Original Research Article

"Influence of nitrogen and zinc on growth and yield of barley (*Hordeum vulgare*)"

ABSTRACT

A field experiment was conducted during *Rabi* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on the topic "Influence of nitrogen and zinc on growth and yield of barley (*Hordeum vulgare*)", to study treatments consisting of three levels of nitrogen (50, 60 and 70 kg/ha) with combination of zinc (15,20 and 25 kg/ha). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 8.0), low in organic carbon (0.62 %), available N (225 kg/ha), available P (38.2 kg/ha) and available K (240.7 kg/ha). The results revealed that significant and higher plant height (92.18 cm), maximum number of tillers /hill (5.00), higher plant dry weight (35.77 g), maximum number of effective tillers/hill (3.33), spike length (8.00 cm), grains/spike (64.07), test weight (38.02 g), grain yield (5.84 t/ha), straw yield (7.59 t/ha), gross returns (1,29,640.00 INR/ha), Net returns (90,919.00 INR/ha) and Benefit cost ratio (2.34) was recorded in treatment 9 [nitrogen (70kg/ha) + zinc (25kg/ha)].

Keywords: Nitrogen, Zinc, Growth, Yield, Economics.

Introduction

Barley (*Hordeum vulgare* L.) is an ancient cereal grain and one of the oldest of the cultivated plants. It is also called as poor man's crop because of its low input requirement. It can be grown in diverse agroclimatic conditions like salinity, alkalinity, frost and drought. Barley is a *rabi* cereal grain crop, which usually used as a food for human beings and feed for animals. In India, about 75% barley is used for feed, 20% for malt and remaining 5% for the food purposes. The utilization of barley for the malting and brewing industry has picked up recently including About 0.23 million tones barley is used by the malting industries for production of beer, whisky and vinegar. Malt syrup is utilized in the preparation of candies, breakfast, beverages and medicines. Barley contains soluble fibers, which reduce hunger and enhances feeling of fullness and even promotes weight loss. Regular adding barley to the diet reduces risk factors for heart diseases, high blood pressure. Barley grain contains 12.5% moisture,11.5% albuminoids, 74% carbohydrates, 3.9% crude fiber and 1.5% ash. Each 100g of barley grains comprises 10.6g proteins, 2.1g fat, 64g carbohydrates, 50mg calcium, 6.0mg iron, 31mg vitamin B_1 and 0.10mg vitamin B_2 **(Dundigala *et al.* 2021)**.

Barley is the world's 4^{th} most essential cereal crop after wheat, rice and maize with a share of about 7% of the global cereals production and 15% of coarse grain consumption. Globally, Russia, China, France, USA and Spain with global productivity of 149.53 million metric tons with average productivity of 5283 kg/ha. India is the major barley producing country, cultivated in an area of 23.83 million hectares with production of 51.15 million tonnes and average productivity of 2146 kg/ha. The major barley growing regions in India are Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, Haryana and Punjab. In Uttar Pradesh, the area under cultivation of barley is about 2.02 million hectares with production of 4.59 million tonnes and average productivity of 2266 kg/ha in 2020-2021 **(GOI, 2021)**.

Problem like, deficiency of nitrogen in barley limits the growth of roots, shoots and reduces tillering, which results in small and weak shoots, small ears and hastens grain maturity, these elements influence the vegetative and reproductive growth and results low yield. A linear increase in grain yield with increasing nitrogen levels was observed. Which results in, significantly increase in plant height, number of effective tillers, grain yield and straw yield of barley. Zinc deficiency in plants leads to low grain yield due to lack of nutrient availability to crop during grain filling stage. Zinc plays a vital role in enzyme activation, carbohydrates metabolism and photosynthesis. Application of zinc in barley tends to increase in grain yield gradually might be due to application of zinc results in enzyme activation and helps in availability of nutrients uptake by plants during grain filling stage, which results in obtaining more yield was observed.

