The Pharma Innovation Journal 2022; 11(9): 2860-2866

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(9): 2860-2866

www.thepharmajournal.com
Received: 14-06-2022
Accepted: 16-07-2022

Prakhar Kumar Nigam
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Dr. T Singh,
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Amit Singh Tiwari
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Divanshu Gupta
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Atul Kumar Namdeo
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Atul Kumar Namdeo
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Corresponding Author:
Prakhar Kumar Nigam
Department of Agronomy, AKS University, Satna, Madhya Pradesh, India

Effect of zinc and KSB levels on growth, yield and quality of paddy (*Oryza sativa* L.)

Prakhar Kumar Nigam, Dr. T Singh, Amit Singh Tiwari, Divanshu Gupta and Atul Kumar Namdeo

Abstract
A field experiment was conducted during *Kharif* season in 2021-2022 at the Research farm, Department of Agronomy, AKS University, Satna (M.P.), to evaluate the effect of zinc and KSB levels on growth, yield and quality of paddy (*Oryza sativa* L.). The experiment was laid out in Factorial Randomized Block Design comprising four zinc levels *viz.* 00 kg Zn_1 ha^{-1}, 10 kg Zn_2 ha^{-1}, 15 kg Zn_3 ha^{-1}, 20 kg Zn_4 ha^{-1} and three KSB levels, 5 ml/kg K_1, 10 ml/kg K_2, 15 ml/kg K_3 and treatments were replicated thrice. Results revealed that different levels of zinc affected the growth parameters as well as yield attributes and yield of paddy. Incorporation of 20 kg Zn1 ha^{-1} recorded maximum plant height at 90 DAS (98.95 cm), number of effective tillers plant (70.86), length of panicles (18.86 cm), grain yield (36.62 q ha^{-1}), straw yield (68.94 q ha^{-1}), Dry weight (9.81 g), and protein content (12.03%), however, number of leaves $plant^{-1}$ at 90 DAS (34.57) and harvest index (34.60%) were higher with incorporation of 15 kg Zn ha^{-1}. Among different KSB levels, maximum number of effective tillers (52.54), number of leaves per plant at 90 DAS (29.79 cm), grain yield (28.656q ha^{-1}), dry weight (8.18. g), harvest index (32.64%), and protein content (10.69%) were observed when crop was sown on 26 July.

Keywords: Zinc and KSB levels, paddy, growth, yield, quality

Introduction
Paddy (*Oryza sativa*. L) Is the most important and popular cereal crop after wheat and one of the most widely consumed grains in the world In India, paddy is grown in an area of 43.9 million hectares, producing around 106.77 million tones (Anonymous, 2018) [1]. India is the second largest consumer of paddy with 100 million metric tons after China which consumes 143.8 million metric tons of paddy (Anonymous, 2019) [2].

Zinc is an essential micronutrient for rice. In order to get the best grain yields from lowland rice, zinc is typically a crucial component. Rice grows and develops primarily as a result of zinc. Zn is the fourth most deficient nutrient element in Indian soils out of the 17 necessary nutrients (Shukla and Behera 2011) [11]. Zinc deficiency continues to be one of the key factors in determining the rice production in several parts of the country. One of the essential nutrients, zinc is needed for a number of biochemical and metabolic processes in rice, including the production of chlorophyll, synthesis of cytochromes and nucleotides, AUXIN metabolism, maintenance of membrane integrity, carbohydrate metabolism, development of cell walls, gene expression, and respiration (IRRI, 2000).

KSB microorganisms isolated from rhizospheric soil may be better adapted to crop plants and provide better growth than organisms isolated from other sources like composts or harsh environments because the former have already been closely associated with the plant system and have also adapted to the local environment [Gopalakrishna *et al*. 2011; Bakhshanded *et al*. 2014] [17]. Growth and productivity of plants are significantly influenced by the availability of nutrients at the soil-root interface. For instance, potassium K is an essential nutrient for paddy growth and K requirement of paddy is greater than nitrogen N and phosphorus requirement.

Materials and Methods
The present investigation was carried out during 2021-2022 in *kharif* season at the Research farm, Department of Agronomy, AKS University, Satna (M.P.). Mean temperature and humidity ranged from 21.71 °C (min) to 32.39º C (max) and 70.67% (morning) to 55.33% (evening), respectively. The soil of experimental field was silty clay loam with low level of organic carbon (0.43%), available nitrogen (176.6 kg ha^{-1}), available phosphorus (12.5 kg ha^{-1}) and medium level of available potassium (200.00 kg ha^{-1}) having 7.5 pH and 0.16 ds/m EC.

