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# Nutrient content, uptake and quality of pearlmillet influenced by phosphorus and zinc fertilization (*Pennisetum galaucum* L.) under rainfed Condition

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**Abstract**
A field experiment was carried out at the Agricultural Farm of Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur to study the effect of phosphorus and zinc application on nutrient content, uptake and quality of pearl millet. On experimental data basis significant improvements were recorded in nutrient content and uptake as N, P K and Zn content and uptake and quality of pearl millet. N, P and K content in pearl millet grain and straw significantly increased from 1.56 to 2.02, 0.773 to 1.320, 1.10 to 1.97 % and 1.11 to 1.41, 0.23 to 0.50 and 0.68 to 1.20 %, respectively. The lowest N, P and K content in grain and straw was recorded in control. The maximum N, P and K content in grain (2.02, 1.320 and 1.97 %) and straw (1.11, 0.23 and 0.68 %) was recorded with application of 30 kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$. The similarly results were found in uptake of N, P and K by grain and straw in pearlmillet. Zn content in grain and straw ranged between 23.43 to 52.32 and 24.88 to 58.46 ppm and the lowest value (23.43 and 24.88 ppm) was recorded in control. The highest Zn content in grain and straw was recorded in the treatment 10 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$. Zn uptake in grain and straw varied between 374.92 to 937.90 and 810.86 to 2109.86 g $ha^{-1}$, respectively. The maximum uptake of Zn in grain and straw was recorded in 10 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$, which was increased by 60 and 62 % over control. The minimum uptake of Zn in grain and straw was recorded in control. The combined effect of phosphorus x zinc were found significant for N & K content and uptake by grain and straw and protein content in grain.

**Keywords:** pearl millet, growth, yield, phosphorus and zinc

## 1. Introduction

Pearl millet [*Pennisetumglaucum* (L.) R. Br. emend Stuntz] is one of the important millet crops for arid and semi arid climatic condition. It grows in poor sandy soil due to drought escaping character. It is provides staple food for the poor man in short period relatively in dry tracts of the country. It is nutritionally better than many cereals, it is a good source of protein having higher digestibility (12.1%), fat (5%), carbohydrate (69.4%) and minerals (2.3%). Green fodder is either used as preserved hay or silage, which are extremely useful in dry regions.

Pearlmillet growing areas in country are mostly confined to course texture soil suffering from the problem of poor moisture retention capacity and low soil fertility. Lack of improved cultural practices, cultivation on poor and marginal lands of low fertility and poor or delayed germination due to soil crusting are some of the major constraints responsible for its poor yield. In the present system of intensive agriculture, mostly farmers are using exhaustive high yielding varieties of the crops, therefore led to heavy withdrawal of nutrients from the soil during past few years and fertilizer consumption remained much below compared to removal. So that Mineral fertilization is one of the most important ways for qualitative and quantitative improving crop yield and its quality can be improved by adequate soil nutrient and crop management practices (Ali *et al.*, 2008 and Pathak *et. al.*, 2012) [4, 24].

Phosphorus (P) is a second leading limiting factor after nitrogen for plant growth and productivity on 40% of the world's arable soil (Vance, 2001) [35]. Adequate phosphorus nutrition enhances many aspects of plant growth development including flowering, fruiting, Root growth, Yield and quality components of different crops. Zinc plat a vital important role in mankind health and functioning the various physiological and metabolic functions of plant (Alam *et al*., 2010) [3]. Zinc is most deficient among all the micronutrients in Indian soils. In many parts of India, zinc as a plant nutrient now stands third in importance next to nitrogen and phosphorus (Takkar and Randhawa, 1980) [32]. Zinc is essential element for crop production and growth development of plant (Ali *et al*., 2008) [4]. Phosphorus and zinc interaction affects the availability and utilization of both the nutrients and imbalance of any in soil matrix affects the dynamics (Nayak and Gupta, 1995) [20].

## 2. Material and methods

The present investigation entitled "Nutrient content, uptake and quality of pearlmillet influenced by phosphorus and zinc fertilization (*Pennisetum galaucum* L.) Under rainfed condition" was carried out during *kharif* season, 2012 at the Agronomy farm of Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur, which is situated in *Vindhyan* region of district Mirzapur (25º 10' latitude, 82º 37' longitude and altitude of 427 meters above mean sea level). *Vindhyan* soil comes under rainfed and invariably poor fertility status. This region comes under Agro-Climatic Zone III A (semi-arid eastern plain zone).