Solution for problem obtain by nitrogen deficiency is to maintain adequate nitrogen fertilization to overcome poor fertility of the soil and deficiency of nitrogen, which are the major production constraints in barley. Barley is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization. Nitrogen is vitally important plant nutrient and is one of the universally deficient plant nutrients in soils of India particularly the loams and semi-arid regions of Uttar Pradesh. The important role of nitrogen in the plant is, its presence in the structure of protein and nucleic acid, which are the most important building and formative substances form which the living material or protoplasm of every cell is made. In addition, nitrogen is also essential for photosynthesis and chlorophyll synthesis. In other hand, excess nitrogen leads to disproportionate vegetative growth, resulting in greatly increased danger of lodging, delayed crop maturity and greater susceptibility to diseases and pests. Farmers use nitrogen fertilizers without any adequate information concerning actual soil requirement **(Dubey *et al.* 2018).** The efficiency of utilization of added nitrogen fertilizer is about 50-70%, as applied nitrogen is subjected to various kinds of losses in the environment, causing for low yield. In order to get maximum benefit from nitrogen, it should apply at right with adequate quantity. Use of proper split dose of nitrogen, which helps to meet the crop requirement throughout life cycle for higher production and less accumulation of nitrogen in grains, may be one of the strategies to achieve the high yield and quality of barley **(Jadon *et al.* 2015).**

Zinc deficiency in soils is prevalent worldwide both in temperate and tropical climates. In India, about 50% of the soils are deficient in the zinc and this remains the most important nutritional disorder affecting crop production. Zinc deficiency is expected to increase from 42-63% by 2025 due to continuous depletion of soil fertility **(Kumari *et al.* 2016)**. Zinc is one of the essential plant micro nutrients required for optimum plant growth and plays a vital role in carbohydrate metabolism and photosynthesis. It required in small quantity but critical concentration for the functioning of several plants physiological function like photosynthesis, sugar formation, pollen formation, seed production, growth regulation and disease resistance. Zinc deficiency not only retards growth and yield if plants, but also has effect on human beings, more than 3 billion people world-wide are suffering Zn and Fe deficiencies. This is actually due to low Zn content of the crop grown in the Zn deficient soils. In addition, zinc activates enzymes and is required in the synthesis of indole acetic acid, a growth hormone. Zn is required in synthesis of tryptophan which is a precursor of IAA, it also has an active role in the production of an essential growth hormone auxin. Keeping in view the above fact, the experiment was conducted to find out "Influence of nitrogen and zinc on growth and yield of barley (*Hordeum vulgare*)"

Materials and Methods

The experiment was conducted during *Rabi* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) on the topic "Influence of nitrogen and zinc on growth and yield of barley", to study treatments consisting of three levels of nitrogen (50, 60 and 70 kg/ha) with combination of zinc (15,20 and 25 kg/ha). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 8.0), low in organic carbon (0.62 %), available N (225 kg/ha), available P (38.2 kg/ha) and available K (240.7 kg/ha). There were 10 treatments, each being replicated thrice and laid out in Randomized Block Design. The treatment combinations are treatment 1 [Nitrogen (50kg/ha) + Zinc (15kg/ha)], treatment 2 [Nitrogen (50kg/ha) + Zinc (20kg/ha)], treatment 3 [Nitrogen (50kg/ha) + Zinc (25kg/ha)], treatment 4 [Nitrogen (60kg/ha) + Zinc (15kg/ha)], treatment 5 [Nitrogen (60kg/ha) + Zinc (20kg/ha)], treatment 6 [Nitrogen (60kg/ha) + Zinc (25kg/ha)], treatment 7 [Nitrogen (70kg/ha) + Zinc (15kg/ha)], treatment 8 [Nitrogen (70kg/ha) + Zinc (20kg/ha)], treatment 9 [Nitrogen (70kg/ha) + Zinc (25kg/ha)] and treatment 10 (Control). The data recorded on different aspects of crop such as, growth parameters, yield attributes and economics were subjected to statistical analysis by variance method **Gomez and Gomez (1976)**.

RESULT AND DISCUSSION

Growth parameters

Plant height (cm)

The data revealed that, significantly higher plant height (92.18 cm) was recorded in treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] as compared to rest of the treatments. However, the treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 1]. Significant and higher plant height was with application of Nitrogen (70 kg/ha) might be due to higher nitrogen levels lead to more nitrogen uptake, which enhance protein synthesis, cell division and cell elongation, results in growth and development of plants. Similar results were also reported by **Dundigala *et al.* (2021).** Further, significant and higher plant height was observed with application of Zinc (25kg/ha) which might be due to zinc involves in different physiological process like enzyme activation, stomatal regulation and chlorophyll formation which results in plant growth. Similar result was also reported by **Muhammad *et al.* (2017)** in wheat.

Number of tillers/hill

The data revealed that, significantly maximum number of tillers/hill (5.00) was recorded in treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] as compared to rest of the treatments. However, the treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 1]. Significant and maximum number of tillers/hill was with application of Nitrogen (70 kg/ha) might be due favorable soil physical conditions and adequate quantity, balanced proportion of plant nutrients supplied to the crop as per need during the growing period resulting in favorable environment for tiller growth. Similar result was also reported by **Dundigala *et al.* (2021)**. Further, significant and maximum number of tillers/hill was with application of zinc (25kg/ha) might be due to increase in production of metabolites which synthesize and enhance, required nutrients to plant to bear more tillers/plant. Similar result was also reported by **Muhammad *et al.* (2017)** in wheat.

