Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP1: 574-576

Balwinder Singh
General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, Punjab, India

Kamlesh Kumar
General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, Punjab, India

Manpreet Kaur
General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, Punjab, India

Correspondence
Balwinder Singh
General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala, Punjab, India

(Special Issue- 1)
2nd International Conference
"Food Security, Nutrition and Sustainable Agriculture - Emerging Technologies"
(February 14-16, 2019)

Effect of nitrogen and zinc on yield and economics of winter maize (*Zea mays* L.) Under irrigated condition of Punjab

Balwinder Singh, Kamlesh Kumar and Manpreet Kaur

Abstract
Experiment was conducted during *rabi* season of 2015-16 at the Agricultural Research Farm Dhablan of the G.S.S.D.G.S. Khalsa college Patiala, Punjab. The experiment consisted of two factors viz. three nitrogen levels (N_0, N_{100}, N_{150} kg/ha) in main plots and four zinc levels (Z_0, $Z_{1.5}$, Z_3, Z_6 kg/ha) and was laid out in a Factorial Randomized block design replicated thrice. Cobs/plant, length of cob, number of grains/cobs, 1000-grain weight and weight of cobs increased with all fertilizer rates consistently and significantly over control. Nitrogen 150 kg/ha and zinc 6 kg/ha gave maximum 1000-grain weight (445.0 g), length of cob (19.20 cm), cob weight (240.40 g), number of grains/cob (368.30), grain yield (41.80 q/ha), stover yield (251.0 q/ha) and B.C ratio (2.62) followed by nitrogen 100 kg/ha and zinc 3 kg/ha.

Keywords: Nitrogen, zinc, economics, irrigated condition, *Zea mays* L.

Introduction
Maize (*Zea mays* L.) is one of the most important cereal crop which is used for human consumption and feed for animals. Maize can be grown during the whole year due to its adaptability to any season and is one of the most efficient crop which can give high biological yield as well as grain yield in a short period of time due to its unique photosynthetic mechanism. In India maize is cultivated over an area of 9.4 m ha with production of 23 million tonnes (2012-2013). In Punjab, maize ranks third in acreage and production after wheat and rice, occupying 133 thousand hectares, with a production of 91 thousand tonnes (Anonymous 2013). The introduction of new hybrid seeds that can survive low winter conditions, off-season diseases and pests with high productivity has made maize a profitable alternative even for small farmers in UP, Bihar, Andhra Pradesh and Karnataka. Hybrid seeds are also responsible for making maize a pan-India crop. Increase in Rabi production, along with increased acreage and supply, has turned Indian into a net exporter. Mukhtar *et al.* (2011) [4] evaluated the response of maize crop to various NP levels results showed that all fertilizer, rates significantly increased the plant height, 1000-grain weight, grain number/ear, grains weight/ear and grains yield over control. Raskar *et al.* (2013) [9] results revealed that highest B:C ratio was found to be significant under application of N3 (160 kg N ha-1), P3 (80 kg P2O5 ha-1)and Z2 (5 kg Z ha-1) over other treatments.

Materials and Methods
A field experiment entitled "Effect of nitrogen and zinc levels on the growth, yield and quality of winter maize (*Zea mays* L.)" was conducted at Research Farm, Dhablan, and Khalsa College Patiala during Rabi season 2015. The soil of experimental field was clayey texture having p^H 7.2.For post harvest studies 5 randomly marked plants in each plot were counted before Harvesting and then averaged as number of cobs/plant. While From the count of cob in each plot after harvesting, the length of 5 randomly selected cobs without husk was measured with meter scale and averaged as cob length. It was expressed in centimeters. In case of total number of Grains /cob of 5 randomly marked plants in each plot were counted before

Harvesting and then averaged as number of maize/plant. For cost of cultivation the cost of labor wages, amount spent on mechanical power for different operations and cost of inputs such as seed, fertilizers were calculated on the basis of the prevailing market rates. Gross return was calculated from the cost of produce i.e. Grain yield and straw yield prevailing in the market at the time of experimentation.

