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MITIGATING ENVIRONMENTAL IMPACTS WHILE BOOSTING MAIZE YIELD: THE ROLE OF OPTIMIZED PLANT DENSITY AND REDUCED NITROGEN FERTILIZATION

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Abstract

Plant density is one of the most important cultural practices determining grain yield, as well as other important agronomic attributes of this crop. Stand density affects plant architecture, alters growth and development, similarly maize productivity depends upon the external supply of nutrients, therefore application of nitrogen and adequate planting density might be a feasible technology to improve maize yield and yield components. A field study was conducted to determine the effects of plant density and nitrogen fertilization on the growth and yield of maize. The experiment was laid out in a Randomized Complete Block Design with a split-plot arrangement during the Kharif 2022 season. Treatments consisted of three plant populations (60,000, 75,000, and 90,000 plants ha^{-1}) as the main factor and three nitrogen levels (100, 150, and 200 kg N ha^{-1}) as the subplot factor. Results demonstrated that nitrogen application significantly influenced all measured parameters. The highest nitrogen level (200 kg N ha^{-1}) resulted in the greatest biological yield (13,205 kg ha^{-1}), thousand-grain weight (301.6 g), grain yield (5,057 kg ha^{-1}), and delayed physiological maturity. In contrast, plant population had a divergent effect: the highest plant density (90,000 plants ha^{-1}) produced the maximum biological yield (13,455 kg ha^{-1}), while the lowest density (60,000 plants ha^{-1}) optimized grain yield (5,091 kg ha^{-1}) and harvest index (41%). The interaction between plant population and nitrogen was not significant for any parameter. It is concluded that for the maize variety "Jalal" in the agro-climatic conditions of Swabi, a combination of a lower plant population (60,000 plants ha^{-1}) with a high nitrogen rate (200 kg ha^{-1}) is the most effective strategy for maximizing grain yield and harvest index.

Keywords: *plant density, nitrogen management, maize yield, sustainable agriculture, environmental impact, nitrogen use efficiency, harvest index.*

INTRODUCTION

Maize (*Zea mays* L.) Family (poaceae) is the third most important cereal crop after wheat and rice in Pakistan. it is consumed as human and animal food and provides a major raw material for starch industry.it is short duration and quick growing crop and is potentially capable of production very high quantity of grain per unit area. Grain yield is the combined outcome of genetic potential and environment relations. Variability in genetic potential among varieties is a major component of variable yield. average maize yield in Pakistan is an account of suboptimal plant density, inadequate fertilizer use, insufficient water supply, weed infestation, insect pest attack and the selection of unsuitable cultivars under a given set environment (Tahir et al., 2008).

Maize is an important food and feeds crop of the world. In Pakistan, area under maize occupies third position after wheat and rice 98% of which is grown in Pakistan Punjab and Khyber Pakhtunkhwa. In Pakistan, Maize is grown on an area of 1.016 million hectares with an annual production of 3.037-million-hectare tons of grain and average grain yield of about 2864 kg / ha_1 (GOP,2019). Maize grain has high nutritional value as it contains 72% starch ,10% protein,4.8% oil, 8.5% fiber,3% sugar and 1%ash. (Chaudhary, 1983; Mondal et al., 1992).

Its commercial products are corn oils, corn flakes, corn starch, tanning material for leather industry, custard, glucose, jelly, energize etc. improved quantities of corn have been used in the manufacturing compound, soap, varnishes, paints and similar other products (Martin et al., 1975).

Maize is a standout amongst the most potential oats that become all around and is the third after wheat and rice altogether sustenance grain generation. because of its high versatility and profitability. Maize being the most noteworthy yielding grain crop on the planet is of critical significance for nations such as Pakistan. In Pakistan maize is imperative oat after wheat and rice represents 4.8% of the aggregate trimmed territory and 3.5% of the estimation of farming yield. The mass (97%) of the generation originates from two noteworthy areas, KPK, representing 57% of the aggregate range and 68% of aggregate creation and Punjab contributes 38% land with 30% of aggregate maize grain creation. Almost no maize 2-3% is created around Sindh. Additionally, an extremely developing and high yielding segment of maize, the spring maize range and generation in Punjab is not represented, which covers around 0.070 million tons of maize grains being delivered (Shah, et al., 2014).

Stand density affects plant architecture, alters growth and developmental patterns and influence carbohydrate production. At low densities, many modern maize varieties do not tiller effectively and quite often produce only one ear per plant. Whereas, the use of high population increases interplant competition for light, water and nutrients, which may be detrimental to final yield because it stimulates apical dominance, induces barrenness, and ultimately decreases the number of ears produced per plant and kernels set per ear (Sangoi, 2001).

There are several biotic and abiotic factors that affect maize yield considerably; however, it is more affected by variations in plant density than other members of the grass family (Abuzar et al., 2011).

