

Effect of Micronutrients and Biofertilizers on N, P, K and S Content Uptake and Yield of Chickpea Crop

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Abstract

The experiment was made in split plot design with six levels of micro-nutrient in combination of recommended doses of NPK and two levels of biofertilizers inoculation replicated thrice. All the micronutrient treatments and biofertilizer inoculations responded significantly higher in yield and nutrients uptake of crop over the control. Among the treatment levels highest yield and nutrients uptake of crop were recorded with treatment RDF of NPK + ammonium molybdate at 1 kg/ha (M_3). The highest grain yield (1,866 kg/ha) and straw yield (1,841 kg/ha) was recorded with the treatment RDF of NPK + ammonium molybdate at 1 kg /ha + (M_3) followed by treatment RDF + $FeSO_4$ + Borax + $ZnSO_4$ + Am (M_6). Biofertilizer inoculation responded more grain yield (1,473 kg/ha), straw yield (1,423 kg/ha) and nutrients uptake with treatment rhizobium + PSB inoculation as compared to the control.

Key words : Grain yield, Straw yield, Macronutrient uptake, Chickpea.

Chickpea for the most important pulse crop in India, covers 34% in area contributes 45% production of total pulse. One of the major constraints of chickpea production is insufficient and unbalanced use of micronutrient fertilizers. The average uptake of N, P, K and s per tonne of grain was found to be 60,5, 30 and 10 kg, respectively. Intensification of agriculture, unbalanced use of FYM and no use of micronutrient and biofertilizers result in imbalance use of fertilization. The situation becomes worse on with the soil containing low level of organic matter. Therefore, the present investigation was carried out to assess the effect of RDF and micronutrients along with rhizobium inoculation on yield, content and uptake of nutrients by chickpea.

Methods

The study was conducted at Sehor, Agriculture Farm, MP (India) in 2003. The experiment was made in split plot design with six levels of micronutrient in combination of recommended doses of NPK and levels of biofertilizers inoculation replicated thrice. The soil was slightly alkaline pH (7.5), E 45 ds/m and organic carbon 0.40%. Available NPK were 150, 12.445

and 368.93 kg/ha, respectively. Micronutrients like available Zn, Fe, B and Mo were 2.15, 74.8, 0.015 and 0.10ppm, respectively. The treatments comprised M_1 — control with no micro-nutrients and no biofertilizers inoculation; M_2 —RDF + $FeSO_4$ (10 kg/ha); M_3 —RDF + borex (10 kg/ha); M_4 —RDF + $ZnSO_4$ (25 kg/ha); M_5 —Ammonium molybdate at 1 kg/ha (M_3), and M_6 — RDF + $FeSO_4$ + borax + $Znso_4$ + AM and two levels of biofertilizer inoculation (with Rhizobium + PSB and without this). Recommended doses of N, P, K and S were applied at 20, 40, 20 and 20 kg/ha, respectively. Chickpea was sown by seed drill maintaining proper row-to-row and plant -to-plant distances. Yield and yield attributing characters were recorded periodically and yield data was taken after maturing the crop harvested on 2×2 m² area. The soil and plant were analyzed by standard procedures (1).

Results and Discussion

Yield

Table 1 reveals that the highest grain yield (1,866 kg/ha) was produced with the micronutrient treatment of RDF + AM at 1 kg/ha (M_3) followed by combination of micronutrients viz Fe, B, Zn and M_0 (M_6) (1,

Table 1. Yield of grain and straw of chickpea as influenced by different micronutrients and biofertilizers inoculation.

Treatments		Grain yield (kg/ha)	Straw yield (kg/ha)
Micronutrients (M)			
M ₁	M ₁ Control - RDF	1151	1015
M ₂	M ₂ RDF + FeSO ₄	1289	1231
M ₃	M ₃ RDF + borex	1297	1286
M ₄	M ₄ RDF + ZnSO ₄	1283	1217
M ₅	M ₅ RDF + ammonium molybdate (1 kg/ha)	1866	1841
M ₆	M ₆ RDF + FeSO ₄ + borex + ZnSO ₄ + AM	1477	1443
	CD at 5%	185	162
Inoculation (I)			
I ₀	I ₀ No inoculation	1313	1285
I ₁	I ₁ Rhizobium + PSB inoculation	1473	1432
	CD at 5%	107	97
	Interaction CD at 5%	NS	NS

