A REPORT ON

EFFECT OF Zn APPLICATION AT DIFFERENT GROWTH STAGES OF RICE (*ORYZA SATIVA,* L) AND ITS IMPACT ON GROWTH AND YIELD PARAMETERS

DISSERTION -I

SUBMITTED

TO

Department of Agronomy

School of Agriculture

Lovely Professional University

Punjab 144411

LOVELY PROFESSIONAL UNIVERSITY

Transforming Education Transforming India

SUMITTED BY

REZWANULLAH RASOOLY

Registration No: 117717536

Under the guidance of

Dr. Chandra Mohan Mehta

Department of Agronomy

Lovely Professional University

SYNOPSIS

Effect of Zn application at different growth stages of rice (*Oryza sativa* l.) and its impact on growth and yield parameters

Name of student:	Rezwanullah Rasooly
Registration No:	11717536
Major Subject:	Agronomy
Major Advisor:	Dr. Chandra Mohan Mehta

Certified the topic entitled “Effect of Zn application at different growth stages of rice (*Oryza sativa* L.) and its impact on growth and yield parameters” has been decided and formulated by the student himself and is appropriate for this program.

(Signature of student)	(Signature of the major advisor)
Rezwanullah Rasooly	Dr. Chandra Mohan Mehta
Reg No. 11717536	UID.18376

CERTIFICATION

This is to certify that Rezwanullah Rasooly registration No (117717536) is doing project titled "Effect of Zn application at different growth stages of rice (*Oryza sativa* L.) and its impact on growth and yield parameters" under my guidance and supervision. To the best of my knowledge the present work is the result of his original investigation and study. No part of the project has ever been submitted for any other degree at any university. The project is fit for submission and the partial fulfillment of the condition for the award of degree of M.Sc. in Agronomy.

(Signature of student)

Rezwanullah Rasooly

(Signature of supervisor)

Dr. Chandra Mohan Mehta

Designation: Assistant Professor

Department of Agronomy

School of Agriculture

Lovely professional university

(Signature of co-advisor)

Dr. Bhupendra Mathpal

Designation: Assistant Professor

School of Agriculture

Lovely professional university

DECLARATION

I hereby declare that the project work entitled "Effect of Zn application at different growth stages of rice (*Oryza sativa* L.) and its impact on growth and yield parameters" is an authentic record of my work carried out by Lovely Professional University as requirement of project work for the award of degree of Master of Science of Agronomy, under the guidance of Dr. Chandra Mohan Mehta, School of Agriculture, Lovely Professional University, Phagwara, Punjab.

Rezwanullah Rasooly

(11717536)

Table of content

S. No.	Content	Page No.
1	Introduction	5
2	Review of literature	7
3	Plan of work	11
5	Reference	16

INTRODUCTION

Rice *(oryza sativa)* is very important crop for food about third population of the world from its grain used as food. Rice have two important species *Oryza sativa* and *Oryza glabarium* the *Oryza sativa* belong to Asia and *Oryza glabarium* belong to west Africa (Chhidda Singh et al 2017). Fertilizer is very important for intensive yield and growth of plant. Rice plant require to macro and micro nutrients. Macronutrients are essential in less quantity for growth than micronutrients. Micronutrients enhanced both the quality and yield. Micronutrients like Zn, Fe affected by pH, $CaCO_3$. Application of Zn and Fe plays a major role in plant height, biological yield, harvest index, grain yield and growth. Previous reports also suggested that Zn influence nitrogen uptake (associated with Protein synthesis) and also play a major role in photosynthesis (Esfahani 2014).

For rice most important micronutrient is Zn and its deficient may cause decrease rice yield in flooding lands. And also Zn increasing plant height, leaf area, yield, root and steam dry weight. According reported of Bandr (2003) Zn foliar application increasing grain yield of rice Zn applied at 45 days after planting .application of Zn to quantity one kilogram on per hectare from the source of chelate Zn had most grain yield 4.56 ton per hectare and straw 6.88 ton per hectare (Neshaie 2015).

