OriginalResearchArticle

# EffectofNitrogenandZinconGrowthandYieldofCowpea

## ABSTRACT

Thefieldtrailtitled“EffectofNitrogenandZincongrowthandyieldofCowpea”wasconductedduring*Zaid*,2022atCropResearchFarm,DepartmentofAgronomy,NainiAgricultureinstitute, SHUATS, Prayagraj, Uttar Pradesh. The soil of experimental field was sandy loamy intexture, nearly neutral in a soil reaction ($p^H$ 7.8) low in organic carbon (0.62), available nitogen(225 kg/ha),available phosphorus (38.2kg/ha)and available potassium (240.7kg/ha). Theexperiment was carried out in Randomized Block Design with nine treatments each replicatedthrice. The treatments combination are $T_1$: N-20 kg/ha + Zn-10 kg/ha, $T_2$: N-20 kg/ha + Zn-20kg/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-20kg/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-20kg/ha and $T_9$: N-40 kg/ha + Zn-30 kg/ha. Results revealed thatcombined application of Nitrogen30 kg/ha along with Zinc 30 kg/ha significantly Higher plant height (51.39 cm), number ofbranches/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 highereconomics *viz*., higher gross returns (1,01,380.00 INR/ha), net returns (67,812.00 INR/ha) andB:Cratio (2.02).


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

## INTRODUCTION

Cowpea (Vignaunguiculata L.) is commonly known as "Lobia". It is also known as black eyepea, black eye bean, southern pea, Chinese pea, marble pea. Compared to cereal grains, theprotein in cowpea seeds is rich in the amino acids lysine and tryptophan. Ripe cowpea seedcontains protein (24.8%), carbohydrates (63.6%), fat (1.9%), fiber (6.3%), thiamin (7.4 ppm),riboflavin(4.2 ppm) and niacin (28.1 ppm)**(Ahlawat and Shivkumar, 2005)**.“ Legumes havethe unique ability to maintain and restore soil fertility through biological nitrogen fixation andalsobyaddingsmallamountsofplantresiduestothesoil.Legumesleaveareasonableamountofnitrogeninthesoilintherangeof(30kg/ha)”**(Verma*et.al*.,2015).**

“Globally,Africaistheleadingproducer,withNigeriaandNigerbeingthepredominantcountriesfollowedbyBrazil,India,Myanmar,America,WestIndiesandAustralia.Mostcowpeasare grown on the Africancontinent,especiallyin Nigeriaand Niger,whichaccountfor 66% of the world'spopulation”**(Raja andSingh, 2022).“** In India, pulsesare grown onnearly25.43mhawithanannualproductionof17.20milliontonnesandanaverageproductivityof679kg/ha.Thepercapitaavailabilityofpulsesin Indiais35.5g/dayagainstthe minimum requirement of 70 g/day. Cowpea grown worldwide on an area of14.5 m ha oflandplantedeveryyearandthetotalannualproductionis6.2milliontonnes.InIndiain2020-21,thevineisgrownonabout13.3mhawithanannualproductionof8.06milliontonnesanda productivity of 596 kg/ha. Some of the states like Uttar Pradesh have an area ofabout 2.38 mha with an annual production of 2.56 and a productivity of 1079 kg/ha the major producer ofcowpeain India”**(GOI, 2021)**.

“The constant draining of nitrogen resourcesfrom the soil and the need for higher crop yieldshave led to an increasing emphasis on means to cover the limited supply of the element. Lightsoils and sodic soils develop zinc deficiency and plants grown under zinc deficient conditionsshow chlorosis and stunted growth resulting in drastic reduction in crop yield, therefore thisexperiment was conductedtodetermine the effect of nitrogen andzinconnodulation, growthand growthepeayield”**(UpadhyayandSingh,2016).**

“Aplantrequiresessentialelementsforgrowthanddevelopment,amongallthedifferentnutrients, nitrogen is the most important nutrient. Nitrogen plays an important role in variousmetabolicprocessesofplants.Nitrogenisanessentialcomponentofproteins,chlorophyllandisp resentinmanyothercompounds,ithelpsinplantmetabolismsuchasnucleotides,phosphatides, alkaloids, enzymes, hormones, vitamins, etc. It gives plants a darkgreen color,they grow fast. Plants require large amounts of nitrogen for sufficient growth. Plants take up Nfrom the soil as($NH^{-4}$)ammonium or ($NO^{-3}$) nitrate. Although legumescan fix nitrogeninplantsintheearlystagesofgrowth.Beforetheformationofnodesintherootsystem,itneedsanit rogenfertilizertoimprovetheabilitytofixatmosphericnitrogen,symbioticallyandrespondsto a smallamount of nitrogen fertilizersapplied asa starter dose”**(Verma*et. al.*,2015)**.