Treatment wise benefit: cost ratio was calculated to ascertain economic viability of the treatment using the formula:

$$\text{B: C ratio} = \frac{\text{Net returns}}{\text{Cost of cultivation}}$$

Results and Discussion

Effect of nitrogen on yield attributes and yield

The study showed that various yield contributing characters viz. Cobs/plant, length of cob, number of grains/cobs, 1000-grain weight and weight of cobs were significantly influenced by nitrogen application @ 150 kg/ha. Singh (2001) [11], Singh and Choudhary (2008) [12] reported increase in prolificacy with higher rates of nitrogen. Bhat *et al*. (2008) [2] also observed that increase in the application of nitrogen from 100 to 150 kg/ha resulted in improvement in corns/plant, corn length, corn girth and corn fresh weight. Vigorous and luxuriant growth of maize was observed when fertilized with 150 kg N/ha, which may have produced favorable influence on yield attributing characters. Studies on winter maize showed that there was significant and consistent increase in the grain yield with increase in the nitrogen levels. Highest grain yield were observed with application of nitrogen @ 150 kg/ha. This might be due to the fact that higher levels of N led to adequate supply of nutrients to the plant resulting in better growth which in turn led to better physiological process and movement of photosynthates to sink, Mahdi (2015) [5] and Khan *et al*. (2014) [9] reported that grain yield of sweet corn, pop corn and hybrid maize increased significantly with increasing levels of nitrogen (0– 150kg ha^{-1}) and highest was obtained at 150kg ha-1.

The study further revealed significant and consistent increase in stover yield with each enhancement in nitrogen level. However higher value of stover yield was observed with application of nitrogen @ 150 kg/ha. The vigorous and luxuriant growth of crop as noticed from improved growth characters viz. plant height and dry matter accumulation at higher levels of nitrogen might have contributed to the higher stover yield. Khatun *et al.* (2012) [6] found that application of 130 kg N ha-1 gave significantly higher stover yield as compared to no nitrogen in maize.

Effect of nitrogen on yield attributes and yield

The study showed that various yield contributing characters viz. Cobs/plant, length of cob, number of grains/cobs, 1000-grain weight, weight of cobs and yield were significantly influenced by zinc fertilization. Highest yield and attributes was obtained with application of zinc @ 6 kg/ha. Ali *et al*. (2008) [1] and Hariss *et al.* (2007) [3] reported increase in yield attributing characters viz. corns/plant, corn length, girth and weight with higher doses of zinc. The positive effect of zinc on maize yield results in the fact that this nutrient stimulates the activity of several enzymes, including carbonic hydrase. However, one of the most important functions relates to the activity of hormones, such as auxins. The result are in agreement with Kanwal *et al*. (2010) [7] who reported that increasing dose of zinc increasing grain yield of maize.

Effect of nitrogen and zinc on relative economics

The efficiency of a treatment is finally decided in terms of the economics (benefit: cost ratio) of that treatment. It is important to observe that increase in economic yield justify the expenditure involved. The present investigation revealed that treatment combination, nitrogen 150 kg/ha and zinc level 6 kg/ha gave the highest benefit cost ratio which also gave the highest gross and net returns. Raskar *et al*. (2013) [9] reported that highest B: C ratio was found to be significant under application of N_3 (160 kg N ha-1), P_3 (80 kg P2O5 ha-1) and Z_2 (5 kg Z ha-1) over other treatments.

Conclusion

The results obtained from this investigation, it is concluded that for obtaining maximum yield and net profit, it is advisable to supply 150 kg/ha and zinc level 6 kg/ha to winter maize. Different methods of application of fertilizer and their efficiency goes through the judging so that cost of cultivation is decreased in order to minimize the load of investment on farmer But before the final recommendation it is suggested that the experiment should be repeated at least two season for observing the consistency and applicability of treatments.