Plant populations affect most growth parameters of maize even under optimal growth conditions and therefore it is considered a major factor determining the degree of competition between plants (Sangakkara et al., 2012). The grain yield per plant is decreased in response to decreasing light and other environmental resources available to each plant (Luque et al., 2006).

Maize is one of Pakistan's main crops, but its production is very limited in Khyber Pakhtunkhwa (KP) Province. (Amanullah et al., 2009, 2016). Among the cereals its ranks third because of its importance. It is short-term plant with the ability to produce large quantities of food grain (Niwamanya et al., 2025). It is becoming popular amongst growers because of its multifunctional uses such as food for humans, raw materials for various industries and animal feed. Maize grain is a good source of fat, minerals, starch, protein, vitamin (Mian et al., 2021). Maize has an important nutrient value with about 72% starch, protein approximately 10%, and fiber up to 12% and oils approximately 3% (Swati et al., 2024). Maize is an important staple cereal crop in Pakistan and is a major source of income and food security for many farmers (Ahmad et al., 2020).

Nitrogen (N) is an important plant yield limiting macronutrient. Plants take N in the form of ammonia and nitrate (Javed et al., 2022). It is an imperative element for proper growth and development of the plant, enhance yield and improve quality by playing a key role in the physiochemical functions of the plant (Leghari et al., 2016). Nitrogen is a key component of chlorophyll, protein, and amino acids, and it plays an important role in maize yield (Mohammed et al., 2025). Large amounts of inorganic nitrogen are lost during crop development, resulting in soil, water and environmental pollution (Mattas et al., 2011). In such scenario, combining organic and inorganic fertilizers improves crop production and yield components while also improving soil structure (Zhang et al., 2016).

Objectives:

To investigate the effect of plant population on yield and yield components of maize crops.

To determine the optimum rate of nitrogen fertilizer for high maize production.

To study the interactive effect of plant population and nitrogen levels for yields and yields components of maize crop

MATERIALS AND METHODS

A field experiment was conducted during the Kharif season of 2022. The experiment was laid out in a Randomized Complete Block Design (RCBD) with a split-plot arrangement, replicated three times. Plant population levels were assigned to the main plots, and nitrogen levels were assigned to the sub-plots.

Factor A *Plant population (ha⁻¹) — Main plot*

P_1 = 60,000
P_2 = 75,000
P_3 = 90,000

Factor B *Nitrogen (kg ha⁻¹) — Subplot*

N_1 = 100
N_2 = 150
N_3 = 200

Each replication consisted of nine treatments (3 x 3 = 9) having three levels of plant population (60,000, 75,000 and 90,000 ha^{-1}) which were allotted to main plot and three levels of nitrogen (100, 150 and 200 kg ha^{-1}) which were allotted to subplot. Plot size of 5m x 3m (15m^{-2}) was used accommodating 5 rows for P_1, 4 rows for P_2 and 3 rows for P_3. Plant population (P_1) was maintained by planting 50cm x 20cm, R-R and P-P distance respectively by accommodating 150 plants per plot. Similarly plant population (P_2) was maintained by planting 75cm x 20cm, R-R and P-P distance respectively accommodating 100 plants per plot while for P_3, 75 plants per plot were maintain by keeping 100cm x 20cm R-R and P-P distance respectively. The field was twice ploughed through cultivator and rotavator and then leveled through back leveler. Maize variety (Jalal) was sown in the first week of July 2022. The required nitrogen (N) rates were applied from Urea in two equal splits i.e., half at sowing, and half with first irrigation after emergence. All agronomic and management practices were kept uniformly for each experimental unit.

Data was collected on following parameters during the experiment:

1. Days to physiological maturity

Days to maturity were recorded by counting the number of days from sowing till 75% of plants reached to physiological maturity in each plot indicated by turning yellow the color of spikes (Rajendra, 2017).

2. Biological yield (kg ha^{-1})

Biological yield was recorded by harvesting four central rows in each plot. The harvested materials were then sun dried, weighed and converted into kg ha^{-1}.

$$Biological\ yield = \frac{Biological\ yield\ off\ our\ central\ rows}{No.\ of\ rows\ harvested \times row\ to\ row\ distance \times row\ length} \times 10000\ \mathrm{m}^2 5$$

3. Thousand grains (g)

A sample of thousand grains was counted using electronic grains counting machine and separated for each plot. The grains were then weighed with the help of a sensitive electronic balance, and thousand grains weight was noted.

4. Grain yield (kg ha^{-1})

The harvested material for obtaining biological yield was threshed using a mini wheat thresher and the grains obtained were weighed with the help of a sensitive digital balance and then data were converted to kg ha^{-1}. Formula for grain yield:

$$\text{Grain yield} = \frac{\text{Grain yield of four centralrows}}{\text{No. of rows } \times R - R \text{ distance} \times \text{row length}} \times 10000 \text{ m}^2$$

5. Harvest index (%)

Harvest index for each p1ot was calculated by using the fol1owing formula:

$$\text{Grain yield} = \frac{\text{Grain yield of four centralrows}}{\text{No. of rows } \times R - R \text{ distance} \times \text{row length}} \times 10000 \text{ m}^2$$

Statistical analysis:

Data recorded on each parameter was subjected to analysis of variance (ANOVA) techniques appropriate for a Randomized Complete Block Design (RCBD) with a split-plot arrangement having three replications to compare the meaning differences among different plant populations and to assess the effect of nitrogen on various parameters.

