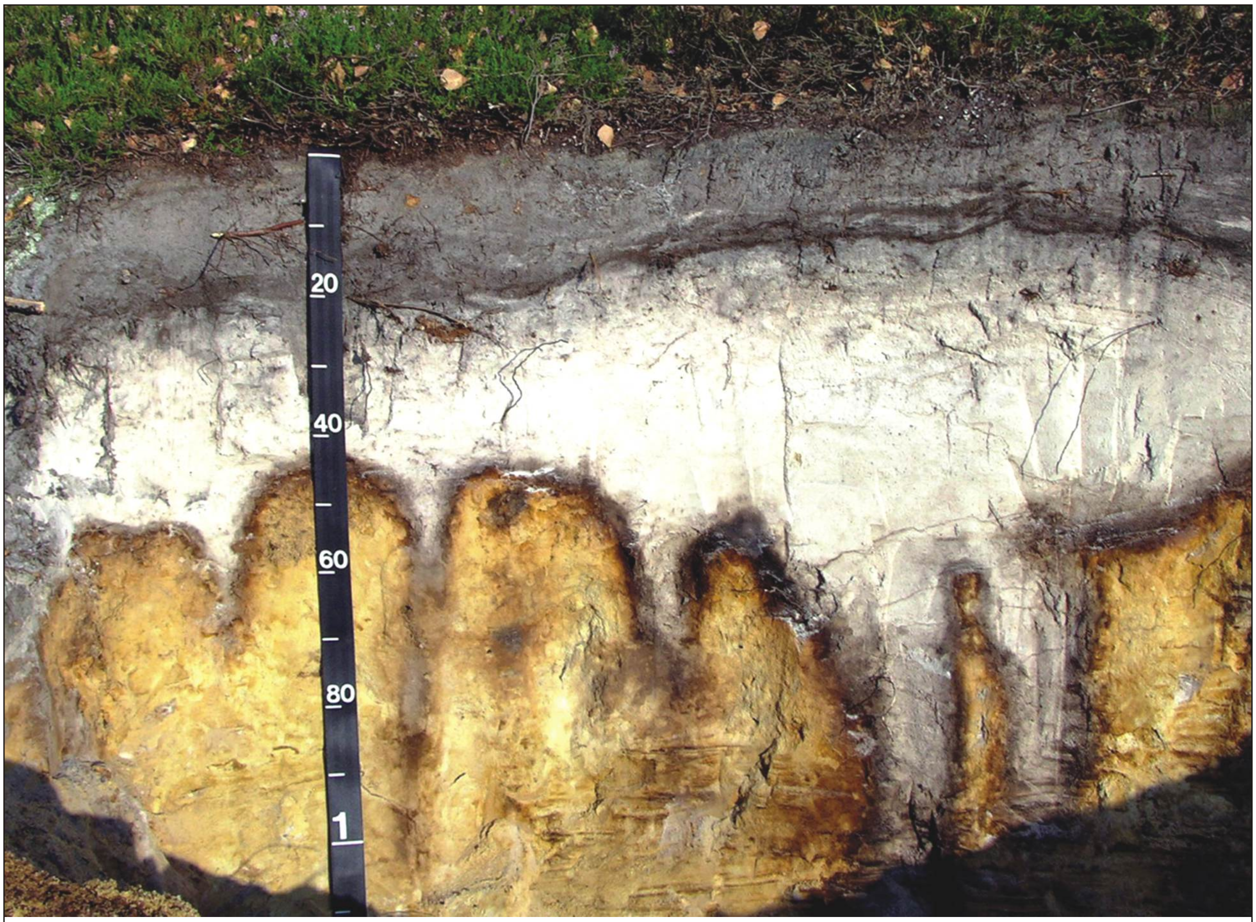

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Effect of Soil Compaction, Potassium and Cobalt on Growth and Yield of Moth Bean

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Abstract: A field experiment was conducted during Kharif season of 2004 and 2005 to study the effect of soil compaction, potassium and cobalt on growth and yield of moth bean. The results revealed that total number of nodules, number and weight of effective nodules, dry matter accumulation, pods per plant, test weight and seed yield of moth bean increased significantly with increasing levels of soil compaction, potassium and cobalt upto 4 passings of 500 kg iron roller, 40 kg K_2O ha^{-1} and 500 ppm cobalt, respectively.