“Legumesrequire not onlysufficient macronutrients,but alsomicronutrientstoincrease thebacterialactivityofthenodule.Toachievehigherproductivity,anoptimalsupplyofmicronutrients under balanced conditions is therefore very important”**(Mondal*et. al*., 2011).“**Zinc plays a vital role in plant growth and development and the formation of chlorophyll in theplant. It is also involved in several enzyme systems, growth hormone (auxins) and nucleic acidsynthesis and plays an important role in plant water uptake and utilization. A lack of Zn in thesoil leads to dietary malnutrition and health problems in humans and animals. Crops grown onZn-deficient soils generally have lower zinc content (resulting in lower Zn uptake) and intake ofsuchcropproductionleadstohealthproblemsinhumansandanimals.Sincezincisnotmobilein plants, symptoms of zinc deficiency mainly occur during the growth of new terminals. Due topoor plant motility, a constant supply of zinc is essential for optimal growth. Zinc should beapplied with the starter fertilizer or just after seeding. Delaying zinc application may show signsofzincdeficiency” (Mondal et. al., 2011).Keepingalltheseabovefactsinthemind,thepresentexperimentwasundertakentofindout**“Effect ofNitrogen andZincon Growth andYield of Cowpea.**

**MaterialsandMethods**

Thefieldexperimentwasconducteddduring Rabiseason2022atCropResearchFarm,Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the field forming part of thecentral Ganges alluvium is neutral and deep. The soil of the experimental field was sandy loamtexture,almostneutralinsoilreaction(pH7.8),lowleveloforganiccarbon(0.62%),availableN

(225Kg/ha),P (38.2kg/ha),K(240.7kg/ha)andzinc(2.32mg/kg).Thetreatmentconsistsof

3differentlevelsofNitrogensuchas20,30and40kg/hawithcombinationofthedifferentlevelsof Zinc such as10, 20 and 30 kg/ha. The experiment was laid out in RBD with 9 treatments eachreplicated thrice. The treatment combinations are such as $T_1$: 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-30kg/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-40kg/ha+Zn-20kg/haand$T_9$:N-40kg/ha+Zn-30kg/ha.Growthparametersandyield,productionwasrecordedat harvest from randomlyselectedplantsineachplot.Data werecalculated and analyzed according to the following statistical method of **Gomez and Gomez(1984).**

**RESULTANDDISSCUSSION**

**Growth**

**parametersPlanthei**

**ght(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) compared to the rest of the treatments. However, treatment 5(nitrogen 30 kg/ha + zinc 20 kg/ha) was found to be statistically equal to treatment 6 (nitrogen 30kg/ha + zinc 30 kg/ha). Significant and higher plant height was recorded with nitrogen (30 kg/ha),which may be due to nitrogen composed of protein and chlorophyll, promotes vegetative growthand improves the quality of leafy vegetables, increasing the amount of growth substances andnaturally occurring phytohormones with increased nitrogen supply. Similar reports have also beenreported **(Raja and Singh, 2022).** Furthermore, a significant and higher plant height was recordedwith zinc (30 kg/ha), which may be due to the beneficial effect of zinc on the metabolism andbiological activity of plants and their stimulating effect on photosynthetic pigments and enzymeactivity,whichinturnsupportvegetativegrowth.Similarreportswerealsoreportedby**(Shaiket .al.,2021).**

**Numberofbranches/plant**

The data showed that, significantly maximum number of branches/plant (6.87) was recorded intreatment number 6 (Nitrogen 30 kg/ha + Zinc 30 kg/ha) as compared to the other treatments.However,thetreatmentnumber5(Nitrogen30kg/ha+Zinc20kg/ha)wasfoundtobestatistic allyatparwith treatmentnumber6(Nitrogen30kg/ha+Zinc30kg/ha).

