

Effect of Phosphorus, Sulphur and Seaweed Sap on Productivity of Chickpea (*Cicer arietinum* L.)

Shankar Lal Yadav*
Ph.D. Scholar

Dr. Arvind Verma**
Major Advisor

ABSTRACT

A field experiment entitled “**Effect of Phosphorus, Sulphur and Seaweed Sap on Productivity of Chickpea (*Cicer arietinum* L.)**” was conducted at Instructional Farm, College of Technology and Engineering, Udaipur during two consecutive *rabi* seasons of 2012-13 and 2013-14, to assess the growth, productivity, quality and economics of chickpea through the enjoyment of appropriate phosphorus and sulphur levels and foliar application of seaweed saps. The soil of the experimental field was sandy clay loam in texture with low in nitrogen, phosphorus and sulphur and high in potassium and slightly alkaline in reaction. The experiment consisted of 27 treatments combinations comprising three phosphorus levels (20, 40 and 60 kg P₂O₅ ha⁻¹), three sulphur levels (0, 20 and 40 kg S ha⁻¹) and three foliar sprays (water spray, *Kappaphycus* sap 10 % and *Gracilaria* sap 10 %). These treatments were evaluated using split plot design (phosphorus and sulphur in main plot and foliar sprays in sub plot) with three replications.

The results of present investigation indicated that the growth of chickpea in terms of plant height, number of primary branches plant⁻¹, DMA plant⁻¹, DMA by plant parts (leaf, stem and reproductive parts), CGR, AGR, RGR, BMD and total chlorophyll content brought about improvement by applying phosphorus at 60 kg ha⁻¹ which was significantly superior over lower level of phosphorus at 20 kg ha⁻¹ but at par with 40 kg P₂O₅ ha⁻¹. With regard to sulphur levels the results indicated the superiority of 40 kg S ha⁻¹ over 20 kg S ha⁻¹ and control, which brought about significant improvements in various growth parameters. Similarly, foliar application of *Kappaphycus* and *Gracilaria* saps 10%, significantly improved all the growth parameters over water spray. However, both the seaweed saps were statistically same in improvement of all aforesaid growth parameters.

* Ph.D. Scholar, Department of Agronomy, RCA, Udaipur

** Professor, Department of Agronomy, RCA, Udaipur

The chickpea plants exhibited maximum values of yield components viz., pods plant⁻¹, grains pod⁻¹, grains plant⁻¹, grain yield plant⁻¹ and 100-grain weight and yields viz., grain, haulm and biological by applying graded levels of phosphorus. Application of 60 kg P₂O₅ ha⁻¹ resulted in maximum grain, haulm and biological yield which were significantly superior over 20 kg P₂O₅ ha⁻¹ and being at par with 40 kg P₂O₅ ha⁻¹. The magnitude of increase in grain, haulm and biological yield with 60 kg P₂O₅ ha⁻¹ was 14.39, 14.58 and 14.52 per cent, respectively over P₂O₅ at 20 ha⁻¹. Furthermore, application of 40 kg S ha⁻¹ recorded greater values of the yield attributes to control and 20 kg S ha⁻¹. Maximum grain, haulm and biological yield was observed with soil enrichment with 40 kg S ha⁻¹ which was statistically superior over its preceding levels. Soil application of 40 kg S ha⁻¹ to chickpea resulted in higher grain yield (1546 kg ha⁻¹), haulm yield (2920 kg ha⁻¹) and biological yield (4465 kg ha⁻¹) which were 3.83 and 22.99; 3.80 and 23.21 and 3.79 and 23.14 per cent higher, respectively over control and 20 kg S ha⁻¹. Foliar application of *Kappaphycus* sap 10%, being at par with *Gracilaria* sap 10%, significantly improved all the yield attributes. The positive effect of *Kappaphycus* and *Gracilaria* saps on yield attributes consequently resulted in increase of grain, haulm and biological yield by 15.96 and 13.43; 16.25 and 13.64; 16.15 and 13.57 per cent, respectively over water spray. Further, interaction effect of phosphorus and sulphur application to chickpea were found significant in pods plant⁻¹, grain yield plant⁻¹, grain yield, haulm yield and biological yield. Combined application of phosphorus at 60 kg ha⁻¹ with sulphur at 40 kg ha⁻¹ recorded maximum grain yield (1558 kg ha⁻¹) which was at par with application of other combination of P₆₀S₂₀, P₄₀S₄₀, P₄₀S₂₀ and P₂₀S₄₀.

Soil enrichment with 60 kg P₂O₅ ha⁻¹ significantly improved the protein content in grain and concentration of nutrients viz., N, P, K and S in leaves at 60 DAS and grain and haulm at harvest and their uptake by grain, haulm and total of chickpea plant and available soil N and P over 20 kg P₂O₅ ha⁻¹. Application 40 kg S ha⁻¹ significantly enhanced the protein, methionine, cysteine and cystine content in grain, N, P, K and S content in leaves at 60 DAS, grain and haulm and their uptake by grain, haulm and total over control. Similarly foliar spray of *Kappaphycus* and *Gracilaria* saps significantly improved protein, methionine, cysteine and cystine content, NPK and S content by leaves at 60 DAS and grain and haulm and their uptake over water spray.

In respect to economics of experimental treatments phosphorus application at 60 kg ha⁻¹ to chickpea crop gave maximum net returns of ₹ 31228 ha⁻¹ which was ₹ 4901 ha⁻¹ higher than obtained with 20 kg P₂O₅ ha⁻¹. However, application of 40 kg P₂O₅ ha⁻¹ recorded at par results with 60 kg P₂O₅ ha⁻¹. Maximum benefit cost ratio of 1.37 was recorded with application of 40 kg P₂O₅ ha⁻¹ with at par to 60 kg P₂O₅ ha⁻¹. Application of 40 kg S ha⁻¹ to chickpea gave maximum net returns of ₹ 33324 ha⁻¹ against obtained by 20 kg S ha⁻¹ (₹ 31561 ha⁻¹) and control (₹ 23220 ha⁻¹) with maximum benefit cost ratio of 1.49, but application of 20 kg S ha⁻¹ recorded at par results with 40 kg S ha⁻¹. *Kappaphycus* sap gave highest net returns of ₹ 31346 ha⁻¹. The interaction effect between phosphorus and sulphur under study was significant on net returns and B C ratio. The highest net returns (₹ 33929) was registered by conjoint application of 20 kg P₂O₅ ha⁻¹ and 40 kg S ha⁻¹ which was at par with the net returns obtained when phosphorus at 40 with sulphur at 40 kg ha⁻¹, phosphorus at 40 with sulphur at 20 kg ha⁻¹, phosphorus at 60 with sulphur at 20 kg ha⁻¹ and 60 kg P₂O₅ combined with sulphur at 40 kg P₂O₅ treatments. Similarly, maximum B C ratio (1.58) was recorded with combined application of 20 kg P₂O₅ ha⁻¹ with 40 kg S ha⁻¹ with at par results with combined application of phosphorus at 40 kg ha⁻¹ and sulphur at 20 and 40 kg ha⁻¹.