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Response of Chickpea (*Cicer arietinum* L.) to Potassium Fertilization

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ABSTRACT

This study was conducted to evaluate the optimal potassium supply to improve yield and quality of chickpea. The trials were carried out in pots under field conditions at two different sites. Under controlled conditions mineral potassium improved the number of nodules by plant. Application of potassium (50 kg/ha) increased the nodular, shoot and root biomass while its higher dose (150 kg/ha) reduced the biomass production compared to control. Furthermore depressive effect of high amounts of potassium on the growth of the culture of chickpea was noticed. These results were confirmed by the trials carried out under field conditions.

Key Word: Chickpea; (*Cicer arietinum* L); Nodulation; Potassium; Yield

INTRODUTION

Chickpea (*Cicer arietinum* L.) is a grain legume crop grown primarily for its nutritional value. Because of high protein content, it is considered as an economical source of quality vegetable protein in human diet. Farmers have a wrong notion that chickpea being a legume crop, does not need any nutrition and usually grow it on the marginal lands, without applying any fertilizer. The yield gap of chickpea may be attributed to improper agro-technology used by the farmers. Yield gap can be abridged, by adopting the advanced production technology accompanying with use of inoculums, balanced nutrition, weed management and high yielding varieties Hakoomat *et al*. (2004). Low organic matter content in the soil is one of the major causes of the deficency of nutrients (Ahmed *et al.*, 1988). It is established that potassium is essential for N and carbohydrate metabolism, activation of various enzymes and adjustment of stomatal movement and water relations (Boyer & Stout, 1959). Due attention towards nutrient management is not paid in case of low input high risk rain fed legume crops, frequently grown in low fertility soils (Halliday, 1992). To maintain or improve the fertility of soil, the supplies must compensate what was exported at the harvest time. The reports are generally uniform and reliable, and the products are easy to handle and relatively simple to manage. They are, drawn from non-renewable resources (RayMc Vicar, 1999).

Present studies were carried out to investigate the response of chickpea to varying levels of potassium.

MATERIALS AND METHODES

The trial was carried out at the Research Area of Tunisian Agricultural Research Istitute, Tunisia, during 2000-2001. The variety of chickpea used was INRAT 93.1. Crop was fertilized with superphosphate 45% at a rate of 200 kg/ha before sowing. The experiment under greenhouse with pots at Ariana consisted of 5 treatments: T1=0, T2=50, T3=100, T4=150, T5=200 kg K_2O/ha. The seeds were pre-germinated during 6 days in humidified Petri boxes. The seedlings were transplanted in plastic pots containing 2 kg of the collected soil from Ariana. For each treatment 10 replications were prepared. The experiment under field conditions at Oued Beja and Oued Meliz, (experiment stations) consisted of 16 treatments: T1: 0 kg/ha K*, T2: 0 kg/ha K + 50 kg/ha NK*, T3: 0 kg/ha K + 50 kg/ha NPK*, T4: 0 kg/ha K + 50 kg/ha So*, T5: 50 kg/ha K, T6: 50 kg/ha K + 50 kg/ha NK, T7: 50 kg/ha K + 50 kg/ha NPK, T8: 50 kg/ha K + 50 kg/ha So, T9: 100 kg/ha K, T10: 100 kg/ha K + 50 kg/ha NK, T11: 100 kg/ha K + 50 kg/ha NPK, T12: 100 kg/ha K + 50 kg/ha So, T13: 150 kg/ha K, T14: 150 kg/ha K + 50 kg/ha NK, T15: 150 kg/ha K + 50 kg/ha NPK, T16: 150 kg/ha K + 50 kg/ha So.

*K = Sulphate of potassium, NK = Nitrate of potassium, NPK = Nitrate phosphate of potassium, So = Solucat

The experiment was repeated 4 times in completely random block design. The surface of an experimental plot is 1276 m^2 divided into 64 elementary plots of 10 m^2 separated by 1 m. The data collected on yield component were analysed using the computer statistical program AGROBASE, and differences among treatment means were compared by least significant differences test (LSD) at 5% probability level (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

The results show that potassium increased the number of nodules per plant (Fig. 1). On the other hand, the nodules

Fig. 1. Effect of potassium on nodules number at flowering at the station of Ariana. Treatments with the same letter are not significantly different (p = 0.05). LSD=26.4; C.V.=24.7

