Original Research Article

"Effect of Nitrogen and Zinc on Growth and Yield of Cowpea"

ABSTRACT

The field experiment titled "Effect of Nitrogen and Zinc on growth and yield of Cowpea" was conducted during *Zaid*, 2022 at Crop Research Farm, Department of Agronomy, Naini Agriculture institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P). The soil of experimental plot was sandy loamy in texture, nearly neutral in a soil reaction (p^H 7.8) low in organic carbon (0.62), available nitogen (225 kg/ha), available phosphorus (38.2 kg/ha) and available potassium (240.7 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The treatments combination are T_1: N-20 kg/ha + Zn-10 kg/ha, T_2: N-20 kg/ha + Zn-20 kg/ha, T_3: N-20 kg/ha + Zn-30 kg/ha, T_4: N-30 kg/ha + Zn-10 kg/ha, T_5: N-30 kg/ha + Zn-20 kg/ha, T_6: N-30 kg/ha + Zn-30 kg/ha, T_7: N-40 kg/ha + Zn-10 kg/ha, T_8: N-40 kg/ha + Zn-20 kg/ha and T_9: N-40 kg/ha + Zn-30 kg/ha. Results obtained that combined application of Nitrogen 30 kg/ha along with Zinc 30 kg/ha significantly Higher plant height (51.39 cm), number of branches/plant (4.80), dry weight (16.60 g), number of pods/plant (10.60), number of Seeds/pod (5.47), seed index (100.80 g), seed yield (1.30t/ha), stover yield (1.73 t/ha). And also higher economics *viz*., higher gross returns (1,01,380.00 INR/ha), net returns (67,812.00 INR/ha) and benefit cost ratio (2.02).

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

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is commonly known as "Lobia". It is also known as black eye pea, black eye bean, southern pea, china pea, marble pea. The protein in cowpea seeds, is rich in lysine and tryptophan amino acids compared to cereal grains. The mature cowpea seed contains protein (24.8%), carbohydrate (63.6%), fat (1.9%), fiber (6.3%), thiamine (7.4 ppm), riboflavin (4.2 ppm) and niacin (28.1 ppm) **(Ahlawat and Shivkumar, 2005)**. Pulses have a unique property of maintaining and restoring soil fertility through biological nitrogen fixation as well as addition of small amount of plant residues to the soil. Pulse crops leave behind reasonable quantity of nitrogen in soil to the extent of (30 kg/ha) **(Verma *et. al.,* 2015).**

Globally africa is the leading producer with Nigeria and Niger the predominating countries followed by Brazil, India, Myanmar, America, West Indies and Australia also have significant production. Most cowpeas or grown on the African continent, particularly in Nigeria and Niger, which account for 66% of world population **(Raja and Singh, 2022)**. In India pulses are grown nearly in 25.43 m ha with an annual production of 17.20 m t and a median productivity of 679 kg/ha. The per capita availability of pulses in India is 35.5 g/day as against the minimum requirement of 70 g/day. Cowpea grown across the world on an area 14.5 m ha of land planted each year and the total annual production is 6.2 m t. In India during 2020-21 cowpea is grown in about 13.3 m ha with an annual production of 8.06 m t and productivity of 596 kg/ha. Some of the states like Uttar Pradesh is about 2.38 m ha with an annual production of 2.56 and productivity of 1079 kg/ha major producer of cowpea in India **(GOI, 2021)**.

The continuous drain upon the nitrogen resources of the soil and necessity for higher crop yield have lead to an ever increasing emphasis on the means of covering the limited supply of the element. Light soils and Sodic soils are developing zinc deficiency and plants grown under zinc deficient conditions show chlorosis and growth stunting which results in drastic reduction in crop yield, therefore the present experiment was conducted to find out the effect of nitrogen and zinc on nodulation, growth and yield of cow pea **(Upadhyay and Singh, 2016)**.

Plant requires essential elements for growth and development, among all different nutrients, nitrogen is most important nutrient. Nitrogen plays an important role in various metabolic process of plant. Nitrogen is an essential constituent of protein, chlorophyll and is present in many other compounds helps in plant metabolism, such as nucleotides, phosphatides, alkaloids, enzymes, hormones, vitamins, etc. It imparts dark-green colour of plants, produces rapid early growth. Plants require large amounts of nitrogen for adequate growth. Plants take up N from the soil as (NH^{-4}) ammonium or (NO^{-3}) nitrate. Although leguminous crops can fix nitrogen in plants, at the initial stage of growth. It needs nitrogen fertilizer before formation of nodules in the root system to improves capacity to fix atmospheric nitrogen. symbiotically and it responds to small quantity of nitrogenous fertilizers applied as starter dose **(Verma *et. al.,* 2015)**.