477 kg/ha). Further, the treatment of RDF + AM at 1 kg/ha (M₅) and combination of all micronutrients (M₆) increased the grain yield of chickpea significantly over the control (M₁) and also over most of the other micronutrient treatments (M₂ and M₄). As regards biofertilizer inoculation (Rhizobium + PSB) significantly increased the grain yield over no inoculation (I₀). Interaction between micronutrients and inoculation with Rhizobium + PSB was found non-significant. Gupta et al. (2) also reported similar results. Data also revealed that the straw yield was significantly influenced by different micronutrient treatments and also by biofertilizer inoculation. Molybdenum application alone (RDF + AM at 1 kg/ha) and combination with other micronutrients viz. Fe, B, Zn could also significantly increase the straw yield of chickpea over control (M₁) and also over the other treatments (M₂ to M₄). Biofertilizers inoculation (Rhizobium + PSB) significantly increased the straw yield over no inoculation (I₀). Interaction was found to be non-significant. Harvest index was also not influenced significantly due to micronutrient application, biofertilizers inoculation and also due to M × I interaction.

Nutrients Content and Uptake

Micronutrient application significantly increased

the grain over control. Maximum content in grain (3.75%) was recorded with RDF + AM at 1 kg/ha (M₅) followed by 3.70% in RDF FeSO₄ + borex + ZnSO₄ + AM (M₆). Treatment M₅ was found to be significantly superior over control. Similar results were also reported earlier (2). Biofertilizer inoculation also significantly influenced the N content. The treatment RDF + AM at 1 kg/ha (M₅) recorded highest N content in 1.13% followed by combination of all micronutrients (M₆) which recorded 1.12% N content in straw. Biofertilizer also increased N content in straw compared to without biofertilizers inoculation. Total N uptake data indicate significant effect of micronutrients application and also of biofertilizer inoculation. Micronutrient treatment RDF + AM (M₅) recorded highest N uptake by grain + straw (91.15 N kg/ha) followed by the treatment RDF + FeSO₄ + borex + ZnSO₄ + AM (71.55 kg N/ha). These were significantly superior over all the micronutrient treatments (M₂ to M₄) in respect of N uptake. Biofertilizers inoculation (I₁) showed significantly superior uptake of N over without inoculation. This is due to higher yield in this treatment.

Table 2 shows that the maximum (0.24%) phosphorus content was found in the grain in the treatment RDF + AM (M₅) and in RDF + FeSO₄ + borex + ZnSO₄ + AM (M₆). These two treatments were significantly superior over the control (3). Biofertilizer inoculation was also superior over those without inoculation. The maximum of 0.12% phosphorus content was recorded in straw in the treatment RDF + AM (M₅) and in combination of all the micronutrients (M₆). Total P uptake was significantly affected by micronutrients and by biofertilizer inoculation. Micronutrient treatment RDF + AM (M₅) recorded highest P uptake by grain + straw (5.56 P kg/ha) followed by treatment RDF + FeSO₄ + borex + ZnSO₄ + AM (5.01 p kg/ha). These treatments were significantly superior over all the the micronutrient (M₂ to M₄). Biofertilizer inoculation was significantly superior over without inoculation (I₀).

Maximum (1.2%) potassium content was found in grain with the micronutrient treatment RDF + AM (M₅) and in combination of all micronutrients. These treatments were significantly superior over the control. Biofertilizer inoculation was significantly superior over without inoculation (I) in increasing the potassium content in chickpea grain. The K content

Table 2. Nitrogen and phosphorus content (%) and uptake (kg/ha) in grain, straw and total uptake of chickpea as influenced by different micronutrients and biofertilizer inoculation.

Treatment	N content (%)		Nitrogen uptake(kg/ha)			Phosphorus content			Phosphorus uptake (kg/ha)		
	Grain	Straw	Grain	Straw	Total	Grain	Straw	Grain	Straw	Total	
Micronutrients (M)											
M ₁	Control -RDF	3.50	0.90	40.28	9.14	49.42	0.20	0.08	2.30	0.81	3.11
	RDF + FeSO ₄	3.55	1.03	45.76	12.68	58.43	0.24	0.10	2.58	0.98	3.56
M ₃	RDF + borex	3.56	1.01	46.17	12.99	59.16	0.20	0.08	3.11	1.28	4.40
M ₄	RDF + ZnSO ₄	3.60	1.04	46.19	12.66	58.84	0.20	0.08	2.56	0.97	3.54
M ₅	RDF + ammonium molybdate	3.75	1.13	70.35	20.81	91.15	0.24	0.12	3.73	1.73	5.56
M ₆	RDF + FeSO ₄ + borex + ZnSO ₄ + AM	3.70	1.12	55.39	16.16	71.55	0.24	0.12	3.54	1.47	5.01
	CD at 5%	0.24	0.09	3.12	2.24	3.75	0.0032	0.002	0.72	0.18	0.85
Inoculation (I)											
I ₀	No inoculation	3.57	1.01	46.37	12.57	59.44	0.21	0.08	2.75	0.99	3.74
I ₁	Rhizobium + PSB inoculation	3.78	1.12	55.38	16.04	71.42	0.23	0.10	3.38	1.43	4.81
	CD at 5%	0.12	0.02	1.56	0.92	1.89	0.012	0.003	0.51	0.02	0.15
	Interaction M × I (CD at 5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	CV%	2.04	2.12	7.10	8.04	7.55	3.16	2.49	9.20	8.35	8.78