The soil was sandy loam, acidic (pH 5.6), low in initial organic carbon (0.29%), available N (188.2 kg/ha) and $P_2O_5$ (9.66 kg/ha) and medium in available $K_2O$ (186.4 kg/ha), with EC 0.44 dS/m (table-1). The experiment comprising 10 treatment with different combinations of phosphorus levels (10, 20 and 30 kg $P_2O_5$/ha) and zinc levels (10, 20 and 30 kg Zn/ha) and control as without application of phosphorus and zinc was laid out in randomized block design with thrice replications. Pearl millet *cultivar* Kaveri Super Boss – A recommended variety for cultivation in *Kharif* season matures in 80-85 days. The fertilizer N and K was uniformly applied @ 80 and 30 kg $ha^{-1}$ respectively. Half of the recommended dose of nitrogen and full of potassium were applied at the time of sowing. Remaining half dose of N was applied one month after sowing. The phosphorus and zinc was applied as per treatments at the time of sowing. The source of phosphorus and zinc was single super phosphate (SSP) and Zink Sulphate. All the agronomic practices except those under study were kept normal and uniform for all the treatments.

The samples of collected grain and straw at the time of harvest from each plot were grinded to fine powder and utilized for determination of N, P, K and Zn content as per the procedure adapted. Percent N was estimated by colorimetric method on spectronic-20 after development of colour with Nesseler's reagent (Snell and Snell, 1939). Oven dried grain and straw from each plot of the crop were digested in mixture of $HNO_3$: $HClO_4$ (3:1) separately as per standard procedure (Jackson, 1973) [9]. Vanedo-molybdo-phosphoric yellow colour method adopted for Phosphorus content (Jackson, 1967) [10]. The potassium content (%) in grain and straw of the pearl millet crop were analyzed in the laboratory as per standard procedure by flame photometer (Richards (1954) [27]. Zinc content analysed by the atomic absorption spectrophotometer method (Lindsay and Norvell, 1978) [16]. The N, P, K, and Zn content was expressed as per cent and its uptake in kg $ha^{-1}$ was calculated by using following formula.

$$\text{Nutrient uptake (N, P, K kg ha}^{-1}\text{)} = \frac{\text{Nutrient content in grain\& straw (\%)} \times \text{Seed \& straw yield (kg ha}^{-1}\text{)}}{100}$$

$$\text{Nutrient uptake (Zn g ha}^{-1}\text{)} = \frac{\text{Nutrient content in grain\& straw (ppm)} \times \text{Seed \& straw yield (kg ha}^{-1}\text{)}}{1000}$$

Protein content in seed was calculated by multiplying per cent nitrogen in seed with a constant factor 6.25 (A.O.A.C. 1960) [1]. The data gathered in each observation were statistically analyzed using analysis of variance technique and significant differences among treatments mean were tested using least significant difference (LSD) test at 5% probability (Panse and Sukhatme 1985) [23].

## 3. Result and Discussion

### Nutrient content in grain and straw

#### Nitrogen content

N content in pearl millet grain (1.56 to 2.02 %) and straw (1.11 to 1.41 %) significantly increased and where minimum value was recorded in control. The maximum N content in grain (2.02 %) and straw (1.41 %) were recorded with application of 30 kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$, which have shown about 22.8 and 21.3 % increase over control, respectively (table 2). The treatments $P_{20}Z_{20}$, $P_{20}Z_{30}$ and $P_{30}Z_{10}$ were found statistically at par with each other. Phosphorus and zinc application had shown remarkable improvement in nitrogen content in grain and straw of pearl millet. These findings are reported by Upadhay *et al.* (2012) [33] and rathore *et al* (2014) [26].

