Original Research Article

Effect of Nitrogen and Zinc levels on Yield and Economics of Mustard (*Brassica juncea*L.)

Abstract

A field experimental trial entitled "Effect of Nitrogen and Zinc levels on Yield and Economics of Mustard (*Brassica juncea* L.)" was undertaken during *Rabi* season (2021-2022) at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (Allahabad) (U.P.). The size of experimental field is 243m^2 and soil of experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28 %), available Nitrogen (225 kg/ha.), available Phosphorus (19.50 kg/ha.) and available Potassium (213 kg/ha.). The treatments consisted of 3 levels of Nitrogen N_1 (60 kg/ha.), N_2(80 kg/ha.), N_3 (100 kg/ha.) and 3 levels of Zinc Zn_1 (5 kg/ha.), Zn_2 (10 kg/ha.) and Zn_3 (15 kg/ha.). The experiment was laid out in Randomized Block Design with 9 treatments and 3 replications. The results revealed that the application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. recorded maximum siliqua length (5.20 cm), number of siliquae per plant (398.90), number of seeds per siliqua (24.40), test weight (3.53 g). The economic analysis demonstrates that Nitrogen 100 kg/ha. + Zinc 15 kg/ha. treatment produced higher grain yield (1.89 t/ha.), stover yield (3.11 t/ha.), gross returns (103650.00 INR/ha.), net returns (70264.08 INR/ha.) and B:C ratio (2.10). The major challenges experienced throughout the research work were mostly related to the use of nitrogen and zinc.

Key words: *-Nitrogen, Growth, Yield, Zinc, Rabi, Economics.*

INTRODUCTION

Indian mustard (*Brassica juncea* L.) belonging to the family cruciferae is one of the important oilseed crops and currently ranked as world's third important oilseed crop in terms of production and area. It have a major role in Indian agriculture since each part of the plant is consumed either by human beings or animals depending upon the crop and its growth stage. Among the seven edible oilseeds cultivated in India, mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy and predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. Rajasthan ranks first in area and production of rapeseed and mustard with 2.50 million ha. area and 3.71 million tonnes production. Mustard oil is used as condiment in pickles, flavoring curries and vegetables, preparation of hair oils, medicines, soap making and in the tanning industry for softening of leather. The mustard cake is used mostly for cattle feed and manure. Mustard also has potential pharmacological effects in cancer, diabetes and cardiovascular disease ; however, there are limited clinical trials to support its uses for any indication. Nitrogen is vital for crops because it is a major constituent of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide through the process of photosynthesis. It is

correspondingly a major factor of amino acids, the building blocks of proteins. Lacking proteins, plants wither and die. The main nutrients are required for plant growth are nitrogen (N), phosphorus (P), and potassium (K) and the use of nitrogen fertilizer outcomes in improved crop production costs and atmospheric pollution. Numerous plant particles such as amino acids, chlorophyll, nucleic acids, ATP and phytohormones, that contains nitrogen as a basic part, are required to complete the biological processes, involving carbon and nitrogen metabolisms, photosynthesis and protein production. Nitrogen application is more important than the other major important fertilizers/nutrients for successful crop production.Zinc is a divalent action exhibiting important role in health & disease as evidenced by the role of Zn in the functional capacity more than 200 metallic enzymes including Carbonic anhydrase, Carboxypeptidases, Alcohol dehydrogenases, Alkaline phosphatases, and RNA Polymerases etc. It is also required to maintain the structure of nucleic acid protein, cell membrane and also exerts vital role in various physiological functions viz., Cell growth, division, maturation and reproduction etc. **(Alam *et al.*, 2010; Alloway, 2008).**The main functions of zinc is tendency to make up tetragonal complexes with nitrogen, oxygen and sulphur thus zinc have a catalytic, building and activating role in the enzymes (**Alloway, 2008**). Zinc is essential element for crop production and optimal size of fruit, also it required in the carbonic enzyme which present in all photosynthetic tissues and required for chlorophyll biosynthesis. **(Ali *et al.*, 2008).**