Twelve treatment combinations (Zn_1K_1, Zn_1K_2, Zn_1K_3, Zn_2K_1, Zn_2K_2, Zn_2K_3, Zn_3K_1, Zn_3K_2, Zn_3K_3, Zn_4K_1, Zn_4K_2, Zn_4K_3) of four levels of zinc *viz*. Zn_1 = 00 kg Zn_2 = 10 kg/ha, Zn_3 = 15 kg/ha, Zn_4 = 20 kg/ha and three KSB levels *viz* K1 = 5 ml/kg, K_2 = 10 ml/kg, K_3 = 15 ml/kg were laid out in Factorial Randomized Block Design and replicated thrice.

Variety Sujala (CNR-2) was used and seeds at the rate of 100 kg ha^{-1} were broadcasted in experimental units. The experimental plots were fertilized as per treatments. Urea (46% N), single super phosphate (16% P2O5) and muriate of potash (60% K2O) were used as a source of nitrogen, phosphorous and potassium, respectively. Full recommended dose of phosphorus at the rate of 60 kg P2O5 per ha and potassium @ 40 K2O kg/ha was uniformly applied to each plot as basal dose before seed sowing. Zinc was supplied to experimental units as per treatment through Urea. Half dose of nitrogen was applied as basal dose at the time of sowing and remaining half dose of nitrogen was applied in two equal splits at tillering and panicle initiation stage.

Results and Discussion

Experimental results on the effect of treatments are explained as under:

The beneficial effect of different levels of zinc on mean plant height at 90 DAS, number of effective tillers, number of leaves $plant^{-1}$ at 90 DAS, number of panicles $plant^{-1}$, length of panicles, grain yield (q ha^{-1}), straw yield (q ha^{-1}), dry weight, harvest index, protein content were evident during active growth and maturity period of paddy crop.

Incorporation of 20 kg Zn ha^{-1} (Zn4) produced significantly higher mean plant height at 90 DAS (98.95 cm), number of effective tillers (70.86), followed by incorporation of 15 kg Zn ha^{-1} (Zn3), however, maximum number of leaves $plant^{-1}$ at 90 DAS (29.33) was observed with application of 15 kg Zn ha^{-1} followed by 20 kg Zn ha^{-1} (Table 1).

Data on yield and yield contributing traits *viz.*, length of panicles (cm), grain yield (q ha^{-1}), straw yield (q ha^{-1}), dry weight, harvest index as influenced by different zinc levels was found to be significant and have been presented. Incorporation of 20 kg Zn ha^{-1}(Zn4) produced maximum, length of panicles (18.86 cm), grain yield (36.62q ha^{-1}), straw yield (68.94q ha^{-1}), fresh weight (33.68 g), followed by incorporation of 15 and 10 kg Zn ha^{-1}, respectively. However, harvest index (34.60%) was highest when crop was supplied 15 kg Zn ha^{-1}. All above mentioned yield and yield attributes were recorded to be lowest with control treatments. The results are in conformity with those of Jyoti *et al*. (2018) and Kumar *et al*. (2019) [18].

Protein content also influenced by different levels of zinc. Highest protein content (12.03%) was noted with application of 20 kg /ha^{-1} followed by 15, 10 kg Zn ha^{-1}, respectively.

The beneficial effect of different KSB levels on plant height at 90 DAS, number of effective tillers, number of leaves $plant^{-1}$ at 90 DAS, length of panicles, grain yield (q ha^{-1}), straw yield (q ha) fresh weight, harvest index, protein content were evident during active growth and maturity period of paddy crop. Crop sown on 26 July produced maximum number of effective tillers (52.54), number of leaves $plant^{-1}$ at 90 DAS (29.79), however, highest plant height (90.64 cm) at 90 DAS was recorded.

The yield and yield contributing traits like, length of panicles (cm), grain yield (q ha^{-1}), straw yield (q ha^{-1}), fresh weight, and harvest index were also significantly influenced by different KSB levels. Highest grain yield (28.65 q ha^{-1}) was obtained with (26th July) which was statistically. In addition to that crop sown on 26 July also gave highest fresh weight (29.39 g) and harvest index (32.64%), however, length of panicles (16.14 cm), and straw yield (57.27 q ha^{-1}) were recorded higher when crop was sown on 26 July.