Zn deficiency has been reported in rice crop in the world. Zn deficiency not only reduction yield but also Zn malnutrition in humans .some factors such as water saving systems may decrease Zn availability. Increased application of fertilizer is not sufficient to compensate for over use of cultivated land (Zhejiang 2014). Zn deficiency is greater than other crops in rice with 50 per cent worldwide crop prone to this nutritional disorder. Zn applied to soil, seed and leaved (Adel Ghoneim 2016).

Fifty per cent of the world population especially of the East cultivated and used its grain as food. In 1999-2000 world rice produce was 58687 thousand tons. Rice seeds have oil, protein, starch, fiber, and salt all of them are essential for human body. And also contain more vitamins like vitamins B, E, and G. rice husk have this vitamins too. According survey food agricultural organization (FAO) on 1996 rice provides more than 60 per cent national calories in Myanmar, Bangladesh, Indonesia that is follow to 50 -60 per cent in Vietnam, Thailand, Korea, and in

Japan and India to 40-50 per. Only 30 per cent national calories it provides in USA and Pakistan. Rice is also called paddy in English, Irz in Arabic, chawal in Hindi and Urdu, Biranj in Persion language (Pakistan economic2002).

Rice is most important cereal crop and main food source for more than third population of the world. 90 per cent of world rice cultivated and consumed in Asia rice provide 30-60 per cent of the world calories that calories consumed by 3 billion Asian. About 148 million hectares world land annually cultivated rice. Rice is the almost consumed by humans. In (1996) rice production was 553 million tons. China is the largest producer of rice in the world that produce was 187 million tons per year Followed by India, Indonesia, Bangladesh, Vietnam, Thailand, and Myanmar. Thailand is world rice exporter, selling 4-6 million tons yearly. Second largest exporter of rice is United States it ranks 11^{th} in production. Its production was 6 million tons and market about 40 per cent. Pakistan, Vietnam and Myanmar market are about a million tons yearly. In 1995 India market was about 4 million tons decline in 1996 only about a million. Saudi Arabia and Iraq are the main foreign counties buyers about 0.9, 0.7 and 0.5 million tons annually. And also Africa demand to increasing rice at the rate of 2 per cent yearly. Food Agricultural Organization (FAO) determined that on 2050 the world rice requirement will be 524 million toned annually required 2 million from the present level production (Pakistan economic, 2002).

Rice production increased during green revolution that increased at rate of 2.3 to 2.5 per year during 1970 and 1980. But yield growth rate declined during the first decade of third century (Singh et al 2017). According to many estimate the world rice production must increase at the rate of 2 million tons per year. And also have challenged, rice verities with higher yield potential. Various strategies for increasing yield potential of rice including, F1 hybrid breeding, hybridization selection, modification of plant architecture, enhancement of photosynthesis (Dogara 2014). Therefore, proposed work is planned to evaluate effect of foliar Zn application at different growth stages on growth and yield attribute of rice under following objectives.

1. To study the effect of zinc application on growth attribute of rice crop.
2. To evaluate the efficacy of zinc on yield attribute of rice.
3. To study the residual effect of zinc on soil nutrients.

REVIEW OF LITERATURE

There are several experiment conducted for evaluation of the effect of Zn foliar application on different stage growth on rice with different factors. An experiment conducted to study effect of zinc foliar application on yield and yield component of rice (*Oryza sativa*) under flooded condition by (Neshaie, 2015) indicate that increased Zn application and maximum yield of the seed (11216.5 kg/h) in concentration of 1.92 g/lit. However there is negative effect i.e. 41.49 per cent decreased in number of empty seed per ear. Other studies revealing the similar effect such as a study conducted on influence zinc impregnated urea on growth, yield and grain in rice by (Nazirl et al, 2016) indicate that application of Zn is having a significant impact on enhancing growth, yield, and grain of rice. 1.5 per cent Zn coated urea was reported as the most suitable does in improving crop growth. About 15 -20 per cent increase in yield and grain was observed by the application of Zn at the rate of 1.5 per cent bio activated coated urea.

An experiment was conducted to effect of foliar application of zinc on yield of wheat growth by avoiding irrigation at different growth stages by (Sultantai et al 2016) indicate foliar application of Zn by skipping irrigation at grain filling stage with four application of Zn (0.0, 0.02, 0.04 and 0.06) per cent . Foliar application of Zn influenced the yield and component of rice. Highest yield 5.59 ton per hectare was recorded in normal irrigation at flowering and heading stage with 0.06 per cent foliar application of Zinc.