The highestnumber of branches per plantwas observed with nitrogenconsumption (30 kg/ha).This may be due to increased nitrogen availability and increased cell number and cell size, whichmay result in better growth in terms of height and number of shoots per plant. Similar results werealsoreportedby**(Verma*etal.*,2015).**Also,thehighestandmostsignificantnumberofshoots/plant recorded with Zn (30 kg/ha) was due to the positive effects of Zn application, mainlydue to the increase in shoot and shoot growth by auxin, which was probably due to the increase. Inthe height and branches, on the other hand, Zn application ultimately increased the availability ofother nutrients and accelerated the translocation of photosynthesis. Similar results were reported**(Ravichandra*etal*., 2015).**

**Plantdryweight(g)**

The data showed that the dry weight of the plant (16.60 grams) was significantly recordedfor treatment 6 (30 kg/ha nitrogen + 30 kg zinc) compared to the rest of the treatments.However, treatment 5 (30 kg/ha N + 20 kg Zn) was statistically equivalent to treatment 6(30 kg/ha N + 30 kg Zn/ha). The significantly higher dry weight recorded for N (30 kg/ha)may be due to increased auxin supply with high levels of N, resulting in increased drymatter and shoots/plants. Similar results were also reported by **(Sharma and Dayal, 2005).**In addition, the significantly higher plant dry weight recorded when zinc was applied (30kg/ha) may be duetoenhanced growthcharacteristics andhigher plant auxinactivity,whichresultedinhigherdrymatterbiomassaccumulation.Similarresultswerealsoreportedby**(Kumar and Bohra, 2014).**

**B.POSTHARVESTOBSERVATIONS**

**Numberof Pods/plant**

The data revealed that significant and maximum number of pods/plant (15.00) was recorded intreatment 6 (nitrogen 30 kg/ha + zinc 30 kg/ha) compared to rest of the treatments. However,treatment 5 (nitrogen 30 kg/ha + zinc 20 kg/ha) was found to be statistically equal to treatment 6(nitrogen30kg/ha+zinc30kg/ha).Significantandmaximumnumberofpods/plantwasrecordedfornitrogen(30kg/ha)couldbe due tobalancedapplicationofnitrogenandthefindings of **Mahmood (1989), Ahmad *et al.* (1992)** phosphorus which promotes plant growth,**Imtaisal (1997)** who also reported an increase in the growth of fruit bearing branches, seed setandharvest indexofmungbeaninresponsetoseeddevelopmentapplication**Malik*et.al*.,(2003).**

Furthermore, a significant and maximum number of pods/plant was recorded for zinc (30 kg/ha),which may be due to the fact that zinc is also vital for the oxidation process in plant cells andhelps in carbohydrate conversion, plant sugar regulation and flowering into pods **Thummar*et.al*.,(2022).**

**4.7 Numberofseeds/pod**

The data showed that the highest number of seeds in the pod (10.27) was recorded intreatment 6 (30 kg nitrogen + 30 kg zinc) compared to other treatments. However, treatment 5(30 kg/ha N + 20 kg Zn) was statistically equivalent to treatment 6 (30 kg/ha N + 30 kgZn/ha). The highest number of seeds/pod was recorded with nitrogen (30 kg/ha), becausenitrogen fertilization made the photosynthetic activity of plants more efficient and producedgrowth-promoting substances, and as a result, less plant energy was required for mineralproduction. Increased absorption of nutrients**Tomar*et.al*., (2022).** In addition, the highestand most significant number of seeds/pod was recorded when zinc was applied (30 kg/ha),indicating that zinc affects the activity of growth enzymes that are very important in themetabolism of plant processes. It has a role in carbohydrate metabolism, maintenance of cellmembrane integrity, protein synthesis, regulation of auxin synthesis and pollen formation.**Shaik*et.al*., (2021).**

**4.8 SeedIndex (g)**

The data showed that, highest seed index (133.43 g) was observed in treatment 6 (N 30 kg/ha +Zn 30 kg/ha) as compared to rest of the treatments and there was no significance differencebetweenthem.

