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Effect of phosphorus and zinc application on yield and uptake of nutrients by cowpea (Vigna unguiculata L.)

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Abstract

A field experiment was conducted during kharif seasons of 2010-11 at the research farm of R.B.S College Bichpuri, Agra to study the effect of phosphorus and zinc on yield and uptake of nutrients by cowpea (Vigna unguiculata L.). The soil used in the experiment was sandy loam in texture having pH 8.6, organic carbon 0.44%, available N 215.30 kg ha^{-1}, P 15.55 kg ha^{-1}, K kg ha^{-1} and Zn 3.6 ppm. The treatments consisted of four level of P (0, 20, 40 and 60 kg ha^{-1}) and three level of Zn (0,10, and 20 kg ha^{-1}). These treatment combinations were replicated thrice in R.B. D. (Randomized Block Design). The levels of phosphorus influence the grain and straw yield of cowpea, nutrients content and their uptake by cowpea crop and increased significantly with P1 @ 20 kg ha^{-1}, P2 @ 40 kg ha^{-1} and P3 @ 60 kg ha^{-1} levels of phosphorus as compared to control. The levels of zinc also affected significantly the grain and straw yield of cowpea and nutrients composition of cowpea crop. The maximum grain and straw yield of cowpea, nutrients content and their uptake by cowpea crop were maximum at 20 kg^{-1} of zinc over control. However, the phosphorus @ 60 kg^{-1} and zinc @ 20 kg^{-1} provided significantly higher grain and straw yield of cowpea over rest of the treatments.

Key words: Phosphorus, zinc, yield, nutrient uptake, cowpea

Introduction

Phosphorus and zinc are the principal plant nutrients normally used for fertilization. Phosphorus is a constituent of nucleic acid, phytin and phosphor-lipids. It is also an essential constituent of majority of enzyme which are of great importance in transformation of energy, in carbohydrate metabolism, in fat metabolism and also in respiration of plants. It is closely related to cell division and development. Zinc is essential for promoting certain metabolic reactions. It is necessary for production of chlorophyll and carbohydrates. Zinc is directly or indirectly by several enzymes systems, auxin and protein synthesis, seed production and rate of maturity. Zinc is believed to promote RNA synthesis, which is needed for protein production. Zinc is not translocated within the plant. Application of P and Zn may change the behavior of each other when applied together. Low recovery of applied zinc is an important limitation in enhancing the yield of wheat crop. Under such conditions, balanced use of Zn and P is highly imperative to obtain higher yield of crop. The investigation was therefore, undertaken to study the effect of different doses of Zn along with P on yield, quality and nutrient uptake by crop.

Methods and Materials

The field experiment was conducted during Kharif seasons of 2010-11 at the research farm of R.B.S College Bichpuri, Agra. The soil used in the

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experiment was sandy loam in texture having pH 8.6, organic carbon 0.44%, available N 215.30 kg ha^{-1}, P 15.55 Kg/ha, K 240.60 Kg/ha and Zn 3.6 ppm. The treatments consisted of four level of P (0, 20, 40, 60 Kg P_2O_5 ha^{-1} and three level of Zn (0, 10, 20 kg ZnSO4 ha^{-1}). These treatment combinations were replicated thrice in R.B.D (randomized block design). A recommended dose of nitrogen and phosphorus was given through urea and single superphosphate to the mustard crop, respectively. Plant analyzed for N, P, K and Zn their uptake at final harvest. Grain and straw samples were analyzed for N by Snell and Snell (1953) method, P by vanadomolybdate phosphoric yellow colour method, K by flam photometer, Zn by atomic absorption spectrophotometer.

Results and Discussion

The grain and straw yield of cowpea increased significantly with phosphorus and zinc application over control (Table -1). The higher grain and straw yield of cowpea was noted with highest level of phosphorus and zinc. Significantly higher grain yield of cowpea was observed with the application of phosphorus @ 20 kg ha^{-1} (16.74 q ha^{-1}), 40 kg P_2O_5 ha^{-1} (31.52 q ha^{-1}) and 60 kg P_2O_5 ha^{-1} (44.19 q ha^{-1}) compared to control (13.19 q ha^{-1}). Significantly higher grain yield of cowpea was observed with the application of zinc @ 10 kg Zn ha^{-1} (12.83 q ha^{-1}), and 20 kg Zn ha^{-1} (18.39 q ha^{-1}) compared to control (10.85 q ha^{-1}) respectively. Earlier reported that maximum grain and stover yield of faba bean was noted under highest level of phosphorus and molybdenum (Munna et at el. 2016).