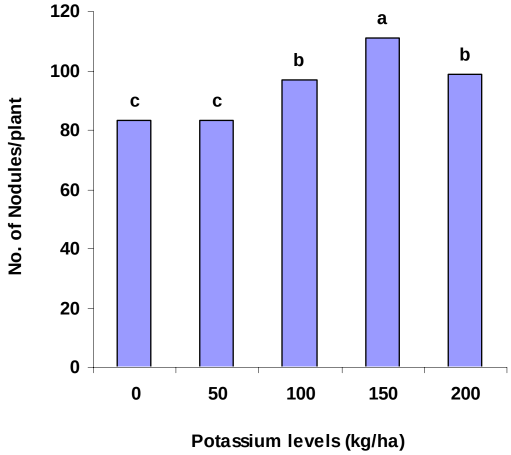


Fig. 2. Effect of potassium on nodules mass at flowering at the station of Ariana. Treatments withe the same letter is not significantly different (p = 0.05). LSD=29.5; C.V.=28.4

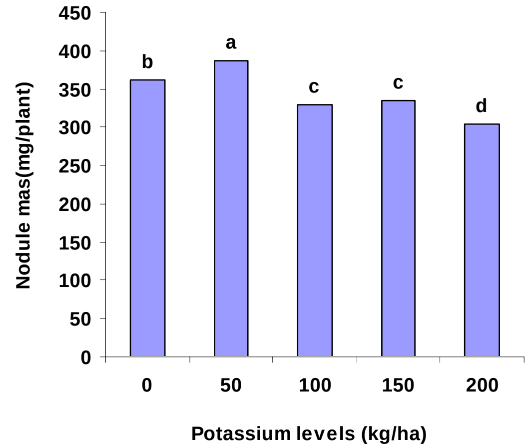


Fig. 3. Effect of potassium on dry shoot biomass at flowering at the station of Ariana. Treatments withe the same letter is not significantly different (p = 0.05). LSD=37.8; C.V.=35.4.

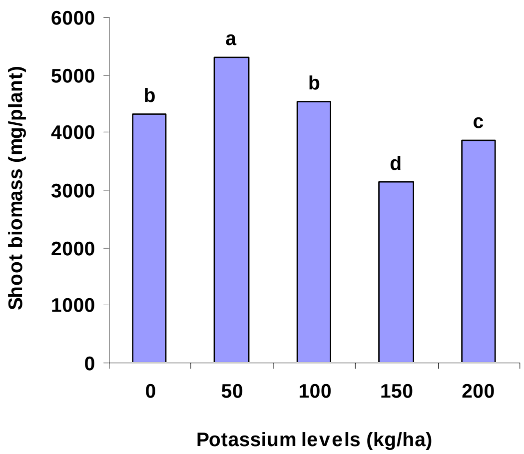
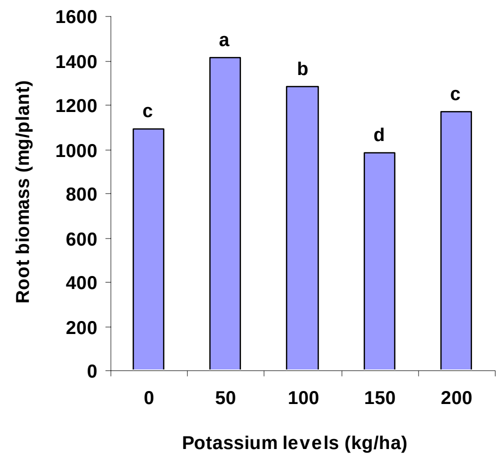


Fig. 4. Effect of potassium on dry root biomass at flowering at the station of Ariana. Treatments withe the same letter is not significantly different (p = 0.05). LSD=19.5; C.V.=18.6.



mass, shoot and root biomass increased at lower doses. While high fertilizer application even reduces biomass than control (Fig.2, 3, 4). Higher doses of fertilizer application even had a depressive effect on growth. Sherwood (1970) and Vincent (1977) reported that the needs for legumes plants and *Rhizobia* in K are only qualitative. Under both the field trials only 50 kg/ha of K improved the root and shoot biomass, though statistically non significant, while higher dosed had even a depressive effect (Tables I, II). It is commonly considered that chickpea crop need not any fertilization. Present results confirmed this idea. The depressive effect of the Potassium fertilization on the productivity is probably due to the high amount, which inhibits the growth of the plant. It should be noted that the response of the plants to fertilizers is variable according to the species and varieties (Robson, 1969). For example the annual alfalfa *Medicago truncatula* because of a less root mass and a light absorption, needs higher amounts of fertilizer for the maintenance of an optimal growth than white clover (Robson, 1969; Robson *et al.*, 1970).