MATERIALS AND METHODS

The experiment entitled "Effect of Nitrogen and Zinc levels on Yield and Economics of Mustard (*Brassica juncea* L.)" was conducted during *Rabi* season of 2021-2022. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications. The size of experimental field is 243m^2 and the soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.1) with low level of organic carbon (0.28%), available N (225 kg/ha.), P (19.50 kg/ha.) and higher level of K (213 kg/ha.). The treatment combinations are T_1 Nitrogen 60 kg/ha. + Zinc 5 kg/ha., T_2 Nitrogen 60 kg/ha. + Zinc 10 kg/ha., T_3 Nitrogen 60 kg/ha. + Zinc 15 kg/ha., T_4 Nitrogen 80 kg/ha. + Zinc 5 kg/ha., T_5 Nitrogen 80 kg/ha. + Zinc 10 kg/ha., T_6 Nitrogen 80 kg/ha. + Zinc 15 kg/ha., T_7 Nitrogen 100 kg/ha. + Zinc 5 kg/ha., T_8 Nitrogen 100 kg/ha. + Zinc 10 kg/ha., T_9 Nitrogen 100 kg/ha. + Zinc 15 kg/ha. The observations were recorded on different yield parameters at harvest viz. Number of siliquae per plant, number of seeds per siliqua, length of siliqua, test weight, seed yield and stover yield and after harvest cost of cultivation (INR/ha.), gross return (INR/ha.), net return (INR/ha.) and B:C ratio is calculated.

ANOVA for RBD

Sources of variance	**Df**	**SS**	**MS**	**F**
Replication	r-1	RSS	RMS	RMS/EMS

Treatment	t-1	TSS	TMS	TMS/EMS
Error	(r-1) (t-1)	ESS	EMS	
Total	rt-1	Total SS		

Computation of ANOVA

C.F. = Correction factor = G^2/N

G = Grand total

N = Number of observations

Total sum of squares (T.S.S.) = $\Sigma i \Sigma j X^2 ij$- C.F.

$$\text{Replication Sum of Square (R.S.S.)} = \frac{\Sigma_j R^2 j}{T} - \text{C.F.}$$

$$\text{Treatment Sum of Square (Tr.S.S.)} = \frac{\Sigma_j T^2 i}{T} - \text{C.F.}$$

Error Sum of Square (E.S.S.) = T.S.S. – R.S.S. – Tr.S.S

RESULT AND DISCUSSION

A. Yield Attributes

The data pertaining to yield parameters have been presented in Table 1. The important yield parameters are number of siliquae per plant, number of seeds per siliqua, length of siliqua (cm), test weight (g), seed yield (t/ha.), stover yield (t/ha.) and harvest index (%) which were influenced by significantly by various treatments.

No. of Siliquae per plant

Treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was recorded maximum number of siliquae per plant (398.90) which was significantly superior over all other and treatment with application of Nitrogen 100 kg/ha. + Zinc 10 kg/ha. (375.40) which was statistically at par with the treatment with application of Nitrogen 100 kg/ha. + Zinc 15kg/ha.

No. of Seeds per Siliqua

Treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was recorded maximum number of seeds per siliqua (24.40) which was significantly superior over all other treatment and treatment with application of Nitrogen 100 kg/ha. + Zinc 10 kg/ha. (22.30)

which was statistically at par with the treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha.

Length of Siliqua (cm)

Treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was recorded maximum length of siliqua (5.20) which was significantly superior over all other treatment and treatment with application of Nitrogen 100 kg/ha. + Zinc 10 kg/ha. (5.10) which was statistically at par with the treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha.

Test Weight (g)

Treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was recorded maximum test weight (3.53 g) which was significantly superior over all other and treatment with application of Nitrogen 100 kg/ha. + Zinc 10 kg/ha. (3.29 g) which was statistically at par with the treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha.

Seed Yield (t/ha.)

Treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was recorded maximum seed yield (1.89 t/ha.) which was significantly superior over all other treatments with application of Nitrogen 100 kg/ha. + Zinc 10 kg/ha. (1.79 t/ha.) and Nitrogen 80 kg/ha. + Zinc 15 kg/ha. (1.75 t/ha.) which was statistically at par with the treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha.

Stover Yield (t/ha.)

Treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was recorded maximum stover yield (3.11 t/ha.) which was significantly superior over all other treatment with application of Nitrogen 100 kg/ha. + Zinc 10 kg/ha. (3.06 t/ha.) which was statistically at par with the treatment with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha.