Plant dry weight (g)

The data revealed that, significantly higher plant dry weight (35.77 g) was recorded in treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] as compared to rest of the treatments. However, the treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 1]. Significant and higher plant dry weight was with application of Nitrogen (70 kg/ha) might be due to increased nitrogen rates improves overall growth and development of plants, which enhance morphological and photosynthetic components along with accumulation of nutrients, which results in accumulation of more dry matter at the successive growth stages. Similar result was also reported by **Jadon *et al.* (2015).** Further, significantly higher plant dry weight was with application of Zinc (25kg/ha) might be due to zinc plays a vital role in a various physiological and biochemical processes culminating in more dry matter production. Similar result was also reported by **Muhammad *et al.* (2017)** in wheat.

Crop growth rate (g/m^2/day)

The data revealed that, significantly higher crop growth rate (8.99 g/m^2/day) was recorded in treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] as compared to rest of the treatments. However, the treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 1]. Significant and maximum crop growth rate was with application of Nitrogen (70 kg/ha) might be due to adequate supply of nitrogen at initial stage results in rapid crop growth which was obtained by increased rate of light absorption, high photosynthetic activities. Similar findings were also reported by **Dubey *et al.* (2018).**

Relative growth rate (g/g/day)

The data revealed that, highest relative growth rate (0.136 g/g/day) was recorded in treatment 6 [nitrogen (60kg/ha) + zinc (25kg/ha)] as compared to rest of the treatments and there is no significance difference between the treatments [Table 1].

Yield attributes

Number of effective tillers/hill

The data revealed that, significant and maximum number of effective tillers/hill (3.33) was recorded with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] which was superior over all other treatments. However, treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)], treatment 7 [nitrogen (70kg/ha + zinc (15kg/ha)], treatment 6 [nitrogen (60kg/ha) + zinc (25kg/ha)], treatment 5 [nitrogen (60kg/ha) + zinc (20kg/ha)] and treatment 4 [nitrogen (60kg/ha) + zinc (15kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 2]. Significant and maximum number of effective tillers was with Nitrogen (70kg/ha) could be due to sufficient supply of nitrogen the competition for nutrient requirement is reduced and helped in better root establishment, which increases the better uptake of nutrients from soil and resulted increased in development of effective tillers/hill. Similar result was also reported by **Dubey *et al.* (2018)**. Further, significant and maximum number of effective tillers/hill was with application of zinc (25kg/ha) might be due to application of zinc has increase the production of metabolites and activates required enzymes, which synthesize and enhance required nutrients to plant in development of effective tillers/hill. Similar result was also reported by **Muhammad *et al.* (2017)** in wheat.

Spike length (cm)

The data revealed that, significant and higher spike length (8.00cm) was recorded with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] which was superior over all other treatments. However, treatment 7 [nitrogen (70kg/ha + zinc (15kg/ha)] and treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc

(25kg/ha)] [Table 2]. Significant and higher spike length was with application of Nitrogen (70 kg/ha) might be due to adequate supply of nitrogen, which helps in the increased production of leaves due to meristematic activities in the cell helps in maximum utilization of sunlight and production of more photosynthates translocation from leaves to reproductive parts of barley. Similar results were also reported by **Jadon *et al.* (2015).**

Number of grains /spike

The data revealed that, significant and maximum number of grains/spike (64.93) was recorded with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] which was superior over all other treatments. However, treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha) [Table 2]. Significant and maximum number of grains/spike was with application of Nitrogen (70 kg/ha) might be due to higher uptake of nitrogen and adequate availability of required nutrients from soil enhance the transportation of photosynthates from source to sink, which resulted in formation of more grains/spike. Similar result was also reported by **Saha *et al.* (2017)** in rice**.** Further, significant and maximum number of grains/spike was with application of Zinc (25 kg/ha) could be due to favorable effect of zinc which plays a significant role in pollen tube formation, pollen viability, starch utilization and chlorophyll biosynthesis results in better seed formation. Similar result was also reported by **Muhammad *et al.* (2017)** in wheat.