A study was conducted on effect of different levels of zinc on growth and uptake ability in rice by (Muamba, 2013) indicate different level of Zn effect on some growth characteristics like plant height, number of tiller and spade value. Data showed that the plant height significantly increased at 20 Kg ZnSo4/h and 30Kg ZnSo4/h from our data however the ZnSo4/h in IR7398 and Thanu from high and low zinc group respective. Number of effective tillers that data show very little different between zero and 20 Kg ZnSo4/h, BPT5204 and R73898 different from zero zinc and number of effective tillers was the lowest at zero zinc for high zinc group application of Zn significant increase in the uptake of Zn from the soil irrespective of soil pH. The date for spade chlorophyll showed chlorophyll level was high and significantly increased at 20 Kg ZnSo4/h and 30 Kg ZnSo4/h compared with the zero zinc. Grewal et al has reported application of Zn increased the chlorophyll content. Effect of Zn on dry matter of rice to study of data dry matter production was highest at 30 Kg $ZnSO_4$ per hectare.

An experiment was conducted by (kumar et al) have reported that application of 10 mg Zn on per gram soil along with 200 mg nitrogen on per gram soil increased the dry matter yield of pearl millet. More use of Zn (20mg Zn/g soil) might decrease the nitrogen concentration.

An experiment was conducted by (Shivag et al 2015) indicate Zn application increased not only Zn concentration but also increased protein content of rice (karnal) and concentration of Fe, N, P and K due to the overall improvement in crop growth. Zn application significantly increased tillers m^2 and grain panicle in rice but not the panicle length. Zn application increased Zn concentration in rice kernel, husk and straw and the highest values were obtained for soil + foliar application of Zn. Zn application significantly increased potassium concentration in kernel only and soil application of Zn and soil +foliar application of Zn were at por significantly superior to soil application of ZnCu or foliar application of Zn.

A study was conducted on effect of foliar pray and source of Zn yield, zinc content and uptake by rice by (Kulhar et al 2017). Indicate the application of Zn increased the grain yield of rice. Foliar spray of zinc 1.0 per cent Zn salt significantly increased the rice grain and straw yield over 0.5 sprays of Zn salts alone and 1% Zn salt along with 0.5% lime application.

A study was conducted by (Gharib et al 2014) indicate Zn application effect on leaf area index, dry weight per m^2 and number of tillers per m^2 were substantially increased by application of Zn fertilizer. Application of ZnSo4 at rate 24 or 36 Kg per hectare produce greater number of tillers than the rate of 12 Kg ZnSo4 per hectare. And also have vital role in improve rice growth subsequently increased photosynthesis leading to high dry matter production.

An experiment was conducted to study effect of different level of zinc on growth and yield of rice and Red *Amarnathus* by (Malik et al 2016). Reported concentration of Zn increased with increasing Zn treatment in rice and red *Amaranthus*, shoot, grain. For red *Amranthus* the length of root shoot, fresh and dry matter production decrease with Zn level. And also increasing Zn level and highest was observed at 200 ppm Zn increase length of root, shoot, and spikelet. The result indicated Zn influenced on growth and yield of rice and red *Amaranthus*.

A study was conducted by (Hafeez et al 2013) reported Zn is necessary for health crop growth and high yield. Zinc deficiency effect on stunning plant, growth, increasing crop maturity period, decreasing number of tillers, and produce small leaves.

An experiment was conducted on zinc application on growth and yield of rice by (Qaisran, 2011). Reported was comprised of eight treatment like control, rice nursery root dipping in 0.5 per cent Zn solution, $ZnSO_4$ application at the rate of 25 Kg per hectare as basal dose, foliar application 0.5 per cent solution at 15, 30, 45, 60, and 75 days after transplanting. Maximum productive tillers per m^2 (249.80) were noted with basal application at the rate 25 Kg per hectare 21 per cent $ZnSO_4$ and minimum (220.28) were recoded with foliar application at 60 DAT at 0.5% per cent Zn solution. Zn application method and timing had significantly pronounced effect on paddy yield. Paddy yield 5.21 ton per hectare was achieved in treatment Zn^2 and minimum paddy yield 4.17 ton per hectare was noted in Zn7. Zinc application increase the crop growth rate of rice.