#### Phosphorus content

Perusal of data clearly indicated the phosphorus content in grain (0.77 to 1.32 %.) and straw (0.23 to 0.50 %) were significantly increased with fertilization of phosphorus and zinc. The highest phosphorus content were recorded with the application of 30kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$ (1.32 & 0.50 %) followed by 30 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$ (1.26 & 0.48 %), however, minimum P content in grain and straw (0.77 & 0.23 %) was recorded in control (table 2). Treatment 30kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$ has shown 41 & 54 % Increased over control, respectively. Treatments $P_{20}Z_{20}$, $P_{20}Z_{30}$ and $P_{30}Z_{10}$ were found to be statistically at par with each other. The present findings support the results of Alam *et al.*, (2000) [2] Ashoka *et al.* (2008) [5] and Morshedi and Farahbakhsh (2010) [18].

#### Potassium content

Potassium content in grain (1.10 to 1.97 %.) and straw (0.68 to 1.20 %) significantly increased due to combined application of phosphorus and zinc (Table 2). Maximum K content was recorded with application of 30kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$, which have shown 44 and 43 % increase over control, respectively. However, minimum was recorded in control. The treatments $P_{20}Z_{20}$ and $P_{20}Z_{30}$ were found to be statistically at par. According this results the finding were reported by Jain and Dahama (2005) [11] and Chavan *et al.,* (2012) [6].

#### Zinc content

Critical perusal of data in the table 2 showed that the Zn content significantly increased in pearl millet grain and straw due to application of phosphorus and zinc. Zinc content in grain ranged between 23.43 to 52.32 ppm, the lowest value (23.43 ppm) was recorded in control. The highest Zn content in grain was recorded with the application of 10 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$, which showed 52 % increase in Zn content in grain over control, also, it was significantly different with all other treatments. Treatments $P_{10}Z_{10}$, $P_{20}Z_{10}$ and $P_{30}Z_{10}$ were found to be statistically at par and treatments $P_{10}Z_{30}$ was at par with $P_{20}Z_{30}$ and $P_{30}Z_{20}$. Zn content in straw ranged between 24.88 to 58.46 ppm, where maximum was recorded with application of 10 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$. The lowest Zn content in straw was recorded in control. Which was increased the Zn content in straw by 58 % over control. Treatments $P_{10}Z_{30}$, $P_{10}Z_{20}$ and $P_{20}Z_{30}$ were statistically at par. It might be because of the fact that zinc is recognized as an essential component in several hydrogenases, proteinases and peptidases and plays an important role in auxin formation and other enzyme system. Thus, although zinc does not seem to have direct role in oil content of coriander but it seemed to influences the oil synthesis indirectly by modulating the enzymic and auxin activities. The increase in oil yield was due to corresponding increase in oil content and seed yield. The result are corroborated the findings of Mourya (1990) [19] and Said *et al.* (2009) [28].

## Nutrient uptake by grain and straw

### Nitrogen uptake

Nitrogen uptake in grain varied from 24.90 to 43.06 kg $ha^{-1}$ and minimum was recorded in control (table 3). The maximum N uptake was recorded with application of 20 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$, which have shown 42% increase over control. The treatments $P_{20}Z_{10}$ and $P_{20}Z_{20}$ were found to be statistically at par with each other. N uptake in straw ranged between 36.75 to 60.75 kg $ha^{-1}$. The maximum uptake of N in straw was recorded with the application of 30 kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$, which was increased by 40 % over control. Lowest N uptake by straw was recorded in control. Treatments $P_{30}Z_{30}$ and $P_{30}Z_{20}$ were statistically at par with $P_{30}Z_{10}$ and $P_{20}Z_{10}$, respectively. This could be attributed to effective utilization of nutrients through the extensive root system developed by crop plants under adequate P application (Jain and Dahama, 2006). Zinc plays a pivotal role in regulating the auxin concentration in plant and nitrogen metabolism and might have improved nutrient uptake. In dry land areas Zn application increases root absorption of minerals. These results are in close conformity with those of Dashadi *et al.* (2013) [7] and Kumawat *et al*. (2015) [15].