Seed yield per unit area is a function of the combined effect of all the individual yield components, which are influenced differently by the various agronomic practices and environmental factors (Muhammad, 2004). The current results are in line with those of Ahmed *et al.* (1988), Ghaffar (1990), Kar *et al.* (1989) and Halliday (1992) who reported differential response of chickpea to various fertilizer doses. Poor yield response of chickpea to varying levels of fertilizer might be due to lodging at higher levels and stunted at lower levels of fertilizer. Boyer and Stout (1959)

Table I. Effect of the potassium fertilization on the components of the chickpea yield (variety INRAT 93.1) at the station Wad Béja

Treatments	Yield (g/plant)	Yield (g/m²)	Weight of 100 g/plant
0 kg/ha K	10.62^{NS}	220^{NS}	31,5^{NS}
0 kg/ha K+50 kg/ha NK	10.31	310	31,4
0 kg/ha K+50 kg/ha NPK	12.81	238.12	28,75
0 kg/ha K+50 kg/ha So	9.37	264.75	28,7
50 kg/ha K	14.6	229.37	31.72
50 kg/ha K+50 kg/ha NK	13.12	298.12	31
50 kg/ha K+50kg/haNPK	13.2	265	32.1
50 kg/ha K+50 kg/ha So	11.87	311.25	33.5
100 kg/ha K	11.25	294.34	33.02
100 kg/ha K+50kg/ha NK	11.87	326.87	31.72
100kg/haK+50kg/haNPK	11.56	230.62	31.67
100 kg/ha K+50 kg/ha So	14.37	323.75	29.67
150 kg/ha K	11.25	240	30.57
150 kg/ha K+50kg/ha NK	12.5	244.37	31.7
150kg/haK+50kg/haNPK	12.87	271.87	31.97
150 kg/ha K+50 kg/ha So	13.75	238.12	31.75
L.S.D.	*17.27*	*35.46*	*3.17*
C .V.	*29.93*	*27.74*	*8.53*

Table II. Effect of the potassium fertilization on the components of the chickpea yield (variety INRAT 93.1) at the station Wad Méliz

Treatments	Yield (g/plant)	Yield (g/m²)	Weight of 100 g/plant
0 kg/ha K	18.87^{NS}	372.5^{NS}	31.6^{NS}
0 kg/ha K+50 kg/ha NK	24	360	32.26
0 kg/ha K+50 kg/ha NPK	23.62	407.5	32.26
0 kg/ha K+50 kg/ha So	21.5	423.75	32.4
50 kg/ha K	22.25	395	35.7
50 kg/ha K+50 kg/ha NK	22	355.5	34.99
50 kg/ha K+50kg/haNPK	23.3	386.25	35.3
50 kg/ha K+50 kg/ha So	23.81	398.75	32.86
100 kg/ha K	25.81	397.5	34.66
100 kg/ha K+50kg/ha NK	22.12	374.37	31.5
100kg/haK+50kg/haNPK	21.93	411.25	33.46
100 kg/ha K+50 kg/ha So	25,93	376.25	32.23
150 kg/ha K	24.12	353.75	33.7
150 kg/ha K+50kg/ha NK	23.43	387.5	32.46
150kg/haK+50kg/haNPK	24.87	423.57	31.53
150 kg/ha K+50 kg/ha So	19.62	430	32.86
L.S.D.	4.227	74.88	5.94
C .V.	15.48	16.12	15.40

Values of each column with the same letter are not significantly different (p = 0.05); *The amounts of fertilizers are expressed in kg/ha
*K: Sulphate of potassium, NK: Nitrate of potassium, NPK: Nitrate phosphate of potassium, So: Solucat

and Sarwar (1988) have reported similar results in this regard.

CONCLUSION

The potassium fertilization at low rate (50 kg/ha of K_2O) to chickpea improved nodulation and root and shoot biomass, however, yield remained unaffected. While higher potassium level had depressive effect on the productivity of the crop during various stages of vegetative development. Thus, it seems quite of limited interest to carry out potassium fertilization in chickpea under the present experimental conditions.

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