RESULTS AND DISCUSSION

1. Days to physiological maturity

Data regarding number of days to physiological maturity is presented in (Table 1& fig. 1). Analysis of the data showed that nitrogen significantly affected days to physiological maturity of maize, while plant population had no significant effect on days to physiological maturity. Mean data regarding the different levels of nitrogen showed that maturity delayed (103 to 107 days) as nitrogen rate increased from 100 to 200 kg ha^{-1}, respectively. However, the interaction between the different plant populations and nitrogen was also not significant for days to physiological maturity. The reason for delayed maturity due to N might be the better growth and development with the application of N which enhanced the lifecycle of the crop and delayed the maturity. These results are in line with (Imran et al., 2021; Vyas and Gulati. 2009) who reported a significant effect of N on days to maturity of maize.

Table 1. Number of days to physiological maturity of maize as affected by plant population and different levels of nitrogen.

Nitrogen (Kg ha^{-1})	Plant Population (ha^{-1})			Mean
	60,000	75,000	90,000	
100	103	103	103	103 c
150	105	105	105	105 b
200	108	107	107	107 a
Mean	105	105	105	

LSD(P<0.05) for plant population (PP) = NS
LSD(P<0.05) for nitrogen (N) = 1.80
LSD(P<0.05) for PP x N = NS

Means of the levels of each factor are significantly different at P value equal or less than 0.05, presented by various letters (a, b, c) using LSD test.

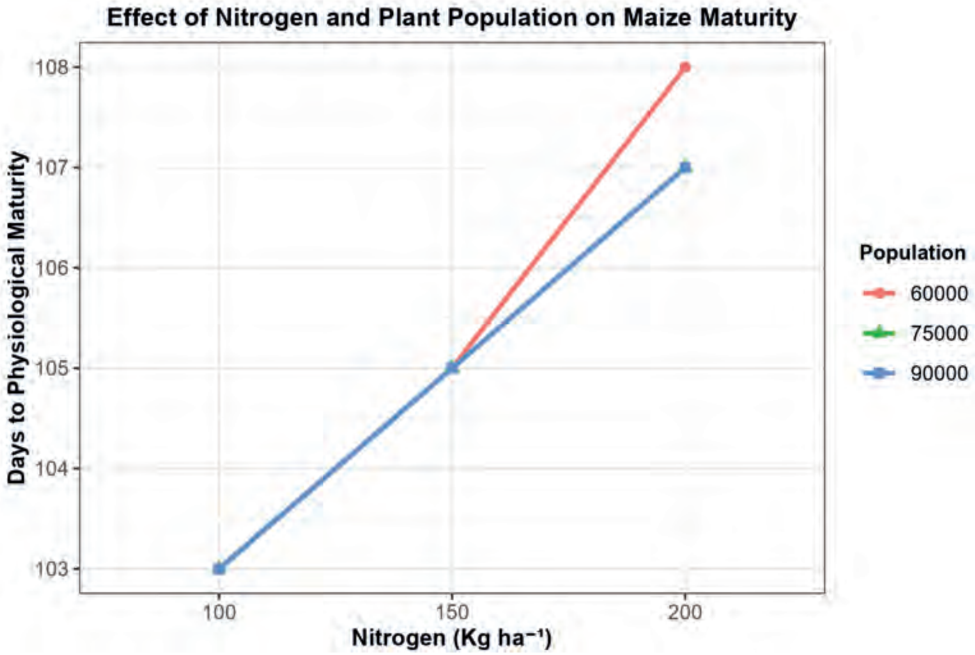

Figure 1. Number of days to physiological maturity of maize as affected by plant population and different levels of nitrogen.

2. Biological yield (kg ha^{-1})

The effect of plant population and nitrogen on biological yield is presented in Table 2. Analysis of the data indicated that plant populations and nitrogen levels significantly affected biological yield of maize. Highest rate of N (200 kg ha^{-1}) resulted in maximum biological yield (13205 kg ha^{-1}), while minimum biological yield (12661 kg ha-1) was recorded with the lowest rate of N (100 kg ha^{-1}). Likewise higher biological yield (13455 kg ha^{-1}) was recorded in the plots where plant population was maintained higher (90,000 ha^{-1}), while lower biological yield (12424 kg ha^{-1}) was noted in the plots where plant population was maintained lower (60,000 ha^{-1}). Similar results were earlier reported (Ali et al., 2012; Imran et al., 2015). Plant density is one of the most important cultural practices determining biological and grain yield, as well as other important agronomic attributes of this crop. Stand density affects plant architecture, alters growth and developmental patterns and influences carbohydrate production and partition (Casal, 1985).