Harvest Index (%)

Treatment with application of Nitrogen 80 kg/ha. + Zinc 10 kg/ha. was recorded maximum harvest index (38.63 %) and minimum with application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. (36.83 %). There was no significance difference between different treatment combinations.

Table.1 Effect of Nitrogen and Zinc levels on Yield Attributes and Yield of Mustard.

Treatments	No. of Siliquae per plant	No. of Seeds per Siliqua	Length of Siliqua	Test Weight (g)	Seed Yield (t/ha.)	Stover Yield (t/ha.)	Harvest Index (%)
Nitrogen 60 kg/ha. + Zinc 5 kg/ha.	289.80	17.90	4.40	2.52	1.41	2.39	36.98
Nitrogen 60 kg/ha. + Zinc 10 kg/ha.	312.70	18.70	4.70	2.69	1.51	2.43	38.25
Nitrogen 60 kg/ha. + Zinc 15 kg/ha.	330.20	19.40	4.80	2.74	1.59	2.64	37.62
Nitrogen 80 kg/ha. + Zinc 5 kg/ha.	320.20	18.90	4.70	2.68	1.54	2.57	37.49
Nitrogen 80 kg/ha. + Zinc 10 kg/ha.	348.50	20.20	4.80	2.91	1.71	2.75	38.63
Nitrogen 80 kg/ha. + Zinc 15 kg/ha.	365.00	21.70	4.90	3.04	1.75	2.87	37.93
Nitrogen 100 kg/ha. + Zinc 5 kg/ha.	341.00	19.70	4.80	2.88	1.66	2.70	38.16
Nitrogen 100 kg/ha + Zinc 10 kg/ha.	375.40	22.30	5.10	3.29	1.79	3.06	37.06
Nitrogen 100 kg/ha. + Zinc 15 kg/ha.	398.90	24.40	5.20	3.53	1.89	3.11	36.83
SEm (±)	7.85	0.71	0.08	0.12	0.05	0.05	1.08
CD (5%)	23.54	2.13	0.25	0.35	0.15	0.17	-----

Source – Experimental Field, Crop Research Farm, SHUATS, Prayagraj (U.P.)