Protein content was also influenced by different KSB levels. Crop sown on 26 July had more protein content (10.69%) than rest of the sowing dates. This might be due to the fact that late sowing delayed the peak growth of rice crop and zinc concentration decreases in the plant from the late reproductive period to harvest. The results are in conformity with that of Mahajan *et al*. (2011) [10].

Table 1: Number of leaves per plant of paddy at 90 DAT as influenced by KSB and Zinc levels and their interactions

KSB levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	17.53	23.66	28.73	32.06	25.49
K2 (10ml/kg)	19.66	26.4	29.53	33	27.14
K3 (15ml/kg)	23.4	27.4	29.73	38.66	29.79
Mean	20.19	25.82	29.33	34.57	

Table 2: Plant height (cm) of paddy at 90 DAT as influenced by KSB, Zinc levels and their interactions

KSB levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	62.65	78.33	91.37	97.49	82.46
K2 (10ml/kg)	66.71	88.54	92.91	99.16	86.83
K3 (15ml/kg)	75.85	90.29	96.23	100.2	90.64
Mean	68.40	85.72	93.50	98.95	

Table 3: Number of effective tillers per plant of paddy as influenced by KSB and Zinc level and their interaction

KSB-levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	21.8	32.26	50.33	64.66	42.26
K2 (10ml/kg)	22.46	38.33	56.86	66.8	46.11
K3 (15ml/kg)	29.4	42.66	57	81.13	52.54
Mean	24.55	37.75	54.73	70.86	

Table 4: Fresh weight of plant of field paddy at 45 DAS as influenced by different Zinc and KSB levels and their interaction

KSB-levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	21.69	24.84	28.67	32.54	26.84
K2 (10ml/kg)	22.12	26.09	30.09	33.73	28.01
K3 (15ml/kg)	23.70	27.56	31.51	34.77	29.39
Mean	22.50	26.16	30.09	33.68	

Table 5: Length of panicle (cm) of paddy as influenced by KSB, Zinc levels and their interactions

KSB-levels (kg//ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	6.44	13.35	16.62	18.17	13.64
K2 (10ml/kg)	9.97	15.03	17.45	18.81	15.31
K3 (15ml/kg)	11.22	15.79	17.92	19.59	16.14
Mean	9.21	14.72	17.33	18.86	

Table 6: Grain yield per hectare of paddy as influenced by Zinc, K.SB levels and their interaction (t/ha).

KSB-levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	15.11	19.05	26.11	33.47	23.43
K2 (10ml/kg)	15.36	21	29.44	34.19	24.99
K3 (15ml/kg)	16.25	23.44	32.69	42.22	28.65
Mean	15.57	21.16	29.41	36.62	

Table 7: Straw yield of paddy as influenced by Zinc and KSB levels and their interaction.

KSB-levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	37.93	40.30	53.92	66.84	49.74
K2 (10ml/kg)	38.13	41.92	59.01	67.86	51.73
K3 (15ml/kg)	38.95	51.64	66.38	72.12	57.27
Mean	38.33	44.62	59.77	68.94	

Table 8: Harvest index (%) of paddy as influenced by Zinc and KSB levels and their interaction

KSB-levels (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	28.45	32.06	32.60	33.41	31.49
K2 (10ml/kg)	28.60	33.34	33.24	33.49	32.16
K3 (15ml/kg)	29.35	31.22	33.09	36.92	32.64
Mean	28.8	32.20	32.97	34.60	

Table 9: Protein content (%) of paddy as influenced by Zinc and KSB levels and their interaction

KSB-level (kg/ha)	Zn levels (kg/ha)				Mean
	Zn_1 (0 kg/ha)	Zn_2 (10 kg/ha)	Zn_3 (15 kg/ha)	Zn_4 (20 kg/ha)	
K1 (5ml/kg)	8.5	9.98	10.49	11.07	10.01
K2 (10ml/kg)	8.74	10.11	10.68	12.22	10.43
K3 (15ml/kg)	8.77	10.29	10.93	12.79	10.69
Mean	8.67	10.12	10.70	12.03	