Table 1: Effect of P and zinc levels on straw yield of cowpea

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
Phosphorus levels		
P_0	13.61	47.25
P_1	16.74	54.40
P_2	31.52	57.88
P_3	44.19	61.05
SEm±	0.39	0.43
C.D.at 5%	1.17	1.25
Zinc Levels		
Zn_0	10.85	40.11
Zn_1	12.83	43.58
Zn_2	18.39	45.15
SEm±	0.28	0.212
C.D.at 5 %	0.84	0.61

Significantly higher straw yield of cowpea was observed with the application of phosphorus @ 20 kg ha^{-1} (54.40 q ha^{-1}), 40 kg P_2O_5 ha^{-1} (57.88 q ha^{-1}) and 60 kg P_2O_5 ha^{-1} (61.05 q ha^{-1}) compared to control (47.25 q ha^{-1}). Significantly higher straw yield of cowpea was observed with the application of zinc @ 10 kg Zn ha^{-1} (43.58 q ha^{-1}), and 20 kg Zn ha^{-1} (45.15 q ha^{-1}) compared to control (40.11q ha^{-1}) respectively. These results are in favor of Singh and Yadav (2007). The nitrogen content of cowpea significantly affected with the application of phosphorus.

It is noted from Table 2 That nitrogen, phosphorus, potassium and zinc uptake by cowpea increased significantly with increasing levels of phosphorus and zinc over control. Significantly higher nitrogen uptake by cowpea was observed with the application of phosphorus @ 20 kg ha^{-1} (123.31 kg ha^{-1}), 40 kg P_2O_5 ha^{-1} (163.78 kg ha^{-1}) and 60 kg P_2O_5 ha^{-1} (188.45 kg ha^{-1}) compared to control (69.40 kg ha^{-1}). Significantly higher nitrogen uptake by cowpea was observed with the application of zinc @ 10 kg Zn ha^{-1} (95.84 kg ha^{-1}), and 20 kg Zn ha^{-1} (140.51 kg ha^{-1}) compared to control (62.38 kg ha^{-1}) respectively. Significantly higher phosphorus uptake by cowpea was observed with the application of phosphorus @ 20 kg ha^{-1} (37.53 kg ha^{-1}), 40 kg P_2O_5 ha^{-1} (45.15 kg ha^{-1}) and 60 kg P_2O_5 ha^{-1} (54.90 kg ha^{-1}) compared to control (23.45 kg ha^{-1}). Significantly higher phosphorus uptake by cowpea was observed with the application of zinc @ 10 kg Zn ha^{-1} (26.52 kg ha^{-1}), and 20 kg Zn ha^{-1} (48.70 kg ha^{-1}) compared to control (24.48 kg ha^{-1}) respectively. Significantly higher potassium uptake by cowpea was observed with the application of phosphorus @ 20 kg ha^{-1} (93.30 kg ha^{-1}), 40 kg P_2O_5 ha^{-1} (114.11 kg ha^{-1}) and 60 kg P_2O_5 ha^{-1} (125.10 kg ha^{-1}) compared to control (75.50 kg ha^{-1}). Significantly higher potassium uptake by cowpea was observed with the application of zinc @ 10 kg Zn ha^{-1} (78.18 kg ha^{-1}), and 20 kg Zn ha^{-1} (85.16 kg ha^{-1}) compared to control (68.50 kg ha^{-1}) respectively. Significantly higher zinc uptake by cowpea was observed with the application of phosphorus @ 20 kg ha^{-1} (21.08 kg ha^{-1}), 40 kg P_2O_5 ha^{-1} (27.35 kg ha^{-1}) and 60 kg P_2O_5 ha^{-1} (32.55 kg ha^{-1}) compared to control (18.15 kg ha^{-1}). Significantly higher zinc uptake by cowpea was observed with the application of zinc @ 10 kg Zn ha^{-1} (24.12 kg ha^{-1}), and 20 kg Zn ha^{-1} (27.48 kg ha^{-1}) compared to control (16.14 kg ha^{-1}) respectively. Earlier reported that maximum nitrogen, phosphorus, potassium

Table 2: Effect of phosphorus and zinc levels on Nitrogen, Phosphorus, Potassium and Zinc uptake (kg ha^{-1}) by cowpea

Treatments	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})	Zinc (kg ha^{-1})
Phosphorus levels				
P_0	69.40	23.45	75.50	18.15
P_1	123.31	37.53	93.30	21.08
P_2	163.78	45.15	114.11	27.35
P_3	188.45	54.90	125.10	32.55
SEm±	2.68	0.993	1.78	0.059
C.D. at 5%	7.70	2.85	5.10	0.170
Zinc levels				
Zn_0	62.38	24.48	68.50	16.14
Zn_1	95.84	26.52	78.18	24.12
Zn_2	140.51	48.70	85.16	27.48
SEm±	3.05	0.85	1.34	0.411
C.D. at 5%	8.77	2.44	3.85	1.18

and molybdenum utilization by faba bean was noted under highest level of phosphorus and molybdenum (Munna at el. 2016), Kumawat and Kumawat (2009) and Singh (2010).

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