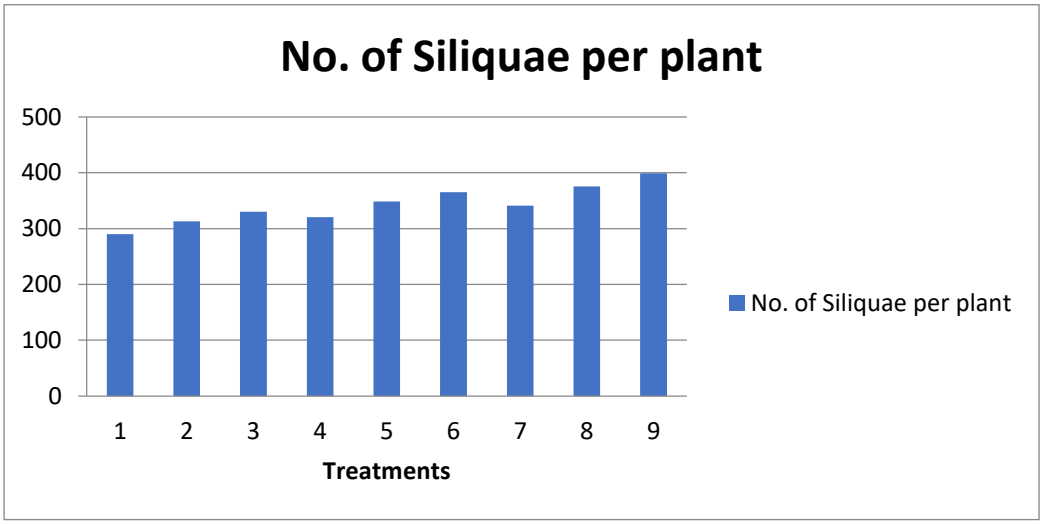


Fig. 1

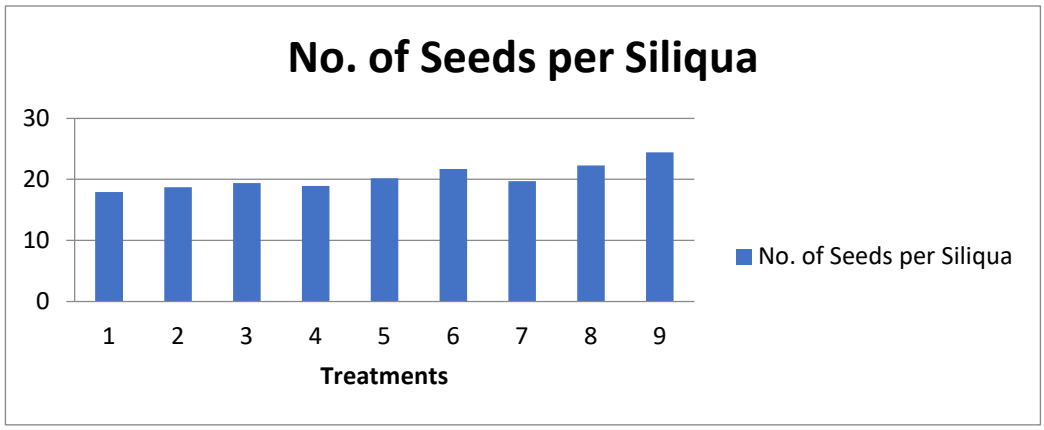
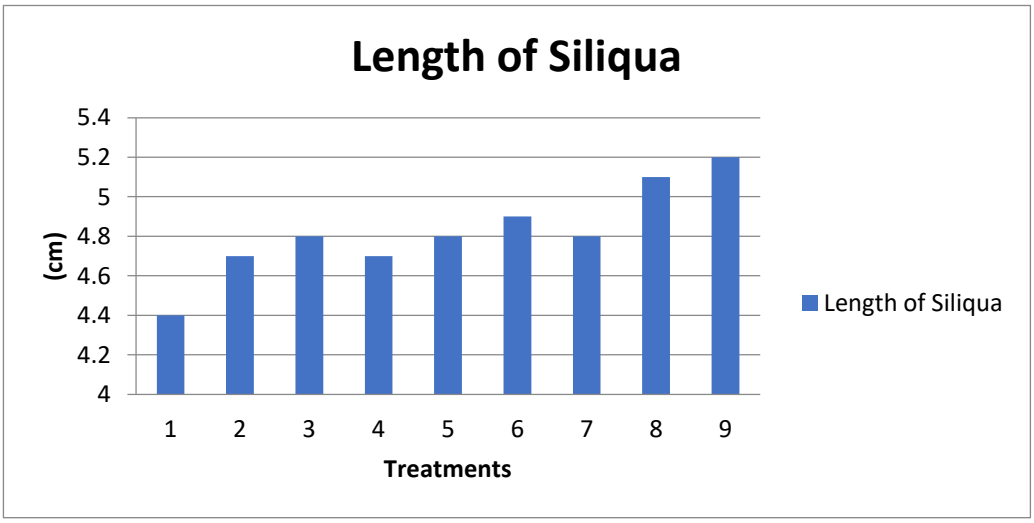


Fig. 2



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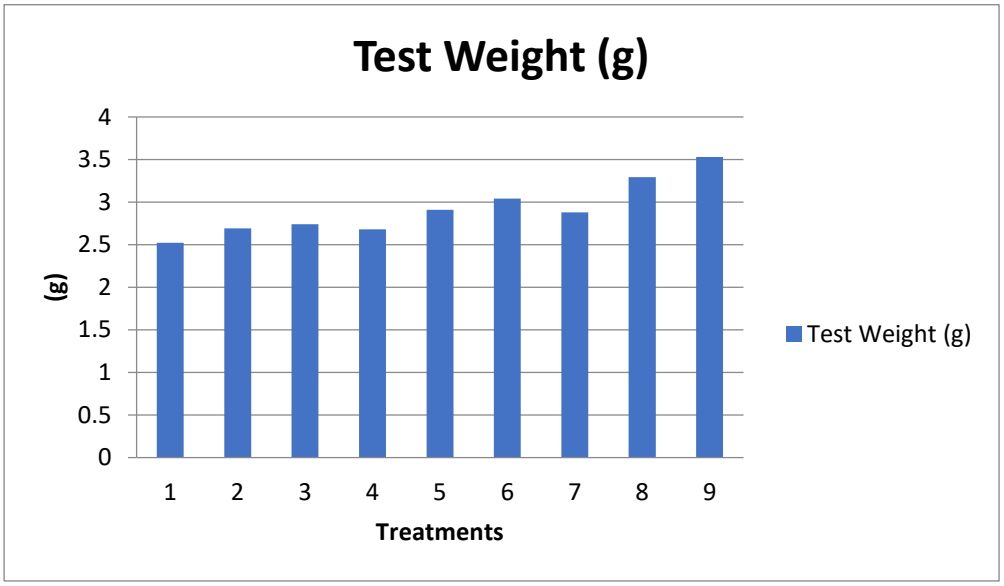