Table 2. Biological yield (kg ha^{-1}) of maize as affected by plant population and different levels of nitrogen

Nitrogen (kg ha^{-1})	Plant Population (ha^{-1})			Mean
	60,000	75,000	90,000	
100	12172	12537	13274	12661 c
150	12474	12828	13249	12850 b
200	12628	13146	13841	13205 a
Mean	12424 b	12837 b	13455 a	

LSD(P<0.05) for plant population (PP) = 217
LSD(P<0.05) for nitrogen (N) = 246
LSD(P<0.05) for PP x N = NS

Means of the levels of each factor are significantly different at P value equal or less than 0.05, presented by various letters (a, b, c) using LSD test.

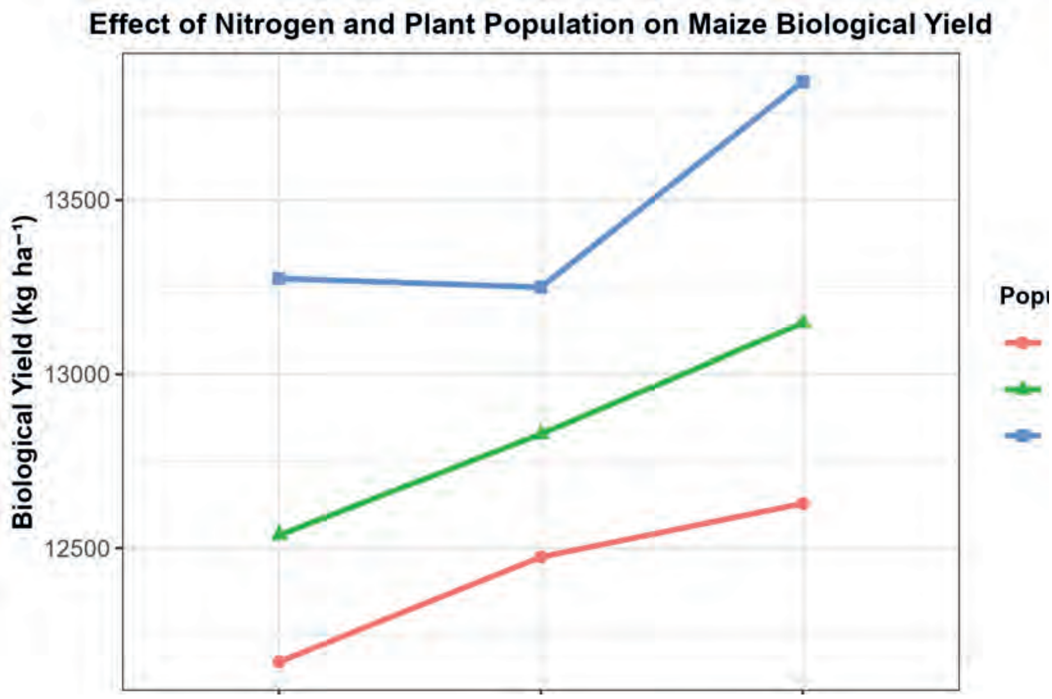

Figure 2. Biological yield (kg ha-1) of maize as affected by plant population and different levels of nitrogen.

Thousand grain weight (g)

Analysis of the data indicated that plant populations and nitrogen levels significantly affected thousand grain weight of maize, while the interaction between the different plant populations and nitrogen was not significant (Table 5). Highest rate of N (200 kg ha^{-1}) resulted highest thousand grain weight (301.6g), followed by 150 kg N ha^{-1} (289.9g), while lowest thousand grain weight (282.1g) was recorded with the lowest rate of N (100 kg ha^{-1}). Likewise higher thousand grain weight (304.8g) was observed in the plots where plant population was kept lower (60,000 ha^{-1}), while minimum thousand grain weight (278.1g) were noted in the plots where plant population was maintained higher (90,000 ha^{-1}). Hossain, (2015) stated that maximum thousand grain weight was produced by planting density of 45000 plants ha^{-1} when compared with other treatments.

Table 3. Thousand grains weight (g) of maize as affected by plant population and different levels of nitrogen.

Nitrogen (kg ha^{-1})	Plant Population (ha^{-1})			Mean
	60,000	75,000	90,000	
100	295.7	286.7	264.1	282.1 c
150	303.2	288.3	278.0	289.9 b
200	315.5	297.0	292.3	301.6 a
Mean	304.8 a	290.7 b	278.1 c	

LSD(P<0.05) for plant population (PP) = 12.40
LSD(P<0.05) for nitrogen (N) = 7.88
LSD(P<0.05) for PP x N = NS

Mean of the levels of each factor are significantly different at P value equal or less than 0.05, presented by various letters (a, b, c) using LSD test.

