applied in the ratio of 150: 60 kg ha^{-1}. These results are in line with those reported by Sharma and Sharma (1991).

Number of row cob: Table 6 shows data concerning number of rows cob^{-1}. Analysis of the data indicated that number of rows cob^{-1} was significantly ($P \leq 0.05$) affected by various levels of N and P applied alone or in various combinations. Mean values of the data showed that maximum number of 12.31 rows cob^{-1} was produced by those plots which received P at the rate of 90 kg ha^{-1} which was at par with other levels of P (i.e. 60 and 150 kg ha^{-1}). It is also clear from the data that N when applied at the rate of 150 kg ha^{-1} resulted in maximum number of rows cob^{-1} while control plots produced minimum number of rows cob^{-1}. Mean values of the data also indicated that the highest number of rows cob^{-1} was observed when plots were treated with NP combination at the ratio of 150:90 kg ha^{-1} (Table 6). The probable reason could be that the combination of 150:90 NP kg ha^{-1} was the major dose of these nutrients, which fulfilled the requirement of maize crop for their growth and development. These results are confirmed by Ram *et al.* (1993).

Number of grains cob^{-1}: Statistical analysis of the data revealed that application of N and P had a significant ($P \leq 0.05$) effect on number of grains cob^{-1}, while their interaction was non significant (Table 7). It can be inferred from the mean values of the data that more number of grains cob^{-1} (287.0) was produced by plots, which received P at the rate of 90 kg ha^{-1} which was at par with other levels of P but was significantly different from control. Similarly, N when applied at the rate of 150 kg ha^{-1} resulted in maximum number of grains cob^{-1} when compared with other treatments. When interaction between N and P was taken into account, a non-significant effect was observed. However, number of grains cob^{-1} was maximum in plots, which received N and P at the rate of 150:90 kg ha^{-1}.

Thousand grains weight: Table 8 shows that thousand grains weight was significantly ($P \leq 0.05$) affected by various doses of N and P while their interaction was non significant. Mean values of the data indicated in Table 8 suggested that P when applied at the rate of 90 kg ha^{-1} produced heavier grains (268.86 g 1000 grains^{-1}) which was at par with other treatments of P. Data in Table 8 also show a linear increase in grain weight with increased levels of N. It is clear from these results that N when applied at the rate of 150 kg ha^{-1} produced maximum thousand grains weight (293.47g), while plots treated with 0 N kg ha^{-1} resulted in minimum thousand grains weight. Non-significant differences were observed due to the application of N and P in various combinations. However, plots, which received NP combinations of 150.90 kg ha^{-1} produced heavier grains when compared with other treatments. Similar results were also reported by Ram *et al.* (1993).

Shelling percentage: N and P when applied alone or in various combinations had significant ($P \leq 0.05$) effect on shelling percentage (Table 9). Mean values of the data indicated that P when applied at the rate of 120 kg ha^{-1} resulted in higher shelling percentage (68.34%) while minimum shelling percentage was recorded in plots treated with 90 kg. P_2O_5 ha^{-1}. Similarly, a positive correlation was observed between shelling percentage and various levels of N. It can be seen from the data presented in Table 9 that shelling percentage was maximum (68.80%) in those plots which received N at the rate of 150 kg ha^{-1} followed by plots treated with 90 kg ha^{-1} while control plots recorded minimum shelling percentage. The plots treated with N and P in combination of 150:120 kg ha^{-1} resulted in maximum shelling percentage while check plots recorded minimum shelling percentage (Table 9).

Grain yield: Table 10 shows data concerning grain yield. Statistical analysis of the data revealed that N, P and their interaction had a significant ($P \leq 0.05$) effect on grain yield. Mean values of the data presented in Table 10 indicated that maximum grain of 3033.23 kg ha^{-1} were produced by those plots, which received P at the rate of 60 kg ha^{-1} when compared with other treatments. Similarly, a positive correlation between various levels of N and grain yield was observed. It can be inferred from the data presented in Table 10 that maximum grain yield of 3424.95 kg ha^{-1} was produced by those plots which received nitrogen at the rate of 150 kg ha^{-1} when compared with other treatment. It can be seen from the data (Table 10) that NP applied in a ratio of 150:90 kg ha^{-1} resulted in maximum grain yield (3841.35 kg ha^{-1}) which was at par with NP combination of 15:60 kg ha^{-1} and control. Similar results are also reported by Ran *et al.* (1993), Sharma (1991), Nigrila and Negrila (1994) and Brar *et al.* (1989).

References

Arain, A.S., S.M. Alam and A.K.G. Tuno, 1989. Performance of maize genotypes under varying NP fertilizer environments. Sarhad J. Agric., 5: 623-626.

Brar, S.P.S., S. Bhajan, D.I. Benbi and B. Sing, 1989. Effect of long term application of N and P on crop yield, nitrogen uptake and soil nitrogen status in maize wheat rotation. J. Res., 26: 572-580.

Dahiya, S.S., G.Sunil, R.S. Antil, S. Anoop, A. Sing and S. Goel, 1991. Effect of Cd and nitrogen on dry matter yield and uptake of nutrients in corn. Ann. Biol., 7: 205-208.

Gunarto, D., 1992. Response of maize to NPK and trace element fertilizer on a Regosol at Maliana, East Timor. Agrivita, 15: 65-69.

Kostic, M.A., D. Dokic and M. Jelic, 1991. The effect of long term phosphorus fertilization on P deficient soil. Arhiv-za-Poljoprivredne-Nauk, 52: 195-213.

Negrila, M. and E. Negrila, 1994. Nitrogen and phosphorus ratio in wheat and maize crop. Statistica si Aplicata, 16: 119-133.

Onisie, T., G. Timariu, G. Jitareanu, 1993. Studies on the influence of different fertilizer rates on the yield of phaseolus and maize grown together on sloping land subject to erosion. Cercetari Agronomica in Moldova, 26:73-78.

Ram, S., R.S. Dhuka, S. Kanwar and K. Singh, 1993. Effect of residual phosphorus applied to forages and nitrogen on maize yield. Crop-Research-Hisar, 6: 362-369.

Sharma, J.P. and U.C. Sharma, 1991. Effect of nitrogen and phosphorus on the yield and severity of turcicum blight in maize in Nagaland. Indian Phytopathol., 44: 383-385.

Zada, K., A. Saeed and S. Ahmad, 1992. Biologic and intercrop studies on yield and nitrogen fixation of soybean and maize. Sarhad J. Agric., 8: 613-622.