**4.9 Seedyield(t/ha)**

The data revealed that, Significant and higher seed yield (1.02 t/ha) was recorded in treatment 6(Nitrogen30kg/ha+ Zinc30kg/ha)ascomparedtotheothertreatments.However,thetreatment5(Nitrogen 30 kg/ha + Zinc 20 kg/ha) was foundtobe statistically atpar withtreatment 6(Nitrogen30kg/ha+Zinc30kg/ha).Significantandhigherseedyieldwasrecordedwith Nitrogen

(30kg/ha) could be due to nitrogen increased nitrogen supply and their higher absorption byplantscouldstimulatetherateofvariousphysiologicalprocessesintheplantandleadtoincreased parameters of growth and yield and lead to an increase in seed **verma*et. al.,* (2015).**Further and more, significant and higher seed yield was recorded for zinc (30 kg/ha), which maybe because zinc plays a vital role in increasing seed yield, as zinc is involved in many plantphysiological processes such as chlorophyll formation, regulation stomata, utilization of starch.increase seed yield. Zinc also converts ammonia into nitrates in crops which contribute to yield.**MailaandDebbarma (2022).**

**Stoveryield(t/ha)**

The data revealed that treatment 6 (nitrogen 30 kg/ha + zinc 30 kg/ha) recorded significant andhigher stover yield (1.72 t/ha) compared to the rest of the treatments. However, treatment 5(nitrogen 30 kg/ha + zinc 20 kg/ha) was found to be statistically equal to treatment 6 (nitrogen 30kg/ha + zinc 30 kg/ha). Asignificant and higherStover yieldwasrecordedfor nitrogen (30kg/ha) may be due to higher biological yield may be due to increased dry matter and number ofbranches/plant, vegetative development creates too many sites for photosynthetic translocation,resulting in an increase in the number of yield characteristics, i.e. biological yield **Karthik*et.al.,***(2021). Furthermore, a significant and higher seed yield was recorded for zinc (30 kg/ha), whichmay be due to a cumulative effect in increasing the growth of contributing characters, whichincreases stover yield**Thummar*et. al.,* (2022).**

**4.10 HarvestIndex(%)**

Thedatarevealedthat,Highestharvestindex(39.76%)wasobservedin treatment6(N 30kg/ha + Zn 30 kg/ha) as compared to rest of the treatments and there was no significance differencebetweenthem.

## Economicsanalysis

Grossreturn,Netreturnandbenefitcostratioofvarioustreatments areshowedin(Table3)

**Costofcultivation(INR/ha)**

Costofcultivation(33,568.00INR/ha)was foundtobehighestintreatment6(Nitrogen30kg/ha +Zinc30kg/ha)andminimumcostofcultivation(31633.00INR/ha)wasfoundtobeintreatment1(Nitrogen20 kg/ha+Zinc10 kg/ha)ascomparedto restof thetreatments.

**Grossreturn(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(Nitrogen20 kg/ha+Zinc20 kg/ha)as comparedtorestofthetreatments.

**Netreturns (INR/ha)**

Netreturns(67,812.00INR/ha)werefoundtobehighestintreatment6(Nitrogen30kg/ha+Zinc30 kg/ha) and minimum net returns (35,014.00 INR/ha) was found to be in treatment 1 (Nitrogen20kg/ha+ Zinc10 kg/ha)as compared to restof thetreatments.

**Benefitcostratio(B:C)**

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

**Table1Effectofnitrogenandzincongrowthparametersof Cowpea**

| S. No. | Treatmentscombinations | Growthparameters | | |
|---|---|---|---|---|
| | | **Plantheight(cm) 60 DAS** | **Number ofBranches/plant60 DAS** | **Plant dryweight (g)60 DAS** |
| 1. | Nitrogen 20kg/ha+Zinc10kg/ha | 44.54 | 5.00 | 13.03 |
| 2. | Nitrogen 20kg/ha+Zinc20kg/ha | 45.61 | 5.47 | 13.32 |
| 3. | Nitrogen 20kg/ha+Zinc30kg/ha | 47.85 | 6.07 | 14.95 |
| 4. | Nitrogen 30kg/ha+Zinc10kg/ha | 47.20 | 5.80 | 14.49 |
| 5. | Nitrogen 30kg/ha+Zinc20kg/ha | 50.53 | 6.60 | 16.07 |
| 6. | Nitrogen 30kg/ha+Zinc30kg/ha | 51.39 | 6.87 | 16.60 |
| 7. | Nitrogen 40kg/ha+Zinc10kg/ha | 46.72 | 5.60 | 13.85 |
| 8. | Nitrogen 40kg/ha+Zinc20kg/ha | 48.47 | 6.13 | 15.12 |
| 9. | Nitrogen 40kg/ha+Zinc30kg/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 |