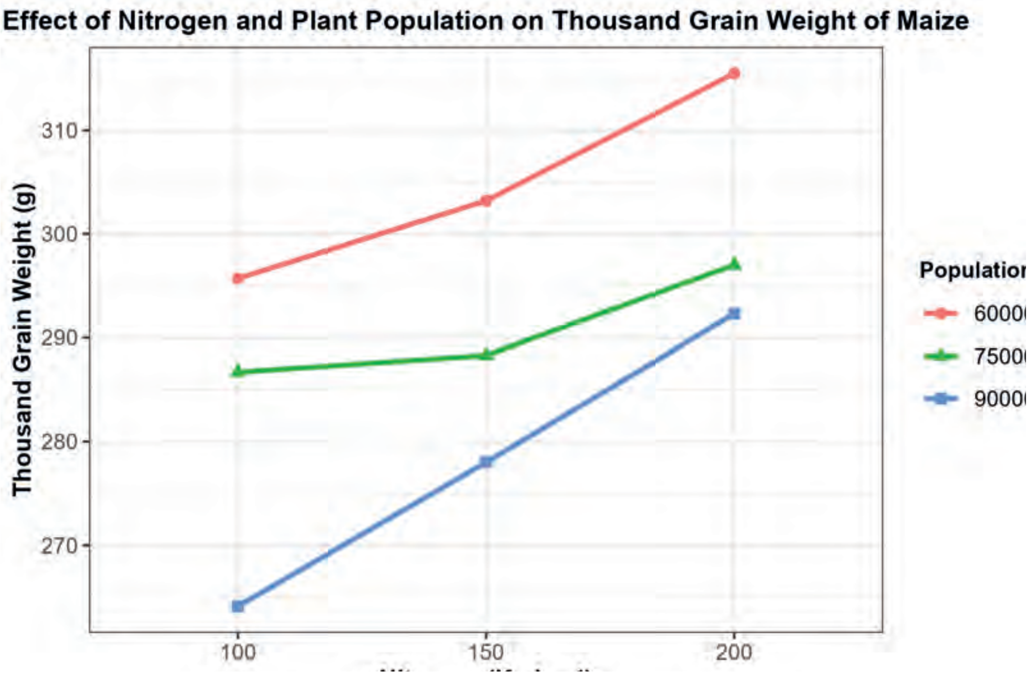

Figure 3. Thousand grains weight (g) of maize as affected by plant population and different levels of nitrogen.

4. Grain yield (kg ha^{-1})

The effect of plant population and nitrogen on grain yield is presented in Table 4. Analysis of the data indicated that plant populations and nitrogen levels significantly affected grain yield of maize, while the interaction between the different plant populations and nitrogen was not significant. Highest rate of N (200 kg ha^{-1}) resulted maximum grain yield (5057 kg ha^{-1}), while minimum grain yield (5003kg ha^{-1}) was recorded with the lowest rate of N (100 kg ha^{-1}). Likewise higher grain yield (5091 kg ha^{-1}) was recorded in the plots where plant population was maintained lower (60,000 ha^{-1}), while lower grain yield (4966 kg ha^{-1}) was noted in the plots where plant population was maintained higher (90,000 ha^{-1}). The increase in grain yield due to combining application of P form organic and inorganic source might be due to the higher yield components like grains ear^{-1} and higher growth with the application of P from combining organic and inorganic sources. These results are in agreement of those reported by (Adamu et al., 2015; Ali et al., 2012) who reported higher grain yield with the combined application of P from organic and inorganic sources. Maize grain yield declines when plant density is increased beyond the optimum plant density primarily because of decline in the harvest index and increased stem lodging (Tollenaar *et al*., 1997).

Table 4. Grain yield (kg ha-1) of maize as affected by plant popuslation and different levels of nitrogen.

Nitrogen (kg ha^{-1})	Plant Population (ha^{-1})			Mean
	60,000	75,000	90,000	
100	5059	4995	4953	5003 b
150	5098	5024	4956	5026 b
200	5117	5065	4988	5057 a
Mean	5091 a	5028 b	4966 c	

LSD(P<0.05) for plant population (PP) = 30
LSD(P<0.05) for nitrogen (N) = 29
LSD(P<0.05) for PP x N = NS