A study was conducted by (Kadam et al., 2018) reported effect of zinc and iron fortification on growth and developmental stages of upland irrigated rice *(Oryza sativa L.).* The treatments were laid out in factorial randomized block design (FRBD) with three replications. Two years results indicate that among varieties PBNR-03-02 explored highest growth and developmental stages whereas combine application of $ZnSO_4$ + $FeSO_4$ with RDF treatment recorded maximum growth and yield attributing characters respectively.

An experiment was conducted by (Khan et al, 2014). Reported The highest concentration 1.37 and 1.08 mg Kg per hectare were recorded by the application of 10 Kg Zn per hectare. The lower concentration 0.81 and 0.78 mg Kg per hectare were obtained from 5 Kg Zn per hectare while the lowest concentrations of (0.47, 0.46 and 0.45 mg Kg^{-1}) were recorded from check plots. The application of zinc in rice significantly affected the concentration of zinc in soil over check that ranged from 0.45 to 1.18 mg Kg per hectare. The highest concentration was recorded by the cumulative application of 10 kg Zn per hectare, followed by 1.02 mg per kilo gram achieved with direct application of 10 Kg Zn per hectare and lowest concentration was recorded from control. Result showed 10 Kg Zn per hectare applied to wheat can prove economical for rice production in wheat-rice system.

A study was on effect of zinc on yield, quality, and grain zinc content of rice genotypes by (Sedha, 2015) reported effect of zinc application on yield, quality and grain zinc content of different rice genotypes in a split plot design. The application of zinc significantly increased the plant height, number of productive tillers, filled grains per panicle, panicle length and on thousand grains weight as compared to NPK fertilization alone. The yield of grain 4623 to 7434 Kg per hectare and straw 6657 to 10041 Kg per hectare of different rice genotypes significantly increased with the application of zinc in which the grain and straw yields were increased by 14 and 16 per cent respectively. In 2015, Anisoara reported effect of different Zn concentration (50 mg/l, 100 mg/l, 200 mg/l, 400 mg/l, 500 mg/l, 600 mg/l) influenced seed germination and growth in early ontogenetic stages of *cucmis melo l.* and also affect the seedling growth, the growth process of the lateral roots and the seedling vigor. Another study conducted on effect of zinc on root growth, cell division and nucleoli of *allium* by (Lia et al, 1996) indicated that zinc could obviously inhibit root growth at concentration from 0.0004 to 0.002 m/l.

An experiment was conducted on effect of zinc on seed germination and seedling growth of *Brassica Rapa l* by (Tiwatri et al, 2014). Reported seeds were treated with various concentration (10, 50, 100, 200, 500, and 100 ppm) of zinc and allowed to germinated under laboratory conditions for ten days and effect on root length, shoot length, seed germination and fresh weight of *Brassica rapa l*. on tenth day it was determined that seed germination and shoot length both show inhibited result with both heavy metals treatment except at lower concentration of zinc where the result are better than control.

A study was conducted on physiological impact on zinc nanoparticle on germination of rice (*oryza sativa)* seed by (Upadhyaya, 2017). Reported result indicated effect of zinc in germination of growing seedling of rice was significant. An exposure to zinc (5 mg, 10 mg, 15 mg, 20 mg, and 50 mg) per liter caused significant changes on radicle and plumule length, mas (fresh and dry mass) and seed moisture content in the tested cultivar of rice.

An experiment was conducted on effect of sulphur and zinc on growth yield and nutrient uptake of rice by (Rahman et al, 2008). Reported there were seven treatments viz S0Zn0, S10Zn0, S20Zn1, S0Zn1, S0Zn3, S10Zn1.5, and S20Zn3. The subscripts of S and Zn represent the dose in Kg per hectare. The highest grain 5.76 ton per hectare and straw 7.32 ton per hectare yield were recorded in the S20Zn3 (100 per cent recommended dose). The S0Zn0 had lowest grain yield with 4.35 ton per hectare as well as the lowest straw yield with 5.47 ton per hectare.