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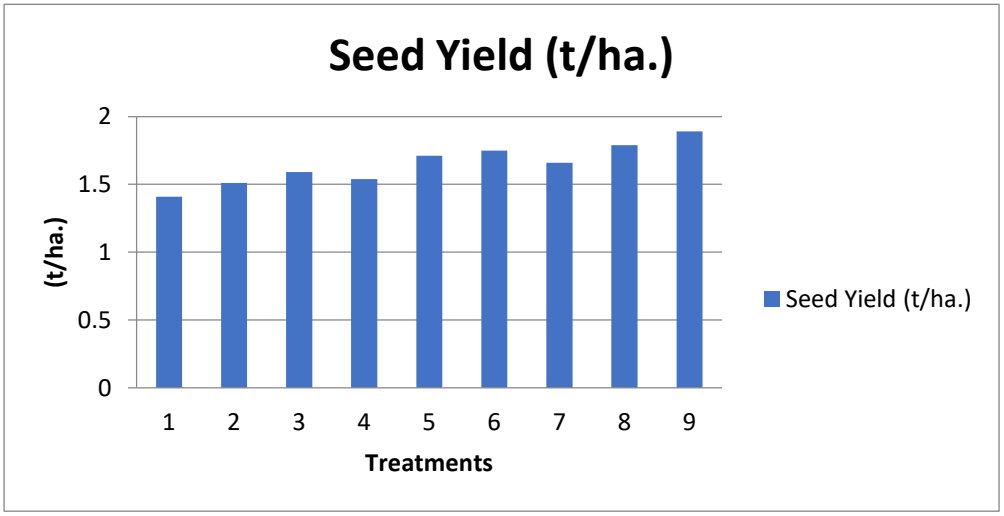

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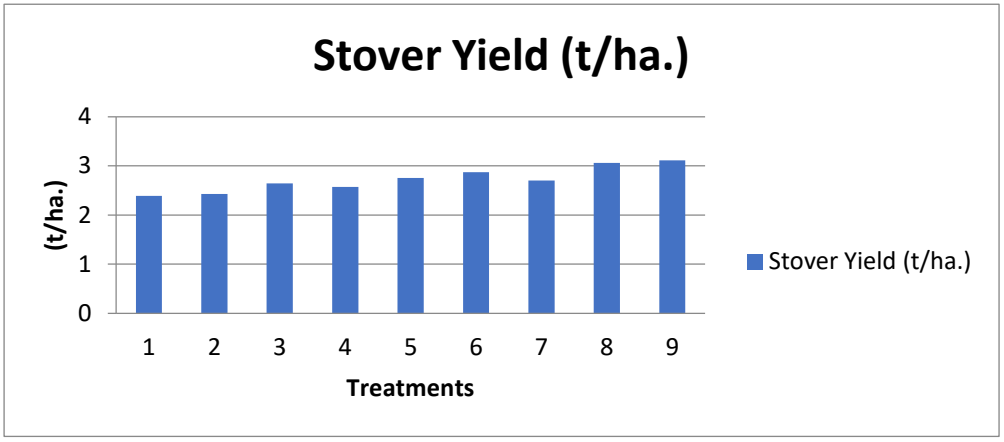