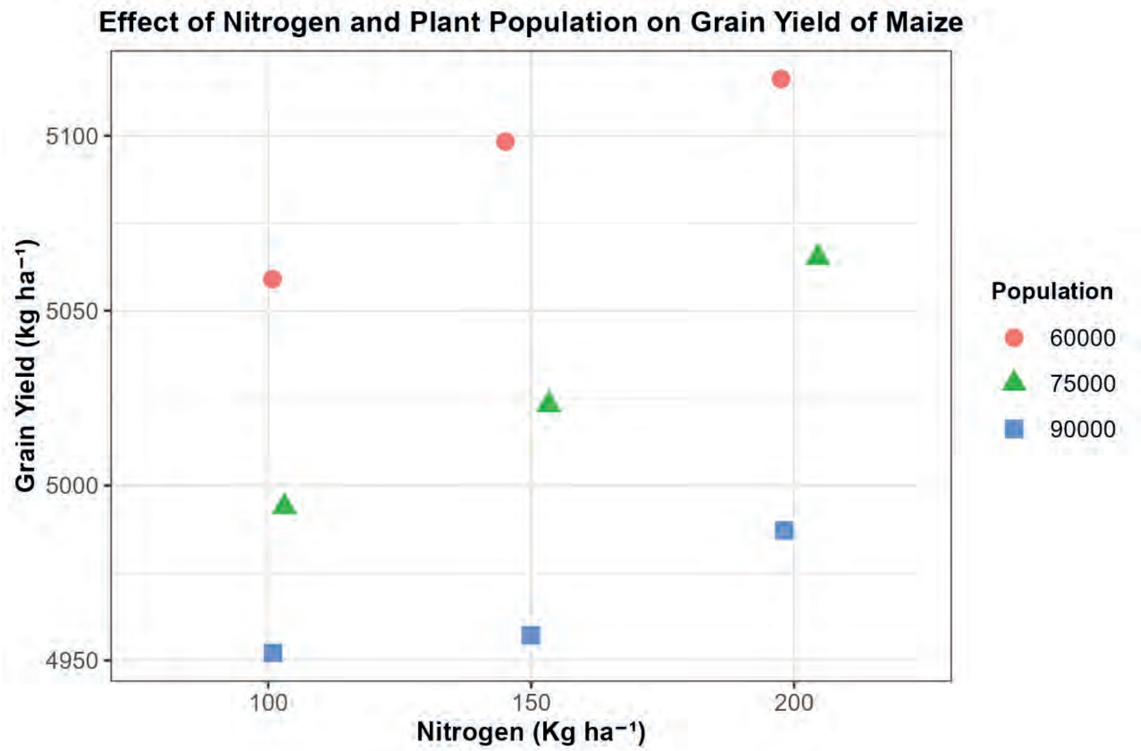

Figure 4. Grain yield (kg ha-1) of maize as affected by plant population and different levels of nitrogen.

5. Harvest index (%)

Data regarding harvest index (%) is presented in Table 5. Analysis of the data showed that plant population and nitrogen significantly affected harvest index of maize. The different levels of nitrogen had a minute effect on harvest index as there was no significant difference observed between the mean values of harvest index. Likewise higher harvest index (41%) was recorded in the plots where plant population was maintained lower (60,000 ha^{-1}) as compared to the plots where plant population (75,000 and 90,000) was maintained higher (39.2 and 36.9%), respectively. The interaction between the different plant populations and nitrogen was not significant. The harvest index is the ratio of grain yield to biological yield which increased with higher grain ratio the probable reason for higher harvest index might be that higher grain to Stover ratio due to combining application of organic and inorganic P similar results were reported earlier by (Ali *et al.*, 2019; Ochami, 2021).

Table 5. Harvest index (%) of maize as affected by plant population and different levels of nitrogen.

Nitrogen (kg ha^{-1})	Plant Population (ha^{-1})			Mean
	60,000	75,000	90,000	
100	41.6	39.8	37.3	39.6 a
150	40.9	39.2	37.4	39.2 a
200	40.5	38.5	36.0	38.4 a
Mean	41.0 a	39.2 b	36.9 c	

LSD(P<0.05) for plant population (PP) = 0.50
LSD(P<0.05) for nitrogen (N) = 0.87
LSD(P<0.05) for PP x N = NS

Mean of the levels of each factor are significantly different at P value equal or less than 0.05, presented by various letters (a, b, c) using LSD test.