in straw was maximum (2.24% and 2.25%) in the micronutrient treatment RDF + AM (M₅) and combina-

tion of all micronutrient with RDF (M₆) respectively, which were significantly superior over the control.

Table 3. Potassium and sulfur contents (%) and uptake in grain and straw of chickpea as influenced by different micronutrients and biofertilizers inoculation.

Treatment	K content (%)		Total potassium uptake (kg/ha)			Sulfur content (%)		Total sulfur uptake (kg/ha)			
	Grain	Straw	Grain	Straw	Total	Grain	Straw	Grain	Straw	Total	
Micronutrients (M)											
M ₁	Control - RDF	0.80	2.00	9.21	20.30	30.10	0.142	0.112	1.63	1.14	2.77
M ₂	RDF + FeSO ₄	1.00	2.20	12.89	27.08	39.97	0.142	0.112	1.83	1.38	3.21
M ₃	RDF + borex	1.10	2.22	14.26	28.29	42.55	0.141	0.110	1.83	1.41	3.24
M ₄	RDF + ZnSO ₄	1.10	2.24	14.11	27.26	41.37	0.145	0.115	1.86	1.36	3.22
M ₅	RDF + ammonium molybdate	1.20	2.24	22.39	36.77	69.16	0.142	0.110	2.65	2.03	4.68
M ₆	RDF + FeSO ₄ + borex + ZnSO ₄ + AM	1.20	2.25	17.72	32.47	50.19	0.143	0.113	2.11	1.62	3.73
	CD at 5%	0.018	0.015	2.01	2.24	2.45	0.0013	0.0010	0.10	0.12	0.38
Inoculation (I)											
I ₀	No inoculation	1.00	2.00	13.13	24.90	38.03	0.141	0.100	1.85	1.25	3.20
I ₁	Rhizobium + PSB inoculation	1.10	2.23	16.20	31.93	48.43	0.144	0.110	2.12	1.57	4.12
	CD at 5%	0.02	0.032	0.75	1.25	1.21	0.006	0.003	0.15	0.13	0.27
	Interaction (CD at 5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	CV%	2.61	2.49	10.14	9.12	8.29	2.35	2.31	9.05	7.65	8.78

Biofertilizer inoculation was also superior over without inoculation of biofertilizer. Total K uptake by grain + straw was found to be significantly affected by micronutrient application and also by biofertilizers inoculation (Table 3). Micronutrient treatment RDF + AM (M_5) recorded highest K uptake by grain + straw which was 69.16 K kg/ha followed by the treatment RDF + $FeSO_4$ + borex + $ZnSO_4$ + AM (M_6) which was 50.19 k kg/ha. These were significantly superior over the rest of the micronutrients treatments (M_2 , M_3 and M_4) and also over control. Biofertilizers inoculation was statistically significant over those without inoculation. Interaction was not significant. Earlier report was also recorded similar results (4).

Table 3 shows the maximum sulfur content in grain (0.145) and straw (0.115%) in the micronutrients treatment RDF + $ZnSO_4$ at 25 kg/ha (M_4) followed by (0.143%) and (0.113%) in the treatment RDF + $FeSO_4$ + borex + $ZnSO_4$ + AM (M_6) in grain and straw respectively. Treatment was significantly superior over the control in respect of sulfur content in grain and straw (5). Total S uptake was significantly affected by the micronutrient application and also by the biofertilizer inoculation. Micronutrient treatment RDF + AM (M_5)

recorded highest S uptake by grain and straw (4.68 kg S/ha) followed by treatment RDF + $FeSO_4$ + $ZnSO_4$ + borex + AM (3.73 kg/ha S). These were significantly superior over all the micronutrient treatments (M_2 to M_4) in respect of total S uptake in chickpea.

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