A study was conducted on effect of zinc application on rice yield and some agronomic characters by (Yakan et al, 2001) reported the objective of study were to examine the effect of zinc application on rice grain yield and some agronomic characters and to find out suitable zinc application rate. Four zinc treatments 0, 15, 30 and 45 Kg per hectare were utilized and $ZnSo_4$ was used as zinc source. On average grain yields increased 8.9 per cent and also zinc concentration of the plant and the rice grain increased with zinc application. In addition to yield increased with zinc application. As result 15 Kg per hectare zinc seems to be suitable for zinc application.

PLAN OF WORK

The present experiment will be conducted warm season 2018 at agricultural farm of lovely professional university, Jalandhar, Punjab. Materials and method used during this experiment are described below.

DESIGN AND LAYOUT OF THE EXPERIMENT

EXPERIMENTAL DETAILS:

- Year of the experimentation: 2018
- No of treatment: Eight(8)
- No of replication: Three(3)
- Total no of plots: Twenty four(24)
- Plot size: 3m×4m($12m^2$)
- Irrigation channel: 0.5m
- Total area: $350m^2$
- Row to row spacing: 20cm
- Plant to plant spacing: 10cm
- Crop: Rice

Recommended dose of fertilizers kg/ ha

N 120 kg, P_2O_5 60 kg, K_2O 60 kg

TREATMENT DETAILS

Variety:	PR variety
Sowing time:	20- 25 May
Seed rate:	15 kg/h
Sowing depth:	3-4 cm

NUTRIENT MANAGEMENT TREATMENTS

T1	control (no zinc application)	
T2	Tillering stage	Application of Zn (T2–T8)
T3	Penicle initiation stage	
T4	Booting stage	
T5	Heading stage	
T6	Grain filling stage	
T7	Booting stage+ heading stage	
T8	Booting stage + Grain filling stage	

Number of replication: Three (3)

Number of irrigation channel: Two

Collection of soil sample:

Soil sample will be taken before crop sowing to chick the soil pH, organic carbon, electric conductivity, N, P, K and Fe ratio presence in soil.

Observation:

A: **Frequency of observation**

1. Soil pH and EC
2. Organic Carbon
3. Available Nitrogen, Phosphorus and Potassium

B: **Plant growth parameter**

1. Plant height
2. Number of tillers
3. Length peduncle
4. Dry biomass

C: Yield parameter

1. Number of grains
2. Thousand grain weight
3. Grain yield
4. Harvest index
5. Straw dry weight
6. Plant dry weight

Analysis: soil analysis

Initial soil: initial soil sample will be analyzed for pH, EC, Organic carbon, available N, P, K and Fe amount present in soil.