Key words: Compaction, cobalt, moth bean, nodule, potassium

Introduction

Moth bean [*Vigna aconitifolia* (Jacq.) Marechal] is primarily a rainy season crop and it is usually grown on marginal lands with poor fertility status. Potassium helps in maintaining turgor pressure and eliminates water imbalances in plants. It acts as catalytic agent in activating a number of enzymes, synthesis of peptide bonds and phosphate group transferase. Sandy soils are extensively permeable, their moisture retention capacity is very low and more than 1/3rd of applied or rain water gets lost through deep percolation (Khan and Singh, 2005; Mann and Singh, 1975). Compaction of such soils at proper moisture content creates a barrier of relatively high bulk density in sub surface layers, which helps in minimizing percolation losses of nutrients and to improve moisture storage in the soils. The extent of nutrients loss is higher particularly in case of nitrogen followed by potash and least in phosphorus (Mc Arthur and Knowles, 1993; Gupta and Majumdar, 1994). Potassium maintains the cellular organization by regulating the permeability of cellular membranes and keeping the protoplasm in a proper degree of hydration by stabilizing the emulsion of highly colloidal particles. Potassium salts are found to buffer the metabolic actions and stabilize various enzyme systems. Potassium also increases the tolerance in the plants against moisture stress, heat, frost and diseases (Singh, 2000). Cobalt has been found essential for nodulating bacteria for fixing atmospheric nitrogen in leguminous crops. It is a structural components of vitamin B_{12} (Cyanocobalamine). Therefore, experiments were conducted to study the effect of soil compaction, potassium and cobalt on the performance of moth bean crop in loamy sand soil.

Materials and Methods

Field experiment was conducted during Kharif season of 2004 and 2005 at the Research field, Department of Botany, J.N.V. University, Jodhpur (Rajasthan). The soil of the experimental site was loamy sand in texture, low in available N (132 kg ha^{-1}), available P_2O_5 (17.98 kg ha^{-1}), medium in available potassium (182 kg K_2O ha^{-1}) and low in available cobalt (0.21 ppm) with pH. 8.3. The available N, P and K content in soil were determined by Jackson (1973) and Co content in soil was determined by Lindsay and Norwell (1978) methods. The treatments consisted of 3 levels of compaction i.e., control, 2 and 4 passing of 500 kg iron roller (C_0, C_2 and C_4), three levels of potassium

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(0, 20 and 40 kg K_2O ha^{-1}) and three levels of cobalt viz., 0, 250 and 500 mg Co/kg seeds were treated (M_0, M_{250} and M_{500}) through cobalt nitrate. The experiments were laid out in split plot design with compaction and potassium levels in main plots and levels of cobalt in sub plots with 3 replications. Potassium as per treatment was applied through MOP before sowing and cobalt as per treatment was applied through cobalt nitrate as seed treatment. Moth bean variety 'maru moth' was sown at the rate of 20 kg ha^{-1} in lines, 30 cm apart in 2004 and 2005, respectively. The crop growth and performance in general, was poor in the year 2004 in comparison to 2005. It might be due to better distribution of rainfall in 2005 as compared to 2004.

Results and Discussion

The data (Table 1) revealed that total number of nodules, number and weight of effective nodules, dry matter accumulation, pod per plant, test weight and seed yield of moth bean significantly increased

Table 1: Effect of compaction, potassium and cobalt levels on growth parameters and seed yield of moth bean

	Total No. of nodules/plant		No. of effective nodules/plant		Wt. of effective nodules/plant (mg)	
Treatments	2004	2005	2004	2005	2004	2005
Compaction levels						
C_0	18.60	19.00	12.50	15.00	22.50	27.10
C_2	21.80	22.00	15.60	18.40	26.00	31.50
C_4	23.20	23.10	16.40	19.80	27.90	32.20
SM±	0.41	0.43	0.41	0.45	0.56	0.63
CD (p = 0.05)	1.37	1.39	1.36	1.45	1.84	2.09
Potassium levels (kg ha^{-1})						
K_0	19.80	20.20	13.50	16.20	23.70	28.60
K_{20}	21.30	21.40	15.10	18.30	25.50	30.50
K_{40}	22.70	22.80	15.80	18.80	27.20	32.60
SM±	0.41	0.42	0.42	0.44	0.57	0.64
CD (p = 0.05)	1.38	1.40	1.37	1.46	1.85	2.10
Cobalt levels (mg kg^{-1})						
M_0	19.00	19.10	12.60	15.00	22.70	27.30
M_{250}	21.50	21.90	15.10	18.10	25.90	31.00
M_{500}	23.20	23.40	16.70	20.00	27.90	33.50
SM±	0.33	0.35	0.26	0.27	0.34	0.44
CD (p = 0.05)	0.96	0.99	0.77	0.79	1.01	1.30