Legume crops require not only required adequate macronutrients but also micro nutrients for increasing the bacterial activity of nodule. Therefore, an optimum supply of micronutrients under balanced condition is very important for achieving higher productivity **(Mondal *et. al.*, 2011)**. Zinc plays vital role in plant growth and development and formation of chlorophyll in plant. It is also involved in several enzyme systems, growth hormone (auxins) and the synthesis of nucleic acids and plays an important role in the intake and use of water by plants. Deficiency of Zn in the soil leads to the dietary malnutrition and health problems in human and animals. The crops grown in Zn deficient soils are generally having lower zinc content (consequently lower Zn uptake) and intake of produce of such crops leads to health problems in the humans and animals. Since zinc is not mobile in the plants, thus zinc deficiency symptoms occur mainly in new-terminal growth. Due to poor mobility in plants, constant supply of zinc is essential for optimum growth. Zinc should be applied with initial fertilizer or just after the sowing. Delaying in application of zinc may show signs of zinc deficiency. Keeping in view the above facts, the present experiment was undertaken to find out **"Effect of Nitrogen and Zinc on Growth and Yield of Cowpea.**

Materials and Methods

A field experiment was conducted during Rabi season of 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the field constituting a part of central Gangetic alluvium is neutral and deep. The soil of the experimental field was sandy loam in texture, nearly neutral in soil reaction (pH 7.8), low level of organic carbon (0.62%), available N (225 Kg/ha), P (38.2 kg/ha), K (240.7 kg/ha) and zinc (2.32 mg/kg). The treatment consists of three different levels Nitrogen@ 20, 30 and 40kg/ha with combination of different levels of Zinc@ 10, 20 and 30. The experiment was laid out in RBD with 9 treatments each replicated thrice. The treatment combinations are T_1: N-20 kg/ha + Zn-10 kg/ha, T_2: N-20 kg/ha + Zn-20 kg/ha, T_3: N-20 kg/ha + Zn-30 kg/ha, T_4: N-30 kg/ha + Zn-10 kg/ha, T_5: N-30 kg/ha + Zn-20 kg/ha, T_6: N-30 kg/ha + Zn-30 kg/ha, T_7: N-40 kg/ha + Zn-10 kg/ha, T_8: N-40 kg/ha + Zn-20 kg/ha and T_9: N-40 kg/ha + Zn-30 kg/ha. The growth parameters and yield, production was recorded at harvest from randomly selected plants in each plot. The data was computed and analysed by following statistical method of **Gomez and Gomez (1984).**

RESULT AND DISSCUSSION

Growth parameters

Plant height (cm)

The data revealed that, significantly higher plant height (58.37 cm) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha). Significant and higher plant height was recorded with Nitrogen (30 kg/ha) might be due to nitrogen consists of proteins and chlorophyll, promotes vegetative growth and improves quality of leafy vegetables. increase in amount of growth substances and naturally occurring phytohormones with increased nitrogen supply. Similar reports was also reported by **(Raja and Singh, 2022)**. Further, significant and higher plant height was recorded with Zinc (30 kg/ha) might be due to favorable influence of zinc, on plant metabolism and biological activity and their stimulating effect on photosynthetic pigments and enzyme activity, which in turn encourage vegetative growth. Similar reports was also reported by **(Shaik *et .al.,* 2021)**.

Number of branches/plant

The data revealed that, significantly maximum number of branches/plant (6.87) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha).

Significant and maximum number of branches/plant was recorded with Nitrogen (30 kg/ha) might be due to increased availability of nitrogen might have increased cell number and cell size leading to better growth in terms of height and number of branches per plant. Similar result was also reported by **(Verma *et. al*., 2015)**. Further, significant and maximum number of branches/plant was recorded with Zinc (30 kg/ha) might be due to positive effect of application of zinc, enhancs plant height and branches, which mainly attributed to promotion of bud and branch development by the auxins, whereas zinc application ultimately increased the availability of other nutrients and accelerated the translocation of photo assimilates. Similar results were reported by **(Ravichandra *et. al*., 2015).**

Plant dry weight (g)

The data revealed that, significantly higher plant dry weight (16.60 g) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha). Significant and higher dry weight was recorded with Nitrogen (30 kg/ha) might be due to increase in auxin supply with higher levels of nitrogen brought about increase in the dry matter and branches /plant. Similar result was also reported by **(Sharma and Dayal, 2005)**. Further, significant and higher plant dry weight was recorded with zinc (30 kg/ha) might be due to increase in the higher auxin activity in plant which promoted growth attributes and higher biomass accumulation of dry matter. Similar result was also reported by **(Kumar and Bohra, 2014)**.