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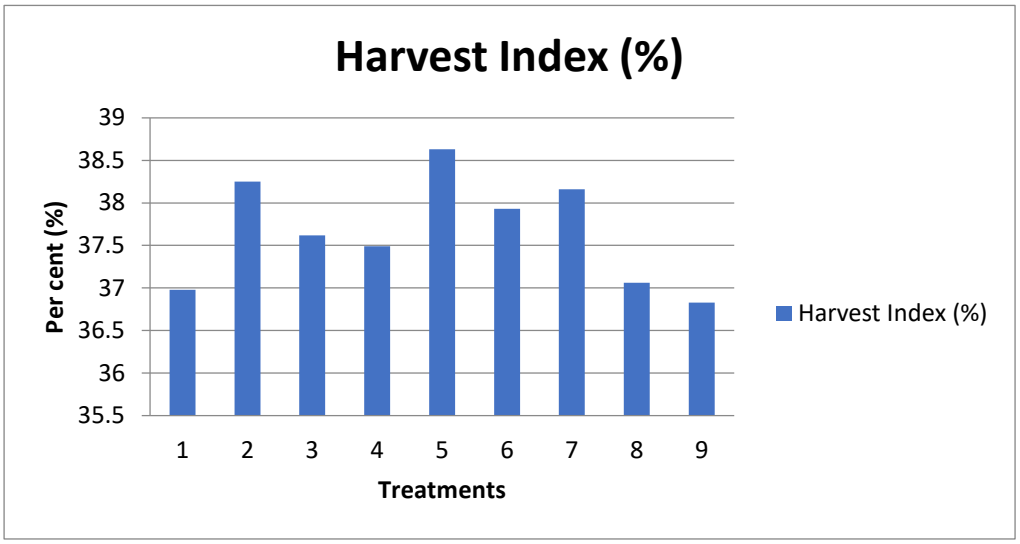

Fig. 7

B. Economics

Gross returns, Net returns and benefit cost ratio of different treatments are depicted inTable2.

Cost of Cultivation (INR/ha.)

Cost of cultivation (33385.92 INR/ha.) was found to be highest in Nitrogen 100 kg/ha. + Zinc 15 kg/ha. And the minimum cost of cultivation (31171.52 INR/ha.) was found to be in Nitrogen 60 kg/ha. + Zinc 5 kg/ha. as compared to other treatments.

Gross Returns (INR/ha.)

Gross returns (103650.00 INR/ha.) were found to be highest in Nitrogen 100 kg/ha. + Zinc 15 kg/ha. and the minimum gross returns (78450.00 INR/ha.) was found to be Nitrogen 60 kg/ha. +Zinc 5 kg/ha. as compared to other treatments.

Net Returns (INR/ha.)

Net returns (70264.08 INR/ha.) were found to be highest in Nitrogen 100 kg/ha. + Zinc 15 kg/ha. and the minimum net returns (47278.48 INR/ha.) was found to be Nitrogen 60 kg/ha. + Zinc 5 kg/ha. as compared to other treatments.

Benefit Cost Ratio (B:C)

Benefit Cost ratio (2.10) was found to be highest in Nitrogen 100 kg/ha. + Zinc 15 kg/ha. and the minimum benefit cost ratio (1.51) was found to be in Nitrogen 60 kg/ha. + Zinc 5 kg/ha. as compared to other treatments.

Table.2 Effect of Nitrogen and Zinc levels on Yield and Economics of Mustard.

Treatments	Total Cost of Cultivation (INR/ha.)	Gross Returns (INR/ha.)	Net Returns (INR/ha.)	B:C ratio
Nitrogen 60 kg/ha. + Zinc 5 kg/ha.	31171.52	78450.00	47278.48	1.51
Nitrogen 60 kg/ha. + Zinc 10 kg/ha.	32171.52	81800.00	49628.48	1.54
Nitrogen 60 kg/ha. + Zinc 15 kg/ha.	33171.52	87400.00	54228.48	1.63
Nitrogen 80 kg/ha. + Zinc 5 kg/ha.	31278.72	84750.00	53471.28	1.70
Nitrogen 80 kg/ha. + Zinc 10 kg/ha.	32278.72	92850.00	60571.28	1.82
Nitrogen 80 kg/ha. + Zinc 15 kg/ha.	33278.72	95750.00	62471.28	1.87
Nitrogen 100 kg/ha. + Zinc 5 kg/ha.	31385.92	90400.00	59014.08	1.88
Nitrogen 100 kg/ha + Zinc 10 kg/ha.	32385.92	99700.00	67314.08	2.07
Nitrogen 100 kg/ha. + Zinc 15 kg/ha.	33385.92	103650.00	70264.08	2.10

Source – Experimental Field, Crop Research Farm, SHUATS, Prayagraj (U.P.)