	Dry matter accumulation/ plant (g)		Pods/plant		Test weight (g)		Seed yield (q ha^{-1})	
Treatments	2004	2005	2004	2005	2004	2005	2004	2005
Compaction levels								
C_0	3.30	4.00	9.70	13.60	72.80	72.70	4.80	6.30
C_2	4.70	5.80	10.90	15.30	75.40	75.50	6.80	8.90
C_4	5.80	7.10	12.10	16.90	77.30	77.40	8.00	10.20
SM±	0.08	0.09	0.16	0.24	0.34	0.32	0.19	0.20
CD (p = 0.05)	0.26	0.29	2.55	0.80	1.11	1.05	0.60	0.66
Potassium levels (kg ha^{-1})								
K_0	4.20	4.90	10.50	14.70	74.40	74.40	5.90	7.80
K_{20}	4.50	5.80	11.00	15.50	75.20	75.30	6.60	8.60
K_{40}	5.20	6.20	11.20	15.70	75.90	76.00	7.10	9.10
SM±	0.08	0.09	0.16	0.25	0.33	0.32	0.19	0.20
CD (p = 0.05)	0.27	0.30	0.56	0.81	1.12	1.06	0.61	0.67
Cobalt levels (mg kg^{-1})								
M_0	4.10	5.10	10.50	14.70	74.60	74.60	6.10	7.80
M_{250}	4.40	5.60	10.90	15.40	75.30	75.30	6.60	8.60
M_{500}	5.30	6.20	11.20	15.70	75.70	75.70	7.00	9.00
SM±	0.07	0.08	0.13	0.16	0.27	0.25	0.10	0.16
CD (p = 0.05)	0.20	0.23	0.38	0.46	0.78	0.73	0.30	0.46

with compaction upto 4 passings of roller (C_4) over no compaction (C_0) in both the years. The improvement in growth parameters could have resulted from increase water storage and nutrient retention under compaction treatment (Majumdar and Das, 1997).

The total number of nodules, weight of effective nodules and dry matter accumulation increased significantly upto 40 kg K_2O ha^{-1} over all the lower levels in both the years. However, number of effective nodules, pods per plant and test weight increased significantly only upto 20 K_2O ha^{-1}. The seed yield of moth bean showed increase with increase in the level of applied potassium but the increase in seed yield under application of 40 kg K_2O ha^{-1} (K_{40}) was not significant over 20 kg K_2O ha^{-1} during both the years. Application of potassium at the rate of 20 kg K_2O ha^{-1} recorded an increase of 11.74 and 11.06% seed yield over control (K_0) during the year 2004 and 2005, respectively. These improvements in the growth and yield attributing characters might be due to the fact that potassium acts as catalytic agent in activating a number of enzymes and synthesis of peptide bonds. The results so obtained get support with those of Khan *et al*. (2001).

The increasing levels of cobalt significantly increased the growth and yield attributing characters and yield of moth bean during both the years (Table 1). However, the significant increases in pods per plant and test weight were found only upto 250 ppm cobalt (M_{250}) in both the years. The application of cobalt at increasing rates tended to increase the seed yield but the increase was significant upto 500 ppm cobalt (M_{500}) during the year 2004 while, in the year 2005, the significant increase was observed only upto 250 ppm cobalt (M_{250}). Significant increase in yield attributes and yield of moth bean with cobalt application has been also reported Pattanayak *et al*. (2000). The data explicitly showed that compaction x potassium x cobalt interaction did not influence the yield attributes and yield of moth bean significantly in any of the years of experimentation.

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