### Phosphorus uptake

Phosphorus uptake in grain significantly varied between 12.35 to 28.18 kg $ha^{-1}$. The maximum P uptake was recorded with application of 30 kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$, which was 56 % greater than control. The lowest uptake of P was recorded with control. P uptake in straw ranged between 7.56 to 22.22 kg $ha^{-1}$, maximum P uptake was recorded in treatment 30 kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$ followed by 30kg P $ha^{-1}$ + 10 kg Zn $ha^{-1}$. However, minimum uptake was recorded with control (table 3). Treatment 30 kg P $ha^{-1}$ + 30 kg Zn $ha^{-1}$ have shown 66% increase in P uptake by straw over control. The significant positive response of pear millet to P and Zn application on P content and uptake could be attributed to an enhanced availability of zinc in soil at which the optimum requirement of crop is fulfilled where as the reduction in the concentration of P owing to higher levels of zinc applications might be due to antagonistic relationship of zinc and phosphorus (Olsen, 1972) [21]. The increased concentration of zinc created in range in absorption and translocation of phosphorus from the root to the above part (Sharma and Abrol 2007) [30]. The significant increase in the P uptake in grain and straw was probably due to increase in grain and straw yield of pearl millet. The results obtained get support from the finding of Jat *et al.* (2003) [13].

### Potassium uptake

Application of phosphorus and Zinc significantly increased the potassium uptake in grain ranged between 17.58 to 42.14 kg $ha^{-1}$. The highest K uptake was recorded in treatment 30 kg P $ha^{-1}$ + 20 kg Zn $ha^{-1}$, which was increase by 58 % over control. The lowest K uptake in grain was recorded in control. Treatments $P_{20}Z_{20}$ and $P_{20}Z_{30}$ were statistically at par, also, treatments $P_{30}Z_{10}$ and $P_{30}Z_{30}$ were statistically at par with each other. K uptake in straw increased significantly from 22.06 to 53.20 kg ha-1. Similarly results were reported as K uptake by straw. The increment of K uptake by straw was 59 % over control. This can be attributed to the increase in the zinc concentration of soil solution, which resulted in increased intake of the nutrient from the soil solution and consequently increased nutrient content in seed and stover. Since uptake is the function of nutrient content in seed and stover and their respective yields. As both the content and yields enhanced so the total uptake of nitrogen, phosphorus, potassium and zinc also increased significantly with the application of phosphorus and zinc. These results are in line with those of Upadhyay (2013) [34] and Jat *et al.* (2013) [14].

### Zinc uptake

Perusal of data clearly indicated that phosphorus and zinc levels had significant effect on zinc uptake in grain (g $ha^{-1}$). The Zn uptake varied between 374.92 to 937.90 g $ha^{-1}$ where maximum uptake was recorded in $P_{10}Z_{30}$, which has 60 % higher than control, however, minimum was recorded in control (table 3). The treatments $P_{30}Z_{30}$, $P_{30}Z_{20}$, $P_{20}Z_{30}$, $P_{20}Z_{20}$ and $P_{10}Z_{30}$ were found statistically at par. The phosphorus and zinc levels $P_{10}Z_{30}$ resulted maximum uptake (2109.86 g $ha^{-1}$) which was 62 % higher than control and minimum $P_0Z_0$ (810.86 ppm mg/$ha^{-1}$) was recorded zinc uptake in straw (g $ha^{-1}$). Application of zinc to deficient soil increased the availability of zinc in rhizosphere at a level below where the optimum requirement of crop is fulfilled. The beneficial role of zinc in increasing CEC of roots helped in increasing absorption of nutrients from the soil. Further, the beneficial role of zinc in chlorophyll formation, regulating auxin concentration and its stimulatory effect on most of the physiological and metabolic processes of plant might have helped the plants to absorb greater amount of nutrients from the soil. Thus, the favourable effect of zinc on photosynthesis and metabolic processes augmented the production of photosynthates and their translocation to different plant parts including seed, which ultimately increased the concentration of nutrients in the seed and straw. Similar results were also reported by Summaria and Yadav (2008) [29] and Upadhay *et al.* (2012) [33].

### Protein content

The data of protein content in grains of pearl millet as influenced by application of phosphorus and zinc have been presented in table 3. The protein content in pearl millet grains significantly increased from 9.75 to 12.63 % where minimum value was recorded in control. The maximum N content in grains (12.63 %) was recorded in $P_{30}Z_{20}$, which have shown about 22.8 % increase over control. Positive effect of zinc application on nitrogen content may be due to activation of physiological processes because zinc acts as a catalyst and/or co-enzyme. Higher availability of nitrogen under zinc treatments may be due to their synergetic effect. The increment in protein content was due to its direct correlation with the nitrogen content. The increase in protein content of pearl millet due to application of zinc and phosphorus has also been reported by Hamza and Sadanandan (2005) [8], Pathak *et al.* (2012) [24] in chickpea and Jakhar *et al.* (2013) [12].