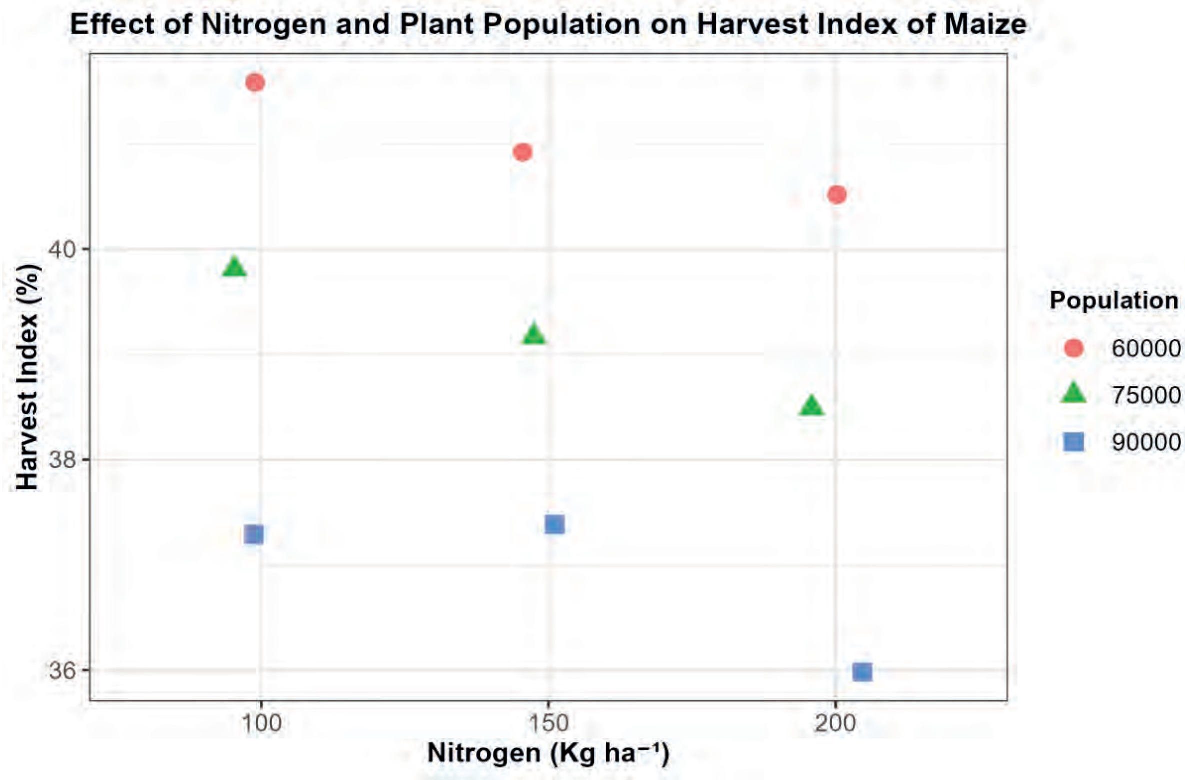

Figure 5. Harvest index (%) of maize as affected by plant population and different levels of nitrogen.

CONCLUSION

Based on the findings of this study, it can be concluded that both nitrogen application and plant population significantly influence the growth and yield of maize. The results demonstrate that a higher nitrogen level of 200 kg ha^{-1} was optimal for enhancing key yield parameters, including biological yield, thousand grain weight, grain yield, and harvest index. Conversely, among the plant populations tested, a lower density of 60,000 plants ha^{-1} proved to be more beneficial for maximizing grain yield, biological yield, and harvest index compared to higher densities. Therefore, for the maize variety 'Jalal' under the agro-climatic conditions of Swabi during the Kharif season, the combination of a lower plant population (60,000 plants ha^{-1}) with a higher nitrogen rate (200 kg ha^{-1}) appears to be the most effective strategy for optimizing yield and yield-related attributes. This suggests that under these experimental conditions, compensating for lower plant density with enhanced nutrient supply per plant is a more productive approach than relying on higher plant populations.

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APPENDICES

Appendix-A

Table 1. Analysis of variance of number of days to physiological maturity of maize as affected by plant population and different levels of nitrogen.

Source of Variation (SOV)	DF	SS	MS	F-Value	Probability	Significance
Replication	2	4.22	2.11	0.66	0.57	NS
Plant Population	2	0.89	0.44	0.14	0.88	NS
Error 1 (Main Plot)	4	12.89	3.22			
Nitrogen	2	80.22	40.11	13.05	0.00	***
PP × N	4	1.56	0.39	0.13	0.97	NS
Error 2 (Sub Plot)	12	36.89	3.07			
Total	26	136.67				

CV_1 (%) = 1.71
CV_2 (%) = 1.67

Table 2. Analysis of variance of biological yield (kg ha^{-1}) of maize as affected by plant population and different levels of nitrogen.

Source of Variation (SOV)	DF	SS	MS	F-Value	Probability	Significance
Replication	2	71 994.74	35 997.37	1.31	0.37	NS
Plant Population	2	4 841 140.07	2 420 570.04	88.08	0.00	***
Error 1 (Main Plot)	4	109 923.70	27 480.93			
Nitrogen	2	1 373 582.74	686 791.37	12.01	0.00	**
PP × N	4	179 243.04	44 810.76	0.78	0.56	NS
Error 2 (Sub Plot)	12	685 964.22	57 163.69			
Total	**26**	**7 261 848.52**				

CV_1 (%) = 1.28
CV_2 (%) = 1.85

Table 3. Analysis of variance of thousand-grain weight (g) of maize as affected by plant population and different levels of nitrogen.