Test weight (g)

The data revealed that, significant and higher test weight (38.02 g) was recorded with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] which was superior over all other treatments. However, treatment 7 [nitrogen (70kg/ha + zinc (15kg/ha)] and treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 2]. Significantly higher test weight was with application of Zinc (25 kg/ha) might be due to zinc plays a vital role in enzyme activation and makes hydrocarbon and proteins quick transfer towards grain which led to increase in grain weight. Similar result was also reported by **Muhammad *et al.* (2017)** in wheat.

Grain yield (t/ha)

The data revealed that, significant and higher grain yield (5.84 t/ha) was recorded with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] which was superior over all other treatments. However, treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 2]. Significant and higher grain yield was with application of Nitrogen (70 kg/ha) might be due to vigorous and enhanced plant growth and development of reproductive parts due to continuous and synchronize supply of nitrogen throughout the growth stages of crop. Similar result was also reported by **Saha *et al.* (2017)** in rice. Further, significant higher grain yield was with application of Zinc (25 kg/ha) might be due to zinc plays a major role in reproductive physiology, especially in initiation of reproductive primordial and favorable partitioning of photosynthates towards sink that led to significant improvement in yield characters resulting higher grain yield. Similar result was also reported by **Kumar *et al.* (2011).**

Straw yield (t/ha)

The data revealed that, significant and higher straw yield (7.59 t/ha) was recorded with which was superior over all other treatments. However, treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] was found to be statistically at par with treatment 9 [nitrogen (70kg/ha) + Zinc (25kg/ha)] [Table 2]. Significant and higher straw yield was with application of Nitrogen (70 kg/ha) might be due to adequate supply of nitrogen leads to higher photosynthesis and assimilation rate, metabolic activity and protein synthesis, which were responsible for increase in growth, grain and straw yield of crop. Similar results were also reported by **Chauhan *et al.* (2014)** in wheat. Further, significant and higher straw yield was with application of Zinc (25 kg/ha) might be due to increased availability of Zn in soil helps in absorption of other nutrients which led to improved functioning of physiological process and improves the straw content of barley. Similar result was also reported by **Kumar *et al.* (2011)**.

Harvest index (%)

The data revealed that, significant and higher harvest index (43.65%) was recorded with treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] which was superior over all other treatments. however, the treatment 3 [nitrogen (50kg/ha) + Zinc (25kg/ha)], treatment 4 [nitrogen (60kg/ha) + Zinc (15kg/ha)], treatment 5 (nitrogen 60kg/ha + zinc at 20kg/ha), treatment-6 (nitrogen at 60kg/ha + zinc at 25kg/ha), treatment-7 (nitrogen at 70kg/ha + zinc at 15kg/ha) and treatment 9 [nitrogen (70kg/ha) + zinc (25kg/ha)] was found to be statistically at par with treatment 8 [nitrogen (70kg/ha) + Zinc (20kg/ha)] [Table 2]. Significant and higher harvest index was with application of Nitrogen (70 kg/ha) might be due to availability of nitrogen in all growth stages through split application resulted in higher grain and straw yield. Further, significant and higher harvest index was with application of Zinc (20 kg/ha) could be due to application of zinc through soil results in the reduction of adverse effect of salinity stress at both vegetative and reproductive stages. Similar findings have also reported by **Singh *et al.* (2022)**.

Economics

The results showed that, maximum gross returns (1,29,640.00 INR/ha), higher net returns (90,919.00 INR/ha) and highest Benefit cost ratio (2.34) was recorded in treatment 9 [nitrogen (70kg/ha) + zinc (25kg/ha)] [Table 3]. Highest Benefit cost ratio was recorded with Nitrogen (70 kg/ha) might be due to higher grain and straw yield with low cost of nitrogen sources and also split application of nitrogen minimize nitrogen utilization, which provides nitrogen in all growth stages to obtain better farm profitability and productivity. Further, higher gross return, net return was with application of zinc (25 kg/ha) might be due to activation of required enzymes during growth and reproductive stages of crop resulted in higher grain and straw yield, which helps to obtain higher benefit cost ratio.