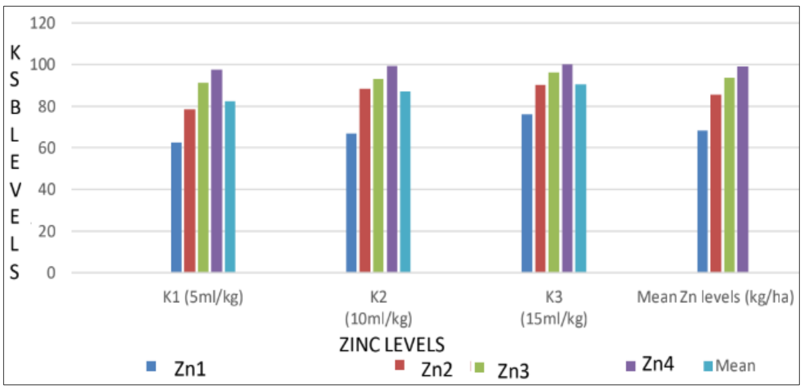

Fig 1: Plant height (cm) of paddy at 90 DAT as influenced by KSB, Zinc Levels and their interactions

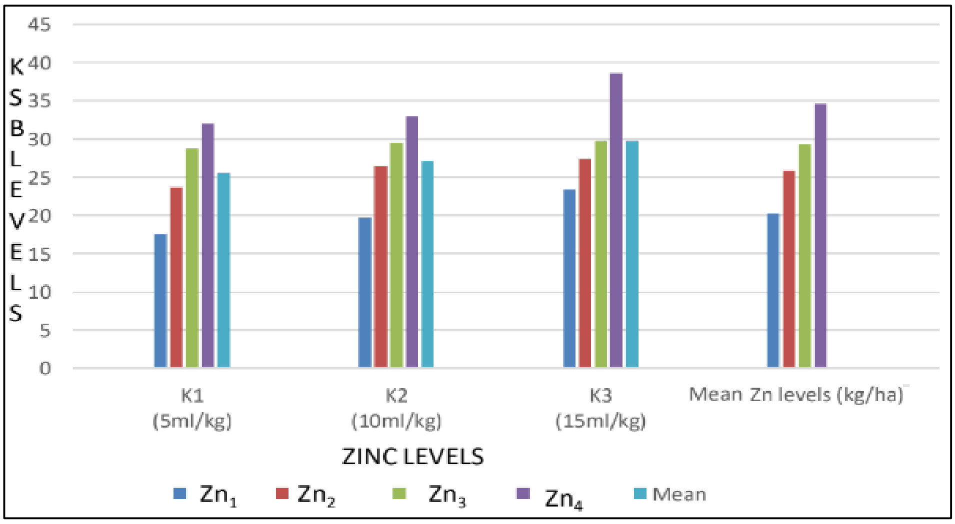

Table 2: Number of leaves per plant of paddy at 90 DAT as influenced by KSB and Zinc levels and their interactions

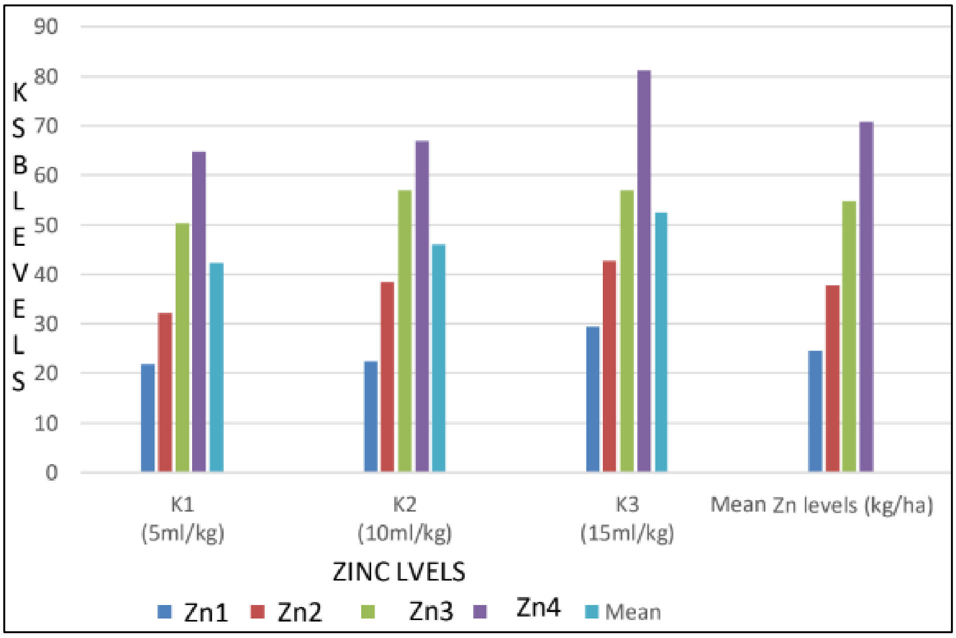

Table 3: Number of effective tillers per plant of paddy as influenced by KSB and Zinc level and their interaction