Table 1: Effect of nitrogen and zinc on grain yield (q/ha) of winter maize

	Z_0	**Z_1**	**Z_2**	**Z_3**	**Mean**
N_0	19.50	21.30	23.50	33.30	24.41
N_1	23.70	26.20	33.30	38.00	30.29
N_2	24.10	29.90	36.00	41.80	33.03
Mean	22.54	25.79	30.93	37.72	

	F-Test	**SE(d)±**	**CD 0.05**
Nitrogen	S	0.20	0.43
Zinc	S	0.24	0.50
N*Z	S	0.41	0.86

Notation:

Z_0 = Control N_0= Control

Z_1 = 1.5 kg/ha N_1 =100 kg/ha

Z_2 = 3 kg/ha N_2=150 kg/ha

Z_3 = 6 kg/ha

Table 2: Effect of nitrogen and zinc on Stover yield (q/ha) of winter maize

	Z_0	**Z_1**	**Z_2**	**Z_3**	**Mean**
N_0	116.80	127.80	139.00	197.20	145.19
N_1	142.20	157.30	197.00	228.50	181.24
N_2	147.70	179.50	215.80	251.00	198.51
Mean	135.54	154.89	183.93	225.55	

	F-Test	**SE(d)±**	**CD 0.05**
Nitrogen	**S**	0.82	1.71
Zinc	**S**	0.95	1.98
N*Z	**S**	1.65	3.43

Notation

Z_0 = Control N_0= Control

Z_1 = 1.5 kg/ha N_1 =100 kg/ha

Z_2 = 3 kg/ha N_2=150 kg/ha

Z_3 = 6 kg/ha

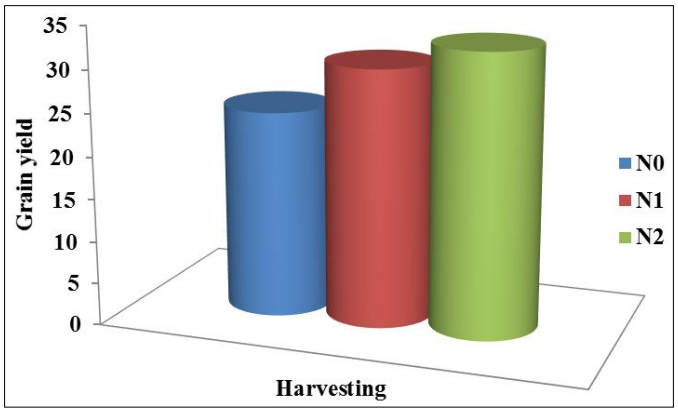

Fig 1a: Effect of nitrogen on grain yield (q/ha) of winter maize

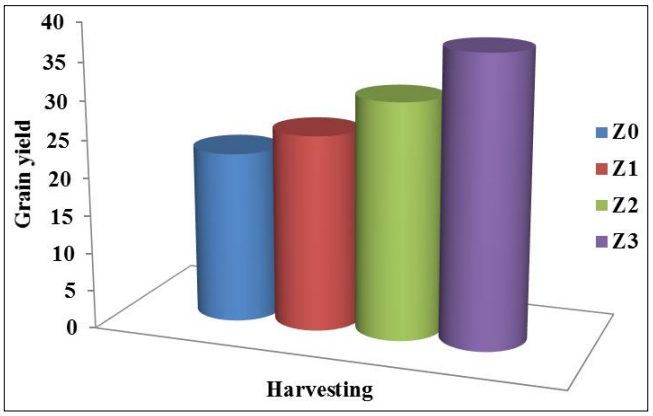

Fig 1b: Effect of zinc on grain yield (q/ha) of winter maize

Table 3: Economics of the treatment combination (Rabi, 2015-2016)