Source of Variation (SOV)	DF	SS	MS	F-Value	Probability	Significance
Replication	2	28.29	14.14	0.16	0.86	NS
Plant Population	2	3 203.95	1 601.97	17.84	0.01	*
Error 1 (Main Plot)	4	359.19	89.80			
Nitrogen	2	1 731.90	865.95	16.76	0.00	***
PP × N	4	251.77	62.94	1.22	0.35	NS
Error 2 (Sub Plot)	12	620.08	51.67			
Total	**26**	**6 195.18**				

CV_1 (%) = 3.25
CV_2 (%) = 2.47

Table 4. Analysis of variance of grain yield (kg ha^{-1}) of maize as affected by plant population and different levels of nitrogen.

Source of Variation (SOV)	DF	SS	MS	F-Value	Probability	Significance
Replication	2	330.30	165.15	0.31	0.75	NS
Plant Population	2	71 316.96	35 658.48	67.10	0.00	***
Error 1 (Main Plot)	4	2 125.70	531.43			
Nitrogen	2	13 212.74	6 606.37	8.25	0.01	**
PP × N	4	1 615.93	403.98	0.50	0.73	NS
Error 2 (Sub Plot)	12	9 612.67	801.06			
Total	**26**	**98 214.30**				

CV_1 (%) = 0.46
CV_2 (%) = 0.56

Table 5. Analysis of variance of harvest index (%) of maize as affected by plant population and different levels of nitrogen.

Source of Variation (SOV)	DF	SS	MS	F-Value	Probability	Significance
Replication	2	0.87	0.44	2.94	0.16	NS
Plant Population	2	74.92	37.46	252.21	0.00	***
Error 1 (Main Plot)	4	0.59	0.15			
Nitrogen	2	6.75	3.37	4.75	0.03	*
PP × N	4	1.06	0.26	0.37	0.82	NS
Error 2 (Sub Plot)	12	8.53	0.71			
Total	**26**	**92.72**				

CV_1 (%) = 0.99
CV_2 (%) = 2.16

Note. *CV_1 and CV_2 represent the coefficients of variation for the main-plot and subplot errors, respectively.*
*NS = non-significant; * = significant ($p < 0.05$); ** = highly significant ($p < 0.01$); *** = very highly significant ($p < 0.001$).*

Appendix B

Table 1. Replicated data of number of days to physiological maturity of maize as affected by plant population and different levels of nitrogen.

Plant population (ha^{-1})	Nitrogen (kg ha^{-1})	Rep 1	Rep 2	Rep 3
60 000	100	102	104	104
	150	105	104	106
	200	107	110	106
75 000	100	103	103	102
	150	106	106	104
	200	109	105	106
90 000	100	104	102	103
	150	104	106	105
	200	111	104	107

Table 2. Replicated data of biological yield (kg ha^{-1}) of maize as affected by plant population and different levels of nitrogen.

Plant population (ha^{-1})	Nitrogen (kg ha^{-1})	Rep 1	Rep 2	Rep 3
60 000	100	11 897	12 387	12 231
	150	12 589	12 520	12 312
	200	13 008	12 534	12 341
75 000	100	12 432	12 552	12 627
	150	12 749	13 002	12 734
	200	13 367	13 087	12 984
90 000	100	13 234	13 453	13 134
	150	12 876	13 542	13 330
	200	13 856	13 698	13 970

Table 3. Replicated data of thousand-grain weight (g) of maize as affected by plant population and different levels of nitrogen.

Plant population (ha^{-1})	Nitrogen (kg ha^{-1})	Rep 1	Rep 2	Rep 3
60 000	100	290.0	293.0	304.0
	150	298.1	300.4	311.2
	200	310.2	315.6	320.8
75 000	100	290.0	283.0	287.0
	150	281.0	301.0	283.0
	200	307.0	288.0	296.0
90 000	100	264.8	267.5	260.0
	150	278.0	276.0	280.0
	200	289.0	305.0	283.0

Table 4. Replicated data of grain yield (kg ha^{-1}) of maize as affected by plant population and different levels of nitrogen.

Plant population (ha^{-1})	Nitrogen (kg ha^{-1})	Rep 1	Rep 2	Rep 3
60 000	100	5 063	5 054	5 061
	150	5 145	5 084	5 065
	200	5 087	5 143	5 121
75 000	100	4 993	4 983	5 010
	150	5 041	5 022	5 008
	200	5 032	5 043	5 121
90 000	100	4 934	4 950	4 976
	150	4 956	4 960	4 951
	200	4 975	5 002	4 986

Table 5. Replicated data of harvest index (%) of maize as affected by plant population and different levels of nitrogen.

Plant population (ha^{-1})	**Nitrogen (kg ha^{-1})**	**Rep 1**	**Rep 2**	**Rep 3**
60 000	100	42.56	40.80	41.38
	150	40.87	40.61	41.14
	200	39.11	41.03	41.50
75 000	100	40.16	39.70	39.68
	150	39.54	38.62	39.33
	200	37.64	38.53	39.44
90 000	100	37.28	36.79	37.89
	150	38.49	36.63	37.14
	200	35.91	36.52	35.69

CONTENTS