**Table 1:** Physico-chemical properties the soil of experimental plot

| Soil properties | Unit | Value | Method employed |
|---|---|---|---|
| A. Physical | | | |
| Course sand | (%) | 7.14 | Piper, 1967 |
| Fine sand | (%) | 50.41 | |
| Silt | (%) | 19.45 | |
| Clay | (%) | 23.00 | |
| Textural class | Sandy clay loam | | |
| Bulk density | ($Mg/m^3$) | 1.46 | |
| Particle density | ($Mg/m^3$) | 2.65 | |
| B. Chemical | | | |
| pH | | 5.6 | Jackson (1973) [9] |
| EC | ($dSm^{-1}$) | 0.44 | |
| Organic carbon | (%) | 0.29 | Walkley and Black, 1934 [36] |
| Available N | (kg/ha) | 188.2 | Subbiah and Asija, 1956 [31] |
| Available P | (kg/ha) | 9.66 | Olsen *et al.*, 1954 [22] |
| Available K | (kg/ha) | 186.4 | Metson (1956) [17] |

**Table 2:** Effect of phosphorus and Zinc application on nutrient content in grain and straw of pearl millet.

| Treatments | Grain content | | | | Straw content | | | |
|---|---|---|---|---|---|---|---|---|
| | N (%) | P (%) | K (%) | Zn (ppm) | N (%) | P (%) | K (%) | Zn (ppm) |
| $T_1$- 0 kg $P_2O_5$ + 0 kg Zn $ha^{-1}$ | 1.56 | 0.773 | 1.10 | 23.43 | 1.11 | 0.23 | 0.68 | 24.88 |
| $T_2$- 10 kg $P_2O_5$ + 10 kg Zn $ha^{-1}$ | 1.65 | 0.790 | 1.29 | 33.17 | 1.23 | 0.30 | 1.02 | 43.12 |
| $T_3$- 10 kg $P_2O_5$ + 20 kg Zn $ha^{-1}$ | 1.70 | 0.809 | 1.45 | 42.57 | 1.31 | 0.33 | 1.10 | 53.21 |
| $T_4$- 10 kg $P_2O_5$ + 30 kg Zn $ha^{-1}$ | 1.73 | 0.820 | 1.58 | 52.32 | 1.28 | 0.38 | 1.13 | 58.46 |
| $T_5$-20 kg $P_2O_5$ + 10 kg Zn $ha^{-1}$ | 1.75 | 0.852 | 1.65 | 36.03 | 1.33 | 0.37 | 1.20 | 38.36 |
| $T_6$-20 kg $P_2O_5$ + 20 kg Zn $ha^{-1}$ | 1.80 | 0.930 | 1.72 | 47.75 | 1.37 | 0.42 | 1.00 | 48.68 |
| $T_7$-20 kg $P_2O_5$ + 30 kg Zn $ha^{-1}$ | 1.77 | 0.980 | 1.72 | 51.12 | 1.36 | 0.44 | 1.10 | 54.66 |
| $T_8$-30 kg $P_2O_5$ + 10 kg Zn $ha^{-1}$ | 1.92 | 1.215 | 1.82 | 31.53 | 1.35 | 0.44 | 1.15 | 33.87 |
| $T_9$-30 kg $P_2O_5$ + 20 kg Zn $ha^{-1}$ | 2.02 | 1.320 | 1.97 | 43.76 | 1.41 | 0.50 | 1.20 | 40.76 |
| $T_{10}$-30 kg $P_2O_5$ + 30 kg Zn $ha^{-1}$ | 1.95 | 1.263 | 1.85 | 42.32 | 1.39 | 0.48 | 1.10 | 43.99 |
| S.Em.± | 0.018 | 0.007 | 0.019 | 3.50 | 0.015 | 0.007 | 0.073 | 3.01 |
| CD (p=0.05) | 0.05 | 0.02 | 0.056 | 10.42 | 0.044 | 0.02 | NS | 8.97 |