**Table2Effectofnitrogen andzinconyieldandyieldattributes ofcowpea**

| S. No. | Treatmentscombinations | Number ofpods/plant | Numberofseeds/pod | Seed Index(g) | Seed Yield (t/ha) | Stover Yield (t/ha) | HarvestIndex(%) |
|---|---|---|---|---|---|---|---|
| 1. | Nitrogen20kg/ha+Zinc10kg/ha | 9.26 | 4.76 | 88.10 | 0.86 | 1.11 | 43.50 |
| 2. | Nitrogen20kg/ha+Zinc20kg/ha | 9.45 | 4.86 | 89.82 | 0.92 | 1.18 | 43.72 |
| 3. | Nitrogen20kg/ha+Zinc30kg/ha | 10.06 | 5.18 | 95.52 | 1.10 | 1.40 | 44.02 |
| 4. | Nitrogen30kg/ha+Zinc10kg/ha | 9.85 | 5.07 | 93.60 | 1.04 | 1.33 | 43.93 |
| 5. | Nitrogen30kg/ha+Zinc20kg/ha | 10.49 | 5.41 | 99.73 | 1.26 | 1.62 | 43.65 |
| 6. | Nitrogen30kg/ha+Zinc30kg/ha | 10.60 | 5.47 | 100.80 | 1.30 | 1.73 | 43.04 |
| 7. | Nitrogen40kg/ha+Zinc10kg/ha | 9.55 | 4.91 | 90.60 | 0.95 | 1.25 | 43.26 |
| 8. | Nitrogen40kg/ha+Zinc20kg/ha | 10.27 | 5.29 | 97.50 | 1.17 | 1.47 | 44.30 |
| 9. | Nitrogen40kg/ha+Zinc30kg/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 | - |

**Table3EffectofnitrogenandzinconeconomicsofCowpea**

| S. No. | Treatments | Cost of Cultivation(INR/ha) | Gross returns(INR/ha) | Net Return(INR/ha) | B:Cratio |
|---|---|---|---|---|---|
| 1 | Nitrogen20kg/ha+Zinc10kg/ha | 31,633.00 | 66,647.00 | 35,014.00 | 1.11 |
| 2 | Nitrogen20kg/ha+Zinc20kg/ha | 32,533.00 | 71,247.00 | 38,714.00 | 1.19 |
| 3 | Nitrogen20kg/ha+Zinc30kg/ha | 33,433.00 | 85,653.00 | 52,220.00 | 1.56 |
| 4 | Nitrogen30kg/ha+Zinc10kg/ha | 31,768.00 | 80,527.00 | 48,759.00 | 1.53 |
| 5 | Nitrogen30kg/ha+Zinc20kg/ha | 32,668.00 | 97,707.00 | 65,039.00 | 1.99 |
| 6 | Nitrogen30kg/ha+Zinc30kg/ha | 33,568.00 | 1,01,380.00 | 67,812.00 | 2.02 |
| 7 | Nitrogen40kg/ha+Zinc10kg/ha | 31,894.00 | 73,747.00 | 41,853.00 | 1.31 |
| 8 | Nitrogen40kg/ha+Zinc20kg/ha | 32,794.00 | 90,700.00 | 57,906.00 | 1.77 |
| 9 | Nitrogen40kg/ha+Zinc30kg/ha | 33,694.00 | 94,540.00 | 60,846.00 | 1.81 |

## CONCLUSION

ItisconcludedthatincowpeawiththecombinationofNitrogen30kg/haandZinc30kg/haintreatment6was observed higher growth ,yield andbenefitcostratio.

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