Treatment Combinations	Mean yield (q/ha)		Gross returns (Rs/ha)	Total cost* of cultivation	Net returns (Rs/ha)	B: C ratio
	Grain	Stover				
T1 (Z_0N_0)	19.50	116.80	38,980	20,480	18,500	0.90
T2 (Z_0N_1)	23.70	142.20	47,400	21,740	25,660	1.18
T3 (Z_0N_2)	24.50	147.70	49,070	22,370	26,700	1.19
T4 (Z_1N_0)	21.30	127.80	42,600	20,652	21,948	1.06
T5 (Z_1N_1)	26.20	157.30	52,410	21,912	30,498	1.39
T6 (Z_1N_2)	29.90	179.50	59,810	22,542	37,268	1.65
T7 (Z_2N_0)	23.50	139.00	46,800	20,823	25,977	1.24
T8 (Z_2N_1)	33.30	197.00	66,320	22,083	44,237	2.00
T9 (Z_2N_2)	36.00	215.80	71,980	22,713	49,267	2.16
T10 (Z_3N_0)	33.30	197.20	66,340	21,166	45,174	2.13
T11 (Z_3N_1)	38.00	228.00	76,000	22,426	53,574	2.38
T12 (Z_3N_2)	41.80	251.00	83,620	23,056	60,564	2.62

* Cost of cultivation + cost of treatments (c) Selling price of produce
Cost of cultivation = 20480 (i) Maize grain = 1400/q
(ii) Maize stover = 100/q
(a) Cost of Nitrogen = Rs 12.60/kg
(b) Cost of Zinc = Rs. 114.28/kg

References

1. Ali Sajid. Assessment of different crop nutrient management practices for yield improvement. Australian Journal of Crop Science. 2008; 2(3):150-157.
2. Bhat RA, Wani A, Dawson J. Integrated nutrient management on the growth & yield of maize under conditions of U.P. The Asian Journal of Horticulture. 2008; 3(2):229-231.
3. Hariss D, Rashid A, Miraj G, Arif M, Shah H. On-farm seed priming with zinc sulphate solution a cost effective way to increase the maize yields of resource poor farmers. Field Crops Research. 2007; 102:119-127.
4. Mukhtar T, Arif M, Hussain S, Tariq M, Mehmood K. Effect of different rates of nitrogen and phosphorus fertilizers on growth and yield of maize. J Agric. Res. 2011; 49(3):333-338.
5. Mahdi Ayman HA, Samier Ismail KA. Maize productivity as affected by plant density and nitrogen fertilizer. Int. J Curr. Microbiol. App. Sci. 2015; 4(6):870-877.
6. Khatun HA, Hasan1 MM, Sultana1 S, Khatun1 M, Rahman SME, Deog-Hwan Oh. Effect of Irrigation and Nitrogen Levels on the Growth and Yield of Maize. Biological and Biomedical Reports. 2012; 2(2):87-93.
7. Kanwal S, Rahmatullah A, Ranjha M, Welch RM, Allaway WH, House WA *et al*. Zinc partitioning in maize grain after I. Kubota, 1991. Geographic distribution of trace soil fertilization with zinc sulfate. Int. J Agric. Biol., element problems. In: Micronutrients in Agriculture. 2010; 12:299-302.
8. Raskar SS, Sonani VV, Patil PA. Study of Economics of Maize as influenced by different levels of Nitrogen, Phosphorus and Zinc. International Journal of Scientific and Research Publications, 2013, 7.
9. Khan F, Khan S, Fahad S, Faisal S, Hussain S, Ali S *et al*. Effect of Different Levels of Nitrogen and Phosphorus on the Phenology and Yield of Maize Varieties. American Journal of Plant Sciences. 2014; 5:2582-2590. Doi: 10.4236/ajps.2014.517272.
10. Singh SD. Effect of irrigation regimes and nitrogen levels on growth, yield and quality of baby corn. Madras Agricultural Journal. 2001; 88(7-9):367-370.
11. Singh D, Choudhary J. Effect of plant population and fertilization levels on yield and economics of popcorn (*Zea mays indurata*). Indian Journal of Agricultural Sciences. 2008; 78(4):370-371.