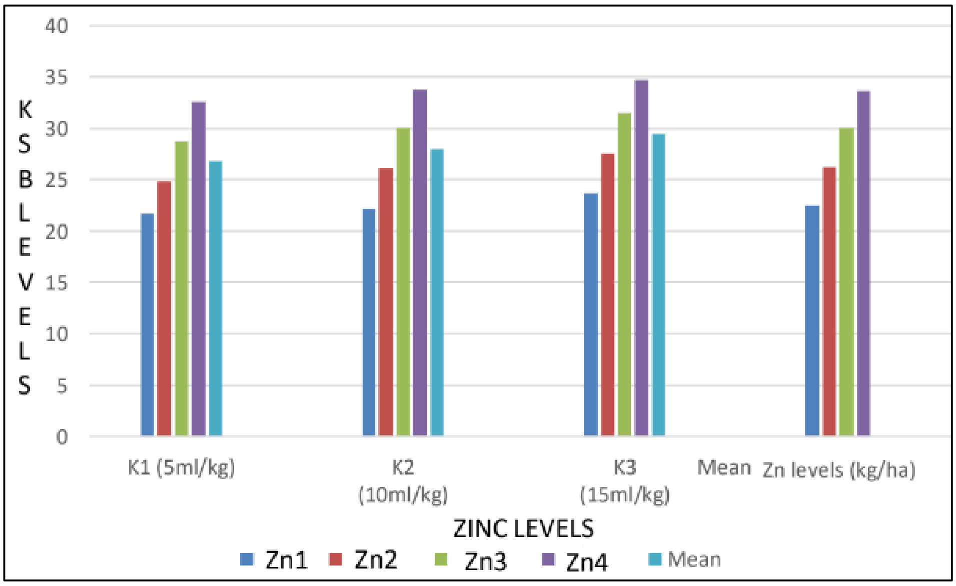

Table 4: Fresh weight of plant of field paddy at 45 DAS as influenced by different Zinc and KSB levels and their interaction

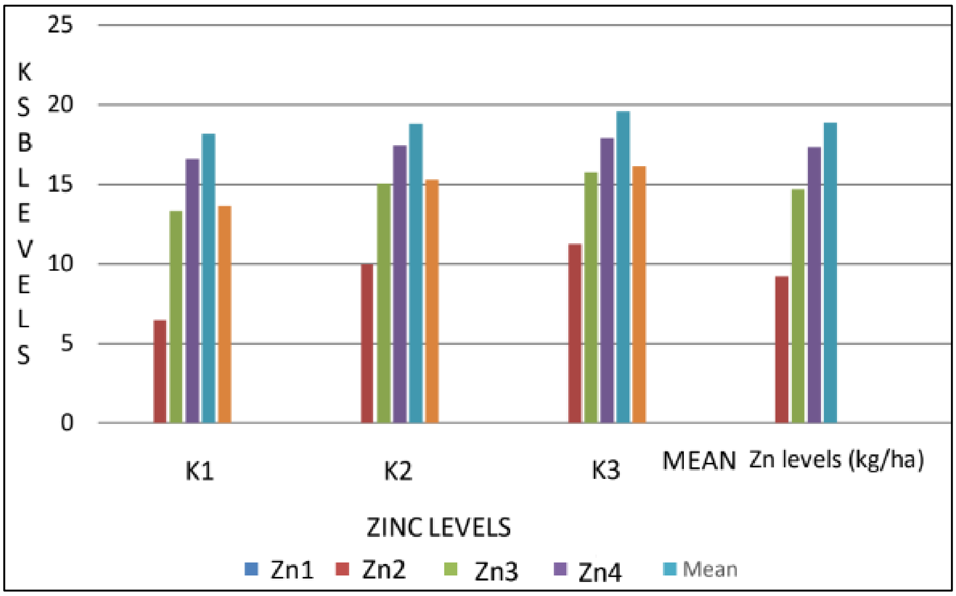

Table 5: Length of panicle (cm) of paddy as influenced by KSB, Zinc levels and their interactions