Table 1 Influence of Nitrogen and Zinc on growth attributes of barley

S.No.	Treatments combinations	Plant height(g)	Number of tillers/hill	Dry weight (g)	CGR(g/m^2/day) (60-80) DAS	RGR (g/g/day) (60-80) DAS
1	Nitrogen at 50kg/ha + Zinc at 15kg/ha	84.13	3.40	17.66	4.22	0.118
2	Nitrogen at 50kg/ha + Zinc at 20kg/ha	85.33	3.73	19.41	4.83	0.121
3	Nitrogen at 50kg/ha + Zinc at 25kg/ha	86.00	3.93	21.64	5.47	0.121
4	Nitrogen at 60kg/ha + Zinc at 15kg/ha	86.37	4.13	23.44	5.77	0.129
5	Nitrogen at 60kg/ha + Zinc at 20kg/ha	88.25	4.47	25.96	6.49	0.129
6	Nitrogen at 60kg/ha + Zinc at 25kg/ha	89.10	4.53	27.22	6.67	0.136
7	Nitrogen at 70kg/ha + Zinc at 15kg/ha	89.41	5.00	30.59	7.71	0.124
8	Nitrogen at 70kg/ha + Zinc at 20kg/ha	91.04	5.67	33.06	8.36	0.133
9	Nitrogen at 70kg/ha + Zinc at 25kg/ha	92.18	6.20	35.77	8.99	0.126
10	Control	82.21	3.13	15.56	3.53	0.130
	F- test	S	S	S	S	NS
	S Em (±)	0.44	0.20	0.15	0.38	0.005
	CD (p =0.05)	1.32	1.38	0.46	0.13	-

Table 2 Influence of Nitrogen and Zinc on yield attributes of barley

S.No.	Treatments combinations	Number of effective tillers/hill	Spike length (cm)	Number of grains /spike	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
1	Nitrogen at 50kg/ha + Zinc at 15kg/ha	2.87	6.00	58.00	36.07	3.19	5.24	37.84
2	Nitrogen at 50kg/ha + Zinc at 20kg/ha	3.00	6.33	58.33	36.33	3.33	5.56	37.46
3	Nitrogen at 50kg/ha + Zinc at 25kg/ha	3.07	6.60	59.07	36.67	3.90	5.83	40.08
4	Nitrogen at 60kg/ha + Zinc at 15kg/ha	3.13	7.00	59.20	37.07	4.26	5.90	41.92
5	Nitrogen at 60kg/ha + Zinc at 20kg/ha	3.17	7.20	60.20	37.13	4.53	6.17	42.33
6	Nitrogen at 60kg/ha + Zinc at 25kg/ha	3.20	7.40	61.87	37.20	4.83	6.59	42.29
7	Nitrogen at 70kg/ha + Zinc at 15kg/ha	3.27	7.73	63.67	37.28	5.31	6.87	43.59
8	Nitrogen at 70kg/ha + Zinc at 20kg/ha	3.30	7.87	64.07	37.70	5.44	7.02	43.65
9	Nitrogen at 70kg/ha + Zinc at 25kg/ha	3.33	8.00	64.93	38.02	5.84	7.59	43.48
10	Control	2.67	5.94	55.00	33.55	2.59	4.53	36.37
	F- test	S	S	S	S	S	S	S
	S Em (±)	0.11	0.13	0.35	0.24	0.15	0.20	1.30
	CD (p =0.05)	0.33	0.39	1.04	0.72	0.45	0.60	3.86

Table 3 Influence of Nitrogen and Zinc on economics of barley

S. No.	Treatment combinations	Cost of Cultivation (INR/ha)	Gross returns (INR/ha)	Net Return (INR/ha)	B:C ratio
1.	Nitrogen at 50kg/ha + Zinc at 15kg/ha	33,984.00	75,190.00	41,206.00	1.21
2.	Nitrogen at 50kg/ha + Zinc at 20kg/ha	36,984.00	78,850.00	41,866.00	1.13
3.	Nitrogen at 50kg/ha + Zinc at 25kg/ha	38,484.00	89,620.00	51,136.00	1.32
4.	Nitrogen at 60kg/ha + Zinc at 15kg/ha	34,100.00	96,020.00	61,920.00	1.81
5.	Nitrogen at 60kg/ha + Zinc at 20kg/ha	33,710.00	1,01,690.00	67,980.00	2.01
6.	Nitrogen at 60kg/ha + Zinc at 25kg/ha	38,603.00	1,08,470.00	69,867.00	1.81
7.	Nitrogen at 70kg/ha + Zinc at 15kg/ha	36,221.00	1,17,750.00	83,529.00	2.25
8.	Nitrogen at 70kg/ha + Zinc at 20kg/ha	37,221.00	1,20,560.00	83,339.00	2.23
9.	Nitrogen at 70kg/ha + Zinc at 25kg/ha	38,721.00	1,29,640.00	90,919.00	2.34
10.	Control	26,635.00	62,150.00	35,515.00	1.33

CONCLUSION

Based on the above findings it is concluded that application Nitrogen (70 kg/ha) and Zinc (25 kg/ha) was observed higher in yield and benefit cost ratio.

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