Analytical methods to be followed during investigation are as under

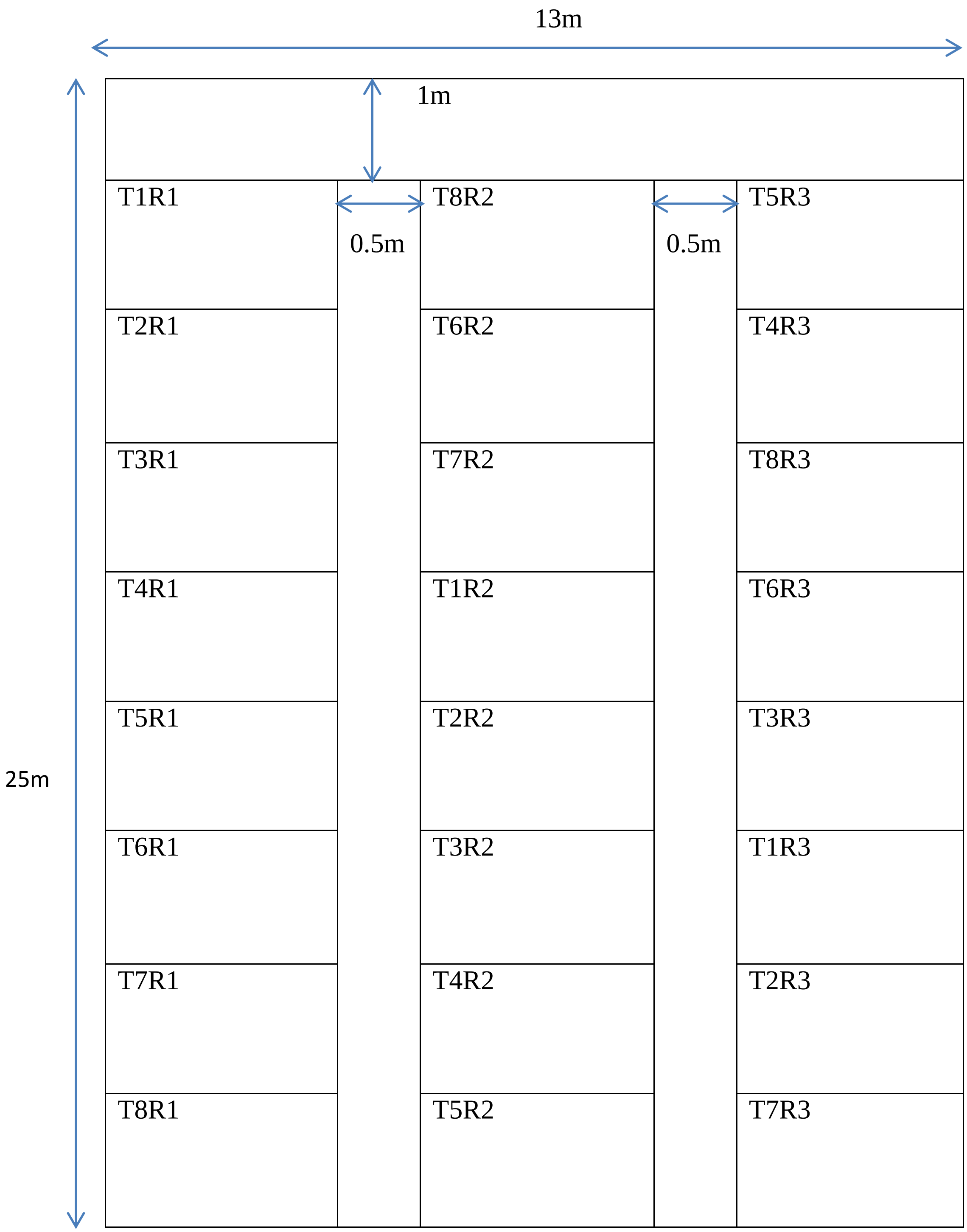
S.N	Test parameter	Method	References
1	pH(1:1.5)	Glass electrode	Sparks (1996)
2	EC(1:2.5)	Conductivity meter	Sparks(1996)
3	Organic carbon	Wet digestion	Walkley and black (1934)
4	Available N	Alkaline potassium permanganate method	Subbiah and Asija (1956)
5	Available P	Olsen's method	Olsen et al (1954)
6	Available K	Flame photometer	Jackson(1973)
7	Zinc	Atomic absorption spectroscopy	Walsh(1955)

Plan of proposed work

Area:	350m^2
Seed rate:	15 kg/h
Time of transplanting:	20- 25 June
Spacing:	20×10cm

S.N	Plant growth stage at which foliar zinc Spray application (1.2 lit/plot)
1	Panicle initiation
2	Booting
3	Tillering
4	Heading
5	Grain filling
6	Booting and heading
7	Booting and Grain filling stage

Layout of the field experiment on Rice



Reference

Abdul SM, Balasubramanian S. 1988. Influence of N, Zn and their interaction on the yield and nutrient uptake of ‘IR20’ rice (Oryza sativa) in different seasons. Indian J Agric. Sci. 58(3):190-193.

Avsar F, Beser N, Durek H, Gurbuz MA, Yakan HM. 2001.The effect of zinc application on rice yield and some agronomic character. In: Chataigner J.

Awan TH, Ali R., Manzoor Z, Ahmed M, Akhtar M. 2011. Effect of different nitrogen levels and row spacing on the performance of newly evolved medium grain rice variety, KSK-133. J. Anim. Plant Sci. 21(2): 231-234.