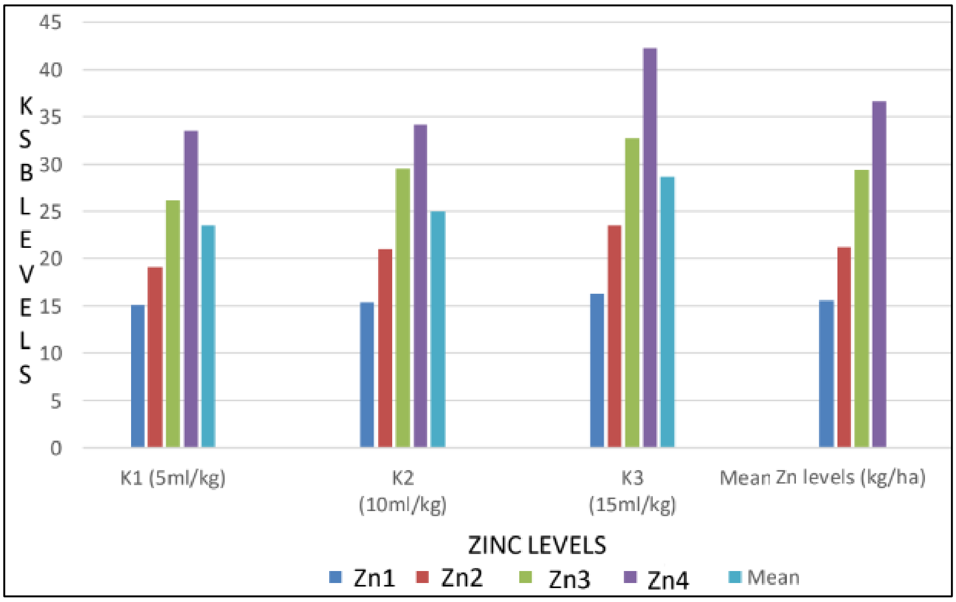

Table 6: Grain yield per hectare of paddy as influenced by Zinc, K.SB levels and their interaction (t/ha)

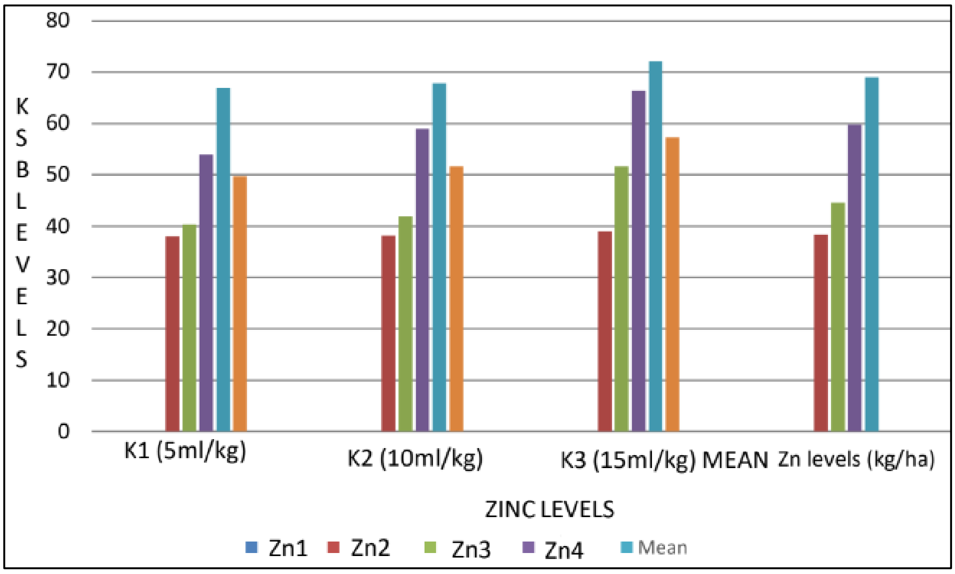

Table 7: Straw yield of paddy as influenced by Zinc and KSB levels and their interaction