B. POST HARVEST OBSERVATIONS

Number of Pods/plant

The data revealed that, Significant and maximum number of pods/plant (15.00) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha). Significant and maximum number of pods/plant was recorded with Nitrogen (30kg/ha) might be due to balanced application of nitrogen and the findings of Mahmood (1989), Ahmad et a/.(1992) phosphorus which enhances the plant growth that and Imtaisal (1997) who also reported an increase in increases fruit bearing branches, seed setting and harvest index of mungbean in response to application seed development **Malik *et.al.*, (2003).** Further, significant and maximum number of pods/plant was recorded with with zinc (30 kg/ha) might be due to Zinc is also vital for the oxidation process in plant cells and helps in transformation of carbohydrates, regulation of sugar in plant and realisation of flower into pods **Thummar *et. al*., (2022)**

4.7 Number of seeds/pod

The data revealed that, Significant and maximum number of seeds/pod (10.27) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha). Significant and maximum number of seeds/pod was recorded with Nitrogen (30kg/ha) might be due to Nitrogen fertilization made the plants more efficient in photosynthesis activity, growth promoting substances and consequently increased absorption of mineral nutrients with lesser plant energy. **Thummar *et. al.*,(2022).** Further, significant and maximum number of seeds/pod was recorded with with zinc (30 kg/ha) might be due to zinc plays a very important role in the metabolism of the plant process by influencing the activity of growth enzymes as well as it is involved in carbohydrate metabolism, maintenance of the integrity of cellular membranes, protein synthesis, and regulation of auxin synthesis and pollen formation. **Shaik *et. al.*,(2021)**.

4.8 Seed Index (g)

The data revealed that, Highest seed index (133.43 g) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments and there was no significance difference between them.

4.9 Seed yield (t/ha)

The data revealed that, Significant and higher seed yield (1.02 t/ha) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha). Significant and higher seed yield was recorded with Nitrogen

(30kg/ha) might be due to nitrogen increased supply of nitrogen and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and led to increased growth and yield parameters and resulted in increased seed **verma *et. al.,* (2015).** Further, significant and higher seed yield was recorded with Zinc (30kg/ha) might be due to Zinc play a vital role in increasing seed yield because zinc takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhance seed yield. Zinc also converts ammonia to nitrate in crops which contribute to yield. **Maila and debbarma (2022).**

4.10 Stover yield (t/ha)

The data revealed that, Significant and higher Stover yield (1.72 t/ha) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments. However, the treatment 5 (Nitrogen 30 kg/ha + Zinc 20 kg/ha) was found to be statistically at par with treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha). Significant and higher Stover yield was recorded with Nitrogen (30kg/ha) might be due to The higher biological yield may be due to enlarge in terms of dry matter and number of branches/plant, vegetative development creates too many sites for photosynthetic translocation, resulting in an increasing in the number of yield characteristics i.e. biological yield **Karthik *et.al.,* (2021).** Further, significant and higher seed yield was recorded with Zinc (30kg/ha) might be due to cumulative effect in increasing growth contributing characters which increases the stover yield. **Thummar *et. al.,* (2022).**

4.11 Harvest Index (%)

The data revealed that, Highest harvest index (39.76 %) was recorded in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to rest of the treatments and there was no significance difference between them.

Economics analysis

Gross return, Net return and benefit cost ratio of different treatments are depicted in (Table 3)

Cost of cultivation (INR/ha)

Cost of cultivation (33,568.00 INR/ha) was found to be highest in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) and minimum cost of cultivation (31633.00 INR/ha) was found to be in treatment 1 (Nitrogen 20 kg/ha + Zinc 10 kg/ha) as compared to other treatments.

Gross return (INR/ha)

Gross returns (1,01380.00 INR/ha) were found to be highest in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) and minimum gross returns (71,247.00 INR/ha) was found to be in treatment 2 (Nitrogen 20 kg/ha + Zinc 20 kg/ha) as compared to other treatments.

Net returns (INR/ha)

Net returns (67,812.00 INR/ha) were found to be highest in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) and minimum net returns (35,014.00 INR/ha) was found to be in treatment 1 (Nitrogen 20 kg/ha + Zinc 10 kg/ha) as compared to other treatments.

Benefit cost ratio (B:C)

Benefit Cost ratio (2.02) was found to be highest in treatment 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) and benefit cost ratio (1.11) was found to be in treatment 1 (Nitrogen 20 kg/ha + Zinc 10 kg/ha) as compared to other treatments.