**Table 3:** Effect of phosphorus and Zinc application on nutrient uptake by grain and straw and quality of pearl millet.

| Treatments | Uptake by Grain | | | | Uptake by Straw | | | | Protein content (%) |
|---|---|---|---|---|---|---|---|---|---|
| | N ($kg\ ha^{-1}$) | P ($kg\ ha^{-1}$) | K ($kg\ ha^{-1}$) | Zn ($kg\ ha^{-1}$) | N ($g\ ha^{-1}$) | P ($kg\ ha^{-1}$) | K ($kg\ ha^{-1}$) | Zn ($g\ ha^{-1}$) | |
| $T_1$- 0 kg $P_2O_5$ + 0 kg Zn $ha^{-1}$ | 24.90 | 12.35 | 17.58 | 374.92 | 36.15 | 7.56 | 22.06 | 810.86 | 9.75 |
| $T_2$- 10 kg $P_2O_5$ + 10 kg Zn $ha^{-1}$ | 27.55 | 13.19 | 21.55 | 555.97 | 41.40 | 9.90 | 34.37 | 1563.09 | 10.31 |
| $T_3$- 10 kg $P_2O_5$ + 20 kg Zn $ha^{-1}$ | 29.64 | 14.13 | 25.28 | 734.61 | 46.88 | 11.82 | 39.07 | 1866.93 | 10.63 |
| $T_4$- 10 kg $P_2O_5$ + 30 kg Zn $ha^{-1}$ | 31.75 | 15.05 | 28.94 | 937.90 | 55.06 | 16.20 | 40.53 | 2109.86 | 10.81 |
| $T_5$-20 kg $P_2O_5$ + 10 kg Zn $ha^{-1}$ | 33.50 | 15.79 | 30.65 | 669.02 | 51.82 | 14.41 | 46.84 | 1495.00 | 10.94 |
| $T_6$-20 kg $P_2O_5$ + 20 kg Zn $ha^{-1}$ | 33.76 | 17.94 | 33.12 | 920.75 | 57.58 | 17.51 | 39.75 | 1942.68 | 11.25 |
| $T_7$-20 kg $P_2O_5$ + 30 kg Zn $ha^{-1}$ | 35.64 | 19.69 | 34.57 | 893.74 | 60.27 | 19.40 | 44.88 | 2430.35 | 11.06 |
| $T_8$-30 kg $P_2O_5$ + 10 kg Zn $ha^{-1}$ | 39.43 | 24.90 | 37.72 | 646.77 | 55.67 | 18.23 | 48.11 | 1392.53 | 12.00 |
| $T_9$-30 kg $P_2O_5$ + 20 kg Zn $ha^{-1}$ | 43.06 | 28.18 | 42.14 | 905.30 | 60.75 | 22.22 | 53.20 | 1810.90 | 12.63 |
| $T_{10}$-30 kg $P_2O_5$ + 30 kg Zn $ha^{-1}$ | 40.37 | 26.10 | 38.22 | 903.56 | 58.57 | 20.58 | 46.29 | 1953.71 | 12.19 |
| S. Em.± | 0.433 | 0.136 | 0.670 | 64.67 | 0.737 | 0.242 | 4.77 | 118.15 | 0.11 |
| CD (p=0.05) | 1.28 | 0.40 | 1.99 | 192.15 | 2.19 | 0.72 | 14.18 | 351.05 | 0.31 |

## 4. Conclusion

On the basis of the findings of the present investigation, it can be concluded that the levels of phosphorus (30 kg $ha^{-1}$) and zinc (20 kg $ha^{-1}$) was found most suitable levels of phosphorus and zinc, among all the levels of phosphorus and zinc under rain fed condition. Application of phosphorus and zinc was significantly influenced the content, uptake and quality of pearl millet. Increasing doses of phosphorus reduced zinc uptake and similarly increasing dose of Zinc was also reduced the content and uptake of phosphorus. It might be due to antagonistic effect of P and Zn. Higher concentration of P in soil from insoluble zinc phosphate which reduces uptake of zinc by grain and straw, eventually reduce the zinc content in grain and straw. The combined effect of phosphorus x zinc were found significant for N & K content and uptake by grain and straw and protein content in grain.

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