Bhargava, A.K. and bhargava, S. 2005. Effect of zinc effluent on seed germination and seedling growth of Vicia faba. Adv. Plant sci. 18(2) :721-723

Charati & Malakouti, M. J. (2006). Effect of zinc and cadmium concentrations on the rates of their absorption by rice and on some growth characteristics of the plant (*Oryza sativa* L.) part 2: yield and composition. 18th world congress of soil science (pp: 155-173).Philadelphia, Pennsylvania, July 9-15, 2006.

Chaudhary, S. K Thakur, S. K. & Pandey, A. K. (2007). Response of rice (Oryza sativa) to nitrogen and zinc . 44(1), 31-34.

Ekiz, H., S. A. Bagcı, A. S. Kıral, S. Eker, I. Gu¨ ltekin, A. Alkan and I. Cakmak. 1998. Effects of zinc fertilization and irrigation on grain yield and zinc concentration of various cereals grown in zinc-deficient calcareous soils. J. Plant Nutr. 21: 2245– 2256

Ghani, A,Shah M, Khan DR. 1990. Response of rice to elevated rate of Zn in mountainous areas of Swat. Sarhad J. Agric. 6: 411-415.

IRRI (International Rice Research Institute).(2009). Rough rice production by country and geographical region, USDA. Trend in the rice economyIn: world rice statistics.

Javaid M. 1989. Effect of copper and zinc on the growth, yield and chemical composition of rice (Basmati-370). M. Sc. (Hons.) Agric., Thesis, Deptt. Soil Sci.. Univ. Agric. Faisalabad, Pakistan.

Kadam, S.R., Bhale, V.M., Kubade, K.J. and Deshmukh, M.R., 2018. Effect of Zinc and Iron Fortification on Growth and Developmental Stages of Upland Irrigated Rice (*Oryza sativa* L.) Cultivars. Int. J. Curr. Microbiol. App. Sci, 7(1), pp.1950-1958.

Khan MU, Qasim M and Khan I 2007. Effect of Zn fertilizer on rice grown in different soils. Dera Ismail Khan. Sarhad Journal of Agriculture 23(4): 1033-1040.

Kumar, B., V.P. Singh and B. Kumar. 1997. Zinc status of rice plant as influenced by different levels and methods of zinc application. J. Soil Crops, 7: 105-108.

Malik NJ, Chamon NJ, Mondol NJ, Elahi SF, Faiz SMA. 2011. Effect of different levels of zinc on growth and yield of red amaranth (*Amaranthus* sp.) and rice (*Oryza sativa*, variety-br49). J Bangladesh Assoc. Young Res. 1(1): 79-91.

Muthukumararaja, T. M., & Sriramachandrasekharan, M. V. (2012). Effect of zinc on yield, zinc nutrition and zinc use efficiency of lowland rice. Journal of Agril. Tech., 8, 551-561.

Rahman, M. T., Jahiruddin, M., Humauan, M. R., Alam, M. J., & Khan, A. A. (2008). Effect of Sulphur and Zinc on Growth, Yield and Nutrient Uptake of Boro Rice (Cv. BrriDhan 29) . J. Soil. Nature., 2, 10-15.

Saha B, Saha S, Roy PD, Hazra GC and Das A 2013. Zinc fertilization effects on agromorphological and quality parameters of commonly grown rice. SAARC Journal of Agriculture 11(1): 105-120.

Sahaa, P. K., Ishaqueb, M., Salequeb, M. A., Miahb, M. A. M., Panaullahb, G. M., & Bhuiyanb N. I. (2007). Long-Term Integrated Nutrient Management for Rice-Based Cropping Pattern: Effect on Growth, Yield, Nutrient Uptake, Nutrient Balance Sheet, and Soil Fertility Communications in Soil Science and Plant Analysis, 38(5-6), 579-610.

Yadi R, Dastan S and Yasari E 2012. Role of zinc fertilizer on grain yield and some qualities parameters in Iranian rice genotypes. Annals of Biological Research 3(9): 4519-4527.

Fageria, NK. and VC. Baligar, 2005. Growth components and zinc recovery efficiency of rice upland genotypes. Pesq. Agropec. Brasilia, 40(12): 1211-1215.