Table 1 Effect of nitrogen and zinc on growth parameters of Cowpea

S. No.	Treatments combinations	Growth parameters		
		Plant height (cm) 60 DAS	Number of Branches/plant 60 DAS	Plant dry weight (g) 60 DAS
1.	Nitrogen 20 kg/ha + Zinc 10 kg/ha	44.54	5.00	13.03
2.	Nitrogen 20 kg/ha + Zinc 20 kg/ha	45.61	5.47	13.32
3.	Nitrogen 20 kg/ha + Zinc 30 kg/ha	47.85	6.07	14.95
4.	Nitrogen 30 kg/ha + Zinc 10 kg/ha	47.20	5.80	14.49
5.	Nitrogen 30 kg/ha + Zinc 20 kg/ha	50.53	6.60	16.07
6.	Nitrogen 30 kg/ha + Zinc 30 kg/ha	51.39	6.87	16.60
7.	Nitrogen 40 kg/ha + Zinc 10 kg/ha	46.72	5.60	13.85
8.	Nitrogen 40 kg/ha + Zinc 20 kg/ha	48.47	6.13	15.12
9.	Nitrogen 40 kg/ha + Zinc 30 kg/ha	49.26	6.40	15.47
	F-test	S	S	S
	S Em (±)	0.32	0.09	0.06
	CD (p =0.05)	0.96	0.28	0.25

Table 2 Effect of nitrogen and zinc on yield and yield attributes of cowpea

S. No.	Treatments combinations	Number of pods/plant	Number of seeds/pod	Seed Index (g)	Seed Yield (t/ha)	Stover Yield (t/ha)	Harvest Index (%)
1.	Nitrogen 20 kg/ha + Zinc 10 kg/ha	9.26	4.76	88.10	0.86	1.11	43.50
2.	Nitrogen 20 kg/ha + Zinc 20 kg/ha	9.45	4.86	89.82	0.92	1.18	43.72
3.	Nitrogen 20 kg/ha + Zinc 30 kg/ha	10.06	5.18	95.52	1.10	1.40	44.02
4.	Nitrogen 30 kg/ha + Zinc 10 kg/ha	9.85	5.07	93.60	1.04	1.33	43.93
5.	Nitrogen 30 kg/ha + Zinc 20 kg/ha	10.49	5.41	99.73	1.26	1.62	43.65
6.	Nitrogen 30 kg/ha + Zinc 30 kg/ha	10.60	5.47	100.80	1.30	1.73	43.04
7.	Nitrogen 40 kg/ha + Zinc 10 kg/ha	9.55	4.91	90.60	0.95	1.25	43.26
8.	Nitrogen 40 kg/ha + Zinc 20 kg/ha	10.27	5.29	97.50	1.17	1.47	44.30
9.	Nitrogen 40 kg/ha + Zinc 30 kg/ha	10.38	5.35	98.82	1.22	1.52	44.51
	F-test	S	S	NS	S	S	NS
	S Em (±)	0.12	0.09	0.50	0.03	0.05	0.90
	CD (p =0.05)	0.39	0.29	-	0.12	0.15	-

Table 3 Effect of nitrogen and zinc on economics of Cowpea

S. No.	Treatments	Cost of Cultivation (INR/ha)	Gross returns (INR/ha)	Net Return (INR/ha)	B:C ratio
1	Nitrogen 20 kg/ha + Zinc 10 kg/ha	31,633.00	66,647.00	35,014.00	1.11
2	Nitrogen 20 kg/ha + Zinc 20 kg/ha	32,533.00	71,247.00	38,714.00	1.19
3	Nitrogen 20 kg/ha + Zinc 30 kg/ha	33,433.00	85,653.00	52,220.00	1.56
4	Nitrogen 30 kg/ha + Zinc 10 kg/ha	31,768.00	80,527.00	48,759.00	1.53
5	Nitrogen 30 kg/ha + Zinc 20 kg/ha	32,668.00	97,707.00	65,039.00	1.99
6	Nitrogen 30 kg/ha + Zinc 30 kg/ha	33,568.00	1,01,380.00	67,812.00	2.02
7	Nitrogen 40 kg/ha + Zinc 10 kg/ha	31,894.00	73,747.00	41,853.00	1.31
8	Nitrogen 40 kg/ha + Zinc 20 kg/ha	32,794.00	90,700.00	57,906.00	1.77
9	Nitrogen 40 kg/ha + Zinc 30 kg/ha	33,694.00	94,540.00	60,846.00	1.81

CONCLUSION

It is concluded that is cowpea with the combination of Nitrogen 30kg/ha and Zinc 30kg/ha in treatment 6 was observed higher growth ,Yield and Benefit cost ratio.

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