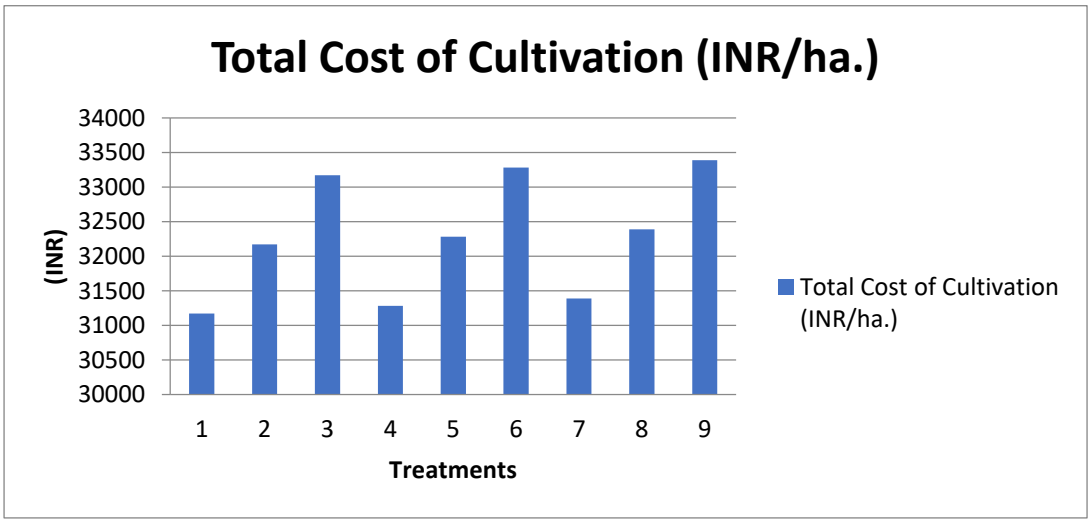

Fig. 8

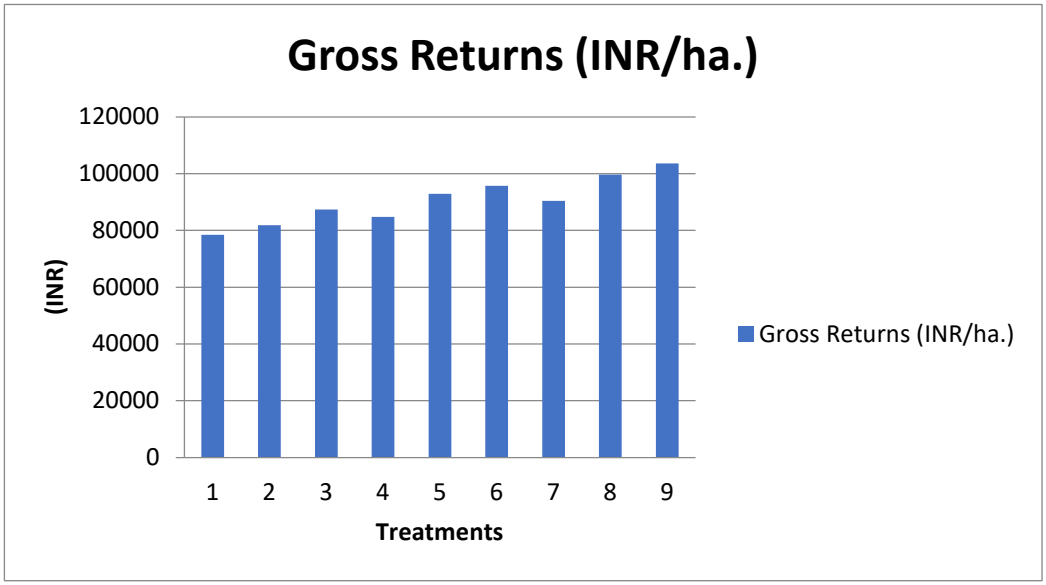

Fig. 9

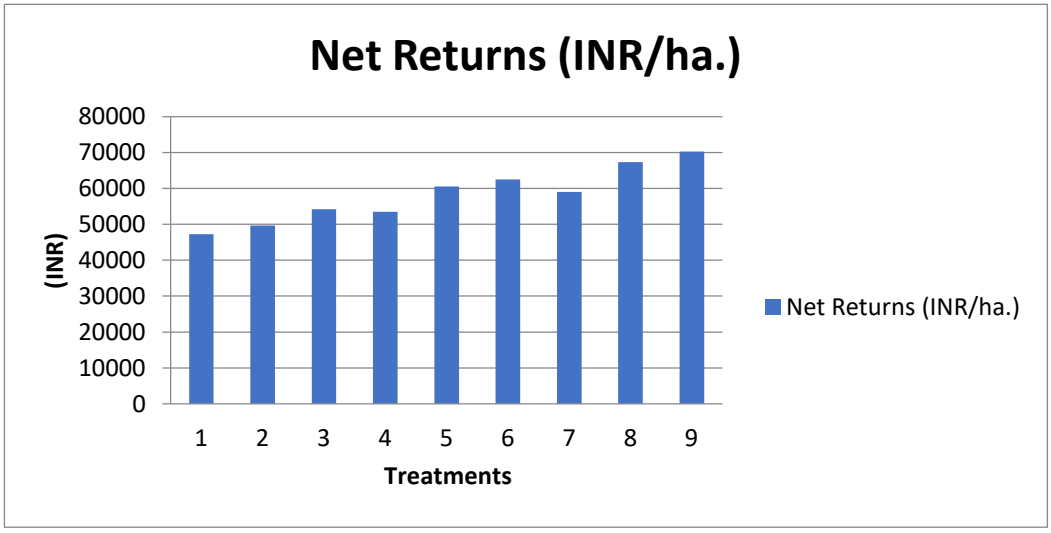

Fig. 10

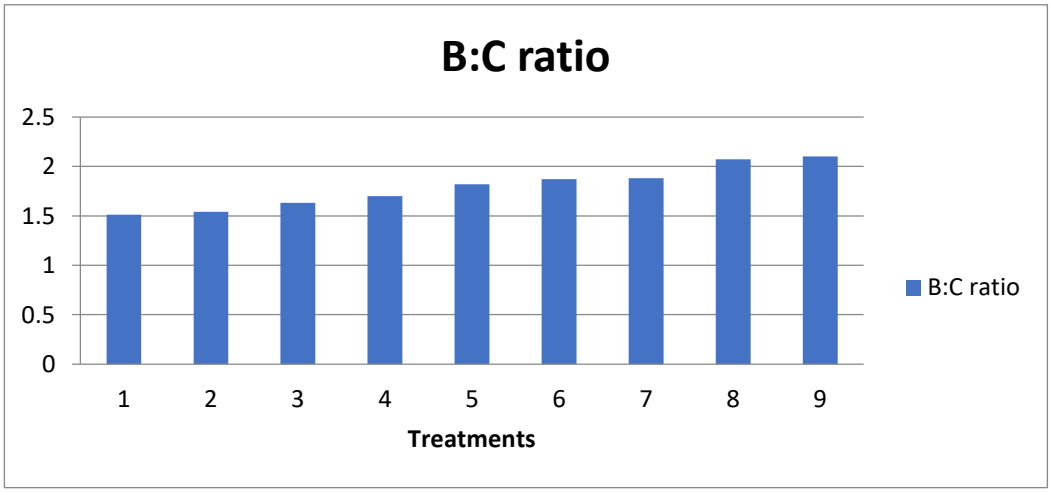

Fig. 11

Fig 12. Fertilizer application before sowing

Fig 13. Weeding at 20 DAS

Fig 14. Observation recorded at 60 DAS

Fig 15. Mustard seed at 120 DAS

CONCLUSION

On the basis of one season experimentation it is concluded that combined application ofNitrogen 100 kg/ha. + Zinc 15 kg/ha. gave significant effect on yield and economics parameters in mustard. The combined application of Nitrogen 100 kg/ha. + Zinc 15 kg/ha. was found more productive (1.89 t/ha.) as well as economically viable (INR 70264.08/ha.) also. The conclusions drawn are based on one season research only which requires further confirmation and recommendation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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