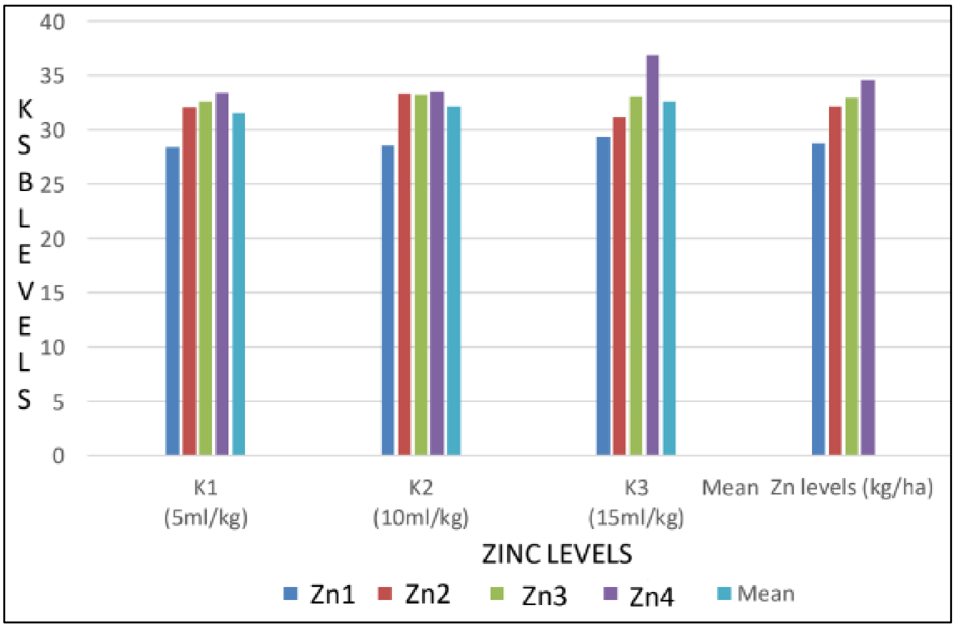

Table 8: Harvest index (%) of paddy as influenced by Zinc and KSB levels and their interaction

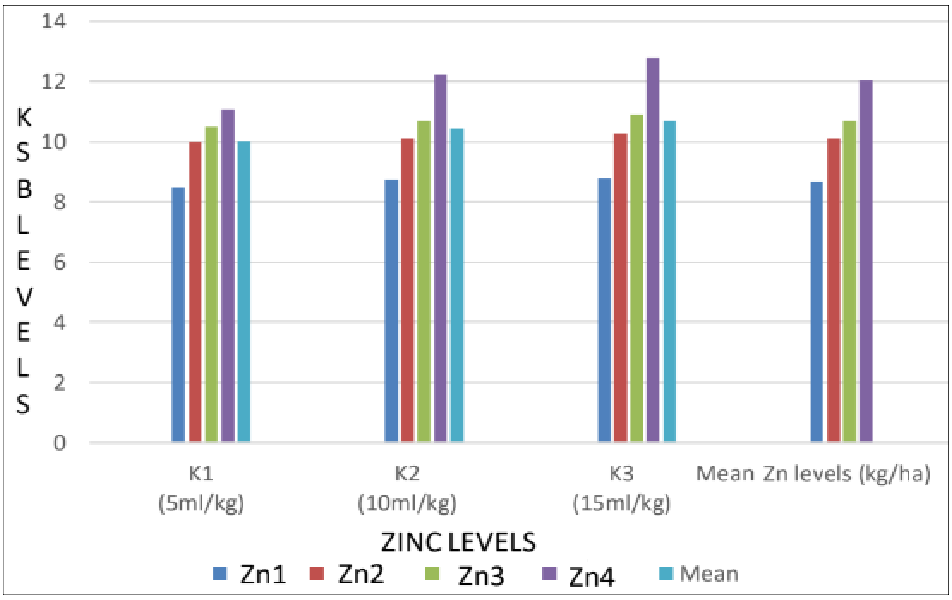

Table 9: Protein content (%) of paddy as influenced by Zinc and KSB levels and their interaction

Summary and conclusion

All growth parameters except number of leaves per plant at 90 DAS were highest with the application of 20 kg Zn ha^{-1}. Crop sown on 26 July produced maximum number of effective tillers and leaves at 90 DAS whereas highest plant height was obtained when crop was sown on 26 July. Yield attributes *viz.* number of grain panicles per plant and length of panicles were higher with the incorporation of 20 kg Zn ha^{-1} and sowing of crop on 26 July. The significant higher grain yield per hectare, dry weight and protein content of paddy was recorded with the incorporation of 20 kg Zn $ha^{-1}$and with the sowing of paddy crop on 26 July.

Acknowledgement

First author of this manuscript is very much thankful to Dr. T. Singh, Prof. & Head Agronomy, AKS University, Sherganj, Satna for providing all the experimental facilities and critical suggestions for successful conduct of the experiment and preparation of manuscript.

References

1. Anonymous. Economic Survey, Government of India; c2018.
2. Anonymous, 2019. Statista; c2019. www.satatista.com
3. Dixit V, parihar AKS, Shukla G. Effect of Sulphur and Zinc on Yield Quality and Nutrient uptake of Hybrid Paddy in Sodic Soil. J Agri. Sci. & Tech. 2012;1(2):74-79.
4. Singh A, Pandey N, Ahmad A, Verma. Nutrient uptake and economics of paddy grown under aerobic conditions as influenced by CPE based irrigation schedules and nutrient levels. Jawaharlal Nehru Krishi Vishwa Vidyalaya Research Journal. 2013;47:42-44.
5. Panda R, Sahu SK. Effects of Zinc on the biochemical and production parameters of the paddy plant (*Oryza sativa*). Cytobios. 1999;98(388):105-112.
6. Kulandaivel S, Mishra BN, Gangaiah B, Mishra PK. Effect of levels of Zinc and iron and their chelation on yield and soil micro nutrient status in hybrid paddy

(*Oryza sativa* L.), Cropping system. Indian Journal of Agronomy. 2004;49(2):80-83.
7. Singh T, Shivay YS, Singh S. Effect of transplanting and nitrogen on productivity and nitrogen use indices in hybrid and non-hybrid aromatic rice. Acta Agronomic Hungarica. 2004;52(3):245-252.
8. Tetarwal JP, Ram B, Meena DS. Effect of integrated nutrient management on productivity, profitability, nutrient uptake and soil fertility in rainfed maize. *I*ndian Journal of Agronomy. 2011;56(4):373-376.
9. Pokharel BB, Sah SK, Amgain LP, Ojha BR. Response of promising maize cultivars to different nitrogen levels in winter. Proceeding the Tenth Asian Regional Maize Workshop, C2009.p. 479-483.
10. Mahajan G, Bharaj TS, Timsina J Yield and water productivity of rice as affected by time of transplanting in Punjab, India. Agricultural water Management. 2009;96:525-532.
11. Shukla AK, Behera SK. Zinc management in India agriculture. India J Fertile. 2011;7:14-33
12. Chaudhary JP, Singh SK, Jha S. Effect of integrated nitrogen management on yield, quality and nutrient uptake of paddy (*Oryza sativa*) under the different dates of planting. Indian Journal of Agronomy. 2011;56(3):228-231.
13. Verma AK, Pandey N, Tripathi RS. Effect of planting time and nitrogen level on physiological parameters and grain yield of hybrid paddy, Oryza. 2008;45(4):300-302.
14. Ahaman MKM, Chowdhury AK, Sharmeen F, Sarkar A, Hye MA, Biswas GC. Effect of zinc and phosphorus on yield of *Oryza sativa*. Research publication Journal. 2011;5(4):351-358.
15. Tripathi AK, Tripathi HN. Studies on zinc requirements of paddy (*Oryza sativa*) relation to different modes of zinc application in nursery and rates of ZnSo4 in field. Haryana J Agron. 2004;20(1-2):77-79.
16. Rathore RS, Pyare Lal, Pandey PC, Bisht PS. Effect of long-term application, of fertilizers and farmyard manure on soil fertility and paddy productivity undre paddy wheat system, Oryza. 2004;41(142);45-47.
17. Patel V, Chatterji S, Chisholm D, Ebrahim S, Gopalakrishna G, Mathers C, *et al*. Chronic diseases and injuries in India. The Lancet. 2011 Jan 29;377(9763):413-28.
18. Beg T, Jyoti S, Naz F, Ali F, Ali SK, Reyad AM, Siddique YH. Protective effect of kaempferol on the transgenic Drosophila model of Alzheimer's disease. CNS & Neurological Disorders-Drug Targets (Formerly Current Drug Targets-CNS & Neurological Disorders). 2018 Aug 1;17(6):421-9.